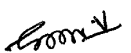
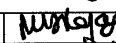
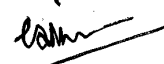
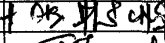
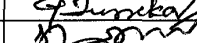
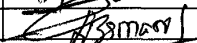
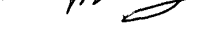
 Ranipet	<b>Splicing Norms for Plates &amp; sheets of APH components</b>		Doc. No	<b>PRQA: 410</b>
			Rev	<b>05</b>
			Date	<b>21 06 08</b>
			Page NO	<b>1 of 3</b>

## 1.0 Scope

1.1 This procedure details out the **SPLICING NORMS** for **DIAPHRGM PLATES, Housing Panels and Pedestals, Sector plate, connecting plate assembly, cleaning device Assembly of Air pre Heater.**

## 2.0 General Requirement

- 2.1 Check for the material specifications of plates/sheets, which are to be joined to avoid mix up of material. TCN to be obtained for change of material.
- 2.2 Electrode Selection shall be as per respective WPS. (E 7018 shall only be used for carbon steel)
- 2.3 Welding shall be followed with suitable methods and controls to minimize the distortion.
- 2.4 Stiffeners parallel to joint (Splice) shall be in such a way that welds over joint is avoided and a minimum distance between stiffeners parallel to weld joint shall be maintained as Two times the thickness of thicker plate.
- 2.5 Whenever back grinding is not feasible due to location of the plate /sheet, root welding to be carried out with 3.15 mm electrode and LPI to be carried out after thorough cleaning and repeat LPI after final welding.
- 2.6 Plus joint shall not be permitted when building up of plate to drawing size. However minimum offset of 100 mm is to be maintained.
- 2.7 Cut out on welds shall be avoided. In case any such opening on the joint the same shall be strengthened with pad plate of 50mm width all round on one side with the thickness equal to the parent material.
- 2.8 Unless otherwise mentioned against specific requirement minimum joint piece shall not be less than 500 mm. For hot end center section (tub plate) end joint piece shall be min 500 mm however for other joint piece shall be of max available sizes in order to reduce the number of joints.

Prepared By	Reviewed By			Approved BY
	M G Rajashankar	QA		 <b>(DGM/ QA &amp; BE)</b>
	B Srinivasa Rao	QC		
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 Ranipet	<b>Splicing Norms for Plates &amp; sheets of APH components</b>	Doc. No	<b>PRQA: 410</b>
		Rev	<b>05</b>
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		Page NO	<b>2 of 3</b>

2.9 Following are the guidelines if Edge preparation (EP) is not specified in drawing/ OP&C Sketch.


- **Plates and sheets up to 5mm:** No EP is required. Provide 2 to 3 mm root gap, weld on both sides.
- **Plates of 6mm** No EP is required. Welds shall be with square butt with 2 to 3 mm gap. Weld from first side and turn the plate for back grind and conduct LPI. Complete the weld.
- **Plates above 6mm and up to 8 mm** Single 'V', 60° EP. Weld from V side and turn the plate, Back grind and conduct LPI, complete the weld.
- **Plates above 8 mm:** Double 'V', 60° EP. Weld one side. Carry out back chipping/Grinding, conduct LPI to ensure sound metal and weld from other side.

2.10 Wherever cross members are fouling on the weld, Flush grind weld metal and ensure flatness. There shall not be any depression at weld zone. Thickness at weld zone shall not go below the actual thickness of the plate. Check 100 % visual inspection.

2.11 Cleaning device support channel plate: One joint is permitted up to 4 meters length and 2 joints for more than 4 meters (perpendicular to the bend line.) and the minimum Joint piece shall be 500mm.

### 3.0 Specific Requirements for Diaphragm plate

1. One joint only allowed perpendicular to axis of the Rotor post. (Along the Length of the Plate)
2. Joint shall be made at least 650 mm from the edge.
3. Place the plates to-be-welded together. Check for straightness of minimum two sides & right angle of the plate. Check the mismatch of joint edge. The mismatch shall be within 1 mm. Check for length, width and diagonal as per OP&C Sketch. Length and Width tolerance shall be as per OP & C Sketch, Maximum allowed diagonal difference is 2 mm and record the readings.
4. Weld one side and reverse & back grind. Conduct LPI. Ensure defect free joint and weld the other side. Butt welds shall be ground flush. Conduct final LPI.

	<b>Splicing Norms for Plates &amp; sheets of APH components</b>	Doc. No	<b>PRQA: 410</b>
		Rev	<b>05</b>
		Date	<b>21 06 08</b>
		Page NO	<b>3 of 3</b>

5. Identify the Right angle corner of the each plate with Paint and Hard punch the Specification, size, Firm code by punching and border with white paint.
6. Load all the plates in such a way that the identified right angle corners are in one corner with details visible from top.
7. Tack welds the stack as per OP&C Sketch.

#### **4.0 Specific Requirements for Pedestals**

1. One joint only allowed parallel to flange bend. (90° Deg) in addition to site joints envisaged in drg.
2. Joint shall be made at least 500 mm away from any side.

#### **5.0 Specific Requirements for Housing Panels**

1. One joint only permitted in either Horizontal or Vertical direction of each panel plate.
2. Minimum Joint shall be 500mm from any edge

#### **6.0 Specific Requirements for bottom plate and side Plates and plate formed channels of Sector plates**

1. No joint is permitted on Bottom plate.
2. One joint is permitted up to 4 meters length and 2 joints for more than 4 meters (across the bend line.) in side Plates and plate formed channels. Minimum Joint piece shall be 500mm.
3. EP and other requirement shall be as per Clause 2.9 and 100% LPI shall be carried out on final weld in the joint area.

#### **7.0 Splicing of stay plate and Shell plate.**

1. Splicing of stay plate and Shell plate is permitted if both dimension (length and width) is more than 1 meter. Joint shall be perpendicular to the axis of the rotor post. Minimum joint piece shall be 500 mm. Weld one side and reverse & back grind. Conduct LPI. Ensure defect free joint and weld the other side. Butt welds shall be ground flush. Conduct final LPI.

- 8.0 Splicing of duct wall is permitted if both dimension length and width is more than 1 meter. Minimum joint piece shall be 500 mm.

<b>Revision Number/Date</b>	<b>Changes made</b>
00/13 05 96	Original Issue.
01/31 05 96	Cl 2.10 Deleted
02/04 12 02	Requirement are reviewed & Up dated
03/ 01 09 04	Revised to include splicing norms for pedestals and housing panels
04/ 20 09 06	Clause 6 added in sub section-3 based on shop feed back.
05/ 21 06 08	Requirements completely reviewed and updated based on the discussion with WRI /Trichy. Amendment A1 details merged.



**SPLICING NORMS FOR SHEETS, PLATES AND  
ROLLED SECTIONS APPLICABLE TO  
GATES AND DAMPERS**

Doc. No	PR: QA: 476
Rev	00
Date	30.05.2013

**SPLICING NORMS FOR SHEETS, PLATES AND ROLLED SECTIONS  
APPLICABLE TO GATES AND DAMPERS**

PREPARED BY :

DEPARTMENT	NAME S/Shri	SIGNATURE
QA	K. Jothi Arulanandam Dy Mgr /QA	

REVIEWED BY:

DEPARTMENT	NAME S/Shri	SIGNATURE
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EDC – Gates & Dampers	V. Kesavan Sr. Mgr / Engg(GAD)	
Quality Control (OLI)	O. K. Abdulhuq Sr. Mgr /QC(OLI)	
Quality Assurance	R. Arunachalam Mgr/QA	

APPROVED BY:

DEPARTMENT	NAME S/Shri	SIGNATURE
QA	G. Balasubramanian Sr. DGM /QA, QC(Proc.) & BE	



## SPLICING NORMS FOR SHEETS, PLATES AND ROLLED SECTIONS APPLICABLE TO GATES AND DAMPERS

Doc. No	PR: QA: 476
Rev	00
Date	30.05.2013

### 1.0 SCOPE:

This procedure details out the **SPLICING NORMS** for Blade Plates and Rolled Sections viz., Angles, Channels, Beams and other structural applicable to Guillotine Gates and various Dampers.

### 2.0 GENERAL REQUIREMENTS:

- 2.1 Check for the material specifications of plates/sections, which are to be joined to avoid mix up of material.
- 2.2 TCN to be obtained for change of material
- 2.3 Welding Electrode selection shall be as per respective WPS.
- 2.4 Welding shall be followed with suitable methods and controls to minimize the distortion.
- 2.5 Welds over joint shall be avoided and minimum distance between stiffeners parallel to weld joint is 50mm.
- 2.6 Whenever back grinding is not feasible due to location of the plate / sheet, root welding to be carried out with 3.15 mm electrode and LPI to be carried out after thorough cleaning and repeat LPI after final welding.
- 2.7 Plus joint shall not be permitted when building up of plate to drawing size.
- 2.8 Cut out/opening /drilling on weld joint shall be avoided.

### 3.0 GUIDE LINES FOR EDGE PREPARATION ( EP ) :

Following are the guidelines for Edge Preparation (EP) if not specified in drawing.

- 3.1 **Plates and sheets up to 5mm:** No EP is required. Welds shall be with square butt with 2 to 3 mm root gap, weld on both sides. Final LPI / MPI
- 3.2 **Plates of 6mm:** No EP is required. Welds shall be with square butt with 2 to 3 mm gap. Weld from first side and turn the plate for back grind and conduct Root LPI. Complete the weld. Final MPI.
- 3.3 **Plates of 7mm, 8 mm:** Single "V" 60° EP on any one Plate. Weld from "V" side and turn the plate, back grind and conduct LPI, complete the weld. Final MPI.
- 3.4 **Plate above 8 mm:** Double "V" 60° EP . Weld one "V" side. Carry out back grind and conduct LPI, complete the weld. Final MPI.
- 3.5 **For structural (Angles, Channels, Beams) :** Single "V" 60° EP. Weld from "V" side and back grind and conduct LPI, complete the weld. Final LPI before splice plate setting.
- 3.6 **For Pipe Strut Joints –** Refer the clause no. 7.8

**Note:** Wherever cross members / seals are fouling on the weld, Flush grind weld metal and ensure flatness. There shall not be any depression at weld zone. Thickness at weld zone shall not go below the actual thickness on the plate. Check 100 % visual inspection.



**SPLICING NORMS FOR SHEETS, PLATES AND  
ROLLED SECTIONS APPLICABLE TO  
GATES AND DAMPERS**

Doc. No	PR: QA: 476
Rev	00
Date	30.05.2013

**4.0 SPECIFIC REQUIREMENTS FOR GATE BLADE:**


- 4.1 Splicing of Gate (blade) plate may be either horizontal or vertical. Minimum width of plate shall be 500mm for blades joint and no joint shall be permitted within 200 mm from the middle of blade for vertical joint.
- 4.2 No splicing in gate blade is permitted if blade width is 1.2 meter or less
- 4.3 Guillotine Gates – Electrically Operated (With or Without Bulb Seal) and Pneumatically Operated (Without Bulb Seal) – One joint is permitted for a plate width more than 1.2 mtr and up to 2.4 meter.
- 4.4 Guillotine Gates – Pneumatically Operated (Cold Air Gate / Hot Air Gate) with Bulb Seal – No joint is permitted on these gate blades as the width of blade will be always less than 2 Mtr.
- 4.5 For Plates of width more than 2.4 Mtr maximum two joints are permitted.
- 4.6 For Plate butt joints – Root LPI, back grinding and LPI shall be conducted 100%. Flush grind the joint and straighten the plate. Final MPI shall be conducted on both sides, if the plate thickness is more than 8 mm. Otherwise follow the clause no. 3.0 of this PR:QA.
- 4.7 Linear tolerance on length and width is + / - 1 mm /mtr subject to maximum of 5 mm.
- 4.8 Diagonal variation shall be within 1 mm / Mtr subject to maximum of 5 mm.
- 4.9 Blade bend shall not be more than 5 mm.
- 4.10 Blade shall be identified with size (Thickness X Length X Width) in each corner with Firm code.
- 4.11 Blade shall be stacked on a leveled platform to avoid any damage during stacking. Proper handling to be followed to avoid bend and damage.

**5.0 SPECIFIC REQUIREMENT FOR SEAL AIR CHAMBER PLATE AND PLATE FORMED CHANNEL**

- 5.1 No joint is permitted if the length is up to 2.0 Mtr and one joint is permitted for above 2.0 Mtr and up to 5.0 Mtr.
- 5.2 For above 5.0 Mtr two joints are permitted to build up the required length. However in any case more than two joints are not permitted.
- 5.3 The NDT requirements for this type of butt joints will be as per the clause no.3.0 & 4.6 as applicable of this PR:QA.

**6.0 SPECIFIC REQUIREMENT FOR GATE FRAME**

- 6.1 No joint is permitted for the channel section used in the gate frame (Bottom, side and super structure).
- 6.2 No joint is permitted in Port / Bonnet angles and plates.

	<b>SPLICING NORMS FOR SHEETS, PLATES AND ROLLED SECTIONS APPLICABLE TO GATES AND DAMPERS</b>	Doc. No	PR: QA: 476
		Rev	00
		Date	30.05.2013

**7.0 SPECIFIC REQUIREMENT FOR CONTROL, LOUVER AND BI-PLANE DAMPER BLADES / CHANNELS / PLATES AND ANGLES**

- 7.1 For Plates / Channels / Angles – No joint is permitted if the length is up to 2.0 Mtr and one joint is permitted for above 2.0 Mtr and up to 5.0 Mtr.
- 7.2 For above 5.0 Mtr two joints are permitted to build up the required length. However in any case more than two joints are not permitted.
- 7.3 Damper Blade joints are to be staggered on top and bottom.
- 7.4 Damper Frame – One joint (Plate) shall be permitted in length wise to built up the drawing size.
- 7.5 Damper side wall plate joint shall be 75 mm away from the end of Glade plate location.
- 7.6 Splicing of Channel joint is to be done inside only (in damper frame). For angle and plate no splicing plate is required on the joint area.
- 7.7 NDT requirement for this type of joints shall be as per the clause no. 3.0 & 4.6 as applicable.
- 7.8 For pipe strut joints, the same pipe for a length of 1.25 D has to be cut and strap joint has to be made with 3mm all around fillet weld.

**NOTE:**

The Splicing requirements mentioned in this PR:QA (PR:QA:476 Rev.00) is superseding the requirements mentioned in SQP:NP:03 with its relevant amendments and as well as SQP:NP:04 with its relevant amendments.

00	30.05..2013	<p>a) As per QMI 1, this document has been renumbered to PR:QA:476 as this QWI is pertaining to Gates &amp; Dampers and the existing PR:QA 602 Rev.00 Dtd.03.09.2009 has been withdrawn.</p> <p>b) Based on the requirement of Engg, OS and feedback from OS Vendors – more clarity and interpretation had been brought and incorporated in this document for Gate blade joints-Clause No.4, Pipe strut joints-Clause no.3.6 &amp; 7.8 and Port &amp; Bonnet joint requirements-Clause no.6.2</p> <p>d) This document has been released with new QWI No as PR:QA:476 applicable to Gates &amp; Dampers.</p>
<b>Rev No.</b>	<b>Effective Date</b>	<b>Details of Revision / Changes Made</b>

**Record Of Revisions**

**BHEL**  
**RANIPET**

**BHARAT HEAVY ELECTRICALS LTD.**  
**BOILER AUXILIARIES PLANT**  
**RANIPET 632 406**

**PR:QA:500**  
**PAGE 01 OF 05**

**QUALITY DEPARTMENT**

**PROCEDURE FOR**

**ALLOWABLE DEVIATIONS FOR**  
**DIMENSIONS WITHOUT SPECI-**  
**FIED TOLERANCES**

**EFFECTIVE DATE**

**16/01/93**

	<b>NAME</b>	<b>SIGNATURE</b>	<b>DATE</b>
<b>PREPARED BY</b>	<b>K NITHIANANDAM</b>	<i>K. Nithianandam</i>	<b>16/1/93</b>
<b>REVIEWED BY</b>	<b>S ANIL KUMAR</b>	<i>S. Anil Kumar</i>	<b>16/1/93</b>
<b>APPROVED BY</b>	<b>P H TAMBAKHE</b>	<i>P. H. Tambakhe</i>	<b>16/1/93</b>

**ISSUED BY**

**: QUALITY ASSURANCE**

**REVISION**

**: NIL**

**DATE**

**:**

**DOCUMENT CONTROL NO:**

**7**

**File Name :PHT.RSU**

**QUALITY DEPARTMENT**

1. Table 1 given below indicates the permissible variation in Linear Dimension of fabricated and machined components. The coarse grade is to be followed for fabricated components and medium grade for machined components.
2. Table 2 given below indicates the permissible deviations for Radii & Chamfers for machined components.
3. Table 3 given below indicates the permissible deviations for Angular dimensions for machined components.
4. Table 4 given below indicates the conditions under which the deviations given in this standard are not applicable.
5. Special rulings may be stated for linear dimensions of welded structures consisting of several assemblies.
6. If closer tolerances than those given in this procedure are necessary, the same shall be indicated in the relevant drawings.

TABLE - 1

Deviations in mm for the nominal size range in mm

Degree of accuracy	0.5 * up to 3	Over 3 upto 6	Over 6 upto 30	Over 30 upto 120	Over 120 upto 400	Over 400 upto 1000	Over 1000 upto 2000	Over 2000 upto 4000	Over 4000 upto 8000	Over 8000 upto 12000	Over 12000 upto 16000	Over 16000 upto 20000
F (fine)	± 0.05	± 0.05	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8	-	-	-	-
m (medium)	± 0.1	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.0	± 2	± 3	± 4	± 5	± 6
g (coarse)	± 0.15	± 0.2	± 0.5	± 0.8	± 1.2	± 2	± 3	± 4	± 5	± 6	± 7	± 8
sg (very coarse)	-	± 0.5	± 1	± 1.5	± 2	± 3	± 4	± 6	± 8	± 10	± 12	± 12

\* In the case of nominal sizes below 0.5 mm, the deviations must be specified directly by the side of the nominal size.

TABLE - 2

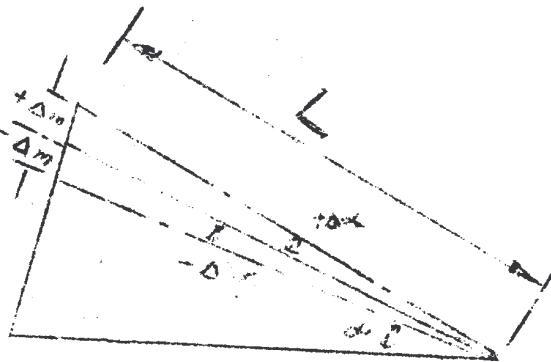
DEVIATIONS FOR RADII & CHAMFERS

All dimensions are in mm

CLASS OF DEVIATION	RANGE OF NOMINAL DIMENSIONS					
	Above	0.5	3	6	30	120
Fine & Medium	Upto and Including	3	6	30	120	315
		$\pm 0.2$	$\pm 0.5$	$\pm 1$	$\pm 2$	$\pm 4$

TABLE - 3

DEVIATIONS FOR ANGULAR DIMENSIONS



$\Delta\alpha$ =Angle Tolerance  
in angular units  
 $\Delta m$ =Angle Tolerance  
in linear units

All Dimensions are in mm

CLASS OF DEVIATIONS	Length (L) of shorter side of angle in mm							
	Above	-	10	50	120	500	800	1250
	Upto & including	10	50	120	500	800	1250	2000
FINE AND MEDIUM	$\Delta m$ (mm)	$\pm 0.1$	$\pm 0.2$	$\pm 0.6$	$\pm 0.8$	$\pm 0.96$	$\pm 1.125$	$\pm 1.5$
	$\Delta\alpha$ (deg or min)	$\pm 1^\circ$	$\pm 30'$	$\pm 20'$	$\pm 10'$	$\pm 4'$	$\pm 3'$	$\pm 2'3''$

TABLE - 4  
NON APPLICABILITY OF THE STANDARD

SPECIAL AGREEMENTS	PRODUCTION METHOD	DIMENSIONS	CONDITIONS FOR TOLERANCING	STANDARD SPECIFICATION
<p>where variations from this standard are agreed upon between the purchaser and the manufacturer</p>	<p>Casting, forging, pressing, rolling, welding, flame cutting</p>	<p>For dimensions required to give a certain class of it</p>	<p>where higher values than those specified in Table 1 and 2 may be allowed.</p>	<p>where permissible deviations have been specified</p>
		<p>For dimensions resulting after assembly</p>	<p>Where only positive or only negative deviations are desired</p>	
		<p>Where concentricity between parts is required</p>	<p>Where parts are manufactured separately and are required to be assembled together without any further treatment (selective assembly, spare parts etc)</p>	
		<p>For angular dimensions of a circular division (For example, angular position- ing of teeth of clutches)</p>		
		<p>For angular dimensions in precision taps and in pipe bends</p>		
		<p>For dimensions of welded assemblies (unless the part is to be machined)</p>		






BHEL: BAP:RANIPET  
QUALITY DEPARTMENT

PR : QA :505  
REV . NO . 01  
DATE . 14 .07 .93  
PAGE 01 OF 05

PROCEDURE FOR STORAGE OF SHELF LIFE ITEMS LIKE RUST  
PREVENTIVE FLUIDS, PAINTS, RUBBER COMPONENTS,  
GREASE AND ANTISEIZE COMPOUNDS AND SIMILAR  
COMPONENTS / ITEMS.

EFFECTIVE DATE : 14 . 07 . 93

	Name	Signature with date
Prepared by	V JAYRAMAN	 14/7/93
Reviewed by	P H TAMBAKHE	 14/7/93
Approved by	R N MISRA	 14/7/93

ISSUED BY : SM / QUALITY ASSURANCE

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INFORMATION COPY | |

BHEL : BAP : RANIPET  
QUALITY DEPARTMENT

PR : QA : 505  
REV . NO . 01  
DATE . 14 . 07 . 93  
PAGE 02 OF 05

Record of Revisions

Sl no	Revision carried out	Reason
01	S1 nos 1, 5, 7, 9 & 10 the method of storage revised.	-----

PROCEDURE FOR STORAGE OF LOW SHELF LIFE ITEMS LIKE

-----  
ANTI SEIZE / THREAD COATING COMPOUNDS , GREASES , PAINTS ,  
-----  
RUST PREVENTIVE FLUIDS, RUBBER COMPONENTS  
-----

1.0 SCOPE:  
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This procedure spells out the method of storage of low shelf life items like antisize/thread coating compounds , greases , paints , rust preventive fluids and rubber compounds .

2.0 STORAGE  
-----

Please See the table . 1 . The method of storage of low shelf items is given in the table .

TABLE 1

S.No.	Description	Category	Method of storage	Items covered under the category .
01	Anti Seize compound/greases	L	Indoor storage in closed containers well ventilated and dry rooms , away from heat sources sunshine , flames , gas cylinders .	Thread Coating compounds , greases , molysulf lubricants etc.
02	Sealing Compounds	L	Indoor storage closed containers well ventilated and dry rooms , away from heat sources sunshine , flames , gas cylinders / solvents etc . If containers are damaged, reject the item	All sealing compounds

03	Rust preventive fluids ( film forming type)	RPF	Outdoor, undershade Dry condition away from 1)Flame heat 2) Sunshine, 3)Gas cylinders, 4)Petrol Diesel, Kerosene other solvents 5) Near Fire extinguishing equipment .	Collecting Electrode rust preventive fluids, candopeel, strippable Coating.
04	Rust preventive fluids ( non film forming type)	RPN	- DO -	APH heating element rust preventive fluids .
05	Natural Rubber  Solvents, alkalis ,	RB	Indoor storage well ventilated dry rooms with paper and chalk powder wrapings, Away from oils, acids and flames , sunshine , weld heat.	Gaskets ,washers, forms, shapes, tubes pipes , conduits etc. .
06	Synthetic Rubber	RS	- DO -	- DO -
07	Red Oxide Zinc Chrome paints IS 2074	PR	In sealed containers indoors: In dry and well ventilated rooms Away from heat & flame , gas cylinders, flammable materials like Petrol , Diesel ,Kerosene etc .	- DO -
08	IS 2932 Synthetic enamel paints		- DO -	All Colors shades .

09 . Epoxy Paints	PEPX	In sealed containers. Indoor Dry condition . On separate racks ; Away from heat , flammable materials like Petrol , Diesel Kerosene , solvents .	This category includes Inorganic Zinc Rich paints also .
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10 . Chlorinated rubber paints .	PCLR	In sealed containers. Cool Dry place . Indoor only. Away from flame , heat, flammable materials like petrol , Diesel kerosene.
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D: PRQA

BHEL  
RANIPET  
QUALITY DEPARTMENT

PR :QA:509

PAGE 01 OF 02

GUIDELINES FOR

NDT REQUIREMENTS ON  
GAS CUT EDGES

EFFECTIVE DATE

04-08-93

PREPARED BY

B SRINIVASA RAO



REVIEWED BY

P.H.TAMBAKHE



APPROVED BY

R N MISTRA



ISSUED BY: QUALITY ASSURANCE

REV. NO.:00

CONTROL NO

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1.0 SCOPE :

The procedure specifies the items for which for which Magnetic Particle Testing shall be conducted on gas cut edges.

2.0 PREFERENCE:

Sheet 7 of 12 of CE spec .M&P spec No.: 5.11.1.1.(s) dated 05-11-84 and review with SM/QA

3.0 GENERAL :

All gas cut edges which are machined later need not be examined by MT (Magnetic Particle Testing )

3.1 Plates above 38.1 mm for the items specified below shall only be tested. Stiffeners need not be non-destructively tested.

3.1 A FANS: Center plate , AP fan impeller hub flanges. Flanges for Conical cover plate, Flange for AP fan cover plate ,Impeller rings made of plate ,Conical cover plate seating rings.

3.1 A APH: Lug plates of lug assembly ,Rotor post header plates.

3.1 C ESP/Structural items: plates used as flanges for floor beams and those structural items for which NDT requirements are specified in other transmittals like QPS, Letters etc.

4.0 Reference standard and acceptance norm for MT shall be as per BHE :NDT:RP:MT:01/ latest revision.

\*\*\*\*\*

BHEL::BAP::RANIPET  
QUALITY DEPARTMENT

PR:QA:512  
REV:00  
Dt:31.1.94  
Page 01 OF 04

PROCEDURE FOR CONTROL OF SURFACE PREPARATION AND  
PAINTING OF FABRICATED COMPONENTS  
AT SUB-CONTRACTORS WORKS.

EFFECTIVE DATE 31.1.94

	NAME	SIGNATURE & DATE
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REVIEWED BY	H ANANTHANARAYAN	<i>H. Ananthanarayan</i>
APPROVED BY	R V MISRA	<i>R. V. Misra</i>

ISSUED BY QUALITY ASSURANCE

CONTROL COPY NUMBER

**MASTER COPY**

PROCEDURE FOR CONTROL OF SURFACE PREPARATION AND PAINTING OF  
FABRICATED COMPONENTS AT SUB-CONTRACTORS WORKS.

1.0 SCOPE:

1.1 This procedure details out the requirement for surface preparation and painting of all fabricated components at sub-contractors works.

1.1.1 Surface preparation equipment:

The sub-contractor should have the minimum surface preparation equipment as mentioned below:

- a) Wire brush
- b) Emery sheets of rough type
- c) Power wire brush to be used with pneumatic or electrical motors
- d) Brush for cleaning the dust removed by wire brushing power tool cleaning

1.2 Whenever any special requirement for surface preparation and painting are required, the same shall be indicated in the drawing or shall be informed separately to sub-contractors.

1.3 This PRQA is in line with the requirement of Painting Schedule RP 0674199.

2.0 SURFACE PREPARATION:

2.1 CLEANING OF OIL, GREASE ETC

2.1.1 The entire outer surface of the fabricated components shall be thoroughly cleaned using mineral turpentine, wire wheel, grinding wheel to make it free from OIL, GREASE, RUST, MILL SCALES and weld spatters.

2.2 METHOD OF RUST REMOVAL

2.2.1 Wire brush, emery sheets of rough type, Power /rotary wire wheel may be used for removing the dust, rust and mill scales from the surface.

2.2.2 The "Rustkil" (rust remover/converter) shall be applied whenever the rust cannot be removed by using power tool cleaning.

2.2.3 Only after clearance of surface preparation by BHEL Inspection/BHEL Authorised Inspection Agencies the sub-contractor can proceed with painting.

0 PAINTING

1 Only paints from BHEL approved suppliers shall be applied.

2 After visual inspection and clearance by QC BHEL/Authorised Inspection Agency one coat of red oxide Zinc chrome primer as per IS 2074 shall be applied by brushing to a dry film thickness of approx 25 microns.

3 The paint shall be allowed to hard dry and thoroughly before applying the second coat. Second coat shall be applied only after 18 hours.

4 A second coat of IS 2932 Synthetic Enamel smoke grey paint shall be applied over the primer to a coating thickness of 20 microns approximately.

5 The small items shall be dipped in the paint tank.

The final inspection of the component shall be offered to QC BHEL/Authorised Inspection Agency only after hard drying of the enamel paint and stencilling of work order No, D.U.No, details.

All edge prepared areas for welding at shop/site at later stage shall be applied with one coat of weldable primer.

Any scratches and soil sticking on the surfaces during handling shall be repaired before despatch to BHEL/Shipping.

*Keliana*  
200

RECORDS:

The firm shall record the make/brand name and batch number of the approved paint used in the dimension report.

1. The sub-contractors shall maintain records of the primer paints procured, the source of the primer paints namely dealer, the manufacturer of the primer paints, the batch number of the primer paints and the delivery chalan reference for the paint procured along with the quantity and also copy of the test certificates certifying the quality of the paint. These records shall be verified by BHEL inspector immediately on procurement of the paint by sub-contractor and shall be countersigned by BHEL inspector. This record is subject to audit by Quality Assurance.

4.2 The firm shall show the details/evidence for procurement of approved paints to QC personnel (BHEL)/Authorised Inspection Agency whenever required during surveillance checks/audits. The sub-contractor before use of primer paints shall verify the correctness of specification of the primer paints before opening the drums. The drum shall be rolled roughly 20 times before opening the seal and stirring the contents. The contents shall be thoroughly stirred using a steel rod and shall be checked for any settling of pigment. If any pigment settlement is observed the process of resealing, rolling, stirring thereby redispersal of the paint pigment into the medium is to be ensured. Now a small quantity can be transferred to painting cans and applied by neat brushes of width atleast 3 inches.


4.3 The sub contractor shall ensure that the required number of primer coats are given on the components as per the painting schedule RP 0674199. Visual inspection shall be done for checking damages, poor paints, improper finish. After the paint films dry the inspector will randomly check the coating thickness with coating thickness gauge for the correctness of the thickness of the paint in case of any doubt.

#### 5.0 TESTING OF PAINT SAMPLES

5.1 QC BHEL personnel shall collect random samples of paint (approx 1 litre) and submit the same to Quality Assurance for testing. Such random samples may be collected whenever any doubt arises about the quality of paint while carrying out visual inspection. Alternately QC/OLI may scrape dried paint film from painted surfaces for testing at paint test lab.

5.2 In case any batch of paint is found not conforming to requirement, the concerned brand of paint shall be removed from the approved list of paint suppliers of BAP, Ranipet.



 Ranipet	<b>Rust preventive fluid specification (Non drying type)</b>	Doc. No	<b>PRQA: 522</b>
		Rev	<b>00</b>
		Date	<b>12 02 08</b>
		Page NO	<b>01 of 01</b>

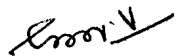


### 1.0 Scope

1.1 This specification covers the requirements of temporary rust preventive fluid (Non drying type) used for APH heating elements by dipping process.

### 1.2 Details of specification

SL No	Details	Acceptance norms
01	Specific gravity at 27 ° C	0.80 – 0.85
02	Flash point degree C (Min)	35°C
03	Viscosity Ford Cup 4	18± 2 seconds
04	Water content (max)	0.5%
05	Drying time max (hard dry)	No drying
06	Corrosion under conditions of condensation for 300 hrs	No rusting
07	Corrosion resistance under indoor conditions for one month	No rusting.

1.3 shop QC to verify the viscosity using ford cup 4 at regular interval (once in a week time) to maintain with in 18± 2 seconds and record.

 <b>Prepared By</b>	<b>Reviewed By</b>	QC		 <b>Approved BY</b>
		QA	B. Srinivasulu	



RANIPET

## QUALITY ASSURANCE

### SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS

PRQA: 526

REVISION: 01

DATE: 14.08.01

PAGE: 1 OF 5

<b>PROCEDURE FOR</b>		<b>SURFACE PREPARATION AND PAINTING OF COMPONENTS OF DESALINATION PLANTS</b>	
<b>EFFECTIVE DATE</b>		14.08.2001	
<b>PREPARED BY</b>	<b>NAME</b>	<b>DEPARTMENT</b>	<b>SIGNATURE</b>
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<b>ISSUED BY</b>		QUALITY ASSURANCE	
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RANIPET

## QUALITY ASSURANCE

### **SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS**

PRQA: 526


REVISION: 01

DATE: 14.08.01

PAGE: 2 OF 5

## **RECORD OF REVISIONS**

<b>REVISION NO.</b>	<b>DETAILS OF ISSUE</b>	<b>DATE OF ISSUE</b>
<b>00</b>	<b>ORIGINAL ISSUE</b>	<b>09.05.96</b>
<b>01</b>	<b>EDITORIAL CORRECTION</b>	<b>14.08.01</b>

 <p>RANIPET</p>	<p><b><u>QUALITY ASSURANCE</u></b></p> <p><b>SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS</b></p>	<p><b>PRQA: 526</b></p> <p><b>REVISION: 01</b></p> <p><b>DATE: 14.08.01</b></p> <p><b>PAGE: 3 OF 5</b></p>
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**PROCEDURE FOR SURFACE PREPARATION AND PAINTING OF  
COMPONENTS OF DESALINATION PLANTS**

**1.0 SCOPE:**

This procedure gives guidelines for surface preparation and painting of components of Desalination Plants.

**2.0 The following are not under the purview of this procedure.**

2.1 Masonry structures, PVC tubes, pipes & fittings, FRP vessels, pipes components and glass.


**3.0 PROCEDURE:**

3.1 The following components of Desalination Plants are under the purview of this procedure.

- (a) Membrane Racks
- (b) Valve supports and clamps, Pipe supports and clamps
- (c) Supporting Structures
- (d) Carbon steel filters, hand rails, platforms
- (e) Shed Structures
- (f) Handling Equipment
- (g) Cranes
- (h) Electric motors, base frame
- (i) Any other component specified in the drawings.

**4.0 SURFACE PREPARATION SCHEME:**

4.1 Except stainless steel pipes and fittings (and Aluminium if any) all other steel surfaces shall be sand / shot blasted to SA 2½ finish as per Swedish Standard SIS 055900 before painting.

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	<b>SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS</b>	REVISION: 01 DATE: 14.08.01 PAGE: 4 OF 5

## 5.0 PAINTING SCHEME:

See Table – 1 below.


TABLE – 1

Scheme	Paint Type
PS 1	Epoxy Zinc Phosphate Primer Paint
PS 2	Epoxy finish Paint

5.1 The probable paint supplier can be as follows:

- a. Asian Paint (India) Ltd.
- b. Bombay Paints
- c. Berger paints India Ltd.
- d. Goodlass Nerolac paints Ltd.
- e. Garware Paints
- f. Jenson & Nicholson
- g. Shalimar paints

Sl. No	Component	Surface Preparation	Primer	No. of Coats	DFT Total Microns	Finish Paint	No. of Coats	DFT Total Microns
01	Membrane Racks	SA 2 ½	PS 1	2	100	PS 2	2	100
02	Valve Supports and Clamps	SA 2 ½	PS 1	2	100	PS 2	2	100
03	Supporting Structures	SA 2 ½	PS 1	2	100	PS 2	2	100
04	Carbon steel filters (outer surfaces)	SA 2 ½	PS 1	2	100	PS 2	2	100
05	Hand Rails & Platforms	SA 2 ½	PS 1	2	100	PS 2	2	100
06	Shed Structures & Clamps	SA 2 ½	PS 1	2	100	PS 2	2	100
07	Handling Equipment	Leave greased/oiled surfaces free (for other follow scheme)	PS 1	2	100	PS 2	2	100
08	Cranes	- do -	PS 1	2	100	PS 2	2	100

 <p>RANIPET</p>	<p><b><u>QUALITY ASSURANCE</u></b></p> <p><b>SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS</b></p>	<p><b>PRQA: 526</b></p> <p><b>REVISION: 01</b></p> <p><b>DATE: 14.08.01</b></p> <p><b>PAGE: 5 OF 5</b></p>
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**6.0 GENERAL PRECAUTIONS:**

- 6.1 Do not delay painting after Sand / Shot blasting. Maximum delay permitted is only half an hour.
- 6.2 Do not paint when the weather is rainy or the temperature is below 20<sup>0</sup> C.
- 6.3 The epoxy primer and finished paints are two component paints. The components must be mixed in the proportions given by the manufacturer only. The application of epoxy paints shall be completed with in 2 hours of mixing.
- 6.4 The etch/wash primers are also two component paints, which must be mixed in proportions given by the manufacturer.

**7.0 IMPORTANT:**

If the components are to be painted at site one coat of EPOXY FINISH PAINT of DFT 50 Microns SHALL BE GIVEN.

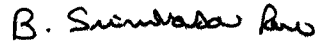
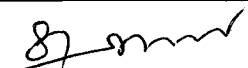
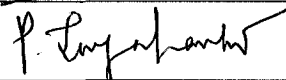
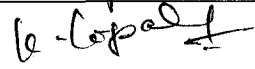
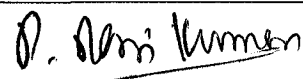



## Procedure for Surface Preparation and Painting

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# Procedure for Surface preparation and Painting

<b>Prepared By</b>	V SUNDARAM SEF/QA	
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<b>Approved By</b>	H ANANTHANARAYANAN AGM/QA&OLI	
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### Record of revision

Rev No.	Effective Date	Details of revision
00	10 10 02	RP0674199 Rev 05 requirements and PRQA 590 rev 12 requirements were fully reviewed and this document is released as Rev 00 taking care of painting requirements of BAP projects. For project specific painting schemes respective CIS or contract specific painting schemes to be referred.
01	22 05 07	Painting requirement are fully reviewed. Red oxide Zinc chromate for primer application (IS 2074) is corrected as Red oxide Zinc phosphate primer (IS 12744) and also number coats & DFT corrected.



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### 1.0 SCOPE

- 1.1. This procedure specifies requirements for surface preparation and painting and coating, for APH, Fan, ESP, Gates & Dampers and Chimney. (For WEG and Desalination, please refer PRQA: 518/Latest and PRQA: 526/Latest respectively).
- 1.2. Section I deals with surface preparation schedule and section II deals with painting and coating.
- 1.3. Special contractual requirements, if any, will be indicated through a separate contract specific documents with customer approval, when required. The linkage will be provided in the CQR issued by QA.

### 2.0 GENERAL

- 2.1 This procedure specifies painting requirements to provide adequate protection up to one year in open yard at site.
- 2.2 No painting shall be applied on the stainless steel, galvanized and any plated surfaces. For estimation of requirements of painting, the approximate area of coverage on non-absorbing surface is as given below: -

SL. No.	Generic nature of paint	Theoretical covering area (Sq.M/litre)	DFT /Coat (Min)	Shade
1	Red oxide zinc phosphate primer to IS 12744	10	30	Red oxide
2	Synthetic enamel paint to IS 2932	10	20	Smoke grey
3	Heat resistant aluminum paint to IS 13183	10	20	Aluminium

- 2.3 For bought out items, the painting scheme shall be as per purchase specification. If this is not specified in purchase specification, the following is the minimum requirement
  - a) Primer: One coat of red oxide zinc Phosphate primer to IS 12744- DFT 30 microns
  - b) Finish: Two coats of synthetic enamel to IS 2932 smoke grey shade No.692 of IS 5. -DFT 20 microns per coat

## Section -I

### 3.0 SURFACE PREPARATION REQUIREMENTS FOR PAINTING AND COATING

- 3.1. The effectiveness and duration of the protection provided by organic, inorganic and metallic coatings for corrosion protection depends among other things decisively on proper surface preparation. This section deals with the methods of surface preparation, their effectiveness and fields of application.
- 3.2. This section largely based on ISO 8501 - 1: 1988 that in turn is based on the Swedish standard SS 05 59 00.



## Procedure for Surface Preparation and Painting

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### 3.3. SURFACE PREPARATION METHODS

3.3.1. Surface preparation depends on initial condition of uncoated surfaces. The details of rust level, rust removal methods and characteristics surfaces are given in table 1.0.

### 3.4. DEFINITIONS AND METHODS OF CLEANING

#### 3.5. CLEANLINESS OF SURFACES.

3.5.1. Cleaning requirements and levels of cleanliness, contaminants such as dirt, oil that will interfere with the adhesion or effectiveness of the proposed coating must be removed. Coats of materials related to the metal (scale, rust) and coats of different materials (e.g. existing coating) should be removed until the agreed level of cleanliness is attained.

3.5.2. Contaminants/coats, both of related material and of materials different from the metal may be removed in one operation if the nature, level and thickness permit this. The required level of cleanliness depends on

- The corrosion protection system selected
- The type of corrosion exposure expected
- The initial condition of the surface being prepared
- The possible rust removal method
- Economic considerations

3.5.3. Generally, the standard levels of cleanliness as in table 1.0 should be used as a basis. This does not cover the removal of weld spatter, weld or flame cutting slag or chips, repair grinding of rolling defects (laminations) deburring and similar operations.

### 3.6. MECHANICAL METHODS OF REMOVING RUST

#### 3.6.1. Manual rust removal:

3.6.1.1. This applies to standard levels of cleanliness St 2, St3 as per table 1.0 manual cleaning uses wire brush, stripping knife, Swedish scraper, rust removing hammer etc., The method must not damage the metal being derusted. Subsequent cleaning by sweeping or brushing off or by blowing off with dry air.

#### 3.6.2. Mechanical rust removal:

3.6.2.1. This applies to standard levels of cleanliness St2, St3 as per table 1.0 cleaning can be done by mechanically driven rust removing tools viz., rotating wire brush, impact piston devices or rotary descalers, sanding discs etc. The surface areas where the power driven tool cannot enter, manual cleaning should be done. The method must not damage the metal being derusted. Subsequent cleaning by sweeping or brushing off or blowing off with dry air.

#### 3.6.3. Blast cleaning

3.6.3.1. This applies to standard levels of cleanliness Sa 1, Sa 2½, Sa 3 as per table- 1.0. Chemically contaminated surfaces must be pre-washed. Surfaces having coarse rust must be pre-cleaned with impact tools prior to blast cleaning.

3.6.3.2. Compressed air blasting is generally recommended for our operations. It is a freely directed air blasting in blasting cubicles, Rooms or sheds with re-circulation of blasting abrasives.



## Procedure for Surface Preparation and Painting

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### 3.6.4. REMOVAL OF CONTAMINANTS/COATS OF MATERIAL DIFFERENT FROM THE METAL

3.6.4.1. Surface of metal contaminated with cutting fluid (machine coolant) oil or grease shall be wiped with mineral turpentine/tri-chloroethylene prior to applying any methods of mechanical surface preparation.

3.6.4.2. If any old paint film or rust preventive films are present they may be removed with paint removing jelly.

3.6.4.3. As far as possible the cleaning method should be so chosen that all the scale is removed from the metallic surface to be coated. For heavily scaled metallic surfaces either blasting or pickling may be adopted over and above the requirements called for in the table 1.0.

### 3.6.5. NOTES TO TABLE 1.0

3.6.5.1. Initial condition of uncoated surfaces (rust grade as per SS 05 59 00)

- a) Steel surface largely covered with adhering mill scale but little, if any rust.
- b) Steel surface, which has begun to rust, and from which the mill scale has begun to flake.
- c) Steel surface on which the mill scale has rusted away or from which it can be scrapped, but with slight pitting visible under normal vision.
- d) Steel surface on which the mill scale has rusted away and on which general pitting is visible under normal vision.

3.6.5.2. Standard level of cleanliness equivalent to steel structures painting council of US (SSPC) also given in brackets in table 1.0.

**Table 1.0**

Standard level of cleanliness	Rust removal method	Initial condition of steel surfaces (Uncoated ref.4.5)	Essential Characteristics of the prepared steel surface
St 2 (SSPC-SP 2)	Thorough hand and power tool cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust coatings and foreign matter.
St 3 (SSPC SP 3)	Very Thorough hand and power tool cleaning	B, C, D	As for St 2, but the surface shall be treated much more thoroughly to give a metallic sheen arising from the metallic substrate.
Sa 1 (SSPC SP 7)	Light blast cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, great and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter.
Sa 2 (SSPC SP 6)	Thorough blast cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from most of the mill scale, rust, paint coatings and foreign matter. Any residual contamination shall be firmly adhering.



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Standard level of cleanliness	Rust removal method	Initial condition of steel surfaces (Uncoated ef.4.5)	Essential Characteristics of the prepared steel surface
Sa 2 ½ (SSPC SP 10)	Very Through blast cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from the mill scale, rust, paint coatings, and foreign matter. Any remaining traces of contaminations shall show only as slight stains in the form of spots or stripes
Sa 3 (SSPC SP 5)	Blast cleaning to visually clean steel.	A,B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from mill scale, rust, paint coatings and foreign matter. It shall have a uniform metallic colour.

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**Section -II**

**4.0 SCHEDULE OF PAINTING AND COATING:**

**Table 2.0**

Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in µm (Min)	Finish	DFT in µm (Min)	Total DFT (Min)
<b>1.0</b>	<b>Regenerative Air Pre-Heaters</b>						
1.0.1	Heating element baskets (without elements) 52 010, 024, 025	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	NIL	--	30
1.0.2	Heating elements (with elements) 52 010, 024, 025	--	(*) Temporary rust preventive oil non dry type (Dipping)	--	NIL	--	--
1.0.3	Rotor post assembly machined items of (52 011), Pin rack assembly (52 012) seals (52 013,054,055), sector plates (52 041,042) and machined components of APH.	--	(**) Temporary rust preventive oil Dry type	20	NIL	--	20
1.0.4	<b>Components in flue gas path and insulated</b> Rotor post assy (52 011), T bars (52 013), Rotor housing assy. (52 030), Hot and cold connecting plate assy. (52 041,042),	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	60	NIL	NIL	60

(\*) Specification as per PRQA 522/Rev 00

(\*\*) Specification as per PRQA 523/Rev 00

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## Procedure for Surface Preparation and Painting

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Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in µm (Min)	Finish	DFT in µm (Min)	Total DFT (Min)
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1.0.5	<b>Components exposed to Atmosphere</b> Rotor drive assy (52 100), Access door (52 210, Air seal piping (52 211), observation port other than glass part (52 212), Rotor stoppage alarm other than aluminum (52 217), Loose items of Air receiver (52 220), Guide bearing assy (52 261), Support bearing assy (52 262), Oil piping GB, SB (52 271,272) oil circulation unit (52 274), Deluge and wash pipe assy. (52 301,302,401,402) Cleaning device assy (52 325, 326), Cleaning device drive (52 329,429), Thermo couple pipe assy. Other than SS (52 360)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70
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<b>2.0 TUBULAR AIRPREHEATER</b>							
2.1	Side walls (external surfaces and internal surfaces).	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	60	--	--	60
2.2	Machined surfaces, tubes of TAPH, Tube plates and intermediate plates	---	(**) Temporary rust preventive oil Dry type	20	NIL	NIL	20

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Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in $\mu$ m (Min)	Finish	DFT in $\mu$ m (Min)	Total DFT (Min)
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<b>3.0</b>	<b>Fans</b>						
3.1	Foundation materials 55 0XX, 56 0XX	Power tool cleaning to ST-3 (SSPC SP3)	Temporary Rust preventive	20	--	--	20
3.2	Components exposed to atmosphere a) Bearing Pedestals, Base frame, Servomotor assy, shaft with Bearing assy, OGV, IGV (55-1XX, 55-2XX 55-3XX). b) Bearing Pedestals, Base frame, Shaft with bearing assy, RVC, IGV, Support for Seal, shaft protecting tube, Spiral casing (if no insulation is applicable), Damper (56-1XX, 56-2XX 56-3XX, 56-4XX) c) Coupling guard (56-8XX, 55-8XX). Tools (56-000, 55-000)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl/d)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70
3.3	Components in AIR/GAS and under insulation a) Suction chamber, diffuser, housing, OGV, impeller (55-1XX, 55-2XX, 55-3XX), b) Spiral casing, damper, IGV, RVC, impeller, shaft (56-1XX, 56-2XX, 56-3XX 56-4XX). c) Silencer (56-9XX, 55-9XX)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl/d)	60	NIL	NIL	60
3.4	Journal area Of shaft (55-1XX, 56-1XX, 55-2XX, 56-2XX, 55-3XX, 56-3XX 56 4XX						
3.5	All machined surfaces shall be applied with rust preventive.						
<b>Refer PRQA 341 / Latest</b>							

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Ranipet

## Procedure for Surface Preparation and Painting

Doc. No	<b>PRQA: 590</b>
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Sl.No.	Component/P/GMA	Surface preparation	Primer	DFT in $\mu$ m (Min)	Finish	DFT in $\mu$ m (Min)	Total DFT (Min)
--------	-----------------	---------------------	--------	----------------------	--------	----------------------	-----------------

<b>4.0</b>	<b>Electro static precipitator</b>						
4.1	GD drive Arrangement (7X X10), Drive arrangement for emitting system (7X X17), Inspection doors (7X X23), Drive arrangement for CE rapping (7X X26), Outer roof (7X X42), ESP pent House (7X X55), ESP test equipment (7X X61) Water washing system (7X X66) Tools and tackles (7X 996), Lifting beam (7X X20), Columns (7X X81) Hopper approach platform (7X X 65), Stringer and Guard plates (7X 610).	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (Varnish medium alkyd)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70

4.2	Insulator Housing assy.(7X X06), Gas distribution assy.(7X X08),GD rapping mechanism(7X X09), Gas screening (7X X11), Emitting system suspension (7X X13), Emitting electrode rapping (7X X16), Suspension arrangement for CE (7X X19), Frame of Emitting system Top & Bottom and Middle.(7X X21,X22,X32),Shock bars(7X X24), CE Rapping mechanism (7X X25), Ridges(7X X43), Hopper upper and Lower & Middle part (7X X44, X45),Insulator support panel (7X X46), Roof panel assy. (7X X47), Casing structure (7X X28, X48), Casing shell (7X X49), ESP Funnel (7X X50), Splitter&Guidevane (7X X57)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (Varnish medium alkyd)	60	NIL	--	60
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## Procedure for Surface Preparation and Painting

Doc. No	<b>PRQA: 590</b>
Rev	<b>01</b>
Date	<b>02 02 08</b>
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Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in µm (Min)	Finish	DFT in µm (Min)	Total DFT (Min)
4.3	Hand rails, post, step treads, Floor grills (89 610,611,7X X65)	Power tool cleaning to ST-3 (SSPC SP3) *	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 black shade	40	70
4.4	EE (7X X15)EE hook, EE suspension hook (7X X13), CE (7X X20)CE, CE suspension hook (7X X19), Foundation material foe ESP structures& ducts (7X X80).	--	(**) Temporary rust preventive oil Dry type	20	--	--	20

<b>5.0 Gates and Dampers</b>							
5.1	Gates and dampers temperature ≤ 95°C (57 XXX)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70
5.2	Gates and dampers temperature > 95°C (57 XXX)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	60	NIL	--	60
5.3	Gate blades, Machined components of G&D	---	(**) Temporary rust preventive oil Dry type	20	NIL	NIL	20

<b>6.0 Chimney</b>							
6.1	Foundation bolt (87 010)	Power tool cleaning to ST-3 (SSPC SP3)	(**) Temporary Rust preventive	20	--	--	20
6.2	Shells-Inside and Un insulated side, base plate (87 100),	Blast Cleaning to Sa 2 ½ (Near white metal with Surface profile 35 - 50 µm)	Two coats of Heat resistant aluminum paint as per IS 13183 (GR I -Up to 600°C,GR II 200°C to 400°C,GR III Up to 200°C)	40	NIL	--	40
6.3	Ducts un insulated, Strakes, (87 150), Painter trolley (87 200)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of Heat resistant aluminum paint as per IS 13183 (GR I -Up to 600°C,GR II 200°C to 400°C,GR III Up to 200°C)	40	NIL	--	40

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## Procedure for Surface Preparation and Painting

Doc. No	<b>PROA: 590</b>
Rev	<b>01</b>
Date	<b>02 02 08</b>
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Sl. No.	Component/PGMA	Surface preparation	Primer	DFT in $\mu\text{m}$ (Min)	Finish	DFT in $\mu\text{m}$ (Min)	Total DFT (Min)
6.4	Shells -out side insulated (87 100), Ducts- Insulated (87 150)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl).	60	--	--	60
6.5	Ladders, Hand rails, floor grills, platforms (87 300)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 black shade	40	70

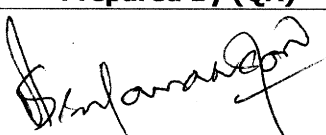

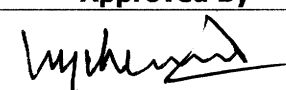
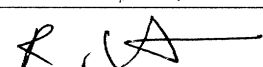
<b>7.0 Products meant for overseas application</b>							
7.1	Internal and External parts of APH, ESP, Fan and Gates and Damper	Blast Cleaning to Sa 2 1/2 (Near white metal with Surface profile 35 - 50 $\mu\text{m}$ )	Epoxy red oxide Zinc phosphate primer to IS 13238	30	Epoxy polyamide cured paint to IS 14209	30	60


Note: All components covered under different PGMA are to be painted. In case any component is left out, the same shall be deemed to be included under relevant section.

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<b>QUALITY ASSURANCE</b>	
<b>QWI NO: PR:QA:590 Rev.01 Dtd.02.02.2008</b>	
<i>Amendment to Quality Work Instruction (QWI)</i>	
<b>Amendment No: A1</b>	<b>Date:11.10.2013</b>
<b>Title: <i>Procedure for Surface Preparation and Painting</i></b>	

<b>Details of Amendment</b>		
<b>Clause No</b>	<b>Amended As</b>	<b>Basis for Amendment</b>
<p>Refer Clause no 4.0 – Table 2 and further clause no. 3.2 a) and 3.3 a) of Table.</p>	<p>AP Fan components like Servo Motor Assy, Shaft with Bearing Assy (refer clause 3.2 a) and impeller (refer clause 3.3 a) of table 2.0 Presently Existing Painting Scheme:</p> <ol style="list-style-type: none"> <li>1. Primer: one coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyd) DFT = 30 µm.</li> <li>2. Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 Unless specified otherwise Finish= 40 µm(Primer+Finish: total DFT- 30+40=70 µm)</li> </ol> <p>The above painting scheme has been modified as below - only for AP fan components like Servo Motor Assy, Shaft with Bearing Assy (refer clause 3.2 a) and impeller (refer clause 3.3 a) of table 2.0</p> <ul style="list-style-type: none"> <li>• Epoxy based Zinc Phosphate Primer (Two Pack system) as per IS:13238 – Two coats and each coat min. 30µm and total DFT will be 60 µm</li> <li>• Finish Paint : Not Applicable</li> </ul>	<p>Feedback from RCA Sub-Committee Meeting. Dt- 14.05.2013 (For quick drying of paint)</p>

<b>Prepared By (QA)</b>	<b>Reviewed By</b>	<b>Approved By</b>
	QC-Shop 	
	QA 	

 Ranipet	<b>Procedure for  Fabrication of Gland plate and follower  plate, Gland and Stud welding</b>	Doc. No	<b>PRQA: 599</b>
		Rev	<b>00</b>
		Date	<b>18 09 08</b>
		Page NO	<b>1 of 5</b>

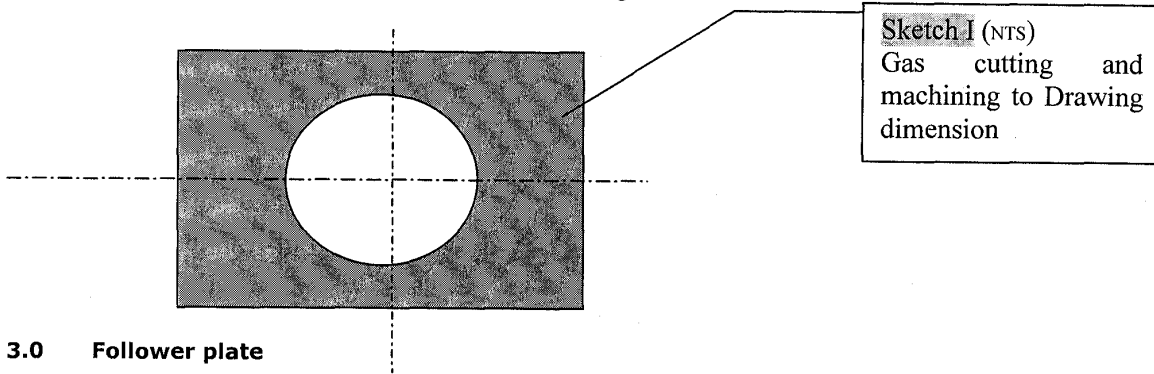
**1.0** This procedure gives the Guide line / method of fabrication of Gland and Follower with Gland and stud welding assembly used in Damper assembly

**2.0 Gland plate**

2.0.1 Mark the size of the gland plate with plus 3 mm on each side and Gas cut using pug cutting machine

2.0.2 Grind the gas cutting sides to a maximum square out of 1 mm. Mark the center line on both axis as shown in the sketch I and prick punch the line and extend this to two sides on thickness.

2.0.3 Mark the Hole size with sufficient machining allowance and gas cut. Machine to drawing dimension. Check and record the readings.

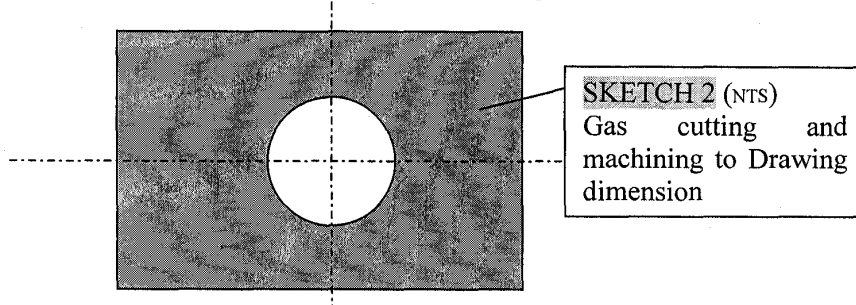


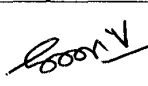
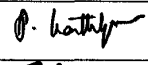
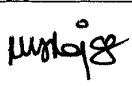
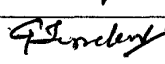
**3.0 Follower plate**


3.0.1 Mark the size of the follower plate with plus 3 mm on each side and Gas cut using pug Cutting machine.

3.0.2 Grind the gas cutting sides to a maximum square out of 1 mm. Mark the center line on both axis as shown in the sketch I and prick punch the line and extend this to two sides on thickness.

2.0.4 Mark the Hole size with sufficient machining allowance and gas cut. Machine to drawing dimension. Check and record the readings.



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	P Karthikeyan DM/QA		 Head / QA
	G Jeyasekar /SM/QC-OLI		

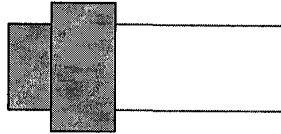
 Ranipet	<b>Procedure for  Fabrication of Gland plate and follower  plate, Gland and Stud welding</b>	Doc. No	<b>PRQA: 599</b>
		Rev	<b>00</b>
		Date	<b>18 09 08</b>
		Page NO	<b>2 of 5</b>

**Note:** Gland plate and Follower plate Hole can be done by drilling and further enlarging of Gland plate by boring in Butted condition of the both plates. However reference of Stud pitch shall be taken reference from Gland plate and follower plate hole.

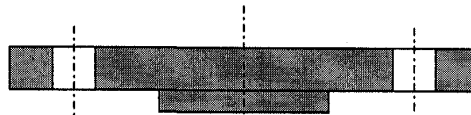
**4.0 Assembly of Gland plate and follower plate, Stud**

4.0.1 Place the Gland plate over the Follower plate. Align the co axiality both holes by using stepped pin gauge as per Sketch 3 and tack weld.

(Sketch 3 NTS)



4.0.2 Using template mark the Stud location (the template shall be made in such a way that stud location-marking w.r.to Gland and follower plate center. as per Sketch 4



(Sketch 4 NTS)

4.0.3 Match drill the Stud hole using drill jig supplied by BHEL . Insert the Stud and complete the stud welding as per WPS.Flush grind the stud weld. Ensure Pre heating and Root run, Root LPI and Final MPI to have a defect free weld. (Refer detailed welding procedure issued by QC OLI to sub contractor for better understanding of the requirement)

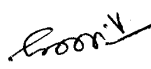
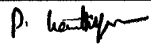
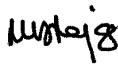
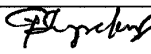
4.0.4 Match mark to have a unique identification after dismantling.

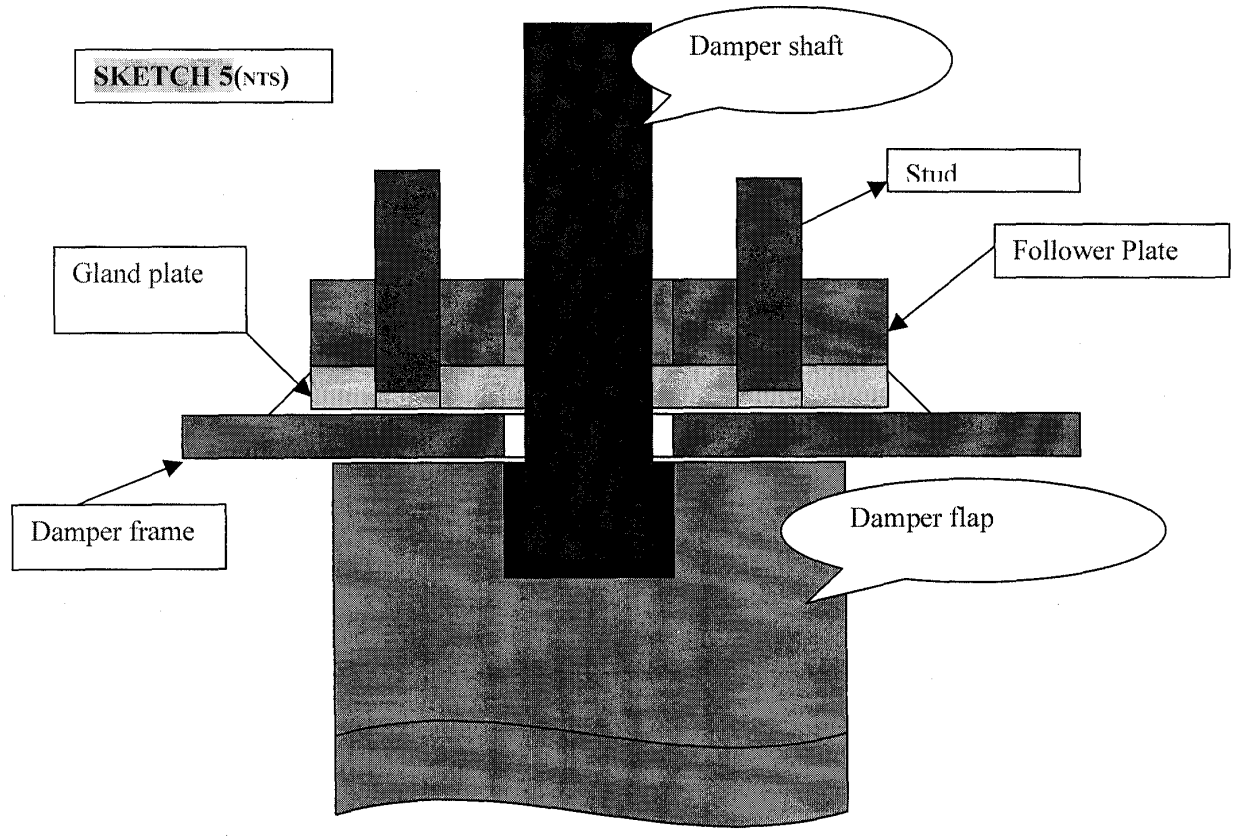
4.0.5 Dismantle the Gland plate and Follower plate and Grind the Tack weld.



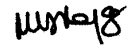
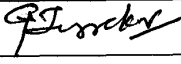
4.0.6 Weld the Gland with Gland plate (In order to avoid weld distortion use suitable shaft, which is having same diameter of damper shaft being assembled. Claen and grind.


4.0.7 Re assemble the Gland plate assembly with Follower plate to ensure any interference with the stud and follower plate hole as shown in the sketch 5. Do not enlarge follower plate hole.

4.0.8 Clean and apply rust preventive coating and preserve for further assembly with Damper

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	G Jeyasekar /SM/QC-OLI		



Prepared By	Reviewed By		Approved BY
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	G Jeyasekar /SM/QC-OLI		

	<b>Procedure for Fabrication of Gland plate and follower plate, Gland and Stud welding</b>	Doc. No	<b>PRQA: 599</b>
		Rev	<b>00</b>
		Date	<b>18 09 08</b>
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PROCEDURE FOR GLAND STUD WELDING

01. Ensure Gland plates (GP) and Follower plates (FP) are received intact with match marking and firm code.
02. Ensure Gland studs received are having proper identification for specification SA193B7 with inspector's seal.
03. Ensure GPs and FPs are having dimensions as per drg. taking care of co-axiality and w.r.t center axis of stud holes and record 100%.
04. During the process, butting surfaces of GP & FP should not be reversed and should not be interchanged.
05. Locate the GP on a fixture having guides for bore and stud holes to maintain 1mm uniform clearance of Gland bush and tack the gland bush. Ref Fig 5
06. Weld the Gland bush (GB) all round maintaining fillet all-round and remove / ground flush any excess weld.
07. Conduct LPI on GB weld.
08. Gland studs that are having chamfers already are to be chamfered further to accommodate 2.5 electrodes for root welding.
09. Fit up of Gland studs should be made using follower plate also as per the sketch enclosed, maintaining gap 6mm / as per drg for plug welding. Sufficient chamfering of gland stud holes also necessary for proper plug welding. (Ref Fig 6)
10. After Gland studs tacked and after fit up clearance plug weld the gland stud. Please note during fit up and welding of stud pre-heating of stud opposite to plug weld should be done. Electrode specification and pre heating temperature shall be as per WPS.
11. Ensure root weld slag and subsequent layer weld slag are cleaned properly.
12. After welding Gland stud, ensure perpendicularity of stud.
13. Grind the plug welding area properly without making undulations.
14. Conduct MPI on plug weld after 48 hours of plug weld.
- 15 Also, tighten the stud with assy. of Follower plate to ensure soundness of weld.

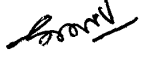
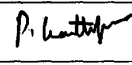
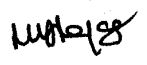

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	P Karthikeyan DM/QA		 <b>Head /QA</b>
	G Jeyasekar /SM/QG-OLI		

FIG -5

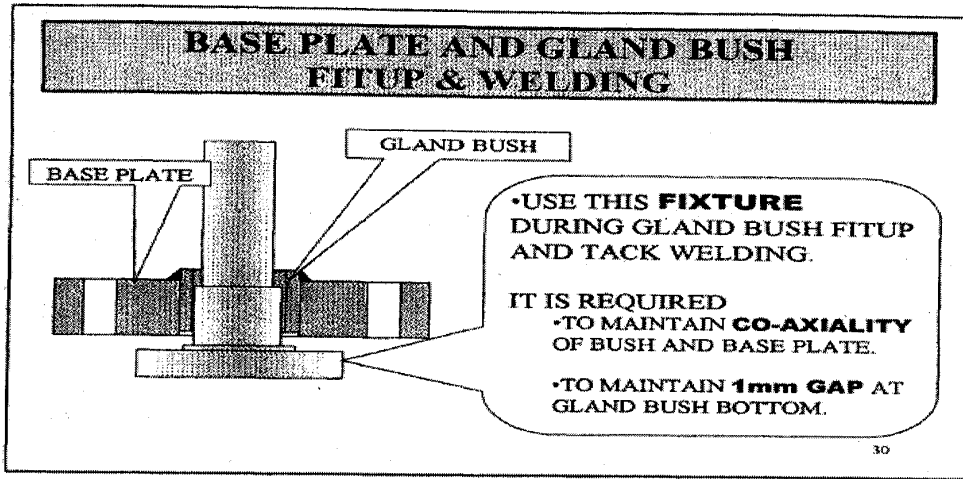
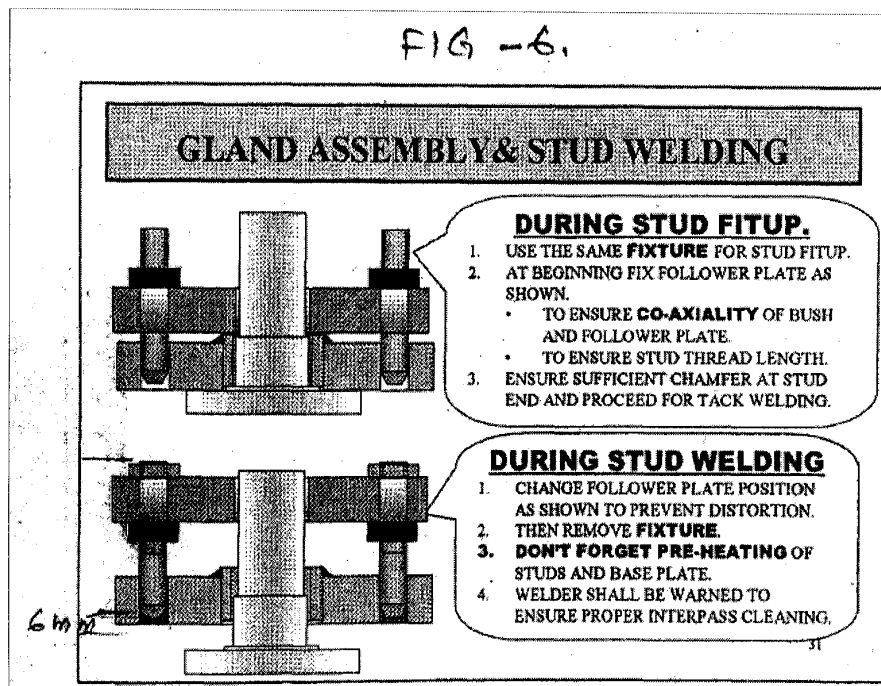
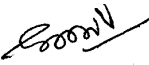
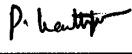
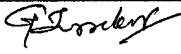
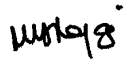



FIG -6.



Prepared By	Reviewed By	Approved BY
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	G Jeyasekar /SM/QC OLI	
		 Head /QA

 <b>Ranipet</b>	<b>Non Destructive Examination (NDE)</b> <b>requirement for Gates and Dampers</b>	Doc. No	<b>PRQA: 603</b>
		Rev	<b>02</b>
		Date	<b>17 02 2011</b>
		Page NO	<b>1 of 1</b>

**1.0 Scope**

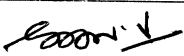
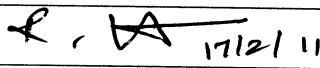
1.1 This procedure details out the **Liquid penetration Inspection (LPI), Magnetic Particle Inspection (MPI) requirement** for the Components of Gates and Dampers

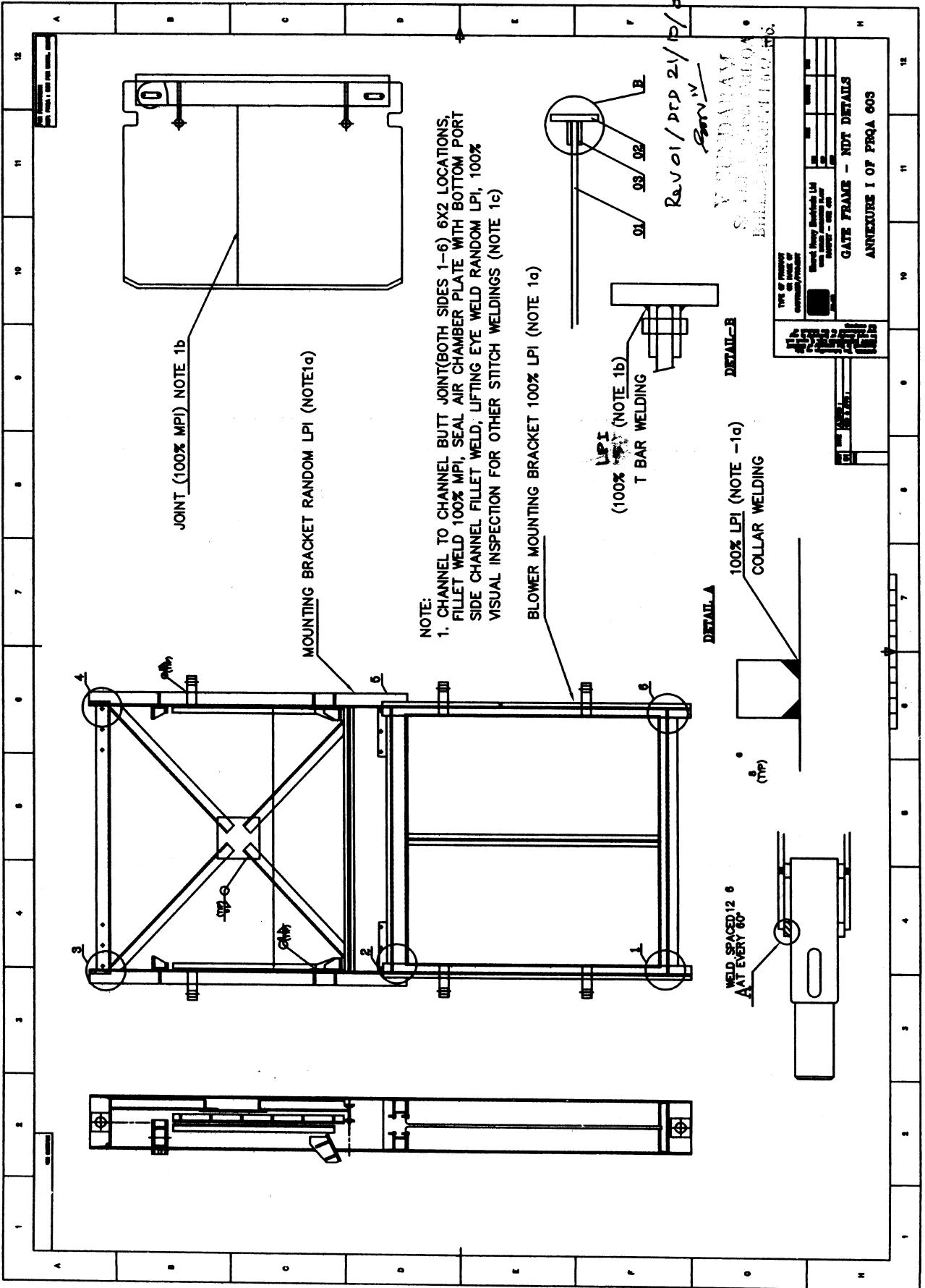
**1.2 Reference.**

- RQP for Gates : 0000-999-QVM-P-267 Rev 02 DT 27 06 08 / Clause 2.1 Note 1a,1b,and 1c
- RQP for Dampers: 0000-999-QVM-P-268 Rev 02 DT 26 05 08 / Clause 2.1 Note 1a,1b.

1.3 The details of NDE locations for gates are as per **Annexure I** and for Dampers as per **Annexure II**

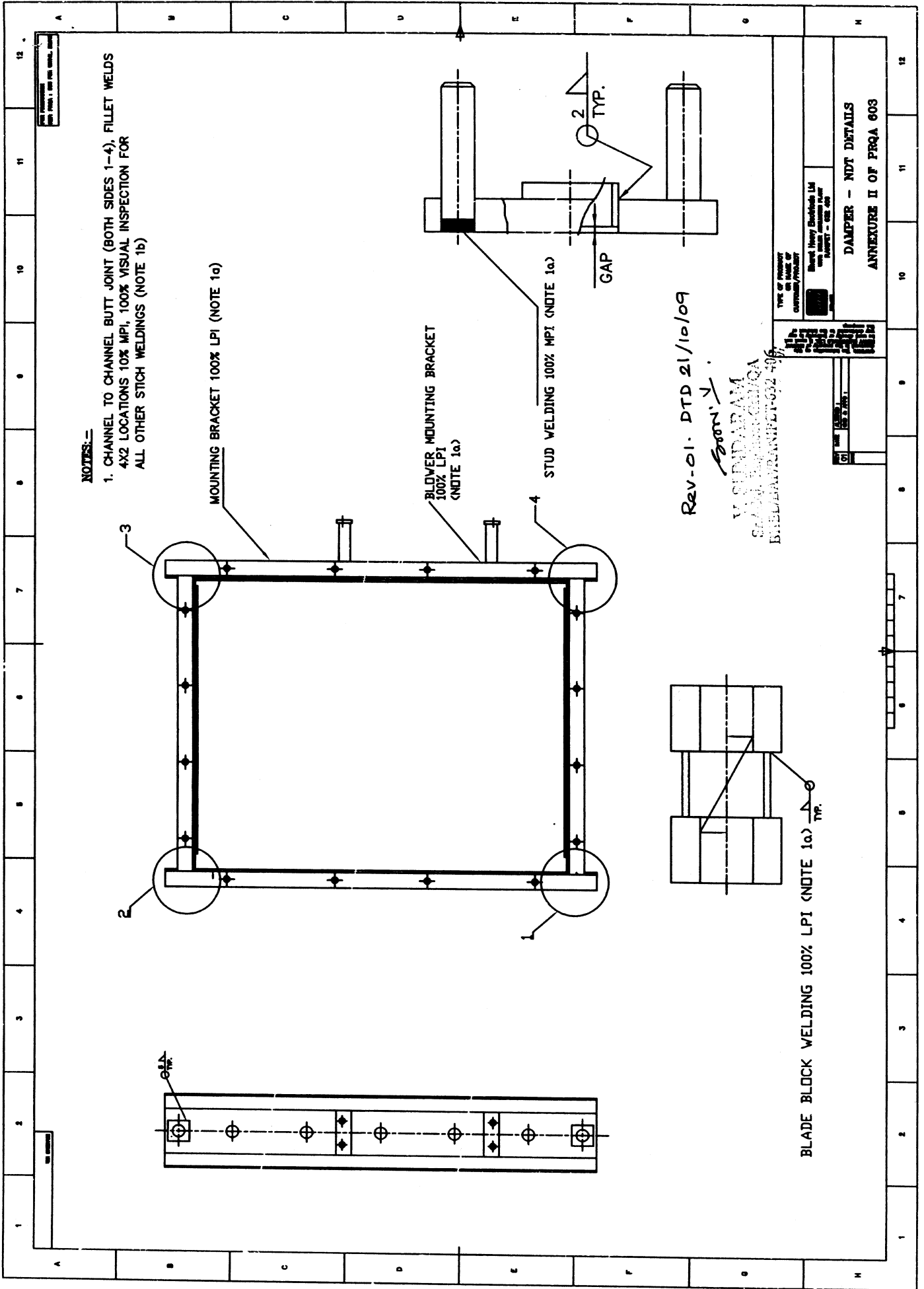
Revision Number/Date	Changes made
00/ 05 09 09	Original Issue.
01/24 10 09	Correction done in Note - C of Annexure I & II
02/17 02 11	Correction done in Annexure under Note 1b (T bar welding )

Prepared By	Reviewed & Approved BY
	 17/2/11



REV-02 / DT. 17-02-2011

*Goodly*



**NOTES:-**

1. CHANNEL TO CHANNEL BUTT JOINT (BOTH SIDES 1-4), FILLET WELDS 4X2 LOCATIONS 10% MPI, 100% VISUAL INSPECTION FOR ALL OTHER STITCH WELDINGS (NOTE 1b)

MOUNTING BRACKET 100% LPI (NOTE 1a)

BLOWER MOUNTING BRACKET 100% LPI (NOTE 1a)

STUD WELDING 100% MPI (NOTE 1a)

GAP

2 TYP.

Rev-01. DTD 21/10/09

*From V.*

V. SUNDARAM  
 Sr. Design Engineer  
 BRIDGE/AN/PET-02 406

TYPE OF PROJECT  
 BRAND NAME  
 BRAND MAKE  
 BRAND MODEL

BLADE BLOCK WELDING 100% LPI (NOTE 1a)

DAMPER - NDT DETAILS  
 ANNEXURE II OF PRQA 603

DATE: 21/10/09  
 TIME: 10:30 AM  
 PROJECT: BRIDGE/AN/PET-02 406

SCALE: AS SHOWN

DR: V. SUNDARAM  
 CHECKED: [Signature]  
 APPROVED: [Signature]



BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET - 632406  
NON - DESTRUCTIVE TESTING

BHE:NDT:RP:MT:01  
REVISION : 02  
PAGE NO:1 OF 15

**PROCEDURE**  
**FOR**  
**MAGNETIC PARTICLE EXAMINATION**  
**OF**  
**FERRITIC MATERIALS AND WELDED COMPONENTS**

---

Prepared by:

K.Velladurai  
Level II

---

Reviewed and  
Approved by:

L.Senguttuvan  
Level III

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Effective Date: 14.08.03

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**MASTER COPY**



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RANIPET - 632406  
NON - DESTRUCTIVE TESTING

BHE:NDT:RP:MT:01  
REVISION : 02  
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### RECORD OF REVISION

Rev.No.	Date of revision	Reason for revision
01	28 07 99	Revision in entirety
02	14 08 03	Clause 14.0,19.44,18.1and23.0 added Clause 15.1.1,21.2,21.3,22.2 and22.3 modified



## 1.0 SCOPE

- 1.1 This procedure describes the method, techniques and acceptance standards for Magnetic particle Examination of all shapes of ferromagnetic product forms in Boiler components, Boiler Auxiliaries, pressure vessels, Heat Exchangers and Structural.
- 1.2 The examination shall include all Gas cut openings, attachment welds with a throat thickness over 6mm and on finished surface of welds as required by referencing code/section. The examination includes base material 13mm on each side of the welds.

## 2.0 REFERANCE

- 2.1 ASME Section V,I & VIII (Division 1 & 2) – 2002 Addenda
- 2.2 ASME B 31.1 ( 2001 )
- 2.3 ANSI / AWS D 1.1 ( 2002 )

## 3.0 EQUIPMENT

- 3.1 Equipments generating half-wave rectified alternating current employing prods at the end of magnetizing cables shall be used for examination by circular magnetization method.
- 3.2 Direct / Alternating current electromagnetic yokes shall be used to detect discontinuities that are open to the surface of the part by longitudinal magnetization method and to examine the surface where arcing is not permitted or prod method is not practicable.

## 4.0 EXAMINATION MEDIUM

- 4.1 The ferromagnetic particles used as examination medium shall be either wet or dry. Wet particles shall be non – fluorescent type.
- 4.2 Dry magnetic particles black, gray or red in color shall be used as examination medium for examination of welds and other product forms to provide adequate contrast with the surface being examined. The surface temperature of the part examined with dry particles shall not exceed 315°C.
- 4.3 Non fluorescent wet particles will be black or reddish brown in color that provide adequate contrast with the surface being examined. Wet particles shall be suspended in kerosene for application to the test surface by flowing or spraying. Suitable conditioning agents shall be added to the water to provide proper wetting and corrosion protection for the parts being examined.
- 4.4 The temperature of the wet particle suspension and the surface of the part being examined shall not exceed 57°C.



4.5 The bath concentration shall be determined by measuring the settling volume through the use of pear-shaped centrifuge tube. The settling volume shall be within 1.2 ml to 2.4 ml for non- fluorescent particles.

## 5.0 SURFACE CONDITIONING

### 5.1 Preparation

5.1.1 As welded, as rolled, as cast or as forged surface is generally acceptable provided the surface irregularities will not mask the indication due to discontinuities. Otherwise surface preparation by grinding or machining may be necessary. Undercuts, Overlaps or abrupt ridges and valleys in the welds and opening shall be smoothly merged with the parent metal.

5.1.2 Prior to magnetic particle examination, ensure that the surface to be examined and adjacent area within at least 25mm of the area of interest shall be dry and free of any dirt, grease, lint, scale, welding flux, spatter, oil or other extraneous matter that would interfere with the examination.

5.1.3 Cleaning may be accomplished by detergents, organic solvents, descaling solution and paint removers, sand or grit blasting method.

5.1.4 Thin nonconductive coating such as painting will not normally interfere with the formation of indications. They must be removed at all points where electrical contact is to be made for direct magnetisation.

### 5.2 Surface contrast Enhancement

5.2.1 When coating are applied temporarily to enhance particle contrast or if coating are left on the part being examine, it must be demonstrated that indications can be detected through the enhanced coating thickness on a test plate with machined grooves as in 16.0

5.2.2 If indications of required sensitivity could not be detected, the coating shall be removed.

## 6.0 METHOD OF EXAMINATION

6.1 Examination shall be made by continuous method.

### 6.1.1 Dry continuous magnetisation method

6.1.1.1 The magnetizing current remains on while the examination medium (Dry particle) is being applied and while the excess of the examination medium is being removed.



### 6.1.2 Wet continuous magnetisation method

6.1.2.1 The magnetic particle application involves bathing the surface of the part with examination medium and terminating the bath application immediately prior to cutting off the magnetizing current with two or more shots given to the part. The duration of the magnetizing current is typically on the order of  $\frac{1}{2}$  seconds.

## 7.0 TECHNIQUES

7.1 One of the following magnetization techniques shall be used.

- a) Prod Technique
- b) Yoke Technique

## 8.0 TYPE OF CURRENT FOR MAGNETISATION

8.1 Single phase half -wave rectified current (HWAC) / (HWDC) shall be employed for testing with prod techniques.

8.2 The amperage required with single - phase Half-wave rectified current shall be verified by measuring the average current during the conducting half cycle only.

8.3 For Yokes, the current shall be either AC or DC.

## 9.0 CALIBRATION

9.1 Ammeter of magnetizing equipment shall be calibrated as per NDT: WI:004 at least once a year, or after each time it has been subjected to major electrical repair, periodic overhaul or damage. If equipment has not been in use for a year or more, calibration shall be done prior to first use.

### 9.2 Lifting power of yokes

9.2.1 The magnetizing force of yokes shall be checked at least once a year or whenever a yoke has been damaged. If a yoke has not been in use for a year or more, a check shall be done prior to first use.

9.2.2 Each alternating current electromagnetic yoke shall have a lifting power of at least 4.5 kg and direct current / permanent magnetic yoke shall have a lifting power of 18.kg, at the maximum pole spacing that will be used or the pole distance shall be the spacings at which the yoke lifts the stipulated weight.

9.2.3 Each weight shall be weighed with a scale from a reputable manufacturer and stenciled with the applicable nominal weight prior to first use. A weight need only be verified again if damaged in a manner that could have caused potential loss of material.



## 10.0. EXAMINATION

### 10.1 Direction of magnetization

10.1.1 At least two separate examination shall be carried out on each area. During the second examination the prods/poles are spaced so that the lines of flux are approximately perpendicular to those used during the first examination. A different technique for magnetization may also be used for the second examination

### 10.2 Examination Coverage

10.2.1 Examination shall be made with sufficient overlap to assure 100% coverage of testing.

## 11.0 PROD TECHNIQUE: (Fig. 1,2&3)

### 11.1 Magnetizing procedure

11.1.1 The prod electrodes are pressed firmly against the surface in the area to be examined. In order to avoid arcing a remote control switch shall be built in to the prod handles, to permit the current to be turned on after the prods have been properly positioned and to be turned off before they are removed.

### 11.2 Magnetising current

11.2.1 The current shall be 100 to 125 (maximum) amperes/25mm of prod spacing for sections 19mm thick or greater.

11.2.2 For sections less than 19mm thick, the current shall be 90 to 110 amperes / 25mm of prod spacing.

### 11.3 Prod spacing

11.3.1 Prod spacing shall not be less than 75mm nor exceed a maximum of 200mm.

11.3.2 The prod tips shall be kept clean and dressed and the contact areas of the test surface shall be free from dirt, scale, oil etc, to minimize electrical arcing. In the open circuit voltage of the magnetizing current is greater than 25 volts, Lead, steel or Aluminum rather than copper tipped prods shall be preferred to avoid copper deposits on the part being examined.

## 12.0 YOKE TECHNIQUE

12.1 The pole spacing shall be between 100mm to 150mm. The field indicator will be used to check the direction of the part magnetization.



### 13.0 APPLICATION OF DRY PARTICLES

13.1 The dry particles shall be applied in such a manner that a light uniform dust-like coating settles on the surface of the area being examined. The application technique shall be such that the particles are suspended in air and reaches the examination surface in a uniform cloud with a minimum forces, using a hand powder applicators (Squeeze bulb) or specially designed mechanical blower or by a spray nozzle.

13.1.1 Dry particles shall not be applied to a wet surface nor when there is excessive wind. The particles shall not be applied by pouring, throwing, or spreading with fingers.

13.1.2 Any excess powder shall be removed while the magnetization current is on and shall be with a gentle air stream without removing or disturbing particles attracted by a leakage field that may prove to be a relevant indication.

### 13.2 APPLICATION OF WET PARTICLES

13.2.1 The application of wet particles involves the bathing of the area to be examined, by spraying or flowing during the application of magnetizing current.

13.2.2 Two or more shots shall be applied, but the last shot shall be applied while the bath still remains on the area to be examined and after the particles flow has been stopped. Care shall be taken to cut off the bath application before removing the magnetic field, to prevent high-velocity particle flow that wash away or remove fine or weakly held indications.

### 14.0 MAGNETISING FIELD ADEQUACY AND DIRECTION

14.1 By using one or more of the following three methods, the magnetizing field adequacy and direction may be verified.

14.1.1 Pie shaped Magnetic Field Indicator, artificial flaw shims and Hall effect Tangentisl Field probe.

### 15.0 LIGHTING

#### 15.1 Visible Light Intensity

15.1.1 The examination and evaluation of indications shall be performed under minimum light intensity of 100 fc (1000 lx).

### 16.0 SYSTEM PERFORMANCE CHECK (Fig. 4)

16.1 For prod magnetization with HWAC, performance sensitivity shall be checked at least once in a shift before start of the examination on a test plate that contains machined grooves to different depths. The indication of a groove at 3mm depth from the surface of the test plate will indicate adequate sensitivity.



- 16.2 If the part is to be tested with contrast coat, the sensitivity shall be checked with the contrast coat on the surface of the test block.
- 16.3 For electromagnetic yokes, the adequacy or direction of the magnetizing force shall be verified by positioning the 'Magnetic Field Indicator' on the surface to be examined. The pattern in the indicator should be clearly developed on the surface of the block.
- 17.0 DEMAGNETISATION**
- 17.1 No demagnetization will be done after the test except specifically required.
- 18.0 EVALUATION OF INDICATION**
- 18.1 Mechanical discontinuity at the surface would be indicated by the retention of the powder or medium.
- 18.1.1 All the indication are not necessarily discontinuity indications since certain metallurgical discontinuities and magnetic permeability variation may produce similar unacceptable discontinuity indication. These non-relevant indications shall be reexamined by any other suitable NDT methods such as Liquid penetrant or macro etching.
- 18.2 Relevant indications are those which result from unacceptable mechanical discontinuities.
- 18.2.1 Linear indications are those indications in which length is greater than three times the width.
- 18.2.2 Rounded indications are circular or elliptical with the length equal to or less than three times the width.
- 19.0 ACCEPTANCE STANDARDS AS PER ASME (SEC I,VIII Div 1&2 and B 31.1) AND OTHERS**
- 19.1 Welds and Materials**
- 19.2 An indication of an imperfection may be larger than the imperfection that causes it: however, the size of the indication is the basis for acceptance for evaluation.
- 19.3 Only indications with major dimension greater than 1.6mm shall be considered relevant.
- 19.4 All surface to be examined, except as mentioned in 19.5, 19.6 and 19.7 shall be free of
- 19.4.1 Relevant linear indications.



19.4.2 Relevant rounded indication greater than 4.8mm

19.4.3 Four or more relevant rounded indications in a line separated by 1.6mm or less edge to edge.

19.4.4 Ten or more rounded indications in any 3870 mm<sup>2</sup> (6 inch<sup>2</sup>) of surface with the major dimension of this area not to exceed 150mm with the area taken in the most unfavourable location relative to the indication being evaluated.

19.5 Cut edges and openings:

19.5.1 All surface to be examined shall be free of

(a) Cracks

(b) Laminations exceeding 25mm in length.

19.6 In welds joining nipples to drums, spheres or headers, all slag or porosity indications shall be investigated to assure that no leak – path exists.

19.7 In attachment welds of non-load carrying class, indications from crack or due to material separation are unacceptable.

## 20.0 ACCEPTANCE STANDARD FOR STRUCTURAL COMPONENTS AS PER AWS

20.1 The magnetic particle acceptance criteria is based on the size of the actual discontinuity and not the size of the discontinuity as indicated by the magnetic particle inspection medium. Where discontinuity cannot be visually seen (with magnification if required) after removal of the indicating medium, evaluation shall be based on size and nature of the magnetic particle indication.

### 21.0 Statically loaded Non tubular connections

21.1 Cracks, Lack of Fusion, and Incomplete penetration are not acceptable.

21.2 **Undercut**-for material with thickness less than 25mm undercut shall not exceed 1.0mm, except that a maximum 2.0 mm is permitted for a accumulated length of 50mm in any 300mm. For material equal to or greater than 25.0 mm thick, undercut shall not exceed 2.0 mm for any length of weld.

21.3 **Porosity** – a complete joints penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no visible piping porosity. For all other groove welds and for fillet welds, the sum of the visible piping porosity 1.0mm or greater in diameter shall not exceed 10mm in any linear 25mm of weld and shall not exceed 20mm in any 300mm length of weld.



## 22.0 Cyclically Loaded Non tubular Connections

- 22.1 **Undercut** - In primary members, undercut shall be no more than 0.25mm deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall not be more than 1.0mm deep for all other cases.
- 22.2 **Porosity** - The frequency of piping porosity in fillet welds shall not exceed one in each 100 mm of weld length and the maximum diameter shall not exceed 2.5mm. Exception : for fillet connecting stiffeners to web, the sum of the diameter of the piping porosity shall not exceed 10mm in any linear 25mm of weld and shall not exceed 20mm in any 300 mm length of weld.
- 22.3 Complete joint penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity.
- 22.3 **PIPING POROSITY** - (General) is elongated porosity whose major dimension lies in a direction approximately normal to the weld surface. Frequently referred to as pin holes when the porosity extends to the weld surface.

## 23.0 EDGE DISCONTINUITIES IN CUT MATERIALS

- 23.1.1 No crack is acceptable.
- 23.1.2 Mill induced discontinuity
- 23.1.3 Length 25mm and less- Acceptable
- 23.1.4 Length over 25mm and depth up to 3mm- Acceptable
- 23.1.5 Length over 25mm and depth between 3mm and 25mm - indications to be removed.
- 23.1.6 Length over 25mm and depth greater than 25mm - indications to be removed to a depth up to 25mm.

## 24.0 REPAIR AND RE-EXAMINATION

- 24.1 Whenever an imperfection is repaired by chipping or grinding or and subsequent repair by welding is not required, the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners.
- 24.2 After a defect is thought to have been removed and prior to making weld repairs, the area will be examined by suitable method to ensure that the defect has been removed or reduced to an acceptable size of an imperfection.



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24.3 where welding is required after repair of an imperfection the area shall be cleaned and repair carried out. After repairs have been made the repaired area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners.

24.4 After repairs have been made, the repaired area shall be re-examined by methods of examination that were originally required for the affected area.

#### 25.0 PERSONNEL QUALIFICATION

25.1 All personnel carrying out the examination and evaluation shall be qualified to minimum Level - I as per ASNT:SNT - TC - 1A.

#### 26.0 FINAL CLEANING

26.1 When the inspection is concluded, the magnetic particles shall be removed by any suitable means, leaving the product in a dry and clean condition.

#### 27.0 REPORT

27.1 Copies of the report in a standard format R 49-719-B or equivalent duly signed by a minimum Level - II personnel shall be issued after the test.

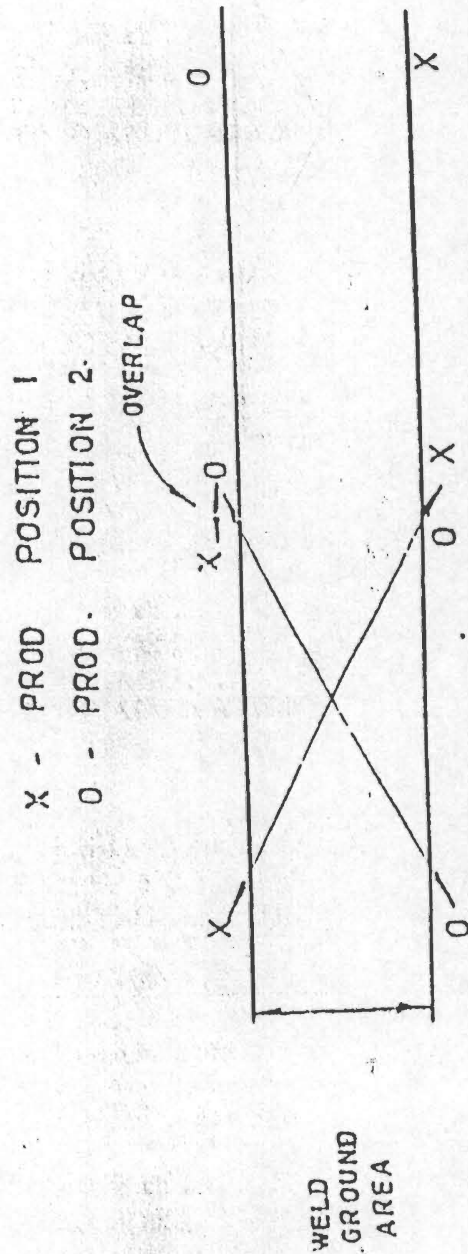


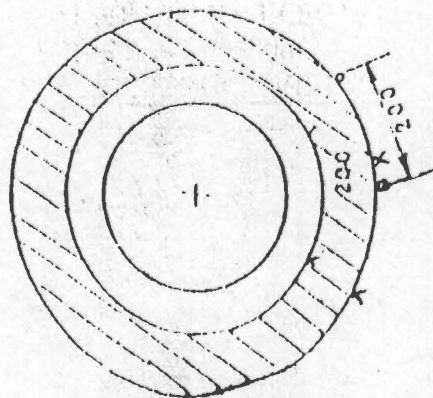
FIG. (1) TECHNIQUE FOR EXAMINATION OF LONG SEAMS & CIRCUMFERENTIAL SEAMS.

NOTE:

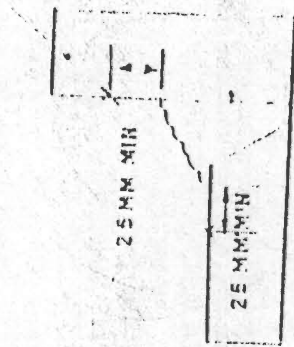
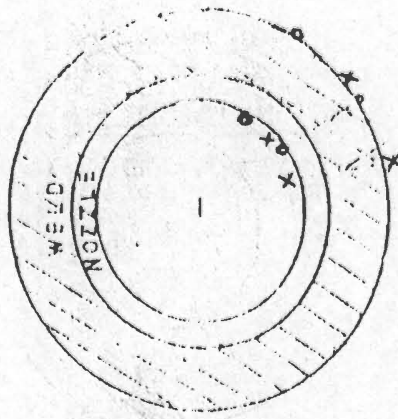
1. SUCCESSIVE SHOTS SHALL OVERLAP A MINIMUM OF 10% OR 20 MM
2. EXAMINATIONS ON O.D. AND I.D. OF THE SEAM SHALL BE CARRIED OUT IN THE SAME MANNER.
3. PRODS MUST BE PLACED ON DRUM / VESSEL PERPENDICULAR TO PLATE SURFACE.



LONGITUDINAL INDICATIONS



TRANSVERSE INDICATIONS



O - PROD POSITION . 1  
 X - PROD POSITION . 2

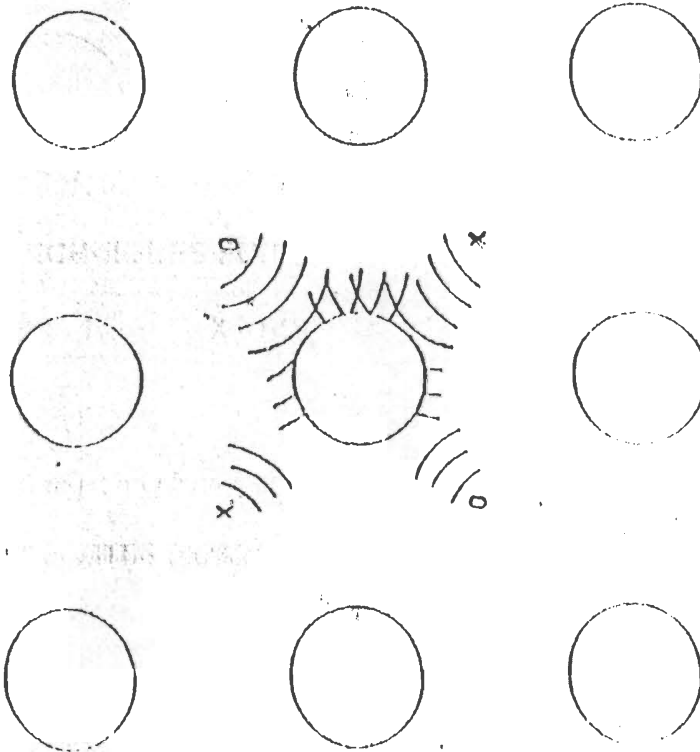
FIG. (2) TECHNIQUE FOR EXAMINATION OF CORNER JOINTS

1. PROD LOCATION AT TOP OF WELD  
 ALL THE WAY AROUND & AT THE  
 BOTTOM ALL THE WAY AROUND
2. O, X - 10% OVERLAP BETWEEN SHOTS

- PROD LOCATED AT LEAST 25MM UP ON  
 NOZZLE ± 25MM OUT ON DRUM / VESSEL
- 10% OVERLAP (15MM) BETWEEN SHOTS

NOTE:

PRODS MUST BE PLACED ON DRUM / VESSEL / NOZZLE  
 PERPENDICULAR TO PLATE SURFACE.



**FIG (3) TECHNIQUES FOR EXAMINATION OF FILLET WELDS**

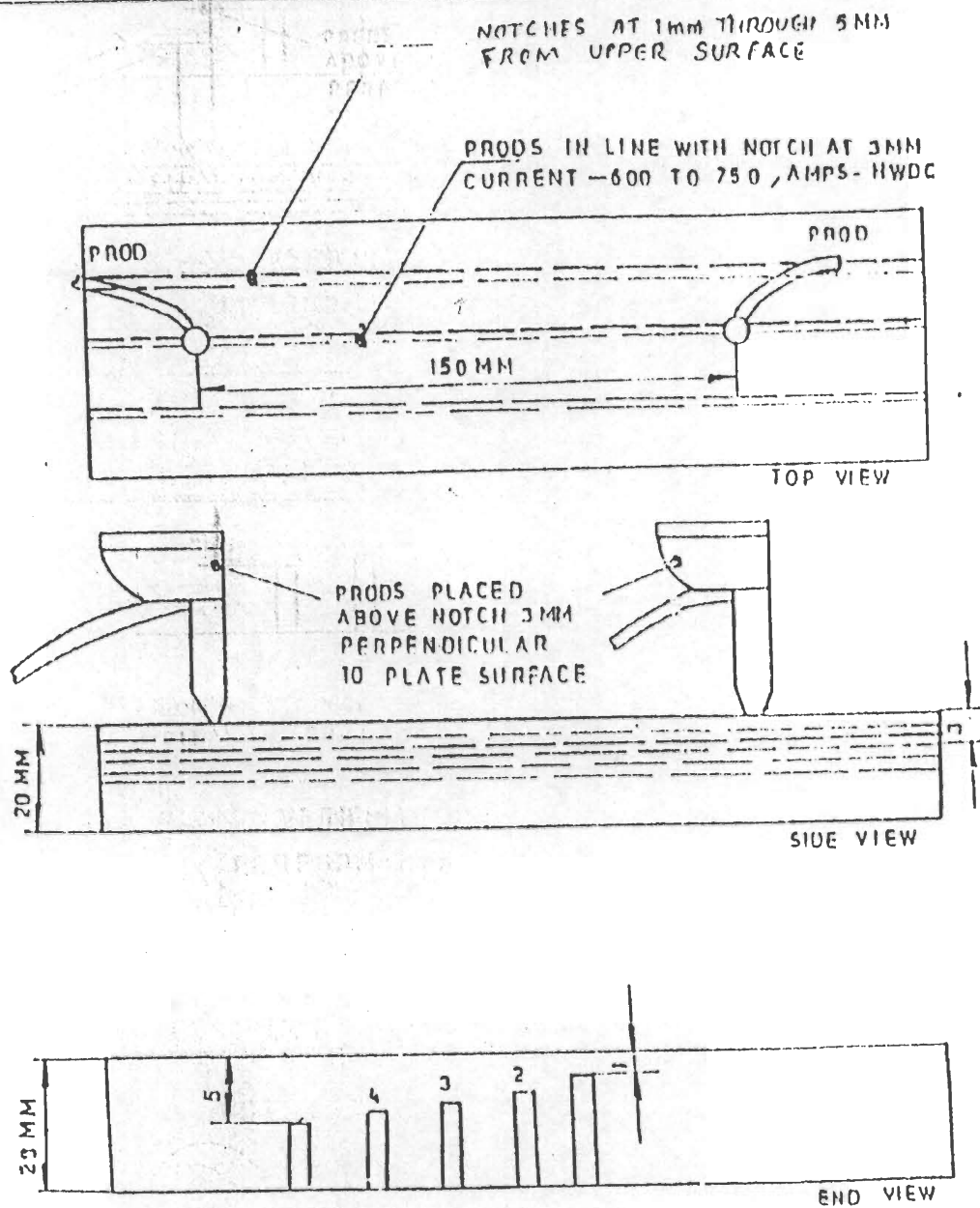
**0 - POSITION - 1**

**X - POSITION - 2**

**ARC BREAK LOCATION**

**NOTE :**

- 1) PRODS must be placed on drum / header perpendicular to plate surface.
- 2) Inspection will be 100% of weld for each shot.



PERFORMANCE CHECK - EQUIPMENT AND DRY POWDER COMBINATION PRIOR TO TEST

FIG (4)

VERIFICATION OF SYSTEM  
PERFORMANCE FOR PROD TECHNIQUE



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## PROCEDURE FOR LIQUID PENETRANT EXAMINATION

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MASTER COPY



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### RECORD OF REVISION

Revision No.	Date of revision	Reason for revision
01	28 07 99	Revision in entirety
02	14 08 03	Clause 2.1, 2.2, 2.3, 12.1.2.2, 12.1.3.1, 12.1.3.2 and 13.1.2.1 modified  Clause 8.2 added



## 1.0 SCOPE

1.1 This procedure defines the method, techniques and acceptance standards for Liquid penetrant Examination of all shapes of ferrous and Non-ferrous product forms in Boilers, Boiler Auxiliaries, pressure vessels, Heat Exchangers and structural.

1.2 In pressure vessels the Examination shall include all welds around openings, attachment welds with a throat thickness over 6mm and on finished surfaces of welds as required by referencing code. The examination includes base material 13mm on each side of the weld.

## 2.0 REFERENCE

2.1 ASME Section V, I & VIII (Division 1 & 2) -2002 Addenda

2.2 ASME B 31.1 / 2001

2.3 ANSI / AWS D 1.1 / D1.1M: 2002

## 3.0 EQUIPMENT

3.1 The term 'penetrant materials' as used in the procedure is intended to include all liquid penetrants, solvents (penetrant removers) or cleaning agents, developers etc used for 'Liquid penetrant Examination'.

3.2 Penetrant used shall be of solvent removable type and have a color contrast, which can be seen, readily in daylight or under normal interior illumination.

3.3 The cleaner used for the surface cleaning shall be an organic chemical such as Acetone or Trichloro Ethylene.

3.4 Developer shall be of non-aqueous suspendible type. When the developer dries, it shall form a white coating of fine powder on the part.

3.5 The Chemicals used for the examination of austenitic stainless steel or nickel base alloys shall be analysed for sulphur and total halogens. The residual amount of total sulphur and chlorine content shall not exceed 1% by weight.

## 4.0 SURFACE PREPARATION

4.1 In general satisfactory results may be obtained when the surface is as welded, as rolled, as forged or as cast condition. When the surface irregularities might mask the indications of unacceptable discontinuities, the surface shall be prepared by grinding or machining or any other suitable method.



- 4.2 The surface to be examined and all adjacent areas within at least 25mm shall be dry and free of any dirt, grease, lint, scale, welding flux, weld spatter, rust, paint, oil or any other extraneous matter that could obscure surface openings or otherwise interfere with the examination by preventing the penetration.
- 4.3 Shot blasting may close discontinuities at the surface and should not be used before conducting penetrant examination. If the component is shot blasted, the surface is to be etched before conducting penetrant examination.
- 4.4 Prior to the application of the penetrant, the surface is recleaned with typical industrial cleaning agents such as Acetone.
- 5.0 DRYING AFTER PREPARATION
- 5.1 After cleaning, drying of the surface shall be accomplished by normal evaporation and ensure that the cleaning solution has evaporated. The minimum time required for the cleaner to dry from the surface is 20 to 30 seconds depending on the position.
- 6.0 TECHNIQUES
- 6.1 Color contrast (visible) penetrant shall be used with solvent removable penetrant process.
- 6.1.1 The temperature of the penetrant and the surface of the part shall not be below 10°C and not above 52°C throughout the examination period. Local heating or cooling is permitted provided the part temperature remains in the range of 10°C to 52°C during the examination.
- 6.2 TECHNIQUE RESTRICTIONS
- 6.2.1 Intermixing of penetrant materials from different families or different manufacturers is not permitted.
- 7.0 EXAMINATION
- 7.1 Penetrant Application
- 7.1.1 The penetrant shall be applied by brushing, spraying or dipping after the surface is dried. For spraying a handpump or an aerosol spray cans will be used.



## 7.2 Penetration time

7.2.1 The penetrant shall be allowed to remain wet on the part for a minimum period for 10 minutes. (dwell time).

7.2.2 If the penetrant has completely dried up during the dwell time, then the surface shall be recleaned and reexamined.

## 7.3 REMOVAL OF EXCESS PENETRANT

7.3.1 After the required dwell time has elapsed, the excess penetrant remaining on the surface shall be removed by wiping with a lint free cloth, repeating the operation until most traces of penetrant have been removed. Final left out penetrant shall be remove by wiping with a clean cloth moistened with the solvent. Excessive application of the cleaner shall be avoided to prevent the possibility of removing the penetrant from discontinuities causing a decrease in the sensitivity of the test. FLUSHING THE MATERIAL SURFACE WITH THE SOLVENT FOLLOWING THE APPLICATION OF PENETRANT AND PRIOR TO DEVELOPING IS PROHIBITED.

### 7.3.2 Drying after excess penetrant removal.

7.3.2.1 After the removal of excess penetrant the surface shall be dried by normal evaporation. The minimum time required for the surface to get dried by normal evaporation is 20 seconds.

## 7.4 DEVELOPING

7.4.1 The developer shall be applied by spraying to provide uniform coating as soon as possible to the dry surface after the removal of excess penetrant. Insufficient coating thickness may not draw penetrant out of discontinuities. Excessive coating thickness may mask indications.

### 7.4.2 WET DEVELOPER APPLICATION

7.4.2.1 Prior to applying suspension type wet developer to the surface the developer must be thoroughly agitated too ensure adequate dispersion of suspended particles. The developer shall be applied by spraying using spray pump or aerosol spray can. The developer shall be applied over the surface in such a manner to assure complete coverage of the part with a thin, uniform film of developer. Drying of developer shall be by normal evaporation.



#### 7.4.3 DEVELOPMENT TIME

7.4.3.1 The surface shall be closely observed during the application of the developer to monitor the behavior of the indication, which tends to bleed-out. Developing time for final interpretation begins as soon as a wet developer coating is dry. The minimum developing time shall be 7 minutes.

#### 8.0 INTERPRETATION

8.1 Final interpretation shall be made within 7 to 60 minutes after the wet developer coating is dry. If the bleed - out does not alter the examination results longer periods are permitted.

8.2 The surface shall be examined in increments if the surface to be examined is large enough to complete the inspection within the prescribed time.

8.3 A minimum light intensity of 50 foot candle (500 lux) is required to ensure adequate sensitivity during the examination and evaluation of indications, which can be achieved by a hand lamp or torch light positioning at a distance of 300mm.

#### 9.0 EVALUATION

9.1 Flaws at the surface will be indicated by bleed out of the penetrant. However localized surface irregularities such as machining marks or other surface conditions may produce false indications. Broad areas of pigmentation which would mask indications are not acceptable and such areas shall be cleaned and reexamined.

9.2 Welds made to ASME Boiler and pressure vessel code

9.2.1 An indication of an imperfection may be large than the imperfection that causes it: however, the size of the indication is the basis for acceptance evaluation.

9.2.2 Relevant indications are those which result from mechanical discontinuities (imperfection).

9.2.3 Only indications with major dimension greater than 1.6mm shall be considered relevant.

9.2.4 Any indication which is believed to be non-relevant shall be regarded as a defect until the indication is either eliminated by surface conditioning or it is evaluated by other non - destructive testing and proved to be non - relevant.



- 9.2.5 Linear indications are those indications in which the length is more than three times the width.
- 9.2.6 Rounded indications are those which are circular or elliptical with the length equal to or less than three times the width.
- 9.2.7 Any questionable or doubtful indications shall be reexamined to determine whether they are relevant, or not.
- 10.0 ACCEPTANCE STANDARD (as per ASME Sec I and VIII Div 1&2)
- 10.1 Cut edges and openings
- 10.1.1 All surfaces to be examined shall be free of
- (a) Cracks
  - (b) Non laminar discontinuities (having length not parallel to the material surface).
  - (c) Laminations exceeding 25mm in length.
  - (d) Laminations under 25mm in length and adjacent to each other within 25mm shall be considered as one defect.
- 10.2 Welds and Materials
- 10.2.1 All surfaces to be examined shall be free of
- a) Relevant linear indications.
  - b) Relevant rounded indications greater than 4.8mm.
  - c) All relevant indications shall be investigated to assure that no leak-path exists in welds joining nipples to drums, dished – ends and headers.
- 10.2.2 Four or more relevant rounded indications in a line separated by 1.6mm or less edge to edge.
- 10.2.3 Ten or more rounded indication in any 3870mm<sup>2</sup> (6 inch<sup>2</sup> ) of surface with the major dimension of this area not exceed 150 mm with the area taken in the most unfavorable location relative to the indication being evaluated.



- 10.2.4 In attachment welds of non-load carrying class, indications from cracks or due to material separation are unacceptable.
- 11.0 WELDS MADE TO STRUCTURAL WELDING CODE ANSI / AWS D 1.1
- 11.1 For statically and cyclically loaded non-tubular connections made to AWS code the acceptance of any discontinuity shall be based upon a visual examination of the discontinuity after the removal of developer medium and evaluated for its nature and size. Where the discontinuity cannot be seen after removal of the developer medium either directly or using magnifying glass evaluation shall be based on the size and nature of liquid penetrant indication.
- 12.0 ACCEPTANCE STANDARD (AS PER AWS)
- 12.1 Statically loaded non-tubular connections.
- 12.1.1 Indications from cracks, lack of penetration and lack of fusion are not acceptable.
- 12.1.2 Porosity.
- 12.1.2.1 Complete joint penetration groove welds in butt joints transverse to the computed tensile stress shall have no visible piping porosity.
- 12.1.2.2 For all other groove welds and for fillet welds, the sum of the visible piping porosity of 1.0 mm or greater in diameter shall not exceed 10 mm in any linear 25 mm of weld and shall not exceed 20 mm in any 300 mm length of weld.
- 12.1.3 Undercut
- 12.1.3.1 For material less than 25 mm thick, undercut shall not exceed 1.0 mm except that a maximum 2.0 mm is permitted for an accumulated length of 50 mm in any 300 mm
- 12.1.3.2 For material equal to or greater than 25 mm thick undercut shall not exceed 2.0 mm for any length of weld.
- 13.0 Cyclically loaded non-tubular connections.
- 13.1 Indications from Cracks, Lack of penetration and lack of fusion are not acceptable in any welds.



### 13.1.2 Porosity

13.1.2.1 Complete joint penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 100mm of length and the maximum diameter shall not exceed 2.5 mm.

13.1.2.2 The Frequency of piping porosity in fillet welds shall not exceed one in each 100mm of weld length and the maximum diameter shall not exceed 2.5mm. EXCEPTION for fillet welds connecting stiffeners to web, the sum of the diameter of piping porosity shall not exceed 10mm in any linear 25mm of weld and shall not exceed 20mm in any 300mm length of weld.

### 13.1.3 Undercut.

13.1.3.1 In primary members, undercut shall not be more than 0.25mm deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall not be more than 1mm deep for all other cases.

## 14.0 REPAIR AND RE-EXAMINATION

14.1 Whenever an imperfection is repaired by chipping or grinding the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners.

14.2 After a defect is thought to have been removed and where welding is required after repair, the area shall be examined for removal of defects, area cleaned and repair carried out. The repaired area shall be blended into the surrounding surface as in 14.1 and re-examined by the liquid penetrant or any other NDT methods originally required for the affected area.

## 15.0 PERSONAL QUALIFICATION

15.1 Wherever penetrant examination is required by the referencing code, the same shall be conducted and evaluated by a personnel qualified to minimum, Level – I as per ASNT SNT-TC-1A.



BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET 632406  
NON-DESTRUCTIVE TESTING

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#### 16.0 POST CLEANING

- 16.1 After the examination and evaluation is completed all penetrant testing material shall be removed from the surface, so that it will not interfere with the subsequent processing or service requirements.

#### 17.0 REPORTING

- 17.1 Where penetrant test is mandatory, a copy of the report signed by personnel certified to minimum Level II will be issued in the format R49-720B or equivalent, after the completion of the examination.

\*\*\*\*\*


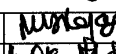
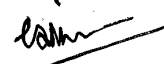
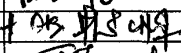
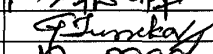
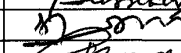
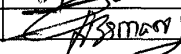
 Ranipet	<b>Splicing Norms for Plates &amp; sheets of APH components</b>		Doc. No	<b>PRQA: 410</b>
			Rev	<b>05</b>
			Date	<b>21 06 08</b>
			Page NO	<b>1 of 3</b>

## 1.0 Scope

1.1 This procedure details out the **SPlicing NORMS** for **DIAPHRGM PLATES, Housing Panels and Pedestals, Sector plate, connecting plate assembly, cleaning device Assembly of Air pre Heater.**

## 2.0 General Requirement

- 2.1 Check for the material specifications of plates/sheets, which are to be joined to avoid mix up of material. TCN to be obtained for change of material.
- 2.2 Electrode Selection shall be as per respective WPS. (E 7018 shall only be used for carbon steel)
- 2.3 Welding shall be followed with suitable methods and controls to minimize the distortion.
- 2.4 Stiffeners parallel to joint (Splice) shall be in such a way that welds over joint is avoided and a minimum distance between stiffeners parallel to weld joint shall be maintained as Two times the thickness of thicker plate.
- 2.5 Whenever back grinding is not feasible due to location of the plate /sheet, root welding to be carried out with 3.15 mm electrode and LPI to be carried out after thorough cleaning and repeat LPI after final welding.
- 2.6 Plus joint shall not be permitted when building up of plate to drawing size. However minimum offset of 100 mm is to be maintained.
- 2.7 Cut out on welds shall be avoided. In case any such opening on the joint the same shall be strengthened with pad plate of 50mm width all round on one side with the thickness equal to the parent material.
- 2.8 Unless otherwise mentioned against specific requirement minimum joint piece shall not be less than 500 mm. For hot end center section (tub plate) end joint piece shall be min 500 mm however for other joint piece shall be of max available sizes in order to reduce the number of joints.

Prepared By	Reviewed By			Approved BY
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 Ranipet	<b>Splicing Norms for Plates &amp; sheets of APH components</b>	Doc. No	<b>PRQA: 410</b>
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2.9 Following are the guidelines if Edge preparation (EP) is not specified in drawing/ OP&C Sketch.


- **Plates and sheets up to 5mm:** No EP is required. Provide 2 to 3 mm root gap, weld on both sides.
- **Plates of 6mm** No EP is required. Welds shall be with square butt with 2 to 3 mm gap. Weld from first side and turn the plate for back grind and conduct LPI. Complete the weld.
- **Plates above 6mm and up to 8 mm** Single 'V', 60° EP. Weld from V side and turn the plate, Back grind and conduct LPI, complete the weld.
- **Plates above 8 mm:** Double 'V', 60° EP. Weld one side. Carry out back chipping/Grinding, conduct LPI to ensure sound metal and weld from other side.

2.10 Wherever cross members are fouling on the weld, Flush grind weld metal and ensure flatness. There shall not be any depression at weld zone. Thickness at weld zone shall not go below the actual thickness of the plate. Check 100 % visual inspection.

2.11 Cleaning device support channel plate: One joint is permitted up to 4 meters length and 2 joints for more than 4 meters (perpendicular to the bend line.) and the minimum Joint piece shall be 500mm.

### 3.0 Specific Requirements for Diaphragm plate

1. One joint only allowed perpendicular to axis of the Rotor post. (Along the Length of the Plate)
2. Joint shall be made at least 650 mm from the edge.
3. Place the plates to-be-welded together. Check for straightness of minimum two sides & right angle of the plate. Check the mismatch of joint edge. The mismatch shall be within 1 mm. Check for length, width and diagonal as per OP&C Sketch. Length and Width tolerance shall be as per OP & C Sketch, Maximum allowed diagonal difference is 2 mm and record the readings.
4. Weld one side and reverse & back grind. Conduct LPI. Ensure defect free joint and weld the other side. Butt welds shall be ground flush. Conduct final LPI.

	<b>Splicing Norms for Plates &amp; sheets of APH components</b>	Doc. No	<b>PRQA: 410</b>
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5. Identify the Right angle corner of the each plate with Paint and Hard punch the Specification, size, Firm code by punching and border with white paint.
6. Load all the plates in such a way that the identified right angle corners are in one corner with details visible from top.
7. Tack welds the stack as per OP&C Sketch.

#### **4.0 Specific Requirements for Pedestals**

1. One joint only allowed parallel to flange bend. (90° Deg) in addition to site joints envisaged in drg.
2. Joint shall be made at least 500 mm away from any side.

#### **5.0 Specific Requirements for Housing Panels**

1. One joint only permitted in either Horizontal or Vertical direction of each panel plate.
2. Minimum Joint shall be 500mm from any edge

#### **6.0 Specific Requirements for bottom plate and side Plates and plate formed channels of Sector plates**

1. No joint is permitted on Bottom plate.
2. One joint is permitted up to 4 meters length and 2 joints for more than 4 meters (across the bend line.) in side Plates and plate formed channels. Minimum Joint piece shall be 500mm.
3. EP and other requirement shall be as per Clause 2.9 and 100% LPI shall be carried out on final weld in the joint area.

#### **7.0 Splicing of stay plate and Shell plate.**

1. Splicing of stay plate and Shell plate is permitted if both dimension (length and width) is more than 1 meter. Joint shall be perpendicular to the axis of the rotor post. Minimum joint piece shall be 500 mm. Weld one side and reverse & back grind. Conduct LPI. Ensure defect free joint and weld the other side. Butt welds shall be ground flush. Conduct final LPI.

- 8.0 Splicing of duct wall is permitted if both dimension length and width is more than 1 meter. Minimum joint piece shall be 500 mm.

<b>Revision Number/Date</b>	<b>Changes made</b>
00/13 05 96	Original Issue.
01/31 05 96	Cl 2.10 Deleted
02/04 12 02	Requirement are reviewed & Up dated
03/ 01 09 04	Revised to include splicing norms for pedestals and housing panels
04/ 20 09 06	Clause 6 added in sub section-3 based on shop feed back.
05/ 21 06 08	Requirements completely reviewed and updated based on the discussion with WRI /Trichy. Amendment A1 details merged.



**SPLICING NORMS FOR SHEETS, PLATES AND  
ROLLED SECTIONS APPLICABLE TO  
GATES AND DAMPERS**

Doc. No	PR: QA: 476
Rev	00
Date	30.05.2013

**SPLICING NORMS FOR SHEETS, PLATES AND ROLLED SECTIONS  
APPLICABLE TO GATES AND DAMPERS**

PREPARED BY :

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REVIEWED BY:

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APPROVED BY:

DEPARTMENT	NAME S/Shri	SIGNATURE
QA	G. Balasubramanian Sr. DGM /QA, QC(Proc.) & BE	



## SPLICING NORMS FOR SHEETS, PLATES AND ROLLED SECTIONS APPLICABLE TO GATES AND DAMPERS

Doc. No	PR: QA: 476
Rev	00
Date	30.05.2013

### 1.0 SCOPE:

This procedure details out the **SPLICING NORMS** for Blade Plates and Rolled Sections viz., Angles, Channels, Beams and other structural applicable to Guillotine Gates and various Dampers.

### 2.0 GENERAL REQUIREMENTS:

- 2.1 Check for the material specifications of plates/sections, which are to be joined to avoid mix up of material.
- 2.2 TCN to be obtained for change of material
- 2.3 Welding Electrode selection shall be as per respective WPS.
- 2.4 Welding shall be followed with suitable methods and controls to minimize the distortion.
- 2.5 Welds over joint shall be avoided and minimum distance between stiffeners parallel to weld joint is 50mm.
- 2.6 Whenever back grinding is not feasible due to location of the plate / sheet, root welding to be carried out with 3.15 mm electrode and LPI to be carried out after thorough cleaning and repeat LPI after final welding.
- 2.7 Plus joint shall not be permitted when building up of plate to drawing size.
- 2.8 Cut out/opening /drilling on weld joint shall be avoided.

### 3.0 GUIDE LINES FOR EDGE PREPARATION ( EP ) :

Following are the guidelines for Edge Preparation (EP) if not specified in drawing.

- 3.1 **Plates and sheets up to 5mm:** No EP is required. Welds shall be with square butt with 2 to 3 mm root gap, weld on both sides. Final LPI / MPI
- 3.2 **Plates of 6mm:** No EP is required. Welds shall be with square butt with 2 to 3 mm gap. Weld from first side and turn the plate for back grind and conduct Root LPI. Complete the weld. Final MPI.
- 3.3 **Plates of 7mm, 8 mm:** Single "V" 60° EP on any one Plate. Weld from "V" side and turn the plate, back grind and conduct LPI, complete the weld. Final MPI.
- 3.4 **Plate above 8 mm:** Double "V" 60° EP . Weld one "V" side. Carry out back grind and conduct LPI, complete the weld. Final MPI.
- 3.5 **For structural (Angles, Channels, Beams) :** Single "V" 60° EP. Weld from "V" side and back grind and conduct LPI, complete the weld. Final LPI before splice plate setting.
- 3.6 **For Pipe Strut Joints –** Refer the clause no. 7.8

**Note:** Wherever cross members / seals are fouling on the weld, Flush grind weld metal and ensure flatness. There shall not be any depression at weld zone. Thickness at weld zone shall not go below the actual thickness on the plate. Check 100 % visual inspection.



**SPLICING NORMS FOR SHEETS, PLATES AND  
ROLLED SECTIONS APPLICABLE TO  
GATES AND DAMPERS**

Doc. No	PR: QA: 476
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**4.0 SPECIFIC REQUIREMENTS FOR GATE BLADE:**

- 4.1 Splicing of Gate (blade) plate may be either horizontal or vertical. Minimum width of plate shall be 500mm for blades joint and no joint shall be permitted with in 200 mm from the middle of blade for vertical joint.
- 4.2 No splicing in gate blade is permitted if blade width is 1.2 meter or less
- 4.3 Guillotine Gates – Electrically Operated (With or Without Bulb Seal) and Pneumatically Operated (Without Bulb Seal) – One joint is permitted for a plate width more than 1.2 mtr and up to 2.4 meter.
- 4.4 Guillotine Gates – Pneumatically Operated (Cold Air Gate / Hot Air Gate) with Bulb Seal – No joint is permitted on these gate blades as the width of blade will be always less than 2 Mtr.
- 4.5 For Plates of width more than 2.4 Mtr maximum two joints are permitted.
- 4.6 For Plate butt joints – Root LPI, back grinding and LPI shall be conducted 100%. Flush grind the joint and straighten the plate. Final MPI shall be conducted on both sides, if the plate thickness is more than 8 mm. Otherwise follow the clause no. 3.0 of this PR:QA.
- 4.7 Linear tolerance on length and width is + / - 1 mm /mtr subject to maximum of 5 mm.
- 4.8 Diagonal variation shall be within 1 mm / Mtr subject to maximum of 5 mm.
- 4.9 Blade bend shall not be more than 5 mm.
- 4.10 Blade shall be identified with size (Thickness X Length X Width) in each corner with Firm code.
- 4.11 Blade shall be stacked on a leveled platform to avoid any damage during stacking. Proper handling to be followed to avoid bend and damage.

**5.0 SPECIFIC REQUIREMENT FOR SEAL AIR CHAMBER PLATE AND PLATE FORMED CHANNEL**

- 5.1 No joint is permitted if the length is up to 2.0 Mtr and one joint is permitted for above 2.0 Mtr and up to 5.0 Mtr.
- 5.2 For above 5.0 Mtr two joints are permitted to build up the required length. However in any case more than two joints are not permitted.
- 5.3 The NDT requirements for this type of butt joints will be as per the clause no.3.0 & 4.6 as applicable of this PR:QA.

**6.0 SPECIFIC REQUIREMENT FOR GATE FRAME**

- 6.1 No joint is permitted for the channel section used in the gate frame (Bottom, side and super structure).
- 6.2 No joint is permitted in Port / Bonnet angles and plates.

	<b>SPLICING NORMS FOR SHEETS, PLATES AND ROLLED SECTIONS APPLICABLE TO GATES AND DAMPERS</b>	Doc. No	PR: QA: 476
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**7.0 SPECIFIC REQUIREMENT FOR CONTROL, LOUVER AND BI-PLANE DAMPER BLADES / CHANNELS / PLATES AND ANGLES**

- 7.1 For Plates / Channels / Angles – No joint is permitted if the length is up to 2.0 Mtr and one joint is permitted for above 2.0 Mtr and up to 5.0 Mtr.
- 7.2 For above 5.0 Mtr two joints are permitted to build up the required length. However in any case more than two joints are not permitted.
- 7.3 Damper Blade joints are to be staggered on top and bottom.
- 7.4 Damper Frame – One joint (Plate) shall be permitted in length wise to built up the drawing size.
- 7.5 Damper side wall plate joint shall be 75 mm away from the end of Glade plate location.
- 7.6 Splicing of Channel joint is to be done inside only (in damper frame). For angle and plate no splicing plate is required on the joint area.
- 7.7 NDT requirement for this type of joints shall be as per the clause no. 3.0 & 4.6 as applicable.
- 7.8 For pipe strut joints, the same pipe for a length of 1.25 D has to be cut and strap joint has to be made with 3mm all around fillet weld.

**NOTE:**

The Splicing requirements mentioned in this PR:QA (PR:QA:476 Rev.00) is superseding the requirements mentioned in SQP:NP:03 with its relevant amendments and as well as SQP:NP:04 with its relevant amendments.

00	30.05..2013	<p>a) As per QMI 1, this document has been renumbered to PR:QA:476 as this QWI is pertaining to Gates &amp; Dampers and the existing PR:QA 602 Rev.00 Dtd.03.09.2009 has been withdrawn.</p> <p>b) Based on the requirement of Engg, OS and feedback from OS Vendors – more clarity and interpretation had been brought and incorporated in this document for Gate blade joints-Clause No.4, Pipe strut joints-Clause no.3.6 &amp; 7.8 and Port &amp; Bonnet joint requirements-Clause no.6.2</p> <p>d) This document has been released with new QWI No as PR:QA:476 applicable to Gates &amp; Dampers.</p>
<b>Rev No.</b>	<b>Effective Date</b>	<b>Details of Revision / Changes Made</b>

**Record Of Revisions**

**BHEL**  
**RANIPET**

**BHARAT HEAVY ELECTRICALS LTD.**  
**BOILER AUXILIARIES PLANT**  
**RANIPET 632 406**

**PR:QA:500**  
**PAGE 01 OF 05**

**QUALITY DEPARTMENT**

**PROCEDURE FOR**

**ALLOWABLE DEVIATIONS FOR**  
**DIMENSIONS WITHOUT SPECI-**  
**FIED TOLERANCES**

**EFFECTIVE DATE**

**16/01/93**

	<b>NAME</b>	<b>SIGNATURE</b>	<b>DATE</b>
<b>PREPARED BY</b>	<b>K NITHIANANDAM</b>	<i>K. Nithianandam</i>	<b>16/1/93</b>
<b>REVIEWED BY</b>	<b>S ANIL KUMAR</b>	<i>S. Anil Kumar</i>	<b>16/1/93</b>
<b>APPROVED BY</b>	<b>P H TAMBAKHE</b>	<i>P. H. Tambakhe</i>	<b>16/1/93</b>

**ISSUED BY**

**: QUALITY ASSURANCE**

**REVISION**

**: NIL**

**DATE**

**:**

**DOCUMENT CONTROL NO:**

**7**

**File Name :PHT.RSU**

**QUALITY DEPARTMENT**

1. Table 1 given below indicates the permissible variation in Linear Dimension of fabricated and machined components. The coarse grade is to be followed for fabricated components and medium grade for machined components.
2. Table 2 given below indicates the permissible deviations for Radii & Chamfers for machined components.
3. Table 3 given below indicates the permissible deviations for Angular dimensions for machined components.
4. Table 4 given below indicates the conditions under which the deviations given in this standard are not applicable.
5. Special rulings may be stated for linear dimensions of welded structures consisting of several assemblies.
6. If closer tolerances than those given in this procedure are necessary, the same shall be indicated in the relevant drawings.

TABLE - 1

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Deviations in mm for the nominal size range in mm

Degree of accuracy	0.5 * up to 3	Over 3 upto 6	Over 6 upto 30	Over 30 upto 120	Over 120 upto 400	Over 400 upto 1000	Over 1000 upto 2000	Over 2000 upto 4000	Over 4000 upto 8000	Over 8000 upto 12000	Over 12000 upto 16000	Over 16000 upto 20000
F (fine)	± 0.05	± 0.05	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8	-	-	-	-
m (medium)	± 0.1	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.0	± 2	± 3	± 4	± 5	± 6
g (coarse)	± 0.15	± 0.2	± 0.5	± 0.8	± 1.2	± 2	± 3	± 4	± 5	± 6	± 7	± 8
sg (very coarse)	-	± 0.5	± 1	± 1.5	± 2	± 3	± 4	± 6	± 8	± 10	± 12	± 12

\* In the case of nominal sizes below 0.5 mm, the deviations must be specified directly by the side of the nominal size.

TABLE - 2

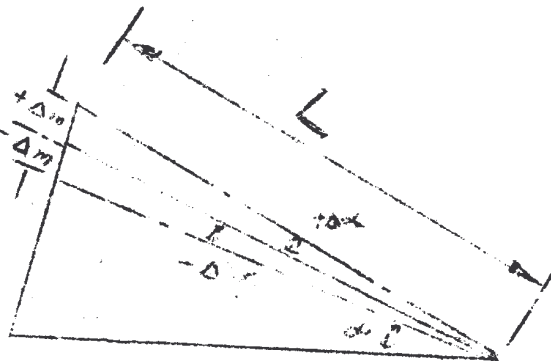
DEVIATIONS FOR RADII & CHAMFERS

All dimensions are in mm

CLASS OF DEVIATION	RANGE OF NOMINAL DIMENSIONS					
	Above	0.5	3	6	30	120
Fine & Medium	Upto and Including	3	6	30	120	315
		$\pm 0.2$	$\pm 0.5$	$\pm 1$	$\pm 2$	$\pm 4$

TABLE - 3

DEVIATIONS FOR ANGULAR DIMENSIONS



$\Delta\alpha$  = Angle Tolerance in angular units  
 $\Delta m$  = Angle Tolerance in linear units

All Dimensions are in mm

CLASS OF DEVIATIONS	Length (L) of shorter side of angle in mm							
	Above	-	10	50	120	500	800	1250
	Upto & including	10	50	120	500	800	1250	2000
FINE AND MEDIUM	$\Delta m$ (mm)	$\pm 0.1$	$\pm 0.2$	$\pm 0.6$	$\pm 0.8$	$\pm 0.96$	$\pm 1.125$	$\pm 1.5$
	$\Delta\alpha$ (deg or min)	$\pm 1^\circ$	$\pm 30'$	$\pm 20'$	$\pm 10'$	$\pm 4'$	$\pm 3'$	$\pm 2'3''$

TABLE - 4  
NON APPLICABILITY OF THE STANDARD

SPECIAL AGREEMENTS	PRODUCTION METHOD	DIMENSIONS	CONDITIONS FOR TOLERANCING	STANDARD SPECIFICATION
<p>where variations from this standard are agreed upon between the purchaser and the manufacturer</p>	<p>Casting, forging, pressing, rolling, welding, flame cutting</p>	<p>For dimensions required to give a certain class of it</p>	<p>where higher values than those specified in Table 1 and 2 may be allowed.</p>	<p>where permissible deviations have been specified</p>
		<p>For dimensions resulting after assembly</p> <p>Where concentricity between parts is required</p> <p>For angular dimensions of a circular division (For example, angular position- ing of teeth of clutches)</p> <p>For angular dimensions in precision taps and in pipe bends</p> <p>For dimensions of welded assemblies (unless the part is to be machined)</p>	<p>Where only positive or only negative deviations are desired</p> <p>Where parts are manufactured separately and are required to be assembled together without any further treatment (selective assembly, spare parts etc)</p>	






BHEL: BAP:RANIPET  
QUALITY DEPARTMENT

PR : QA :505  
REV . NO . 01  
DATE . 14 .07 .93  
PAGE 01 OF 05

PROCEDURE FOR STORAGE OF SHELF LIFE ITEMS LIKE RUST  
PREVENTIVE FLUIDS, PAINTS, RUBBER COMPONENTS,  
GREASE AND ANTISEIZE COMPOUNDS AND SIMILAR  
COMPONENTS / ITEMS.

EFFECTIVE DATE : 14 . 07 . 93

	Name	Signature with date
Prepared by	V JAYRAMAN	 14/7/93
Reviewed by	P H TAMBAKHE	 14/7/93
Approved by	R N MISRA	 14/7/93

ISSUED BY : SM / QUALITY ASSURANCE

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BHEL : BAP : RANIPET  
QUALITY DEPARTMENT

PR : QA : 505  
REV . NO . 01  
DATE . 14 . 07 . 93  
PAGE 02 OF 05

Record of Revisions

Sl no	Revision carried out	Reason
01	S1 nos 1, 5, 7, 9 & 10 the method of storage revised.	-----

PROCEDURE FOR STORAGE OF LOW SHELF LIFE ITEMS LIKE

-----  
ANTI SEIZE / THREAD COATING COMPOUNDS , GREASES , PAINTS ,  
-----  
RUST PREVENTIVE FLUIDS, RUBBER COMPONENTS  
-----

1.0 SCOPE:  
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This procedure spells out the method of storage of low shelf life items like antisize/thread coating compounds , greases , paints , rust preventive fluids and rubber compounds .

2.0 STORAGE  
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Please See the table . 1 . The method of storage of low shelf items is given in the table .

TABLE 1

S.No.	Description	Category	Method of storage	Items covered under the category .
01	Anti Seize compound/greases	L	Indoor storage in closed containers well ventilated and dry rooms , away from heat sources sunshine , flames , gas cylinders .	Thread Coating compounds , greases , molysulf lubricants etc.
02	Sealing Compounds	L	Indoor storage closed containers well ventilated and dry rooms , away from heat sources sunshine , flames , gas cylinders / solvents etc . If containers are damaged, reject the item	All sealing compounds

03	Rust preventive fluids ( film forming type)	RPF	Outdoor, undershade Dry condition away from 1)Flame heat 2) Sunshine, 3)Gas cylinders, 4)Petrol Diesel, Kerosene other solvents 5) Near Fire extinguishing equipment .	Collecting Electrode rust preventive fluids, candopeel, strippable Coating.
04	Rust preventive fluids ( non film forming type)	RPN	- DO -	APH heating element rust preventive fluids .
05	Natural Rubber  Solvents, alkalis ,	RB	Indoor storage well ventilated dry rooms with paper and chalk powder wrapings, Away from oils, acids and flames , sunshine , weld heat.	Gaskets ,washers, forms, shapes, tubes pipes , conduits etc. .
06	Synthetic Rubber	RS	- DO -	- DO -
07	Red Oxide Zinc Chrome paints IS 2074	PR	In sealed containers indoors: In dry and well ventilated rooms Away from heat & flame , gas cylinders, flammable materials like Petrol , Diesel ,Kerosene etc .	- DO -
08	IS 2932 Synthetic enamel paints		- DO -	All Colors shades .

09 . Epoxy Paints	PEPX	In sealed containers. Indoor Dry condition . On separate racks ; Away from heat , flammable materials like Petrol , Diesel Kerosene , solvents .	This category includes Inorganic Zinc Rich paints also .
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10 . Chlorinated rubber paints .	PCLR	In sealed containers. Cool Dry place . Indoor only. Away from flame , heat, flammable materials like petrol , Diesel kerosene.
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D: PRQA

BHEL  
RANIPET  
QUALITY DEPARTMENT

PR :QA:509

PAGE 01 OF 02

GUIDELINES FOR

NDT REQUIREMENTS ON  
GAS CUT EDGES

EFFECTIVE DATE

04-08-93

PREPARED BY

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ISSUED BY: QUALITY ASSURANCE

REV. NO.:00

CONTROL NO

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1.0 SCOPE :

The procedure specifies the items for which for which Magnetic Particle Testing shall be conducted on gas cut edges.

2.0 PREFERENCE:

Sheet 7 of 12 of CE spec .M&P spec No.: 5.11.1.1.(s) dated 05-11-84 and review with SM/QA

3.0 GENERAL :

All gas cut edges which are machined later need not be examined by MT (Magnetic Particle Testing )

3.1 Plates above 38.1 mm for the items specified below shall only be tested. Stiffeners need not be non-destructively tested.

3.1 A FANS: Center plate , AP fan impeller hub flanges. Flanges for Conical cover plate, Flange for AP fan cover plate ,Impeller rings made of plate ,Conical cover plate seating rings.

3.1 A APH: Lug plates of lug assembly ,Rotor post header plates.

3.1 C ESP/Structural items: plates used as flanges for floor beams and those structural items for which NDT requirements are specified in other transmittals like QPS, Letters etc.

4.0 Reference standard and acceptance norm for MT shall be as per BHE :NDT:RP:MT:01/ latest revision.

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BHEL::BAP::RANIPET  
QUALITY DEPARTMENT

PR:QA:512  
REV:00  
Dt:31.1.94  
Page 01 OF 04

PROCEDURE FOR CONTROL OF SURFACE PREPARATION AND  
PAINTING OF FABRICATED COMPONENTS  
AT SUB-CONTRACTORS WORKS.

EFFECTIVE DATE 31.1.94

	NAME	SIGNATURE & DATE
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REVIEWED BY	H ANANTHANARAYAN	<i>H. Ananthanarayan</i>
APPROVED BY	R V MISRA	<i>R. V. Misra</i>

ISSUED BY QUALITY ASSURANCE

CONTROL COPY NUMBER

**MASTER COPY**

PROCEDURE FOR CONTROL OF SURFACE PREPARATION AND PAINTING OF  
FABRICATED COMPONENTS AT SUB-CONTRACTORS WORKS.

1.0 SCOPE:

1.1 This procedure details out the requirement for surface preparation and painting of all fabricated components at sub-contractors works.

1.1.1 Surface preparation equipment:

The sub-contractor should have the minimum surface preparation equipment as mentioned below:

- a) Wire brush
- b) Emery sheets of rough type
- c) Power wire brush to be used with pneumatic or electrical motors
- d) Brush for cleaning the dust removed by wire brushing power tool cleaning

1.2 Whenever any special requirement for surface preparation and painting are required, the same shall be indicated in the drawing or shall be informed separately to sub-contractors.

1.3 This PRQA is in line with the requirement of Painting Schedule RP 0674199.

2.0 SURFACE PREPARATION:

2.1 CLEANING OF OIL, GREASE ETC

2.1.1 The entire outer surface of the fabricated components shall be thoroughly cleaned using mineral turpentine, wire wheel, grinding wheel to make it free from OIL, GREASE, RUST, MILL SCALES and weld spatters.

2.2 METHOD OF RUST REMOVAL

2.2.1 Wire brush, emery sheets of rough type, Power /rotary wire wheel may be used for removing the dust, rust and mill scales from the surface.

2.2.2 The "Rustkil" (rust remover/converter) shall be applied whenever the rust cannot be removed by using power tool cleaning.

2.2.3 Only after clearance of surface preparation by BHEL Inspection/BHEL Authorised Inspection Agencies the sub-contractor can proceed with painting.

0 PAINTING

1 Only paints from BHEL approved suppliers shall be applied.

2 After visual inspection and clearance by QC BHEL/Authorised Inspection Agency one coat of red oxide Zinc chrome primer as per IS 2074 shall be applied by brushing to a dry film thickness of approx 25 microns.

3 The paint shall be allowed to hard dry and thoroughly before applying the second coat. Second coat shall be applied only after 18 hours.

4 A second coat of IS 2932 Synthetic Enamel smoke grey paint shall be applied over the primer to a coating thickness of 20 microns approximately.

5 The small items shall be dipped in the paint tank.

The final inspection of the component shall be offered to QC BHEL/Authorised Inspection Agency only after hard drying of the enamel paint and stencilling of work order No, D.U.No, details.

All edge prepared areas for welding at shop/site at later stage shall be applied with one coat of weldable primer.

Any scratches and soil sticking on the surfaces during handling shall be repaired before despatch to BHEL/Shipping.

*Keliana*  
200

RECORDS:

The firm shall record the make/brand name and batch number of the approved paint used in the dimension report.

1. The sub-contractors shall maintain records of the primer paints procured, the source of the primer paints namely dealer, the manufacturer of the primer paints, the batch number of the primer paints and the delivery chalan reference for the paint procured along with the quantity and also copy of the test certificates certifying the quality of the paint. These records shall be verified by BHEL inspector immediately on procurement of the paint by sub-contractor and shall be countersigned by BHEL inspector. This record is subject to audit by Quality Assurance.

4.2 The firm shall show the details/evidence for procurement of approved paints to QC personnel (BHEL)/Authorised Inspection Agency whenever required during surveillance checks/audits. The sub-contractor before use of primer paints shall verify the correctness of specification of the primer paints before opening the drums. The drum shall be rolled roughly 20 times before opening the seal and stirring the contents. The contents shall be thoroughly stirred using a steel rod and shall be checked for any settling of pigment. If any pigment settlement is observed the process of resealing, rolling, stirring thereby redispersal of the paint pigment into the medium is to be ensured. Now a small quantity can be transferred to painting cans and applied by neat brushes of width atleast 3 inches.


4.3 The sub contractor shall ensure that the required number of primer coats are given on the components as per the painting schedule RP 0674199. Visual inspection shall be done for checking damages, poor paints, improper finish. After the paint films dry the inspector will randomly check the coating thickness with coating thickness gauge for the correctness of the thickness of the paint in case of any doubt.

#### 5.0 TESTING OF PAINT SAMPLES

5.1 QC BHEL personnel shall collect random samples of paint (approx 1 litre) and submit the same to Quality Assurance for testing. Such random samples may be collected whenever any doubt arises about the quality of paint while carrying out visual inspection. Alternately QC/OLI may scrape dried paint film from painted surfaces for testing at paint test lab.

5.2 In case any batch of paint is found not conforming to requirement, the concerned brand of paint shall be removed from the approved list of paint suppliers of BAP, Ranipet.



 Ranipet	<b>Rust preventive fluid specification (Non drying type)</b>	Doc. No	<b>PRQA: 522</b>
		Rev	<b>00</b>
		Date	<b>12 02 08</b>
		Page NO	<b>01 of 01</b>

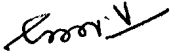


### 1.0 Scope

1.1 This specification covers the requirements of temporary rust preventive fluid (Non drying type) used for APH heating elements by dipping process.

### 1.2 Details of specification

SL No	Details	Acceptance norms
01	Specific gravity at 27 ° C	0.80 – 0.85
02	Flash point degree C (Min)	35°C
03	Viscosity Ford Cup 4	18± 2 seconds
04	Water content (max)	0.5%
05	Drying time max (hard dry)	No drying
06	Corrosion under conditions of condensation for 300 hrs	No rusting
07	Corrosion resistance under indoor conditions for one month	No rusting.

1.3 shop QC to verify the viscosity using ford cup 4 at regular interval (once in a week time) to maintain with in 18± 2 seconds and record.

 <b>Prepared By</b>	<b>Reviewed By</b>	QC		 <b>Approved BY</b>
		QA	B. Srinivasulu	



RANIPET

## QUALITY ASSURANCE

### **SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS**

PRQA: 526

REVISION: 01

DATE: 14.08.01

PAGE: 1 OF 5

<b>PROCEDURE FOR</b>		<b><i>SURFACE PREPARATION AND PAINTING OF COMPONENTS OF DESALINATION PLANTS</i></b>	
<b>EFFECTIVE DATE</b>		14.08.2001	
<b>PREPARED BY</b>	<b>NAME</b>	<b>DEPARTMENT</b>	<b>SIGNATURE</b>
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<b>REVISION NO.</b>		01	
<b>ISSUED BY</b>		QUALITY ASSURANCE	
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RANIPET

## QUALITY ASSURANCE

### **SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS**

PRQA: 526


REVISION: 01

DATE: 14.08.01

PAGE: 2 OF 5

## **RECORD OF REVISIONS**

<b>REVISION NO.</b>	<b>DETAILS OF ISSUE</b>	<b>DATE OF ISSUE</b>
<b>00</b>	<b>ORIGINAL ISSUE</b>	<b>09.05.96</b>
<b>01</b>	<b>EDITORIAL CORRECTION</b>	<b>14.08.01</b>

 <p>RANIPET</p>	<p><b><u>QUALITY ASSURANCE</u></b></p> <p><b>SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS</b></p>	<p><b>PRQA: 526</b></p> <p><b>REVISION: 01</b></p> <p><b>DATE: 14.08.01</b></p> <p><b>PAGE: 3 OF 5</b></p>
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**PROCEDURE FOR SURFACE PREPARATION AND PAINTING OF  
COMPONENTS OF DESALINATION PLANTS**

**1.0 SCOPE:**

This procedure gives guidelines for surface preparation and painting of components of Desalination Plants.

**2.0 The following are not under the purview of this procedure.**

2.1 Masonry structures, PVC tubes, pipes & fittings, FRP vessels, pipes components and glass.


**3.0 PROCEDURE:**

3.1 The following components of Desalination Plants are under the purview of this procedure.

- (a) Membrane Racks
- (b) Valve supports and clamps, Pipe supports and clamps
- (c) Supporting Structures
- (d) Carbon steel filters, hand rails, platforms
- (e) Shed Structures
- (f) Handling Equipment
- (g) Cranes
- (h) Electric motors, base frame
- (i) Any other component specified in the drawings.

**4.0 SURFACE PREPARATION SCHEME:**

4.1 Except stainless steel pipes and fittings (and Aluminium if any) all other steel surfaces shall be sand / shot blasted to SA 2½ finish as per Swedish Standard SIS 055900 before painting.

	<b>QUALITY ASSURANCE</b>	PRQA: 526
	<b>SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS</b>	REVISION: 01 DATE: 14.08.01 PAGE: 4 OF 5

## 5.0 PAINTING SCHEME:

See Table – 1 below.


TABLE – 1

Scheme	Paint Type
PS 1	Epoxy Zinc Phosphate Primer Paint
PS 2	Epoxy finish Paint

5.1 The probable paint supplier can be as follows:

- a. Asian Paint (India) Ltd.
- b. Bombay Paints
- c. Berger paints India Ltd.
- d. Goodlass Nerolac paints Ltd.
- e. Garware Paints
- f. Jenson & Nicholson
- g. Shalimar paints

Sl. No	Component	Surface Preparation	Primer	No. of Coats	DFT Total Microns	Finish Paint	No. of Coats	DFT Total Microns
01	Membrane Racks	SA 2 ½	PS 1	2	100	PS 2	2	100
02	Valve Supports and Clamps	SA 2 ½	PS 1	2	100	PS 2	2	100
03	Supporting Structures	SA 2 ½	PS 1	2	100	PS 2	2	100
04	Carbon steel filters (outer surfaces)	SA 2 ½	PS 1	2	100	PS 2	2	100
05	Hand Rails & Platforms	SA 2 ½	PS 1	2	100	PS 2	2	100
06	Shed Structures & Clamps	SA 2 ½	PS 1	2	100	PS 2	2	100
07	Handling Equipment	Leave greased/oiled surfaces free (for other follow scheme)	PS 1	2	100	PS 2	2	100
08	Cranes	- do -	PS 1	2	100	PS 2	2	100

 <p>RANIPET</p>	<p><b><u>QUALITY ASSURANCE</u></b></p> <p><b>SURFACE PREPARATION AND PAINTING PROCEDURE FOR DESALINATION COMPONENTS</b></p>	<p><b>PRQA: 526</b></p> <p><b>REVISION: 01</b></p> <p><b>DATE: 14.08.01</b></p> <p><b>PAGE: 5 OF 5</b></p>
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**6.0 GENERAL PRECAUTIONS:**

- 6.1 Do not delay painting after Sand / Shot blasting. Maximum delay permitted is only half an hour.
- 6.2 Do not paint when the weather is rainy or the temperature is below 20<sup>0</sup> C.
- 6.3 The epoxy primer and finished paints are two component paints. The components must be mixed in the proportions given by the manufacturer only. The application of epoxy paints shall be completed with in 2 hours of mixing.
- 6.4 The etch/wash primers are also two component paints, which must be mixed in proportions given by the manufacturer.

**7.0 IMPORTANT:**

If the components are to be painted at site one coat of EPOXY FINISH PAINT of DFT 50 Microns SHALL BE GIVEN.

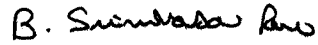
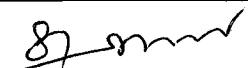
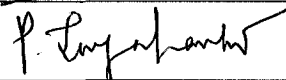
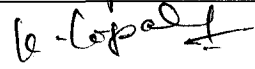
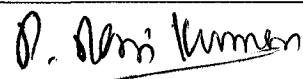


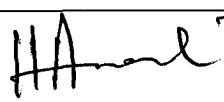
## Procedure for Surface Preparation and Painting

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# Procedure for Surface preparation and Painting

<b>Prepared By</b>	V SUNDARAM SEF/QA	
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<b>Reviewed By</b>	B SRINIVASA RAO DGM/QA	
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<b>Approved By</b>	H ANANTHANARAYANAN AGM/QA&OLI	
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### Record of revision

Rev No.	Effective Date	Details of revision
00	10 10 02	RP0674199 Rev 05 requirements and PRQA 590 rev 12 requirements were fully reviewed and this document is released as Rev 00 taking care of painting requirements of BAP projects. For project specific painting schemes respective CIS or contract specific painting schemes to be referred.
01	22 05 07	Painting requirement are fully reviewed. Red oxide Zinc chromate for primer application (IS 2074) is corrected as Red oxide Zinc phosphate primer (IS 12744) and also number coats & DFT corrected.



## Procedure for Surface Preparation and Painting

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### 1.0 SCOPE

- 1.1. This procedure specifies requirements for surface preparation and painting and coating, for APH, Fan, ESP, Gates & Dampers and Chimney. (For WEG and Desalination, please refer PRQA: 518/Latest and PRQA: 526/Latest respectively).
- 1.2. Section I deals with surface preparation schedule and section II deals with painting and coating.
- 1.3. Special contractual requirements, if any, will be indicated through a separate contract specific documents with customer approval, when required. The linkage will be provided in the CQR issued by QA.

### 2.0 GENERAL

- 2.1 This procedure specifies painting requirements to provide adequate protection up to one year in open yard at site.
- 2.2 No painting shall be applied on the stainless steel, galvanized and any plated surfaces. For estimation of requirements of painting, the approximate area of coverage on non-absorbing surface is as given below: -

SL. No.	Generic nature of paint	Theoretical covering area (Sq.M/litre)	DFT /Coat (Min)	Shade
1	Red oxide zinc phosphate primer to IS 12744	10	30	Red oxide
2	Synthetic enamel paint to IS 2932	10	20	Smoke grey
3	Heat resistant aluminum paint to IS 13183	10	20	Aluminium

- 2.3 For bought out items, the painting scheme shall be as per purchase specification. If this is not specified in purchase specification, the following is the minimum requirement
  - a) Primer: One coat of red oxide zinc Phosphate primer to IS 12744- DFT 30 microns
  - b) Finish: Two coats of synthetic enamel to IS 2932 smoke grey shade No.692 of IS 5. -DFT 20 microns per coat

## Section -I

### 3.0 SURFACE PREPARATION REQUIREMENTS FOR PAINTING AND COATING

- 3.1. The effectiveness and duration of the protection provided by organic, inorganic and metallic coatings for corrosion protection depends among other things decisively on proper surface preparation. This section deals with the methods of surface preparation, their effectiveness and fields of application.
- 3.2. This section largely based on ISO 8501 - 1: 1988 that in turn is based on the Swedish standard SS 05 59 00.



## Procedure for Surface Preparation and Painting

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### 3.3. SURFACE PREPARATION METHODS

3.3.1. Surface preparation depends on initial condition of uncoated surfaces. The details of rust level, rust removal methods and characteristics surfaces are given in table 1.0.

### 3.4. DEFINITIONS AND METHODS OF CLEANING

#### 3.5. CLEANLINESS OF SURFACES.

3.5.1. Cleaning requirements and levels of cleanliness, contaminants such as dirt, oil that will interfere with the adhesion or effectiveness of the proposed coating must be removed. Coats of materials related to the metal (scale, rust) and coats of different materials (e.g. existing coating) should be removed until the agreed level of cleanliness is attained.

3.5.2. Contaminants/coats, both of related material and of materials different from the metal may be removed in one operation if the nature, level and thickness permit this. The required level of cleanliness depends on

- The corrosion protection system selected
- The type of corrosion exposure expected
- The initial condition of the surface being prepared
- The possible rust removal method
- Economic considerations

3.5.3. Generally, the standard levels of cleanliness as in table 1.0 should be used as a basis. This does not cover the removal of weld spatter, weld or flame cutting slag or chips, repair grinding of rolling defects (laminations) deburring and similar operations.

### 3.6. MECHANICAL METHODS OF REMOVING RUST

#### 3.6.1. Manual rust removal:

3.6.1.1. This applies to standard levels of cleanliness St 2, St3 as per table 1.0 manual cleaning uses wire brush, stripping knife, Swedish scraper, rust removing hammer etc., The method must not damage the metal being derusted. Subsequent cleaning by sweeping or brushing off or by blowing off with dry air.

#### 3.6.2. Mechanical rust removal:

3.6.2.1. This applies to standard levels of cleanliness St2, St3 as per table 1.0 cleaning can be done by mechanically driven rust removing tools viz., rotating wire brush, impact piston devices or rotary descalers, sanding discs etc. The surface areas where the power driven tool cannot enter, manual cleaning should be done. The method must not damage the metal being derusted. Subsequent cleaning by sweeping or brushing off or blowing off with dry air.

#### 3.6.3. Blast cleaning

3.6.3.1. This applies to standard levels of cleanliness Sa 1, Sa 2½, Sa 3 as per table- 1.0. Chemically contaminated surfaces must be pre-washed. Surfaces having coarse rust must be pre-cleaned with impact tools prior to blast cleaning.

3.6.3.2. Compressed air blasting is generally recommended for our operations. It is a freely directed air blasting in blasting cubicles, Rooms or sheds with re-circulation of blasting abrasives.



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### 3.6.4. REMOVAL OF CONTAMINANTS/COATS OF MATERIAL DIFFERENT FROM THE METAL

3.6.4.1. Surface of metal contaminated with cutting fluid (machine coolant) oil or grease shall be wiped with mineral turpentine/tri-chloroethylene prior to applying any methods of mechanical surface preparation.

3.6.4.2. If any old paint film or rust preventive films are present they may be removed with paint removing jelly.

3.6.4.3. As far as possible the cleaning method should be so chosen that all the scale is removed from the metallic surface to be coated. For heavily scaled metallic surfaces either blasting or pickling may be adopted over and above the requirements called for in the table 1.0.

### 3.6.5. NOTES TO TABLE 1.0

3.6.5.1. Initial condition of uncoated surfaces (rust grade as per SS 05 59 00)

- a) Steel surface largely covered with adhering mill scale but little, if any rust.
- b) Steel surface, which has begun to rust, and from which the mill scale has begun to flake.
- c) Steel surface on which the mill scale has rusted away or from which it can be scrapped, but with slight pitting visible under normal vision.
- d) Steel surface on which the mill scale has rusted away and on which general pitting is visible under normal vision.

3.6.5.2. Standard level of cleanliness equivalent to steel structures painting council of US (SSPC) also given in brackets in table 1.0.

**Table 1.0**

Standard level of cleanliness	Rust removal method	Initial condition of steel surfaces (Uncoated ref.4.5)	Essential Characteristics of the prepared steel surface
St 2 (SSPC-SP 2)	Thorough hand and power tool cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust coatings and foreign matter.
St 3 (SSPC SP 3)	Very Thorough hand and power tool cleaning	B, C, D	As for St 2, but the surface shall be treated much more thoroughly to give a metallic sheen arising from the metallic substrate.
Sa 1 (SSPC SP 7)	Light blast cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, great and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter.
Sa 2 (SSPC SP 6)	Thorough blast cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from most of the mill scale, rust, paint coatings and foreign matter. Any residual contamination shall be firmly adhering.



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Standard level of cleanliness	Rust removal method	Initial condition of steel surfaces (Uncoated ef.4.5)	Essential Characteristics of the prepared steel surface
Sa 2 ½ (SSPC SP 10)	Very Through blast cleaning	B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from the mill scale, rust, paint coatings, and foreign matter. Any remaining traces of contaminations shall show only as slight stains in the form of spots or stripes
Sa 3 (SSPC SP 5)	Blast cleaning to visually clean steel.	A,B, C, D	When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from mill scale, rust, paint coatings and foreign matter. It shall have a uniform metallic colour.

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**Section -II**

**4.0 SCHEDULE OF PAINTING AND COATING:**

**Table 2.0**

Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in µm (Min)	Finish	DFT in µm (Min)	Total DFT (Min)
<b>1.0</b>	<b>Regenerative Air Pre-Heaters</b>						
1.0.1	Heating element baskets (without elements) 52 010, 024, 025	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	NIL	--	30
1.0.2	Heating elements (with elements) 52 010, 024, 025	--	(*) Temporary rust preventive oil non dry type (Dipping)	--	NIL	--	--
1.0.3	Rotor post assembly machined items of (52 011), Pin rack assembly (52 012) seals (52 013,054,055), sector plates (52 041,042) and machined components of APH.	--	(**) Temporary rust preventive oil Dry type	20	NIL	--	20
1.0.4	<b>Components in flue gas path and insulated</b> Rotor post assy (52 011), T bars (52 013), Rotor housing assy. (52 030), Hot and cold connecting plate assy. (52 041,042),	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	60	NIL	NIL	60

(\*) Specification as per PRQA 522/Rev 00

(\*\*) Specification as per PRQA 523/Rev 00

**Issued by: Quality Assurance Dept BHEL Ranipet.**



Ranipet

## Procedure for Surface Preparation and Painting

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Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in µm (Min)	Finish	DFT in µm (Min)	Total DFT (Min)
--------	----------------	---------------------	--------	-----------------	--------	-----------------	-----------------

1.0.5	<b>Components exposed to Atmosphere</b> Rotor drive assy (52 100), Access door (52 210, Air seal piping (52 211), observation port other than glass part (52 212), Rotor stoppage alarm other than aluminum (52 217), Loose items of Air receiver (52 220), Guide bearing assy (52 261), Support bearing assy (52 262), Oil piping GB, SB (52 271,272) oil circulation unit (52 274), Deluge and wash pipe assy. (52 301,302,401,402) Cleaning device assy (52 325, 326), Cleaning device drive (52 329,429), Thermo couple pipe assy. Other than SS (52 360)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70
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<b>2.0 TUBULAR AIRPREHEATER</b>							
2.1	Side walls (external surfaces and internal surfaces).	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	60	--	--	60
2.2	Machined surfaces, tubes of TAPH, Tube plates and intermediate plates	---	(**) Temporary rust preventive oil Dry type	20	NIL	NIL	20

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## Procedure for Surface Preparation and Painting

Doc. No	<b>PRQA: 590</b>
Rev	<b>01</b>
Date	<b>02 02 08</b>
Page NO	<b>9 of 12</b>

Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in $\mu\text{m}$ (Min)	Finish	DFT in $\mu\text{m}$ (Min)	Total DFT (Min)
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<b>3.0</b>	<b>Fans</b>						
3.1	Foundation materials 55 0XX, 56 0XX	Power tool cleaning to ST-3 (SSPC SP3)	Temporary Rust preventive	20	--	--	20
3.2	Components exposed to atmosphere a) Bearing Pedestals, Base frame, Servomotor assy, shaft with Bearing assy, OGV, IGV (55-1XX,55-2XX 55-3XX). b) Bearing Pedestals, Base frame, Shaft with bearing assy, RVC, IGV, Support for Seal, shaft protecting tube, Spiral casing (if no insulation is applicable), Damper (56-1XX, 56-2XX 56-3XX, 56-4XX) c) Coupling guard (56-8XX, 55-8XX). Tools (56-000,55-000)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (Varnish medium alkyl/d)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70
3.3	Components in AIR/GAS and under insulation a) Suction chamber, diffuser, housing, OGV, impeller (55-1XX, 55-2XX, 55-3XX), b) Spiral casing, damper, IGV, RVC, impeller, shaft (56-1XX, 56-2XX, 56-3XX 56-4XX). c) Silencer (56-9XX, 55-9XX)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (Varnish medium alkyl/d)	60	NIL	NIL	60
3.4	Journal area Of shaft (55-1XX, 56-1XX, 55-2XX, 56-2XX, 55-3XX, 56-3XX 56 4XX						
3.5	All machined surfaces shall be applied with rust preventive.						
			<b>Refer PRQA 341 / Latest</b>				

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## Procedure for Surface Preparation and Painting

Doc. No	<b>PRQA: 590</b>
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Sl.No.	Component/P/GMA	Surface preparation	Primer	DFT in $\mu$ m (Min)	Finish	DFT in $\mu$ m (Min)	Total DFT (Min)
--------	-----------------	---------------------	--------	----------------------	--------	----------------------	-----------------

<b>4.0</b>	<b>Electro static precipitator</b>						
4.1	GD drive Arrangement (7X X10), Drive arrangement for emitting system (7X X17), Inspection doors (7X X23), Drive arrangement for CE rapping (7X X26), Outer roof (7X X42), ESP pent House (7X X55), ESP test equipment (7X X61) Water washing system (7X X66) Tools and tackles (7X 996), Lifting beam (7X X20), Columns (7X X81) Hopper approach platform (7X X 65), Stringer and Guard plates (7X 610).	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyd)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70

4.2	Insulator Housing assy.(7X X06), Gas distribution assy.(7X X08),GD rapping mechanism(7X X09), Gas screening (7X X11), Emitting system suspension (7X X13), Emitting electrode rapping (7X X16), Suspension arrangement for CE (7X X19), Frame of Emitting system Top & Bottom and Middle.(7X X21,X22,X32),Shock bars(7X X24), CE Rapping mechanism (7X X25), Ridges(7X X43), Hopper upper and Lower & Middle part (7X X44, X45),Insulator support panel (7X X46), Roof panel assy. (7X X47), Casing structure (7X X28, X48), Casing shell (7X X49), ESP Funnel (7X X50), Splitter&Guidevane (7X X57)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyd)	60	NIL	--	60
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## Procedure for Surface Preparation and Painting

Doc. No	<b>PRQA: 590</b>
Rev	<b>01</b>
Date	<b>02 02 08</b>
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Sl.No.	Component/PGMA	Surface preparation	Primer	DFT in µm (Min)	Finish	DFT in µm (Min)	Total DFT (Min)
4.3	Hand rails, post, step treads, Floor grills (89 610,611,7X X65)	Power tool cleaning to ST-3 (SSPC SP3) *	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 black shade	40	70
4.4	EE (7X X15)EE hook, EE suspension hook (7X X13), CE (7X X20)CE, CE suspension hook (7X X19), Foundation material foe ESP structures& ducts (7X X80).	--	(**) Temporary rust preventive oil Dry type	20	--	--	20

<b>5.0 Gates and Dampers</b>							
5.1	Gates and dampers temperature ≤ 95°C (57 XXX)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 unless specified otherwise.	40	70
5.2	Gates and dampers temperature > 95°C (57 XXX)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	60	NIL	--	60
5.3	Gate blades, Machined components of G&D	---	(**) Temporary rust preventive oil Dry type	20	NIL	NIL	20

<b>6.0 Chimney</b>							
6.1	Foundation bolt (87 010)	Power tool cleaning to ST-3 (SSPC SP3)	(**) Temporary Rust preventive	20	--	--	20
6.2	Shells-Inside and Un insulated side, base plate (87 100),	Blast Cleaning to Sa 2 ½ (Near white metal with Surface profile 35 - 50 µm)	Two coats of Heat resistant aluminum paint as per IS 13183 (GR I -Up to 600°C,GR II 200°C to 400°C,GR III Up to 200°C)	40	NIL	--	40
6.3	Ducts un insulated, Strakes, (87 150), Painter trolley (87 200)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of Heat resistant aluminum paint as per IS 13183 (GR I -Up to 600°C,GR II 200°C to 400°C,GR III Up to 200°C)	40	NIL	--	40

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Ranipet

## Procedure for Surface Preparation and Painting

Doc. No	<b>PROA: 590</b>
Rev	<b>01</b>
Date	<b>02 02 08</b>
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Sl. No.	Component/PGMA	Surface preparation	Primer	DFT in $\mu\text{m}$ (Min)	Finish	DFT in $\mu\text{m}$ (Min)	Total DFT (Min)
6.4	Shells -out side insulated (87 100), Ducts- Insulated (87 150)	Power tool cleaning to ST-3 (SSPC SP3)	Two coats of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl).	60	--	--	60
6.5	Ladders, Hand rails, floor grills, platforms (87 300)	Power tool cleaning to ST-3 (SSPC SP3)	One coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyl)	30	Two coats of synthetic enamel paint to IS 2932 black shade	40	70

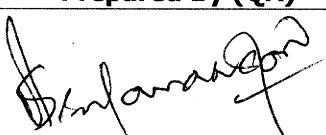

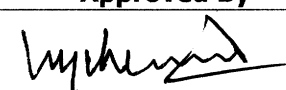
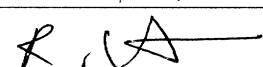
<b>7.0 Products meant for overseas application</b>							
7.1	Internal and External parts of APH, ESP, Fan and Gates and Damper	Blast Cleaning to Sa 2 1/2 (Near white metal with Surface profile 35 - 50 $\mu\text{m}$ )	Epoxy red oxide Zinc phosphate primer to IS 13238	30	Epoxy polyamide cured paint to IS 14209	30	60


Note: All components covered under different PGMA are to be painted. In case any component is left out, the same shall be deemed to be included under relevant section.

Issued by: Quality Assurance Dept BHEL Ranipet.

<b>QUALITY ASSURANCE</b>	
<b>QWI NO: PR:QA:590 Rev.01 Dtd.02.02.2008</b>	
<i>Amendment to Quality Work Instruction (QWI)</i>	
<b>Amendment No: A1</b>	<b>Date:11.10.2013</b>
<b>Title: <i>Procedure for Surface Preparation and Painting</i></b>	

Details of Amendment		
Clause No	Amended As	Basis for Amendment
<p>Refer Clause no 4.0 – Table 2 and further clause no. 3.2 a) and 3.3 a) of Table.</p>	<p>AP Fan components like Servo Motor Assy, Shaft with Bearing Assy (refer clause 3.2 a) and impeller (refer clause 3.3 a) of table 2.0 Presently Existing Painting Scheme:</p> <ol style="list-style-type: none"> <li>1. Primer: one coat of red oxide zinc phosphate primer to IS 12744 (varnish medium alkyd) DFT = 30 µm.</li> <li>2. Two coats of synthetic enamel paint to IS 2932 shade 692 of IS 5 Unless specified otherwise Finish= 40 µm(Primer+Finish: total DFT- 30+40=70 µm)</li> </ol> <p>The above painting scheme has been modified as below - only for AP fan components like Servo Motor Assy, Shaft with Bearing Assy (refer clause 3.2 a) and impeller (refer clause 3.3 a) of table 2.0</p> <ul style="list-style-type: none"> <li>• Epoxy based Zinc Phosphate Primer (Two Pack system) as per IS:13238 – Two coats and each coat min. 30µm and total DFT will be 60 µm</li> <li>• Finish Paint : Not Applicable</li> </ul>	<p>Feedback from RCA Sub-Committee Meeting. Dt- 14.05.2013 (For quick drying of paint)</p>

<b>Prepared By (QA)</b>	<b>Reviewed By</b>	<b>Approved By</b>
	QC-Shop 	
	QA 	

 Ranipet	<b>Procedure for  Fabrication of Gland plate and follower  plate, Gland and Stud welding</b>	Doc. No	<b>PRQA: 599</b>
		Rev	<b>00</b>
		Date	<b>18 09 08</b>
		Page NO	<b>1 of 5</b>

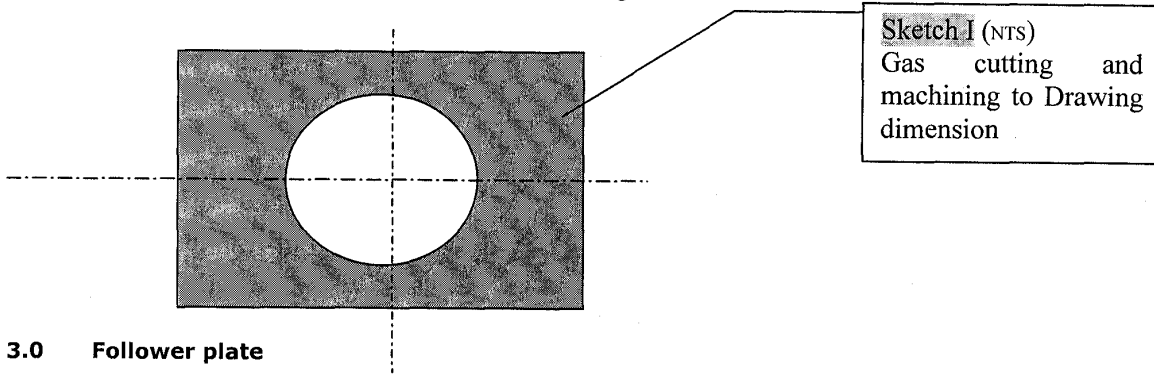
**1.0** This procedure gives the Guide line / method of fabrication of Gland and Follower with Gland and stud welding assembly used in Damper assembly

**2.0 Gland plate**

2.0.1 Mark the size of the gland plate with plus 3 mm on each side and Gas cut using pug cutting machine

2.0.2 Grind the gas cutting sides to a maximum square out of 1 mm. Mark the center line on both axis as shown in the sketch I and prick punch the line and extend this to two sides on thickness.

2.0.3 Mark the Hole size with sufficient machining allowance and gas cut. Machine to drawing dimension. Check and record the readings.

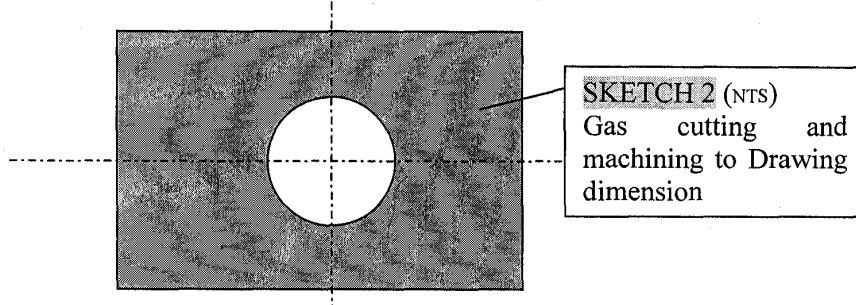


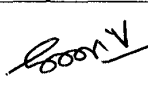
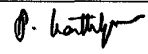
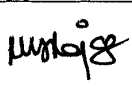
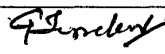
**3.0 Follower plate**


3.0.1 Mark the size of the follower plate with plus 3 mm on each side and Gas cut using pug Cutting machine.

3.0.2 Grind the gas cutting sides to a maximum square out of 1 mm. Mark the center line on both axis as shown in the sketch I and prick punch the line and extend this to two sides on thickness.

2.0.4 Mark the Hole size with sufficient machining allowance and gas cut. Machine to drawing dimension. Check and record the readings.



Prepared By	Reviewed By		Approved BY
	P Karthikeyan DM/QA		 Head / QA
	G Jeyasekar /SM/QC-OLI		

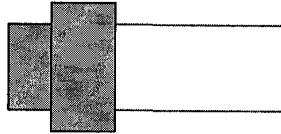
 Ranipet	<b>Procedure for  Fabrication of Gland plate and follower  plate, Gland and Stud welding</b>	Doc. No	<b>PRQA: 599</b>
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**Note:** Gland plate and Follower plate Hole can be done by drilling and further enlarging of Gland plate by boring in Butted condition of the both plates. However reference of Stud pitch shall be taken reference from Gland plate and follower plate hole.

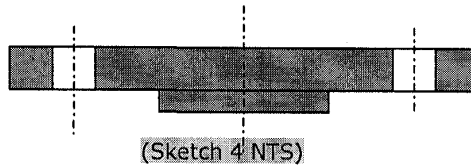
**4.0 Assembly of Gland plate and follower plate, Stud**

4.0.1 Place the Gland plate over the Follower plate. Align the co axiality both holes by using stepped pin gauge as per Sketch 3 and tack weld.

(Sketch 3 NTS)



4.0.2 Using template mark the Stud location (the template shall be made in such a way that stud location-marking w.r.to Gland and follower plate center. as per Sketch 4



4.0.3 Match drill the Stud hole using drill jig supplied by BHEL . Insert the Stud and complete the stud welding as per WPS.Flush grind the stud weld. Ensure Pre heating and Root run, Root LPI and Final MPI to have a defect free weld. (Refer detailed welding procedure issued by QC OLI to sub contractor for better understanding of the requirement)

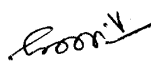

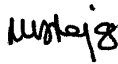
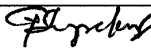
4.0.4 Match mark to have a unique identification after dismantling.

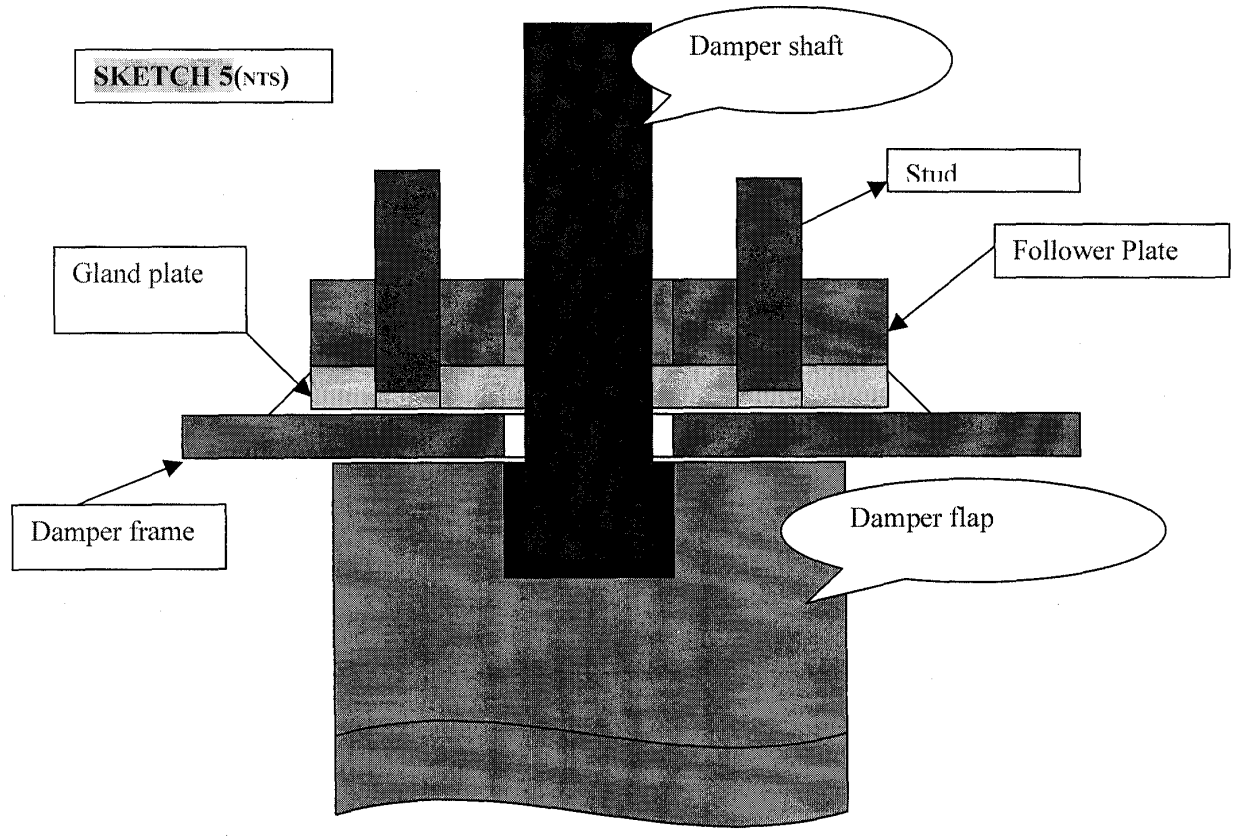
4.0.5 Dismantle the Gland plate and Follower plate and Grind the Tack weld.



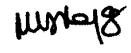
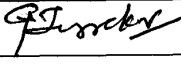
4.0.6 Weld the Gland with Gland plate (In order to avoid weld distortion use suitable shaft, which is having same diameter of damper shaft being assembled. Claen and grind.


4.0.7 Re assemble the Gland plate assembly with Follower plate to ensure any interference with the stud and follower plate hole as shown in the sketch 5. Do not enlarge follower plate hole.

4.0.8 Clean and apply rust preventive coating and preserve for further assembly with Damper

Prepared By	Reviewed By		Approved BY
	P Karthikeyan DM/QA		 Head /QA
	G Jeyasekar /SM/QC-OLI		



Prepared By	Reviewed By		Approved BY
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	G Jeyasekar /SM/QC-OLI		

	<b>Procedure for Fabrication of Gland plate and follower plate, Gland and Stud welding</b>	Doc. No	<b>PRQA: 599</b>
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PROCEDURE FOR GLAND STUD WELDING

01. Ensure Gland plates (GP) and Follower plates (FP) are received intact with match marking and firm code.
02. Ensure Gland studs received are having proper identification for specification SA193B7 with inspector's seal.
03. Ensure GPs and FPs are having dimensions as per drg. taking care of co-axiality and w.r.t center axis of stud holes and record 100%.
04. During the process, butting surfaces of GP & FP should not be reversed and should not be interchanged.
05. Locate the GP on a fixture having guides for bore and stud holes to maintain 1mm uniform clearance of Gland bush and tack the gland bush. Ref Fig 5
06. Weld the Gland bush (GB) all round maintaining fillet all-round and remove / ground flush any excess weld.
07. Conduct LPI on GB weld.
08. Gland studs that are having chamfers already are to be chamfered further to accommodate 2.5 electrodes for root welding.
09. Fit up of Gland studs should be made using follower plate also as per the sketch enclosed, maintaining gap 6mm / as per drg for plug welding. Sufficient chamfering of gland stud holes also necessary for proper plug welding. (Ref Fig 6)
10. After Gland studs tacked and after fit up clearance plug weld the gland stud. Please note during fit up and welding of stud pre-heating of stud opposite to plug weld should be done. Electrode specification and pre heating temperature shall be as per WPS.
11. Ensure root weld slag and subsequent layer weld slag are cleaned properly.
12. After welding Gland stud, ensure perpendicularity of stud.
13. Grind the plug welding area properly without making undulations.
14. Conduct MPI on plug weld after 48 hours of plug weld.
- 15 Also, tighten the stud with assy. of Follower plate to ensure soundness of weld.

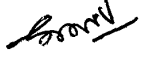
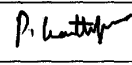
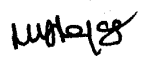

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	P Karthikeyan DM/QA		 <b>Head /QA</b>
	G Jeyasekar /SM/QG-OLI		

FIG -5

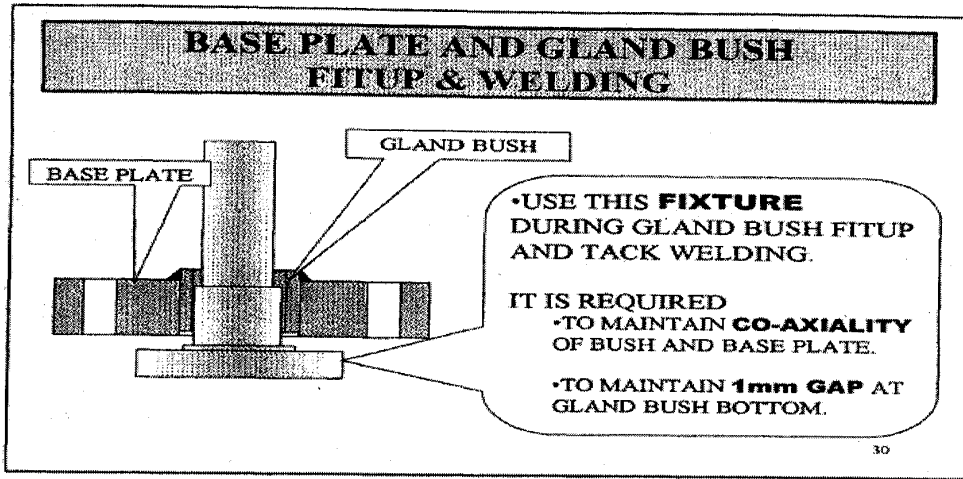
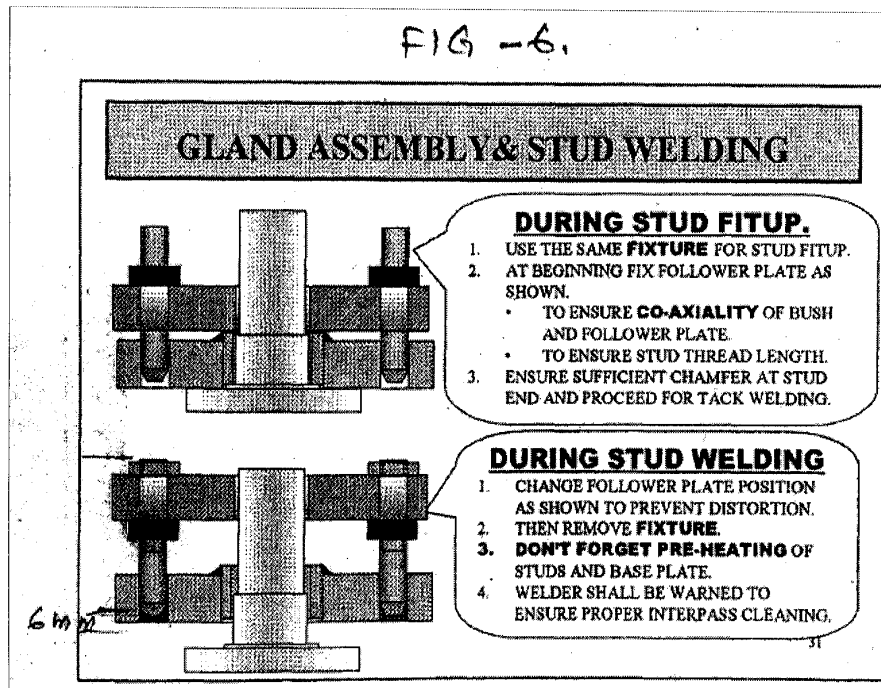
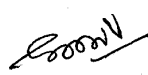
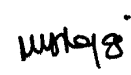



FIG -6.



Prepared By	Reviewed By	Approved BY
	P Karthikeyan DM/QA	 Head /QA
	G Jeyasekar /SM/QC OLI	

 <b>Ranipet</b>	<b>Non Destructive Examination (NDE)</b> <b>requirement for Gates and Dampers</b>	Doc. No	<b>PRQA: 603</b>
		Rev	<b>02</b>
		Date	<b>17 02 2011</b>
		Page NO	<b>1 of 1</b>

**1.0 Scope**

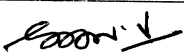
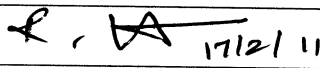
1.1 This procedure details out the **Liquid penetration Inspection (LPI), Magnetic Particle Inspection (MPI) requirement** for the Components of Gates and Dampers

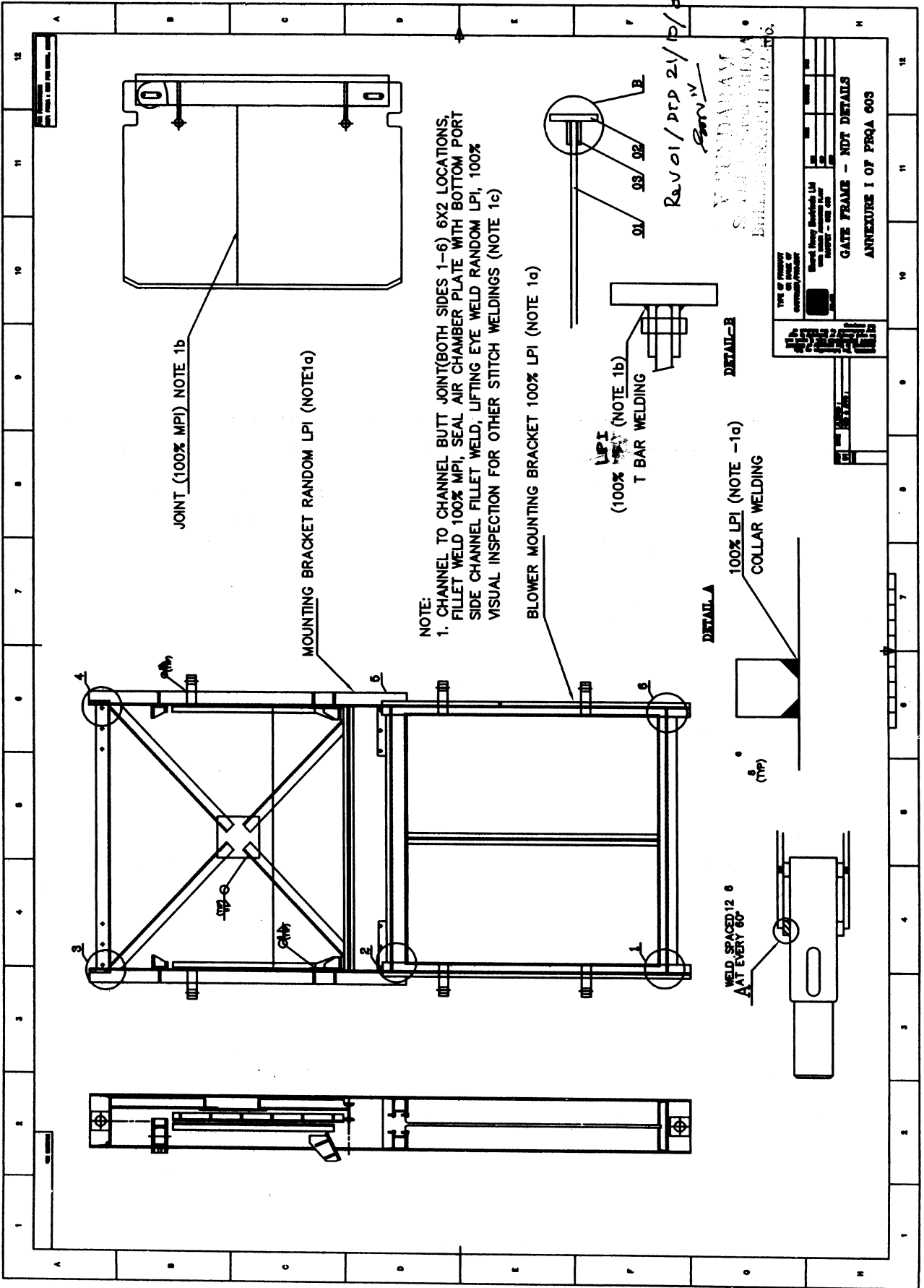
**1.2 Reference.**

- RQP for Gates : 0000-999-QVM-P-267 Rev 02 DT 27 06 08 / Clause 2.1 Note 1a,1b,and 1c
- RQP for Dampers: 0000-999-QVM-P-268 Rev 02 DT 26 05 08 / Clause 2.1 Note 1a,1b.

1.3 The details of NDE locations for gates are as per **Annexure I** and for Dampers as per **Annexure II**

Revision Number/Date	Changes made
00/ 05 09 09	Original Issue.
01/24 10 09	Correction done in Note - C of Annexure I & II
02/17 02 11	Correction done in Annexure under Note 1b (T bar welding )

Prepared By	Reviewed & Approved BY
	 17/2/11



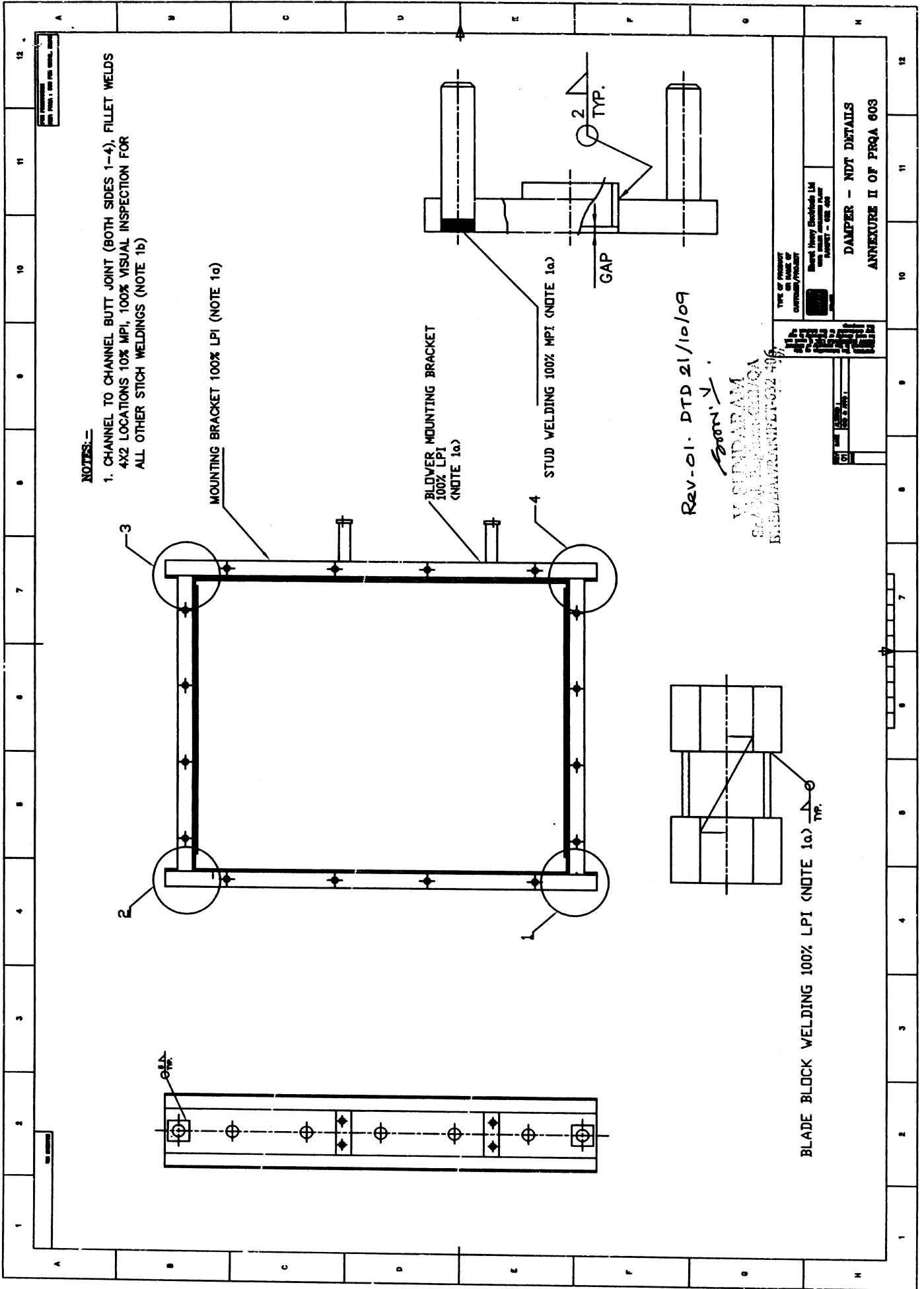
Rev 01 / PRD 21 / 10 / 09  
 PART IV

VERENDAVAM  
 S. VERENDAVAM  
 ENGINEER (REGISTERED)

NO.	DESCRIPTION	DATE

GATE FRAME - NOT DETAILS  
 ANNEXURE I OF PRQA 603

Rev-02 / DT. 17-02-2011  
 SPOON



**NOTES:-**

1. CHANNEL TO CHANNEL BUTT JOINT (BOTH SIDES 1-4), FILLET WELDS  
4X2 LOCATIONS 10% MPI, 100% VISUAL INSPECTION FOR  
ALL OTHER STITCH WELDINGS (NOTE 1b)

MOUNTING BRACKET 100% LPI (NOTE 1a)

BLOWER MOUNTING BRACKET  
100% LPI  
(NOTE 1a)

STUD WELDING 100% MPI (NOTE 1a)

BLADE BLOCK WELDING 100% LPI (NOTE 1a)

Rev-01. DTD 21/10/09

*From V.*  
**V. SUNDARAM**  
 Sr. Design Engineer  
 BRIDGE/AN/PET-02 406

TYPE OF PROJECT  
 BRAND NAME/PRODUCT  
 BRAND Heavy Bridge Ltd  
 with main structure part  
 MARKET - INDIA

CI No. (REV. 01)

**DAMPER - NDT DETAILS**  
**ANNEXURE II OF PRQA 603**

**BHARAT HEAVY ELECTRICALS LIMITED  
TIRUCHIRAPPALLI 620 014 INDIA**

**QUALITY CONTROL PROCEDURE FOR  
MANUFACTURE OF NON PRESSURE PARTS**

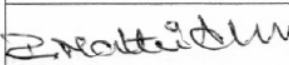
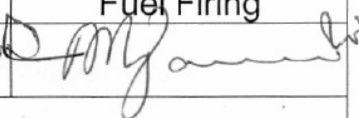
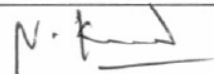
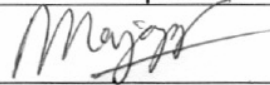

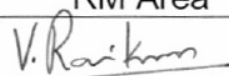

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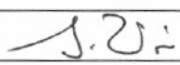
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Prepared by  
Quality Assurance

G S N Murthy



Reviewed by	Signature	
	Engineering	Structures
		
OP & C		
Manufacturing	Shops	Ancillary Development
		
Quality Assurance		
Quality Control	RM Area	OLI
		

Revision No.	Date	Approved by	Signature
00	01/04/93	SM / QA	-sd-
01	01/01/95	SM / QA	-sd-
02	24/04/04	SDGM /QA	

**Proprietary Data - For Internal Use Only**

**RECORD OF REVISIONS**

Rev No...	Clause No	Details of revision
00	--	This document consolidates all the general requirements and technical disciplines covered in the various previous
01	--	All amendments issued has been regularized and editorial correction made for better clarity. Scope of machining added in this document.
<b>02</b>		<b>Shaded clauses are Revised /added</b>

## 1.0 SCOPE

- 1.1 This procedure details out the process control and quality requirements for manufacture of Non Pressure Parts.

## 2.0 REFERENCE DOCUMENTS

- 2.1 AWS D.1.1, D1.6, IS 7215 and CE: M&P 5.11.1.1, 5.11.2.1 & 5.11.2.2 as guidelines.

## 3.0 MATERIALS

- 3.1 CLASSIFICATION OF MATERIALS (commonly used):

<u>P No. Group</u>	<u>Specifications</u>
P1 - Group 1 - 515 Gr 60.	Carbon steel IS 2062 Gr A & B, IS 1239, IS 1161, A 36, SA
P1 - Group 2 - IS 8500.	H.Strength CS :SA105, SA 515 Gr 70, SA 299, SA 516 Gr 70,
P4 - Alloy Steel	SA 387 Gr 11 & Gr 12, SA 182 Gr F 11 & F 12.
P5 – Gr A,	SA 387 Gr 22, SA 182 Gr F 22
P6 -	SA 240-410,429
P8 - Stainless steel	SA 240 - 304 ,309,310, 316, 321, 347

Any other materials as specified in the drawings.

- 3.2 Raw materials used shall conform to the relevant specification as given in drawings and applicable TDC/PO. Any substitution of materials shall be done only with prior approval of engineering through applicable documents. Where subcontractors procure the raw materials, the same shall have valid test certificates.
- 3.3 Raw materials shall be free from visual defects like cracks, seams, laps, laminations, heavy pitting etc. When defects are noticed in visual inspection the same shall be confirmed using appropriate NDE techniques and repaired using applicable approved process .
- 3.4 All materials are procured with permitted dimensional tolerances of the material specifications and / or TDC. Wherever required, the raw materials shall be corrected prior to fabrication to achieve the required product tolerances.
- 3.5 Customer supplied materials are to be verified as per SP 0626.
- 3.6 The requirements of material traceability shall be as indicated in the respective drawings.
- 3.6.1 Product Attest "P" items indicated as in drawings are traceable to the test certificates and identified with material Specification, grade and melt number by stamping.
- 3.6.2 CERTIFIED items indicated as "C" in drawings are traceable to material Specification / grade only and identified by stamping / engraving / stenciling / painting.
- 3.6.3 Raw materials not covered by the above shall be identified by its W.O.No / material code / Specification / grade by painting / stenciling / engraving.
- 3.6.4 All subdeliveries shall be identified by its material code by painting or through name plates / tags.

3.7 When materials ( including stock) are to be upgraded for special contract requirements QC shall ensure that the respective specification / contract TDC ( as applicable) are complied..

#### 4.0 FABRICATION

##### 4.1 MARKING, CUTTING AND PREPARATION

4.1.1 Raw material shall be marked and cut to size by shearing, machining, saw cutting , flame or plasma (for SS materials) cutting. Flame cut edges shall be cleaned to remove slag. Uneven edges shall be dressed by grinding. Gas cutting notches shall be filled up by welding using compatible electrodes and ground before taking up for further fabrication.

4.1.2 Wherever raw materials supplied / available are not sufficient for the sizes required, the same can be built up using the splicing instructions given in the respective SQPs/ Drawings (Incl. Production Notes) / DCN.

4.1.3 Layout for size and shape shall be marked before cutting (for other than CNC applications) The tolerance for marking shall be maintained within + 2mm unless otherwise specified. The diagonal difference shall be within 3 mm.

4.1.4 The markings shall be punched at convenient intervals and bordered with white paint.

4.1.5 Stainless Steel (SS) materials shall be cut using plasma cutting or shearing only. Any further dressing/ grinding of cut surfaces should be done with separate and clean abrasive wheels.

4.1.5.1 The cut edges should be smoothly ground.

4.1.5.2 Notches above 3 mm or 20 % 'T' shall be thoroughly cleaned and welded by using a qualified WPS and examined visually and by LPI . The repaired surfaces are to be cleaned to bright metal surface.

4.1.6 Clip / Cleat angles above 10mm thick used for beam connections which are sheared to length shall require heat treatment.

4.1.7 Heat treatment shall be done after shearing for P4 materials  $t > 12.5\text{mm}$  and for P5 materials  $t > 10\text{mm}$ .

4.1.8 The requirements of preheat for gas cutting are as follows:

Carbon steel	$t \leq 50\text{mm}$ :	: Nil
Carbon steel	$t > 50\text{mm}$ :	: 100 ° C.min.
Alloy steel (P4)	$t \leq 25\text{mm}$ :	: Nil
Alloy steel (P4)	$t > 25\text{mm}$ :	: 150 ° C
Alloy steel (P5)	All	: 150 ° C
Stainless steel	Not applicable	

4.1.8.1 Stress relieving for gas cut edges shall be as follows.

Material	Thickness	Heat treatment cycle
P1	> 50 mm	600 ° - 650 ° C for 30 minutes . Furnace cool (Alternatively, the cut surface can be ground / machined upto 3 mm to remove HAZ)
P4	> 16 mm	650 ° – 700 ° C for 30 minutes . Furnace cool
P5	All	680 ° - 730 ° C for 30 minutes . Furnace cool
SS (plasma)	Any	Not required

4.1.9 The prepared plates shall be visually inspected and repaired if required as per SIP:NP:06.

4.1.10 The raw materials after cutting shall be identified with relevant WO No., DU No., Part No. and Material Spec / Grade (transferred).

## 4.2 FORMING

4.2.1 Forming shall be done using proper tooling free from damages. Method of forming and work centre shall be identified in OPS / relevant QWI referred in PO.

4.2.2 Forming operations of sheets / plates shall be done by rolling / pressing. Circularity of rolled shells shall be checked using templates (of length > ¼ of ID).

4.2.3 Suitable nonmetallic padding shall be provided while forming of stainless steels to avoid contamination.

4.2.4 All formed components shall be checked for orientation, angle, and other dimensions as per drg. All formed parts shall have smooth finish and shall be free from bends, folds and sudden transitions.

4.2.5 Minimum thickness after forming shall be ensured whenever specified in drg.

4.2.6 Tolerances for formed components when not specified in drg. Shall be as follows

- a) St.Length / Dia, : + 1 mm / M, 5 mm Max  
Width & Height
- b) Verticality : 1 mm / M, 5 mm Max
- c) Squareness : 1 mm / M of length / Dia
- d) Straightness : 1 mm / M, 5 mm Max
- e) Radius : + 5 mm
- f) Bend Angle : + 2°
- g) Ovality : 1%
- h) E.P Angle : + 5° / - 2.5°
- i) Diagonal diff : 3 mm

## 4.3 WELDING

### 4.3.1 WELDING CONSUMABLES

4.3.1.1 Welding consumables conforming to the qualified welding procedures shall be used. However the following guide lines are provided.

4.3.1.2 Only Basic coated electrodes shall be used in the following cases:-

- a. All Strength welds like welds in main ceiling girders, flange butt welds in other beams, columns etc.
- b. For all structural welds, or when thickness of any one member of the weld joint is > 12 mm (unless otherwise indicated in the drawings / Qualified WPS).
- c. For welding of high tensile steels like IS 8500, SA299, SA515 Gr.70, SA516 Gr.70.

4.3.1.3 Rutile electrodes may be used for other weld joints.

4.3.1.4 All low hydrogen electrodes (EXX 16 & EXX 18) shall be dried in the baking oven at 350 deg.C for 2 hours and the electrodes shall be held at 100 deg.C until they are used.

- 4.3.1.5 All rutile electrodes (EXX 13) shall be dried at 100 deg. C for 1 hour min. and held at 100 deg.C till use.
- 4.3.1.6 Fluxes for SAW shall be dried at 200 deg.C for 1 hour min. before use. Height of flux bed while drying in pan or oven, shall not be more than 100mm.

4.3.1.7 Unless otherwise specified, SS consumable shall be baked as per Electrode manufacturer's recommendations and stored at 120 ° - 150 ° C until use.

#### 4.3.2 FIT UP

- 4.3.2.1 Proper fit up shall be ensured before welding as per Drawing. Tack welding or mechanical clampings shall be used to maintain the fit up requirements before and during welding. Bridge pieces used during fit up shall be of ferritic for ferritic materials and stainless for stainless steel materials.
- 4.3.2.2 Dimensions of the cross sections of groove welded joint shall be within the following tolerances w.r.t. drawing requirements:

	Root not back gouged	Root back gouged
1. Root face of joint(land)	± 2 mm	Not limited
2. Root opening of joint (with out backing)	± 2 mm	+ 2 mm - 3 mm
Root opening of joint* with backing)	+ 6 mm - 2 mm	Not Applicable
3. Groove angle of of joint	+ 10° - 5°	+ 10° - 5°

\*(NOTE): Root opening wider than permitted by above tolerances but not greater than twice the thickness of the thinner part or 19mm, whichever is less may be corrected by edge buildup to acceptable dimensions prior to welding. Such build up edge shall be MPI / LPI checked.

4.3.2.3 For C. S. fillet welds, the parts shall be as close as practicable and gap shall be limited to 5 mm (If gap exceeds 2 mm, the leg of fillet shall be increased by the amount of gap but in no case shall exceed 4.8 mm). For thickness 75 mm and above gap up to 8 mm can be permitted provided suitable backing is used.

4.3.2.4 For S. S. fillet welds, the parts shall be as close as practicable. Gaps 2 mm and above upto 5mm are acceptable if the fillet size is increased by an amount equal to the gap.

4.3.2.4 Parts to be joined by butt welds shall be properly aligned. An offset not exceeding 10% of the thickness of the thinner part joined can be permitted, but in no case more than 3.2 mm, is permitted.

#### 4.3.3 PRE HEATING

4.3.3.1 Pre heating requirements for welding shall be as per Clause 4.6.7 and controls shall be exercised as detailed below. No preheating is required for stainless steels.

4.3.3.2 Preheating shall be maintained during the entire process of welding.

- 4.3.3.3 Preheating is to be done using gas burner or induction / resistance heating. The temperature must be uniform and verified using thermal chinks or thermocouples prior to start of welding as well as during welding for a width of 't' (maximum) or 75 mm whichever is less.
- 4.3.3.4 Where interpass temperature control is required during welding, the temperature must be ensured using thermal chinks / thermocouples. Inter pass nitrogen / air cooling can be adopted to maintain inter pass temperature in case of stainless steels.
- 4.3.3.5 Wherever post heating is specified, the preheating shall be continued after welding till attaining the post heat temperature and maintained for the required time and cooled slowly by wrapping suitable insulating blankets like asbestos.
- 4.3.4 Welding shall be performed using qualified procedures and qualified personnel. Edge preparation and welding details shall be as per drawing.
- 4.3.5 For items to be manufactured at subcontractor's works, for requirements of qualification of procedure and personnel as per SIP:NP: 07 shall be followed.
- 4.3.6 When double bevel welding is adopted, back gouging and grinding is to be done. Back gouged groove shall be checked with PT / MT before welding from second side.
- 4.3.7 Proper sequence of welding shall be adopted to minimise distortion. The distortion of the finished jobs, if any may be corrected by mechanical means / hot correction.
- 4.3.7.1 For welding of SS extreme care is to be taken in weld sequencing to minimize the weld distortion and shrinkage. For complex weldments a weld sequence instructions may be prepared by contractor prior to work commencement. Weld joints likely to have high shrinkage should be welded ( with minimum restraints) before welding other joints providing allowance for shrinkage.
- 4.3.7.2 While cutting long web plates suitable camber may be required to compensate for the distortion during cutting and welding.
- 4.3.8 All butt welds of divider plate and guide vanes in ducts shall be flush ground inside.
- 4.3.9 The use of jigs and fixtures is recommended where ever practicable. Suitable allowances shall be provided for weld shrinkage. Proper sequence of welding shall be followed to control the distortion during welding.
- 4.3.10 All temporary attachments shall be welded with the required preheat. After their removal welded spots shall be ground flush and LPI checked.
- 4.3.11 Groove welds shall preferably be made with minimum reinforcement unless and otherwise specified in drawing / SQP. In case of butt welds, reinforcement shall not exceed 3.2 mm. and shall have gradual transition to the plane of the base material surface.
- 4.3.12 The surface of the welds shall be free from coarse ripples, overlaps, undercuts and abrupt ridges to avoid stress raisers.
- 4.3.13 Where parts of different thicknesses are welded or surface offset is more, the transition shall be made gradual by grinding / machining with 1: 2.5 taper.
- 4.3.14 Stray arcs shall be avoided to the extent possible. Arc spots if noticed shall be ground and checked by LPI / MPI. Thickness requirements shall be ensured after grinding.

#### 4.4 WELD REPAIRS

- 4.4.1 Removal of defective weld / portions of the base material may be done by machining, grinding, chipping, gas cutting, oxygen gouging or carbon arc gouging. Defective portions of the weld shall be removed without substantial removal of sound base metal.
- 4.4.2 For under sized welds additional weld metal shall be deposited using an electrode preferably smaller than that used for making original weld limited to 4mm in diameter. The surfaces shall be cleaned thoroughly before deposition.
- 4.4.3 Defective welds/base metal shall be repaired by removing or/and rewelding as follows:
- 4.4.3.1 Overlap / excess weld metal shall be removed by grinding.
- 4.4.3.2 For excess concavity, crater, undersize & undercuts, deposit additional weld metal after cleaning the weld surface.
- 4.4.3.3 For Cracks in weld or base metal, ascertain the extent of crack by suitable NDE / acid etching, remove the crack to sound metal upto each end of the crack by arresting the ends for further propagation and reweld.
- 4.4.3.4 For weld porosity, slag inclusions & lack of fusion remove defective portions & reweld

#### 4.5 HOT CORRECTION

- 4.5.1 Members which require hot correction are to be supported at suitable locations and mark the locations for heating.
- 4.5.2 Heat the locations marked by using neutral flame. Torches used for heating shall be moved continuously & uniformly over selected area to avoid localised over heating.
- 4.5.3 For Carbon steels the maximum temperature shall not exceed 650 ° C and shall be ensured using thermal chalks / thermocouples.

For alloy steels P4 – 705° C , P5 – 735° C temperatures are to be maintained for hot corrections

- 4.5.3.1 For Austenitic stainless steels the maximum temperature shall not exceed 430 ° C and shall be made known to inspection authorities . Otherwise , after hot correction solution annealing at 1050 – 1100 deg C is to be done.
- 4.5.3.2 For Ferritic/Martensitic/Duplex stainless steels the maximum temperature shall not exceed 315° C and shall be made known to inspection authorities . The temperature shall be ensured using thermal chalks / thermocouples.
- 4.5.4 Additional dead weights may be placed over the positive side of the bend depending upon the requirement to accelerate hot correction.
- 4.5.5 Allow for natural cooling. Accelerated cooling shall not be adopted. Remove the dead weights used after cooling.
- 4.5.6 Wherever the correction for distortion affects the weld joints, applicable NDE shall be repeated after the correction.

#### 4.6 POST WELD HEAT TREATMENT (PWHT)

- 4.6.1 The process controls ( temperature control and recording) for heat treatment shall cover the activities before, during and after heat treatment.

- 4.6.2 The weldment shall be cleaned to free of grease, oil etc. prior to heat treatment.
- 4.6.3 PWHT shall be done in a furnace or by local heating a band ( including the entire weld and adjacent area of the base metal) .
- 4.6.4 The thermocouples and recording instruments shall be calibrated as per applicable standards and records maintained. The furnace shall have been qualified and calibrated.
- 4.6.5 All materials to be heat treated in furnace shall be loaded in such a way that they shall not be subjected to direct flame impingement. Jobs shall be preferably loaded on raised plat forms so that no material projects into the plane of burners. Alternatively flame deflectors may be provided in front of the burners to avoid direct flame impingement. Ensure loading of test coupons wherever applicable. **The furnace temperature shall not exceed 315 ° C at the time of loading material / weldment.**
- 4.6.6 Number of thermocouples and their location shall be decided covering maximum and minimum thickness and covering all the zones. **The temperature variation within 5 meters shall not exceed 140 ° C during heating period ( above 315 ° C).**
- 4.6.7 The **temperature requirements** for Pre heating, Post Weld Heat Treatment(PWHT) & temperatures are as below.( Unless otherwise specified.)

Material	Thickness	Pre heating	PWHT Temp.	Remarks
P1 Gr 1&2	t < 38	Nil	600 – 650 ° C	a) For all butt welds in plate welded girders when t > 50mm.
	T= 39-62	100 ° C		
	t > 63	150 ° C		
P4 Gr 1&2	All	150 ° C	680 – 700 ° C	a)All butt welds in tension member b)All fabricated components when t > 16mm(Note1)
P5 Gr 1&2	All	150 ° C (Note2)	680 – 730 ° C	All welds (Note 3)
P8	300 type	120 ° C	-	
	400type	205 ° C	-	

Note 1 All fabricated structural components of P4 materials with any member above 16mm thickness, the entire assembly shall be post weld heat treated. However when size of fillet weld is less than 12 mm, PWHT is not required for non load carrying members.

Note 2 All welds on P5 material shall be post heated at 250 ° C for 2 hrs or 150 ° C for 4 Hrs, immediately following welding.

Note 3 All welds of P5 material shall be post weld heat treated. In case where the size of fillet is less than 12 mm, PWHT is not required for non load carrying members.

4.6.7.1 The **soaking time** shall be as follows:

- For P1 materials the soaking time shall be 1 hr/inch of thickness(t) (2.5 mts / mm) upto 2" and 2 hrs + 15 minutes for each additional inch for t > 2".
- For P4 & P5 materials the soaking time shall be 1 hr/inch of thickness (2.5 mts / mm) upto 5" and 5 hrs + 15 minutes for each additional inch for t > 5".

- c. For combination cycles mentioned above, calculate the minimum soaking time for individual components as 2.5 minutes/mm of the thickness of weld/material whichever is applicable. Soaking time selected for the cycle shall not exceed the limits given below:

Material	Thickness (mm)	Max. soaking time (minutes)
P1 (A,B,C), P4, P5A,	Up to 25 mm	125
P1 (A,B) + P4, P4 + P5A	26 - 50 mm	200
	51 - 80 mm	250
	81 - 150mm	375
P1C + P4, P1 + P3	Up to 25 mm	65
	26 - 50 mm	125

4.6.7.2 Unless otherwise specified, in case of mixed loads of materials not covered under simulation HT, the following heat treatment temperatures shall be followed. In such cases, guidelines for soaking can be taken from Clause 4.6.9.

For components having butt joint between P1 & P4, or P3 & P4, the cycle shall be 630 - 670° C.

Where a component has a butt joint between P4 & P5A, the cycle shall be 680 - 710° C.

Where a component has a butt joint between P1 & P3, the cycle shall be 620-660 ° C

For P1+P5A material combination, follow the WPS requirements

The following jobs shall not be combined in the same cycle during PWHT.

Separate jobs of P1 and P4      Separate jobs of P4 and P5

- 4.6.8 The following rules shall apply to establish the thickness to be used in determining the soaking time for PWHT.
- 4.6.8.1 For Butt welds, the thickness shall be the thickness of the material at the weld. For bar stock, the thickness shall be the diameter.
- 4.6.8.2 For fillet welds, the thickness shall be the throat thickness. If a fillet weld is used in conjunction with a groove weld, the thickness shall be the greater of the depth of the groove or the throat thickness.
- 4.6.8.3 For partial penetration branch welds, the thickness shall be the depth of the groove prior to welding.
- 4.6.8.4 For repairs, thickness shall be the depth of the groove as prepared for repair welding.
- 4.6.8.5 For combination of different welds in a component, maximum thickness of weld shall govern.
- 4.6.9 Requirements of Rate of Heating (ROH) above loading temperature 315 ° C and Rate of Cooling (ROC) are as given below. During heating and cooling, variation in temperature between thermocouples shall be 85 ° C maximum, unless otherwise specified.

Thickness	ROH / ROC (Max) Above / upto 315 ° C
Up to 25mm	220 ° C / hour
26 - 50 mm	95 ° C / hour
50 – 75 mm	70° C / hour
Above 75 mm	55 ° C
For S.S Matl	200 ° C / hour min (Forced air cooling)

- 4.6.10 In case of interruption during Heat treatment the following action has to be taken depending on the stage of occurrence:

Type of Heat treatment	Stage of interruption	Action
Annealing & stress relieving	Heating	Heat treat subsequently as specified
	Soaking	Heat treat subsequently for balance soaking
	Cooling	If the ROC during interruption period meets the specified rate, cool subsequently at required rate upto 400° C. Otherwise, reheat to the soaking temperature, hold for 15 minutes and then cool at the specified rate
Normalising(N) Tempering (T) & Soln. annealing (S)	Heating	Heat treat subsequently as specified
	Soaking	Heat treat subsequently for full soaking(N,S) / Balance soaking (T)
	Cooling	Not applicable

- 4.6.11 Local heat treatment can be carried out by Resistance heating or Induction heating. For local heat treatment of weld joints, width of the heated band on either side of the weld must be at least 3 times the width of the weld groove of the thickest part or 3 times the highest section thickness, whichever is greater.
- 4.6.11.1 The width of the insulation band beyond the heating band shall be at least twice the total width of the heating band.
- 4.6.11.2 A minimum of three thermocouples shall be placed such that at least one is on the weldment and the other two on the base material on either side of the weldment.
- 4.6.11.3 The winding arrangement shall be established to attain the required temperature. The initial rate of heating shall be minimum such that it stabilises at the required rate of heating before reaching 400 deg C.
- 4.6.12 After heat treatment, the charts shall be correlated with the job and cleared by QC. The chart shall contain cycle no, Date, W.O and DU details. Temperature, ROH, ROC and soaking time shall be calculated, entered in the chart and signed off by QC.
- 4.6.13 Wherever applicable the test coupons shall be tested and reports obtained to complete the clearance of heat treatment operation.

## 5.0 NON-DESTRUCTIVE TESTING

- 5.1 The requirement of NDE, extent and type of examination shall be as per respective product SQP and / or CQP .Wherever product SQP is not existing the following requirements shall apply.
- 5.2 Visual inspection shall be performed as per SIP:NP:06
- 5.3 RADIOGRAPHY.
- All Butt welds of Carbon steel for thickness  $t \geq 32\text{mm}$
  - All butt welds of alloy steels for thickness  $t > 12.0\text{mm}$  for P5 and  $T > 16\text{mm}$  for P4.
  - All butt welds in monorails.
  - SS butt welds of  $T > 16\text{mm}$  unless otherwise specified.

- 5.3.1 All radiographic films shall possess Firm code , RT agency, Cust. No, Part No, RT reference No. and weld location reference no. The job shall be numbered with Radiograph no.
- 5.4 MPI / LPI BEFORE PWHT
- a. All flame cut edges of Carbon steel for  $t > 37.5$  mm and alloy steels for  $t > 12$ mm.
  - b. All butt welds joining plate members in which one of the plate member is over 25 mm thick for Carbon steel and over 12 mm thick for alloy steel.
  - c. All fillet welds between tension flange and web.
  - d. All fillet welds joining plate members in which both the plate members are over 25 mm thick for Carbon steel and over 12 mm thick for alloy steel.
  - e. For all butt welds of CS & AS weld groove after back chipping prior to welding from second side.
  - f. All main fillet welds for SS require LPI
  - g. MPI/LPI for all fillet welds & HAZ of SA387 Gr.22 materials after HT.
- 5.5 All NDE shall be carried out by qualified personnel as per BHEL NDT procedures. Where subcontractors use their own procedures for NDE the same shall have the approval of BHEL NDTL.

## 6.0 MACHINING

### 6.1 GENERAL

- 6.1.1 Ensure of raw material identification throughout the machining process. Traceability to the contract shall be ensured by stamping or marking / painting or by tags( WO No.and DU / Part no.)
- 6.1.2 Where the material identification is likely to be removed during cutting or machining , the transfer of material identification shall be ensured.
- 6.1.3 In case of components / part processed items received from Subcontracting / other shops, ensure the completeness and clearance by QC / Customer Inspector through Inspection Reports / OPS.
- 6.1.4 Proper care shall be taken during handling of materials at all stages of manufacture. Items stored in the shop floor shall be properly identified and preserved to prevent mixup and damages / rusting / warpages.
- 6.1.5 All Machined surfaces shall be properly protected and stored. Wherever long storage is envisaged, they shall be preserved with grease / rust preventive oils and protected suitably with polythene / gunny bag or plastic peel off coatings.

### 6.2 MARKING

- 6.2.1 The marking on machined components shall be in such a location which will not be detrimental to the surface finish requirements of the component.
- 6.2.2 Purpose of marking is to:
- 1. Ensure availability of machining allowance.
  - 2. Identify locations for machining.
  - 3. Provide reference for setting and inspection.

### 6.3 PROCESS CONTROLS

6.3.1 The following shall be ensured for selection of work centers, tools, jigs and fixtures:

- a The work centre for machining shall be identified in OPS / loading sheet based on the process capability of the machine or Machine accuracy established to suit the tolerances.
- b Test hardware (Jigs, Fixtures and Templates) used as a means of inspection / process control shall have been qualified through first off trials and shall be regulated through valid number. The same shall be reflected in the OPS / loading sheet .
- c Softwares used in case of CNC / NC machines shall have been validated through trials or inspection of similar components produced and accepted.
- d All cutting tools shall have been ensured for its correctness before use. In case of regrinding of tools they shall be verified after regrinding.

6.3.2 The following shall be ensured before setting the job on the machine, during processing and after completion of machining:

- a Ensure the verticality and flatness of the job after clamping by using the reference markings or dialing the surfaces. Ensure the adequacy of clamping.
- b Ensure proper clamping of the correct tool in to the tool holders.
- c After machining the machined surfaces shall be cleaned and all corners shall be deburred. After removing from the machine they shall be properly stored.
- d Before starting reaming ensure proper material allowance for finish operation.
- e During drilling, reaming and tapping the removal of chips shall be done periodically to prevent clogging of chips. For deep drilling ensure that run out and drill travel are verified in free condition and ensure proper clamping of the tools.

### 6.4 INSPECTION

6.4.1 Ensure completeness of all final machining operations. Dimensional inspection shall be done with relevant drawings. Ensure use of calibrated instruments / gauges.

6.4.2 Unless otherwise specified in the drawing or SQP, the following tolerances can be used for untoleranced dimensions.

#### 1. Linear Tolerance (:millimeters) - Medium

PERMISSIBLE DEVIATIONS FOR BASIC SIZE RANGE						
Up to 6	From 6 TO 30	from 30-120	From 120-400	From 400-1000	From 1000-2000	Above 2000
± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2.0

#### 2. Angular Tolerance

- a. Assembly characteristics ± 0.5°
- b. Other characteristics ± 1°

**7.0 FINAL INSPECTION**

7.1 All dimension shall be inspected as per relevant drawings. Tolerances for fabricated items when not specified in drawings shall be as per clause 4.2.6.

**8.0 CLEANING AND PAINTING**

8.1 All the temporary cleats, bridge pieces shall be removed carefully so as to avoid damage to parent material. Temporary tack welds shall be ground smooth. Complete assembly shall be cleaned to remove mill scales, spatter, slag, rust, oil or grease. Surfaces shall be prepared and painted as per SIP:PP:22 (latest). Site EPs shall be applied with weldable primer. All site EP shall be protected suitably from mechanical damage.

8.2 All temporary stiffeners / attachments used for transportation and handling that are removed after site assembly shall be painted with yellow paint.


8.3 Match marking and flow direction for applicable components shall be as per the respective product SQP./Drawing

8.4 The following details shall be clearly marked with relevant details by paint, bordered and covered by one coat of transparent varnish

Project Name :  
Work order number :  
Component / Assly. Designation :  
DU Number :  
Weight :  
Sub-contractor Name / Code :

8.5 Tension flanges in girders are to be identified by hard punching indicating 'TENSION FLANGE'.

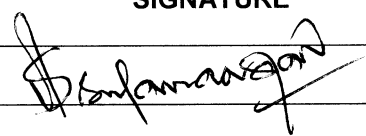
8.6 For subcontracted items the firm code shall be punched and bordered with white paint.

	<b>QUALITY ASSURANCE</b>	QCP : E : 002
	<b>QUALITY CONTROL PROCEDURE FOR SPLICING NORMS FOR SHEETS / PLATES / STRUCTURALS APPLICABLE TO ESP COMPONENTS FABRICATION</b>	Rev. No. 03
		DT. 30.05.2013


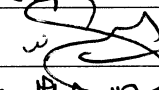
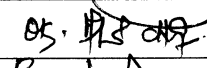
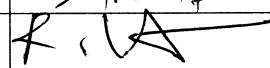
## QUALITY CONTROL PROCEDURE

**FOR SPLICING NORMS FOR SHEETS / PLATES / STRUCTURALS APPLICABLE TO  
ESP COMPONENTS FABRICATION**

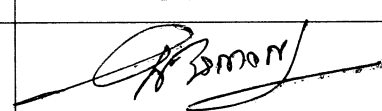
**PREPARED BY :**

DEPARTMENT	NAME & Designation S/Shri	SIGNATURE
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**REVIEWED BY:**

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OUT SOURCING	N. Nandagopal Sr.Mgr/OS	
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**APPROVED BY**

DEPARTMENT	NAME & Designation S/Shri	SIGNATURE
QA	<b>G. BALASUBRAMANIAN</b> SR.DGM / QA, QC(Proc.) & BE	

	<b>QUALITY ASSURANCE</b>	<i>QCP : E : 002</i>
	<b>QUALITY CONTROL PROCEDURE FOR SPLICING NORMS FOR SHEETS / PLATES / STRUCTURALS APPLICABLE TO ESP COMPONENTS FABRICATION</b>	<i>Rev. No. 03</i>
		<i>DT. 30.05.2013</i>

03	30.05.2013	Amendment A1 merged. Feedback from OS and Engg (AQCS) Splicing Norms with applicable Drawing for carbon steel materials and SS Liner Sheet were added and re-issued.
02	03.03.2000	Feedback from MSA and Engg were included and re-issued.
01	16.06.1999	All amendments were merged, feedback from Engg and MSA were included and re-issued.
00	30.10.1985	Original Issue
<b>REV. NO.</b>	<b>EFFECTIVE DATE</b>	<b>REVISIONS MADE</b>

### HISTORY OF RECORD OF REVISIONS

#### 1.0 SCOPE

- 1.1 This Quality Control Procedure (QCP) specifies the requirements for splicing of sheets / plates / structural which may warrant joints to make the required length / width in order to achieve the final product as per drawing.
- 1.2 This QCP is applicable to Sheets / Plates / Structural – Angles, Beams of all types, Sections of Rolled / Built up, Rounds, Pipes and Tubes.
- 1.3 The splicing norms dealt in this QCP is applicable to following ESP components ;
- 1.3.1 7X-X42 Outer Roof Assy
  - 1.3.2 7X-X44 Hopper Upper & Middle
  - 1.3.3 7X-X45 Hopper Lower with SS Liner Sheet
  - 1.3.4 7X-X46 Insulator Support Panels
  - 1.3.5 7X-X47 Inner Roof Panel Assy
  - 1.3.6 7X-X49 Casing Shell Panels
  - 1.3.7 7X-X50 Inlet / Outlet Funnel
- 1.4 This QCP covers both Carbon Steel and SS Liner Sheet materials applicable to ESP Components.

#### 2.0 SPLICING NORMS - GENERAL POLICY

- 2.1 The fabricator or OS cutting plan section shall categorically try to avoid joints as much as possible with the supplied raw materials.
- 2.2 Further to explain the point no. 2.1 – the fabricator and OS cutting plan section shall try to make the supplied raw materials without any joints to cover up the loaded quantities – Eg., Out of 10 Nos of casing shell Panels loaded - maximum no. of panels shall be accommodated without any joints by fabricator and only to reduce the material wastage the balance quantity of casing shell panels shall be made with permitted joints as applicable.



## QUALITY ASSURANCE

### QUALITY CONTROL PROCEDURE FOR SPLICING NORMS FOR SHEETS / PLATES / STRUCTURALS APPLICABLE TO ESP COMPONENTS FABRICATION

QCP : E : 002

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#### 2.3 The joints permitted are considered with a following view only

- 2.3.1 To reduce the material wastage
- 2.3.2 To make the best use of supplied raw materials sizes without prejudice to appearance and quality of final product as applicable
- 2.3.3 Aesthetic appearance shall not be sacrificed in accommodating the splicing norms.
- 2.3.4 Splicing Joints shall be avoided where a cross member is meeting or on bolt hole region. This is to be strictly adhered by fabricator and shall study the drawing fully with all the matching components.

#### 2.4 ESP Components where joints are not permitted

- 2.4.1 Shock Beam
- 2.4.2 Rapping Shaft
- 2.4.3 Vertical Beam
- 2.4.4 Foundation Bolt
- 2.4.5 Suspension Rod
- 2.4.6 Emitting Frame Top, Middle and Bottom
- 2.4.7 Collecting Suspension Arrangements
- 2.4.8 Lifting Holder
- 2.4.9 Vertical Stay
- 2.4.10 Shock bar

### 3.0 SPLICING NORMS – SPECIFIC TO RAW MATERIALS

#### 3.1 SHEETS / PLATES (CARBON STEEL)

- 3.1.1 The preparation of joints shall be staggered one so that formation of ( + ) plus type joint is avoided. The minimum offset (staggering) to avoid the plus type joint shall be minimum 100mm.
- 3.1.2 For a surface area including 2 Mtr X 2 Mtr and less - the permitted smallest dimension of any piece shall be minimum 400 mm ( either length wise or breadth wise) and the same will be 600mm minimum for more than 2 Mtr X 2 Mtr surface area – Refer sketch - S1
- 3.1.3 The distance between nearest stiffener and the joint parallel to it shall be minimum 50mm – Refer sketch – S1
- 3.1.4 The vertical joint is permitted on the taper portion. However the distance between meeting of the vertical joint with the horizontal joint shall be minimum 100mm – Refer sketch – S1
- 3.1.5 Butt weld reinforcement shall be ground flush wherever stiffeners cross them.
- 3.1.6 When bending of the plate is done before welding, the parallel joints shall be minimum 100 mm away from the bend line. The weld quality shall be ensured by



## QUALITY ASSURANCE

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DT. 30.05.2013

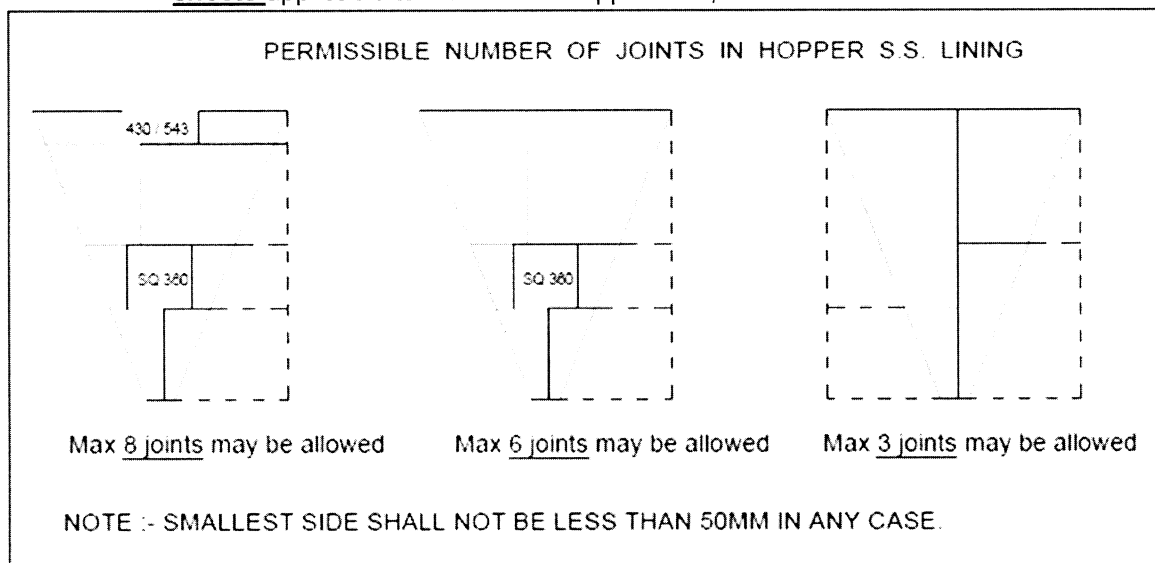
MPI / LPI. If the weld joint is subjected to bend, the weld shall be checked by LPI subsequent to bending.


3.1.7 The maximum number of permitted joints shall be as given below for carbon steel sheets / plates

Sl. No.	Surface Area in Sq. Mtr	Maximum No. Of joints permitted put together both axis (X & Y)
1	Less than & Up to 2	1
2	More than & Up to $> 2 < 5$	3
3	More than & Up to $> 5 < 10$	6
4	More than & Up to $> 10 < 15$	7
5	More than & Up to $> 15 < 20$	9
6	More than & Up to $> 20 < 25$	11
7	More than & Up to $> 25 < 30$	13
8	More than $> 30$	15

**NOTE:** The above permitted joints supersedes the maximum no. of joints given in clause no. 4.13 & 4.14 of SQP:ESP:284 Rev.01 Dtd.06.06.2007

3.1.8 The maximum number of permitted joints shall be as given below for **SS Liner sheets** applicable to ESP Lower hopper area;



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		<i>DT. 30.05.2013</i>

**3.2 ANGLES, CHANNELS, BEAMS (BOTH ROLLED / BUILT UP - INCLUDING NPB&UB) APPLICABLE TO ESP ROOF BEAMS & SUPPORTING COLUMNS 7X-X28 and 7X-X81, 82, 83 & 84**

- 3.2.1 The splicing norms for Angles, Channels and Beams (both rolled / built-up) shall be strictly followed as per the drawing no.1-79-081-02331 Rev.00.
- 3.2.2 Any change other than given in above referred drawing shall be approved by Engg (AQCS) and the request for the same shall be forwarded by cutting plan section of OS Dept.
- 3.2.3 Only one joint is permitted on the transverse roof beams.

**3.3 “ H “ BEAMS APPLICABLE TO CASING STRUCTURE COLUMNS – 7X-X48 (BOTH ROLLED / BUILT UP)**


- 3.3.1 The splicing norms for “H” Beams shall be strictly followed as per the drawing no. 4-79-000-00763 Rev.00.
- 3.3.2 Maximum two joints i.e., one for shop and another for site / field shall be permitted for a maximum length of 16.5 Mtr of section considering ODC constraints.
- 3.3.3 Joints on flange shall be staggered by minimum 300 mm avoiding falling of joint on the same side of the built up sections.
- 3.3.4 The splice plate provided for web joints shall not foul with the gusset plates provided on the “H” beams and a minimum clearance of 50 mm shall be maintained.
- 3.3.5 The minimum distance permissible between a joint and the nearest gusset / bracket location shall be 200mm.

**3.4 RODS, ROUNDS, PIPS AND TUBES**

- 3.4.1 No joint is permitted if the length of rod is 2 M or less.
- 3.4.2 Minimum length for splicing using sleeve shall be 500mm for tubes
- 3.4.3 Only one joint is permitted for Tie Rods / Strut

**4.0 EDGE PREPARATION, WELDING, WELD NDE DETAILS :**

- 4.1 Check for material specification of plates / sections which are to be joined to avoid mix up of material. TCN to be obtained for change of material.
- 4.2 Electrode selection shall be as per the respective WPS.

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		<i>DT. 30.05.2013</i>

- 4.3 Welding shall be followed with suitable methods of sequence and controls to minimize the weld distortion.
- 4.4 Weld over joint shall be avoided and minimum distance between stiffeners parallel to weld joint is 50mm.
- 4.5 Wherever, back grinding is not feasible due to location of the plate / sheet, root welding to be carried out with 3.15mm electrode and LPI to be carried out after thorough cleaning and repeat LPI after final welding.
- 4.6 Following are the guidelines for Edge Preparation (EP) if not specified in drawing;
- a) **Plates / Sheets up to 5mm** : No EP required. Provide 2 to 3 mm root gap, weld on both sides. MPI to be conducted after final welding.
  - b) **Plates of 6 mm** : No EP required. Weld shall be with square butt with 2 to 3 mm gap. Weld from first side and turn the plate for back grinding and conduct root LPI. Complete the weld and conduct the final MPI.
  - c) **Plates of 7 & 8 mm** : Single "V" , 60° EP, Weld from V side and turn the plate, back grind and conduct LPI, complete the Weld. Final MPI.
  - d) **Plates above 8 mm** : Double "V" , 60° EP, Weld one side, Carryout back grind and conduct LPI to ensure sound metal and weld from other side. Final both side MPI after completion of weld.
  - e) **For Structural (Angle, Channel, Beam)** : Single "V" , 60° EP, Weld from V side and back grind and conduct LPI. Complete the weld, conduct final LPI before splice plate setting.

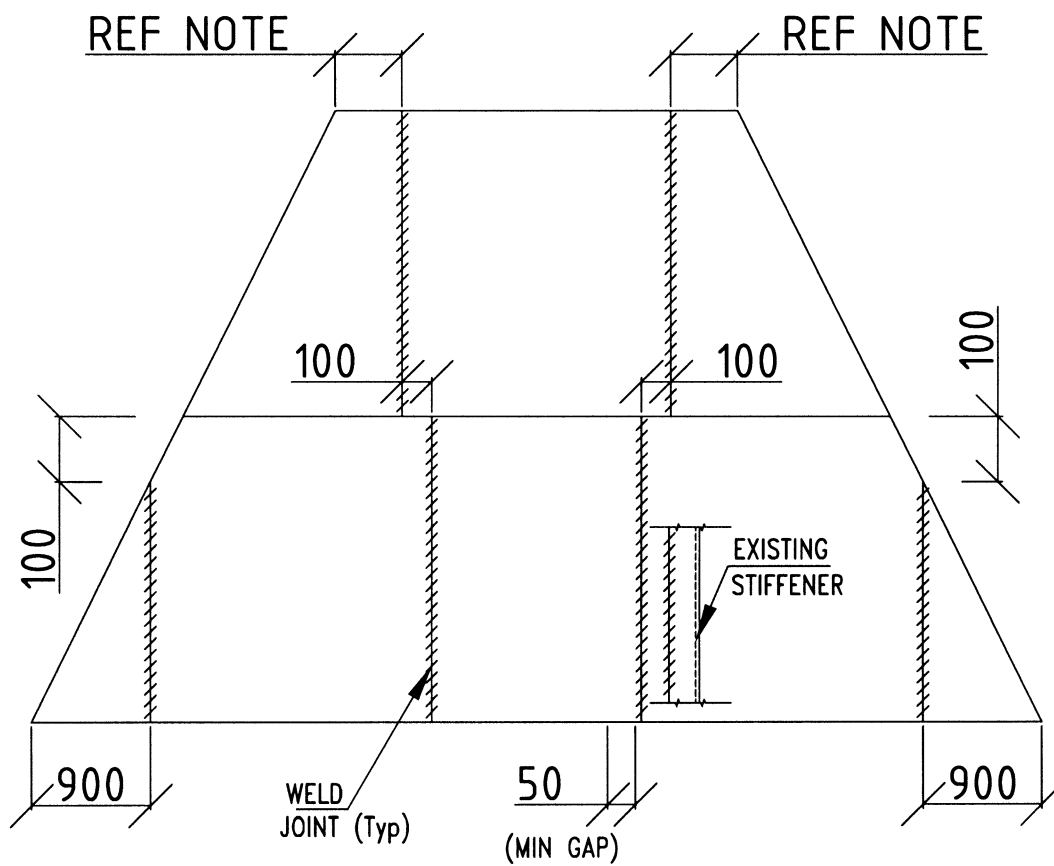
Note:

1. Splice plate details shall be taken from relevant fabrication Engg drawing.
2. Splice Joint shall be avoided where a cross member is meeting.
3. The weld should be ground flush and smooth and the proper splice plate is placed & welded.

!!!@@@###

QUALITY CONTROL PROCEDURE FOR SPLICING OF SHEETS,  
PLATES AND OTHER STRUCTURAL ITEMS

SKETCH FOR CLAUSES 3.1.2 TO 3.1.4



NOTE : MINIMUM DIMENSION OF SPLICED PLATE = 200 MM FOR  
DUCT WALL OF ANY SIZE




ALL DIMENSIONS ARE IN MM

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TIRUCHIRAPALLI 620 014  
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SIP:NP:06/01

PAGE : 1 Of 6

**PROCEDURE FOR VISUAL INSPECTION OF NON PRESSURE PARTS**

REV.	DATE	PREPARED	REVIEWED	APPROVED
00	15/07/96	P.S.Narayanan	A.R.Reddy	V.Raghavendran
01	28/03/04	 A Francis	 G S N Murthy	 C R Raju

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REVISION STATUS  
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REVISION NO:	CLAUSE NO	DETAIL OF REVISION
00	----	1) PR:QE:021/02 renumbered as SIP:NP:06.  2) Editorial corrections for clarity.  3) Clause 3.1 modified.
01	3.1	Code related change
	3.2	For better clarity
	3.2.1	-do-
	3.2.3	Code related change
	3.2.5	For better clarity
	4.4	Code related change

## 1.0 SCOPE

1.1 This procedure details out the visual inspection of all base metal surfaces and weld joints of Non pressure parts.

## 2.0 REFERENCE DOCUMENTS

AWS D 1.1 & Relevant drawings

## 3.0 VISUAL INSPECTION OF GAS CUT EDGES

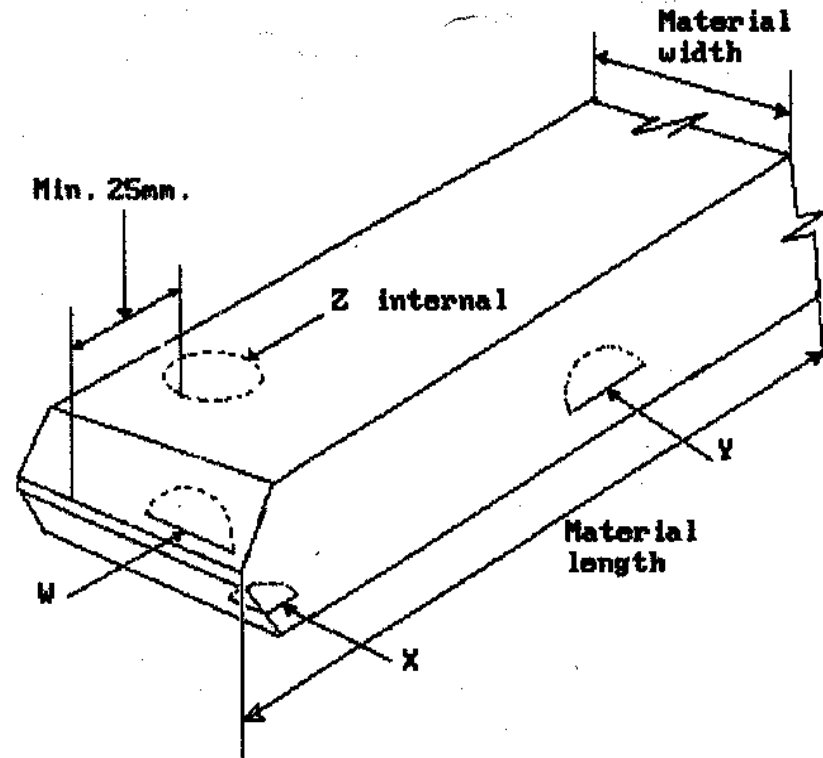
3.1 Acceptability and repair of mill induced laminar discontinuities in cut surfaces

Description of Discontinuity	Repair Required
Any discontinuity 25mm in length or less	No repair .
Any discontinuity over 25mm in length and 3mm max. depth (after grinding & confirmation of depth on 10% of total such locations)	No repair
Any discontinuity over 25mm in length with depth over 3mm but not greater than 6mm.	Remove by grinding and weld
Any discontinuity over 25mm in length with depth over 6mm but not greater than 25mm.	Completely remove and weld.
Any discontinuity over 25mm in length with depth greater than 25mm.	See Cl.3.2

3.2 For discontinuities over 25mm in length with depth greater than 25mm, discovered by visual inspection (and subsequent grinding for depth assessment) of plate cut edges/ bevel edges before welding or during examination of welded joints by radiography or ultrasonic inspection, following procedure shall be followed:

3.2.1 Prior to completing the weld joint, the discontinuities such as (W), (X) or (Y) shall be determined visually (for length) and by NDT (UT, and /or MPI) for depth and recorded for the size and shape of discontinuity as per Fig.1.

**Fig.1 EDGE DISCONTINUITIES IN CUT PLATE**



3.2.2 The repair of the discontinuity by welding shall be allowed in case area of discontinuity does not exceed 4% of the cut area with the following exceptions. If the width of the discontinuity or the aggregate width of discontinuities on any transverse section, as measured perpendicular to the plate length, exceeds 20% of the plate width, the limit of 4% area shall be reduced by percentage amount of the width exceeding 20% (e.g., if the discontinuity is 30% of plate width, the area of discontinuity cannot exceed 3.6% of the plate area). The discontinuity on the cut edge of the plate shall be gouged out to a depth of 25mm beyond its intersection of the surface by chipping, or carbon arc gouging, or grinding and blocked off by welding with manual shielded metal arc process in layers not exceeding 3mm in the thickness.

- 3.2.3 If discontinuity (Z) not exceeding the allowable area is discovered after the joint has been completed and is determined to be 25mm or more away from the face of the weld, as measured on the plate surface, no repair of discontinuity is required. If the discontinuity (Z) is less than 25mm away from the weld, it shall be gouged out to a distance of 25mm from the fusion zone of the weld by chipping, air carbon arc gouging or grinding. It shall then be blocked off by welding with low hydrogen SMAW process for at least four layers not to exceed 3mm thickness per layer. Submerged arc or other welding process may be used for remaining layers.
- 3.2.4 If the area of discontinuity (W), (X), (Y) or (Z) exceeds the allowable limits of Cl.3.2.2, the plate or sub-component shall be rejected.
- 3.2.5 The aggregate length of weld repair shall not exceed 20% of length of plate surface being repaired.

#### 4.0 VISUAL INSPECTION OF WELDS

- 4.1 Visual examination of welds shall be performed after completion of welding and subsequent cooling to room temperature. However for ASTM A514 and A517 steels visual examination of welds shall be performed only after 48 hours of completion of welding.
- 4.2 All welds shall be cleaned to remove slag, spatter etc. and visually examined for defects like crack, undercut, porosity, lack of fusion etc.
- 4.3 The welds shall also be examined for size, shape and reinforcement.

## 4.4 ACCEPTANCE CRITERIA AND DISPOSITION DETAILS ARE AS FOLLOWS

<u>Nature of defects</u>	<u>Acc. norms</u>	<u>Disposition</u>
1) Crack, Lack of fusion, Overlap	Not accepted	Confirm by LPI/MPI, repair and retest.
2) Crater (Except at the ends of stitch welds outside the required length)	Not accepted	Fill by weld deposit.
3) Undercut		
For T < 25.mm	Up to 1.0 mm accepted. (Upto 2.0 mm if within 50mm for any 300 mm weld Length.)	To be ground & merged/welded otherwise.
For T => 25.4 mm	Up to 2 .0 mm accepted.	>2.0mm to be ground and merged/welded
4) Porosity- Transverse Butt Welds	Piping porosity not permitted	
Porosity for other Butt/Fillet welds	One pore of <= 2.5 mm for Each 100 mm of Weld length is permitted. (*)	(*)Combined length of pores in fillet welds in web to stiffener: 10mm for 25 mm weld & 20mm for 300mm weld is however acceptable.
<u>Weld contour</u>		
1) Face of fillet	Flat or concave (meeting the throat) accepted. convexity is acceptable as below. 2mm for weld width <= 8mm 3mm for weld width > 8mm < 25 mm 5mm for weld width >= 25 m	
2) Size (Minimum)	As per drawing. Under size permitted as below (*) 2mm for nominal size < 5mm 2.5mm for nominal size 6mm 3mm for nominal size >= 8 mm * if undersized weld length is less than of 10% of the total weld length.	
3) Reinforcement (groove)	Max. 3 mm	

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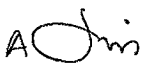

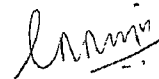


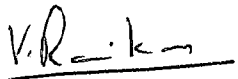
TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

QUALITY ASSURANCE

SIP: NP: 07/02

## WELDING/WELDER QUALIFICATION FOR STRUCTURAL APPLICATIONS

REV.	DATE	PREPARED	REVIEWED	APPROVED
00	15/07/96	P.S.Narayanan	A.R.Reddy	V.Raghavendran
01	13/10/03	 A Francis	 GSN Murthy	 C R Raju
02	25/11/09	 T. Palanisamy	 Bikramaditya Roy	 Ravikumar V

Revision no	Clause no	Revision details
00	--	--
01	--	1.PR:QE:172/00 Renumbered as SIP:NP:07 2.Editorial corrections for better clarity
02	--	1.Completely modified

## 1.0 SCOPE

1.1 This procedure details out the requirements of Welding procedure qualification/ Performance Qualification tests for welders and welding operators/ Welding procedure specification and maintenance of records for the same at sub Vendor works for structural application.

## 1.2 REFERENCE DOCUMENTS

1.2.1 AWS D1.1/D1.1M:2008.

## 2.0 WELDING PROCESS

- a. SMAW -Shielded Metal Arc Welding.
- b. SAW --Submerged Arc Welding.
- c. GMAW -Gas Metal Arc welding. (Note 1to3 to be strictly followed)

### #Note,

1. Prior approval for GMAW to be obtained from BHEL/quality.
2. Gas Mixture of 80% Argon & 20% CO2 to be ensured.
3. All Production welds shall be done inside the closed shed only.

## 3.0 WELDING PROCEEDURE QUALIFICATION

3.1 Prepare draft WPS and get it approved by BHEL WTC.

3.2 Consumable selected for draft WPS shall be as per BHEL approved brand.

3.2.1 All NDE and pre treatment for plate before/after cutting & during/ after welding shall be as per the respective QCP & SQP.

3.3 Test plate of size 180x380mm of Specified thickness-2 nos for all butt (fig 5), corner (Fig 9) & fillet (fig 2) weld joints.

3.4 Minimum procedure qualification test requirement for Structural Fabrication : Carbon Steel to IS 2062 E250 GR A OR B.

Sl. NO	Process	PL. thick	Pre-heat	PWHT	Type of Jt.	Test-position	Position qualified
1	SMAW	25mm	NIL	NIL	Groove butt weld	1G	1G,1F
2	SMAW	40mm	YES 100deg.C	NIL	Groove butt Weld	2G	1G,2G,1F,2F
3	SMAW	56mm	Yes 100deg.C	Yes	Groove Butt weld	1G	1G,1F
4	SMAW	10mm	NIL	NIL	Corner weld	3G	3G, 3F
5	SMAW	*	NIL	NIL	Fillet	3F	3F
6	SAW	25mm	NIL	NIL	Butt weld	1G	1G,1F
7	SAW	25	Yes 100deg.C	NIL	Butt weld	1G	1G & 1F
8	SAW	56mm	YES 100deg.C	NIL	Corner weld	1G	1G & 1F
9	SAW	*	NIL	NIL	Fillet	1F	1F
10	SAW	*	NIL	NIL	Fillet	1F	1F
11	GMAW	10mm	NIL	NIL	fillet	3F	1F
12	GMAW	10mm	NIL	NIL	Groove butt weld	2G	1G,2G,1F,2F

Note:

1.0 \* Ref fig 8 for size of test plates for fillet welds.

- 2.0 For all other material combinations separate procedure to the relevant code/standard shall be qualified before start of production welds.
- 3.0 SAW corner groove weld qualification with  $15^{\circ}+30^{\circ}$  groove angle (ref fig9) shall be done along with plate groove butt weld.
- 4.0 For pipe WPS qualification Dia. 2 inch of schedule 80 and 6 inch of schedule 120 are to be welded in 5G & 2G position respectively. This qualifies for all sizes, positions and unlimited thickness of pipes and tubes.

3.5 Base material other than Carbon steel, applicable welding process is SMAW only. In such cases PQR shall be qualified as per AWS D.1.1.

3.6 Test shall be done in presence of BHEL/ QC or BHEL nominated AIA.

4.0 **BASE MATERIAL.**

4.1 Test plate base material shall match with drawing or other engineering Documents.

4.2 Test plate weld surface shall be ground smooth and free from Oil & scales.

5.0 **WELDING REQUIREMENT**

5.1 Weld groove configuration and dimensions shall be as shown in the Draft WPS, drawing or Sketch authorized by engineering for processing.

5.2 All Procedure qualification and production welds of SAW process shall be done in 1G/1F position only.

5.3 Details of process and consumable used for welding such as Preheat, consumable size, brand name, AWS classification for electrode, Wire and flux, Shielding gas etc shall be recorded and maintained.

5.4 Details of the welding parameters Such as Welding current, voltage, travel speed, wire feed, shielding gas mixture & gas flow rate etc shall be recorded and maintained.

5.5 Details of number of layers and passes of groove or fillet welds (fig6) shall be recorded.

5.6 Back gouge/grind the second side as applicable and ensure weld soundness by MT/PT before second side weld.

5.7 Complete the weld and ensure weld soundness by applicable NDE (MT, PT, and RT or UT).

5.8 Necessary PWHT (as per draft WPS) shall be done before marking the test Specimen for mechanical test.

5.9 The defective portion of the welds in the test plate shall be discarded and not repaired

## 6.0 Test plate Specimen & test requirement:

6.1 Test Specimen for butt welded test plate as per fig 5 and Fillet/ corner welded test plate as per fig 7 shall be punched with inspecting engineer's stamp before cutting the test specimen. (No. of test specimen shall be as per table-2)

6.2 WPS test specimen requirement for mechanical test are as follows:

**Table 2**

Test pl. thickness & dia. In mm	Reduced Section tensile	Bend test $4t, 180^\circ$			Macro	thick qualified		Dia. Qualified
		Root	face	Side		Min.	Max.	
T 3 to 10	2	2	2	*	--	3mm	2T	--
T>10 T < 25	2	--	--	4	--	3mm	2T	--
T25 & over	2	--	--	4	----	3mm	Unlimited	--
Dia. 50 & t6	2	2	2	-	--	3mm	20mm	Dia.20-100
Dia. 150 t12	2	2	2	-	--	5mm	Unlimited	Dia.>100mm
Corner/ fillet weld	--	--	--	--	3	5mm	Unlimited	--

\*For 10mm plate or wall thickness, a side bend test may be substituted for each of the required face- and root- bend tests.

## 7.0 Mechanical test

7.1 Prepare the test specimen as per AWS D1.1 and move to BHEL Lab or NABL accredited lab for mechanical testing.

7.2 Mechanical test to be done in presence of BHEL/QC or BHEL nominated AIA.

## 8.0 Preparation of PQR & WPS

8.1 Generate qualified WPS and PQR (as per the format enclosed in page 9 and 10) indicating all process parameters, Mechanical/ NDE test results, reports as applicable and submit to inspection engineer for verification and approval.

## 9.0 Welder/ Welding operator qualification (WQ)

9.1 The welder/ welding operators engaged for procedure qualification tests are automatically qualified for production welding.

9.2 Test material: for carbon and alloy steel respective materials shall be used for test.

9.3 Test plate size: 200x200x25 mm or 200x200 and respective plate thicknesses.

9.4 WQ Test and production position qualified are as follows.

**Table 3.**

Weld type	Test Position	Production position qualified
Plate Groove	3G	1G, 2G, 3G, 1F, 2F & 3F
Plate groove	1G	1G & 1F
Plate fillet	1F	1F
Plate Fillet	3F	1F, 2F & 3F
Pipe Groove	2G & 5G	All position.
Pipe fillet	4F	1F, 2F & 4F

**Note:** Additional position can be qualified if required. Only qualified personnel shall be engaged in respective positions for production weld.

9.5 WQ Test requirement: Two Nos of side bend tests or 100% RT for butt welded test piece. Macro examination at three faces for fillet welds as per fig 7.

9.6 On successful test results WQR (as per the format enclosed in page 8) to be prepared & countersigned by inspection engineer and maintained for verification.

9.7 **WQ period of effectiveness:**

Qualification is effective unless : 1) The operator or welder is not engaged in welding for a period exceeding six months or unless 2) There is a specific reason to question his ability.

10 **Documentation:**

10.1 Prepare consolidated list of qualified WPS, Welder and Welding operator qualification records and maintain.

11 **Qualification-Types & Limitations**

11.1 Requalification of WPS is required in the following cases

S1. No	Welding variable	SMAW	SAW	GMAW
1.	Change from Low hydrogen to non low hydrogen electrode	Yes	--	--
2.	Change from wire & flux combination	--	Yes	--
3.	Change in nominal filler metal diameter by	>0.8mm	Increase	yes
4.	>7% Change in voltage each dia. used	--	Yes	Yes
5.	% change in travel speed	--	>15	>25
6.	Change in position qualified	Yes	Yes	Yes
7.	A decrease in Groove angle	Yes	Yes	Yes
8.	A decrease in Root gap	Yes	Yes	Yes
9.	An increase in root face	Yes	Yes	Yes
10.	Addition or deletion of PWHT	Yes	Yes	Yes

12 **PQR/ WPS requirement for Different strength Base materials**

12.1 For dissimilar composition of Low strength to high strength welded connections separate PQR and WPS shall be qualified.

12.2 In such cases Low hydrogen electrodes shall only be used. (Preheat, Post heat and PWHT as per applicable SQP and draft WPS).

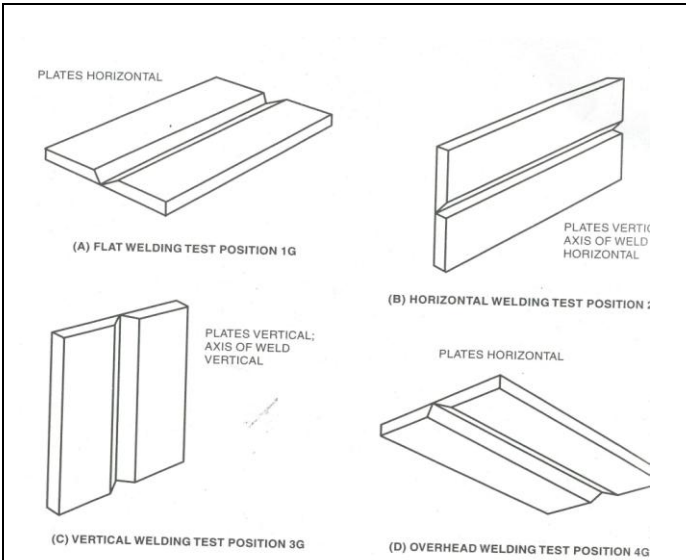


Figure 1

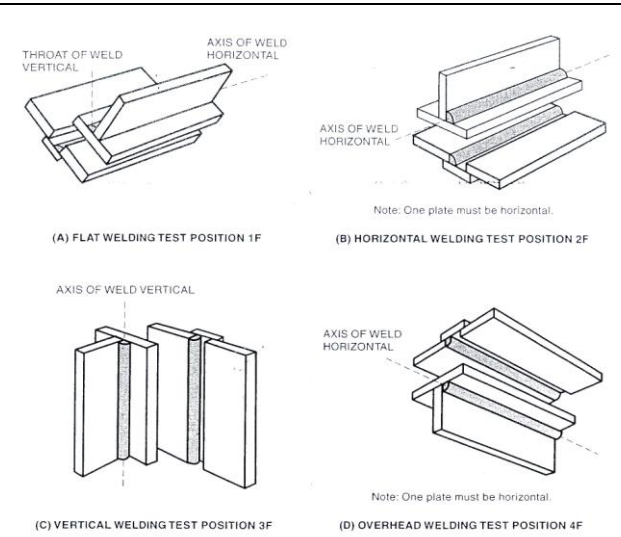


Figure 2

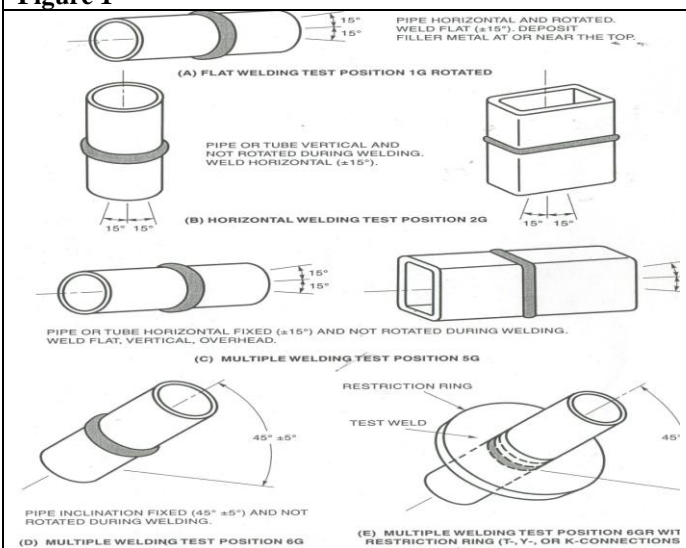


Figure 3

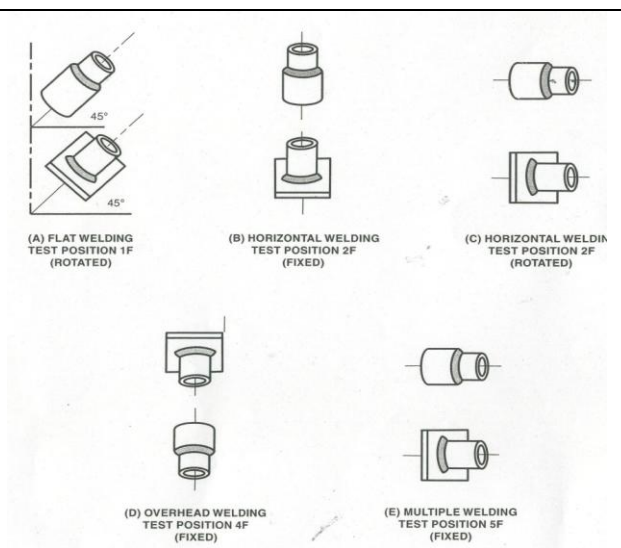


Figure 4

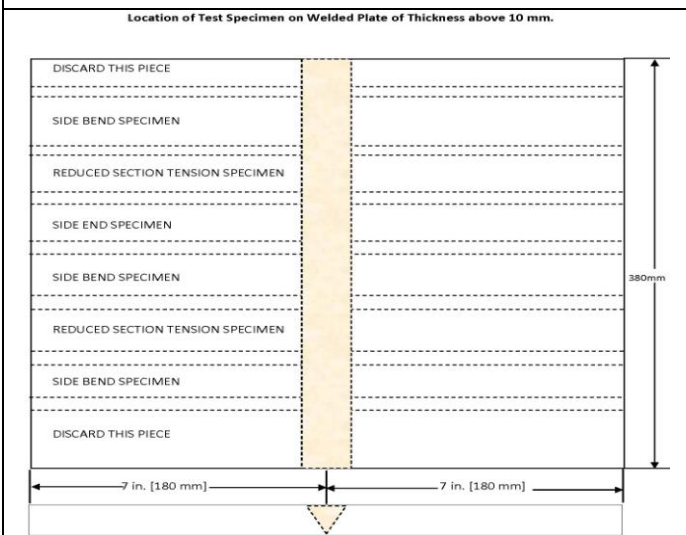
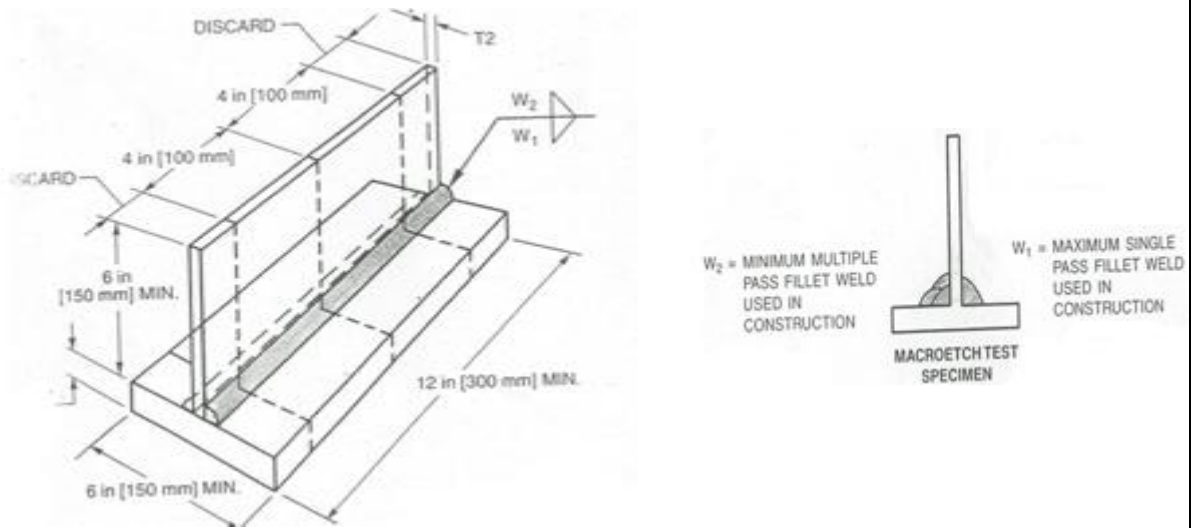


Figure 5

Fillet size	No. of layer	No. of Passes	Joint layer & passes
Up to 10mm	1	1	
12	1 2	1 2	
16	1 2 2	1 2 3	
20	1 2 3 3	1 2 3 4	
25	1 2 3 3 4 4 4	1 2 3 4 5 6 7	

Figure 6

**Figure 7 Fillet weld test specimen Details**

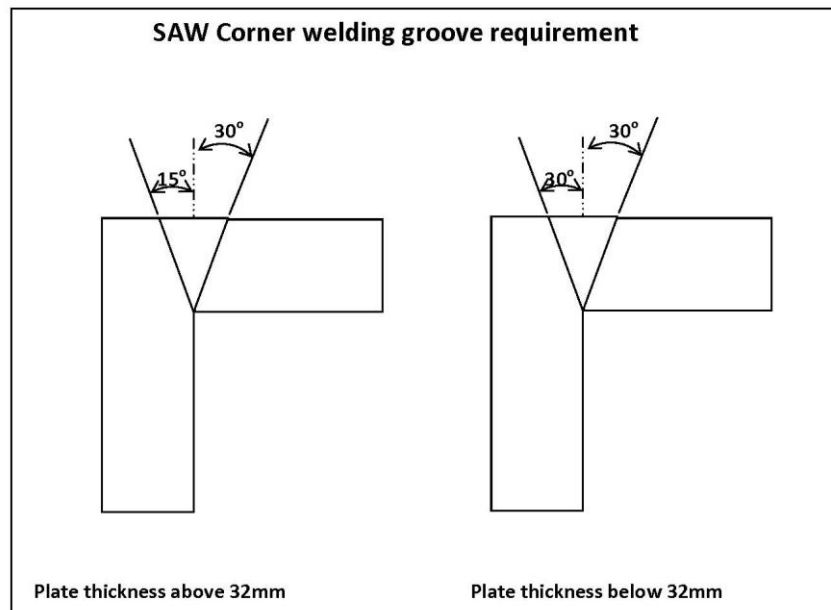


**Figure 8 Fillet weld Test plate Selection details**

Weld Size in mm	T1 minimum	T2 minimum
5	12	5
6	20	6
8	25	8
10	25	10
12	25	12
16	25	16
20	25	20
>20	25	25

Note: Where the maximum plate thickness used in Production is less than the value shown above, the Maximum thickness of the production plates may be Substituted for T1 & T2.

**Figure 9**



**WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD**

Type of Welder \_\_\_\_\_  
 Name \_\_\_\_\_ Identification No. \_\_\_\_\_  
 Welding Procedure Specification No. \_\_\_\_\_ Rev \_\_\_\_\_ Date \_\_\_\_\_

Variables	Record Actual Values Used in Qualification	Qualification Range
Process/Type [Table 4.12, Item (1)]	_____	_____
Electrode (single or multiple) [Table 4.12, Item (7)]	_____	_____
Current/Polarity	_____	_____
Position [Table 4.12, Item (4)]	_____	_____
Weld Progression [Table 4.12, Item (5)]	_____	_____
Backing (YES or NO) [Table 4.12, Item (6)]	_____	_____
Material/Spec.	to	_____
Base Metal	_____	_____
Thickness: (Plate)	_____	_____
Groove	_____	_____
Fillet	_____	_____
Thickness: (Pipe/tube)	_____	_____
Groove	_____	_____
Fillet	_____	_____
Diameter: (Pipe)	_____	_____
Groove	_____	_____
Fillet	_____	_____
Filler Metal (Table 4.12)	_____	_____
Spec. No.	_____	_____
Class	_____	_____
F-No. [Table 4.12, Item (2)]	_____	_____
Gas/Flux Type (Table 4.12)	_____	_____
Other	_____	_____

**VISUAL INSPECTION (4.8.1)**  
 Acceptable YES or NO \_\_\_\_\_

**Guided Bend Test Results (4.30.5)**

Type	Result	Type	Result

**Fillet Test Results (4.30.2.3 and 4.30.4.1)**

Appearance \_\_\_\_\_ Fillet Size \_\_\_\_\_  
 Fracture Test Root Penetration \_\_\_\_\_ Macroetch \_\_\_\_\_  
 (Describe the location, nature, and size of any crack or tearing of the specimen.)

Inspected by \_\_\_\_\_ Test Number \_\_\_\_\_  
 Organization \_\_\_\_\_ Date \_\_\_\_\_

**RADIOGRAPHIC TEST RESULTS (4.30.3.2)**

Film Identification Number	Results	Remarks	Film Identification Number	Results	Remarks

Interpreted by \_\_\_\_\_ Test Number \_\_\_\_\_  
 Organization \_\_\_\_\_ Date \_\_\_\_\_

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (\_\_\_\_\_) *Structural Welding Code—Steel*.  
 (year)

Manufacturer or Contractor \_\_\_\_\_ Authorized By \_\_\_\_\_  
 Form N-4 Date \_\_\_\_\_

**WELDING PROCEDURE SPECIFICATION (WPS) Yes**   
**PREQUALIFIED \_\_\_\_\_ QUALIFIED BY TESTING \_\_\_\_\_**  
**or PROCEDURE QUALIFICATION RECORDS (PQR) Yes**

Company Name \_\_\_\_\_  
 Welding Process(es) \_\_\_\_\_  
 Supporting PQR No.(s) \_\_\_\_\_

Identification # \_\_\_\_\_  
 Revision \_\_\_\_\_ Date \_\_\_\_\_ By \_\_\_\_\_  
 Authorized by \_\_\_\_\_ Date \_\_\_\_\_  
 Type—Manual  Semiautomatic   
 Machine  Automatic

**JOINT DESIGN USED**

Type:  
 Single  Double Weld   
 Backing: Yes  No   
 Backing Material: \_\_\_\_\_  
 Root Opening \_\_\_\_\_ Root Face Dimension \_\_\_\_\_  
 Groove Angle: \_\_\_\_\_ Radius (J-U) \_\_\_\_\_  
 Back Gouging: Yes  No  Method \_\_\_\_\_

**POSITION**

Position of Groove: \_\_\_\_\_ Fillet: \_\_\_\_\_  
 Vertical Progression: Up  Down

**BASE METALS**

Material Spec. \_\_\_\_\_  
 Type or Grade \_\_\_\_\_  
 Thickness: Groove \_\_\_\_\_ Fillet \_\_\_\_\_  
 Diameter (Pipe) \_\_\_\_\_

**ELECTRICAL CHARACTERISTICS**

Transfer Mode (GMAW) Short-Circuiting   
 Globular  Spray   
 Current: AC  DCEP  DCEN  Pulsed   
 Power Source: CC  CV   
 Other \_\_\_\_\_  
 Tungsten Electrode (GTAW)  
 Size: \_\_\_\_\_  
 Type: \_\_\_\_\_

**FILLER METALS**

AWS Specification \_\_\_\_\_  
 AWS Classification \_\_\_\_\_

**TECHNIQUE**

Stringer or Weave Bead: \_\_\_\_\_  
 Multi-pass or Single Pass (per side) \_\_\_\_\_  
 Number of Electrodes \_\_\_\_\_  
 Electrode Spacing Longitudinal \_\_\_\_\_  
 Lateral \_\_\_\_\_  
 Angle \_\_\_\_\_  
 Contact Tube to Work Distance \_\_\_\_\_  
 Peening \_\_\_\_\_  
 Interpass Cleaning: \_\_\_\_\_

**SHIELDING**

Flux \_\_\_\_\_ Gas \_\_\_\_\_  
 Composition \_\_\_\_\_  
 Electrode-Flux (Class) \_\_\_\_\_ Flow Rate \_\_\_\_\_  
 Gas Cup Size \_\_\_\_\_

**PREHEAT**

Preheat Temp., Min. \_\_\_\_\_  
 Interpass Temp., Min. \_\_\_\_\_ Max. \_\_\_\_\_

**POSTWELD HEAT TREATMENT**

Temp. \_\_\_\_\_  
 Time \_\_\_\_\_

**WELDING PROCEDURE**

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			

**Procedure Qualification Record (PQR) # \_\_\_\_\_**

**Test Results**

**TENSILE TEST**

Specimen No.	Width	Thickness	Area	Ultimate Tensile Load, lb	Ultimate Unit Stress, psi	Character of Failure and Location

**GUIDED BEND TEST**

Specimen No.	Type of Bend	Result	Remarks

**VISUAL INSPECTION**

Appearance \_\_\_\_\_  
 Undercut \_\_\_\_\_  
 Piping porosity \_\_\_\_\_  
 Convexity \_\_\_\_\_  
 Test date \_\_\_\_\_  
 Witnessed by \_\_\_\_\_

**Radiographic-ultrasonic examination**

RT report no.: \_\_\_\_\_ Result \_\_\_\_\_  
 UT report no.: \_\_\_\_\_ Result \_\_\_\_\_

**FILLET WELD TEST RESULTS**

Minimum size multiple pass	Maximum size single pass
Macroetch	Macroetch
1. _____ 3. _____	1. _____ 3. _____
2. _____	2. _____

**Other Tests**

**All-weld-metal tension test**

Tensile strength, psi \_\_\_\_\_  
 Yield point/strength, psi \_\_\_\_\_  
 Elongation in 2 in, % \_\_\_\_\_  
 Laboratory test no. \_\_\_\_\_

Welder's name \_\_\_\_\_

Clock no. \_\_\_\_\_ Stamp no. \_\_\_\_\_

Tests conducted by \_\_\_\_\_ Laboratory

Test number \_\_\_\_\_

Per \_\_\_\_\_

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (\_\_\_\_\_) *Structural Welding Code—Steel* (year)

Signed \_\_\_\_\_  
 Manufacturer or Contractor

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

SHARAT HEAVY ELECTRICALS LTD  
BOILER AUXILIARIES PLANT  
KANIPET-632 406 (INDIA)  
QUALITY ASSURANCE DEPT.

STANDARD QUALITY PLAN FOR WELDING

MASTER COPY

Q.P.No. SQM/01  
REV.No. NIL  
DATE 10-06-93  
PAGE 01 of 02

PREPARED BY: *V. Jayaram*

REVIEWED BY: *M. Tamil*

APPROVED BY: *M. Tamil*

No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
2	3	4	5	6	7	8	9	10	11	
1	WELDING ELECTRODE/FLUXES	CHEMISTRY	M	LAB TEST	EACH BATCH	AWS A5.1, 5.7 5.5, 5.17 or 5.18	AWS A5.1.5.5 5.7, 5.17 or 5.18	TC	SUPPLIER	*T.C's WILL BE MAINTAINED BY WTC
2	STORAGE OF ELECTRODES/FLUXES IN STORES	METHOD OF STORAGE	MAJOR	VISUAL	100%	AS PER AWS 5.8, 5.17	A5.1, 5.5, 5.18 etc		STORES WTC	
3	ISSUE CONTROL	METHOD OF ISSUE	MAJOR	WQR	10%	AS PER WTC	DP&DI		WTC	
4	WELDER QUALIFICATION	WQR	MAJOR	LIST OF QUALIFIED WELDERS IN PRODN BAYS TO BE CHECKED	100%				WTC	VERIFICATION OF RECORD i.e, WQR
5	PROCEDURE QUALIFICATION	WPS	MAJOR	WPS TO BE VERIFIED FOR THE PARTICULAR MATL.COMBINATION	100%		ONLY THE QUALIFIED/PRE-QUALIFIED PROCEDURE FOR PARTICULAR MATERIAL COMBINATION AND POSITION METHOD SHALL BE USED		LIST OF QUALIFIED WELDER WTC	VERIFICATION OF RECORDS i.e, WPS
6	BAKING & DRYING OF LOW H2 ELECTRODES	DRYNESS OF LOW HYDROGEN ELECTRODES	MAJOR	VISUAL	RANDOM	WTC I:002/REV 02 DT.15.7.93 AWS D.1.1 (LATEST)			LOG BOOK WTC	VERIFICATION OF RECORDS AT RANDOM

STANDARD QUALITY PLAN FOR  
WELDING

Q.P. SQW01  
REV. NO. NIL  
DATE 10.06.93  
PAGE 02 OF 02

1	2	3	4	5	6	7	8	9	10	11
7	PREHEAT, INTER PASS HEAT POST HEATING	TEMPERATURE OF JOB	MAJOR	BY THERMAL CHALK	RANDOM	PR:QA:/WPS/ OPS AND APPLICABLE	COLOUR CHANGE TO INDICATE CORRECT TEMP		PRODN/ QC	WITNESS AT RANDOM
8	ROOT WELDING OTHER WELDING	QUALITY OF WELD, INTER PASS CLEANING WIRE BRUSHING GRINDING	MAJOR	VISUAL	RANDOM	AS PER APPLI CABLE WPS, OPS, QCP, PR:QA	NO CRACKS ALLOWED		PRODN/ QC	WITNESS WELD REINFORCEMENT WELD UNDERCUT STANDARD REF. OF INSTRUMENT USED
9	NDE	QUALITY OF WELD	MAJOR	UT, RT PT, MT	AS PER APPLICABLE WI	AS PER APPLICABLE WORK INSTRUCTIONS		HC	QC	WITNESS
10	FILLET SIZES OF FILLET WELD	SIZE OF WELD	M	FILLET GAUGE CHECK	100%	AS PER DRAWING		HC	QC	WITNESS
11	POST WELD HEAT TREATMENT	CORRECTNESS OF SRT CYCLE	C	VERIFICA TION OF CYCLE AS PER PRODUCT HT CYCLE FROM HT SCHEDULE HT:001	100%	TEMPERATURE AT WHICH JOB LOADED IN FURNACE HEAT ING RATE SOAKING RATE SOAKING TIME COOLING RATE TEMPERATURE TO WHICH JOB TO BE FURNACE COOLED	AS PER SRT CYCLE IN HT:001 FOR THE PARTICULAR COMPONENT	HC	PRODN/ QC	VERIFICATION HT CYCLE

Bharat Heavy Electricals Ltd. Logo		STANDARD QUALITY PLAN				NAME OF THE CONTRACT & PACKAGE				
BHARAT HEAVY ELECTRICAL LTD. BOILER AUXILIARIES PLANT RANIPET-632 406		ITEM : PENTHOUSE VENTILATION FAN / SEAL AIR FAN		QP NO.: FAN :304 REV.NO.: 01 DATE: 11.09.2013 PAGE: 1 OF 4		STANDARD				
Sl. NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE STANDARDS	ACCEPTANCE STANDARDS	FORMAT OF RECORDS		REMARKS
								M	B	
1	2	3	4	5	6	7	8	9	10	11

1.0	Material	Chem & Mech Properties & Internal Soundness	Major	Chem, Tensile	Melt wise	Respective Material Standard	Respective Material Standard	TC	P	V	**Only indications corresponding to Equivalent Reflector size of 3 mm or less is acceptable by DGS method.
1.1.1	Raw Material Shaft (if applicable)		Major	UT	-DO-	ASTM A388	ASTM** 388	TC	P	P	@ UT shall be done for plates more than 12 mm thick to ASTM A435.
1.1.2	Plates for Impellers	-DO-	Major	Chem, Tensile	Melt wise	Respective Material Standard	Respective Material Standard	TC	P	V	
1.1.3	Plates for Spiral casing	-DO-	Major	UT @	-DO-	ASTM A435	ASTM A435	TC	P	V	
1.1.4	Bearing Housing (if applicable)	Chem & Mech Properties	Major	Chem & Tensile	-DO-	-DO-	-DO-	TC	P	V	

LEGEND:		Prepared By:		Approved By:	
M: Manufacturer	Ram Manoj Chhipa	QA		J. Ravisankar	
B: BHEL/Authorized inspection agency	R Arunachalam	QA			
P: Performed By, W: Witness by					
V: Verified By, TC : Test Certificate					

Bharat Heavy Electricals Ltd. Logo		STANDARD QUALITY PLAN				NAME OF THE CONTRACT & PACKAGE					
Bharat Heavy Electricals Ltd. Boiler Auxiliaries Plant Ranipet-632 406		ITEM : PENTHOUSE VENTILATION FAN / SEAL AIR FAN				STANDARD					
Ranipet-6		QP NO.: FAN :304 REV.NO.: 01 DATE: 11.09.2013 PAGE: 2 OF 4									
Sl NO	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Standards	Acceptance Standards	Format of Records	M	B	Remarks
1	2	3	4	5	6	7	8	9	10**		11
1.2	Bought out items										
1.2.1	Motor	Type & routine test	Major	performance parameters	100%	PR:QA:550 /Latest ##	PR:QA:550 /Latest##	Report	P	V	##Motor capacity less than 30KW.
2.0	In process Inspection		Major	performance parameters	100%	SQP:QP:E:813 /Latest@@	SQP:QP:E:813 /Latest@@	Report	P	V	@@Motor capacity 30 to 200 KW.
2.1	Impeller welds	Weld size	Major	Visual	100%	Drawing	Drawing	Report	P	V	Welders and Weld procedures for rotating parts shall be qualified as per ASME Sec IX.
2.2	Impeller Machining	Impeller bore	Major	MPI / LPI	100%	ASME SEC V Article-7 ASME SEC V Article-6	ASME SEC VIII-DIV-1,Appendix-6 ASME SEC VIII-DIV-1,Appendix-8	Report	P	V	Welders and Weld procedures For static parts shall be qualified as per AWS D1.1
2.3	Casing Fabrication	Overall dimensions	Major	Measurement	100%	Drawing	Drawing	Report	P	V	

LEGEND:  
M: Manufacturer  
B: BHEL/Authorized inspection agency  
P: Performed By, W: Witness by  
V: Verified By, TC: Test Certificate

Prepared By:  
Ram Manoj Chhipa

Reviewed By:  
R Arunachalam

QA

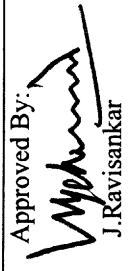
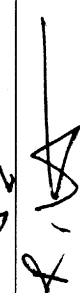
QA


*(Signature)*

A. A.

Approved By:  
*(Signature)*  
J. Ravisankar

SL NO		COMPONENT & OPERATION		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE STANDARDS		ACCEPTANCE STANDARDS		FORMAT OF RECORDS		NAME OF THE CONTRACT & PACKAGE					
																		M	B	REMARKS			
1		2		3		4		5		6		7		8		9		10		11			
2.4		Dynamic balancing		Impeller		Unbalancement Compensation		Major		Dynamic balancing		ISO1940		ISO1940 Gr2.5		Report		P		V		*Tolerance for performance test Volume -5% Efficiency -3% power +10%	
2.5		Performance testing		Parameters Like Efficiency Power, noise, Vibration, Brg temperature, Noise		Major		Measurement		One of each type		BS 848 Engg spec		*BS 848 & Engg spec.		Report		P		W		1. # Motor casing Temperature at the drive and Non drive end (not exceed 75 deg C). 2. @ Vibration at the motor drive end, Non drive end and pedestal (Satisfactory level as per VDI 2056 Group T). 3. \$\$ Noise level limited to 85 dBA	
2.6		Run test		Motor casing Temperature#, Vibration @, Noise level\$\$ (Duration of Test Min. 2 Hours)		Major		Measurement		100%		BHEL:TFN: PHVF:REV:01 DT: 29.11.2007		BHEL:TFN: PHVF:REV:01 DT: 29.11.2007		Report		P		W			
3.0		Identification painting and packing		Painting & preservation		100%		Visual		100%		Customer approved painting schedule/ PRQA:590 (Latest)		Customer approved painting schedule/ PRQA:590 (Latest)		Report		P		W			


LEGEND: M: Manufacturer B: BHEL/Authorized inspection agency P: Performed By, W: Witness by V: Verified By, TC: Test Certificate	Prepared By: Ram Manoj Chhipa	QA	Approved By:  J. Ravisankar
	Reviewed By: R Arunachalam	QA	

		<b>BHARAT HEAVY ELECTRICAL LTD. BOILER AUXILIARIES PLANT RANIPET-632 406</b>				<b>STANDARD QUALITY PLAN</b>				<b>NAME OF THE CONTRACT &amp; PACKAGE</b>			
<b>Ranipet-6</b>		<b>ITEM : PENTHOUSE VENTILATION FAN / SEAL AIR FAN</b>		<b>QP NO.: FAN :304 REV.NO.: 01 DATE: 11.09.2013 PAGE: 4 OF 4</b>		<b>STANDARD</b>							
Sl. NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE STANDARDS	ACCEPTANCE STANDARDS	FORMAT OF RECORDS	M	B	REMARKS		
1	2	3	4	5	6	7	8	9	10**	10	11		

**Note:** Where ever Raw materials TC is not available the same shall be tested in approved laboratories and TC shall be produced.

**Record of Revisions**

	Clause 1.1.2	ASTM A 388	ASTM A435									
	Clause 1.2.1	PRQA:502/ Latest	PR:QA:550/ Latest SQP:QP:E:813/ Latest									
2	11.09.2013	ASME SEC VIII	ASME SEC V									
	Clause 2.1	Run test details not available	Temperature, Vibration & Noise level details furnished.									
	Clause 2.5	PO Spec/ Drawing	Customer approved painting schedule/ PRQA:590 (Latest)									
1	29.10.2001	Original submission										
Sl. No.	Date	Revised Clause	Existing Details (Rev 00)	Revised Details (Rev 01)								

<b>LEGEND:</b> M: Manufacturer B: BHEL/Authorized inspection agency P: Performed By, W: Witness by V: Verified By, TC : Test Certificate	Prepared By: Ram Manoj Chhipa	QA	Approved By:  J. Ravisankar
	Reviewed By: R. Arunachalam	QA	

BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RAMIPET-632 406 (INDIA) QUALITY ASSURANCE DEPT.	QUALITY CONTROL PLAN FOR SEAL AIR FAN	NAME OF CONTRACT PACKAGE STANDARD	OP.NO.FAN306 REV.No.01 DATE:100694 PAGE 1 of 04
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PREPARED BY: *gony* REVIEWED BY: *B. Srinivasulu* APPROVED BY: *HA*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
	MATERIAL MATERIAL FOR ROTATING PARTS									
	SHAFT	CHEM & MECH. PROPERTIES	MAJOR	REVIEW OF TEST CERTIFICATES	100%	RESPECTIVE MATERIAL SPECIFICATION	TC	QC-PROCUREMENT		
	FORGINGS	-DO-	MAJOR	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	
	BRG. HOUSING	-DO-	MAJOR	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	
	PLATES FOR IMPELLER	-DO-	MAJOR	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	
	SUB DELIVERIES									
	MOTOR	ROUTINE/TYP TEST	MAJOR	-DO-	100%	PURCHASE SPECIFICATION	-DO-	SUPPLIER		
	COUPLINGS	(1) DIMENSIONS	MAJOR	MEASUREMENT	100%	-DO-	-DO-	-DO-		
		(2) DYNAMIC BALANCING	MAJOR	BALANCING	100%	-DO-	-DO-	-DO-		
	BEARINGS	COMPLIANCE WITH PURCHASE ORDER	MAJOR	REVIEW OF TCS & VISUAL INSPECTION OF BEARINGS	100%	PURCHASE ORDER	-DO-	-DO-		

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## STANDARD QUALITY CONTROL PLAN FOR

SEAL AIR FAN

QP.NO.FAN306

REV.NO.01

DATE:100694

PAGE:02 OF 04

1	2	3	4	5	6	7	8	9	10	11
2.0.	INPROCESS CONTROL									
2.1.	SHAFT	JOURNAL DIA LENGTHS, SIZE OF KEY WAY &OFFSET	MAJOR	MEASURE- MENT	100%	DRAWING	DRAWING	DR	SUBCONT- RACTOR	
2.2.	IMPELLER	BORE DIA & KEY WAY SIZE &OFFSET	MAJOR	-DO-	100%	DRAWING	DRAWING &NOTE 2	-DO-	-DO-	
2.3.	BLADES & IMPELLER RING	SHAPE & PROFILE	MAJOR	CHECK WITH TEMPLATE	100%	DRAWING	DRAWING &NOTE 2	-DO-	-DO-	
2.4.	BRG.HOUSING & COVER	1)BORE 2)LENGTH	MAJOR	-DO-	100%	DRAWING	DRAWING	-DO-	-DO-	
2.5.	WELD QUALITY	EXTERNAL FINISH&SIZE BUTT WELDS OF IMPELLERS FILLET WELDS FOR IMPELLERS AFTER STRESS RELIEF	MAJOR	VISUAL& MEASURE- MENT CRIT- ICAL CRIT PT/MT	100%	DRAWING	DRAWING &NOTE 1 &2 BHE:NDT:RP:MT1/LATEST BHE:NDT:RP:MT1/LATEST BHE:NDT:RP:PT1/LATEST	-	-DO-	-DO- * MT FROM BOTH SIDES OF COVER PLATE -DO- -DO-
2.6.	STRESS RELIEF OF IMPELLERS	COMPLIANCE TO STRESS RELIEF CYCLE	MAJOR	TIME&TEMP CHART VERIFI- CATION	100%	BAP:HT:001/LATEST		HEAT TREATMENT CHART	-DO-	




1 2 3 4 5 6 7 8 9 10 11

- NOTE 1: 1) WELDERS SHALL BE QUALIFIED AS PER AWS D1.1. /ASME SECTION IX /LATEST
- 2) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs AT 350 DEG C' AND DRIED AT 150 DEG C' BEFORE WELDING.
  - 3) ELECTRODES OPENED TO ATMOSPHERE MORE THAN 4 Hrs SHALL BE REBAKED
  - 4) SEQUENCE OF WELDING SHALL BE ADOPTED
  - 5) FULL PENETRATION WELD SHALL BE ENSURED BY BACK CHIPPING
  - 6) DEFECTS LIKE CRACKS, POROSITY, UNFUSED METAL, SHALL BE REMOVED WHILE WELDING
  - 7) WELD SHALL BE FREE FROM OIL GREASE, RUST ETC. & CRATER TO BE REMOVED
  - 8) THE TOES OF THE FILLET WELDS SHALL BE SMOOTHLY GROUND FOR THE LENGTH AS SHOWN IN THE DRG.
  - 09) BUTT WELDS SHALL BE GROUND FLUSH.
  - 10) TACKS AND BRIDGES SHALL BE REMOVED BY CHIPPING
  - 11) NO JOINT IS ALLOWED ON THE BACK PLATE OR IMPELLER RING'


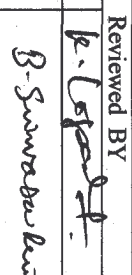

- NOTE 2: 1) PLATES CUT BY FLAME SHALL BE CLEANED TO REMOVE SLAG & UNEVEN EDGES
- 2) GAS CUT NOTCHES SHALL BE FILLED BY WELDING .

- NOTE 3: 1) THE IMPELLERS SHALL BE PAINTED AND PUNCHED WITH FOLLOWING DETAILS
- WORKORDER NO, DU NO, SLNO & SUBCONTRACTOR CODE . DIRECTION OF ROTATION OF IMPELLER SHALL BE
- 014 IMPEL
- 2) SHAFTS SHALL BE PUNCHED WITH ABOVE DETAILS ON BOTH FACES

\*\*\*\*\*

<b>MANUFACTURER'S NAME</b> BHEL Ranipet -632 406		<b>ITEM/SUB SYSTEM:</b> FAN/BLOWER		<b>MANUFACTURING QUALITY PLAN</b>		<b>PROJECT &amp; PACKAGE :</b> STANDARD			
 Ranipet				<b>QP: NO: FAN 316</b> <b>RVE NO: 00</b> <b>DATE : 10 11 05</b> <b>PAGE : 1 OF 3</b>					
<b>Sl no</b>	<b>Component &amp; operation</b>	<b>Characteristics</b>	<b>Type Of Check</b>	<b>Quantum of Check</b>	<b>Reference Documents</b>	<b>Acceptance Norms</b>	<b>Format Of Records</b>	<b>Agency</b>	<b>Remarks</b>
1	2	3	4	5	6	7	8	9 M S B	10

1.0	<b>Material</b>								
1.1	Sheets /plates & forgings	Chemical, mechanical	Chemical & Mechanical.	100%*	Respective material spec./Approved drg		TC	P V V	*Incase manufacturers TC not available sample as per governing spec./std. shall be tested at approved lab.
1.2	AC Motor	Performance	Routine test	100%	P. O Spec/approved data sheet		TC	P V V	@ defects like pin hole under cuts, cracks & liner indication are not acceptable.
2.0	<b>In process inspection</b>								
2.1	<b>Welding \$</b>	Weld size & finish	Visual	100%	Approved deg		Report	P W	\$welders and weld procedures shall be qualified to ASME sec IX /for. rotating parts and AWS D.1.1. for static parts. WPS/PQR will be verified by BHEL
2.1.1	<b>Impeller</b>	Weld soundness @	PT@	100%	ASME E 165		Report	P W V	
2.2	<b>Dimensions</b>	Dimensional	Measurement	100%	Approved drawing		Report	P W V	
2.2.1	<b>Casing</b>	Dimensions	-do-	100%	-do-		Report	P W V	
2.2.2	<b>Impeller</b>								

<b>M - Manufacturer / sub-supplier</b> <b>B - BHEL /BHEL Authorized Inspection Agency,</b> <b>S - Supplier r, P - perform,</b> <b>V - Verification of reports</b> <b>W - Witness, TC - Test certificate</b> <b>DR - Dimensional report.</b>		<b>Prepared BY</b>	<b>Reviewed BY</b>	<b>Approved BY</b>
				
		Engg	B-Sunderbar	
		QA		

MANUFACTURER'S NAME		ITEM/SUB SYSTEM:		MANUFACTURING QUALITY PLAN			PROJECT & PACKAGE :		
BHEL Ranipet -632 406		FAN/BLOWER		QP: NO: FAN 316			STANDARD		
Ranipet				RVE NO: 00			DATE : 10 11 05		
				PAGE : 2 OF 3					
Sl no	Component & operation	Characteristics	Type Of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency	Remarks
1	2	3	4	5	6	7	8	9	10
								M S B	

2.3	<b>Dynamic balancing</b>								
2.3.1	Impeller	Residual Unbalance	Unbalance compensation	100%	Approved drg/data sheet & Po Spec.		Report	P W V	# Vibration shall be satisfactory to VDI 2056
3.0	<b>Final inspection</b>								
3.1	Assembly of fan with motor.	Dimensional	Measurement	100%	Approved drg		Inspection report	P W W	• Group 'G' Noise level shall be within 85 DBA at 1 meter
3.2	Performance test for FAN with motor	Capacity, static pressure, speed, power consumption, efficiency & noise level & vibration #	Performance check	1 No of each model	Approved drg, Approved Data sheet Po Spec. & IS : 4894		Performance test result, sample calculation performance curves	P W W	distance in horizontal & 1.5m distance in vertical.

M - Manufacturer / sub-supplier	Prepared BY		Reviewed BY		Approved BY	
B - BHEL /BHEL Authorized Inspection Agency,	Engg		B. Sankarabharathi		W. Sankarabharathi	
S - Supplier 'r, p - perform,	QA					
V - Verification of reports						
W - Witness, TC - Test certificate						
DR - Dimensional report.						



MANUFACTURER'S NAME

BHEL Ranipet -632 406

MANUFACTURING QUALITY PLAN

PROJECT & PACKAGE :  
STANDARD

ITEM/SUB SYSTEM:  
FAN/BLOWER

QP: NO: FAN 316  
RVE NO: 00  
DATE : 10 11 05  
PAGE : 3 OF 3

Sl no	Component & operation	Characteristics	Type Of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency			Remarks
								9	M	S	
1											

3.3	Run test for FAN With motor	Mechanical run test for vibration\$ Bearing temperature rise, any abnormalities.		100%	Approved drg. PO spec, Approved data sheet & IS 4894	Report	P	W	W	
4.0	Final	Identification, Painting & preservation	visual	100%	Respective Po Spec & Note -2	Report	P	W		

Note 1

- Materials shall be as per approved drg./data sheet/P.O spec.
- Forgings dia more than 63 mm shall be of UT quality as per ASTM A 388 & acceptance Norms 3 mm equivalent reflector size by DGS method.
- Motor inspection testing requirements shall be as in P.O/PO spec./approved drawing/data sheet if same is called in P.O/Po Spec.
- All the requirements of P.O spec shall be verified for the compliance.
- Painting shall be as given below, if no painting is called in PO/PO spec./approved drg.

Note-2

PAINTING

- Surface preparation: by power tool cleaning
- Primer : one coat of red oxide zinc chrome primer to IS 2074 ( DFT 25 microns)
- Finish paint : one coat of synthetic enamel paint to IS 2932 to shade no 692 of IS-5( DFT 20microns)
- Machined surfaces shall be applied with one coat rust preventive fluid. Galvanized surfaces, Aluminum need not be painted.

M - Manufacturer / sub-supplier B - BHEL /BHEL Authorized Inspection Agency, S -Supplier r, P - perform, V - Verification of reports W - Witness, TC - Test certificate DR - Dimensional report.	Prepared BY		Reviewed BY		Approved BY
		Engg	QA	B. Suresh Kumar	B. Suresh Kumar

**QUALITY DEPARTMENT**

**AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )**

QWI NO: SQP:FAN: 317  
AMENDMENT NO. A 2

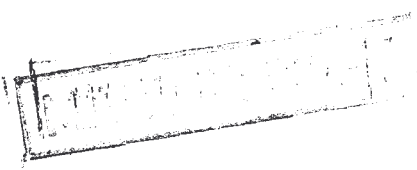
**REV: 04**

DATE : 1108 97  
DATE : 27 12 2000

**DESCRIPTION: RADIAL FAN IMPELLER ASSY**

**DETAILS**

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT/REMARKS						
2.1.6	<p><b>BELL MOUTH IMPELLER COVER PLATES</b></p> <p><b><u>ROLLING/PRESSING OF INDIVIDUAL PARTS</u> : PROFILE SHALL BE CHECKED WITH TEMPLATE AS PER DRG.</b></p> <p><b><u>WELDING</u>: WEDING SHALL BE DONE AS PER CL 2.1.3</b></p>	NEW CLAUSE ADDED TO INCLUDE BELL MOUTH COVER PLATE						
2.6.1	<p>REMARKS : (1) BLADES SHALL BE SUITABLY TRIMMED BEFORE FIT UP</p> <p>(2) COVER PLATE ASSY OFFESET WITH CENTRE PLATE SHALL NOT BE MORE THAN 2 MM.</p>							
NOTES	<p>16 PLATES LESS THAN 12 MM SHALL BE CHECKED BY D METER FOR LAMINATIONS( NOTE 16 IS REFERRED UNDER CLAUSE 1.1)</p>	COST REDUCTION MEETING.						
17	<p>3 MM HOLE SHALL BE MADE IN THE AEROFOIL BLADE BEFORE HEAT TREATMENT AND SAME SHALL BE PLUGGED BY WELDING AND GRINDING AFTER HT.( NOTE 17 IS REFERRED IN CL 2.6.3)</p>	NOTE ADDED TO TAKE CARE OF HT OF AEROFOIL BLADED IMPELLERS						
<p><b>Prepared by</b> <i>KR</i> (KRASADURAI)</p>	<p align="center"><b>Reviewed by</b></p> <table border="1"> <tr> <td>B SRINIVASA RAO</td> <td>QA</td> <td><i>R. Srinivasan</i></td> </tr> <tr> <td>D KRISHNASWAMY</td> <td>QC</td> <td><i>D. Krishnaswamy</i></td> </tr> </table>	B SRINIVASA RAO	QA	<i>R. Srinivasan</i>	D KRISHNASWAMY	QC	<i>D. Krishnaswamy</i>	<p align="center"><b>Approved by</b></p> <p align="center"><i>HANANTHANARAYANAN</i> (HANANTHANARAYANAN)</p>
B SRINIVASA RAO	QA	<i>R. Srinivasan</i>						
D KRISHNASWAMY	QC	<i>D. Krishnaswamy</i>						



BHEL

RANIPET

QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )				
Q.W.I.NO:FAN317		REV: 04		
		AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table>	A	1
A	1			
DESCRIPTION:RADIAL FAN IMPELLER ASSY +CONICAL COVER PLATES		DATE:22 08 98		
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
2.5.4 B	ADD THE FOLLOWING CHECK: REMAINING THICKNESS BELOW THE COUNTER BORE TO BE CHECKED	I PCM DT 03 08 98		
Prepared by : <i>B. Srinivasan</i>		Approved by <i>HA</i>		

Distribution: As per standard distribution list.

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BHEL, RANTPET	STANDARD QUALITY PLAN FOR <u>FANS</u>	
REF.NO.	REVISION NO.	EFFECTIVE DATE
FAN:317	04	11 08 97
TITLE : RADIAL FAN IMPELLER ASSY+ CONICAL COVER PLATES		
		SIGNATURE
PREPARED BY :	B SRTNIVASA RAO	<i>B. Srinivasa Rao</i>
REVIEWED BY :	V SOBRAMANTAM	<i>V. Sobramantam</i>
APPROVED BY :	H ANANTHANARAYANAN	<i>H. Ananthanarayanan</i>
ISSUED & CONTROLLED BY :: QUALITY ASSURANCE BHEL., RANTPET-632 406.		
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BHEL RANTPET		RECORD OF REVISIONS	QPNO: FAN317 REV: 04 DATE 11 08 97 PAGE 02 OF 11
REVNO	CL. NO	REVISION MADE	EFFECTIVE DATE
00	--	ORIGINAL ISSUE	22 11 93
01	--	MODIFIED BY MERGING SQPS FAN: 312, 313, 314, 315 & 316	14-06-97
02	2.1.2C 2.5.4 2.6.6	QC IS MODIFIED AS M.Q.C.D INTRODUCED IN LINE WITH PCM-1/95-96 S.R REMOVED F/O OF COVER PLATE INTRODUCED IN LINE WITH PCM-3/94-95	20-07-95
03	2.1.3 2.3.4 2.4.5 2.5.2 2.5.4 2.6.2 2.6.8 2.6.7 & 2.6.9 3.1	PR:QE:017&PR:QA:106, REPLACED BY PR:QA:337&PR:QA:335 RESPECTIVELY. CLAUSE ADDED FOR AEROFOTLE BLADES PR:QE:017 IS REPLACED BY PR:QA:337 -DO- -DO- -DO- -DO- PR:QE:061 IS REPLACED BY PR:QA:338 AND NON APPLICABILITY OF THIS CLAUSE TO ID FAN FOR UTILITY BOILER IS INCLUDED . PR:QA:512 IS WITHDRAWN	01-07-96
04	2.6.2 2.6.6 2.6.9	ALLOY STEEL IMPELLERS ADDED IN COL.5 NOTE 15 IS ADDED NOTE 14 IS ADDED	11 08 97

BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RAMIPET 632 406 (INDIA) QUALITY ASSURANCE DEPT.	QUALITY CONTROL PLAN FOR  RADIAL FAN IMPELLERS AND CONICAL COVER PLATES	NAME OF CONTRACT PACKAGE  STANDARD	QP.No.FAN317 REV.No.04 DATE 110897 PAGE 03of11
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PREPARED BY: \_\_\_\_\_ REVIEWED BY: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIALS									
1.1.	CENTRE PLATE/ BACK PLATE, WEAR PLATE, BLADE,COVER PLATE,IMPELLERS RING,CONICAL COVER PLATE	CHEMISTRY & MECHANICAL PROPERTIES AND INTERNAL SOUNDNESS	MAJ	VERIFICATION OF TEST CERTIFICATES	100%	APPLICABLE MATERIAL	TDC & STANDARD	TC	QC/PROC	
1.2.	FORGINGS FOR IMPELLER RINGS AND HUBS	_DO_	MAJ	_DO_	100%	-DO-	-DO-	TC	-DO-	
1.3.	FASTENERS	COMPLIANCE TO PURCHASE ORDER	MAJ	VERIFICATION OF COMPLIANCE CERTIFICATE	100%	PURCHASE ORDER		C.CERT	-DO-	
2.0.	INPROCESS INSPECTION									
	MATERIAL SPEC TRANSFER AS APPLICABLE	RMA NO: SPEC: MELT NO;	MAJ	VISUAL	100%	RMA CARD		RMA CARD	HQCD	
2.1.	COVER PLATE ASSY									
2.1.1	GAS CUTTING OF COVER PLATES	INNER RADIUS ROUTER RADIUS	MAJ	DIMENSIONAL	100%	DRAWING & PR:QA:500		--	HQCD	

QC/PROC: QUALITY CONTROL /PROCUREMENT  
\*\*C.CERT: COMPLIANCE CERTIFICATE, HQCD: MANUFACTURERS QUALITY CONTROL DEPARTMENT

QUALITY CONTROL PLAN FOR

Q.P.NO.FAN317

RADIAL FAN IMPELLERS+  
CONICAL COVER PLATES

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DATE:11 08 97

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1	2	3	4	5	6	7	8	9	10	11
2.1.2	IMPELLER RING OF WELDED DESIGN									
(a)	UT OF PLATE BEFORE ROLLING	INTERNAL SOUNDNESS	MAJ	UT	100%	SEL 072	CL.3 OF TABL 1&2/SEL 072	NDT REPORT	NDTL	
(b)	WELDING OF IMPELLER RING	WELD SIZE& SURFACE QUALITY	MAJ	VISUAL	100%		DRAWING & PR:QA:337		MQCD	
		WELD SOUNDNESS	MAJ	UT	100%		BHE:NDT:RP:UT:02 & NOTE 3	NDT REPORT	NDTL	
(c)	STRESS RELIEF	COMPLIANCE TO S.R CYCLE	MAJOR	VERIFICATION OF HT CHART	100%		BAP:HT:001 & NOTE 12	HT CHART	MQCD	
2.1.3	WELDING OF COVER PLATES	ID,OD&HEIGHT RADIUS AS APPROPRIATE	MAJ	MEASUREMENT	100%		DRAWING & PR:QA:500 & NOTE 1&9		MQCD	
		EP&SURFACE QUALITY	MAJ	VISUAL	100%		DRAWING & PR:QA:337, PR:QA:335		MQCD	
		WELD SOUNDNESS	MAJ	UT	100%		BHE:NDT:RP:UT:02	NDT REPORT	NDTL	
			MAJ	MT	100%		BHE:NDT:RP:MT:01& NOTE 3,10			
2.1.4	IMPELLER RING MACHINING	ID,OD&EP	MAJ	MEASUREMENT	100%		DRAWING&PR:QA:500		MQCD	
2.1.5	COVER PLATE ASSY(WELDING) [COVER PLATE+ IMPELLER RING]	SURFACE QUALITY&SIZE	MAJ	VISUAL	100%		PR:QA:337&DRAWING		MQCD	
		WELD SOUNDNESS	MAJ	MT	100%		BHE:NDT:RP:MT:01	NDT REPORT	NDTL	
		HEIGHT	MAJ	MEASUREMENT	100%		DRAWING & PR:QA:500		MQCD	
2.2	BACK PLATE/ CENTER PLATE									
2.2.1	NDT OF RAW** PLATE	INTERNAL SOUNDNESS	MAJ	UT	100%	SEL 072	CL.3 OF TABLE 1&2OF SEL072	NDT REPORT	NDTL	**IN CASE OF NON UT QUALITY

-----S.R CYCLE:STRESS RELIEF CYCLE,HT CHART:HEATTREATMENT CHART,NDTL:NON DESTRUCTIVE TESTING LABORATORY.-----

QUALITY CONTROL PLAN FOR

Q.P.NO:FAN317  
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RADIAL FAN IMPELLER ASSY +  
CONICAL COVERPLATES

1	2	3	4	5	6	7	8	9	10	11
2.2.2	GAS CUTTING	ID,OD	MAJOR	MEASURE- MENT	100%		DRAWING &PR:QA:500& NOTE :1	--	HQCD	
2.2.3	MACHINING	BORE,OD,HOLE DIA&PITCH	MAJOR	-DO-	100%		DRAWING&PR:QA:500	--	HQCD	
2.2.4	WELDING OF SAWTOOTH (IF APPLICABLE)	SURFACE QUALITY & EP	MAJOR	VISUAL	100%		DRAWING &PR:QA:337 NOTE 8,9	--	HQCD	
		WELD SOUNDNESS	MAJOR	WT UT/RT	100%		BHE:NDT:RP:MT:01&NOTE3,10 BHE:NDT:RP:UT:02	NDT REPORT	NDTL	
2.2.5	GAS CUTTING* OF TEETH (FOR SAW TOOTH CENTRE PLATE ONLY)	RADII & PITCH OF TEETH	MAJOR	MEASURE- MENT	100%		DRAWING &PR:QA 500	--	HQCD	GAS CUT EDGES SHALL BE GROUND BY 2 MM. MIN. OR MPI MAY BE DONE AS PER BHE:NDT:RP :MT:01
2.3.	BLADE									
2.3.1	GAS CUTTING OF BLADE	VARIOUS LENGTH&SHAPE	MAJOR	MEASURE- MENT	F.O.T		DRAWING &PR:QA:500 NOTE 1	--	HQCD	:MT:01
2.3.2	DRILLING & COUNTER SINKING OF HOLES	DIA,DEPTH& ORIENTATION OF HOLES	MAJOR	MEASURE- MENT	RANDOM		DRAWING &PR:QA:500	--	HQCD	
2.3.3	ROLLING OF BLADES	BEND RADIUS	MAJOR	-DO-	100%		-DO-	--	HQCD	
2.3.4	AEROFOIL BLADE a)SHEARING OF SHEET b)GASCUTTING OF STIFFENER c)SAWING OF ROUND	LENGTH&SHAPE	MAJOR	_DO_	100%	5	_DO_	--	HQCD	
2.3.4.1	PRESSING OF BLADE&SLOTING	SHAPE&RADIUS	MAJOR	_DO_	100%		_DO_	--	HQCD	
2.3.4.2	WELDING OF BLADE	SURFACE QUALITY	MAJOR	VISUAL	100%		DRAWING&PR:QA:337	--	HQCD	
		SOUNDNESS	MAJOR	PT	100%		BHE:NDT:RP:PT:01	NDT REPORT	NDTL	

QUALITY CONTROL PLAN FOR  
 RADIAL FAN IMPELLER ASSEMBLY +  
 CONICAL COVER PLATES

Q.P.NO.:FAN 317  
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 DATE:11 08 97  
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1	2	3	4	5	6	7	8	9	10	11
2.4.	WEAR PLATE									
2.4.1	GAS CUTTING	VARIOUS LENGTH AND SHAPE	MAJOR	MEASUREMENT	F.O.T		DRAWING & PR:QA:500 & NOTE 1	--	MQCD	
2.4.2	DRILLING & COUNTER SINKING	HOLE DIA & PITCH	"	"	RANDOM		DRAWING & PR:QA:500	--	MQCD	
2.4.3	HOT PRESSING OF BLADES (IF APPLICABLE)	HOT PRESSING TEMP.	"	VISUAL	"		PR:QA:325	--	MQCD	
		BEND RADIUS AND HEIGHT	"	MEASUREMENT	"		-DO-	--	MQCD	
2.4.4	ROLLING	BEND RADIUS	"	-DO-	RANDOM		DRAWING & PR:QA:500	--	MQCD	
2.4.5	WEAR PLATE ASSY (IF APPLICABLE)									
	WELDING OF WEAR PLATES AND CENTRE RIB	SURFACE QUALITY & WELD SIZE	"	VISUAL	100%		PR:QA:337 & DRAWING	--	MQCD	
		WELD SOUNDNESS	"	MT	100%		BHE:NDT:RP:MT:01 & NOTE 3	NDT REPORT	NDTL	
2.5.	CONICAL COVER PLATE									
2.5.1	COVER PLATE ROLLING	ID,OD AND HEIGHT OF CONE	MAJOR	MEASUREMENT	100%		DRAWING & PR:QA:500	--	MQCD	

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RADIAL FAN IMPELLER ASSY +  
CONICAL COVER PLATE

1	2	3	4	5	6	7	8	9	10	11
2.5.2	WELDING OF COVER PLATE	EDGE PREPARATION AND SURFACE QUALITY	MAJOR	VISUAL	100%	DRAWING&PR:QA:337 NOTE 1,9		--	MOCD	
		WELD SOUNDNESS	"	MT	100%	BHE:NDT:RP:MT:01 NOTE 3&10		NOT REPORT	NDTL	
2.5.4	CONICAL COVER PLATE ASSY									
A)	WELDING	SOUNDNESS & SURFACE QUALITY	"	MT VISUAL	100%	BHE:NDT:RP:MT:01 NOTE 3 & 10 PR:QA:337		"	"	
B)	MACHINING	DRILL HOLE SIZE, PITCH OF HOLES, THREADED HOLE SIZES(If Applicable) OD, ID AND HEIGHT	"	MEASURE- MENT	100%	DRAWING & PR:QA:500		HISTORY CARD	MOCD	
2.6.	IMPELLER ASSY									
2.6.1	FIT UP OF* COVER PLATE CENTRE PLATE/ BACK PLATE AND BLADES	HT BETWEEN CENTRE/BACK PLATE AND COVER PLATE DISCHARGE OPENING DIMENSION	MAJOR	MEASURE- MENT	100%	DRAWING & PR:QA:500			MOCD	*CENTRE PLATE SHALL BE STRAIGHTENED AND LEVELLED BEFORE FIT UP OF BLADES WITHIN 2 MM & SUBSEQUENTLY ARRESTED BEFORE TACK WELDING OF COVER PLATES

QUALITY CONTROL PLAN FOR

RADIAL FAN IMPELLER ASSY +  
CONICAL COVER PLATE

Q.P.NO.FAN317

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1	2	3	4	5	6	7	8	9	10	11
2.6.2	WELDING	WELD SOUNDNESS	MAJOR	VISUAL MT FOR ALLOY STEEL IMPELLERS BEFORE SR	100% 100%		PR:QA:337 BHE:NDT:RP:MT:01 NOTE 3,5,10	-- NDT REPORT	HQCD NDTL	
2.6.3	STRESS RELIEF OF IMPELLER ASSEMBLY	COMPLIANCE TO SR CYCLE	CRITI CAL	VERIFI CATION OF CHART	100%		BAP:HT:001 NOTE 4	HT CHART	HQCD	STAINLESS **NOT APPLICABLE FOR AUSTENITIC STAINLESS STEELS
2.6.4	PAINTING OF IMPELLER	COATING THICKNESS	MAJOR	VISUAL	100%		NOTE 2	--	HQCD	
2.6.5	NDT ON WELDS AFTER STRESS RELIEF	WELD SOUNDNESS	MAJOR	MT	100%		BHE:NDT:RP:MT:01	NDT REPORT	NDTL	
2.6.6	MACHINING	a)GROOVE DIA b)BORE DIA & OD OF IMPELLER c)IMPELLER RING ID d)HEIGHT OF IMPELLER f)TAPER CHECK OF HUB	MAJOR	MEASURE MENT	100%		DRAWING &PR:QA:500 NOTE 15	HISTORY CARD	HQCD	
		g)FACE OUT OF COVERPLATE	MAJOR	-DO-	100%		NOTE 11 DRAWING &NOTE 13	-DO-	HQCD	
2.6.7	DYNAMIC* BALANCING OF IMPELLER WITH C.C.PLATE	RESIDUAL UNBALANCEMENT	CRITI CAL	UNBALANCE COMPEN SATION	ALL IMPELLER ASSYS		DRAWING &PR:QA:306,307 309,314,323,338 NOTE 14	HISTORY CARD	HQCD	*NOT APPLICABLE FOR THE ID FANS OF UTILITY BOILERS STAINLESS
							SR:STRESS RELIEF			

QUALITY CONTROL PLAN FOR

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RADIAL FAN IMPELLER ASSY +  
CONICAL COVER PLATE

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1	2	3	4	5	6	7	8	9	10	11
2.6.8	ASSEMBLY OF IMPELLER WITH WEAR PLATES AND CONICAL COVER PLATES	i)PROPER ASSY AND TORQUE TIGHTNESS ii)SOUNDNESS OF WEAR PLATE TO CENTRE PLATE & OF WEAR PLATE HALVES	MAJOR	VISUAL	100%		DRAWING & PR:QA:312 NOTE- 6	--	MQCD	
			MAJOR	VISUAL & MT	100%		PR:QA:337 BHE:NDT:RP:MT:01	NDT REPORT	NDTL	
2.6.9	DYNAMIC BALANCING OF IMPELLER WITH WEAR PLATES AND CONICAL COVER PLATES	RESIDUAL UNBALANCEMENT	CRITI- CAL	UNBALANCE COMPEN- SATION	ALL IMPELLERS		DRAWING & PR:QA:306,307 309,314,323,338 &NOTE 14	HISTORY CARD	MQCD	
3.0.	FINAL INSPECTION									
3.1.	PAINTING IDENTIFICATION PRESERVATION AND PACKING	COATING THICKNESS OF PAINT PROPER PACKING& PRESERVATION	MAJOR	MEASURE- MENT & VISUAL	RANDOM		PR:QA:590 PACKING DRAWING AND GMS NOTE 7	--	MQCD	
3.2.	VERIFICATION OF IMPELLER DOCUMENTATION	COMPLETENESS	MAJOR	VERIFI- CATION OF RECORDS OF COL 9 OF THIS QP	100%		SQP:FAN:317	--	MQCD	

QUALITY CONTROL PLAN FOR

RADIAL FAN IMPELLER ASSY +  
CONICAL COVER PLATES

Q.P. NO. FAN317  
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NOTE : ALL THE DOCUMENTS REFERED SHALL BE OF LATEST REVISION ONLY.

NOTES:

- 1) GAS CUT EDGES SHALL BE GROUND SMOOTH BEFORE WELDING.
- 2) IMPELLER SHALL BE GIVEN PRIMER COAT WITHIN 4 HOURS AFTER SHOT BLASTING AS PER PR:QA:590. WELDS SHALL NOT BE PAINTED.
- 3)(i) IN CASE OF QUENCHED AND TEMPERED ALLOY STEELS LIKE MAXTRA 70, SA517, Gr. F, WELDOX700E/F, RQT701, DILLIMAX690E, WEL-TEN 780 A, MT/UT SHALL BE DONE AFTER 48 Hrs OF COMPLETION OF WELDING.
  - (ii) WELDERS SHALL BE QUALIFIED AS PER ASME SEC IX IN 3G POSITION MINIMUM.
  - (iii) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs BETWEEN 370C° TO 430C° AND HELD IN HOLDING OVEN AT 120-150 DEGREE C° BEFORE USE.
  - (iv) ELECTRODES OPEN TO ATMOSPHERE MORE THAN 5 MINUTES SHALL BE REBAKED AND DRIED IN THE SAME MANNER.
  - (v) ALL THE BUTT JOINTS SHALL BE BAGGAGED TO REMOVE SLAG, UNUSED AREA ETC AND WELDED.
  - (vi) BUTT WELDS ON PLATES OF SIZE 10MM AND BELOW SHALL BE TESTED BY MT FROM BOTH SIDES AND FOR ABOVE 10 MM SIZE, UT AND MT SHALL BE DONE.
- 4) HEAT TREATMENT SCHEDULE BAP:HT:001 COVERS STRESS RELIEF OF CONVENTIONAL MATERIALS. IF A NEW MATERIAL IS USED IN IMPELLER CONSTRUCTION, STRESS RELIEF REQUIREMENTS WILL BE COMMUNICATED BY QA.
- 5) BLADE WELDS SHALL BE TOE GROUND TO A MAX DEPTH OF 0.6 MM AT THE ENTRY AND EXIT OF FILLET WELDS FOR 100 MM LENGTH. BLADES WELDS WITH CENTRE PLATE AND COVER PLATES SHALL BE SMOOTHLY ROUNDED AT ENDS.
- 6) PROJECTION OF FLAT NIBBED BOLTS SHALL NOT EXCEED 1.5MM.
- 7) IMPELLERS SHALL BE IDENTIFIED WITH W.O. NO., DU NO., & PRODUCT NO. BY PAINTING & HARD PUNCHING. DIRECTION OF ROTATION SHALL BE PAINTED ON THE IMPELLER.
- 8) CENTRE PLATE/BACK PLATE SHALL BE STRAIGHTENED TO 1MM/Mt SUBJECT TO THE MAXIMUM OF 2 MM.
- 9) JOINTS SHALL BE FULL PENETRATION WELD JOINTS.
- 10) SURFACE CRACKS SHALL BE INSPECTED AS PER BME:NDT:RP:PT1 BY PENETRANT INSPECTION IN CASE OF AUSTENITIC STAINLESS STEEL.

QUALITY CONTROL PLAN FOR

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RADIAL FAN IMPELLER ASSY +  
CONICAL COVER PLATES

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11) THIS IS APPLICABLE FOR IMPELLERS WITH TAPERED BORE HUB.

A THIN COAT OF PRUSSIAN BLUE SHALL BE UNIFORMLY APPLIED IN THREE BANDS AT 120 DEG. APART ON THE MALE PLUG TAPER GAUGE. THE GAUGE SHALL BE INSERTED IN THE TAPER BORE OF THE IMPELLER AND THE GAUGE SHALL BE ROTATED BY 120 DEG. BOTH CLOCKWISE AND ANTICLOCKWISE. THE GAUGE SHALL BE TAKEN OUT AND THE BLUE TRANSFER ON THE TAPER BORE GIVES THE EXTENT OF MATCHING OF BORES. THE BLUE SHALL BE HAVING 100% CONTACT AT THE SMALL AND BIG ENDS OF TAPER FOR 30% OF HEIGHT OF CONE FROM EITHER END AND OVER THE CENTRE 40% OF THE HEIGHT TO A MINIMUM OF 70 % THE BLUE TRANSFER SHALL BE OBTAINED AS SHOWN IN THE SKETCH GIVEN BELOW:

AREA	HEIGHT
100%	30%
70%	40%
100%	30%

12) SOAKING TIME COMPUTED AS SOAKING TIME REQUIRED FOR IMPELLER RING SUBTRACTED BY SOAKING TIME REQUIRED FOR IMPELLER ASSY (WITHOUT CONSIDERING FOR BUTT WELD OF RING )

13) PERMISSIBLE FACE OUT ON THE IMPELLER COVER PLATE IS AS FOLLOWS. (IF NOT PROVIDED IN DRG.)

IMPELLER TIP DIA IN MM	MAXIMUM FACE OUT
UP TO 1000	3
>1000 UP TO 2500	5
>2500	6

14) PR:QA:306,307,308,338 ARE APPLICABLE FOR CHEL SHOP ONLY. SUBCONTRACTORS SHALL DEVELOP THEIR OWN BALANCING PROCEDURES BASED ON M/C MANUAL.

15) INSTRUMENT NO. FOR MEASUREMENTS OF FLANGE GROOVE DIA AND BORE SHALL BE RECORDED IN HISTORY CARD

16) For thickness less than 12 mm, shall be checked by  $\phi$ -meter.

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BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

CONTROL PLAN FOR  
 AN FAN SHAFT ASSY

NAME OF CONTRACT PACKAGE : QP, NO. FAN326  
 STANDARD : REV. No. 01  
 DATE: 26/7/95  
 PAGE 01 of 06

PREPARED BY: *B. Srinivasan* REVIEWED BY: *Antony* APPROVED BY: *H. H. H.*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIALS									
1.1.	CHEMMECH PROPERTIES OF RAW MATERIALS									
1.1.1	SHAFT TUBE	CHEM & MECH. PROPERTIES	MAJOR	VERIFICATION OF TCs	100%	RESPECTIVE MATERIAL SPECIFICATION AND TDC, IF APPLICABLE		TC	GC/PROC	
1.1.2	SHAFT PINS	-DO-	MAJOR	-DO-	-DO-	-DO-	-DO-	TC	-DO-	
1.1.3	FLANGE	-DO-	MAJOR	-DO-	-DO-	-DO-	-DO-	TC	-DO-	
1.1.4	KEY	-DO-	MAJOR	-DO-	-DO-	-DO-	-DO-	TC	-DO-	
1.2.	INTERNAL QUALITY OF RAW MATERIALS									
1.2.1	SHAFT TUBE	INTERNAL SOUNDNESS	MAJOR	VERIFICATION OF UT-CERT	100%	ASTM E213 AND APPLICABLE TDC		TC	-DO-	
1.2.2	SHAFT PINS	-DO-	MAJOR	-DO-	100%	SA 368 & APPLICABLE TDC		TC	-DO-	
1.2.3	FLANGE	-DO-	MAJOR	-DO-	100%	SEL 072 & APPLICABLE TDC		TC	-DO-	
1.3.	SUBDELIVERIES									
1.3.1	FASTENERS	COMPLIANCE TO MAJOR PURCHASE ORDER		REVIEW OF TCS	100%	PURCHASE ORDER		TC	-DO-	

GC/PROC: QUALITY CONTROL/PROCUREMENT, TC: TEST CERTIFICATE

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BHARAT HEAVY ELECTRICALS LTD  
BOILER AUXILIARIES PLANT  
RANIPET-632 406 (INDIA)  
QUALITY ASSURANCE DEPT.

CONTROL PLAN FOR  
AN FAN SHAFT ASSY

NAME OF CONTRACT PACKAGE : QP.NO.FAN326  
STANDARD :  
REV.No.01  
DATE:260796  
PAGE 01 of 06

PREPARED BY: *B. Srinivasan* REVIEWED BY: *Antony* APPROVED BY: *H. H. H.*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIALS									
1.1.	CHEMMECH PROPERTIES OF RAW MATERIALS									
1.1.1	SHAFT TUBE	CHEM & MECH. PROPERTIES	MAJOR	VERIFICATION OF TCs	100%	RESPECTIVE MATERIAL SPECIFICATION AND TDC, IF APPLICABLE		TC	GC/PROC	
1.1.2	SHAFT PINS	-00-	MAJOR	-00-	-00-	-00-	-00-	TC	-00-	
1.1.3	FLANGE	-00-	MAJOR	-00-	-00-	-00-	-00-	TC	-00-	
1.1.4	KEY	-00-	MAJOR	-00-	-00-	-00-	-00-	TC	-00-	
1.2.	INTERNAL QUALITY OF RAW MATERIALS									
1.2.1	SHAFT TUBE	INTERNAL SOUNDNESS	MAJOR	VERIFICATION OF UT-CERT	100%	ASTM E213 AND APPLICABLE TDC		TC	-00-	
1.2.2	SHAFT PINS	-00-	MAJOR	-00-	100%	SA 368 & APPLICABLE TDC		TC	-00-	
1.2.3	FLANGE	-00-	MAJOR	-00-	100%	SEL 072 & APPLICABLE TDC		TC	-00-	
1.3.	SUBDELIVERIES									
1.3.1	FASTENERS	COMPLIANCE TO MAJOR PURCHASE ORDER		REVIEW OF TCS	100%	PURCHASE ORDER		TC	-00-	

GC/PROC:QUALITY CONTROL/PROCUREMENT ,TC: TEST CERTIFICATE

QUALITY CONTROL PLAN FOR  
AN SHAFT ASSY.

OP. NO: FAN326  
REV. NO: 04  
DATE: 26/02/95  
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1	2	3	4	5	6	7	8	9	10	11
2.0.	INPROCESS CONTROL									
2.1.	VERIFICATION OF MATERIAL SPECIFICATION									
2.1.1	SHAFT TUBE SHAFT PIN SHAFT FLANGE	VERIFICATION OF RMA, MELTNO MAT. SPEC.	MAJOR VERIFICA- TION		100%		RMA CARD	RMA CARD		MGCC
2.2.	MACHINING									
2.2.1	FLANGE	OD, ID, DRILL HOLE DIA IFDC	MAJOR MEASURE- MENT		100%		DRAWING &PR:GA:500 NOTE 1	DR		MGCC
2.2.2	SHAFT TUBE	OD, ID, LENGTH, SURFACE FINISH STATIC UNBALANCE	MAJOR -OO-		100%		DRAWING &PR:GA:322	DR		MGCC
2.2.3	PINS	OD, LENGTH SURFACE FINISH	MAJOR -OO-		100%		DRAWING	DR		MGCC
		DR : DIMENSIONAL REPORT								

STANDARD QUALITY CONTROL PLAN FOR  
AN FAN SHAFT ASSY

GP. NO. FAN326  
REV. NO. 01  
DATE: 260795  
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1	2	3	4	5	6	7	8	9	10
2.3.	WELDING OF SHAFT + PIN FLANGE (If applicable)								
2.3.1	PIN+FLANGE WELDING	WELD SIZE & FINISH	MAJOR	VISUAL & MEASURE-MENT	100%		DRAWING SPR:GE017 NOTE 2&6	—	MGCD
		WELD SOUNDNESS	CRIT	MT	100%		BHE:NDT:RP:MT1	INDT REPORT	INDTL
2.3.2	STRESS RELIEF OF PIN+FLANGE WELDMENT	COMPLIANCE TO STRESS RELIEF CYCLE	MAJOR	VERIFICATION OF HT-CHART	100%		BAP:HT:001	HT CHART	MGCD
2.3.3	PIN+FLANGE WELDMENT AFTER STRESS RELIEF	WELD SOUNDNESS	CRIT	MT	100%		BHE:NDT:RP:MT1	INDT REPORT	INDTL
2.4.	TUBE +PIN ASSY	PROPER ASSEMBLY	MAJOR	VISUAL	100%		DRAWING NOTE 3	—	MGCD
2.5.	SHAFT ASSY WELDING	WELD SIZE & FINISH	MAJOR	MEASURE-MENT	100%		DRAWING PR:QE:017 NOTE 2&6	—	MGCD
		WELD SOUNDNESS	CRIT	MT	100%		BHE:NDT:RP:MT1	INDT REPORT	INDTL
				HT-CHART: HEAT TREATMENT CHART					
				MGCD: MANUFACTURER'S QUALITY CONTROL DEPARTMENT					
				INDTL: NONDESTRUCTIVE TESTING LABORATORY.					

Note: PR:QE-017/03 is superseded by PRQA:337

QUALITY CONTROL PLAN FOR

AN SHAFT ASSY

QP NO: FANS26  
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1	2	3	4	5	6	7	8	9	10	11
2.6.	SHAFT ASBY MACHINING	JOURNAL DIA FLANGE STEP DIA KEY WAY SIZE & OFFSET END TAPPINGS FACE OUT RUN OUT SURFACE FINISH COUPLING BEATING DIA THREAD SIZE LENGTH SLOT SIZE FOR LOCK WASHER	MAJOR MEASURE- MENT		100%	DRAWING & PR:GA:500 NOTE 4		DR	MCCD	**INSTRUMENT INC. USED IN MEASURING JOURNAL DIA IMPELLER SEATING STEP DIA, COUPLING SEATING DIA, LENGTH & KEYWAY DEPTH & WIDTH SHALL BE RECORDED IN DR
2.7.	DYNAMIC BALANCING OF SHAFT ASSY	RESIDUAL* UNBALANCEMENT	CRIT COMPENSATION	UNBALANCE COMPENSATION	100%	**DRAWING AND PR:GA:061, 306,307,309,314,323		HISTORY CARD	MCCD	*HALF KEY SHALL BE ASSEMBLED ON SHAFT
3.0.	FINAL INSPECTION									
3.1.	PRESERVATION PRINTING PACKING IDENTIFICATION IN COL. 7&8	COMPLIANCE TO COMPANY STANDARD	MAJOR	VISUAL	100%	***PR:GA:512, PR:GA:590 PR:GA:0173, PACKING DRAWING NOTE 5			MCCD	***PR:GA:512 IS APPLICABLE FOR SUBCON- TRACTING ONLY
<p>** PR:GA: 061, 306, 307, 309 ARE APPLICABLE FOR BHEL SHW ONLY. SUBCONTRACTORS SHALL DEVELOP PROCEDURES BASED ON THEIR MACHINE MANUAL.</p>										
<p>*****DOCUMENTS REFERED IN COLUMN 7&amp;8 SHALL BE OF LATEST REVISION ONLY.*****</p>										

QUALITY CONTROL PLAN FOR

AN FAN SHAFT ASSY

G.P.NO.FAN326  
 REV.NO.01  
 DATE:260796  
 PAGE:06OF06

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NOTE 1: i) WHEREVER JIG IS NOT ENVISAGED THE SAME SHALL BE MARKED FOR DRILLING AND INSPECTED AND THEN ONLY TO BE DRILLED

NOTE 2: i) WELDERS AND WELDING PROCEDURES SHALL BE QUALIFIED AS PER ASME SEC IX TO 3 G POSITION.

ii) WELD TOES SHALL BE GROUND, MAXIMUM DEPTH OF GRINDING PERMISSIBLE IS 0.5 MM.

iii) WELDS SHALL BE CLEANED IN BETWEEN PASSES AND FURTHER WELDING SHOULD BE CONTINUED AFTER ENSURING COMPLETE REMOVAL OF DEFECTS.

NOTE 3: i) THE ACTUAL MACHINED DIMENSIONS OF END PIN OD AND HOLLOW SHAFT ID SHOULD BE VERIFIED AND RECORDED BEFORE PIPE IS HEATED FOR SHRINK FIT.

ii) HOLLOW TUBE SHALL BE HEATED ONLY BY PRODUCER GAS .OXYACETYLENE FLAME SHOULD NOT BE USED.

iii) THE PIN SHOULD BE INSERTED IN THE PIPE IN VERTICAL POSITION ONLY.

THE PIN AXIS SHOULD NOT BE INCLINED WITH REFERENCE TO PIPE AXIS .PIN INSERTION SHALL BE COMPLETED BEFORE PIPE TEMPERATURE FALLS DOWN FROM 300 DEG C.

NOTE 4: i) THE RELATIVE DISTANCE BETWEEN THE BEARING SEATS WITH REFERENCE TO FLANGE SHALL BE STRICTLY AS PER DRAWING.

ii) KEYWAY OFFSET PERMITTED SHALL BE AS PER TABLE SHOWN BELOW.

ODIA OF SHAFT IN MM	10-22	22-38	38-65	65-110	100-150
OFFSET PERMITTED IN MM	0.1	0.16	0.2	0.3	0.4

QUALITY CONTROL PLAN FOR

AN SHAFT ASBY

Q.P. NO. FAN326  
REV. NO. 01  
DATE: 26/07/95  
PAGE: 06/06

1	2	3	4	5	6	7	8	9	10	11
iii) OIL HOLES OF PINS SHALL BE CHECKED FOR LENGTHS, DIA & THREADSIZES.										
iv) ALWAYS DIMENSIONS SHALL BE MEASURED FROM ONE END ONLY AND ALL TOLERANCES ARE NON CUMULATIVE										
v) SURFACE FINISH AT BEARING SEATING AREAS IS CRITICAL AND SHALL BE AS PER DRAWINGS.										
NOTE 5: i) KEY SHALL BE ASSEMBLED TO THE SHAFT AND SCREWED.										
ii) NO. NO., DU NO., PRODUCT NO., SUBCONTRACTOR FIRM CODE IF ANY SHALL BE PUNCHED AND PAINTED ON ON TH TUBE										
NOTE 6: i) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs ATLEAST 370 -430 DEG C AND SHALL BE KEPT AT 120 -150 DEG C BEFORE USE. IF THE ELECTRODES ARE EXPOSED TO ATMOSPHERE FOR MORE THAN 5 MINUTES THEY SHALL BE REBAKED IN THE SAME MANNER.										
(Empty table cells for inspection and recording)										

BIHEL  
RANIPET

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QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)				
Q.W.I.NO: FAN337	REV: 00	AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table>	A	1
A	1			
DESCRIPTION: AP IMBELLER HUB	DATE: 13 01 94			
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
GENERAL	ALL DOCUMENTS REFERRED IN COLUMN 6&7 SHALL BE OF LATEST REVISION.	REVISION STATUS IS NOT MENTIONED IN THE DOCUMENTS REFERRED		
Prepared by <i>B. Sundarababu</i>		Approved by <i>[Signature]</i>		

Distribution: As per standard distribution list.

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET 632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 AP IMPELLER HUB

NO. OF CONTRACT PACKAGE  
 STANDARD

QP NO : PAM 337  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 01 OF 04

PREPARED BY: B. Srinivas Reddy

REVIEWED BY: H. H. ...

APPROVED BY: H. H. ...

S No	COMPONENT & OPERATION	TYPE OF CHECK	QUANTITY OF CHECK	CHARACTERISTICS	REF STD	ACFT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1.0	RAW MATERIAL BACK COVER, COVER RING, RIBS/FLANGES	MATERIAL VERIFICATION	100%	SPEC HEAT NO TC NO	RMA CARD		QC		RMA CARD	
1.1.	COVER RING	S MEASURE- MENT *	-DO-	ID, OD, EP	DRG APROA: 500		QC	VENNIER, TAPE, BEVEL PROTRACTOR/ EP TEMPLATE		
1.1.1	COVER RING BOTTOM FIELD	WEIGHT	-DO-	SOUNDNESS	BHE: NDT: RF: INT BHE: NDT: RF: UT02		NDT	UT / API EQUIPMENT	NDT REPORT	
1.1.2	COVER RING MACHINING	MEASURE- MENT	-DO-	STEP MACHINING ON BOTH SIDES	DRG	DRG	QC	VENNIER, DEPTH GAUGE	LOG	
1.2	BACK COVER MACHINING	-DO-	-DO-	OD, EP	-DO-	-DO-	-DO-	VENNIER BEVEL PROTRACTOR / EP TEMPLATE	LOG	
1.3	FLANGES	-DO-	-DO-		-DO-	-DO-	-DO-		LOG	

QUALITY CONTROL PLAN FOR

AP IMPELLER HUB

OP NO : FAN 337  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 02 OF 04

PREPARED BY:

REVIEWED BY:

APPROVED BY:

S NO	COMPONENT & OPERATION	TYPE OF CHECK	QUANTITY OF CHECK	CHARACTERISTICS	REF STD	ACPT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.4	HUB ASSEMBLY	WELD QUALITY	100%	FILLET SIZE, POSITION OF STIFFENERS	ENG APPRO:500	QC	QC	FILLET GAUGE, TAPE TRY SQ. GAUGE FOR STIFFENER, SPACING.	LOG	
1.4.2	HUB ASSY 23 BORE MACHINING	MEASURE-MENT	--00--	CENTRE HEIGHT OF BORE, ID OF BORE, STEP IN THE BORE FOR BUSH FIXING	--00--	--00--	--00--	VERNIER, ID MIC VERNIER DEPTH GAUGE	LOG	
1.4.3	HUB FOR WELDING	VISUAL	BYEON	CR ID	--00--	--00--	--00--	VERNIER	LOG	
1.4.4	HUB WITH HUB ASSEMBLY	WELD QUALITY	100%	WELD WELD	--00--	--00--	--00--	WELD SIZE CHECKING GAUGE		
1.4.5	HUB ASSY TREATMENT	VERIFICATION OF HT CHART	--00--	HOT SOAK, SOAKING TIME, SOAKING TIME	BAE HT:001/INTEREST	QC	QC		HT CHART	CHECK FOR THERMOCOUPLE POSITION!



QUALITY CONTROL PLAN FOR

AP IMPELLER HUB

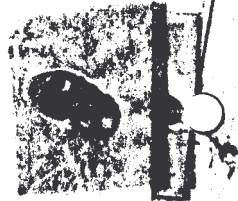
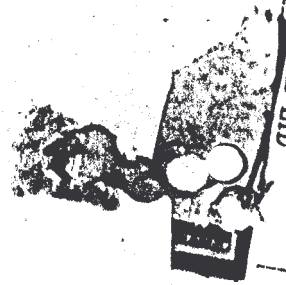
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PREPARED BY:


REVIEWED BY:

APPROVED BY:

S No	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACQPT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.5.1	HUB DRILLING	MEASURE- MENT	100%	DIA OF HOLE, PITCH, POSITION OF HOLES, PILOT HOLE FOR DOHILL PIN	DRG & PROA:500		QC	DRIILL JIG, VERNIER, PCD CHECKING GAUGE	LOG	
1.5.2	HUB PRESERVA- TION.	VISUAL	-DO-	PRESERVATION BY TEMPORARY RUST PREVENTIVE			QC			




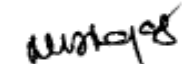
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 Ranipet-6	BHEL: BAP:RANIPAT TAMIL NADU - 632 406		<b>MANUFACTURING QUALITY PLAN</b>				PROJECT: <b>STANDARD</b>			
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1.0	MATERIALS PLATES FOR HUB, BLADE, COVER AND ROOT STIFFENER	CHEMICAL, MECHANICAL PROPERTIES & ULTRASONIC EXAMINATION	REVIEW OF TCs	100%	RESPECTIVE MATERIAL SPECIFICATION	RESPECTIVE MATERIAL SPECIFICATION	TC	P	V*	*Material s stocked after verificati on TC by BHEL
2.0	<b>PROCESS CONTROL</b>									
2.1.	ATTESTATION VERIFICATION									
2.1.1.	a) PETALS OR HUB ASSY b) BLADE c) ROOT STIFFENER (IF APPLICABLE)	RMA NO., MELT NO., MATERIAL SPECN.	VISUAL	100%	RMA CARD	RMA CARD	-	P	W	


**Record of revisions**

Rev 0 Original issue  
 Rev 01 dt 06 07 94 Revised editorial correction  
 Rev 02 dt 16 02 10 format modified and revised reference norms updated.


Best regards, M - Manufacturer B - BHEL /BHEL Authorized Inspection Agency, C -Customer, P - perform, V - Verification of reports W - Witness, TC - Test certificate DR - Dimensional report.	<b>Prepared BY</b>	<b>Reviewed and Approved by</b>
		

 <b>बी एच ई एल</b> <b>BHEL</b> Ranipet-6	BHEL: BAP:RANIPAT TAMIL NADU – 632 406	<b>MANUFACTURING QUALITY PLAN</b>				PROJECT: <b>STANDARD</b> PACKAGE : -- CONTRACTOR: BHEL/RANIPET				
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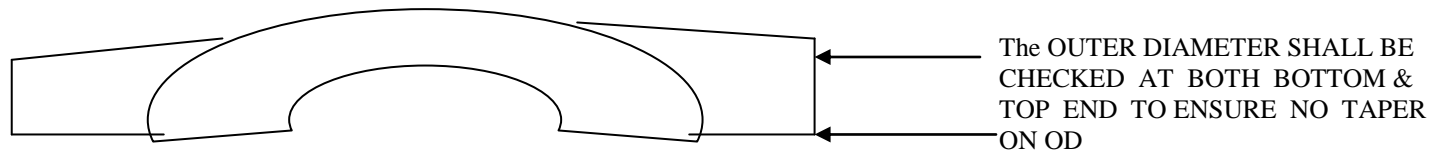
2.2	HUB(DISHED END)									
2.2.2.	DIMENSIONS	PROFILE, OD, HEIGHT	VISUAL & MEASURE MENT	100%	DRAWING & NOTE 1	DRAWING &NOTE 1	DR	P	W	
	WELDING OF PETALS	1) WELDSIZE & FINISH	VISUAL & MEASURE MENT	100%	DRAWING & &NOTE 2	DRAWING &&NOTE 2	NOT REPORT	P	V	
		2)WELD SOUNDNESS	UT/RT	100%	BHE:NDT:RP:UT:02/LA TEST &NOTE 2 bHE:NDT:RP:MT:01/ LATEST	BHE:NDT:RP:UT:02/L ATEST &NOTE 2 bHE:NDT:RP:MT:01/ LATEST	-DO-	P	W	
2.3.	HUB WELDING WITH COVER									
2.3.1	WELD QUALITY	WELD SIZE AND FINISH & SOUNDNESS	VISUAL & MPT	100%	SRAWING AND bHE:NDT:RP:MT:01/ LATEST & NOTE 2	SRAWING AND bHE:NDT:RP:MT:01/ LATEST & Note 2	DR	P	W	
2.4.	HUBASSY MACHINING	BOARE DIA & HEIGHT	HEIGHT MEASUREMENT	100%	DRAWING	DRAWING &	DR	P	W	


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2.5.	BLADES										
2.5.1	HOT PRESSING	PROFILE	CHECKING WITH CHECKING FIXTURE	100%	DRAWING AND NOTE 4	DRAWING & NOTE-4	DR	P	V		
2.6.	IMPELLER ASSY										
2.6.1	HUB+BLADE WELDING	WELD** FINISH& SOUNDNESS	VISUAL & MT	100%	BHE:NDT:RP:MT:01/LATEST&NOTE 2	BHE:NDT:RP:MT:01/LATEST&NOTE 2	NDT REPORT	P	W	<b>**Blade with hub fit up shall be ensured before welding in a fixture</b>	
2.6.2	ASSEMBLY CHECK	PROFILE CHECK & BLADE PITCH	VISUAL	100%	DRAWING & NOTE	BHE:NDT:RP:MT:01/LATEST&NOTE 2	-	P	W		
2.6.3	HEAT TREATMENT										
2.6.3	STRESS RELIEF	COMPLIANCE TO STRESS RELIEF CYCLE	TIME & TEMP.CHART VERIFICATION	100%	BAP:HT:001/LATEST AND NOTE 7	BAP:HT:001/LATEST AND NOTE 7	HT CHART	P	V		
2.6.4	PROFILE CORRECTION AFTER STRESS RELIEF	PROFILE	MEASUREMENT	100%	PROFILE SETTING FIXTURE	NOTE 8	DR	P	W		
2.6.5	NDT	WELD SOUNDNESS	MT	100%	BHE:NDT:RP:MT 01/LATEST	BHE:NDT:RP:MT 01/LATEST	NDT REPORT	P	W		

 Ranipet-6	BHEL: BAP:RANIPAT TAMIL NADU - 632 406	<b>MANUFACTURING QUALITY PLAN</b>				PROJECT: <b>STANDARD</b> PACKAGE : -- CONTRACTOR: BHEL/RANIPET				
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2.6.6	MACHINING									
2.6.6.1	IMPELLER	ID, OD,GROOVE DIA,HEIGHT, HOLES PCD,CHORD DISTANCE	MEASREMENT	100%	DRAWING	DRAWING	DR	P	W	
2.6.6.2	FLANGE	ID,OD,DRILL, HOLES, PCD,CHORD,STEP DIA, THICKNESS	-DO-	100%	DRAWING	DRWING	-DO-	P	W	
2.7.	DYANMIC BALANCING OF IMLLER	UNBALANCE CHECK	UNBALLANCE COMPENSATION	100%	DRAWIMG & NOTE 9	DRAWIMG & NOTE 9	REPORT	P	W	
2.8	NATURAL # FREQUENCY TESTING	NATURAL FREUENCY OF BLADES	RESONANCE CHECK	100%	PRQA 301/IATEST	PRQA 301/IATES	REPORT	P	W	# SHALL BE CARRIED IF DRAWINGS CALLS FOR THE SAME
3.0	FINAL INSPECTION	IDENTIFICATION PAINTING PRESERVATION	VISUAL	100%	PRQA 590/LATEST & PACKING DRAWING AND NOTE 10	PRQA 590/LATEST & PACKING DRAWING AND NOTE 10	-	P	V	



		BHEL: BAP:RANIPAT TAMIL NADU – 632 406		<b>MANUFACTURING QUALITY PLAN</b>			PROJECT: <b>STANDARD</b> PACKAGE : -- CONTRACTOR: BHEL/RANIPET			
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**NOTE 1: HUB MANUFACTURING**

- 1) PETALS SHALL BE CALIBRATED BEFORE USE.
- 2) THE PETAELS BE ASSEMBLED AND TACK WELDED IN ASSY FIXTURE
- 3) THE PROILE OF THE PETALS SHALL BE CHECKED AT THE CONVEX SIDE WITH TEMPLASTE AS PER FIG -1 AND MAXIUM BAP BETWEEN TEMPLETE AND PETAL SURFACE SHALL NOT EXCEED 2MM AT ANY PLACE.

- NOTE 2:**
- 1) ROOT MISMATCH OF WELD JOINT FIT UP OF PETAL ASSY. SHALL NOT EXCEED 1MM
  - 2) THE GAP BETWEEN CIRCU;AR TEMPLATE AND THE PROFILE OF BUILT UP DISHED END AT THE WELD JOINTS SHALL NOT EXCEED 1.5MM(FIG.2).
  - 3) ALL BUTT WELDS SHALL BE FULL PENETRATION TYPE.

- NOTE 3:** THE FLATNESS OF COVER PLATE SHALL BE LIMITED TO ONE THOUSANDS OF THE DISHED AND DIA IN MM(REF./FIG 3)


- NOTE 4:** BLADES SHALL BE HOT PRESSED AND COLD CALIBRATED.

- NOTE 5:** THE BLADE TO HUB WELDS SHALL BE FREE FROM UNDERCUTS, HEAVY RIPPLES AND WELDS SHALL BE SMOOTHLY MERGED BY WELD DRESSING USING SPECIAL TEMPLATE FOR WELDING SIZE CHECKING.

- NOTE 6:**
- 1) THE VERTICALLY OF ANY TWO BLADE SHALL NOT EXCEED 2MM WHILE CHECKING TEMPLATE (FIG.4).
  - 2) THE GAP BETWEEN LEADING AND TRAILING EDGE OF BLADE SHOULD WITHIN THE MEDIUM TOLERANCE AS PER PR:QA:500/LATEST.
  - 3) THE LEVEL VARIATION OF LEADING AND TRAILING EDGE SHALL NOT DIFFER BETWEEN ANY TWO BLADES BY 2MM (FIG.5).
  - 4) THE BLADE PROFILE SHALL BE CHECKED WITH SETTING TEMPLATE AFTER WELDING.
  - 5) THE IDENTIFICATION HOLE FOR LOCATION OF BLADE SHALL BE PLUGGED AFTER CHECKING.
  - 6) THE FLANGE OF IMPELLER SHALL BE DRILED WITH DRILL JIG.

**NOTE 7: HEAT TREATMENT**

- 1) THE IMPELLER SHALL BE STRESS RELIEVED AFTER FULL WELDING.
- 2) SUFFICIENT CARE SHALL BE TAKEN TO AVOID DISTORTION.
- 3) STREES RELIEVING SHALL BE CARRIED OUT PRIOR TO FINAL MACHING AND AFTER ALL CORRECTION.
- 4) ONE ESCAPE HOLE OF DIA 6MM IS TO BE DRILLED ON THE COVER PLATE BEFORE STREES RELIEVEING AND THE SAME SHALL BE PLAGGED AFTER STREES RELEVEING.

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**NOTE 8: PROFILE CORRECTION**

- 1) BLADE PROFILE SHALL BE THERMALLY CORRECTED AFTER HEAT TREATMENT WHEREVER REQUIRED.
- 2) THE VARIATION ALLOWED SHALL BE AS PER TABLE 1.

**NOTE 9:**

- 1) PRODUCT NO. SHALL BE HARD STAMPED BEFORE DYNAMIC BALANCING.
- 2) ALL THE TACKS, UNDERCUTS SHALL BE FILLED. GROUND OFF OR CHIPPED.
- 3) THE BALANCING IS TO BE DONE WITH MANDREL. THE MANDREL SHALL BE FIRST DYNAMICALLY BALANCED TO GR.1 OF ISO 1940 THEN SHOULD BE ASSEMBLED WITH IMPELLER.
- 4) THE COMPENSATING MASS SHALL BE PROPERLY SECURED AS PER DRAWING. THE CUTOUTS ONCOVER PLATES SHALL BE REWELDED AFTER FIXING THE COMPENSATING MASS.

**NOTE 10:**

THE IMPELLER SHALL BE IDENTIFIED WITH W.O.NO., D.U.NO., PRODUCT NO. AND SUB-CONTRACTOR CODE BY PAINTING AND HARD STAMPING


**NOTE 11:**

**TOLERANCE FOR AN FAN IMPELLER BLADE CHECKING WITH THE TEMPLATE AFTER WELDING TO THE HUB.**

1. AN FAN IMPELLERS ARE OF WELDED DESIGN. THE CORRECT FORM AND THE LOCATION OF THE IMPELLER BLADES CAN BE CORRECTED ON THE COMPLETED (FINSH WORK) IMPELLERS BY THE APPLICATION OF HEAT WITH PROPER BLOW PIPES (GAS ORCHES).
2. THE CHECING IS DONE WITH THE HELP OF CHECKING FIXURE WHICH IS FIXED IN THE CORRESPONDING DISTANCE TO THE IMPELLER CENTRE ON A BASE PLATE. THE IMPELLER IS LOCATED ON A PIVOT (CENTRE) AS SHOWN IN FIG.6.
3. THE TOLERANCE ARE SO ESTABLISHED, THE THE AERODYNAMIC REQUIREMENTS AS WELL AS THE MANUFACTURING METHOD CALCULATIONS ARE SUPPORTED.

*THE FOLLOWING MEASUREMENTS ARE MADE, WHERE THE BEARING SURFACES OF THE CHECKING TEMPLATE SHOULD LIE (FIT) AGAINST THE BLADE.*

- (1) GAPS BETWEEN THE IMPELLER BLADE AND THE CHECKING TEMPLATE ON 3 LOCATION OF THE BLADE.(REFER FIGURE7).
  - a) ENTRY (AFTER THE ENTRY RADIUS), b) MIDDLE, C) EXIT (BEFORE THE CHMFERING)
    - i. THESE MEASUREMENTS ARE DEALT ESSENTIAL AT THE OUTER SECTION OF THE CHECKING TEMPLATE AS WELL AS AT THE SECTION THAT LIES UNIFORMLY OVER THE IMPELLER BOTTOM. (REFER FIGURE 8).
    - ii. FOR THE EVALUATION, THE OUTER SECTON IS USED. THE MEASU REMENT AT THE INNER SECTION SERVE MERELY THE INFORMATION AND INTERPRETATION WHEN LARGE DEVIATIONS ARE PRESENT AT THE OUTER SECTION. (REFER FIGHURE 9).
- 2) PROFILE CHORD LENGTH AT THE OUTER PROFILE SECTION.
- 3)THE DISTANCE (5) OF THE ENTRY EDGE FROM THE IMPELLER BOTTOM. WHEN THE LARGE DEVIATIONS ARE PRESENT IN

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DIMENSIONS (5) THE FOLLOWING INFLUENCING FACTORS ARE TO BE CHECKED.

- a) DIFFERENCE IN THE PROFILE CHORD (4)
- b) THE FORM OF THE ENTRY RADIUS

TABLE-1

FAN SIZE	INDIVIDUAL BLADE WELDED ON TO IIMPELLER		SUM OF THE TOLERANCE OF BLADE ON IMPELLER	
	ALLOWABLE PARALLEL GAP IN (MM)	ALLOWABLE DEVIATION FROM PARALLEL GAP IN (MM)	ALLOWABLE AVARAGE PARALLEL GAP (MM)	ALLOWABLE DEVIATION FROM PARALLEL GAP IN (MM)
AN 13	4	2	4	1.5
AN 18	5	2.5	5	2
AN 20	6	3	6	2
AN 21	6	3	6	2
AN 22	6	3	6	2
AN 25	7	3.5	7	2.5
AN 28	8	4	8	2.5
AN 30	8	4	8	2.5
AN 31	8	4	8	2.5
AN 33	9	4.5	9	3
AN 35	9	4.5	9	3
AN 37	10	5	10	3
AN 40	11	5.5	11	3.5
AN 42	11	5.5	11	3.5
AN 45	12	6	12	3.5
AN 47	12	6	12	3.5
AN 50	13	6.5	13	4



BHEL: BAP:RANIPAT  
TAMIL NADU - 632 406

**MANUFACTURING QUALITY PLAN**

Item/subsystem:  
**AN IMPELLER**

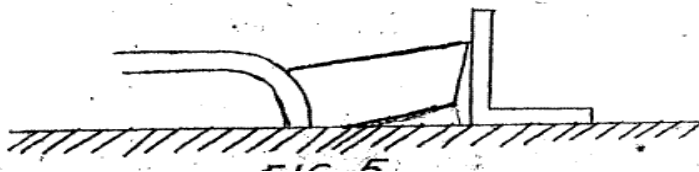
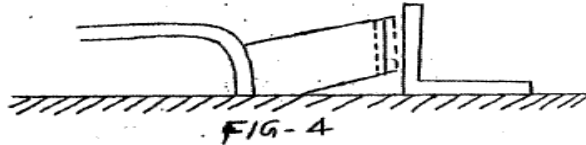
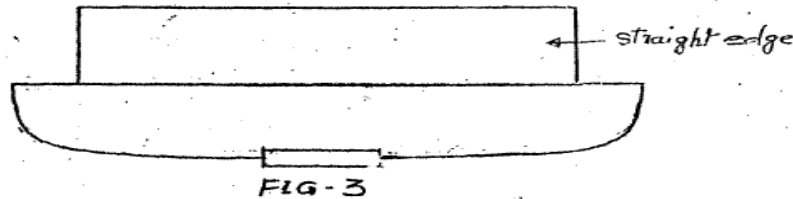
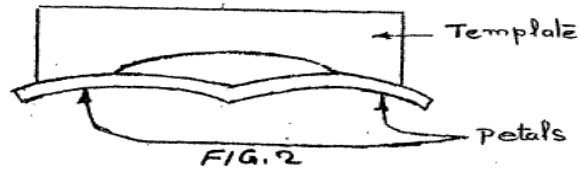
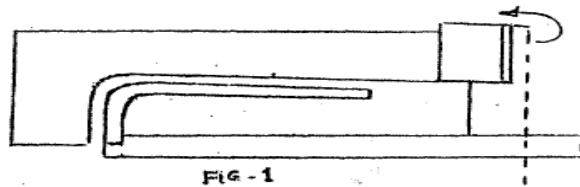
QP:No: **FAN 328**  
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PROJECT: **STANDARD**

PACKAGE : --

CONTRACTOR: BHEL/RANIPET

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BHEL: BAP:RANIPAT TAMIL NADU - 632 406		<b>MANUFACTURING QUALITY PLAN</b> Item/subsystem: <b>AN IMPELLER</b>			QP:No: <b>FAN 328</b> Rev: No: <b>02</b> Date: <b>16 02 10</b> Page : 9 of 010		PROJECT: <b>STANDARD</b> PACKAGE : -- CONTRACTOR: BHEL/RANIPET				

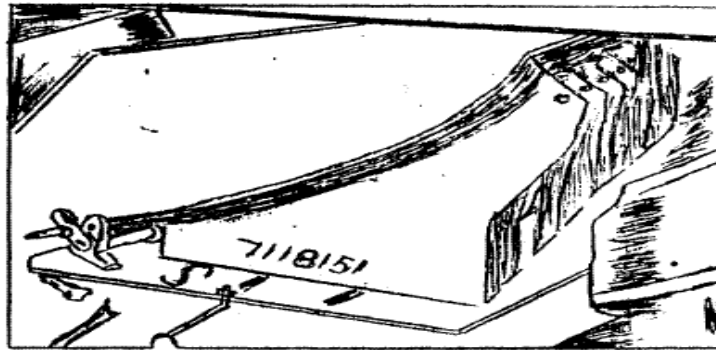


FIG-6

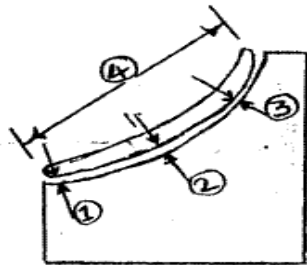


FIG-7

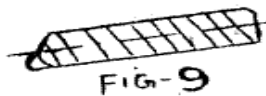


FIG-9

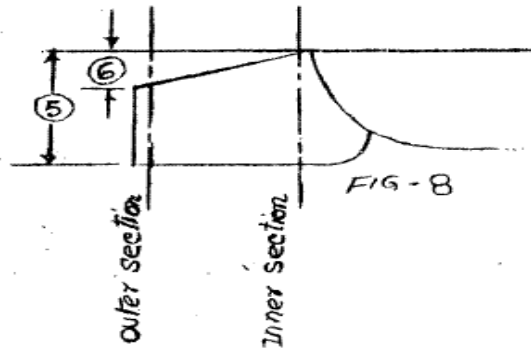

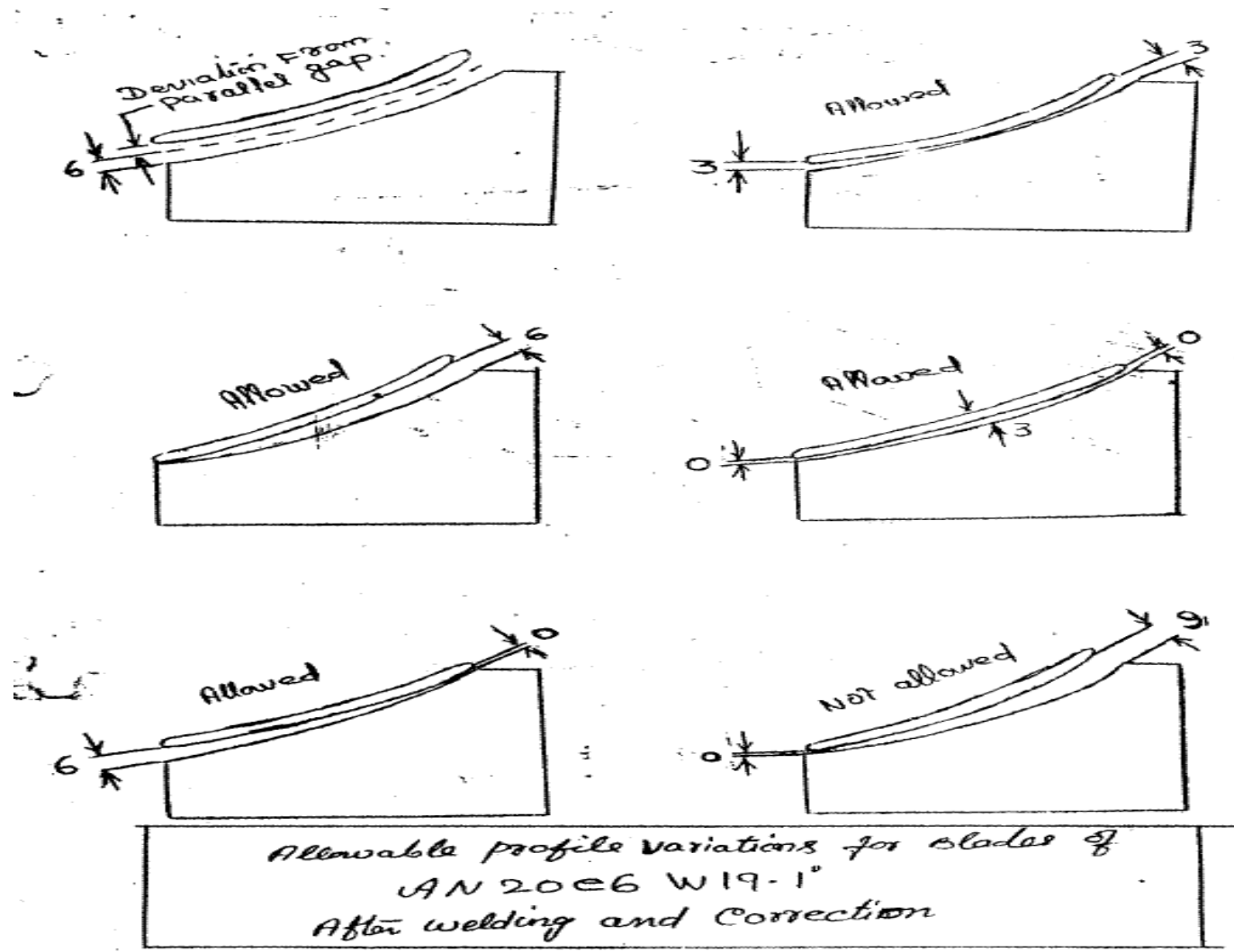


FIG-8

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BHARAT HEAVY ELECTRICALS LTD : STANDARD QUALITY PLAN FOR : NAME OF CONTRACT PACKAGE : QP NO.FAN342  
 BOILER AUXILIARIES PLANT : : STANDARD : REV  
 .NO. 01  
 RANIPET - 632 406 ( INDIA ) : SIPRAL CASINGS OF NDV,NDFV&NDZV : DATE 29 11 94  
 QUALITY ASSURANCE DEPT : : FANS : PAGE  
 01 OF 04

PREPARED BY : B. Srinivasulu REVIEWED BY : [Signature] APPROVED BY : [Signature]

S.No	COMPONENT & AGENCY REMARKS OPERATION	CHARACTERISTICS	CLASS CHECK	TYPE OF CHECK	QUANTUM	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC		
1	2	3	4	5	6	7	8	9	10	11
1.0	MARKING PROC	SHAPE & SIZE	MAJOR	VISUAL	100 &	DRAWING & PRQA : 500/LATEST & NOTE 1		LOG		QC/
2.0	CUTTING & EDGE PREPARATION									
2.0	SIDE WALL LAYOUT MARKING AND PUNCHING	LAYOUT DIMENSION	MAJOR	MEASURE - VISUAL	100 &	- DO -		LOG QC		QC
3.0	WELDING	WELD SIZE AND FINISH	MAJOR	VISUAL	100 &	DRAWING & NOTE 6 & 7		-		QC
4.0	DIMENSIONAL INSPECTION									
4.1	HORIZONTAL INDICATED TRIAL ASSY	DIMENSION * 1)DELIVERY OPENING DIMN 2)DELIVERY DUNT CENTRE TO DIFFUSERD CENTRE DISTANCE 3)DIFFUSER ID REDIAL DIMENSION 4)SIDE WALL& DIFFUSER AREA WATER LEVEL 5)TOP SUCTION CHAMBER EXTENSION SHELL TO DIFFUSER CO-AXIALITY 6)SIDE WALL TO SIDE WALL BETWEEN DISTANCES 7)DIFFUSER TO DIFFUSER BETWEEN DISTANCES	MAJOR	MEASURE- MENT	100 &	DRAWING&PRQA:500/LATEST& PRQA : 092 / 02 &NOTE 2 & 5 PRQA : 112 / 00		HISTORY CARD R49-335 R-037		QC * BELOW R49-392
4.2	VERTICAL QC TRIAL ASSY	DIMENSIONS INDICATED BELLOW 1)DIFFUSER ID RADIAL DIMENSION 2)DIFFUSER ID DIFFUSER AND EXTENSION SHELL CO-AXILIRTY 3)DIFFUSER TO DIFFUSER BEWEEN DISTENCES 4)DIFFUSER PLUMB OUT 5)DIFFUSER CENTRE TO SUCTION FLANGE TOP CENTRE DISTENCE 6)SUCTION FLANG OPEN OUT DIMENSION 7)FOOT WATER OPEN OUT DIMENSION 8)FOOT LAY OUT DIMENSION	MAJOR	MEASURE- MENT	100 &	DRAWING &PRQA 500/LATEST & PRQA : 092/ 02 NOTE 2.3.4 PRQA : 112 / 00				-DO-

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STANDARD QUALITY PLAN FOR

SPIRAL CASINGS OF NDV, NDFV & NDZV FANS  
29 11 94

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1 2 3 4 5 6 7 8 9 10 11

8)SIDE BLOCK & BLOCK DISTANCE FROM CENTRE  
9)FOOT HEIGHT FROM CENTRE OF THE SPIRALCASIG

5.0	FINAL INSPECTION	CLEANING PAINTING & IDENTIFICATION (MATCH MARKS) P.NO.WO.NO & DUNO .	MAJOR	VISUAL	100 & RP 0674199 / 1ATEST	DRG&GMS/OPS DRG/GMS/OPS	-	QC
-----	---------------------	---	-------	--------	------------------------------	----------------------------	---	----

NOTE 1 : GASCUTTING NOTCHES EXCEEDING 0.8 MM SHALL BE REPAIRED  
EDGE PREPARATIONS ARE TO BE MARKED BY PAINTS  
MATCH MARKS ARE TO BE INDICATED

NOTE 1 : 1)FOR RECTAGULAR FLANGS  
a) CENTRE LINE OF BOLT HOLES PARALALITY SHALL BE WITHIM +/- 2.5 MM  
b) PITCH DISTENCES FOR TWOCONSECUTIVE HOLE SHALL BE WITHIN +/- MM  
c) DEVIATION IN FLATENESS OF FLANGES SHALL NOT EXCEED 3MM  
d) DIAGONAL DISTENCE DIFFERENCE SHALL NOT EXCEED 1.5 MM/M  
2) INSIDE OF CIRCULAR FLANGS THE DIMENTRCALLY OPPOSITE HOLE DISTENCES SHLL NO  
EXCEED 1.5 MM/M.

---

STANDARD QUALITY PLAN FOR

Q.P.No.FAN 342

SPIRAL CASINGS OF NDV, NDFV & NDZV FANS  
29 11 94

REV. No .01

DATE :

PAGE : 02 OF 03

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1            2            3            4            5            6            7            8            9            10            11

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NOTE 3 : 1)INDIVIDUAL FOOT WATER LEVEL SHALL NOT EXCEED +/- 1MM  
2)FOOT TO FOOT WATER LEVEL DIFFERENCE SHALL NOT EXCEED 2MM

NOTE4 : 1)PLUMB OUT OF FOOT CENTRE CENTRE WITH RESPECT TO THE LAY OUT SHALL NOT EXCEED +/- 2MM  
2)DIFFUSER PLUMB OUT SHALL NOT EXCEED 3MM

NOTE 5 : AFTER HORIZONTAL TRIAL ASSY BEFORE VERTICAL TRIAL ASSY ALL PARTS TO BE DISMANTLED  
ALL THEWELDING AND HEAT CORRECTION OF HAVINESS SHALL BE CARRIED OUT AND  
COTCHES AND UNDER CUTS SHALL BE REMOVED

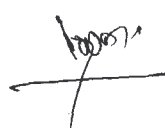
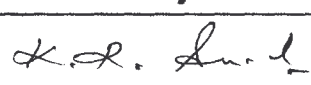

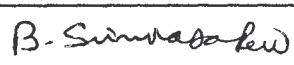
NOTE 6 : 1)LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR ATLEAST 2 HOURS AT 370 TO 430 DEG C  
AND HELD IN GOLDING OVENS AT 120-150 DEG C BEFORE USE .  
IF THE ELECTRODES ARE EXPOSED FOR MORE THAN 4 HOURS TO THE ATMOSPHERE THESE SHALL BE  
REBAKED AND DRIED IN THE SAME MANNER  
2) RUTIKE COATED ELECTRODES SHALL BE DRIED AT 120 - 130 DEG C FOR 1 HOUR BEFORE USF .

NOTE 7 : ALL BUTTJOINTS SHALL BE BAKGOUGED TO REMOVE ALL SLAG . UNFUSED ETC AND WELDED  
ON THE OTHERSIDE .

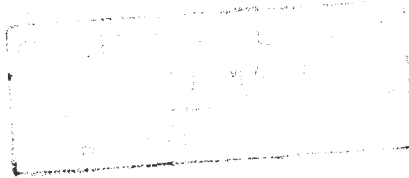
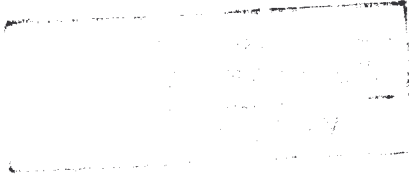
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<b>QUALITY DEPARTMENT</b>		
<b>Amendment to Quality Work Instructions (SQP)</b>		
<b>QWI NO: SQP:FAN:343</b>	<b>:03</b>	<b>DT. 22 07 95</b>
<b>Amendment no: A 2</b>		<b>DT. 02 01 03</b>
<b>Description DAMPER CONTROL ASSY</b>		

<b>Details of Amendment</b>		
<b>Note Sl.no.</b>	<b>Amended As</b>	<b>Basis For Amendment</b>
2.2.2	PT shall be done as per BHE:NDT:RP:PT01 for each layer of the weld for 10% of the damper shafts	Magnetic permeability results false indication in MT

<b>Prepared by</b>	<b>Reviewed By</b>		<b>Approved By</b>
	<b>QC/NDT</b>		 <b>Head (QA)</b>
	<b>QA</b>		

Controlled Copy No	
Issued to Shri	



<b>QUALITY DEPARTMENT</b>		
<b>AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )</b>		
QWI NO: SQP:FAN:343 AMENDMENT NO. A 1	REV 03	DATE : 22 07 95 DATE : 09 05 2001
<b>DESCRIPTION: DAMPER CONTROL ASSY</b>		
<b>DETAILS</b>		
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT/ REMARKS
2.2.2	MT ON WELDS SHALL BE 10%	PCM Ref BAP:QA:99:7079 dt 12 05 99 ( 6 <sup>th</sup> PCM for 98-99, CI No 2.14)
Prepared by <i>[Signature]</i>	Reviewed by B. Srinivas Rao	Approved by <i>[Signature]</i>

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BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET-632 406 (INDIA) QUALITY ASSURANCE DEPT.	STANDARD QUALITY CONTROL PLAN FOR DAMPER CONTROL ASSY	NAME OF CONTRACT PACKAGE STANDARD	QD.No.FAN343 REV.No.03 DATE 220795 PAGE 010F06
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PREPARED BY: *B. Srinivasan* REVIEWED BY: *Anand* APPROVED BY: *H. Anand*

1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIALS									
1.1.	CHEMMECH PROPERTIES OF RAW MATERIALS									
1.1.1	PLATES & CHANNELS	CHEMMECH PROPERTIES	MAJOR	VERIFICATION OF TCs	100%		RESPECTIVE MATERIAL SPECIFICATION	TC	QC-PROC	
1.1.2	ROUNDS	-DO-	MAJOR	-DO-	100%		-DO-	-DO-	-DO-	
1.1.3	TUBES	-DO-	MAJOR	-DO-	100%		-DO-	-DO-	-DO-	
1.1.4	BEARING HSG	-DO-	MAJOR	-DO-	100%		-DO-	-DO-	-DO-	
1.2.	SUBDELIVERIES**									
2.1.	SEALING RING, FASTNERS, SPLIT PINS, ROD ENDS ASSY, DIAL PLATES, DIRECTION PLATES, KEYS, POINTER	COMPLIANCE TO PURCHASE ORDER	MAJOR	-DO-	100%		PURCHASE ORDER	-DO-	-DO-	**APPLICABLE AS APPROPRIATE

QC/PROC: QUALITY CONTROL PROCUREMENT  
TC :TEST CERTIFICATE

MASTER COPY

QUALITY CONTROL PLAN FOR

DAMPER CONTROL ASSY

QP.No.FAN343

REV.No.03

DATE 220795

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1	2	3	4	5	6	7	8	9	10	11
2.0.	INPROCESS CONTROL									
2.1.	MARKING,CUTTING,MACHINING									
2.1.1	DAMPER HOUSING AND FLAPS MARKING & GAS CUTTING	SHAPE & SIZE	MAJOR	VISUAL & MEASUREMENT	100%		DRAWING AND DRQA:500 NOTE 1 <del>DO</del>			NOCD
2.1.2	DAMPER SHAFT FLANGE EP	DIMENSIONS	MAJOR	<del>DO</del>	100%		DRG & DRQA:500			NOCD
2.2.	WELDING									
2.2.1	WELDING OF FLAP, HOUSING, LEVER & LINK	WELD SIZE & FINISH	MAJOR	VISUAL	RANDOM		DRAWING & NOTE 2			NOCD
2.2.2	DAMPER SHAFT WELDING (if applicable)	WELD SOUNDNESS	MAJOR	HT	100%		BHE:NDT:MT1		NDTL REPORT	NDTL
2.3.	HEATTREATMENT									
2.3.1	DAMPER SHAFT (if applicable)	COMPLIANCE TO SR CYCLE	MAJOR	VERIFICATION OF HT CHART	100%		BAD:HT:001		HT CHART	NOCD

NDTL:NONDESTRUCTIVE TESTING LABORATORY  
S.R : STRESS RELIEF HT: HEATTREATMENT

100% ⇒ 100%

STANDARD QUALITY CONTROL PLAN FOR

DAMPER CONTROL ASSY

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1	2	3	4	5	6	7	8	9	10	11
2.4.	DIMENSIONAL INSPECTION									
2.4.1	HOUSING	i) FLANGE HOLE DIMENSIONS ii) HOLES PITCH iii) DIAGONAL iv) HEIGHT OF HOUSING v) WIDTH vi) LENGTH OF HSG vii) DRG HOUSING HOLES LOCATION viii) DRILLING & TAPPING	MAJOR MEASUREMENT		100%		DRAWING DR:QA:500 NOTE 3	HISTORY CARD	NQCD	
2.4.2	DAMPER SHAFT (if applicable)	i) OD OF SHAFT ii) OD OF FLANGE iii) KEY WAY DIMENSIONS iv) BOFF SET v) DRILL HOLE PCD vi) HOLE DIA	-DO-	-DO-	100%		-DO-	-DO-	NQCD	
2.4.3	BEARING HSG (if applicable)	ID, OD, DEPTH DRILL HOLE DIAMETER, PCD	-DO-	-DO-	100%		-DO-	-DO-	NQCD	

QUALITY CONTROL PLAN FOR

DAMPER CONTROL ASSY

QP NO: FAK343

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DATE: 220795

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1	2	3	4	5	6	7	8	9	10	11
2.4.4	LEAD	i) LENGTH ii) WIDTH iii) FLATNESS iv) DIAGONAL v) FLANGE DRILL HOLES PCD, DIA	MAJOR	MEASUREMENT	100%		DRAWING RPR:QA:500 NOTE: 3	HISTORY CARD	QC	
2.4.5	LEVER	i) BORE ii) KEY WAY WIDTH & DEPTH ORIENTATION PARALLELITY OF BIG & SMALL HOLE	MAJOR	-DO-	100%		DRAWING RPR:QA:500	-DO-	-DO-	
2.4.6	LEVER BOSS	BORE, STEP DIA KEY WAY WIDTH, DEPTH	MAJOR	-DO-	100%		-DO-			
2.4.7	LINK ASSY	LENGTH THREAD SIZE OF LEFT & RIGHT HAND THREADS	MAJOR	-DO-	100%		-DO-	-DO-	-DO-	
2.4.8	PIN FOR CONNECTING LEVER LINK	OD, LENGTH	MAJOR	100%	MEASUREMENT		-DO-	-DO-	-DO-	
2.4.9	ADJUSTING RIN	BORE, THICKNESS THREAD SIZE	MAJOR	100%	-DO-		-DO-	-DO-	-DO-	

*Rev*

STANDARD QUALITY CONTROL PLAN FOR

Q.P.NO.FAN343

DAMPER CONTROL ASSY

REV.NO:03

DATE: 220795

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1	2	3	4	5	6	7	8	9	10	11
3.0.	FINAL INSPECTION OF DAMPER ASSY									
3.1.		i)FLAP TO FLAP GAP(IN FULL CLOSE CONDITION) ii)HOUSING TO FLAP GAP	MAJOR	MEASURE MENT	100%		MAXIMUM 3 MM  DRAWING SPR:QA:500 NOTE 5	HISTORY CARD	NOCD	
3.2.	TRIAL OPERATION	EASY CLOSING & OPENING OF FLAPS	MAJOR	VISUAL	100%		FLAPS MUST FREELY OPEN & CLOSE ,NOTE 5	--	-00-	
3.3.		i)CLEANING PAINTING,IDENTIFICATION AND PRESERVATION	MAJOR	VISUAL	100%		GNSPR:QA:590	--	-00-	
<p>NOTE:1 i)PLATES CUT BY FLAME SHALL BE CLEANED TO REMOVE SLAG &amp; UNEVEN EDGES ii) GAS CUTTING NOTCHES EXCEEDING 0.8 MM SHALL BE FILLED BY WELDING BEFORE ASSY</p> <p>NOTE:2 i) WELDERS EMPLOYED SHALL BE QUALIFIED AS PER AWS D.1.1 ii) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs MIN AT 370 DEG C TO 430 DEG C AND HELD IN HOLDING OVEN AT 120-150 DEG C BEFORE USE. iii) ELECTRODES OPENED TO ATM MORE THAN 4 Hrs SHALL BE REBAKED AND DRIED IN THE SAME MANNER. iv) RUTILE ELECTRODES SHALL BE DRIED AT 120-130 DEG FOR 1 HOUR BEFORE USE v) ALL THE BUTT JOINTS SHALL BE BACKGAUGED TO REMOVE SLAG, UNFUSED AREA ETC. AND WELDED ON THE OTHER SIDE</p>										

STANDARD QUALITY CONTROL PLAN FOR

Q.D.NO.FAN343

REV.NO.03

DATE:220795

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DAMPER CONTROL ASSY

1 2 3 4 5 6 7 8 9 10 11

\*\*\*\*\*DOCUMENTS REFERED IN COLUMN 7&8 SHALL BE OF LATEST ONLY.\*\*\*\*\*

- NOTE:3
- i) FOR RECTACULAR FLANGES THE CENTRE LINE OF BOLT HOLES ON OPPOSITE FACES SHALL BE PARALLEL WITH IN +/- 2 MM .
  - ii) PITCH OF TWO COSECUTIVE HOLES SHALL BE WITHIN +/- 1 MM.
  - iii) CUMULATIVE VARIATION ON PITCH DISTANCE SHALL NOT EXCEED +/- 2 MM.
  - iv) STRAIGHTNESS OF LINE JOINING HOLES SHALL BE WITHIN +/- 1 MM.
  - v) DIAGONAL DIFFERENCE SHALL NOT EXCEED +/- 1.5 MM /METRE SUBJECT TO MAX 5 1 FOR HSG AND 3 MM FOR FLAPS.
  - vi) TOLERANCE FOR FLAP LENGTH BWIDTH 0 TO +2MM DIAGONAL 0 TO +3 MM
  - vii) MAXIMUM OUT OF CO-AXIALITY IS 1 MM FOR SHAFT HOLES AND MAX TWIST ON FLAPS IS 2 MM.
  - viii) TOLERANCE FOR HOUSING INSIDE LENGTH BWIDTH IS 0 TO + 2MM AND FOR DIAGONAL IT IS 0 TO + 3MM.
  - ix) GAP BETWEEN FLAP FLANGE AND DAMPER SHAFT FLANGE SHALL BE MAX 0.2 MM AFTER ASSY
  - x) FIXTURE SHALL BE USED FOR DRILLING HOLES ON DAMPER SHAFT FLANGE WITH REFERENCE TO KEYWAYS.

NOTE 4 : NO.NO,DU,PRODUCT NO AND DIRECTION OF ROTATION SHALL BE PAINTED ON THE DAMPER.

- NOTE 5:
- i) SUITABLE HOLE TO BE DRILLED DURING ASSY IN SHAFTS FOR FIXING POINTER/GRUB SCREW
  - ii) SPLIT PINS SHALL BE ENSURED IN ALL THE PINS CONNECTING LEVER AND LINK ASSY .
  - iii) ENSURE THAT AT FULL OPEN OF FLAPS POINTER IS FIXIED AT '0' DEG
  - iv) ENSURE THE FIXING OF DIRECTION PLATE AND DIAL PLATE CORRECTLY.
  - v) ENSURE THE WELDING OF TEMPORARY STOPPERS AND YELLOW PAINTING AFTER THE FINAL OPERATION
  - vi) MINIMUM GAP AS PER DRAWING SHALL BE MAINTAINED BETWEEN FLAPS AND HOUSING.
  - vii)ENSURE THE TACK WELDING OF GRUB SCREW NUT ON ADJUSTING RING .
  - viii) ENSURE PERPENDICULARITY OF FLAPS A FULL OPEN CONDITION.
- VERTICALITY SHALL BE 90 DEG +/- 3 DEG.

*Handwritten notes:*  
 Note 1  
 Flame Solenoid  
 Hall v. 3msd 3ms

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 IMPELLER OF CZECH DESIGN DL TYPE

NAME OF CONTRACT PACKAGE  
 STANDARD

OPNO.FAN347  
 REV.No.02  
 DATE:200695  
 PAGE 01 of 04

PREPARED BY: *B. Suresh Babu*  
 REVIEWED BY: *[Signature]*  
 APPROVED BY: *[Signature]*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIAL									
1.1.	CHEM&MECH PROPERTIES									
1.1.1	PLATES FOR IMPELLER	CHEMISTRY & TENSILE PROPERTIES	MAJOR	VERIFICATION OF TCS	100%	RESPECTIVE MATERIAL STANDARD		TC	QC/RMS	
1.1.2	IMPELLER RING	-DO-	MAJOR	-DO-	-DO-	-DO-		-DO-	-DO-	
1.2.	INTERNAL QUALITY									
1.2.1	PLATES FOR IMPELLER	INTERNAL SOUNDNESS	MAJOR	-DO-	100%	SEL 072		-DO-	-DO-	
1.2.2	IMPELLER RING	-DO-	MAJOR	-DO-	100%	SA 609		-DO-	-DO-	

MASTER COPY

QC-RMS : QUALITY CONTROL RAMMATERIAL STORES  
 TC: TEST CERTIFICATES



STANDARD QUALITY CONTROL PLAN FOR  
 IMPELLER OF CZECH DESIGN DL TYPE

QP.NO.FAN347  
 REV.NO.02  
 DATE:200695  
 PAGE:03 OF 04

1	2	3	4	5	6	7	8	9	10	11
2.4.	HARDFACING									
2.4.1	HARDFACING ON IMPELLER BLADES	HARDNESS	MAJOR	HARDNESS CHECK	**	MIN 500 BHN AND NOTE 2		REPORT	VQCD	**REF. NOTE1
2.5.	DYNAMIC BALANCING									
2.5.1	IMPELLER ASSY UNBALANCEMENT	RESIDUAL CAL	CRITI-UNBALANCE COMPENSATION		100%	MANUFACTURING DRAWING		BALANC- ING REPORT	DO-	
3.0.	IDENTIFICATION PAINTING PRESERVATION	COMPLIANCE TO COMPANY STANDARD(CL.7&8)	MAJOR	VISUAL	100%	PR:QA:512 &NOTE 3			DO-	
<p>NOTE 1: a) WELDERS SHALL BE QUALIFIED AS PER ASME SEC IX IN 3G POSITION</p> <p>b) FOLLOWING WPS SHALL BE REFERRED FOR WELDING:</p> <p>MATERIAL COMBINATION</p> <p>1) NAXTRA70+NAXTRA70 WPS 012</p> <p>2) WSTE355+WSTE355 013</p> <p>3) NAXTRA70+WSTE355 014</p> <p>c) GAS CUT EDGES SHALL BE GROUND SMOOTH BEFORE WELDING.</p> <p>d) INCASE OF QUENCHED AND TEMPERED STEELS LIKE NAXTRA 70 OR EQUIVALENT, MT/UT SHALL BE DONE AFTER 48 HOURS OF COMPLETION OF WELDING.</p> <p>e) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs MIN. AT 370-430 °C AND HELD IN HOLDING OVEN AT 120-150 °C BEFORE USE.</p> <p>f) ELECTRODES OPEN TO ATMOSPHERE FOR MORE THAN 5 MINUTES SHALL BE REBAKED AND DRIED IN THE SAME MANNER</p> <p>g) BLADE WELDS SHALL BE TOE GROUND TO A MAXIMUM DEPTH OF 0.6 MM AT THE ENTRY AND EXIT OF FILLET WELDS.BLADE WELD WITH BACK PLATE AND COVER PLATE SHALL BE SMOOTHLY ROUNDED AT ENDS.</p> <p>h) BACK PLATE SHALL BE STRAIGHTENED TO WITHIN 2 MM BEFORE WELDING.</p>										

STANDARD QUALITY CONTROL PLAN FOR  
 IMPELLER OF CZECH DESIGN DL TYPE

QP.NO.FAN347  
 REV.NO.02  
 DATE:200695  
 PAGE:04 OF 04

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11

NOTE 2: a) ELECTRODE FOR HARD FACING IS CITORAIL-111 OF ADVANI-OERLIKON/BOR-C OF D&H/  
 GRIDUR-600 OF GENERAL ELECTRODES&EQUIPMENT LTD  
 b) PITCH OF HARDFACING RUN SHALL BE 50 MM.  
 c) WIDTH OF RUN SHALL NOT EXCEED 10 MM  
 d) MAXIMUM HEIGHT OF RUN SHALL BE 5 MM.  
 e) ONE MOCKUP PIECE OF SIZE 25x25 MM MINIMUM SHALL BE HARDFACED AND CHECKED FOR  
 HARDNESS BEFORE HARDFACING ON BLADES, FOR EACH IMPELLER.

NOTE 3: IMPELLERS SHALL BE IDENTIFIED WITH M.O.NO, DUNO, AND PRODUCT NO.  
 BY PAINTING AND HARD PUNCHING DIRECTION OF ROTATION SHALL BE PAINTED ON THE  
 IMPELLER.

BHARAT HEAVY ELECTRICALS LTD  
 QPNO:FAN350  
 BOILER AUXILIARIES PLANT  
 00  
 RANIPET -632 406 (INDIA)  
 050695  
 QUALITY ASSURANCE DEPT.

TIME OF CONTRACT PACKAGE  
 STANDARD  
 REV.NO :  
 DATE:

QUALITY CONTROL PLAN FOR  
 EXPANSION JOINT FOR FANS

PREPARED BY :  REVIEWED BY :  APPROVED BY : 

S.NO	COMPONENT & REMARKS OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	PURCHASE ORDER	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT AGENCY OF REC
1.0	MATERIAL								
1.1	a) RUBBER BELT COMPLIANCE b) SS WIRE MESH TO PURCHASE ORDER c) WOOL ORDER d) ANGLES e) PLATES / SHEETS f) RODS g) FASTNERS		MAJOR	REVIEW OF TCs	100%	PURCHASE ORDER	PURCHASE ORDER	TC	QC/PROC
2.0	INPROCESS CONTROL								
2.1	GAS CUTTING	SIZE RADIUS AND EDGE PREPARATION	MAJOR	MEASURE-MENT	100%		DRAWING NOTE 1	--	VQCD
2.2	WELDING VQCD	WELD SIZE & FINISH	MAJOR	RANDOM	100%		DRAWING NOTE 2	--	VQCD
2.3	ROLLING/ BENDING	RADIUS	MAJOR	-DO-	100%		DRAWING	--	VQCD
2.4	DRILLING & SLOTTING	SIZE &	MAJOR	-DO-	100%		DRAWING NOTE 3	DR	VQCD
2.5	RUBBER BELT	SIZE, EP	MAJOR	-DO-	100%		DRAWING & NOTE 4	--	VQCD



(If applicable) VUCANISING  
OR BONDING

QUALITY CONTROL PLAN FOR

QP.NO:FAN350  
REV:NO:00  
DATE:050695  
PAGE 02

EXPANSION JOINTS  
OF02

1	2	3	4	5	6	7	8	9	10	11
3.0	FINAL INSPECTION	a) OPENING DIMENSIONS	MAJOR	MEASURE- MENT	100%		DRAWING		DR	VQCD
		b) WIDTH, HT & DIGONAL	MAJOR	-DO-	100%		DRAWING		DR	VQCD
		c) PROPER ASSY	MAJOR	-DO- OF WOOL, WIRE MASH & RUBBER BELT	100%		DRAWING NOTE 5		DR	VQCD
		d) PAINTING	MAJOR	VISUAL	100%		PR : QA 590&512			VQCD
		e) PRESERVATION		-DO-	-DO-		GMS/P.O			VQCD
		f) IDENTIFICATION		-DO-	-DO-		GMS/P.O			--

NOTE 1: GAS CUTTING NOTCHES EXCEEDING 0.8 MM SHALL BE FILLED BY WELDING BEFORE ASSY

NOTE 2: 1) WELDER SHALL BE QUALIFIED AS PER AWS D1.1 / LATEST

2) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs MIN AT 370 - 470 DEG C AND HELD IN HOLDING OVEN AT 120 - 150 DEG C BEFORE USE.

3) ELECTRODES OPENED TO ATMOSPHERE FOR MORE THAN 4 Hrs SHALL BE REBAKED AND DRIED

4) RUTILE ELECTRODES SHALL BE DRIED AT 120-130 DEG C FOR 1 HOUR BEFORE USE.

5) AVOID WELDING WHEREVER NOTE AS "NOTE TO BE WELDED" IS GIVEN IN DRAW.

NOTE 3: 1) DRILLING SHALL BE DONE WHEREVER DRAWING CALLS FOR.


2) ALL THE DRILL HOLES SHALL BE DEBURRED

3) a) PITCH DISTANCE OF TWO CONSECUTIVE HOLES SHALL BE WITHIN +/- 1 MM

b) DEVIATION OF FLATNESS ON FLANGS SHALL NOT EXCEED 3 MM.


c) DIAGONAL DIFFERENCE SHALL NOT EXCEED 1.5 MM/METRE SUBJECT TO THE MAXIMUM OF 3 MM.

- NOTE 4: 1) FOR JOINING RUBBER SHEETS VULCANISING OR ADHESIVE BONDING CAN BE ADOPTED.  
2) ADHESIVE SHALL BE APPLIED BETWEEN STEEL STRUCTURE AND RUBBER ALSO MAINTAINING MINIMUM OVERLAP AS PER DRAWING.  
3) JOINING SURFACES SHALL BE SMOOTH AND CLEAN. BONDING SHALL BE PREFERABLY DONE IN SEMICLOSED AREA TO AVOID DUST ENTRY.
- NOTE 5: 1) PROPER BONDING OF RUBBER BELT WITH STEEL STRUCTURE MAY BE CHECKED BY PULLING THE BELT BY HAND AND THE BELT SHOULD NOT DEBOND FROM THE STRUCTURE.


 <b>RANIPET-6</b>		<b>BHEL: BAP:RANIPAT</b> <b>TAMIL NADU – 632 406</b>		<b>MANUFACTURING QUALITY PLAN</b>			<b>PROJECT: STANDARD</b>		
		<b>Item/subsystem:</b> <b>Damper Shaft</b>		<b>QP:No : FAN 372</b> <b>Rev: No: 00</b> <b>Date : 21 08 08</b> <b>Page 01 Of 03</b>		<b>ACCEPTANCE</b> <b>NORMS</b>		<b>Agency</b> <b>9</b>	
<b>REMARKS</b> <b>KS</b> <b>10</b>		<b>CONTRACTOR: BHEL/RANIPET</b>		<b>REFERENCE</b> <b>DOCUMENTS</b>		<b>FORMAT</b> <b>OF</b> <b>RECORD</b>		<b>8</b>	
<b>QUANTUM</b> <b>OF</b> <b>CHECK</b>		<b>TYPE OF</b> <b>CHECK</b>		<b>6</b>		<b>7</b>		<b>REMAR</b> <b>KS</b> <b>10</b>	
<b>5</b>		<b>4</b>		<b>3</b>		<b>2</b>		<b>1</b>	

SL NO	COMPONENT & OPERATION	CHARACTERISTI CS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	Agency	REMAR KS
1.0	Material	Chem. & Mech. Properties	Review of test certificates	100%	Respective Material Specification	Respective Material Specification	TC	P	V
1.1	Round & flange								
2.0	INPORCESS								
2.1	Pre Machining								
2.1.1	Couplings	OD.Length & EP	Measurement	100%	Drawing	Drawing	DR	P	W
2.1.2	Flange	OD, facing for shaft seating	Measurement	100%	-DO-	-DO-	DR	P	W
2.2	Welding								
2.2.1	Flange With round fit up	Fit up gap	Visual	100%	-DO-	-DO-	-	P	-
2.2.2	Root welding	Root run defects	LPI	100%	BHE:::NDT:RP:PT: 01/Lates Drawing	BHE:::NDT:RP:PT :01/Lates Drawing	NDT REPT -	P	W
2.2.3	Full welding	Fillet size	Visual	100%				P	-

Best regards, M – Manufacturer  
 B – BHEL / BHEL Authorized Inspection Agency,  
 C – Customer, P – perform,  
 V – Verification of reports  
 W – Witness, TC – Test certificate  
 DR – Dimensional report.



**Prepared BY**  



**Reviewed & Approved By**  


 <b>RANIPET-6</b>		<b>BHEL: BAP:RANIPAT</b> <b>TAMIL NADU – 632 406</b>		<b>MANUFACTURING QUALITY PLAN</b>			<b>PROJECT: STANDARD</b>		
		<b>Item/subsystem:</b> <b>Damper Shaft</b>		<b>QP:No : FAN 372</b> <b>Rev: No: 00</b> <b>Date : 21 08 08</b> <b>Page 02 Of 03</b>		<b>ACCEPTANCE</b> <b>NORMS</b>		<b>FORMAT</b> <b>OF</b> <b>RECORD</b>	
<b>COMPLEMENT &amp;</b> <b>OPERATION</b>		<b>CHARACTERISTI</b> <b>CS</b>		<b>TYPE OF</b> <b>CHECK</b>		<b>REFERENCE</b> <b>DOCUMENTS</b>		<b>Agency</b>	
<b>2</b>		<b>3</b>		<b>4</b>		<b>6</b>		<b>9</b>	
<b>SL</b> <b>NO</b>		<b>1</b>		<b>5</b>		<b>7</b>		<b>8</b>	
<b>REMAR</b> <b>KS</b>		<b>10</b>		<b>CONTRACTOR: BHEL/RANIPET</b>					

<b>2.3</b> <b>Stress relief</b>		<b>Compliance to</b> <b>HT cycle</b>		<b>Verification</b>		<b>100%</b>		<b>BAP: HT:001/Lates</b>		<b>HT</b> <b>Chart</b>		<b>P</b>		<b>V</b>	
<b>2.3.1</b> <b>Damper shaft</b>								<b>BAP: HT:001/Lates</b>							
<b>2.4.0</b> <b>Weld soundness</b>															
<b>2.4.1</b> <b>Damper shaft</b>		<b>Weld soundness</b>		<b>MPI</b>		<b>10%</b>		<b>BHE;</b> <b>NDT:RP:MT:01/latest</b>		<b>BHE;</b> <b>NDT:RP:MT:01/late</b> <b>st</b>		<b>P</b>		<b>W</b>	
<b>2.5</b> <b>Machining</b>															
<b>2.5.1</b> <b>Shaft</b>		<b>OD, lengths</b> <b>Drill holes dia</b> <b>Key way</b> <b>dimensions &amp;</b> <b>Orientation</b> <b>And key way</b> <b>offset</b>		<b>Measure-</b> <b>ment</b>		<b>100%</b>		<b>Drawing</b>		<b>Drawing</b>		<b>DR</b>		<b>P</b>	

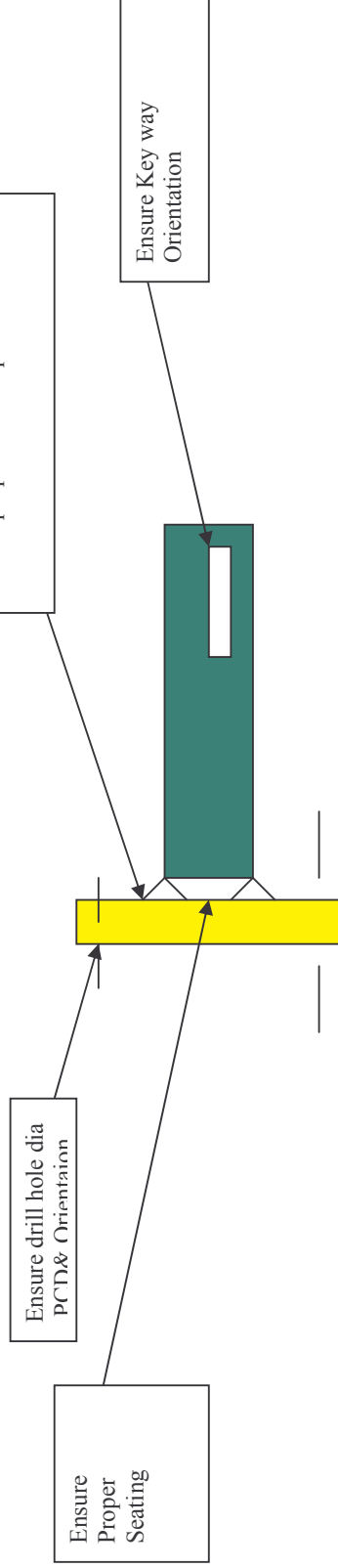
- NOTE 1**
- 1) The flange shall be face machined to ensure proper seating of the round & to ensure no gap between the flange & round.
  - 2) Edgepreparation details shall be verified during fit up –asper drawing.
  - 3) Root run shall be done with 2mm electrode to ensure proper fusion
  - 4) Preheat of 120-150 Deg shall be before doing welding.
  - 5) Shall be post heat treated to 250 Deg C
  - 6) Root Run shall be checked by DP and subsequent layers shall be checked for DP

<b>Best regards,M – Manufacturer</b> <b>B – BHEL /BHEL Authorized Inspection Agency,</b> <b>C -Customer, P – perform,</b> <b>V - Verification of reports</b> <b>W – Witness, TC - Test certificate</b> <b>DR – Dimensional report.</b>		<b>Prepared BY</b> 		<b>Reviewed &amp; Approved By</b> 	
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 <b>RANIPET-6</b>		<b>BHEL: BAP:RANIPAT</b> <b>TAMIL NADU – 632 406</b>		<b>MANUFACTURING QUALITY PLAN</b>			<b>PROJECT: STANDARD</b>		
		<b>Item/subsystem:</b> <b>Damper Shaft</b>		<b>QP:No : FAN 372</b> <b>Rev: No: 00</b> <b>Date : 21 08 08</b> <b>Page 03 Of 03</b>		<b>REFERENCE DOCUMENTS</b> 6		<b>ACCEPTANCE NORMS</b> 7	
<b>SL NO</b> 1		<b>COMPONENT &amp; OPERATION</b> 2		<b>CHARACTERISTI CS</b> 3		<b>TYPE OF CHECK</b> 4		<b>QUANTUM OF CHECK</b> 5	
						<b>REMAR KS</b> 10		<b>Agency</b> 9	
						<b>FORMAT OF RECORD</b> 8		<b>CONTRACTOR: BHEL/RANIPET</b>	

- NOTE1:**
- 1) WELDERS SAHLL BE QUALIFIED AS PER AWS D1.1 /ASME SECTION IX /LATEST .
  - 2) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs AT 350 DEG C AND DRIED AT 150 DEG C BEFORE WELDING.
  - 3) ELECTRODES OPENED TO ATMOSPHERE MORE THAN 4 Hrs SHALL BE RE-BAKED
  - 4) SEQUENCE OF WELDING SHALL BE ADOPTED
  - 5) FULL PENETRATION WELD SHALL BE ENSURED BY BACK CHIPPING
  - 6) DEFECTS LIKE CRACKS, PROSITTY, UNFUSED METAL, SHALL BE REMOVED WHILLE WELDING
  - 7) WELD SHALL BE FREE FROM OIL GREASE, RUSE ETC, & CRATER TO BE REMOVED
  - 8) THE TOES OF THE FILLET WELDS SHALL BE SMOOTHLY GROUND FOR THE LENGTH AS SHOWN IN THE DRG.
  - 9) BUTT WELDS SHALL BE GROUND FLUSH.
  - 10) TACKS AND BRIDGES SHALL BE REMOVED BY CHIPPING
  - 11) NO JOINT IS ALLOWED ON THE BACK PLATE OR IMPELLER RING

- NOTE2:**
- 1) PLATES CUT BY FLAME SHALL BE CLEANED TO REMOVE SLAG & UNEVEN EDGES
  - 2) GAS CUT NOTCHES SHALL BE FILLED BY WELDING.



Best regards, M – Manufacturer  
 B – BHEL /BHEL Authorized Inspection Agency,  
 C -Customer, P – perform,  
 V - Verification of reports  
 W - Witness, TC - Test certificate  
 DR – Dimensional report.

**Prepared By**

*(Signature)*

**Reviewed & Approved By**

*(Signature)*



Ranipet

# Check list for Chimney

(Diameter up to and including 3.5 meter)

Doc No ICL 104

Rev no 01

Date 24 02 2011

Page No 1 of 5

SI No	Details of Check	Acceptance Norm	Records	Agency	
				QC/Shop	QC/OLI
01	a) Butt weld soundness RT/ UT /MPI	BHE NDT RP RT 01/Latest and Note I BHE NDT RP UT 01/Latest and Note 1 BHE NDT RP MT 01/Latest and Note I	Report	--	✓
	b) Fillet welds-LPI.	BHE NDT RP PT 01/Latest / Note I			
02	Shell plate preparation	Note II.			
03	Base plate Assembly	Drawing /Note III	DR	--	✓
04	Shell dimension (Individual)	Drawing/ Note IV	DR	--	✓
05	Trial assembly of Shells	Drawing /Note V	DR	--	✓
06	Final inspection Painting coating thickness Match mark identification Stenciling of WO/DU details Flow direction	PRQA 590/latest, /Note VI	--	--	✓

### Notes:

#### I Welding

1. All butt weld of thickness more than 6 mm shall be double V with back gouging / grinding and root LPI and final MPI.
2. Butt joints of base plates of thickness more than 50 mm shall be UT/RT tested.
3. T joints 100% RT to be tested . All butt joints of shell welds shall be MPI tested. For plate thickness more than 10 mm weld shall be tested with MPI on both sides.

Rev 00 DTD 06 03 06

Original Issue

Rev 01 DTD 24 02 2011

Amendment A1 DTD 06 11 07 width drawn

*Signature*

Prepared By

*Signature*

Reviewed By

*Signature*

Approved By



Ranipet

# Check list for Chimney

(Diameter up to and including 3.5 meter)

Doc No

Rev no

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Page No

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01

24 02 2011

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## II Shell Plate Preparation

- 1 Ensure the edge preparation of each shell plate before pre bend operation.(EP shall be on ID side)
- 2 Ensure the Length, Width and diagonal of each shell plate as per drawing and in no case, plate cut edge shall be out of straightness by more than 2mm to entire length.
- 3 Shell radius shall be checked with template and the chord length of the template shall be  $1/3$  to  $1/5$  of the diameter

## III Base plate assembly

1. Check the dimension of base plate and stool plate segments.
- 2.\* Match drill base plate and stool plate and enlarge the hole in base plate as per drawing and Check the holes pitch after drilling.
3. Check the coaxiality of bottom and stool plate Holes after completion of full welding by suitable plug type gauge.
- 4 Check Vertical assembly dimension for base assly. with Bottom chimney shell (first Shell).

## IV Dimensional check of Individual shell

- 1 Check the height, Top and bottom shell diameter, Axis deviation, Top and bottom face out ovality, Diagonal.


## V Trail assembly (Shells)

- 1 Horizontal /vertical Trial assembly shall be carried out for Flanged chimney shells (Only when there is variation in thickness in adjacent joining shells) after dimensional check of individual shells. For other flanged shells (where there is no variation in thickness in adjacent joining shells) and un flanged shells, only individual dimensional check is applicable.
- 2 Shells under trial assembly shall be placed on the leveled Horizontal supports.

*S. Srinivas*  
Prepared By

*P. Lakshmi*  
Reviewed By

*S. Srinivas*  
Approved By

 Ranipet	<h2>Check list for Chimney</h2> <p>(Diameter up to and including 3.5 meter)</p>		Doc No	ICL 104
			Rev no	01
			Date	24 02 2011
			Page No	3 of 5

- 3 Shell circumferential mismatch shall be checked on the ID of the shell with 1 meter straight edge at the shell joining area with in 2 mm (where ever Turn buckle, wedges are used to bring the mismatch with in 2 mm and the same area to be supported with temporary support and the same to be removed after correcting the permanent stiffener as shown in the drawing.)
- 5 Root gap between the adjacent shells to be within limits as specified in the drawing.
- 6) Following dimensions are to be checked during horizontal trial assembly and recorded as shown in sketch -I

**(a) OVER ALL LENGTH**

A1, B1	A2, B2	A3, B3	A4, B4	A5, B5	A6, B6	Tolerance With in 2mm
A7, B7	A12, B12	A11, B11	A10, B10	A9, B9	A8, B8	

**(b) DIAGONAL CHECK**

A1, B7	A2, B8	A3, B9	A4, B10	A5, B11	A6, B12	Tolerance With in 3mm
B1, A7	B2, A8	B3, A9	B4, A10	B5, A11	B6, A12	

**© F LANGE FACE OUT**

Side A	A1, A7	A2, A6	A3, A5	A12, A8	A11, A9	Tolerance With in 2mm
Side B	B1, B7	B2, B6	B3, B5	B12, B8	B11, B9	

Prepared By 	Reviewed By 	Approved BY 
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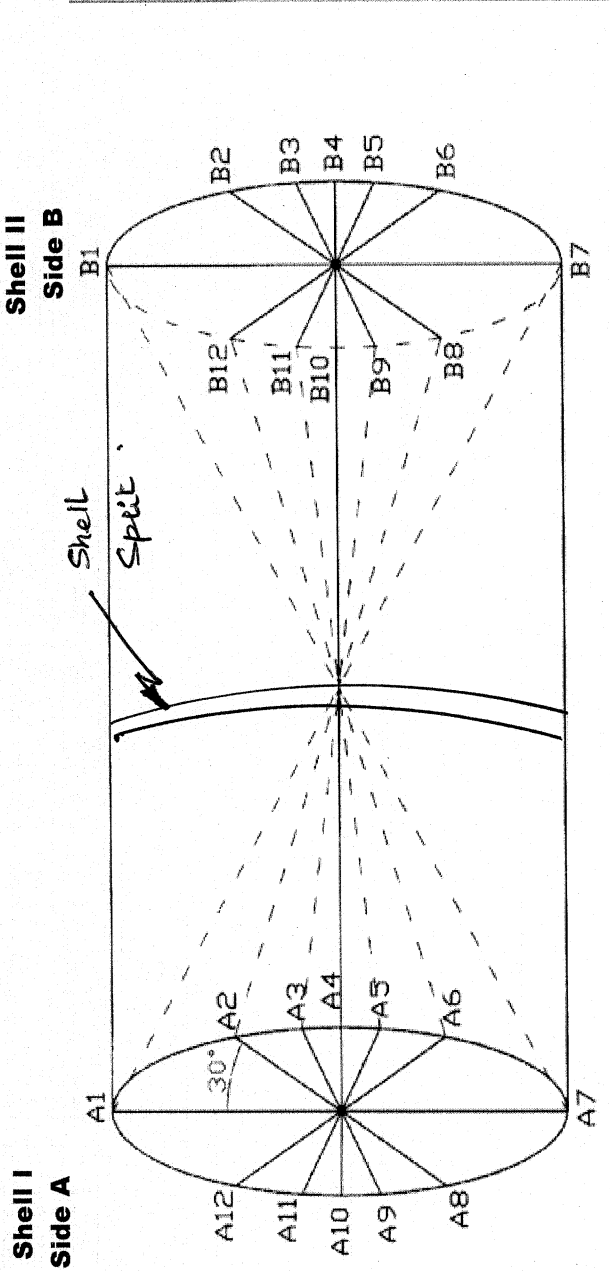
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# Check list for Chimney

(Diameter up to and including 3.5 meter)

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## VI General

1. Surface preparation and Painting shall be as per PRQA 590 / latest
2. For all circumferential joint, match marking shall start with C1, C2.....CXX and for all longitudinal joints, match marking shall start with L1, L2, .....LXX (match mark starts from chimney base plate splits).
3. Assembly reference line in each chimney and chimney height reference line at every 5 meters shall be punched and bordered with paint.
4. All site weld joints shall be applied with weldable primer to a distance of 25 mm from the weld joint

*[Signature]*  
Prepared By

*[Signature]*  
Reviewed By

*[Signature]*  
Approved BY



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# Check list for Chimney

(Diameter up to and including 3.5 meter)

Doc No

Rev no

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24 02 2011

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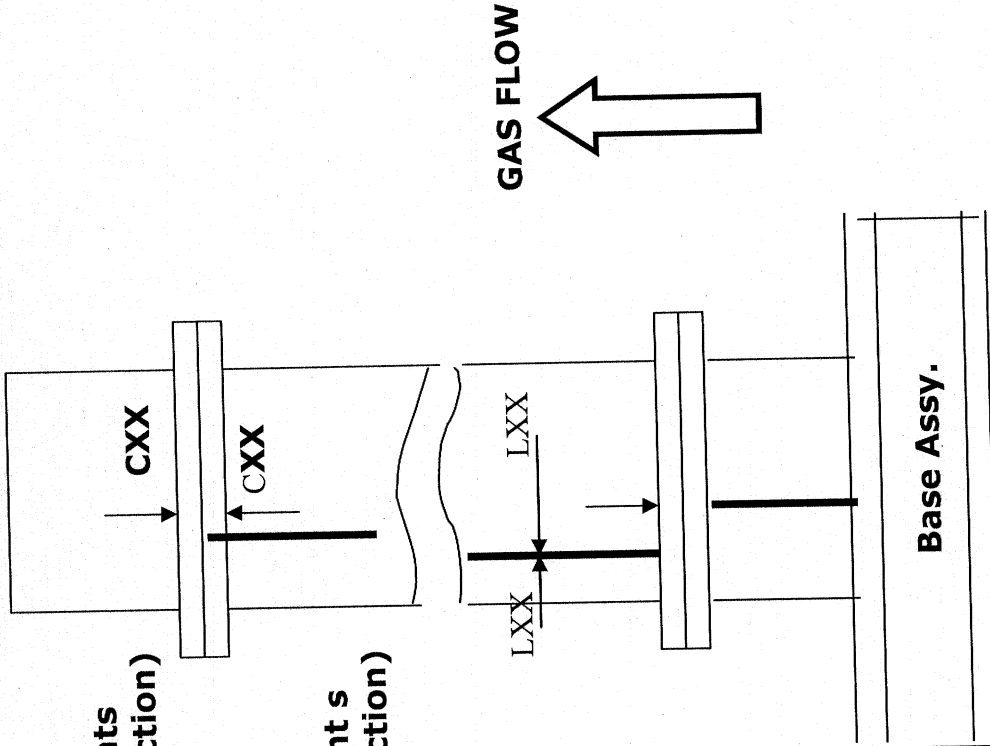
Date

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ICL 104

**Match Mark**  
**L1,L2...Long seam joints**  
**From base (Flow Direction)**


**C1,C2.....Cir seam joint s**  
**From Base (Flow direction)**



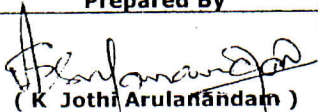
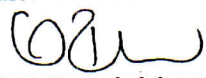
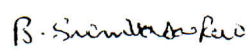
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Reviewed By

*[Signature]*  
Approved BY

	<b>Inspection Check List For BPS Components</b>	Doc Ref:	<b>ICL : 500</b>
		Rev.No.	<b>0 0</b>
		Date:	<b>10 10 2002</b>
		Page No.	<b>Page 1 of 3</b>

SI No	Description & Drg No.	Application	Inspection Requirement	Painting & Preservation Requirement
01	Fixing Pin 6160 - 0130 / 03	ESP	1 & 4	B
02	Outer Arm - I & II 6172 - 0031 / 03 6172 - 0039 / 01	ESP	1,2,3 & 4	B + C
03	Shim Assembly 6171 0003 / 00	APH	1 & 4	B
04	Plain Bearing 6172 - 0066 / 01	ESP	3 & 4	A (for machined Surface) B + C (Other Areas)
05	Sleeve Tube 6172 - 0046/01	ESP	1, 2 & 4	- DO -
06	U - Guide 6172 - 0080	ESP	1, 2 & 4	B + D
07	Rectangular man hole Door - 6124 - 0310 / 03	ESP	1 & 2 (for pl & sheet material only) 4	B + C
08	Inner arm 6172 - 0030 / 00	ESP	1, 2 & 4	B + C ( for external) A (for machined surface)
09	Set Ring 6172 - 0038 / 01	ESP	1, 3 & 4	A
10	Flat Sealing Ring 7147 - 0130 / 01	FANS	4	—
11	Pointer 6173 - 0001	FANS	4	A
12	Clutch 6172 - 0036 / 00	ESP	1, 3 & 4	A
13	Adjusting Screw 6172 - 0084	ESP	1 & 4	A
14	Coupling I,II 6172 - 0035 / 00 6172 - 0037 / 00	ESP	1 & 4	A
15	Shim Assembly 6172 - 0060 / 00 6172 - 0061 / 00	ESP	1 & 4	A
16	Thrust Bearing 6172 - 0051 / 00	ESP	3 & 4	A
17	Blade fixing Screws 40 - A-FAN-452	FANS	1, 2, 3 & 4	A
18	Sleeve Tube 6172 0047 / 00	ESP	1 & 4	B + C
19	Shock Pad 4 79 024 - 00348	ESP	1, 3 & 4	B + C
20	Flat Nibbed Bolt & Nut 3-56-000-0264/01	FANS	1, 3 & 4	A

Prepared By	Reviewed By	Approved By
 ( K Jothi Arulanandam )	 ( V Ramakrishnan )	 ( B Srinivasa Rao )




Ranipet

## Inspection Check List For BPS Components

Doc Ref:	ICL : 500
Rev.No.	00
Date:	10 10 2002
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Sl No	Description & Drg No.	Application	Inspection Requirement	Planning Preservation Requirement
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21	Aluminum Casing Support Var 01 & 02 - 6160 - 0141 / 02	ESP	1, 2 & 4	-
22	Step tread 510506-7800 / 01	ESP	1, 2 & 4	B + E
23	Drift & Taper Pin 6171 - 0001 / 00	APH	1 & 4	A
24	Galvanized Sheet metal Clamp - A & B 6160 - 0120 / 07	ESP	1, 4 & 5	-
25	Lifting Eye 6181 - 0130	ESP	1, 2 & 4	B + E
26	Cable tag 4 - 00 - 114 - 26949/02	ESP	4	-
27	Grease Nipple 474502/ 02	APH	3 & 4	A
28	Packing Box 6172 0050 / 00	ESP	1, 2 & 4	A
29	Saddle Coupling 3 / 8 " 6171 - 0002 / 00	APH	1, 2 & 4	A
30	Adjusting Ring 6173 - 0008	FAN	1, 2 & 4	A
31	Hook 6172 - 0063	ESP	4	B + C
32	Hanging Hook 6172 - 0054	ESP	4	B + C
33	Hook 6172 - 0040 / 02	ESP	4	B + C
34	Emitting Electrode Holder 6172 - 0032	ESP	1 & 4	A
35	Shaft I, II & III 6172-0068 6172 -0070 6172 -0071	ESP	1, 2 & 4	A
36	Lifting Handle. 6181 - 0131	ESP	1 & 4	B
37	Retainer D 6172 - 0062 / 00	ESP	4	A
38	G. I. Casing Support 6160 - 0140 / 02	ESP	1, 2 & 4	-
39	Spherical Handle - Dia 16 6181 0140	FAN	1, 2 & 4	A

	<b>Inspection Check List For BPS Components</b>	Doc Ref:	<b>ICL : 500</b>
		Rev.No.	<b>0 0</b>
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SI No	Description & Drg No.	Application	Inspection Requirement	Painting & Preservation Requirement
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**INSPECTION REQUIREMENTS :**

1. TC Verification for Chemistry
2. TC Verification for Mechanical properties
3. TC Verification for Hardness
4. Dimensional Inspection
5. Galvanizing Coating thickness measurement

**PAINTING & PRESERVATION REQUIREMENTS :**

- A. Temporary rust preventive oil. Minimum DFT = 20  $\mu\text{m}$
- B. Red Oxide Zinc chrome primer to IS 2074. Minimum DFT = 25 $\mu\text{m}$
- C. Synthetic Enamel finish paint to IS: 2932 Minimum DFT = 20  $\mu\text{m}$  ( Shade : Smoke grey)
- D. Synthetic Enamel finish paint to IS: 2932 Minimum DFT = 20  $\mu\text{m}$ ( Shade: Black )
- E. Synthetic Enamel finish paint to IS: 2932 Minimum DFT = 20  $\mu\text{m}$ ( Shade: Golden Yellow)

00	10 10 2002	Original Issue
<b>REV. NO.</b>	<b>DATE</b>	<b>CHANGES MADE</b>

**Record of Revision**

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**INSPECTION CHECK LIST**



**QUALITY ASSURANCE DEPT.**  
**BOILER AUXILIARIES PLANT**  
**BHEL - RANIPET**  
**TAMIL NADU - 632 406**

System / Sub system Description:

**Bi-Plane Dampers**

QP: Ref: **ICL:DAM:502**

Rev. No: **00**

Date: **28 02 2002**

Page No.: **01 OF 02**

SL NO	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	5	6	7	8	9	M B N	10	11

**Specific Notes :** 1. This Inspection Check List (ICL) has to be read along with the SQP:NP:03 - Louvers and Bi-plane Dampers for additional requirements to meet the Leak tightness efficiency of the Bi-plane Dampers.  
2. This ICL is valid only for the projects, where tight shut off duty ( leak tightness ) has to be proved for the Bi-plane Dampers.

SL NO	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1.0	<b>INSPECTION CHECK LIST</b>								
1.1	Jamb seal plate	Flatness of the plate	Measurement	100 %		As per drawing	--	P	W
1.2	Blade Plate	Flatness & straightness of the plate after tip bending	Measurement	100 %		As per drawing	--	P	W

**Legends:**

M - Manufacturer / Subcontractor ( as applicable ) - Record maintenance by QC for shop made items and by sub-contractor for off-loaded items ,  
B - BHEL (QC) / Authorized Inspection Agencies (AIA) N = N T P C P - Perform, V - Verification, W - Witness , D R = Dimensional Report

Prepared By	Reviewed By	Approved By
<i>Performentan</i>	<i>Performentan</i>	<i>Performentan</i>
OP&C	Production	QA

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**QUALITY ASSURANCE DEPT.**  
**BOILER AUXILIARIES PLANT**  
**BHEL - RANIPET**  
**TAMIL NADU - 632 406**

**INSPECTION CHECK LIST**

System / Sub system Description:


**Bi-Plane Dampers**

QP: Ref: **ICL:DAM:502**  
 Rev. No: **0 0**  
 Date: **28 02 2002**  
 Page No.: **02 OF 02**

SL NO	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								M	B	N	
1.3	Blade block hole & blade pin	Diameter	Measurement	100 %	As per drawing		DR	P	W	--	<b>Note: A</b> Schematic sketch may be drawn to indicate the gaps ( for every 300mm pitch) as measured ( on both planes) for the Sl.no. 1.8
1.4	Blade truss	Height of Blade truss	Measurement	100 %	As per drawing		DR	P	W	--	
1.5	Provision of 3 D Washers	Conformance to Col.2	Verification	100 %	As per drawing		--	P	W	--	
1.6	Provision of machined end strip on each end of the blade ( 3.15mm thick sheet )	Conformance to Col.2	Verification	100 %	As per drawing		--	P	W	--	
1.7	Seal plate crust	Coincidence of tip of blade with crust of seal plate	Visual	100 %	Conformance to col. 3		--	P	W	--	
1.8	Gap in various places of Damper	a) Gap between blade end and jamb seal b) Blade tip to tip & blade tip to frame	Measurement (Refer remarks col. 11)	100 %	As per drawing, Remarks col.11 & Linkage adjustments		DR	P	W	W	

**General Notes:**

1. Extra length of seal in blade tip seal may be provided while fixing the end strip on each end of the blade, which may be trimmed exactly.
2. Extra length of jamb seal plate & seal may be provided to suit & trim exactly to the frame height dimension at shop itself.

 Ranipet	<b>Procedure for KEROSENE LEAK TEST</b>	Doc. No	<b>PRQA: 076</b>
		Rev	<b>01</b>
		Date	<b>20 09 06</b>
		Page NO	<b>01 of 02</b>

## 1.0 SCOPE


- 1.1 This procedure details the requirements of Kerosene leak test.
- 1.2 Kerosene leak test shall be carried out for welds if it is required as per drawing.

## 2.0 PREPARATION

- 2.1 Prior to kerosene leak test, it shall be ensured that welds are fully completed with respect to size and location.
- 2.2 Welds shall be thoroughly cleaned by hand wire brush or rotary wire brush to remove slag etc.
- 2.3 Welds shall be inspected visually.
- 2.4 Unacceptable defects found by visual inspection shall be repaired by grinding/welding and grinding.
- 2.5 Kerosene leak test shall be started only after the welds have been cooled to room temperature.

## 3.0 TESTING.

- 3.1 One side of the weld shall be applied with chalk powder mixed with water.
- 3.2 This coat of chalk powder shall be dried before leak test.
- 3.3 Kerosene shall be applied from the other side of the weld.
- 3.4 Check up the side of weld on which chalk is applied for any indication of kerosene absorption after 5 minutes of application.

 Ranipet	<b>Procedure for KEROSENE LEAK TEST</b>	Doc. No	<b>PRQA: 076</b>
		Rev	<b>01</b>
		Date	<b>20 09 06</b>
		Page NO	<b>02 of 02</b>

#### 4.0 REPAIRS.

4.1 The place having indication shall be marked for repair.

4.2 Repair shall be carried out by grinding and welding.

4.3 Retest shall be carried out on repairing areas.

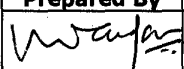
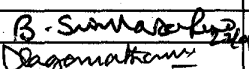
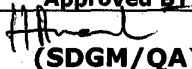
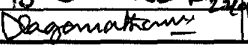
#### 5.0 CLEANING.


5.1 After testing is completed, the chalk powder shall be cleaned off from the welds.

#### 6.0 PAINTING.

6.1 Cleaned surfaces shall be painted as per contract requirements.

<i>Revision Number/Date</i>	<i>Changes made</i>
00/01 10 88	Original issue
01/20 09 06	Cl 1.2 deleted and other clauses renumbered Cl 1.3,2.2,3.2,3.3 and 3.4 are modified

<b>Prepared By</b>	<b>Reviewed By</b>		<b>Approved BY</b>
	B SrinivasaRao/DGM/QA	 B. Srinivasa Rao	 (SDGM/QA)
	G Ulaganathan DM/OLI	 G. Ulaganathan	

	<b>PRQA</b> FOR <b>TRIAL ASSY OF FAN SPIRAL CASINGS</b>  <b>Product : FAN</b>	Doc Ref:	<b>PRQA:305</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 01 03</b>
		Page No	<b>01 of 01</b>

**1.0 SCOPE:**

1.1 This procedure details out the minimum requirements conditions for horizontal and vertical trial assy of NDV,NDZV,NDFV,SF Fan spiral casings.,

**2.0 REFERENCE DOCUMENTS:**

2.1 DRAWING

**3.0 Requirements for horizontal assy:**

3.1.1 All down hand welding of the stiffeners, side wall ,extension tube ,supports are to be completed

3.1.2 All the vertical and overhead welds are to be done with root runs

3.1.3 Spiral casing assembly shall be inspected for all possible dimensions and alignment at this stage.

3.1.4 Full welding of spiral casing is to be carried out after dismantling.

3.1.5 The spiral casing supports are to be welded to the spiral casing assembly.



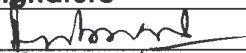
**3.2 Requirements for Vertical trial assembly:**

3.2.1 Full-assembled spiral casing, supported on structurals, in fully erected condition is to be offered for inspection. All dimensions and alignments shall be within tolerances specified.

3.2.2 Welding of footplates to spiral casing supports are to be done.

3.2.3 Before dismantling all matched parts are to be clearly identified by suitable method.

3.2.4 Incase of 45 sidor the boat portion shall be removed after horizontal trial assy & same thing need not be assembled in vertical trial assy.

Prepared by 	Reviewed by	signature	Approved by  (Head/QA)
	QC		
	QA	B. Srinivasa Rao	
Issued by <b>QUALITY ASSURANCE</b>			

Rev No	Clause revised	Revision made	Date
Rev 00	-	<b>ORIGINAL ISSUE</b>	12 10 02
01	-	Totally modified	03 01 03



**PRQA**  
FOR  
**RECOMMENDED BALANCING SPEED OF FAN COMPONENTS**  
Product: FAN


Doc Ref:	PRQA:309
Rev.No.	08
Date:	22 01 2013
Page No	01 of 01

Tolerance on speed is +/- 50 rpm

Sl. No.	Components	Balancing speed in RPM				
		Balancing machine				
		R73	R43	ABRO H-10 *	H-70 *	ABRO H-30
1.0	AN Fan (Upto size 28)					
1.1	Shaft Assy	660	--	725	725	--
1.2	Impeller Assy	450	--	250	250	--
2.0	AP Fan (Upto size 30 / 20)					
2.1	Shaft	660	670	725	725	670
2.2	Piston Assy with adjusting disc and connecting rod with adjusting disc	660	670	725	725	670
2.3	Hub disc	660	670	725	725	670
2.4	Servo Motor cylinder	660	650	650	650	650
2.5	Hub with supporting body and impeller Assy without blades	660	--	650	650	--
2.6	Rigiflex coupling intermediate shaft	660	--	650	650	--
2.7	Rigiflex coupling box	--	670	--	--	670
2.8	AP Fan (size SAF 37.5/21.2)	450	--	450	450	--
3.0	Radial Fan NDV Fan					
3.1	Shaft Assy upto size 25 (including BW di 5F)	660	--	725	725	--
3.2	Impeller with CC plate upto size 25	450	--	305	305	--
3.3	Impeller (BW & SF) with CC plate	265	--	305	305	--
3.4	Rotors					
3.4.1	Upto size 20	450	--	305	305	--
3.4.2	Beyond size 20 and upto size 25	265	--	305	305	--
4.0	Radial Fan NDZV Fan upto 47					
4.1	Shaft Assy (including BW et SF)					
4.1.1	Upto size 25	450	--	465	465	--
4.1.2	Above 25 & upto 33	--	--	400	400	--
4.1.3	Above 33 & upto 47	--	--	350	350	--
4.2	Impeller / Rotor Assy (including BW & SF)					
4.2.1	Upto size 25	265	--	305	305	--
4.2.2	Above 25 & upto 33	--	--	200	200	--
4.2.3	Above 33 & upto 45*	--	--	90	130	--
4.2.4	Above 45 & upto 47*	--	--	90	130	--

\* Tolerance on speed is +/- 10 rpm for ABRO & +/- 15 rpm for H70w

<b>Prepared By</b>  <b>RAM MANOJ CHHIPA</b>	<b>Reviewed by</b> <b>M&amp;S</b>	<b>Signature</b>   	<b>Approved By</b>  <b>(Head/QA)</b>
	QA		
	QC		
	<b>Issued by</b>		
<b>Rev</b>	<b>Clause revised</b>	<b>Revision made</b>	<b>Date</b>
00		<b>ORIGINAL ISSUE</b>	26 05 93
01	-	RPM modified for R73	16 12 94
02	2.1	RPM modified for H70V	08 12 98
03		RPM modified	06 09 00
04		Totally modified	03 02 03
05		ABRO H10 ADDED	27 01 07
06	4.2.3 & 4.2.4	Clause modified	26 02 09
07	Table revised	ABRO H-30 ADDED	03 09 12
08	2.8 Introduced	AP Fan (size SAF 37.5/21.2)	22 01 13

 Ranipet	<b>PRQA</b> FOR <b>TIGHTENING TORQUE FOR THREADED COMPONENTS</b> Product : FAN	Doc Ref:	<b>PRQA:312</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>01 of 02</b>

### 1.0 SCOPE :


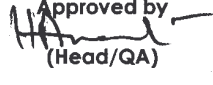
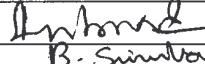
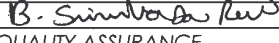
This specification details out the tightening torque to which fasteners are to be tightened, in the form of a table

### 2.0 Torque tightening details

#### 2.1 P1. refer Table I & II

**TABLE-I ( NOMINAL THREAD)**  
**MAXIMUM TORQUE(KG-M)**

SIZE	6.9	8.8	10.9	12.9
M 4 X 0.7	0.20	0.20	0.40	0.40
M 5 X 0.8	0.40	0.40	0.60	0.80
M 6 X 1	0.60	0.80	1.00	1.00
M 7 X 1	1.00	1.20	1.8	1.40
M 8 X 1.25	1.60	2.00	2.60	3.00
M 9 X 1.25	2.20	2.80	3.80	4.60
M 10 X 1.5	3.00	3.80	5.20	6.20
M 12 X 1.75	5.40	6.40	9.00	11.20
M 14 X 2.0	8.80	10.40	14.00	18.00
M 16 X 2.0	13.80	16.00	23.00	27.00
M 18 X 2.5	19.00	23.00	31.00	37.00
M 20 X 2.5	26.00	31.00	44.00	52.00
M 22 X 2.5	34.875	41.25	58.50	69.75
M 24 X 3.0	45.00	54.00	75.00	90.00
M 27 X 3.0	67.00	80.0	114.00	135.00
M 30 X 3.5	90.00	110.00	150.00	180.00
M 33 X 3.5	120.00	142.00	200.00	240.00
M 36 X 4.0	153.00	180.00	254.00	305.00
M 42 X 4.5	244.00	290.00	406.00	488.00
M 48 X 5.8	366.00	434.00	610.00	732.00

Prepared by 	Reviewed by	signature	Approved by  (Head/QA)
	QC		
	QA		
Issued by		QUALITY ASSURANCE	


 Ranipet	<b>PRQA</b> FOR <b>TIGHTENING TORQUE FOR THREADED COMPONENTS</b> Product : FAN	Doc Ref:	<b>PRQA:312</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>02 of 02</b>


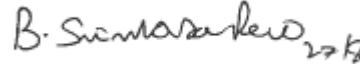
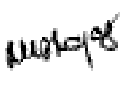

TABLE II ( FINE THREAD)  
MAXIMUM TORQUE KG-M


SIZE	6.9	8.8	10.9	12.9
M 8 X 1	1.80	1.60	2.80	3.60
M 10 X 1.25	3.4	4.00	5.60	6.60
M 12 X 1.25	6	7.40	10.40	12.00
M 12 X 1.5	5.8	6.80	9.40	11.40
M 14 X 1.5	9.40	11.40	16.00	20.00
M 16 X 1.5	15.00	17.00	24.00	29.00
M 18 X 1.5	21.00	25.00	35.00	42.00
M 20 X 1.5	29.00	35.00	48.00	58.00
M 22 X 1.5	39.00	46.00	65.00	79.00
M 24 X 2	49.00	59.00	83.00	98.00
M 27 X 2	73.00	87.00	120.00	147.00
M 30 X 2	102.00	120.00	169.00	203.00

Rev No	Clause revised	Revision made	Date
00	-	ORIGINAL ISSUE	30 07 93
01	-	Totally modified	03 02 03

<b>QUALITY DEPARTMENT</b>	
<b>Amendment to Quality Work Instructions (PRQA)</b>	
<b>QWI NO:PRQA 323 REV: 03</b>	<b>DT. 03 03 07</b>
<b>Amendment no: A 1</b>	<b>DT. 27 08 09</b>
<i>Description</i> : <b>GUIDE LINES FOR FIXING OF BALANCING MASS BY MEANS OF WELDING /SCREWING IN FAN ROTATING PARTS.</b>	

<b>Details of Amendment</b>		
<b>Note Sl.no.</b>	<b>Amended As</b>	<b>Basis For Amendment</b>
1	<p>Note</p> <p>The material of the Balancing Mass can be IS 2062 quality at the least .</p>	

<b>Prepared by</b>	<b>Reviewed By</b>		<b>Approved By</b>
	QC		
	ENGG		

	<b>PRQA</b> FOR <b>GUIDELINES FOR FIXING OF UNBALANCE MASS IN          ROTATING PARTS OF FANS LIKE SHAFT &amp; IMPELLER          BY MEANS OF WELDING /SCREWING.</b> <b>Product:FAN</b>	Doc Ref:	<b>PRQA: 323</b>
		Rev.No.	<b>03</b>
		Date:	<b>03 03 07</b>
		Page No	<b>01 of 04</b>

**1.0 SCOPE**

**1.1** This procedure specifies the methods of unbalance correction by mass addition by Welding Screwing/ riveting (hereinafter called fasteners).

**2.0 REFERENCE**

Respective drawing

**3.0 Procedure:**

**3.1 General guidelines**

3.1.1 Balancing speeds shall be as per PRQA 309 latest.

3.1.2 Cleanliness of roller supports of balancing M/c shall be ensured before balancing

3.1.3 Balancing reference numbers shall be punched on the component at suitable location

3.1.4 Balancing details shall be documented in history card

3.1.5 Balancing machine rollers shall be covered suitably during grinding on the component for unbalancement correction

**3.2 Guideline for screw selection/revitting &fixing**

3.2.1 Minimum number of fasteners required for one kg of balancing mass shall be as per table 1. subject to the least number of fasteners two . When there is a fraction of fasteners, the same shall be rounded to next higher number.

3.2.2 Position of corner fasteners (M) and longitudinal pitch of fasteners (LP) shall be as per table 2. Number of rows of fasteners shall be as per Table 3.

3.2.3 Screws used for fastening shall be of at least 8.8 grades.




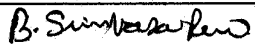
3.2.4 Balancing mass profile shall match with that of parent body. No visible gap is permitted between them. All edges of balancing mass shall be chamfered throughout to 45 deg with 2mm land as shown in fig 1.

This clause is applicable for hollow shafts only. Balancing mass location shall be as per respective Drawing. Depth of threaded hole in parent metal shall be at least 1.5 times the dia of screw subject to maximum of 60 % of tube wall thickness. For tubes of wall thickness 20mm and below where the wall thickness is less than 1.5 dia. of screw, through holes may be made. The location of mass shall be at least 50mm away from pin end.


3.2.5 Arrangement of balancing mass fasteners is shown in fig 2. Countersinking shall Match with screw/rivet head.

3.2.6 Tightening torque for screws shall be as per PRQA312/latest

3.2.7 All the screw heads shall be peened to have positive locking.( ref fig-2a)

<b>Prepared by</b> 	<b>Reviewed by</b>	<b>signature</b>	<b>Approved by</b> (Head/QA) 
	QC		
	QA		
<b>Issued by</b> QUALITY ASSURANCE			

Rev No	Clause revised	Revision made	Date
Rev	--	<b>ORIGINAL ISSUE</b>	10 08 94
01	3.1.6	Class altered	12 03 96
02	--	Totally modified	03 02 03
03	-	Totally modified	03 03 07

 Ranipet	<b>PRQA</b> FOR <b>GUIDELINES FOR FIXING OF UNBALANCE MASS IN  ROTATING PARTS OF FANS LIKE SHAFT &amp; IMPELLER  BY MEANS OF WELDING /SCREWING.</b> Product:FAN	Doc Ref:	<b>PRQA: 323</b>
		Rev.No.	<b>03</b>
		Date:	<b>03 03 07</b>
		Page No	<b>02 of 04</b>

### 3.3 Guidelines for correction on the respective components

Sl no	Description	Methods of correction	Remarks
1.0	<b>Radial Fans</b>		
1.1	Hollow shafts	Screwing	-
2.0	<b>Impellers (KKK &amp; CZECH design)</b>		
2.1	Alloy steel impellers (Naxtra -70,13CrMO4,Stainles steel, etc.)	Riveting	-
2.2	Carbon steel impellers (P355NH, A36,IS 2062 etc)	Welding	-
3.0	<b>AP Fans</b>		
3.1	Impeller	Welding & screwing	Impeller assy with blade brg assy mass addition shall be done by screwing only.
3.2	AP impellers of TLT Design	Welding	-
4.0	<b>AN Fans (KKK &amp; CZECH design)</b>		
4.1	<b>Shafts</b>	Screwing	-
4.2	<b>Impellers</b>	Welding	-

Note: PRQA 321 /latest shall be referred for items subjected to unbalance correction by Mass removal

### 3.4 BALANCING MASS FIXING BY WELDING

- 3.4.1 Balancing mass profile shall match with that of parent body. All sides of balancing mass shall be fillet welded. Fillet welding of balancing mass with parent body shall be smoothly merged. This weld shall be checked by PT or MT and acceptance norm shall be as per BHE:NDT:RP:MT01/BHE:NDT:RP:PT01/latest.

**TABLE - 1**



Ranipet

## PRQA

FOR

**GUIDELINES FOR FIXING OF UNBALANCE MASS IN  
ROTATING PARTS OF FANS LIKE SHAFT & IMPELLER  
BY MEANS OF WELDING /SCREWING.**

Product:FAN

Doc Ref: **PRQA: 323**

Rev.No. **03**

Date: **03 03 07**

Page No **03 of 04**

### MINIMUM NUMBER OF FASTENERS/Kg of unbalance correction Mass

ITEM	SCREWS OF Min 8.8 GRADE		RIVETS OF SA105MATL	
	M10	M12	DIA 10	DIA 12
<b>1.0 IMPELLERS</b>				
<b>1.1 RADIAL FAN</b>				
a) Tip dia up to 2500mm	1.95	1.35	3.90	2.70
b) -do- >2500- 3500mm	1.25	0.85	2.50	1.70
c) -do- >3500 -5000mm	1.00	0.70	2.00	1.40
<b>1.2 AP FAN</b>				
a) 11 & 12 Size	0.95	0.65	1.90	1.30
b)16 & 20 Size	0.70	0.50	1.40	1.00
<b>1.3 AN FAN</b>				
a)Tip dia up to 2200mm	1.70	1.20	3.40	2.40
b) -do- >2200 -2800mm	1.0	0.70	2.00	1.40
<b>2.0 SHAFTS</b>				
<b>2.1 RADIAL FANS</b>				
a) up to NDV/NDZV 25	1.95	1.35	↑ NO REVITTING IS PERMITTED ↓	
b) Beyond NDZV up to NDZV 33	1.25	0.90		
c) Beyond NDZV 33 & up to NDZV 47	1.00	0.70		
<b>2.2 AN FANS</b>				
a) up to AN 22	1.70	1.20		
b) Beyond AN22 & up to AN 28	1.00	0.70		
<b>3.0 AP FAN ITEMS</b>				
<b>3.1 Servomotor cylinder with cover</b>				
a) 11 & 12 size	0.95	0.65		
b) 16 & 20 sizes	0.70	0.50		
<b>3.2 HUB DISC</b>				
a) 12 sizes	0.95	0.65		
b) 16 & 20 sizes	0.70	0.50		


	<b>PRQA</b> FOR <b>GUIDELINES FOR FIXING OF UNBALANCE MASS IN ROTATING PARTS OF FANS LIKE SHAFT &amp; IMPELLER BY MEANS OF WELDING /SCREWING.</b> Product:FAN	Doc Ref: <b>PRQA: 323</b>
		Rev.No. <b>03</b>
		Date: <b>03 03 07</b>
		Page No <b>04 of 04</b>

TABLE -2

Fastener Size (mm )	M Min	LP Min
10/12	35	25

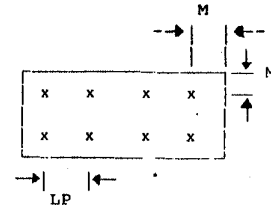


TABLE -3

Fasteners dia 10 mm		Fasteners dia 12 mm	
Width mm	No of Rows	Width mm	No of Rows
≤ 60	ONE	< 70	ONE
60-100	TWO	70-120	TWO
100-160	TWO**	120-200	TWO**
>160	THREE	>200	THREE

\*\* In addition to the two rows, provide 3 extra screws as shown below.

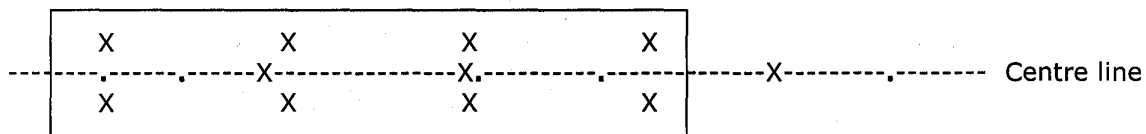


FIG 1

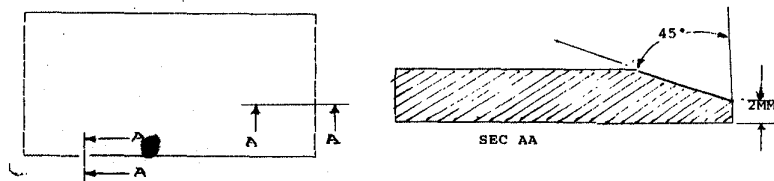
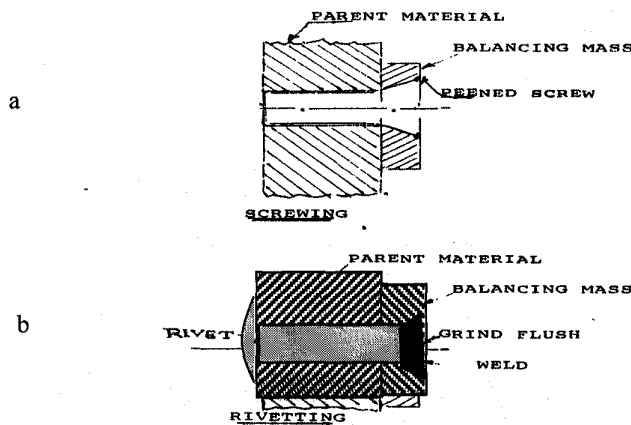



FIG 2



	<b>PRQA</b> FOR <b>HOT PRESSING OF AN IMPELLERS          BLADES, ROOT STIFFENERS, AND GUIDE          VANES OF AP, AN STATIC PARTS</b> Product:FAN	Doc Ref:	<b>PRQA326</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>01 of 01</b>

1.0 SCOPE:

1.1 This procedure details out the hot pressing of AN Impeller blades, Guide Vanes of AP, AN Housings, OGVs&Diffusers and Root stiffeners.

2.0 REFERENCE DOCUMENTS

Drawing

2.0 PROCEDURE:

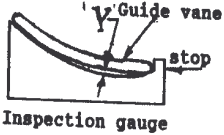
2.1 Check for the blade hot pressing temp within 850 and 1050 deg C and soaking time of 30 minutes.



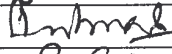
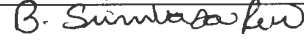
2.3 check for air cooling in still air to room temperature

2.5 check for profile dimensions confirmation using profile checking fixture.

2.5.1 Refer SQP FAN328/Latest for permissible Profile gaps of AN fan blades.

2.5.2 For others following table shall be referred for permissible values

	HUB DIA IN MM	HOUSING DIA RANGE IN MM	PERMISSIBLE GAP 'Y' Max.
 <p>&lt; = Tabulated value 'Y'</p>	1000 To 1413	1334 To 2818	1.5 MM
	1585 TO 1778	2114 TO 3548	2.0 MM
	1995 TO 2239	2661 TO 4467	2.5 MM
	2512 TO 2818	3350 TO 5623	3.2 MM
	3162 TO 3548	4217 TO 7080	4.0 MM

Prepared by 	Reviewed by	signature	Approved by  (Head/QA)
	QC		
	QA		
Issued by <b>QUALITY ASSURANCE</b>			

Rev No	Clause revised	Revision made	Date
Rev 00	-	<b>ORIGINAL ISSUE</b>	18 10 01
01	-	Totally modified	03 02 03



## Hydraulic test Procedure For Air Tank

Doc. No	<b>PRQA: 601</b>
Rev	<b>00</b>
Date	<b>27 03 07</b>
Page NO	<b>01 of 02</b>

### 1.0 Scope

1.1 This procedure covers the requirement of hydraulic testing of air tank used in gates.

### 2.0 Preparation of Hydraulic test

2.1 Before doing hydraulic test, the inspector shall ensure a) Completion of assembly welding, b) Non-destructive examination applicable.

2.2 At least two pressure gauges shall be used for conducting the hydraulic test preferably one at inlet and another one at high point of the component/Air tank.(Refer Sketch -I) Pressure gauges in the range of 0-40 kgs/SQ CM shall be used.

2.3 All welded joints of the air tank shall be applied with wet chalk powder and allowed to dry before filling the tank with water.

2.4 The air tank shall be filled with water and pressure should be raised gradually after necessary venting and vents should be closed.

2.5 The test pressure mentioned in the drawing shall be maintained for a period of 5 minutes and reduced to working pressure for 10 minutes or sufficient time to permit complete examination of inspecting official.

2.6 A close visual examination shall be carried under working pressure for leaks /sweats in welds. No leaks and sweats are permitted.

2.7 If any leaks are found in the weld area, the same shall be ground to a depth till the crack or inclusion is completely removed and this shall be further confirmed by doing LPI before filling with weld on the rework area.

2.8 After rework, the Air tank shall be subjected to re hydro test in line with clause 2.3 to 2.6.

2.9 All details like Vendor code, Work order number, working pressure (WP), Test pressures (TP), Date of test and Inspecting official seal shall be stamped/punched.

### 3.0 Documentation.

3.1 Hydraulic test report shall be prepared and duly signed by the inspection agency before taking in to further assembly.

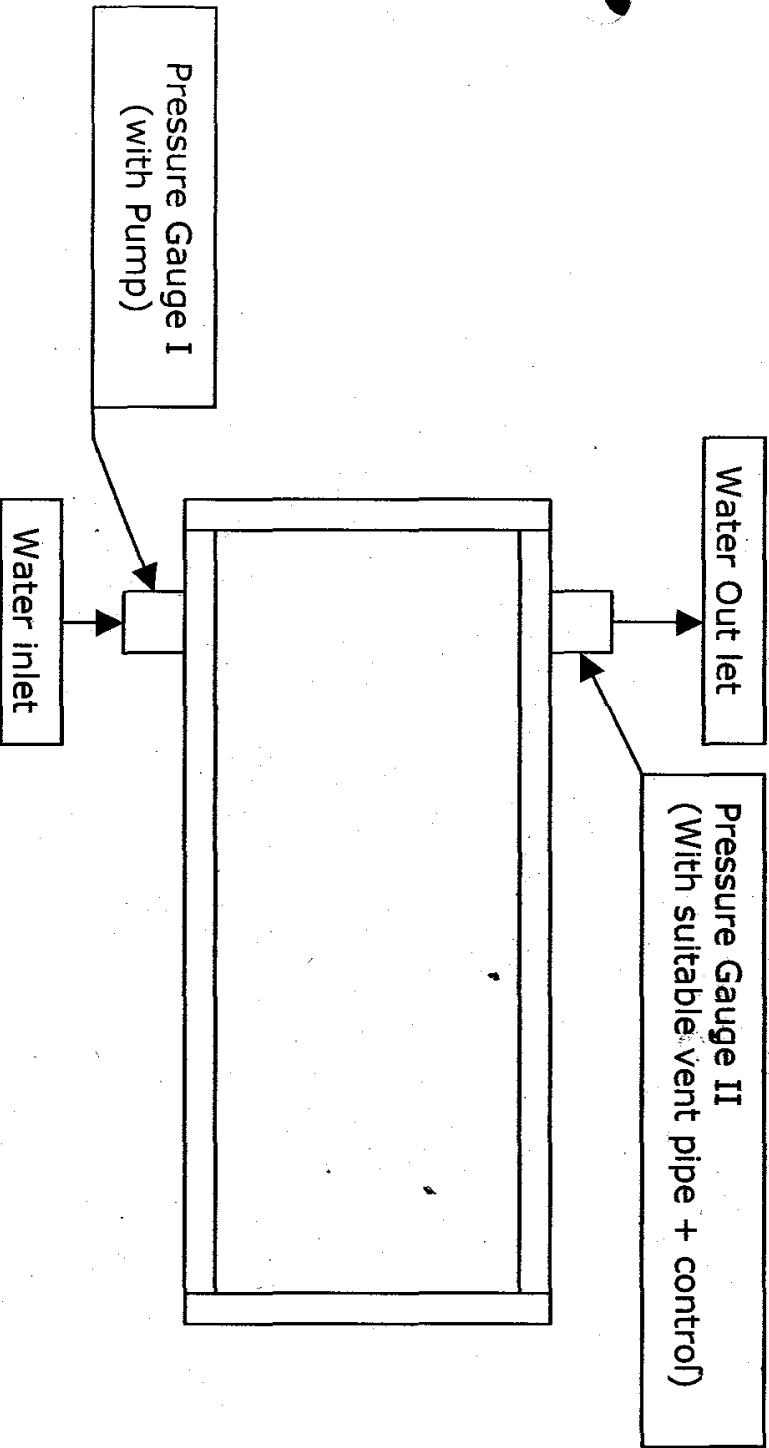
Prepared By	Reviewed By		Approved BY
	QC-OLI		
	QA	B. Sundararao	(Head /QA&OLI)



Ranipet

## Hydraulic test Procedure For Air Tank

Doc. No	PRQA: 601
Rev	00
Date	27 03 07
Page NO	02 of 02



Sketch- I (Typical lay out for hydro connection)



RANIPET

### Trial assembly procedure for chimney Shells ( Diameter more than 3.5 meter)

BAP QA CHIM TAP


REV 00

24 02 2011

PAGE 01 OF 02

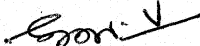

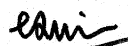
1. Draw a lay out on leveled metallic platform with minimum 10mm thick plate with suitable supporting stiffeners to ensure the following dimension
  - a) ID of the shell as per drawing
  - b) Reference diameter ( minus 100 to ID)
  - c) PCD of the flange hole
  - d) Inner diameter, Outer diameter of the flange hole.
2. Place the shell (Two halves in assembled condition after completion of all weld) over the lay out and align the shell ID to layout ID dimension.
3. Water level the shell with in 2mm.(reference line for water shall be 1 meter from top flange of shell, the same shall be prick punched at every 45 deg interval to a arc length of 100 mm on outer shells )
4. Measure the verticality of the shell by dropping plumb (use reference block 50 mm )
5. Measure gap between metallic platform plate and Chimney bottom flange to ensure flange face out and root gap between adjacent shells.
6. Measure the Concentricity of the top and bottom circle of the shell
7. Measure the PCD of the flange hole and outer diameter of the flange hole.
8. Tolerance for the floor assembly is as follows
  - a) Concentricity of TOP and Bottom Circle shall not exceed 3mm
  - b) verticality with in 2mm maximum
  - c) Height with in 2 mm
  - d) PCD with in 2 mm
  - e) Root gap with in 2mm (max) at any point of the bottom shell flange and bed
- 7 Check the flange Hole pitch with reference to inner diameter of the shell using pin pitch gauge (Min 3 pin, calibration to be done by BHEL/BHEL AIA prior to use)
- 8 Painting requirement shall be as per respective QP/ BHEL standard / Painting schedule.(Ref CQR of the respective work order )

Prepared by	Reviewed by	Approved by

 <b>RANIPET</b>	<b>Trial assembly procedure for chimney Shells  (Diameter more than 3.5 meter)</b>	<b>BAP QA CHIM TAP</b>
		<b>REV 00</b>
		<b>24 02 2011</b>
		<b>PAGE 02 OF 02</b>

**Note:**

- I. For the chimney shells where Inside diameter less than or equal to 3.5 meter, inspection requirement shall be as per ICL 104 Rev 00 with following correction in Note V .(i.e. Horizontal or vertical trial assembly shall be carried out for flanged chimney shells having difference in thickness in adjacent joining shells after individual dimensional check . ( Revised copy will be released shortly )
- II. Base assembly with first shell (Two halves in assembled condition after completion of all weld) to be trial assembled in shop prior to dispatch.
- III. The base plate and stool plate hole concentricity shall be inspected after completion of all ribs welds in base assembly using stepped pin gauge
- IV. NDE requirements shall be as follows.
  - ❖ Base plate and stool plate butt joint 50mm and above -100 RT
  - ❖ T joints 100% RT, for balance butt welds 100% MPI on both sides of the shell up to 10 mm. For below 10 mm second side (final weld side ) to be MPI tested .
  - ❖ Level from BOB (bottom of base) in each shell shall be punched /stenciled at 2 locations in each shells as called in point 3 along with Gas flow arrow directions .
  - ❖ Match marking to be punched and stenciled for base and first shell.
  - ❖ ICL 104 /Latest (Inspection check list ) can be used as reference , guidance and acceptance for other than the specific requirements mentioned in above

		 24.2.2011
<b>Prepared by</b>	<b>Reviewed by</b>	<b>Approved by</b>


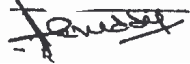

BHARAT HEAVY ELECTRICALS LIMITED  
TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

SIP : NP : 08

PAGE : 1 of 6

QUALITY REQTS FOR MFG. OF SEALS FOR LOUVER/BIPLANE DAMPERS & GATES

REV.	DATE	PREPARED	REVIEWED	APPROVED
00	15/07/96	 P.S.Narayanan	 A.R.Reddy	 V.Raghavendran

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REVISION STATUS

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REVISION NO:    CLAUSE NO

---

DETAIL OF REVISION

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00

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1 ) PR: QE: 063/01 renumbered  
as SIP: NP: 08.

2 ) Editorial corrections  
for clarity.

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## 1.0 SCOPE

1.1 This procedure details out the quality requirements for the manufacture of seals used in Louvre / Biplane Dampers and Guillotine Gates.

## 2.0 MATERIAL

2.1 Materials Normally used are given below.

Seal sheets : ASTM B626 UNS 10276

lates, Sheets : IS 2062, ASTM A588Gr A

2.2 Raw materials other than Hastelloy shall be checked for straightness before taking up for fabrication. Out of straightness of 2mm for the length of 2.5m can be permitted for louver/biplane dampers. For gates out of straightness shall be within 1mm/M subject to a max. of 2mm for the length of 3.6m.

2.3 Seal strips shall be laid on level surface. It shall be held tight at ends by hands or by clamping. Seal shall be checked for flatness and straightness over the full length. Strips shall be checked for side bend and flatness. Strips shall not have waviness more than 3 waves per metre with an amplitude of 0.25mm and length of 75mm. Strips having waviness on both edges shall not be accepted.

2.4 Raw material shall be stored properly in a covered storage to avoid damage. prior to taking up for fabrication.

## 3.0 PREPARATION

3.1 Preparation of seals for Guillotine Gate

3.1.1 Seals strips for bonnet, side and bottom seals shall be cut to length by hand or machine shearing. Ends shall be square to the edges.

3.1.2 In all strips, slots shall be punched ensuring pitch with suitable die and punch.

3.1.3 Retainer sheet ( 1.6 mm ) shall be marked to size and cut by shearing only.

3.1.4 Retainer plate ( 6 mm ) shall be marked to size and cut by shearing or flame cutting.

3.1.5 Position of tapped holes shall be marked, drilled and tapped on retainers.

3.1.6 The seal shall be assembled with retainers and held tight with clamps.

3.1.7 Plates retainer and seals shall be spot welded keeping spot diameter 3-6mm and tested by peel off test as detailed in this procedure.

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## 3.2 PREPARATION OF SEALS FOR LOUVER DAMPER

### 3.2.1 BLADE SEAL

3.2.1.1 Hastelloy, corten steel retainers shall be marked to length and cut by shearing and ends shall be square.

3.2.1.2 Where the length of seal exceeds 2.5 M, splicing shall be done as per relevant drawing.

3.2.1.3 Corten steel retainers shall be clamped with hastelloy and spot welded keeping spot diameter within 3-6 mm.

3.2.1.4 Soundness of spot weld shall be tested by peel off test as detailed in this procedure.

### 3.3 JAMB SEALS FOR LOUVER AND BIPLANE

3.3.1 Hastelloy sheets, bend plate and retainer sheets shall be marked to length and cut to size by shearing and ends shall be square.

3.3.2 Plate shall be marked for bending and bent to shape in a suitable press maintaining the height and stud hole location.

3.3.3 Bent plates shall be checked for profile with suitable template.

3.3.4 Slots shall be punched in all seal strips with suitable die and punch maintaining the pitch dimensions.

3.3.5 Jamb seals shall be trial assembled using screws, washers and nuts and checked for overall dimensions.

3.3.6 Matching parts shall be identified with necessary match marks on parting lines.

### 3.4 BLADE TIP SEALS FOR BIPLANE DAMPER

3.4.1 Hastelloy sheets, retainer plate and back up sheets shall be cut by shearing with ends square.

3.4.2 Mark the axis and pitches of holes dia 12mm and punch these holes with retainers and deburr.

3.4.3 Assemble the retainer, back up sheet and seals with using screws, washers and nuts.

## 4.0 INSPECTION AND TOLERANCES

4.1 All seals shall be inspected visually for and damage, kinks, waviness, burning etc.

- 4.2 All seals shall be inspected for overall dimensions and if made in number of pieces, shall be match assembled and match marked.
- 4.3 Height of bent plate of jamb seal shall be measured by keeping the plate on surface plate and lugs facing upside. Height shall be within + 1mm,- 2mm.
- 4.4 Hole axis on either side of the lugs shall not vary +/- 1mm from the edges of the lugs.
- 4.5 Bend in bent plates in lateral direction shall be within 1mm/metre subjected to a max. of 5mm
- 4.6 Bow in bent plates i.e. level variation of hole axis when placed upside down on level surface shall not exceed +/- 2mm.
- 4.7 Tolerance on pitch of slots and holes.
- |                                  |           |
|----------------------------------|-----------|
| Individual pitches               | : +/- 1mm |
| Cumulative                       | : +/- 2mm |
| Length                           | : +0. 00  |
|                                  | -3. 00mm  |
| Side bend shall be restricted to | : 2mm     |
| for 2.5m length of seal          | :         |
- 4.8 Alignment of holes and straightness after welding shall be within +/- 1mm subjected to max. of 2mm
- 4.9 Completed seal sub-assembly shall be inspected for dimensions and no. of strips as per drawing.
- 4.10 Seal assembly shall be checked by keeping the seals pressed in installed orientation on a level surface. The seal must touch the surface over the entire length. A gap upto 0.5mm to a length of 50mm at 2 places in a metre length of seal may be accepted as deviation.
- 4.11 The side seal length of gates when exceeding 3.6 meters shall be made in modules and shall be overlapped as shown in the drawing and seal length after trial assembly shall be within +/-2mm.
- 5.0 PEEL OFF TEST FOR SEALS
- 5.1 The method of carrying out the peel off test for spot welds done on seals used in dampers and gates is described below.
- 5.2 This test shall be carried out before the production welds of any day/batch in the presence of BHEL/Authorised inspection agency.
- 5.3 METHODOLOGY
- 5.3.1 Preparation of test piece.

- 5.3.1.1 Sample pieces of seals of different sizes or cover strip or retainer plate shall be prepared to a length of 300mm.
- 5.3.1.2 Forming operation if any shall be completed as per original seal assembly drg.
- 5.3.1.3 All the matching surfaces shall be cleaned and free from oil, grease, dust or dirt.
- 5.3.1.4 All the above pieces shall be stacked as per original assembly drawing.

#### 5.4 TEST WELD

- 5.4.1 Trials to ensure the stable condition of the machine shall be carried out initially.
- 5.4.2 All the welding parameters shall be recorded after stabilizing them.
- 5.4.3 Three sample test piece shall be welded with the parameters determined.

#### 5.5 PEEL- OFF TEST

- 5.5.1 The peel of test is performed as detailed below.

1) grip the test piece in vice or with suitable device and bend to convenient position and peel off the pieces apart with chisel and hammer.

- 5.6 The test welds are considered satisfactory, if,

- a) The fusion of weld is good.
- b) The seals tear off on parent material.
- c) Button like holes are observed in seals/retainers after testing.

- 5.6.1 In case of failure, fresh samples shall be welded after adjusting the parameters and retested.
- 5.6.2 All the tested samples shall be identified clearly with weld parameter, date of welding, etc.
- 5.7 Production can proceed only after the satisfactory completion of the above test.

#### 6.0 IDENTIFICATION AND PACKING

- 6.1 Seal sub- assemblies shall be packed in box type crates as per drawing, identified separately for separate style, PGMA wise. Individual seal packs shall be marked with W.O. PGMA and manufacturers code, description of seal viz “ seal for sides “, etc.
- 6.2 Packed seals shall be handed over to BHEL stores/shop.
- 6.3 Stores shall receive and issue the seals in packed condition only.

**QUALITY ASSURANCE DEPARTMENT  
AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q.W.I)**

Q.W.I SQP :NP:03

REV:01

AMENDMENT SL NO: A3


DESCRIPTION:LOUVER &BIPLANE DAMPER S

DATE:07 06 2012

**DETAILS**

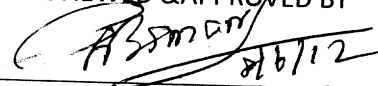
EXISTING CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT /REMARKS.
CLAUSE 5.2.1	<p>Clause no 5.2.1 under NOTE 5 Modified as follows:</p> <p>The Louver Dampers and biplane dampers shall be tested in site Orientation position as indicated in the key plan for the first number of each DU /PGMA, Balance number of each DU/PGMA shall be tested horizontally.</p> <p>Proper supports shall be provided and the damper shall be leveled b y water level.</p>	<p>RCA SUBCOMMITTEE OF GATES&amp;DAMPER dt 260512 outcome.</p>

PREPARED BY





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Manager / QA  
BHEL/BAP/RANIPET-632 406.

REVIEWED & APPROVED BY



**G. BALASUBRAMANIAN**  
Sr. Deputy General Manager  
QA, Business Excellence & QC (Proc.)  
BHEL/BAP/RANIPET-632 406

QUALITY ASSURANCE DEPARTMENT AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q.W.I)		
Q.W.I.NO:SQP:NP:03	REV:01	AMENDMENT SL NO: <span style="border: 1px solid black; padding: 2px;">A 2</span>
DESCRIPTION: LOUVER & BIPLANE DAMPERS		DATE: 27.02.2002
D E T A I L S		
CLAUSE NO.	AMENDED AS ...	BASIS FOR AMENDMENT/ REMARKS.
Add Clause 5.3.5.3 under NOTE 5	For Bi-plane dampers with seals the gap shall be restricted as follows: Blade tip to tip and blade tip to frame : 0.1mm max. Blade end to jamb seal bend plate individually on each side : 0.8mm max. The checks shall be made as per ICL:DAM:502 Rev. 00.	As per feed back from BAP/ Ranipet.
Prepared by  R. Arthanareeswaran		Reviewed & Approved by:  C.R. Raju

Distribution.

- S/Sri  
 R. Jayapal.....SDGM/OP&C/FB/Bldg 2&4  
 P. Soundararajan.....DGM/BPN/RM/Bldg 2&4  
 J. Kannan.....DGM/QC/Bldg 2&4  
 V. Ravikumar.....Mgr/QC/Bldg 2&4  
 G. Mohan.....Sr. Mgr/QC/OLI/ET Hostel  
 S. Anbalagan.....DGM/AD/Bldg 53  
 B. Srinivasa Rao.....Mgr/QA/MAP-RANIPAT  
 H. Ananthanarayanan.....DGM/QA/MAP/Ranipet  
 K. Nagarajan.....Mgr/D&D/PE/FB/Bldg 2&4  
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*Shri KOTA*  
*M*  
*22/8*

*M. S. S.*  
*T - A*

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QUALITY ASSURANCE DEPARTMENT  
AMENDMENT TO QUALITY WORK INSTRUCTIONS. (Q.W.I)

Q.W.I.NO:SQP:NP:03

REV:01

AMENDMENT SL NO: 

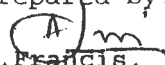
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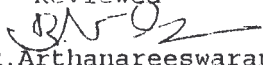
DESCRIPTION: LOUVER & BIPLANE DAMPERS

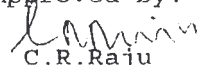
DATE:12.08.2000

D E T A I L S

CLAUSE NO.	AMENDED AS	BASIS FOR AMENDMENT/ REMARKS.
NOTE-3 Clause 3.1.9	Clause no.3.1.9 added as follows. For plates/Channels up to 2 meter, no joint is permitted. Above 2 mtr but less than 5 mtr. 1 joint is permitted. Above 5 mtr. 2 joints are permitted. In any case more than 2 joints are not allowed. However the min.length of a joint shall be 500 mm.	For better clarity
NOTE-5 CLAUSE 5.3.5.1	Reworded as Gap for Louver &Biplane damper with out seals shall be as given below.	For better clarity
5.3.5.2	Reworded as for Louver damper & Biplane damper with seals the gaps shall be restricted as below.	For better clarity
NOTE-7 CLAUSE 7.2	The damper shall be supported suitably to avoid damages during handling and transportation.	For better clarity

Prepared by:  
  
A. Francis.

Reviewed  
  
R. Arthanareeswaran

Approved by:  
  
C.R. Raju

**BHARAT HEAVY ELECTRICALS LIMITED**  
TIRUCHIRAPPALLI 620 014 INDIA

STANDARD  
QUALITY PLAN  
FOR

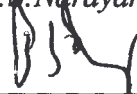
**LOUVER AND BIPLANE  
DAMPERS**



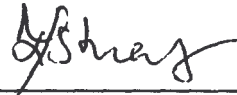

SQP:NP:03/01/



Page 01 of 15

Prepared by  
Quality Assurance

*P. S. Narayanan*



REVIEWED BY	SIGNATURE
ENGINEERING (S.Thangavelu)	
ANCILLARY DEVELOPMENT (S.Murugesan)	
QUALITY CONTROL (S.Muthiah)	
QUALITY ASSURANCE (A.R.Reddy)	

REV.NO.	DATE	APPROVED BY	SIGNATURE
00	01.04.93	Sr.Manager/QA	
01	01.02.95	Sr.Manager/QA	

*Proprietary Data - For Internal Use Only*

**QUALITY ASSURANCE**

**RECORD OF REVISIONS**

Rev. No.	Clause No.	Details of revision
00		This document consolidates all requirements of various previous SQPs.
01		Totally revised incorporating all amendments issued and latest TDC numbers.

MATERIAL

Plates, Sheets, Rolled Sections & Rounds  
 Chemical & Mechanical Properties  
 Review of documents  
 100%  
 TDC/Matl. Spec. Note 1  
 TC QC

SUB-DELIVERIES

.1 Actuators  
 Type & Routine Test  
 Review of documents  
 100%  
 Drawing/Purchase Spec  
 TC QC

.2 Blowers & Motors for Biplane dampers  
 Conformance to Purchase order Documents  
 100%  
 Drawing/Purchase Spec.  
 TC QC

INPROCESS CONTROLS (Ref. QCP 002 for details)

Marking, cutting and preparation  
 Shape, Size and EP  
 Measurement  
 100%  
 Drawing Note 2  
 -- QC

Welding  
 Procedure and Personnel Qlfn  
 Review of  
 100%  
 PR:QE 172  
 R QC

Process controls  
 Surveillance  
 Random  
 Note 3  
 - QC

Weld Inspection  
 Weld Size and quality  
 Visual LPI/MPI  
 100%  
 PR:QE:021  
 BHE:NDT:PB:PT1/MT1, QCP 002  
 - R QC

SL. NO.	COMPONENT AND OPERATION.	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD	AGENCY	REMARKS
0	FINAL INSPECTION							
1	Assembly	Dimensions Match marks	Measurement Trial assy	100%	Drawings Note 4	R	QC	
2	Trial operation	Free operation of Damper	Open/Close movement	100%	Drawings Note 5	R	QC	
		Seal tightness	Check with Feeler gauge	100%	Drawing Note 5	R	QC	
3	Painting and Preservation	Paint finish coat thickness	Visual Measurement	--	PR:QE:104 Note 6	-	QC	
4	Identification and Packing	WO No., DU No. Match marks Flow direction	Visual	--	Drawings Note 7	-	QC	
5	Certification	AS per check List & Test Report	Sign off	--	--	R	QC	

**NOTE 1**

1.0 Materials normally used and their TDC nos are given below:

<u>Material</u>	<u>Specification</u>	<u>TDC_Nos</u>
Rolled sections	IS 2062 Gr.A&B	As per Specification
	AS588 Gr.A	-do-
	SA240 Tp 304	As per Specification
Rounds	ASTM A564 GRXM.25	0:305
	ASTM A276Tp304/316	As per Specification
	AISI 450 SS	-do-
	SA479 Tp 304	0:306
	ASTM A105	0:309
Sheet for Seals	ASTM B575 UNS	0:304
	10276	
	ASTM B 75	As per Specification

**NOTE 2**

2.0 The requirements of marking, cutting and preparation are detailed below:

2.1 Blade skin plates diagonal shall not vary by more than 3mm.

2.1.1 Plates for truss shall be cut to size and deburred. Width of vertical stiffeners shall be closely controlled.

2.1.2 Holes for plug welding and pin connection shall be marked and drilled to size.

2.1.3 Holes for seal air blower mounting shall be marked and drilled if required. Cut out for seal air entry shall be marked and cut.

2.2 The following are the norms applicable for splicing of blades.

2.2.1 For blades of length upto 2M no joint is permitted. Above 2M and upto 5M one joint is permitted. Above 5M two joints are permitted and in no case more than two joints is permitted.

2.2.2 For biplane dampers, max. two joints can be permitted for top and bottom plate of blades and the joints are to be staggered on top and bottom.

2.2.3 Any variation from the above shall have the approval of Quality Assurance.

**NOTE 3 FABRICATION****3.1 FRAME**

3.1.1 The requirements of preheating and welding control is detailed out in QCP 002.

- 3.1.2 The holes for shafts can be gas cut with allowance and ground.
- 3.1.3 Plates for mounting plate, lug plates and rib plates shall be marked and cut.
- 3.1.4 Holes for lug plates shall be match-drilled with mounting plates. Holes on mounting plate for actuator shall be match drilled.
- 3.1.5 Formed channels shall be assembled on a level surface and welded with temporary retainers at all corners to avoid distortion. The inside of frame corner welding shall be dressed up to suit blade corner.
- 3.1.6 The Mounting plate shall be in tack welded condition only till the actuator is mounted and adjusted.
- 3.1.7 Square washer shall be welded with frame co-axially with lifting holes.
- 3.1.8 Gland assembly shall be positioned, held tightly with frame and tack welded.
- 3.2 **BLADE END BLOCKS AND SHAFTS:**
- 3.2.1 Plates for blocks shall be marked to size and machined on all sides maintaining squareness.
- 3.2.2 One side of the block shall be marked for boring and block outer face shall be square to the side marked.
- 3.2.3 The bore shall be machined in stages maintaining the perpendicularity of the bore axis to the machined face.
- 3.2.4 Blade block machined completely shall be deburred.
- 3.2.5 Pin holes shall be drilled only after matching the shafts in assembly.
- 3.2.6 The blade blocks shall be inspected for dimensions as per drg.
- 3.2.7 Bore shall be checked with a shop made cylindrical type plug gauge.
- 3.2.8 Stub shafts shall be machined to size and finish.
- 3.2.9 Shafts and end blocks shall be match assembled maintaining the orientation of key way. Shaft inner end shall be kept as per drg. with end block, so as to maintain the projected length of shaft.
- 3.2.10 Each such assembly shall be match marked by punching on outer flat face of shaft and outer edge of block.
- 3.2.11 Holes for pins shall be match drilled to size and finish.
- 3.2.12 Shaft and end blocks shall be dismantled retaining the match marks.
- 3.3 **BLADES**
- 3.3.1 After marking the bend line skin plates shall be pressed to correct angle in a press.

- 3.3.2 Blade profile shall be checked using a template. Blade end cover plates shall be marked to size and shape.
- 3.3.2.1 The blade inside surface shall be painted with one coat of red oxide primer.
- 3.3.3 The blade skins shall be assembled in suitable fixture.
- 3.3.4 Bottom skin shall be assembled with end blocks.
- 3.3.5 Blocks shall be tack welded and top skin shall be assembled.
- 3.3.6 Both top and bottom skin plates shall be held tightly and tackwelded. Any twist noticed shall be removed.
- 3.3.7 Welding of blades shall be completed progressively.
- 3.3.8 Blade end cover plates shall be assembled and welded.
- 3.4 **GLAND ASSEMBLY**
- 3.4.1 Plates for glands, follower and pipes, rounds for gland and bearing holder shall be marked and cut to size by saw cutting or flame cutting.
- 3.4.2 Holes for shaft and studs shall be marked correctly.
- 3.4.3 Stud holes shall be drilled and deburred. The shaft holes shall be bored to size and finish.
- 3.4.4 Gland and bearing holders shall be machined to size and finish as per drg.
- 3.4.5 Studs shall be machined and threaded as required. Thread shall be checked by thread ring gauges.
- 3.4.6 Gland plate shall be positioned with gland ring. Care shall be taken to ensure the surface of gland plate. Matching frame and gland ring are in the same plane and ring shall not protrude to create gap between gland plate and frame. (A shim can be used to ensure this).
- 3.4.7 Welding between ring and gland shall be completed in the same position with necessary preheating.
- 3.4.8 Studs shall be positioned in holes of gland plate maintaining squareness. Note: Whole gland assembly can be made in upside down position on a level surface by maintaining the gap between gland plates and follower plates by a thickness block to ensure the depth of plug welding of studs. This method of assembly ensures proper alignment of studs and reduced distortion.
- 3.5 **LEVERS**
- 3.5.1 Rods/rounds for hub shall be cut to size by saw.
- 3.5.2 Plate for levers shall be marked using template.

- 3.5.3 Lever plates shall be marked and cut by flame after checking with suitable template.
- 3.5.4 Lever plates shall be set on hubs maintaining squareness with respect to hub axis.  
Note: Proper fixtures shall be used for matching and welding of lever plates to hubs.
- 3.5.5 Welding shall be completed in sequence to avoid distortion.
- 3.5.6 Shaft holes shall be bored to size and finished as per drg. Holes for pins shall be drilled in a fixture to ensure the lever distance.
- 3.5.7 Key way shall be marked in correct orientation with respect to lever plate orientation and cut to size and finish.
- 3.5.8 Completed levers assy. shall be inspected only in a fixture for size and orientation.
- 3.5.9 Holes for lock screw shall be marked, drilled and tapped to size. This shall be checked with thread plug gauge.
- 3.6 **KNUCKLES AND ADJUSTING LINKS**
- 3.6.1 Square bars for knuckles and rods for adjusting link shall be marked and cut to size by saw.
- 3.6.2 Hole for connecting pin shall be marked at centre of square bar on one face. Hole shall be drilled with axis perpendicular to rod axis.
- 3.6.3 Tapped holes of knuckles shall be drilled and tapped, maintaining the alignment of axes of both side holes.
- 3.6.4 Adjusting link rods shall be machined and threaded as required.
- 3.6.5 All threaded components shall be checked with thread gauges.
- 3.6.6 Nuts for spanner shall be assembled with link rod and welded as per part drg. before assembling the link rod with knuckle.
- 3.7 Seals shall be manufactured as per PR:QE:063 and supplied as sub assembly. Check for any damage before assembly.

**NOTE 4**

- 4.0 **ASSEMBLY**
- 4.1 Frame shall be positioned on a level surface.
- 4.2 Jamb seals for drive /non drive end shall be held tightly against the frame using clamps ensuring holes for shafts are aligned.
- 4.3 Assembly of blades in damper shall be from centre towards ends. Care shall be taken to position the drive blade at the correct location.
- 4.4 Blade shall be positioned inside frame and supported so as to facilitate the stub shaft assembly.

- 4.5 Match marking shall be verified before assembly of shafts.
- 4.6 Shaft connecting pins shall be used for positioning the shafts.  
(Match drilled holes will ensure the correct projection of shaft outside).
- 4.7 Both drive and nondrive end shafts shall be assembled progressively.
- 4.8 Plug welding of blade skins with block and pins with blades shall be completed.
- 4.9 Blade assemblies shall be supported on adjusting stands, shafts can be centered with respect to frame holes. Blade rotation shall be ensured.
- 4.10 All gland plates shall be welded after ensuring free rotation of blade.
- 4.11 Gland packing shall be provided in position as rings as given in drg. Care shall be taken to provide lantern ring if seal air arrangement is envisaged.
- 4.12 Grafoil sheets shall be cut to size and formed to shape by mending on the shaft. Assemble gland with grafoil in position and tighten with lock nut.
- 4.13 All blades shall be positioned horizontally and edges aligned.
- 4.14 Blade edge matching shall be done starting from middle blade.  
Hot correction can be adopted to ensure perfect matching of blades. Out of straightness shall be reduced to as minimum as possible to achieve better tightness.
- 4.15 Blade seals shall be positioned and stitch welded on blade edges as 10 (100) 10 (200). End seal bars shall be matched with blade end and welded with frame after assembly of blade, jamb seals and collar. Care shall be taken to avoid any damage due to weld spatters and stray arc.
- 4.16 Levers shall be assembled on to shafts and keyed. Locking screw shall be fixed.
- 4.17 Link and knuckles shall be assembled with Nylon bushes on to levers. Care shall be taken to prevent damage to Nylon bush during assembly.
- 4.18 Links shall be adjusted from middle to end for maximum tightness.
- 4.19 Mounting bracket shall be positioned with respect to drive shaft and held temporarily.
- 4.20 Actuator shall be assembled on to drive shafts and the assembly shall be completed.
- 4.21 Actuator shall be de-clutched and checked for movement with the help of hand wheel.
- 4.21.1 If pneumatic drive is envisaged, mounting bracket shall be welded after ensuring the satisfactory operation.
- 4.22 All the blades shall be pulled towards drive side and collar shall be tightened maintaining distance between blade to frame, such that the initial compression of seals as envisaged in drg. is achieved.
- 4.23 All the lock screws of hubs shall be tightened with shafts.

- 4.24 Lock tabs shall be provided when assembly is completed. Complete the welding of mounting bracket with damper frame.

**NOTE 5****5.0 FINAL INSPECTION AND TESTING**

- 5.1 Dampers shall be match assembled and match marked if they are supplied in pieces as per drawing. The final inspection shall be carried out using the check list enclosed and documented.

- 5.1.1 Seal tightness between blades and blade and jamb seal shall be checked and recorded.

**5.2 TEST PROCEDURE**

- 5.2.1 The louver dampers and biplane dampers shall be tested in site orientation position as indicated in the key plan. Proper supports shall be provided and the damper shall be leveled by water level.

- 5.2.2 Ensure that all components have been installed and inspected. Ensure setting of correct rating of motor/actuator w.r.t C&I data sheet and TC.

- 5.2.2.1 Ensure the free operation of actuator manually before assembling with damper.

- 5.2.2.2 Connect the Actuator electrically as per wiring diagram. Set the torque required for ambient operation of the damper as in the actuator.

- 5.2.3 The damper shall be operated through ten cycles with the actuator in position and the following characteristics shall be recorded.

Electric actuator :	Amperage, voltage, Temperature
Mechanical Operator :	Weight
Pneumatic operator :	Air pressure

- 5.2.3.1 In case of pneumatic actuator regulate the air pressure to 60 psi at the start of every stroke.

- 5.2.4 At the end of ten cycles the damper shall be closed with specified torque for ambient condition. The gap between the blades and blade and jamb seals shall be checked using feeler gauge. The readings of gap shall be recorded.

- 5.2.5 Bulb seals shall be tightened fully after setting the gap.

- 5.2.6 After the completion of the test the damper shall be visually inspected for any damage to blades, seals etc.

- 5.2.7 In the absence of actuator the damper shall be operated manually and tightness of seals checked with torque equal to ambient torque applied by dead weights.

- 5.2.8 The test results shall be recorded in the test report format enclosed and certified by Quality control.

### 5.3 TOLERANCE

5.3.1 Tolerances given in the drawing shall be followed. When not specified in drawing the following tolerances also shall be followed.

5.3.2 Pitch distance of holes for shaft:

Individual:  $\pm 1$  mm

Cumulative:  $\pm 2$  mm

Frame: Length :  $\pm 1$ mm/meter subject to a max. of  $\pm 5$ mm.

Width : + 3mm, -0.00 mm

Diagonal difference : 2mm/metre limited to 5mm max.

5.3.3 Blade length: +0mm, -3mm.

5.3.4 Alignment of shaft holes on frame :  $\pm 2$  mm

5.3.5 Dampers shall be adjusted to have proper closing and with minimum gap. However, the following may be accepted as deviation for both parallel and opposed levers.

5.3.5.1 Gap for Louver Damper without seals shall be as given below.

Blade tip to tip : 1.5 mm (Max.)

Blade tip to frame : 2.5 mm (Max.)

Blade end to frame : 1.5mm (over and above the washer thickness)

The above also applies to control louver dampers closed with specified torque.

5.3.5.2 For Louver Damper with seals the gaps shall be restricted as below:

Blade tip to tip and blade tip to frame : 0.25 mm (max.)

Blade end to jamb seals ( over and above washer thickness) individually on both sides : 1.5 mm (max.)

5.3.6 Alignment of left and right hand threaded holes shall be checked. Off-set/inclination of 2 mm for a length of 500 mm from knuckle face ref. is permitted.

5.3.7 The blade position in open condition shall be within  $\pm 2.5^\circ$  to vertical.

5.3.8 Alignment of lever pins in both open and close position shall be limited to 2 mm from neutral position.

### 5.4 NON DESTRUCTIVE EXAMINATION

5.4.1 All NDE for gas cutting shall be as per QCP 002.

5.4.2 100% LPI shall be carried out on blade block welding, mounting bracket welding and stud welding with gland plate.

5.4.3 100% LPI/MPI shall be carried out on all blade splice joints.

## NOTE 6

6.0 **PAINTING, PRESERVATION AND IDENTIFICATION**

- 6.1 All fasteners ( except SS) shall be applied with high temp.lubricants.
- 6.1.1 Grafoil bearing shall not be lubricated.
- 6.2 The surface preparation and painting shall be as per PR:QE:104.
- 6.3 Match marking shall be done on all parting lines by stenciling and punched and bordered with white paint.
- 6.4 Blade orientation shall be indicated by welding small rods on to shaft or marking a vee groove on the shaft.
- 6.5 Opening and closing direction of blades shall be marked by punching on the damper frame.
- 6.6 Flow direction shall be indicated by means of stickers, arrow plates or paint stenciling.

## NOTE 7

7.0 **PACKING**

- 7.1 Packing shall be performed at shipping unless otherwise specified in OPS/PURCHASE ORDER.
- 7.2 The damper shall be packed in steel crates to avoid damages during handling and transit.
- 7.2.1 The blades shall be arrested from moving during shipping and shall be kept as per drg.
- 7.2.2 Components / subassemblies,like DP switch,actuators,blowers etc. shall be packed separately in polythene sheet and crated in wooden boxes.

TEST REPORT FOR LOUVER/BIPLANE DAMPER

1.0 GENERAL :

CUSTOMER :

WORK ORDER NO. :

DAMPER SIZE :

DU NO.:

NO.OF BLADES:

APPLICATION :

TYPE : LOUVER/BIPLANE

2.0 Actuator name plate details:

Electrical Actuator

3.0 Blower name plate details: (If applicable)

4.0 Test results : Tested with electrical actuator:

Cycles	1	2	3	4	5	6	7	8	9	10
Amps - Opening										
Amps - Closing										
Temp - Opening										
Temp - Closing										

b) Tested with pneumatic actuator (Air pressure shall be set at 60psi before every operation)

Cycle No.	Air pressure	Closing	Opening
1.			
2.			
3.			
4.			
5.			

5.0 Gap between Jamb seal & frame (Gap measured with feeler gauge )

- 1.
- 2.
- 3.
- 4.
- 5.

6.0 Gap between blades: Blade edge No. Gap measured with feeler gauge.

- 1.
- 2.
- 3.
- 4.
- 5.

7.0 Deviation if any shall be referred to Q.A.

8.0 Damper operation: Satisfactory/Not satisfactory.

9.0 Blade tightness :

10.0 Test results : Acceptable/Not acceptable.

Signature/Date

Firm Inspection.

BHEL Inspection.

Customer Inspection.

**CHECK LIST FOR LOUVER/BIPLANE DAMPER**

W.O. No. :

D.U. No. :

Drawing No. :

Supplier Code :

General dimensions:

I. Squareness of blade skins.

II. Length of blades.

III. BEARING ASSEMBLY.

i) Welding of gland plate.

: ok/not ok

ii) Bearing holder assembly

iii) Grafoil sheet

: provided/not provided

Free rotation

: ok/not ok

IV) TRIAL OPERATION OF BLADE MOVEMENT:

i) Individual

: ok/not ok

V) LINK AND LEVERS

i) Nylon bush

: provided/not provided

ii) Thread of knuckle

: Checked with gauge

: ok/not

iii) Alignment of links

: ok/not ok

VI) DAMPER OPERATION:

i) Opening and closing of blades

: sat./not sat.

ii) Free operation of links

: sat./not sat.

iii) Records of :

a) Gap between flap and seal plates

:

b) Gap between blades end and jamb seals

:

VII) GENERAL WORKMANSHIP:

: Sat./Not sat.

VIII) PAINTING OF DAMPERS:

: Done/not done as per QCP

IX) IDENTIFICATION OF DAMPERS

: Done/not done.

SUBCONTRACTOR

QC/BHEL

**QUALITY ASSURANCE DEPARTMENT  
AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q.W.I)**

Q.W.I SQP :NP:03

REV:01

AMENDMENT SL NO: A3


DESCRIPTION:LOUVER &BIPLANE DAMPER S

DATE:07 06 2012

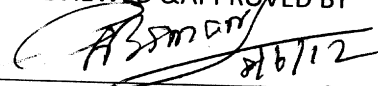
**DETAILS**

EXISTING CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT /REMARKS.
CLAUSE 5.2.1	<p>Clause no 5.2.1 under NOTE 5 Modified as follows:</p> <p>The Louver Dampers and biplane dampers shall be tested in site Orientation position as indicated in the key plan for the first number of each DU /PGMA, Balance number of each DU/PGMA shall be tested horizontally.</p> <p>Proper supports shall be provided and the damper shall be leveled b y water level.</p>	<p>RCA SUBCOMMITTEE OF GATES&amp;DAMPER dt 260512 outcome.</p>

PREPARED BY



REVIEWED & APPROVED BY



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**QUALITY ASSURANCE DEPARTMENT  
AMENDMENT TO QUALITY WORK INSTRUCTIONS. (Q.W.I)**

Q.W.I.NO:SQP:NP:04

REV: 01

AMENDMENT SL NO:

A 1

DESCRIPTION:GUILLOTINE GATES

DATE:04.12.96

**D E T A I L S**

CLAUSE NO.	AMENDED AS ...	BASIS FOR AMENDMENT/ REMARKS.
2.3.1	Splicing of gate plate may be either horizontal or vertical. Minimum width of plate shall be 500 mm for blade joint and no joint shall be permitted within 200 mm from the middle of the blade for vertical joints.	Based on feed back and discussions with Shop, OP&C, Quality of BAP/Ranipet and Engineering/DD/FB during Nov.96.
5.2.3	Diagonal variation shall be within 1 mm/metre limited to 5 mm Max.	Based on feed back and discussions with Shop, OP&C and Quality of BAP/Ranipet during Nov.96.

QUALITY ASSURANCE  
BAP: BHEL: RANIPET.  
MASTER COPY

Prepared by:A.R.Reddy

Reviewed & Approved by:V.Raghavendran

Signature & Dt: A.R.Reddy  
04.12.96

Signature & Dt: V.Raghavendran  
4/12/96

**BHARAT HEAVY ELECTRICALS LIMITED**  
TIRUCHIRAPPALLI 620 014 INDIA

STANDARD  
QUALITY PLAN  
FOR

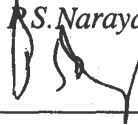
*GUILLOTINE GATES*



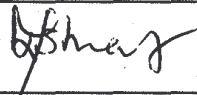
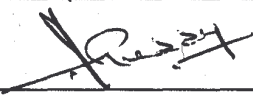
SQP:NP:04/01



Page 01 of 14

Prepared by  
Quality Assurance

*S. Narayanan*



REVIEWED BY	SIGNATURE
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QUALITY CONTROL (S. Muthiah)	
QUALITY ASSURANCE (A. R. Reddy)	

REV.NO.	DATE	APPROVED BY	SIGNATURE
00	01.04.93	Sr. Manager/QA	
01	01.02.95	Sr. Manager/QA	

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**RECORD OF REVISIONS**

Rev. No.	Clause No.	Details of revision
00	--	This document consolidates all requirements of various previous SQPs.
01	--	All amendments issued has been regularised and editorial correction made for better clarity .  Latest applicable TDC Nos incorporated.

SL. NO.	COMPONENT AND OPERATION.	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD	AGENCY	REMARKS
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1.0 MATERIAL

1.1 Plates, Sheets, Sections, Rounds & Tubes. Chemical & Mechanical Properties Review of documents 100% TDC/Mat1 Spec. TC QC

1.2 SUB DELIVERIES

1.2.1 Actuators Performance Review of Records 100% Drawing Purchase Spec. TC QC

1.2.2 Power cylinder Performance Review of Records 100% Drawing Purchase Spec. TC QC

1.2.3 sprockets Mechanical Properties Review of Records 100% Drawing Purchase Spec. TC QC

1.2.4 Chains Chemical, Mechanical Properties & Dimensions Review of Records 100% Drawing Purchase Spec. TC QC

1.2.5 Isolation valve limit Switches Performance Review of Records 100% Drawing Purchase Spec. TC QC

1.2.6 Check valve, Filter cum Lubricator, Solenoid valve Performance Review of Records 100% Drawing Purchase Spec. TC QC

2.0 INPROCESS CONTROLS (Refer QCP 002 for details)

2.1 Marking, cutting and preparation Shape, size & EP Measurement, 100% Drawing Note 2 R QC

SL. NO.	COMPONENT AND OPERATION.	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT / ACCEPTANCE STD.	TYPE OF RECORD	AGENCY	REMARKS
2.2	Welding	Procedure & Personnel Qlfn	Review of Documents / Records	100%	PR:QE:172	R		QC
2.3	Weld Inspection	Weld quality	LPI/MPI	100%	BHE:NDT:PB:PT1 / MT1,QCP 002	R		QC
		Weld size	Visual	100%	PR:QE:021, Note 7			
2.5	Seal assy	Dimension	Measurement	100%	Drawings PR:QE:063	R		QC
3.0	FINAL INSPECTION							
3.1	Assembly	Over all Dimensions & Diagonals	Measurement	100%	Drawings Note 3, 4 & 5	R		QC
3.2	Trial operation	Free operation of Gate	Open/Close movement	100%	Drawings Note 6	R		QC
3.3	Painting and Preservation	Paint finish Paint thickness	Visual Measurement	100% Random	PR:QE:104 Drawings Note 8	R		QC
3.4	Identification And packing	WO No., DU No. Match marks	Visual		Drawings Note 9	-		QC
3.5	Certification	As per check List	Sign off		--	R		QC

## NOTE 1

The materials normally used and their TDC Nos are given below:

Materials	Specification	TDC NO.
Plates, Rolled Sections	IS 2062 Gr.A&B SA 588 GRA	As per Specification -do-
Rounds	ASTM A108 Gr10450 (1045 CRS) AISI 304	0:305 As per Specification
Tubes	SA 193 B7 SA106 GRB ASTM B75	0:309 0:101 As per Specification
Seals	ASTM B575 UNS 10276	0:304
Castings	IS 210	As per Specification

## NOTE 2

The requirements for marking, cutting and preparation are detailed below:

- 2.1 Holes on frames for matching with duct flanges and holes for studs shall be marked correctly. These holes may either be punched or drilled.
- 2.2 Whenever the frame channel size is substituted, seal clamping hole dimensions with respect to groove shall be maintained with respect to centre line of both channels.
- 2.3 **SPLICING OF GATE PLATE:**
- 2.3.1 Splicing of gate plate may be either horizontal or vertical.
- 2.3.2 No splicing is permitted if plate width is 1.2 meter or less.
- 2.3.3 For plates of width upto 2.4 M. only one joint is permitted. For width greater than 2.4 M, maximum two joints are permitted.
- 2.3.4 Any deviation from the above norms shall have the approval of Quality Assurance.

## NOTE 3

- 3.1 **FRAME**
- 3.1.1 Frames shall be made on a level platform. Flange top and bottom surfaces of adjacent members shall be leveled. Studs shall be welded on to frame parts as per drawing prior to assembling the sides into frame.
- 3.1.2 Suitable fixture shall be used for the assembly of frame maintaining dimensions and distance between studs w.r.t. axis of blade movement on all sides.
- 3.1.3 Super structure frame shall be made such that the guide angles are placed at correct distance from the centre line of the channel.

3.1.4 Weld the guide beams as per drawing in port side in level with frame. A curved plate shall be welded with guide beam at entry side to avoid struck up of gate plate.

3.1.5 Ensure that the " T " bar shall be welded square to the gate plate through pin plate to accommodate differential expansion. Connecting nut for piston rod shall also be welded / fastened square to the " T " bar. Plate centre line, piston rod centre line and nut centre line shall be in one axis. Out of squareness if found, shall be corrected by grinding / machining.

### 3.2 SEALS

3.2.1 Seals shall be manufactured as per PR:QE:063 and supplied as subassemblies. Check for any damage before assembly.

### 3.3 MACHINING AND ASSEMBLY OF SHAFTS

3.3.1 Plain turned drive shafts shall be marked for key way milling and milled suitably to size and finish as per drawing.

3.3.2 The rings shall be machined to diameter, edge prepared and welded with the shaft and checked by MPI/LPI.

3.3.3 Finish machined shafts shall be checked for size, finish, eccentricity and key way dimensions.

3.3.4 Tolerance on bearing and sprocket locating dimensions:  
Outside Diameter = +0.00/ -0.10mm.  
Eccentricity = 0.5mm.

3.3.5 Set the shaft sub assembly and tube in assembling fixture as given in the sketch-1.

3.3.5.1 Ensure the co axiality of the shafts and tube assembly by dial gauge after aligning the key ways if provided.

3.3.5.2 Plug weld the shaft and tube and complete the welding of shaft sub- assembly with tube on either side maintaining the fillet size.

3.3.5.3 Completed shaft shall be checked for coaxiality, size, finish, eccentricity, key way orientation, etc as per drg.

3.3.5.4 100% LPI/MPI on fillet / plug welds of assembly shall be carried out.

3.3.6 Machined shafts shall be applied with rust preventive oil.

### 3.4 AIR TANK

3.4.1 Pipes and end covers for air tank shall be cut to size. Weld edges shall be prepared as per drawing. Where pipes are made of plates, it shall be rolled and welded.

3.4.2 Butt welds and long seam of PFP shall be spot radiographed in addition to MPI/LPI as per approved procedure. If unacceptable defect is noticed during spot radiography 100% radiography shall be carried out.

3.4.3 Completed air tank shall be hydraulically tested as envisaged in drg.

#### NOTE 4

- 4.1 The frame shall be assembled with super structures. Assembly shall be done in horizontal position, ensuring that the whole frame is in single plane. Corner welds of angle frame shall be ground to accommodate the seating of seals.
- 4.2 Position the mounting plate and assemble the air tank and blower.
- 4.3 Assemble the cylinder onto the frame and connect the piston rod and ensure the co-axiality of piston rod and gate plate.
- 4.3.1 Check that the piston rod, gate plate and cylinder are in the same plane using spirit level.
- 4.4 Assemble the pneumatic fittings of correct size and qty. starting from the ports of air cylinder. (4 way solenoid valve, transparent type filter cum lubricator etc.). Use teflon tape for threaded connections.
- 4.5 Assemble the junction box for electrical connections. Assemble the limit switches at the correct locations. Complete the electrical connections and identify the wires.
- 4.6 Defect free seals shall be assembled in position in correct orientation as per drg.
- 4.7 Connect the air cylinder to pneumatic lines and check for free operation of gate plate and piston. Adjust the limit switches ensuring the stroke length of blade.
- 4.8. Sprockets shall be assembled with shaft together with end collars.
- 4.9. Assemble the drive shaft and idler shaft assemblies on the mounting brackets. Ensure the offset of axis of both drive and idler shafts. Ensure that the bearings are filled with Grease Servogem HTXX before assembling with shaft.
- 4.10 Ensure the correctness of drive chain size, pitch, length etc., and assemble keeping the plate in open position and locked, over sprocket with gate plate and complete the assembly.
- 4.11 Seal sub/assemblies shall be inspected and trial assembled maintaining match marks prior to assembly for modular construction. Defect free seals, shall be assembled in position in correct orientation as per drawing.
- 4.12 Assemble brace angles of super structure in position and complete welding.
- 4.13 Adjust the chain length and tighten equally on both sides.
- 4.14 Sagging of chain shall be checked on top side of the chain with bottom side of chain resting on gate plate. This sagging shall be set equal to or less than thickness of chain while gates are in horizontal position.
- 4.15 A clear gap of 6 mm shall be ensured between gates plate and sprocket. while the gate is kept in horizontal position so as to ensure free travel of chain with out climbing on the blade during operation.

- 4.16 Install the actuator mounting brackets on to frame and complete the welding.
- 4.17 Install the relevant drive in position with all accessories and connections.
- 4.18 Assemble isolation valve with transition, if required.
- 4.19 Install the blower assembly with transition if required.

**NOTE 5**

- 5.1 The final inspection shall be carried out using the check list and documented.
- 5.2 Tolerances given in the drawings shall be followed. If not specified in drawing the following tolerances shall apply.
  - 5.2.1 Pitch of holes for matching flanges shall be within  $\pm 1$  mm (individual) and  $\pm 3$ mm max. (cumulative).
  - 5.2.2 Linear tolerance on length/width  $\pm 1$ mm/meter. Max 5 mm.
  - 5.2.3 Diagonal variation shall be within 1mm/metre with a max of 3mm.
  - 5.2.4 Waviness of finished gate plate shall be within 6mm. Max.
- 5.3 The gate plates shall be locked using mechanical blade lock assembly.

**NOTE 6****6.1 TESTING**

- 6.1.1 Position the gate in the testing stand maintaining verticality on sides and face (flow direction). It shall not have any twist.
- 6.1.2 Connect the Actuator electrically as per wiring diagram.
- 6.1.3 Adjust the gate in such a way that gate plate is in the middle of its stroke.
- 6.1.4 Set the torque required for ambient operation of the gate as in the actuator data sheet.
- 6.1.5 Gate shall be operated with actuator for 5 complete cycles. (with an idle time of 10 minutes in between every two cycles.)
- 6.1.6 Record amperage, voltage, time taken for each stroke in case of electrical actuator and record air pressure and time for pneumatic actuator.
- 6.1.7 During the test ensure that gate plate is operating freely without rubbing the throat support beam.
- 6.1.8 In case the gate is not lifted with minimum setting of the torque switch / Air pressure, torque rating / air pressure shall be slowly increased so as to enable free operation of the gate. In no case this value shall exceed the no load operating condition indicated by Engineering / C & I.

- 6.1.9 Normal / running current shall not exceed the permitted value. In case current drawn at no load is more than the acceptable value the same shall be referred to Engineering / C & I for approval.
- 6.1.10 The gate shall be visually inspected for any damage to blades, seals etc. Ensure the gate plate is in open position. Provide the lock tab and lock it.
- 6.1.11 The test results shall be recorded as per the test report and certified by Quality control.
- 6.1.12 Set the blade stopper bracket on beam and ensure the stroke length of blade and corner closing.
- 6.1.13 Provide chain guards in position. Provide drain holes in frame and dust guard on super structure.

**NOTE 7**

- 7.1 Mounting bracket welds, "T" bar welding of gate plate, collar welding on shaft, Blower and air mounting bracket welds shall be checked by MPI. Welding of splice joints of gate plates shall be checked with MPI/LPI. Defects revealed shall be repaired and tested again.

**NOTE 8**

- 8.1 Gate plate, Chain and all machined surfaces shall be applied with Rust preventive coating.
- 8.2 Match marking shall be done on all parting lines by stenciling and by punching and bordered with white paint. Mark the flow direction on the frame.

**NOTE 9**

- 9.1 Identification marks shall be as per QCP 002.
- 9.2 Packing shall be performed at shipping unless otherwise specified in OPS/Purchase Order.
- 9.3 The gate shall be packed in steel crates to avoid damages during handling and transit. Air cylinder in case of hot air gate shall be suitably protected from damages.
- 9.3.1 The blades shall be arrested from moving during shipping and shall be kept as per drawing.
- 9.3.2 Components / Sub assemblies like DP switch, actuator, blower etc. shall be packed separately in polythene sheet and crated in wooden boxes.

TEST REPORT OF GUILLOTINE GATE

1.0 General

Customer :  
 Work order No : Du No.  
 Gate size :  
 Application :  
 Type :

2.0 Actuator Name Plate Details :

GMS particulars

3.0 Test results of gate operation :

a) Torque required :

b) Torque set :

Cycles	1	2	3	4	5
Amps. opening					
Amps. closing					

4.0 Gate operation : Satisfactory/Not satisfactory.

5.0 Test results : Acceptable/Not acceptable/Rework-Identified.

Firms inspection

BHEL inspection

Customer inspection.

**CHECK LIST:**

PROJECT: W.O.NO:  
 UNIT : D.U.NO:  
 SIZE : DRG.NO:  
 SL.NO : DG/DL/DB:XXX:XXX/HAG:XXX:XXX

**A1 FRAME ASSEMBLY:**

Pitch of holes for seals  
 Distance between top and bottom row holes.  
 Alignment of holes.  
 Location of the groove from the top of channel flange.  
 Width of the groove.  
 Straightness of the groove.  
 Chamfering/deburring on the rear edge of the groove.

**A2 DIMENSION OF FRAME:**

1.LENGTH  
 2.WIDTH  
 3.DIAGONALS

**B DIMENSIONS OF SUPER STRUCTURES:**

1.WIDTH  
 2.LENGTH  
 3.DIAGONALS

d. The bracket should be ensured for squareness before fitting it on the frame.

**e. POSITIONING OF BRACKET:**

(To be full welded only after final assembly and testing)

**c. ASSEMBLY OF TOTAL FRAME:**

- a. Back gauging and LPI from second side  
 (To be witnessed by Inspector)  
 b. Dimensions:  
 i) Overall Length.  
 ii) Diagonals

**D COMPONENTS:**

- i) Shaft Dimensions Drive Idler  
 a) Length of shaft  
 b) Dia at Bearing location  
 c) Dia at actuator mounting portion of shaft

**ii) Sprocket:**

- a. Bore  
 b. Key-way dimensions

E

## GATE PLATE:

- a. Splicing - (If carried out)
  - i. No. of joints.
  - ii. NDT
- b. Overall Dimensions:
  - i. Length
  - ii. Width
  - iii. Diagonals
- c. Edge beveling with respect to flow direction.
- d. Beveling dimensions.

F

## 'T' BAR:

## A. DIMENSIONS

1. LENGTH
2. WIDTH
3. ADJUSTING BOLT HOLE DIMENSIONS
  - A. PITCH
  - B. DIAMETER

## B. "T" BAR AND CONNECTING NUT DIMENSIONS

- I. LENGTH
- II. WIDTH
- III. SQUARENESS

G

## ASSEMBLY OF GATE:

- a. Shaft assembly                      Drive    Idler  
   S/NS    S/NS
1. Sprocket assembly
2. Bearing assembly
  - a) Bearing Type & No.
  - b) Bearing assy on shaft.
3. Bearing housing assy.
4. Lubrication
  - a. Type of lubrication
  - b. Brand name
5. Trial operation
6. Assembly of drive shaft such assy. with mounting brackets/S/NS.
7. Free rotation check
  - b. Assembly of seal sub-assy. in position
  - c. Positioning of gate plate in super structure
  - d. Positioning of stopper on cross beam
  - e. Assembly of chain with sprocket and plate
  
  - f. Sagging of chain
  - g. Assembly of actuator/Blower/Air cylinder/Pneumatic cylinder

- h. Air cylinder piston, connecting nut, gate plate all should be in one axis.
- i. Positioning of limit switch

H

## TRIAL OPERATION:

## 1. Orientation of Gate:

- a. Theoretical
- b. Test Position

2. Gates operated -- Manually/with actuator/with pneumatic cylinder  
Name plate details of actuator/Air cylinder

- a. No. of cycle operated.
- b. Condition of the seal after operation
- c. Movement of blades:  
Smooth/Difficult/Jerk/Stick-up
- d. Current drawn
- 5 Rectification of defect noticed.
- 6 Retest results.

NOTE:(trial operation shall be repeated till satisfactory operation is achieved)

I

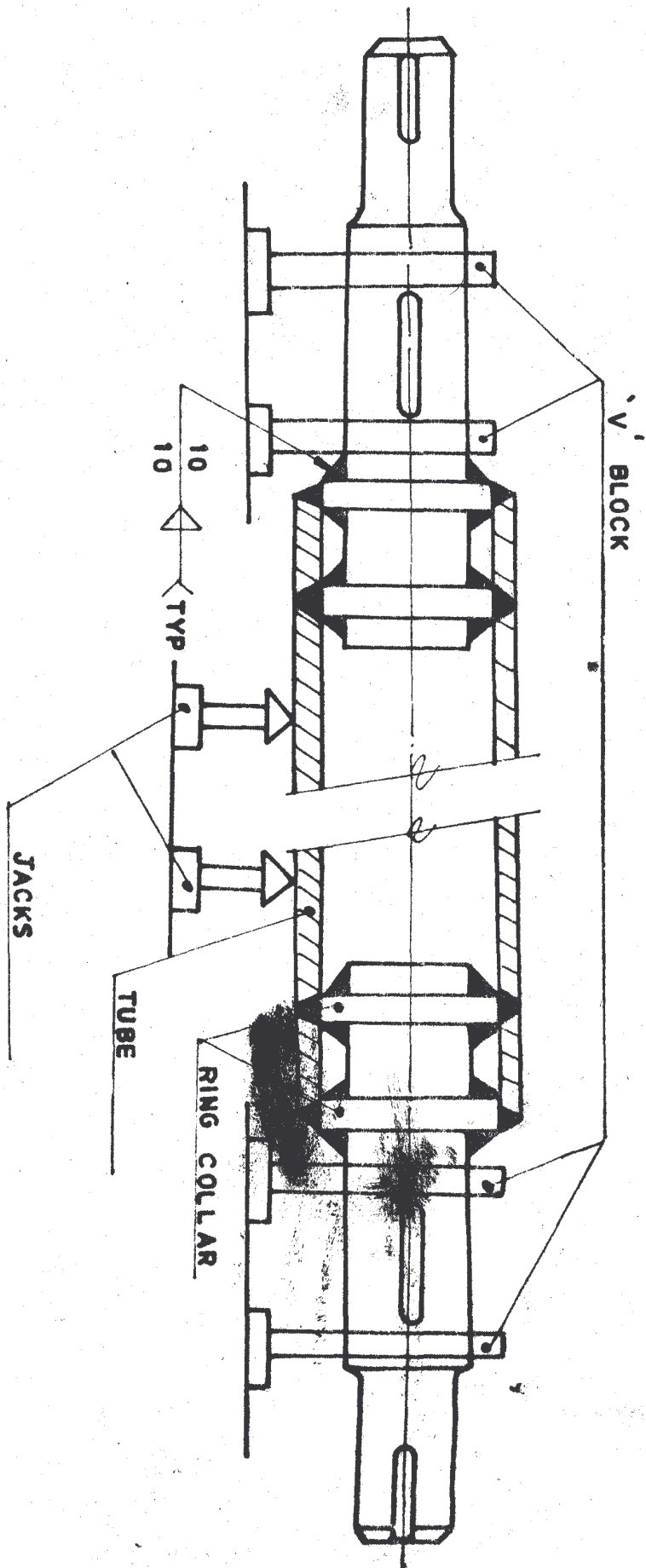
General workmanship

J

Mechanical blade lock provided/not provided

K

Rust preventive oil applied after testing for gate plate.



Sketch 1

**QUALITY DEPARTMENT**

**Amendment to Quality Work Instructions meant for SQP for Tubular Air pre heater**

**SQP APH 104**

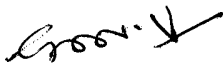

**Rev 01**

**DT 27 01 03**

**Amendment A1 DT 04 02 08**

**SQP for Tubular Air pre heater**

<b>Clause Number and reference.</b>	<b>Amended as</b>	<b>Basis for Amendment</b>
<p align="center"><b>Note</b></p> <p><b>Clause 4.9</b></p>	<p>Calculate percentage of tube thickness using the following formula: -</p> $\% \text{ age of expansion } K = 1 - \left\{ \frac{Dh-d}{2} \right\} \times 100$ <p>Dh = Tube sheet hole ID in mm  d = ID of the expanded tube in mm  T = Thickness of tube in mm  K = %age of tube thinning</p>	<p>Based on feed back from QC</p>

<p align="center"> <b>Prepared by</b></p>	<p align="center"> <b>Reviewed &amp; approved by</b></p>
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Ranipet

**MANUFACTURER'S NAME & ADDRESS**  
M/S BHEL / BAP / RANIPET  
TAMIL NADU-632 406

**STANDARD QUALITY PLAN**

ITEM/SUB SYSTEM:

**Tubular Air pre heater**

S/no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Doc. No	SQP APH 104	Agency 9	Remarks 10
						Rev. No	01		
						Date	27 01 03		
						Page No	01 of 05		
						Acceptance Norms 7			
						Format Of Records 8			

1.0	<b>MATERIAL *</b>	Chemistry, Tensile Properties	Chemical Tensile test	Each Heat	Respective Material Spec.	<b>TC</b>	P	V	
1.1	Plates, Sheets, Tubes,								
2.0	<b>In-process control</b>	<b>Welders are to be qualified to AWS D1.1&amp;Procedures are pre qualified.</b>							
2.1	Welding								
2.1.1	Weld Quality	All Fillet welds	LPI	10 %	AS PER ASME SEC VIII DIV 1	NDT Report	P	V	
3.0	Tube Sheet preparation	Dimensional check	Measurement	100%	Drawing/ Ref note 1.0, 2.0	Records	P	W	
3.1	Tube Block Assy. (Skeleton)	Dimensional check	Measurement	100%	Drawing/ Ref note 3	Records	P	W	
4.0	<b>Tube Expansion</b>								
4.1	<b>Mock up test for tube expansion</b>	Soundness of Expansion	Hammer test & 4.9.3	100%	Refer Note 4.0	Records	P	W	

**LEGENDS:**  
M - Manufacturer, (BHEL Shop / Subcontractor, )  
B - BHEL QC/ Authorised Inspection agency  
P - Performed By, V - Verification Of Reports/Records  
W - Witness T C - Test Certificate R- report.

Record of revision	Rev No	Date	The requirements of QCP A 018 and PRQA 415 are merged and this SQP is formed.
	00	27 01 03	

Prepared by	QA	B. Sundaradevi	APPROVED BY:
	QC		
Changes made			(Head/GA)

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Ranipet

MANUFACTURER'S NAME &  
ADDRESS  
M/S BHEL / BAP / RANIPET  
TAMIL NADU-632 406

ITEM/SUB SYSTEM:

Tubular Air pre heater

STANDARD QUALITY PLAN

Doc. No

SQP APH 104

Rev. No

01

Date

27 01 03

Page No

02 of 05

S/ no	Component & operation	Characteristics	Type Of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency	Remarks
								M B	
4.2	Tube Expansion (In actual)	Soundness of Expansion	Hammer test	100 %	Drawing /Ref Note 4.9.3& 5.0		Records	P W	
5.0	Final Inspection	Over All Dimension	Measurement	100 %	Drawing/ Note 6.0		DR	P W	
5.1	Painting and Preservation	Proper Preservation	Visual	100 %	Ref PRQA 590 Rev 00 & Note 8.0		--	P W	

Note : For Notes referred in column 6 & 7 ,refer the page No 03 ,04, 05 of SQP

## **1.0 Tube Plate preparation**

**page no 03 of 05**

- 1.1 Plates are to be sheared or gas cut . The gas cut edges shall be free from cutting notches and finish should be of 50 microns .The tolerance on length and width shall be  $\pm 1$  mm. the diagonals shall be within 2 mm .
- 1.2 The square ness shall be maintained precisely. Minimum two perpendicular sides shall be taken for tube hole marking reference.
- 1.3 The stock preparation shall be as per the drawing subject to coaxial drilling of top, middle and bottom plate together for the same block with match marks. Match marking shall be carried out. Both top, middle and bottom plates have to be marked for identification.

## **2.0 Marking for drilling**

- 2.1 Drilling shall be done on a batch of plates as a stack. Mark the holes as per the drawing. Check the extreme holes for the diagonal and it should be within 1 mm. Drill the stack with proper support. Check the stack with water level of 1mm before drilling.
- 2.2 The tolerance for the holes shall be as per the drawing and finish shall be 12.5 microns. The pitch variations shall be within 1 mm subject to a cumulative variation of 2 mm maximum.
- 2.3 Dismantle the stack. De burr the holes.
- 2.4 Check the hole sizes using 'Go' and 'No Go' plug gauges which should be checked and approved by BHEL inspector.

## **3.0 Tube Block Skeleton Assembly**

- 3.1 Layout the plates for bottom, middle (where applicable) and top assembly as per the drawing separately as given in the assembly drawing.
- 3.2 Identify the top, middle and end plates with proper match mark. Check the diagonals the variation shall not be more than 3 mm
- 3.3 Fit the tube plates and lifting eye pieces as per the drawing. For proper matching of the plate use eye piece by welding on to the plates at two or three places and using bolts and nuts for fastening. And Weld the lifting lug. Conduct root LPI and final MPI and then paint as per PRQA 590/LATEST.
- 3.4 Do the skeleton assembly with the stay tubes and tack weld, Ensure the tube projection from tube plate as per drawing.
- 3.5 Check water level & Plumb out with reference to the extreme row of hole & also at edge of the plate and Correct Within 1 mm Mark the water level reference & Plumb out with metal punch and bordered with paint.

- 3.6 Check the top diagonals X1,X2 and front and back diagonals F1, F2 & B1, B2 respectively and side diagonals SD1, SD2, SD3 and SD4 . Record the diagonal dimensions on the history card .The tolerance on diagonal shall be 3 mm.
- 3.7 Weld all stay tubes as per drawing.
- 3.8 Dismantle the skeleton from trial assembly if weight of each block with all tubes inserted weights more than 25 MT.
- 3.9 Inspect the tubes for defects such as rust, pitting, bends. The tubes shall be applied with rust preventive oil before inserting it into the holes. Insert the good ones in the tube holes and also ensure the tube length tolerance with in 2mm before tube Insertion.

#### **4.0 Mock Up test for tube Expansion**

- 4.1 The mock up for the tube expansion shall be carried out in the presence of QC personnel separately. Expand both ends of the tubes into the tube sheet using an Electronically torque controlled tube expander ensuring the projection of the tubes as per drawing.
- 4.2 Prepare a tube plate cut bit of size approximately 300 x 300 mm and thickness equivalent to that of actual Tubular air pre heater.
- 4.3 Drill holes of size covering the min and max limits of tolerance and in between size chosen suitably. The max number of holes drilled can be restricted to 8. Mark the holes as A,B,C, etc., as per the details of TAPH drawing. Also mark the corresponding tubes to be inserted as a,b,c etc., Measures the internal dia and pitch of these holes and record.
- 4.4 Select a tube with max and min sizes (thickness) meant for the actual job and cut it to 8 pieces each measuring not less than 250 mm. Measure tube OD/ID and thickness and record.
- 4.5 Set the electronic tube expander to minimum current for tube expansion.
- 4.6 Insert tube in hole A. Expand the ID using electronic tube expander. Electronic tube expander should break on reaching the preset torque and should not break on preset timer. Note current setting and ID of tube after expansion.
- 4.7 Perform Hammer test by giving a blow using a half pound hammer at free end of the expanded tube. There should not be any shake/displacement of tube.
- 4.8 Perform kerosene leak test and confirm that it does not leak from one side to other side of tube plate through the area between tube plate hole and tube OD.

4.9 Calculate percentage of tube thickness using the following formula:-

$$\% \text{ age of Expansion}(K) = \left[ \frac{D_h - d}{2t} - 1 \right] \times 100$$

- D<sub>h</sub> = Tube sheet hole ID in mm
- d = ID of the expanded tube
- t = Thickness of tube in mm
- K = %age of tube thinning

4.9.1 Repeat 4.5 to 4.9 for different current setting to ensure kerosene leak test and hammer test for tube holes B to H.  
 4.9.2 Record the values as follows:-

Hole No.	Current setting	Tube sheet Hole ID (D <sub>h</sub> )	Tube OD	Tube Thickness (t)	Tube ID before expansion	Tube ID after expansion (d)	%age of thinning (k)

4.9.3 Choose the current setting, which gives a thinning %age within 8% for the actual tube thickness. And in any case tube expansion beyond the tube sheet thickness is not acceptable.  
 4.9.4 Complete the expansion of tubes in each split block and offer for inspection.

**5.0 Hammer Test**

- 5.1 Check the tube expansion at both free ends by Hammer test. With half pound hammer, check for any shaking of tubes. If the joint fails to meet hammer test, repeat the expansion up until it passes hammer test.
- 5.2 After two or three expansions if still hammer test fails, seal welding can be resorted on that particular tube-to-tube sheet joint subject to a maximum of two percent of the tubes per block.
- 5.3 Weld the expansion piece and do kerosene leak test for the joint especially in the corners.
- 5.4 Fix the side walls and weld as given in the drawing.

**6.0 Final inspection**

- 6.1 Check overall dimension and water level & Plumb out with reference to the already marked reference and record the readings
- 6.2 Ensure the match mark by punching and bordering with yellow paint.

\*\*\*\*\_\*\*\*\*\_\*\*\*\*



**MANUFACTURER'S NAME & ADDRESS**  
 M/S BHEL / BAP / RANIPET  
 TAMIL NADU-632 406

**STANDARD QUALITY PLAN**  
 ITEM/SUB SYSTEM:  
**Rotor Post/ Module/Housing Assembly**

Doc. No **SQP APH 105**  
 Rev. No **00**  
 Date **01 02 03**  
 Page No **01 of 04**

SI no	Component & operation	Characteristics	Type Of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency	Remarks
1	2	3	4	5	6	7	8	9	10
								M B	

1.0	<b>Raw Materials</b> Plates, Sheets .coils	Chemical & Mech. Prop.	Chemical &Tensile /Bend	Each Heat	Respective material specification	TC	P	V	All Material shall be as per GMS
1.1	Forgings	-----Do-----	Chemical &Tensile, UT	---Do---	TDC: RTA: 403/Latest	TC	P	V	
1.2	Header Plate	-----Do-----	Chemical &Tensile, UT For Thickness > =25mm	100%	-Do-	TC	P	V	
1.3	Lower Post Pins	Soundness	Chemical, Tensile, Hardness	100%	Engineering Specification	TC	P	V	
1.4	In Process Control	Soundness	UT for Rod Dia > 63	100%	TDC:RTG: 500/latest	TC	P	V	
2.0	Welding	Weld Size	Measurement	100%	Drawing	DR	P	W	
2.1	Finish	Visual	Visual	100%	---	---	P	W	

WELDERS ARE QUALIFIED TO AWS D1.1 & PROCEDURES ARE PREQUALIFIED.

**LEGENDS:**  
 M - Manufacturer ( BHEL Shop / Subcontractor, )  
 B - BHEL QC/ Authorised Inspection agency  
 P - Performed By, V - Verification Of Reports/ Records  
 W - Witness T C - Test Certificate R- report,

Record of revision	Rev No	Date	Requirement of QCP: A:001,A:002, A- 007/A -007 S and 2:4:256 are merged and this SQP is Formed.
	00	01 02 03	

Changes made

Prepared by	Reviewed by	QA	QC	APPROVED BY :
<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>

( Head/QA )

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MANUFACTURER'S NAME &  
ADDRESS  
M/S BHEL / BAP / RANIPET  
TAMIL NADU-632 406

STANDARD QUALITY PLAN  
ITEM/SUB SYSTEM:  
**Rotor Post / Module/Housing  
Assembly**

Doc. No  
Rev. No  
Date  
Page No

SQP APH 105  
00  
01 02 03  
02 of 04

Sl no	Component & operation	Characteristics	Type Of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency	Remarks
1	2	3	4	5	6	7	8	9	10

2.1	Ranipet								
2.2	NDE ( Rotor post)	Support Trunnion Shell Butt Weld Support Trunnion Shell To Common Header Plate Rotor Post Butt Weld Header Plate To Rotor Post Shell Rotor Post Shell To Common Header Plate	RT UT /MT PT/ MT ---DO--- ---DO---	100 % 100 % 100 % 100 % 100 %	BHE:NDT:RP:RT:01 / latest BHE:NDT:RP:UT:05/ Latest BHE:NDT:RP:MT:01/ Latest	-DO- -DO- -DO- -DO- -DO-	NDT Report -DO- -DO- -DO- -DO-	P P P P P	W W W W W
2.3	Module Assy	Support trunnion shell to Header plate Lifting Lug Welding Lower Post Pin (*) Lug plate Vs Diaphragm plate	-DO- PT PT PT	100 % 100 % 100 % 10 %	BHE: NDT: RP: PT: 01/ LATEST	-DO- Do Do Do	Do Do Do Do	P P P P	W W V W
2.4	Housing assy	Butt Joint of Plates	PT	10 %		Do	Do	P	W

(\*)  
Verification  
of NDT  
Reports



Ranipet

MANUFACTURER'S NAME &  
ADDRESS  
M/S **BHEL / BAP / RANIPET**  
TAMIL NADU-632 406

**STANDARD QUALITY PLAN**

ITEM/SUB SYSTEM:  
**Rotor Post / Module/Housing  
Assembly**

Doc. No **SQP APH 105**  
Rev. No **00**  
Date **01 02 03**  
Page No **03 of 04**

Sl no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Acceptance Norms 7	Format Of Records 8	Agency 9 M B	Remarks 10
2.5	Rotor Post Assy (Fit up)	Dimension	Measurement	100 %	Drawing / Ref note III 1-5		HC	P	W
2.5.1	Machining	Run out/Face out, Shell Length, Flange Thickness, Header Dia, Hole Size, Pitch, Pin Hole Pitch, Hole Size, Pitch for Upper Rotor Post, Over All Length, Surface Finish	Measurement	100%	Drawing/Ref Note III- 6,7,8		HC	P	W
2.6	Lug plate	Dimension	Measurement	100%	Drawing / Ref note I		HC	P	W
2.6.1	Machining	Dimension	Measurement	100 %	Drawing		HC	P	W
2.7	Module assy	Dimension	Measurement	100 %	Drawing /refer note II		HC	P	W
2.8	Rotor Housing	Dimension	Measurement	100%	Drawing/refer note IV		HC	P	W
2.9	Guide Trunnion To Adaptor Sleeve	a) Taper Match With Adapter Sleeve & Guide trunnion b) Taper Match With Adapter Sleeve & Guide trunnion	Blue match Pressure Test	100%	Drawing No Leakage / PRQA:014/latest		DO HC	P P	W W
3.0	Final Inspection	a)Over all Dimenstions b) Painting And Preservation	Measurement Visual& Measurement	100 % 10 %	Drawing PRQA :590/latest		HC --	P P	W W

## **I LUG ASSEMBLY:**

Page No 04 of 04

1. Machining of all sides of upper lug and also drilling of holes shall be done carefully.
2. Machining of all sides of lower lug and also the radius shall be done using a fixture.
3. Full welding of lug shall be carried out in the lug welding fixture after tack welding on lug assembly fixture.
4. LPI is to be carried out on all fillet welds.
5. Step machining shall be carried out by taking center line passing through the center of the hole of top lug and center of slot of bottom lug as reference.
6. Twist of lug assembly shall be maximum of 0.8 mm.

## **II MODULE ASSEMBLY**

1. Assembly of modules shall be done in the module assembly fixture and tack welded.
2. Ensure proper seating of diaphragm plate and also its end square ness to the module assembly fixture.
3. Ensure that the accepted lug assembly is placed in the fixture without doing any rework on lug assembly and also ensure that the pins are inserted on to the holes in the
4. lug plate smoothly without hammering.
5. The divisional plates shall be tack welded to the diaphragm plate without gap and also ensure the edge preparation of basket support bar, parallel to the diaphragm plate.
6. The complete module assembly shall be thoroughly checked for all dimensions and Shell plate radius, Rotor angle radius as per the relevant drawing.

## **III ROTOR POST ASSEMBLY**

- 1 Rotor/Support Shell plate shall be checked for length, width, diagonal with in 1 mm before it is taken for rolling.
- 2 Ovality of rolled shell ( in tacked condition) shall be maximum of 5 mm and after completion of full welding the shell shall be re rolled and the maximum ovality shall be 3 mm .
- 3 Header plate shall be pre machined & dimension shall be checked as per drawing and Lathe center shall be drilled to ensure proper alignment of the Rotor post.
- 4 Backing ring inside the shell to be properly fit to ensure correct root gap between header plate and shell welding.
- 5 Back grind LPI for all joints to be carried out before doing further welding. And NDT requirements are as per the Clause 2.2 of SQP.
- 6 Ensure the Face out shall be with in 3 mm before machining
- 7 Holes drilling for Guide end of Rotor post Trunion bolt hole and support trunion holes shall be drilled in Jigs.
- 8 All tapped holes shall be thoroughly cleaned and protect with plastic plugs.
- 9 The bottom flange pins shall be fixed in place by metallic adhesive and this shall be inspected.
- 10 Ensure Proper packing & Handling to protect the machined surfaces of the Rotor post as per drawing.

## **IV Rotor Housing assembly**

- 1 Ensure the Height ,width diagonal with in 1 mm and Radius of the axial seal plate checked with template with in 1.5 mm.
- 2 Ensure the Height , Straightness and Hole pitch as per drawing and no gas gutting of holes is accepted other than mentioned in the drawing.
- 3 Panels are lifted with using lifting lugs only and ensure the lifting Hook side shall face the top while shipping to shop/site.

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**QUALITY DEPARTMENT**

PAGE 01 OF 01

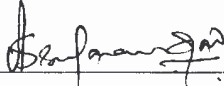

**AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)**

Q.W.I.NO : QP:ESP:260 / REV :00 / AMENDMENT SL NO : A 2

DESCRIPTION : GUILLOTINE GATES ( ESP )

DATE : 15 02 99

**DETAILS OF AMENDMENT**

CLAUSE NO	AMENDED AS	REMARKS
NOTE 1	SEALS MATERIAL SPECIFICATION ASTM B626 UNS 10276 IS DELETED	ENGG HAS REVISED THIS SPECN AS THIS IS MEANT FOR TUBES.
PREPARED BY 	REVIEWED BY B. Srinivasulu	APPROVED BY 

BHEL  
RANIPET

---

QUALITY DEPARTMENT

---

AMENDMENT TO QUALITY WORK INSTRUCTIONS ( S Q P )

---

Q.W.I.NO: ESP: 260

REV: 00

AMENDMENT SL NO: A 1

---

DESCRIPTION: GUILLOTINE GATES ( ESP )

DATE: 05 11 97

---

DETAILS

---

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
10.1	Chain, all machined surfaces and Gate plate after testing preventive coating. Painting of all other areas shall be as indicated below.  Primer coat: one coat of Red ----- Oxide Zinc Chrome Primer (Alkyd base) to IS 2074. ( Coating thickness 25 microns.  Finish Coat: One coat of ----- Synthetic enamel long oil Alkyd to IS 2932 ( Coating thickness 20 microns.	


---



Prepared by



Reviewed by



Approved by

---

Distribution:

As per standard distribution list.

PC File C: \KNM\ESP\QWIRTE66 . KSU ( All same file )

-----  
 BHARAT HEAVY ELECTRICALS LIMITED  
 BOILER AUXILIARIES PLANT  
 RANIPET - 632 406  
 -----

ESP: 260/00  
 PAGE 01 OF 19  
 -----

-----  
 STANDARD QUALITY PLAN FOR  
 -----

GUILLOTINE GATES  
 -----

-----  
 EFFECTIVE DATE  
 -----

31 01 94  
 -----

PREPARED BY ::

( K NITHIANANDAM )  
 QUALITY ASSURANCE



-----  
 DEPARTMENT  
 -----

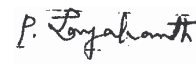
REVIEWED BY

SIGNATURE

DATE  
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EDC/AQCS

P. JAYKANTH



24/1/94  
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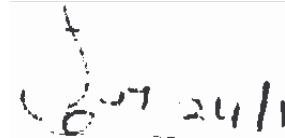
OPERATION PLANNING  
 & CONTROL

J. MANOHARAN



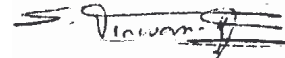
ANCILLARY DEVELOP-  
 MENT

S. JAGANNATHAN



QC ( PRODN )

S. VISWANATHAN



QC ( OLI )

H. B. N. MURTHY



-----  
 APPROVED BY  
 -----

H. ANANTHANARAYANAN  
 SR MGR/QA



-----  
 ISSUED BY  
 -----

: QUALITY ASSURANCE

REV NO

: 00

DATE

: 31 01 94  
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 DOCUMENT CONTROL NO  
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BHEL  
RANIPET

ESP: 260/00  
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RECORD OF REVISIONS  
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REV NO.	DETAILS OF REVISION	REMARKS
00	This SQP has been prepared by merging the documents listed in the remarks column.	SQP 13/00
11 01 94		QCP 2: 5: 322/05 QCP 2: 5: 326/02 QCP 2: 5: 349/01 QCP 2: 5: 392/01 QCP 2: 5: 394/01 PR: QE: 022/01 PR: QE: 044/01 PR: QE: 045/01 PR: QE: 054/01

S. NO.	COMPONENT & REMARKS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF
1	2	3	4	5	6	7	8	9
1.0	MATERIALS							
1.1.	PLATES, SECT RAW MATLS IONS FOR FRAME GLAND PLATE-AND LINKAGES ETC. TC/RANDOM	CHEM. & MECH. PROPERTIES	MAJOR	REVIEW OF TEST CERTIFI- CATES/ RANDOM TESTING	100%	MATERIAL SPECIFICATION	TC QC -DO- TC QC -DO- TC QC -DO-	ARE TAKEN TO TO STOCK VERIFICATION OF TESTING (REF. NOTE: 1)
1.2.	GATE PLATES	-DO-	MAJOR	-DO-		-DO-	TC QC -DO-	
1.3.	ROUNDS FOR SHAFTS AND STUDS	CHEM.& MECH. PROPERTIES	MAJOR	-DO- -DO-		-DO-	TC QC -DO-	
1.5.	SEALS	CHEMICAL & MECHANICAL PROPERTIES	MAJOR	-DO-	100%	MATERIAL SPECIFICATION	TC QC -DO-	

STANDARD QUALITY CONTROL PLAN  
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1	2	3	4	5	6	7	8	9	10	11
2.3.1	20% LPI ON WELDS	WELD QUALITY SIZE AND FINISH		MAJOR VISUAL	20% LPI		DRAWING, PR QE: 021 BHE: NDT: RP: PT: 01		R	QC FILLET OF COLLARS WITH SHAFT
2.4.	GATE PLATE REF. NOTE 4 SPLICING	ROOT GOUGING AND FINISH		MAJOR NDE/LPI MPI		100% BHE: NDT: RP: PT: 01		R	QC	
2.5.	ASSEMBLY QC REF NOTE 5&6	OVERALL DIMENSIONS		MAJOR MEASURE		-DO-	DRAWING		R	
2.5.1	SEAL ASSY. PRIOR TO ASSY IN GATE	CRITICAL DIMENSION		MAJOR	-DO-	-DO-	DRAWING		R	QC
2.6.	TRIAL OPERATION OF GATE	FREE OPERATION AS PER ORIENTATION AT SITE SEAL TIGHTNESS		MAJOR OPEN/CLOSE MOVEMENT		-DO-	RELEVANT DRAWINGS AND		R	
3.0.	FINAL INSPECTION									
3.1	COMPLETENESS QC REF NOTE 8	COMPLIANCE		MAJOR MEASURE		-DO-	DRAWING		R	
3.2.1	SURFACE PREPARATION	SURFACE PREPARATION		-DO-	VISUAL	-DO-	PAINTING SCHEDULE RP: 0674199 (Lattest)			
3.2.2	PAINTING REF NOTE 10	PAINT FINISH COATING THICKNESS		MAJOR VISUAL		-DO-	DRAWING		R	QC
				MAJOR VISUAL		-DO-	PAINTING SCHEDULE RP 0674199 (Lattest)		R	QC
				MAJOR MEASURE		-DO-	DRAWING			

---

FILE NAME: A: ESP260.3

STANDARD QUALITY CONTROL PLAN  
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1 2 3 4 5 6 7 8 9 10 11

3.3. PACKING AND DESPATCH NOTE 11      PACKAGING IDENTIFICATION OF W O CAL NUMBER, DU NO MATCH MARKS      CRITI- VISUAL 100%      DRAWING      R      QC      REF

3.4. CERTIFICATION -DO- -DO- CHECKLIST      AS PER      SIGN OFF      -DO- REFER NOTE 12

NOTE 1 The materials normally used are given below

-----

Plates	IS 2062 ASTM A36 SA 588 GR A
Rounds	ASTM A 654 ASTM A 108 AISI 304 SA 193 B7 SA 105
Seals	ASTM B575 UNS 10276 ASTM B626 UNS 10276
Castings	IS 210

NOTE 2 In Process Control

-----  
The general requirements for process control during fabrication are detailed in QCP 002 ( latest )

NOTE 3 Marking, cutting and preparation

- 
- 3.1 The requirements during marking, cutting and preparation are detailed in QCP 002 ( latest )
  - 3.2 Holes on frames for matching with duct flanges and holes for studs shall be marked correctly. These holes may either be punched or drilled. Studs shall be welded on to frame parts as per drawing prior to assembling the sides into frame.
  - 3.3 Whenever the frame channel size is substituted, seal clamping hole dimensions with respect to line of both channels.

NOTE 4 Splicing of gate plate  
-----

- 4.1 Splicing of gate plate may be either horizontal or vertical.
- 4.2 No splicing is permitted if plate width is 1.2 meter or less.
- 4.3 For plates of width upto 2.4 M. one joint is permitted; Above 2.4 M. maximum two joint is permitted. however the spacing between 2 joints shall be minimum 500 mm.
- 4.4 Any variation for the above norms shall have the approval of Engineering/QA.
- 4.5 Care shall be taken to avoid waviness during fabrication of gate plate. The waviness of the plates during splicing/ fabrication shall be restricted to 1mm per metre subject to a maximum of 3mm.

NOTE 5 Fabrication  
-----

- 5.1 Frames shall be made on a leveled surface after ascertaining water level within 5 mm. Frame top and bottom surfaces of the members shall be leveled.
- 5.1.1 Ensure the assembly of frame maintaining dimensions and distance between studs w. r. t. axis of blade movement on all sides.
- 5.1.2 Super structure frame shall be made such that the guide angles are placed at correct distance from the centre line of the channel
- 5.1.3 Ensure that the gap of gate plate movement is in a single plane of correct width. width deviation shall be restricted within 5 mm.
- 5.1.4 Weld the guide beams as per drg. in port side in level with frame gap. A curved plate shall be welded with guide beam at entry side to avoid struck up of gate plate.
- 5.1.5 Ensure that the "T" bar shall be welded square to the gate plate through pin plate to accommodate differential expansion. Connecting nut for piston rod shall also be Welded / fastened square to the tee bar. Plate centre line and piston rod centre line nut centre line shall be in one axis. Out of squareness if found, shall be corrected suitably.
- 5.1.6 Assemble the Isolation valve with transition for seal air fan blower connection.

- 5.2 Seals shall be manufactured as PR: QE: 063 ( latest ) and supplied as subassembly.  
Check for any damage before assembly.
- 5.3 MACHINING OF SOLID SHAFTS AND HOLLOW SHAFTS
- 5.3.1 Ensure straightness of the rod/tube before taking up for machining. The round shall be held between centres and machined to size and finish as per respective drawings.
- 5.3.3 Plain turned drive shafts shall be marked for key way milling and milled suitably to size and finish as per drawing.
- 5.3.4 The rings shall be machined to diameter, edge prepared and welded with the shaft after a preheat of 150 Degree C with electrode E11018. The shaft shall be post heated at 150 Degree C for 2 hours. This shall be applicable in the case of SA 193 B7 Material only).
- 5.3.5 Plain turned Idler shaft shall be finished to size and finish as per drawing.
- 5.3.6 Completely machined shafts shall be checked for size, finish and eccentricity.
- 5.3.7 Tolerance on bearing and sprocket locating dimensions:  
    outside diameter : + 0.000  
                          - 0.010  
    Eccentricity : 0.05 mm
- 5.3.8 Tubes shall be marked and cut to size with ends square and free from burrs.
- 5.3.9 Set the shaft sub-assembly and tube in assembling fixture as given in the sketch-1
- 5.3.10 Ensure the co-axiality of the shafts and tube assembly by dial gauge after aligning the key ways if provided.

- 5.3.11 Plug weld the shaft and tube and complete the welding of shaft sub - assembly with tube on either side maintaining the fillet size.
  - 5.3.12 Completed shaft shall be checked for co-axiality, size, finish, eccentricity, key way orientation, etc as per drawing.
  - 5.3.13 20% LPI/MPI on fillet/plug welds of assembly shall be carried out.
  - 5.3.14 Machined shafts shall be applied with rust preventive oil over machined area.
  - 5.4 AIR TANK
  - 5.4.1 Pipe for all air tank shall be cut to size maintaining the ends square. Where pipes are made of plates, it shall be rolled and welded.
  - 5.4.2 End cover cut to size and edge prepared as per drawing.
  - 5.4.3 The requirements of preheating and welding control are detailed out in QCP 002 (latest )
  - 5.4.4 Butt welds and long seam welds of PEP shall be spot radiographed in addition to LPI/MPI as per approved procedure. If unacceptable defect is noticed during spot radiography , 100% radiography shall be carried out.
  - 5.4.5 Completed air tank shall be hydraulically tested as envisaged in drawing.
  - 5.4.6 Orientation of drain plug shall be ensured. Always it shall be kept downwards.
- NOTE 6  
-----  
Assembly requirements
- 6.1 The frame shall be assembled with super structures. Assembly shall be done in horizontal position, ensuring that the whole frame is in a plane. Corner welds of angle frame shall be ground to accommodate the seating of seals.
  - 6.2 Position the mounting plate and assemble the air tank and blower.
  - 6.3 Assemble the cylinder on to the frame and connect the piston rod and ensure the co-axiality of piston rod gate plate.

- 6.3.1 Check that the piston rod, gate plate and cylinder are in the same plane using spirit level.
- 6.4 Assemble the pneumatic fittings of correct size and quantity starting from the ports of air cylinder. ( 4 way solenoid valve, transparent type filter cum lubricator etc. )
- 6.5 Ensure the connections are air tight using the teflon tapes.
- 6.6 Assemble the junction box for electrical connections. Assemble the limit switches at the correct locations
- 6.7 Complete the electrical connections as per relevant wiring diagram and identify the wires.
- 6.8 Defect free seals shall be assembled in position in correct orientations per drawing.
- 6.9 connect the air cylinder to pneumatic lines and check for free operation of gate plate and piston.
- 6.10 Adjust the limit switches ensuring the strike length of blade.
- 6.11 Sprockets shall be assembled with shaft together with end collars.
- 6.12 Assemble the drive shaft and idler shaft assemblies in the mounting brackets. Ensure no offset of axis of both drive and idler shafts. Ensure that the bearings are filled with shaft.
- 6.13 Ensure the correctness of drive chain size, pitch, length etc., and assemble keeping the plate to assembly for modular construction. Defect free seals shall be assembled in position in correct orientation as per drawing.
- 6.15 Assemble brace angles of super structure in position and complete welding.

- 6.16 Adjust the chain length and tighten equally on both sides.
- 6.17 Sagging of chain shall be checked on top side of the chain with bottom side of chain resting on gate plate. This sagging shall be set equal to or less than thickness of chain while gates are in horizontal position.
- 6.18 A clear gap of 6mm shall be ensured between gates plate and sprocket. While the gate is kept in horizontal position so as to ensure free travel of chain without climbing on the blade during operation.
- 6.19 Install the actuator mounting brackets on to frame and complete the welding.
- 6.20 Install the relevant drive in position with all accessories and connections.
- 6.21 Assemble isolation valve with transition, if required.
- 6.22 Install the blower assembly with transition if required.
- NOTE 7 Testing
- 
- 7.1 Testing shall be carried out in the same orientation as envisaged for the system at site/as per customer requirement. The gate shall be positioned in the testing stand maintaining verticality on sides and face of ( flow direction ). It shall not have any twist.
- 7.2 Connect the actuator electrically as per wiring diagram
- 7.3 Adjust the gate in such a way that plate is in the middle of its stroke.
- 7.4 Set the torque required for ambient operation of the gate or as specified in the actuator data sheet.
- 7.5 Gate shall be operated with actuator for 5 complete cycles. (with an idle time of 10 minutes in between every two cycles. )
- 7.6 Record amperage, voltage, time taken for each strike in case of electrical actuator and record air pressure for pneumatic actuator.

- 7.7 During the test ensure that gate plate is operating freely without rubbing the throat support beam.
- 7.8 In case the gate is not lifted with minimum setting of the torque switch/torque rating or air pressure shall be slowly increased so as to enable free operation of the gate. In no case this value shall exceed the no load operating condition indicated by Engineering/C&I.
- 7.9 Normal / running current shall not exceed the permitted value. In case current drawn at no load is more than the acceptable value the same shall be referred to Engineering/ Quality Assurance/C&I for approval.
- 7.10 The gate shall be visually inspected for any damage to blades, seals etc., Ensure the gate plate is in open position. Provide the lock tab and lock it.
- 7.11 Set the blade stopper bracket on beam and ensure the stroke length of blade and corner closing.
- 7.12 Provide chain guards in position. Provide drain holes in frame and dust guard on super structure.
- NOTE 8 Final Inspection  
-----
- 8.1 The final inspection shall be carried out using the check list and documented.
- 8.2 Tolerances given in the drawings shall be followed. In addition, the following tolerances also apply.
- 8.2.1 Pitch holes of matching flanges shall be within plus or minus 1mm individually max plus or minus 3mm cumulative.
- 8.2.2 Linear tolerance on length/ width plus or minus 1 mm /metre. max 5mm.
- 8.2.3 Diagonal variation shall be within 1mm/metre with a max of 3mm.
- 8.3 The gate plates shall be locked using mechanical blade lock assembly.

- NOTE 9                    NDE requirements  
-----  
9.1                        Mounting bracket welds “T” bar welding of gate plate, collar welding on shaft, blower and air mounting brackets welds shall be checked by MPI. Welding of splice joints of gate plates shall be checked with MPI/LPI. Defects revealed shall be repaired and tested again.
- NOTE 10                  Preservation & Match marking  
-----  
10.1                       Chain and all machined surfaces shall be applied with Rust Preventive coating. Gate plate shall be applied with one coat of redoxide zinc chrome primer as per IS 2074. Painting of all other areas shall be as indicated in the painting schedule RP 0674199 ( Latest ).  
10.2                       Match marking shall be done on all parting lines by stenciling, if envisaged. Match mark shall also be punched on all parting lines and bordered with white paint. Mark the flow direction on the frame.
- NOTE 11                  Identification and Packing  
-----  
11.1                       Identification marks shall be as per QCP 002 ( latest ).  
11.2                       Packing shall be performed at shipping unless otherwise specified in OPS/ Purchase Order/Drg.  
11.3                       The gate shall be packed in steel crates to avoid damages during handling and transit. Air cylinder in case of hot air gate shall be suitably protected from damages.  
11.3.1                      The blades shall be arrested from moving during shipping and shall be kept as per drawing.  
11.3.2                      Components/sub-assemblies like DP switch, actuator, blower etc. , shall be packed separately in polythene sheet and crated in wooden boxes.

TEST REPORT OF GUILLOTINE GATE

TC No :  
Date :

1.0 General

Customer :  
Work order number :  
Gate size :  
Application :  
Type :

DU NO:

2.0 Actuator Name Plate Details:

GMS particulars

3.0 Test results of gate operation:

-----  
Cycles            1        2        3        4        5        6        7        8        9        10  
-----

Amps  
During  
opening

Amps  
During  
closing

Time taken  
for full  
opening/  
closing  
in seconds

-----  
Note: Full load current during operation shall be  
      lesser than that of full load current of  
      motor.

4.0 Gate operation : Satisfactory/Not satisfactory

5.0 Test results : Acceptable/Not acceptable/  
                  rework identified.

-----  
Firms inspection  
-----

BHEL inspection  
-----

Customer inspection  
-----

Signature of QC Engr

NOTE 12

Check list

-----  
-----  
PROJECT :  
UNIT :  
SIZE :  
DRG NO. :  
SL. NO. : DG/DL/DB: XXX: XXX/HAG: XXX: XXX  
A1 FRAME ASSEMBLY:

Pitch of holes for seals  
Distance between top and bottom row holes  
Alignment of holes  
Location of the groove from the top of channel flange.  
Width of the groove  
Straightness of the groove  
Chamfering / deburring on the rear edge of the groove

A2 DIMENSION OF FRAME:

1. LENGTH
2. WIDTH
3. DIAGONALS

B DIMENSIONS OF SUPER STRUCTURES:

1. WIDTH
2. LENGTH
3. DIAGONALS

The bracket should be ensured for squareness before fitting it on the frame.

POSITIONING OF BRACKET:

( To be full welded only after final assembly and testing )

ASSEMBLY OF TOTAL FRAME:

- a) Back gauging and LPI from second side
- b) Dimensions:
  - i) Overall length
  - ii) Diagonals

- D            COMPONENTS:
- i) shaft dimensions
    - a) Length of shaft
    - b) Dia at Bearing location
    - c) Dia at actuator mounting portion of shaft
  - ii) Sprocket:
    - a) Bore
    - b) Keyway dimensions
- E            GATE PLATE:
- a.        Splicing - ( If carried out )
    - i.        No. of joints
    - ii.       NDT
  - b.        Overall dimensions:
    - i.        Length
    - ii.       Width
    - iii.       Diagonals
  - c.        Edge beveling with respect to flow direction.
  - d.        Beveling dimensions.
- F            “T” BAR:
- A. DIMENSIONS
    - 1. WIDTH
    - 3. ADJUSTING BOLT HOLE DIMENSIONS
      - i) PITCH
      - ii) DIAMETER
  - B. ‘T’ BAR AND CONNECTING NUT DIMENSIONS
    - i) LENGTH
    - ii) WIDTH
    - iii) SQUARENESS
- G            ASSEMBLY OF GATE:
- a. Shaft assembly            Drive S/Ns.            Idler S/Ns.
    - 1. Sprocket assembly
    - 2. Bearing assembly
      - a) Bearing Type & No.
      - b) Bearing assembly on shaft.
    - 3. Bearing Housing
    - 4. Lubrication
      - a. Type of lubrication
      - b. Brand name

5. Trial Operation
6. Assembly of drive shaft assy with mounting brackets serial numbers.
7. Free rotation check
  - a. Assembly of seal sub-assembly in position
  - b. Positioning of gate plate in super structure
  - c. Positioning of stopper on cross beam
  - d. Assembly of chain with sprocket and plate
  - e. Sagging of chain
  - f. Assembly of actuator / Blower / Air cylinder pneumatic cylinder
  - g. Air cylinder piston, connecting nut, gate plate all should be in one axis.
  - h. Positioning of limit switch.

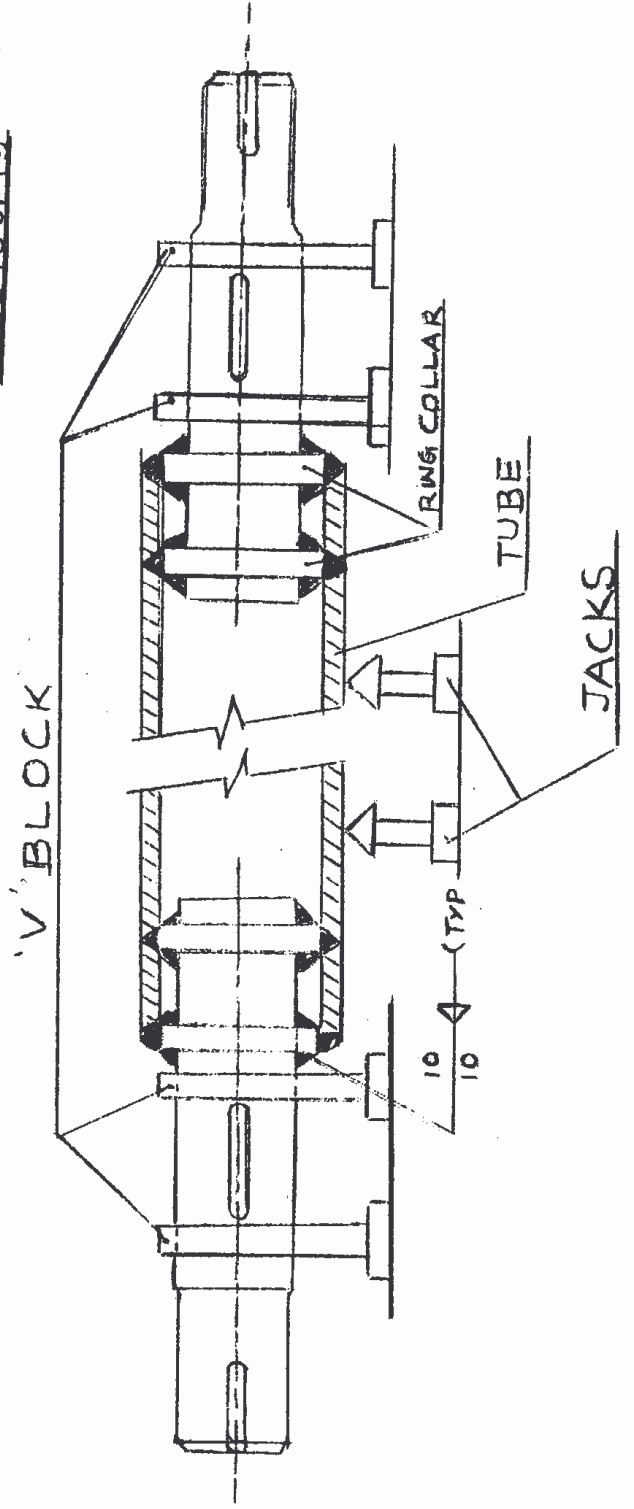
H TRIAL OPERATION:

1. Orientation of Gate:
  - a. Theoretical
  - b. Test Position
2. Gates Operated -- Manually /with actuator /with pneumatic cylinder  
Name plate details of actuator/Air cylinder
  - a. No. of cycle operated
  - b. Condition of the seal after operation
  - c. Movement of blades:  
Smooth/Difficult/Jerk/Stick-up
  - d. Current drawn
  5. Rectification of defect noticed.
  6. Retest results.

NOTE: Trial operation shall be repeated till satisfactory operation is achieved

- I General workmanship
- J Mechanical blade lock provided/not provided
- K Rust preventive oil applied after testing for gate plate.

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SKETCH-1



**MANUFACTURER'S NAME & ADDRESS**  
 BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)

**ITEM: ESP**  
 Sub system: ESP supporting Structure (Columns, Bracing & Longitudinal/Transverse roof Beams)  
 (PGMAs: X81, X48, x28, X82, X83, X84, X85, etc.)

**STANDARD QUALITY PLAN**

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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M.	B.	
1.0	Raw materials									
1.1	Plates, Rolled sections, Hollows.	Chemistry & Mechanical Properties	Chemical & Tensile test	As per TDC	Respective TDC		TC	P	V	Raw Materials are taken to stock on verification of TC /Random testing
2.0	In process control									
2.1	Flame cutting	Lamination and cracks	Visual	-DO-	As per Aws D1.1		R	P	V	
2.2	Welding	1) Procedure Qualifications 2) Personnel Qualifications	Review of Documents -DO-	-DO-	Prequalified welding Procedure as per Aws D1.1 -DO-		R	P	W	

**LEGENDS:**  
 M - Manufacturer / Subcontractor,  
 B - BHEL /BHEL Authorized Inspection Agency,  
 P - perform, V - Verification of Reports  
 W -Witness, TC - Test certificate,  
 DR - Dimensional report,

PREPARED BY *[Signature]*

REVIEWED BY

QA	<i>[Signature]</i>
QC-OLI	<i>[Signature]</i>
ENGG	<i>[Signature]</i>

APPROVED BY *[Signature]*

Rev 00 Dt 20 06 98 Original issue  
 Rev 01 Dt 30 06 07 Totally Reviewed and updated



MANUFACTURER'S NAME & ADDRESS

BHARAT HEAVY ELECTRICALS LTD  
BOILER AUXILIARIES PLANT  
RANIPET-632 406 (INDIA)

STANDARD QUALITY PLAN

ITEM: ESP  
Sub system: ESP supporting Structure  
(Columns, Bracing & Longitudinal/Transverse  
roof Beams)  
\* X81, X48, X28, X82, X83, X84, X85, etc.

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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
2.3	Weld inspection	Size and finish	Visual and Measurement	100%	Drawing, Sip: NP-06		R	P	W	10
2.3.1										
2.4	Weld NDE columns & bracings	Soundness	LPI	100%	AWS D1.1		R	P	W	** Remarks: 1) Weld fit up for back gouged/chipped area before 2 <sup>nd</sup> side welding (for columns) 3) Random 10% LPI for back gouged/chipped area before 2 <sup>nd</sup> side welding (for bracing).
2.4.1	Fillet Base plate & top plate welding in columns	Soundness	LPI	100%	AWS D1.1		R	P	W	
	Other fillet weld of column & bracings	-DO-	-DO-	Random 20%	AWS D1.1		R	P	W	
2.4.2	Weld between flange & web by saw (in case of built up beams)	Soundness	MPI	100%	AWS D1.1		R	P	W	

LEGENDS:

M - Manufacturer / Subcontractor, B - BHEL /BHEL Authorized Inspection Agency, P - perform, V - Verification of Reports, W -Witness, TC - Test certificate, DR - Dimensional report.



Ranipet

**MANUFACTURER'S NAME & ADDRESS**

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)

**STANDARD QUALITY PLAN**

ITEM: ESP  
 Sub system: ESP supporting Structure (Columns, Bracing & Longitudinal/Transverse roof Beams)  
 X81, X48, X28, X82, X83, X84, X85, etc.

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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms		Format Of Records	Agency		Remarks
						6	7		M	B	
2.4.3	1) Welding of Structural for Forming sections 2) Fillet weld of Gusset plates, and plates & Battens.	Soundness	LPI	20% At Random	AWS D1.1			R	P	W	4) Random 10% LPI on finished weld after flush grinding.
2.4.4	Butt welds for structural	Soundness	LPI	**See Remarks	AWS D1.1			R	P	W	
3.0	Dimensional control (Bracings and Columns)	1) Dimensions 2) Twist, sweep camber	Measurement & visual	100%	Drawing			R	P	W	

**LEGENDS:**  
 M - Manufacturer / Subcontractor, B - BHEL /BHEL Authorized Inspection Agency, P - perform, V - Verification of Reports -Witness, TC - Test certificate,  
 DR - Dimensional report.



MANUFACTURER'S NAME & ADDRESS

BHARAT HEAVY ELECTRICALS LTD  
BOILER AUXILIARIES PLANT  
RANIPET-632 406 (INDIA)

STANDARD QUALITY PLAN

ITEM: ESP  
Sub system: ESP supporting Structure (Columns,  
Bracing & Longitudinal/Transverse roof Beams)  
X81, X48, X28, X82, X83, X84, X85, etc.

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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency	Remarks	
1	2	3	4	5	6	7	8	M B	9	10
<b>LONGITUDINAL &amp; TRANSVERSE ROOF BEAMS</b>										
3.01	Weld NDE	1) Roof beams a) Butt welds in tension flanges b) Other butt welds c) Fillet weld between flanges and web by saw @ d) Finish and size	BG LPI & MPI# MPI #	100% 100% 100% 100%***	AWS D1.1 AWS D1.1 AWS D1.1	Drawing and SIP: NP:06	R R R R	P P P P	W W W W	# 1) Weld fit up 100% LPI for back gouged /chipped area. Layer by layer MPI to ensure soundness of welding in between. 2) LPI on finished weld after flush grinding before welding splice plates. 3) LPI on finished weld after flush grinding before welding splice plates.
3.1	Dimensional control (LR & TRB)	Length, section depth straightness thickness of flange, WEB, hole size, location & pitches, end profile, edge preparation	Visual and measurement Visual and measurement	100%	Drawing		R	P	W	

LEGENDS:  
M - Manufacturer / Subcontractor, B - BHEL / BHEL Authorized Inspection Agency, P - perform, V - Verification of Reports -Witness, TC - Test certificate,  
DR - Dimensional report.



**MANUFACTURER'S NAME & ADDRESS**  
**BHARAT HEAVY ELECTRICALS LTD**  
**BOILER AUXILIARIES PLANT**  
**RANIPET-632 406 (INDIA)**

**STANDARD QUALITY PLAN**

**ITEM: ESP**  
 Sub system: ESP supporting Structure (Columns, Bracing & Longitudinal/Transverse roof Beams)  
 X81, X48, X28, X82, X83, X84, X85, etc.

QP NO	ESP 283
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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
4.0	Trial Assy (Applicable for long roof beam only)	If Longitudinal Roof beams are given in more than three variants, trial assy has to be done first with variant 01 & 02, then variant 02 & 03 only. cumulative location of holes & brackets, twist, sweep, camber, joint location, match marking and vendor identification marking by welding.	Visual and measurement	100%	Drawing		R	P	W	@E7018 electrodes /equivalent in case of SMAW shall be used.  **In case of defects % shall be increased.
5.0	Final inspection: Surface cleaning painting, level, center line marking preservation	Welding finish & appearance, match markings, orientation.	Visual	100%	Drawing & painting Schedule PRQA 590/Latest		R	P	W	

**LEGENDS:**  
 M – Manufacturer / Subcontractor, B - BHEL /BHEL Authorized Inspection Agency, P - perform, V - Verification of Reports -Witness, TC - Test certificate, DR – Dimensional report.

## 1.0 NOTE.1.0 GENERAL REQUIREMENTS

- 1.1 Any additional requirement for a specific contract shall be referred separately
- 1.2 Raw materials used shall conform to the grades specified in the drawing & GMS.
- 1.3 Fabricators shall check all the supplied raw material for dimensions, bend etc., Straightening wherever necessary must be carried out before assy and welding.
- 1.4 Raw material shall be free from harmful visual defects like cracks, seams, laps, laminations, heavy pitting etc.
- 1.5 Substitution of materials shall be done with the prior approval of EDC/AQCS
- 1.6 Plates for flanges and web shall be preferably machine gas cut. Cut edges shall be dressed smooth to remove all the undulations. Gas cut notches if any shall be filled up and dressed. The edges shall be straight and square.
- 1.7 Before boxing up the columns i.e. welding of two channels/beams to make up box section, one coat of red oxide zinc chrome primer, after necessary cleaning shall be applied on inner surface of Channel /Beam to coating thickness of 25 microns(min).

## NOTE 2.0 IN PROCESS CONTROL

- 2.1 The general requirements for process control during fabrication are as detailed in QCP 002 (LATEST) read along with Amendment 1.
- 2.2 The number of joints shall be as approved by designs on a case-to-case basis. However all joints shall be staggered to a minimum offset of 300mm from web to flange or vice versa.

## NOTE 3.0 MARKING, CUTTING AND PREPARATION

- 3.1 Holes/slots on flanges, end profile, weld access cutting etc to suit roof beam's / column's flanges / webs edge preparation for site joints shall be marked correctly. These profiles, edge preparation shall be gas cut and ground, the holes shall be drilled.

## NOTE 4.0 WELDING REQUIREMENTS & WELD INSPECTION

- 4.1 In the case of columns: Electrodes of E 6013 for thickness upto and inclusive of 20 mm; E 7016 or E 7018 for thickness above 20mm shall be used.
  - 4.1.1 E 6013 electrodes shall be dried in baking oven at 120-130 deg c until they are used, if the packing were found to be damaged or the electrodes were kept exposed to atmosphere for prolonged period.
  - 4.1.2 In the case of roof beams: Electrodes of E7018 shall be used for welding. Before use all the low hydrogen electrodes (Exx16, Exx18) shall be dried in baking oven between 260-427deg C for 2 hours and held at 100 deg C until they are used.
    - a) In case of Roof beam-E7018 shall be used for welding. These electrodes shall be purchased in hermetically sealed containers. Immediately after opening the hermetically sealed container, electrodes shall be stored in ovens held at a temperature of at least 120 deg c. Electrodes that have been wet shall not be used.
    - b) Electrodes exposed to atmosphere for periods more than four hours shall be baked for at least two hours between 260 to 430 deg c and held at 120 deg c until they are used.

- 4.2 Fillet and butt welds shall be done with a minimum of two layers, ensuring complete root fusion.
- 4.3 Butt joints shall be completed prior to the welding of splice plate.
- 4.4 Sequence of welding shall be so chosen as to minimize the distortion.
  - 4.4.1 All welds shall be deposited in sequence, that will balance the applied heat of welding as the welding progresses.
  - 4.4.2 In the case of fabricated I or H section, the joints in flange or web shall be completed and straightened. Subsequently H section or I shall be formed.
  - 4.4.3 Distortion in the structural members shall be corrected with carefully supervised application of limited amount of localized heat. Temperature of heated areas as measured by approved methods shall not exceed 650c (a dull red colour).
- 4.5 NDT as required shall be carried out on splice joints before cover plate welding.
- 4.6 Arc strike shall not be done straight on the job. Welder shall have a separate piece for striking the arc.
- 4.7 Welding procedure specification and welder's qualification are detailed in SIP: NP: 07 (Latest).
- 4.8 Only BHEL approved brands of electrodes shall be used.

NOTE; 5.0 FABRICATION TOLERANCES:

Following tolerances shall be applicable on different dimensions of: -

COLUMNS

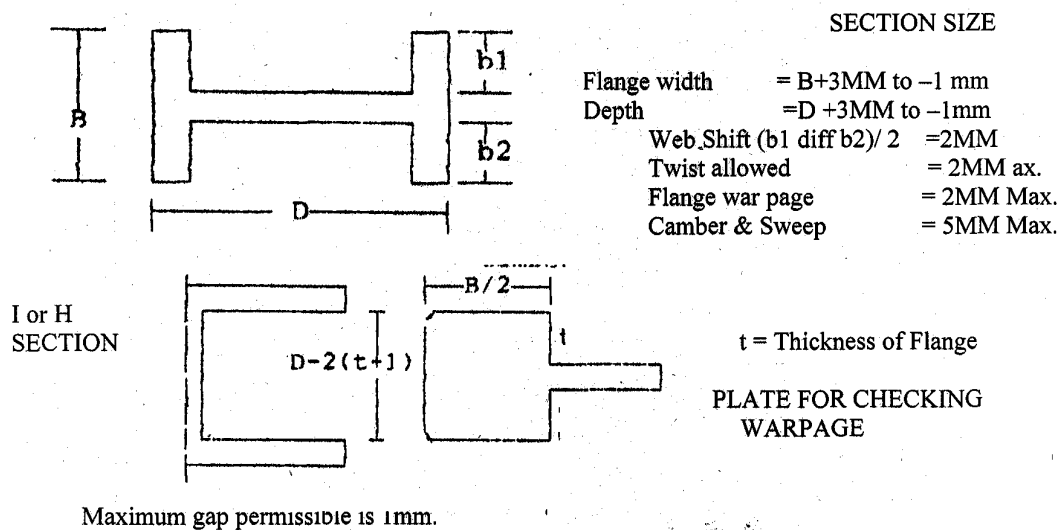
- 5.1 Length of column shall be maintained during fit-up stages, taking care of shrinkage allowance for PGMA's X48, X81, X82, X83, X84, X85.
  - a) For length  $\leq 10\text{m}$ , shrinkage allowance = 5mm.  
Length of column (PGMA: 7X-X81) shall be within  $\pm 5\text{mm}$ .  
Fit up shall be offered for BHEL/BHEL Authorized inspection agency inspection before full welding.
  - b) For length  $> 10\text{m}$ , shrinkage allowance = 7mm.
- 5.1.1 Camber 1 mm per meter length upto a maximum of 5mm of camber only allowed.
- 5.1.2 Sweep 1 mm per meter length upto a maximum of 5mm of sweep only allowed.
- 5.1.3 Twist 3 mm maximum.
- 5.2 All Base / Top plates shall be cut to correct size. Length / Width and shall not vary by more than  $\pm 2\text{ mm}$ . The axes of the column cross section shall be laid out on the base/top plates. The bolt holes and grout holes shall be correctly located with reference to these axes.
  - a) Diagonal difference shall not be more than 3mm.
- 5.2.1 All column Base / Top plates surfaces shall be maintained flat and square to the column axis Within 1mm.

- 5.2.2 Base and Top plates shall be correctly aligned with respect to column cross section. The axial shift between the central axis of column and the base plate shall be within 2mm. Rotation of base plate/top plate axis with respect to beam axis shall be measured by dropping a Plumb. The variation from the plumb line with column axis mark shall not exceed 3mm.
- 5.2.3 Plates shall be in square within 2mm with column and shall be welded.
- 5.2.4 Base / Top plates shall be square. Bolt holes diagonal difference shall not more than 5mm. Holes pitches difference shall not be more than 3mm.
- a) Bolt hole diameter tolerance is +2mm; -0.0mm.  
(Wherever drg specifies tolerance for the hole the same shall be followed)
- 5.2.5 The orientation of the gusset plate welded with column top shall be checked with respect to column base gusset orientation. Location of the gusset plate shall be as per the drawing.
- 5.2.6 Flatness of the base plate after full welding shall be as follows:

Size	Tolerance
Upto 500 X 500 mm	2mm maximum
Above 500 X 500 mm	3mm maximum

FABRICATED I OR H SECTION:

- 5.3 The faces of fillet welds may be slightly convex, flat or concave. Except the outside corner joints, the convexity shall not exceed the value of  $0.1S + 1.5\text{mm}$  where S is the actual size of the fillet weld in mm.
- 5.3.1 Groove welds shall preferably be made with slight or minimum reinforcement. In the case of butt welds and corner reinforcements shall not exceed 3.2mm in height and shall have gradual transition to the plane of the base metal surface.
- 5.3.2 The surfaces of butt joints required to be flush shall be finished so as not to reduce the thickness of the thinner base metal or weld metal by more than 0.8mm or 5% of the thickness which ever is smaller nor leave reinforcement that exceeds 0.8 mm. However all reinforcement must be removed where the weld forms part of contact surface.
- 5.3.3 Undercut shall not be more than 0.33mm deep when its direction is transverse to primary tensile stress in the part that is undercut not more than 0.88mm in all other situations.
- 5.3.4 Welds shall be free from overlap.
- 5.3.5 Specified length of section can vary upto +2.0-0.0mm



- 5.3.6 Abutting parts to be jointed by butt welds shall be carefully aligned. An offset not exceeding 10% of the thickness of the thinner part joined, but in no case not more than 2mm may be permitted as a departure from alignment.

NOTE 5.3.7 CENTRE LINE MARKING OF COLUMNS AND OF FABRICATED COLUMNS OUT OF CHANNELS

- 5.3.7.1 The center line (c1) shall be obtained by joining the center points of web thickness at both ends. This centerline shall be punched for about 100mm length at an interval of every Two meters and also at both ends of the column. Similarly centerline on the web shall be marked taking the mid point of the depth (with web area) at both ends.

- 5.3.7.2 In the case of columns made of channels; center line should be punched on channel web and bottom plates.

NOTE 5.3.8 LEVEL MARKING

- 5.3.8.1 Levels in steps of 5 meters shall be punched on the column, taking the top as the reference. The first level from top shall be the nearest. 13.740 meters, the first level shall be punched at 10 meters and the subsequent levels at 5 meters and "0" meter. The levels shall be identified by Punching 10 M, 5M, "0" M and shall be bordered in white paint. There is no tolerance on the level marking and it shall be carefully done.

- 5.3.8.2 Arrow mark shall be stenciled along with meter mark, arrow pointing downwards.

FABRICATED TYPE BRACINGS FROM CHANNELS

- 5.4 Size and dimensions shall be maintained as per the design requirement.

- 5.4.1. A fit up gap of 2mm shall be maintained with tacks between edges of channel flanges prior to welding.

- 5.4.2. One mm per meter length subject to the maximum of 5mm shall be allowed on Camber and Sweep on the fabricated bracings. Twist shall be controlled within 5mm.

5.5 ROOF BEAMS

Section size:  
Length: +/- 2mm.  
Depth of Beam: +3mm to -1mm  
Flange width: +3mm to -1mm

- 5.5.1 Lateral deviation between centerline of weld and center line of flange at contact surface: 2mm max.

- 5.5.2 Maximum permissible tilt on individual flanges (warp age) 2mm.

- 5.5.3 Flatness of web:

Web shall be flat as far as possible. Maximum out of flatness of web shall be as follows:

- a) For a length of 3 meters - 3mm(max)  
b) For total length of beam - 6mm(max) } Refer X1 of FIG C& D

(Wherever cross members is joining, web flatness shall be within 2mm) (Ref fig enclosed)

- 5.5.4 Flanges shall be straight at the edges. Maximum permissible waviness on individual flanges (Lengthwise) shall be as follows:  
For a length of 3 meter = 3mm (max)  
For a total length of Beam = 6mm (max)  
(Refer Note S1 no 7.6.6 also)

NOTE 6.0 NON DESTRUCTIVE TESTING

- 6.1 All weld shall undergo thorough visual examination to detect the weld defects like undercuts, Non-uniform beading, overlaps, excessive concavity or convexity.
- 6.2 Welds shall be neither undersize nor too much excess than specified.
- 6.3 Cleaning of the entire columns shall be thoroughly examined before NDE and painting.

NOTE 7.0 TRIAL ASSEMBLIES

All the split columns / longitudinal roof beams shall be trial assembled and match marked in works.

- 7.1 Edge preparation for site joints of columns / beams shall be carried out before trial assembly.
- 7.2 During trial assembly, all the pieces of a column / roof beam shall be laid out on a raised level surface. Permanent concrete pedestals or supports out of rolled sections can also be used. These supports below the column / roof beam shall be maintained in one level by water level check. The section of the column / roof beam shall be kept free so that actual out of straightness or twist is reflected. Side support which may tend to neutralise the twist or the out of straightness of the beam shall not be used. For safety purpose, vertical posts may be provided near the column / roof beam. This will avoid toppling of the assembly. The water level shall be maintained within 2 mm.
- 7.3 Center lines of individual column/beams shall be punched on both flanges. This center line punching shall be done for lengths of 100mm at interval of about 2 meter.
- 7.4 The column / beams shall be trial assembled keeping them in 'T' maintaining the bottom flange upwards. Web thickness of the adjacent pieces shall be fully matched.
- 7.5 The columns / beams may be held in position using bridgeon pieces or cleats during trial assembly.
- 7.6 The following shall be carefully checked during trial assembly.
  - 7.6.1 Alignment and straightness of total assembled column / beam. Maximum out of straightness Permitted: 5mm (This shall be checked up with respect to the center line already punched).
  - 7.6.2 Proper matching of butt plates with column / roof beam. Root gap for site welding, Bolt hole distances etc shall be checked
  - 7.6.3 MATCHING OF FLANGES AND WEB AT FIELD JOINTS:

Flanges of connecting pieces of roof beams shall be in same level. Maximum off set of 2mm is permitted to accommodate the depth variations. This out of level may be adjusted on the top flange. (Which is kept downwards during trial assembly).
  - 7.6.4 Total length of assembled beam shall be within +/- 5mm
  - 7.6.5 Maximum twists on the section: 0005H (where H is the section depth in mm).
  - 7.6.6 Flatness on the bolt hole joining area shall be maintained within 1 mm.
- 7.7 All pieces of roof beam shall be match marked during trial assembly.

- 7.7.1 Match marking should ensure proper identification of matching pieces at site to avoid,
- a) Mix up / interchange of pieces between different beam of same EP.
  - b) Mix up / interchange of pieces between beams of different Eps of same boilers.
  - c) Any interchange of pieces in same roof beam.

7.7.2. Following scheme of match marking shall be adopted.

- a) All roof beams and butt plates of one boiler shall be marked in a continuous serial to identify them separately.
- b) For longitudinal roof beams only.  
1A: 1A... 1B...1C  
2A: 2A... 2B...2C likewise

7.7.3 In addition to the match marks detailed above matching lines shall be punched at each joint. Punched details shall be bordered in white paint for identification.

**NOTE 8.0 CLEANING AND PAINTING:**

- 8.1 All columns, bracings, roof beams shall be thoroughly cleaned to remove rust, grease, oil, weld slag, loose mill scales, spatters and other foreign materials.
- 8.2 Cleaned pieces shall be coated with two coats of paint as indicated below, allowing adequate drying time between each coat.
  - 1) Primary coat of red oxide Zinc chrome primer with 25 microns minimum coating thickness conforming to IS 2074.
  - 2) Finish coat of synthetic enamel long oil alkyd conforming to IS 2932 with minimum thickness of 20 microns (smoke gray shade).
  - 3) Weldable Primer shall be applied on the edge prepared area and also for a width of 25 mm in the EP adjoining area from EP edge.

**NOTE: 9.0 MARKING**

- 1) Following shall be stenciled in white paint and stenciled details covered with one coat of transparent varnish.

Sub contractor's code  
W.O.No:  
DU No:  
Weight:  
Project:  
Match marks:

- 2) In addition to the above stenciling, all the above details shall be hard punched with 12mm letter Size in the middle/center of the column/beam on two sides(at 90 degree angle sides) and along with that stencil of those details on the top of the column for easy identification. Further, after punching all the detail, punched area shall be Aluminums painted with a white paint border.

FABRICATED H/I COLUMN

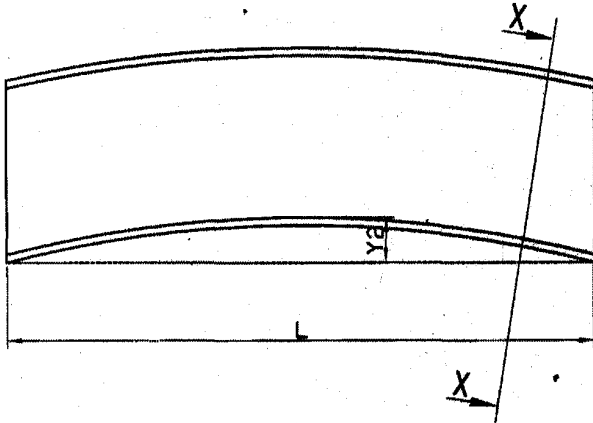
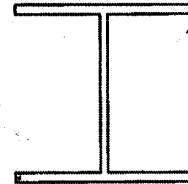


FIG A

CAMBER  $Y_2 = 5\text{MM (MAX)}$



SECTION - XX

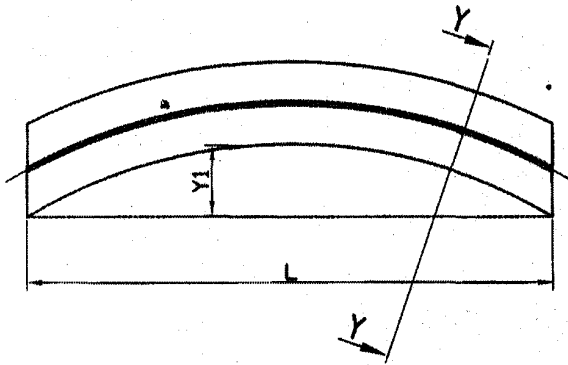
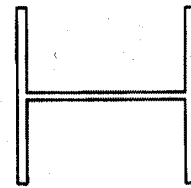


FIG B

SWEEP  $Y_1 = 5\text{MM (MAX)}$



SECTION - YY

BUCKLING OF WEBS IN H / I COLUMN

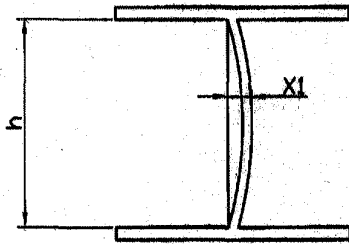


FIG - C

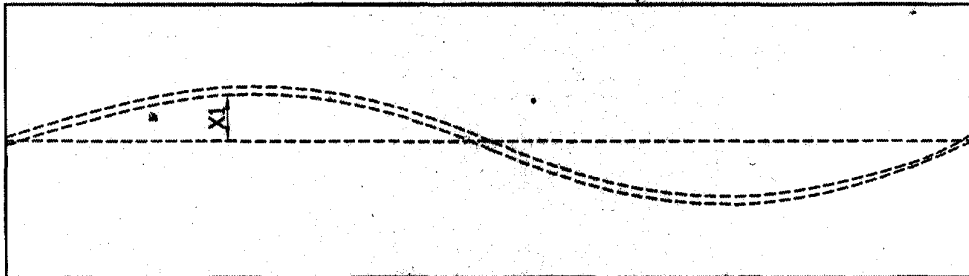


FIG - D

FIG. 13.10.6

LETTER SIZE 12MM METAL PUNCHING TO BE DONE

AT THE MIDDLE OF THE COLUMN/BEAM

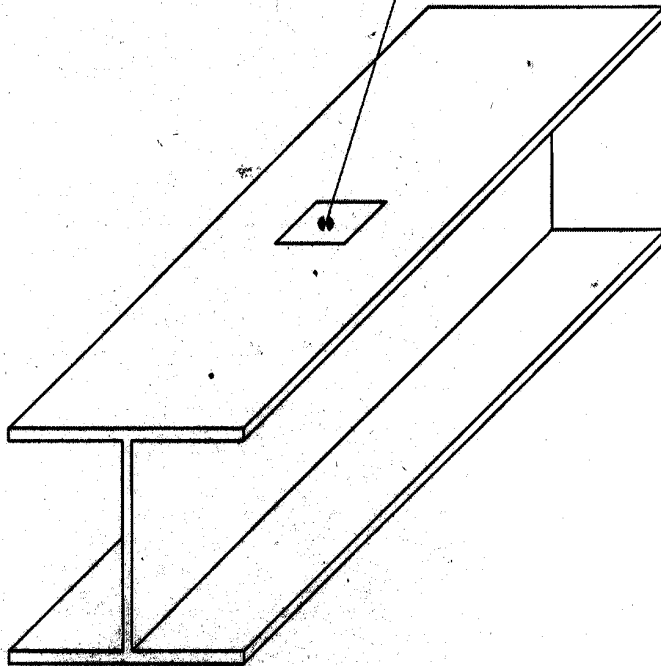


FIG - E

IDENTIFICATION / MARKING



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MANUFACTURERS NAME & ADDRESS

BHARAT HEAVY ELECTRICALS LTD  
BOILER AUXILIARIES PLANT  
RANIPET-632 406 (INDIA)

STANDARD QUALITY PLAN

ITEM: ESP  
Sub system: Sheet/Plate formed Components Shells,  
Panels & Funnel Assy/Splitters, Hopper walls, GD housing  
Panels.

QP NO SQP: ESP: 284

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DATE 06 06 07

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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
1.0	<b>Raw Material</b>									
1.1	Sheets & Plates Rolled section, hollows, Tubes	Chemistry & Mechanical Properties	Chemical & tensile test	As per TDC	Respective TDC		TC	P	V	
2.0	In process control Flame cutting	Lamination and cracks	Visual	100%	As per AWS D1.1		R	P	V	
2.1	Joint 'V' Fit up for plates /Back gouging Welding	Fitup Characteristics "V" Root gap, Land /weld soundness	-DO-	100%	AWS D1.1, Drawing and QCP E002 latest		R	P	V	
2.2			Review of documents -DO-	-DO-	Prequalified welding procedure As per AWS D1.1		R	P	W	
2.3					AWS D1.1		R	P	W	

LEGENDS:0  
M - Manufacturer / Subcontractor,  
B - BHEL /BHEL Authorized Inspection Agency,  
P - perform, V - Verification of Reports  
W - Witness, TC - Test certificate,  
DR - Dimensional report,

PREPARED BY *[Signature]*

REVIEWED BY

QA  
QC-OLI  
ENG

*[Signature]* 6/6/07

*[Signature]*

APPROVED BY *[Signature]*



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 BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)

**STANDARD QUALITY PLAN**  
 ITEM: **ESP**  
 Sub system: Sheet/Plate formed Components  
 Shells, Panels & Funnel Assy/Splitters, Hopper  
 walls, GD housing Panels.

**QP NO :** SQP : ESP : 284  
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**DATE** 06 06 07  
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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
1										
2.4	Weld insp'n	3.	4	5	6	7	8			10
2.4.1	Size and finish									
2.5	Weld NDE		VISUAL	-DO-	DRAWING AND SIP; NP;06		R	P	V	
2.5.1	But welds on soundness Structural joints	SOUNDNESS	Visual & LPI	See Remarks*	ASW D 1.1		R	P	V	REMARKS** 1) Weld flup 2) On all Primary stiffeners 100% LPI. On back gouged area 100% LPI. 3) 20% Random LPI on other joints
2.5.2	Fillet weld in structural	-DO-	LPI	10% Random @	-DO-		R	P	V	
3.0	Dimensional control			100%	Drawing		R	P	W	@;In case of defects % shall be increased.
3.1	Hopper walls	Length, width and diagonal straightness waviness, stiffener location and orientation	Measurement and visual							

**LEGENDS:**  
 M - Manufacturer / Subcontractor,  
 B - BHEL /BHEL Authorized Inspection Agency,  
 P - perform, V - Verification of Reports  
 W -Witness, TC - Test certificate,  
 DR - Dimensional report,

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*[Signature]*

REVIEWED BY

ENG

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 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)

**STANDARD QUALITY PLAN**  
 ITEM: ESP  
 Sub system: Sheet/Plate formed Components Shells,  
 Panels & Funnel Assy/Splitters, Hopper walls, GD  
 housing Panels.

**QP NO :**  
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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
1	2	3	4	5	6	7	8	9	10	
3.2	Roof panels	Position of support insulator, holes, length width, diagonals & straightness, waviness, stiffener location & orientation.	Measurement & visual	DO	DO		R	P	W	
3.3	Casing Shells	Length, width diagonal, straightness, waviness, stiffener location & orientation	DO	100%	DRAWING		R	P	W	
3.4	Top Panels	Length, width diagonal, straightness, waviness, stiffener location and orientation, hole size & location.	DO	100%	DRAWING		R	P	W	

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 M - Manufacturer / Subcontractor, B - BHEL  
 /BHEL Authorized Inspection Agency,  
 P - perform, V - Verification of Reports  
 W Witness, TC - Test certificate,  
 DR - Dimensional report,

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 QC-011  
 ENGG

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STANDARD QUALITY PLAN  
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 Sub system: Sheet/Plate formed Components Shells,  
 Panels & Funnel Assy/Splitters, Hopper walls, GD  
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QP NO :  
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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
1	Dimensional control contd...	3.	4	5	6	7	8		9	10
3.5	Vertical/horizontal splitters; shape	Slope, height location of flat with tracks	Measurement in layout	100%	Drawing	R	R	P	W	
3.6	Trial assy of hopper lower with heating chamber	Weld gap, overall dimm gap between hopper and heating chamber, matching of poke tube holes.	Measurement and visual	1(one) assy	DO	R	R	P	W	
3.7	Funnel assy									
3.7.1	Floor assy center line offset if any	Overall dimm length, width diagonal, taper, profile matching holes location ref	Visual measurement template for profile Match marking	100%	Drawing	R	R	P	W	

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 W -Witness, TC - Test certificate,  
 DR - Dimensional report,

PREPARED BY  
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STANDARD QUALITY PLAN

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Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
1										
3.7.2	As a funnel assy flange dimms, level	Over all dimms. bottom/top openings height, diagonals of funnel, and orientation and alignment of corner end plates, verticality.	Visual measurement	100%	DO	Drawing, panting schedule PRQA 590(Latest)	R	P	W	
4.0	Final insp:n: Surface cleaning, painting & preservation, marking	Welding, finish and appearance.	Visual	100%			R	P	W	

LEGENDS:	PREPARED BY	REVIEWED BY	QA		APPROVED BY
			QC-OII	ENGG	
M - Manufacturer / Subcontractor, B - BHEL /BHEL Authorized Inspection Agency, P - perform, V - Verification of Reports W -Witness, TC - Test certificate, DR - Dimensional report,					

1.0 Note 1.0 GENERAL REQUIREMENT

- 1.1 Any additional requirement for a specific contract shall be referred separately.
- 1.2 Raw materials used shall confirm to the grades specified in the drawing &GMS.
- 1.3 Raw material shall be free from harmful visual defects like cracks, seams, laps, lamination, heavy pitting etc.
- 1.4 Fabricators shall check all the supplied raw materials for dimensions ,bend, camber etc. Straightening wherever necessary must be carried out before assy and welding.
- 1.5 Substitution of materials shall be done with the prior approval of EDC/AQCS.
- 1.6 Plates for flange shall be preferably machine gas cut. Cut edges shall be dressed smooth to remove all the undulations. Gas cut notches if any shall be filled up and dressed. The edges shall be straight and square.

Note: 2.0 INPROCESS CONTROL

- 2.1 The general requirements for process control during fabrication in QCP;002[Latest] read along with amendment 1.

Note:3.0 MARKING, CUTTING AND PREPARATION

- 3.1 Bottom level hopper lower part shall be flat and square and the same shall be assured during assembly.

Note: 4.0 WELDING REQUIREMENT & WELD INSPECTION

- 4.1 Splice joints shall be completed prior to the welding of cover plate.
- 4.2 Sequences of welding shall be so chosen as to minimize the distortion.
- 4.3 NDT as required shall be carried out on splice joints before cover plate welding.
  - 4.3.1 Visual inspection; after fabrication is completed, all welds shall be visually examined for arc strikes, sharp nicks, undercuts and size
- 4.4 Arc strike shall not be done straight on the job. Welder shall have a Separate piece for striking the arc
- 4.5 Welding procedure specification and welders qualification are detailed in SIP; NP;07[latest].
- 4.6 Butt welds in plate to make up the length shall be done carefully with suitable edge preparation. The stiffener angles & channels are to be welded to the casing shell only after completing all the splice joints and correcting weld distortions.
- 4.7 Splice joints if required, shall be in line with the following clauses.

- 4.8 Plates of 6 mm can be jointed using one of the following two alternatives;
- a) Single v preparation of 60-70 degree with 1-2 mm land and 2-3 mm gap Welding shall be done on the v side. Subsequently, the plates to be turned and backside cleaned by wire brush. Then 2<sup>nd</sup> side welding to be done. If this method of welding is adopted the inspectors hold point shall be joint fit up stage.
  - b) The plates can be jointed by keeping straight butt faces with a gap of 2-3 mm. Welding to be done from the first side. Subsequently, the back side to be fully gouged/ground and then welded. In this type, the inspectors hold Point shall be the stage after back gouging. The back gouging shall be checked visually.
- 4.9 5mm plates shall be joined by straight butt keeping a gap of 2-3mm. Inspectors may have surveillance on joint fit-up but no hold point is required.
- 4.10 In case of stiffener of small sections, used in casing shell, weld preparation may be single "v". Inspectors shall check the back gouging/grinding after first side welding.
- 4.11 Weld the "v" from the reversed side by a min of two layers.
- 4.12 The min strip to be used for weld joint shall be 500mm.
- 4.13 The distance between the nearest stiffener and the splice joint parallel to it shall be min. 50mm.

NUMBER OF JOINTS

<u>CASING SHELL AREA</u> IN .M. sq	<u>MAX.NO OF VERTICAL</u> <u>JOINTS</u>
Less than 4	-NIL-
Above 4 to 8	2
Above 8 to 12	3
Above 12 to 16	4
Above 16 to 20	5
Above 20 to 24	6
Above 24 to 30	8
Above 30	10

- 4.14 Wherever the horizontal joints are not in full length then those joints may be counted along with other vertical joints and the same may be allowed as follows.

<u>CASING SHELL AREA</u> in M sq	<u>MAX. NO. OF JOINTS</u>
Less than 2	-NIL-
Above 2-5	3
Above 5-10	5
Above 10-15	6
Above 15-20	8
Above 20-25	10
Above 25- 30	12
Above 30-32	14
Above 32	16

4.15 The joints shall be uniformly distributed throughout the casing shall be inline with above table.

**Note: 5.0 FABRICATION TOLERANCES**

**Following tolerances shall be applicable on different dimensions of casing shells, roof panels, hopper walls.**

- 5.1 Surface of finished casing shell /Hopper wall shall be flat. The manufactures shall take extra care while carrying out the welding and handling/turning the casing shell/hopper wall to avoid out of flatness or waviness. Maximum out of flatness or waviness, as checked by piano wire or straight edge shall not be more than 15mm( i. e.  $\pm 7.5$ mm).
- 5.2 Variation in liner dimensions shall not exceed plus or minus 1mm/Metere of nominal dimensions limited to
- a) Length 5mm
  - b) With 3mm
  - c) Diagonal difference 7mm (Max)
  - d) Out of straightness of the sides 3mm.
  - e) Out of squareness of flanges shall not exceed 2mm.
- 5.3 Hole size and pitch on the flange shall be strictly as per drawing. Hole size Variation shall be limited to +2mm variation in distance between hole centers shall not vary more than  $\pm 2$ mm.
- 5.3.1 Stiffener placement shall be with in  $\pm 5$ mm.
- 5.3.2 The disposition of dia 500mm hole with respect to the longitudinal center line of the panel shall be with in  $\pm 3$ mm.
- 5.3.3 Distance between the rectangular hole (for lifting tool) center of dia 400mm opening is  $\pm 1.5$ mm.
- 5.3.4 Diagonal difference of dia 400mm opening in middle roof panel (with two sets of Opening). 3mm max.

**Note: 5.3.5 FABRICATION & DIMENSIONAL TOLERANCE OF SIDE PANELS AND MIDDLE PANNEL**

**5.3.5.1 FABRICATION**

- 5.3.5.2 Butt welds in plate to make up the length shall be done carefully. All weld distortions shall be corrected before other stiffeners and Sections are welded to the plates.

### 5.3.5.3 TOLERANCE

- a) Length  $\pm 3\text{mm}$
- b) Width  $\pm 2\text{mm}$
- c) Distance between  
guide pin  $\pm 2\text{mm}$
- d) Diagonal difference  $5\text{mm}(\text{Max})$
- e) Bottom panel walls – position of hole for collecting rapping shall be maintained with in  $\pm 3\text{mm}$  from the bottom edge and the side of the panel. Similarly the position of cut-out for emitting rapping drive shall be with  $\pm 3\text{mm}$  with respect to top and side of the panel.

#### Note; DIMENSIONAL TOLERANCE OF FUNNEL ASSY

- 5.3.5.4 Variation in liner dimensions of the funnel wall shall not exceed  $\pm 1\text{mm}/\text{meter}$  of nominal dimensions limited to a maximum of 5mm.
- 5.3.5.5 Difference between diagonals shall not exceed 1mm/metre of approximate nominal diagonals length limited to max.of 7mm.
- 5.3.5.6 Out of squareness of flanges shall not exceed 1mm.
- 5.3.5.7 The level of the flanges is to be ensured by water level. The deviations Permitted is 2mm max.
- 5.3.5.8 The local out flatness allowed in individual panels is 5mm max. Flange holes, pitches of flange holes with in  $\pm 1\text{mm}$ .

#### Note: 6.0 Marking\*

- 6.1 The following details shall be stenciled with white paint and the stenciled details covered with one coat of transparent varnish at the center of casing shell.
  - . Sub-Contractor code
  - . Work Order Number.
  - . DU Number.
  - . Weight
  - . Project
- 6.2 In addition of above stenciling , following details shall also be welded /punched and bordered in white paint.
  - . Sub-Contractor code
  - . Work Order Number.
  - . DU Number.

\*\*\*

BHEL  
RANIPET

STANDARD QUALITY PLAN FOR ESP (MECHANICAL)

REF.NO.	REVISION NO.	EFFECTIVE DATE
QP: ESP: 285	00	20 06 98

TITLE : COLLECTING AND EMITTING ELECTRODES  
SUSPENSION FRAMES OF ESP

SIGNATURE

PREPARED BY : A ELANGO VAN/QA

REVIEWED BY : K NITHIANANDAM/QA

: P RAJASEKARAN/QC OLI

: T GNANAPRAKASAM /AQCS

APPROVED BY : H ANANTHANARAYANAN/QA

ISSUED & CONTROLLED BY : :QUALITY ASSURANCE, BHEL, RANIPET- 632 406

DOCUMENT STATUS -----  
ISSUED TO ----- INFORMATION COPY

Mr. -----

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PC FILE :D:\KNM\ESPQ\ESP285.SQP

PAGE 01 OF 12

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BHEL  
RANIPET

STANDARD QUALITY PLAN FOR ESP (MECHANICAL)

REF.NO. REVISION NO. EFFECTIVE DATE

QP:ESP:285 00 20 06 98

TITLE COLLECTING AND EMITTING ELECTRODES  
: SUSPENSION FRAMES OF ESP

RECORD OF REVISION

REF DETAILS OF REVISION DATE AMENDED  
REVISED

REVISION 00 TOTALLY REVIEWED. 20 06 98  
MERGED SQP: ESP 254,  
262, QCPE023 & E-024 AND  
ISSUED AS SQP:ESP:285

MANUFACTURER'S NAME & ADDRESS      MANUFACTURING QUALITY PLAN      QP:ESP:285

BHARAT HEAVY ELECTRICALS LTD ITEM:  
BOILER AUXILIARIES PLANT

REV : 00      STANDARD  
DATE : 20 06 98

RANIPET - 632 406 (INDIA)  
QUALITY ASSURANCE DEPARTMENT SUB SYSTEM :--

PLAN

QUALITY

S.NO.	COMPONENT & AGENCY OPERATION RISTICS M C E	CHARACTE-REMARKS	CLASS TYPE OF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF
			CHECKOF CHECK		DOCUMENT	NORMS	RECORDS

1	2	3	4	5	6	7	8	9	D*	10	11
---	---	---	---	---	---	---	---	---	----	----	----

1.0 RAW MATERIALS

1.1.1 RECTANGULAR CHEMISTRY & MAJOR REVIEW OF EACH LOT MATERIALS TC P V

- RAW MATERIALS ARE HALLOWS, TUBES MECHANICAL TCS/ ORD HEAT SPECIFICATIONS AS PER DRG  
TAKEN TO STOCK ON CHANNELS, PROPERTIES RANDOM AS PER TESTING MATERIAL  
VERIFICATION OF ANGLES, TCs/RANDOM HOOKS. TESTING. SPECIFICATION

1.2	RECTANGULAR TUBES/HOLLOWES HOOKS	CRACKS	MAJORVISUAL 100%	CRACKS NOT PERMITTED	R	P	W
		PROFILE, TOOL MARKS & CRACK	D0 DO 100%	CRACKS AND TOOL MARKS NOT PERMITTED	R	P	W

-----

LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.  
\*\*M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR/NOMINATED INSPECTION AGENCY, E: CUSTOMER.  
R: REPORT, TR: INSPECTION REPORT, "P" PERFORM, "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE.  
TC: TEST CERTIFICATES, "CHP" (CUSTOMER HOLD POINT) : CUSTOMER SHALL IDENTIFY IN COLUMN "E"

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MANUFACTURER'S NAME & ADDRESS      MANUFACTURING QUALITY PLAN      QP:ESP:285

BHARAT HEAVY ELECTRICALS LTD    ITEM:  
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REV : 00  
DATE : 20 06 98

STANDARD

QUALITY

RANIPET - 632 406 (INDIA)  
QUALITY ASSURANCE DEPARTMENT SUB SYSTEM :--

PLAN

PAGE : 04 OF 12

S.NO.    COMPONENT & AGENCY OPERATION M C E    CHARACTER REMARKS    CLASS TYPE OF RISTICS    QUANTUM CHECKOF CHECK    REFERENCE DOCUMENT    ACCEPTANCE NORMS    FORMAT OF RECORDS

1    2    3    4    5    6    7    8    9    D\*    10    11

2.0    INPROCESS CONTROL

2.1    HOOK FIT WITH THE TUBE LOCATION    FIT UP OF @VERIFY:    DO    MEASURE    3 TUBES/    DRAWING    DRAWING  
R P W    WITH THE TUBE HOOKS IN THE    MENT AND ANGLES    DO    MEASURE    3 TUBES/    DRAWING    DRAWING  
LOCATION    /HOLLOW/ANGLE/    FIXTURE    VISUAL    DURING    START OF    1)REF TO    OF

2.2    ASSY OF TUBES    FIT UP OF    DO    #MEASURE    2 FRAMES    DRAWING    DRAWING  
R P W    /HOLLOWS/    TUBES/HOLLOW    MENT &    DURING    [NOTE:# 1) TUBE/HOLLOW/ANGLE  
ORIENTATION & LOCATION, 2) DIAGONAL OF    VISUAL    START OF    HOOKS & HOLES, 3) FRAME 4) OVER ALL  
ANGLES AS A S/ANGLES    DIMENSION]    FRAME PART/    WELDED WITH HOOKS    WORK

2)HOOK PITCH  
3)HOOK LEVEL FOR  
CE SUSPENSION  
DRAWING

2.3 STRUCTURE AS A FRAME AS A FRAME MAJOR REVIEW OF 100% PRE QUALIFIED WELDING R  
 WELDING 1)PROCEDURE  
 P W QUALIFICATION DOCUMENTS PROCEDURE AS PER AWS D 1.1  
 2) PERSONAL DO DO 100% AWS D 1.1 R P W  
 QUALIFICATION

-----  
 LEGEND: \*RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

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MANUFACTURER'S NAME & ADDRESS      MANUFACTURING QUALITY PLAN      QP:ESP:285

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DATE : 20 06 98

RANIPET - 632 406 (INDIA)  
QUALITY ASSURANCE DEPARTMENT SUB SYSTEM :-

PAGE : 05 OF 12      PLAN

S.NO.    COMPONENT & AGENCY OPERATION M C E    CHARACTER REMARKS    CLASS TYPE OF RISTICS    CHECKOF CHECK    QUANTUM    REFERENCE DOCUMENT    ACCEPTANCE NORMS    FORMAT OF RECORDS

1      2      3      4      5      6      7      8      9      D\*      10      11

2.3.1 WELD INSPN ON HOOK WELDING, AFTER      SIZE & FINISH DO      \$\$ VISUAL 100%      DRAWING & SPIP: NP:06      \$\$:1) PIN HOLE, BLOW R P W HOLES      2)SHARP CORNER      HOOK WELDING      3) EXCESSIVE FILLET SIZE ON HOOK      ARE NOT ACCEPTED. R

WELDING

3.0 DIMENSIONAL DIMENSIONS DO CONTROL      MEASURE DO DO DO DO      RANDOM      DRAWING      DRAWING      R      P      W      R

1) LENGTH & WIDTH OF FRAMES  
2) LOCATION OF ANGLES MEANT FOR BEAMS W.R.T CENTRE OF FRAMES, SOLES PITCHES  
3) LOCATION OF HOLES / BACK MAJOR MEASURE      RANDOM      DRAWING      R

P W  
 MARK IN ANGLE.CHANNEL MENT R P W  
 4) HOOK PITCHES:LONGITUDIANL \ DO DO RANDOM DRAWING R P W  
 5) HOOK PITCHES:TRANSVERSE DO DO @100% DRAWING R P W  
 6) BOW & SIDE BEND ON THE DO DO 100% DRAWING R P W  
 TUBE/HOLLOW/ANGLES

-----  
 LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.  
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 MANUFACTURER'S NAME & ADDRESS MANUFACTURING QUALITY PLAN QP:ESP:285  
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 BHARAT HEAVY ELECTRICALS LTD ITEM: REV : 00  
 BOILER AUXILIARIES PLANT DATE : 20 06 98 STANDARD  
 RANIPET - 632 406 (INDIA) PAGE : 06 OF 12 PLAN  
 QUALITY ASSURANCE DEPARTMENT SUB SYSTEM :--

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S.NO.	COMPONENT & AGENCY OPERATION M C E	CHARACTE- RISTICS	CLASS TYPE OF REMARKS	QUANTUM CHECKOF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS				
1	2	3	4	5	6	7	8	9	D*	10	11

-----

3.0 CONTD...

7) CE HOOK LEVEL, HOOK & HOLES DIAGONAL, TWIST, CAMBER & SWEEP OF FRAMES AFTER WELDING AND COMPLETE FABRICATION

CRITICAL MEASUREMENT 100% AS PER DRAWING [TWIST, CAMBER & SWEEP NOT PERMITTED] R P W

4.0 FINAL INSPECTION

SURFACE P W PACKING SURFACE DO VISUAL 100% AS PER PACKING R

CLEANING, DRESS, WELDING, PAINTING AND FINISH PRESERVATION SH & APPEARANCE DRAWING AND PAINTING SCHEDULE RP 0674199

LEGEND: \* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

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1.0 NOTE.1. 0 GENERAL REQUIREMENTS  
-----

- 1.1 Any additional requirement for a specific contract shall be refereed separately.
- 1.2 Raw material; used shall conform to the grades specified In the drawing & GMS.
- 1.3 Raw material shall be free from harmful Visual defects like cracks, seams, laps, laminations, heavy pittings etc.
- 1.4 Fabricators shall check all the supplied raw materials for Dimensions, bend camber etc. Straightening wherever necessary must be carried out before assy and welding.
- 1.5 Substitution of materials shall be done with the prior approval of EDC/AQCS.
- 1.6 Fabricator to impose sufficient process control, necessary Stage inspection so that the components made are consistent On quality and conforms to the drawing and specification. It is the responsibility of the fabricator to adopt sufficient measures to avoid non conformances.
- 1.7 Tubes/Hollows/Angles shall be gas cut. Cut edges shall Be dressed smooth to remove all the undulations. Gas cut notches if any shall be filled up and dressed. The edges shall be straight and square.
- 1.8 Tubes /Hollows/Angles shall be cut carefully to the required size and profile and dressed square. No joint on Hollows and Angles shall be permitted.

NOTE 2.0 INPROCSS CONTROL

- 2.1 The general requirements for process control during fabrication are detailed in QCP:002 (Latest) read along with amendment 1.

NOTE 3.0. WELDING REQUIREMENTS & WELD INSPECTION  
-----

- 3.1 Electrodes :E6013 shall be used for welding.
- 3.1.1 E6013 electrodes shall be dried in backing ovens at temperature 100 Degree C, until they are used, If the packing were found to be damaged or the electrodes were kept exposed to atmosphere for prolonged period.
- 3.2 Pre qualified welding procedure as per AWS D1.1 (Latest) Shall be used.
- 3.3 Welders employed shall be qualified as per AWS D1.1 latest. Welders qualified to other codes may also be permitted to carryout welding at the discretion of Inspection Engineers.
- 3.4 Fillet and butt welds shall be done with a minimum of Two layers, and 6mm fillet or less can be done in single run ensuring complete root fusion.

- 3.5 Sequence of welding shall be so chosen to balance Applied heat and to minimise the distortion.
- 3.6 Arc strike shall be done straight on the job. Welder Shall have a separate piece for striking the arc.
- 3.7 weld procedures and welder's qualification are detailed in SIP : NP : 07 (Latest)
- 3.8 All welds shall undergo thorough visual examination to Detect the weld defects like undercuts, non-uniform Beading, overlaps, excessive concavity or convexity etc.
- 3.9 Welds shall be neither undersize nor excess than specified.
- 3.10 Only BHEL approved bands of electrodes shall be used,
- 3.11 Cleaning of the entire Job shall be thoroughly Examined before painting.
- 3.12 While welding the Frames adequate care has to be taken to control the distortion.

#### 4.0 WORKMANSHIP AND TOLERANCE

##### 4.1 COLLECTING ELECTRODES

-----

- 4.1.1 All support angles shall be straight and parallel. Maximum out of straightness shall be within 2 mm.
- 4.2 All components shall be inspected for dimensions. Permissible tolerance shall be as per the drawing.
- 4.3 Alignment of hooks across the frame as checked on first set of hooks at edge stiffener end shall be within 2mm.
- 4.4 Disposition of bolt holes shall be within +/- 1mm.
- 4.5 Distance between any two support angles are to be maintained as per the drg. This shall be measured at the bottom edge of the support angles.
- 4.6 Diagonal variation as measured between corner angles / Hooks max. 5mm.

##### 5.0 EMITTING ELECTRODES FRAMES

- 5.1 Raw material shall be free from bend and twist. Straightening wherever necessary shall be carried out on individual numbers before they are taken up for fabrication.
- 5.1.1 All Flame cut edges shall be dressed smooth and square by grinding.

- 5.1.2 The following sequence shall be adopted in fabricating the frame part top and bottom.
- a) Straighten the rectangular tubes if necessary. Maximum twist permitted on supplied tube 2mm.
  - b) Cut to length within +/- 1mm.
  - c) Remove the rust preventive coat on the rectangular tubes to ensure proper welding.
  - d) Dress the cut edges by grinding.
  - e) Weld the electrode holders on the tubes using fixture. All holders shall be on the tube face not having ERW seem.
  - f) Electrodes holders shall be welded on to the tube with smooth bead avoiding undercuts, weld ripples and spatters.
  - g) Straighten the tubes.
  - h) For the tubes meant for frame part bottom weld the end cover sheets.
  - i) Fix the tubes with the channels/angles on the fixture. The channels/angles shall be cut to the correct size and straightened before they are assembled in the fixture.
  - j) Check the diagonals.
  - k) Tack weld the frame.
  - l) Remove the frame from the fixture: check all the dimensions and full weld.
  - m) Correct all welding distortions.
  - n) Dress the sharp corners that may be present at the ends of the electrode holders.
  - o) Check all the dimensions and alignment of holders.
- 5.1.3 The following sequence shall be adopted in fabricating the frame part middle.
- a) Cut the tube to correct size.
  - b) Dress the tube to correct size
  - c) Drill the holes at one end for plug welding the pin.
  - d) Weld the end cover sheet at the other end

- e) Place tube fixture. Fix the pin maintaining overall length and tack weld. Tack weld all electrodes holders on both sides of the tube maintaining them at 180 Degree to reach other.
  - f) Remove the piece from the fixture and full weld.
  - g) Dress all the sharp corners that may be present at the edges of the holders.
  - h) Flush grind the pin plug welding.
  - i) Straighten the frame.
  - j) CHECK all the dimensions.
- 5.1.4 No joint is permitted to make up the length of the Rolled sections.
- 5.1.5 Fillet welds shall neither be underrun nor too much Oversized than the specified.
- 5.1.6 No undercuts in the welds shall be permitted.
- 5.2 FRAME PART TOP AND BOTTOM:
- 5.2.1 Finished frames shall be free from twist and bend.
  - 5.2.2 All tubes shall be straight.
  - 5.2.3 All electrode holders on a tube shall be in a straight line.
  - 5.2.4 Length of frame +/-1mm.
  - 5.2.5 Diagonal variation between extreme corner holders as well as bolt holes shall be within 5mm max.
  - 5.2.6 Cumulative distance between roes i.e. the dimension 300, 600, 900 mm... +/- 1mm. This shall be measured atleast in three places in each frame i.e. at both ends at the middle of the frame.
  - 5.2.7 all electrode holders shall be perpendicular to the tube face.
  - 5.2.8 First holders at both ends (in all tubes) shall be within:
    - a) 385 +/- 1mm for frame part top.
    - b) 285 +/- 1mm for frame part bottom.
  - 5.2.9 Pitch of holders on a tube +/- 3mm.
  - 5.2.10
    - a) In frame part top, bolt holes shall be in the middle of two end tubes with +/- 1mm.
    - b) In frame part bottom bolt holes shall be in line With the centre axis of end tubes within +/- 1mm.

5.2.11 The need channel angles shall be square to the tube surface.

### 5.3 FRAME PART MIDDLE

5.3.1 Finished pieces shall be straight.

5.3.2 All electrode holders shall be in one line.

5.3.3 The electrode holders on both sides of the tube shall be at 180 Degree with each other and diametrically opposite on the tube.

5.3.4 First holder shall be 405 +/- 1mm from pin end & 355 +/-1mm at the other end.

5.3.5 Pitch of electrode holders +/- 3mm.

5.3.6 Overall length of frame part middle +/-1mm.

### 6.0 CLEANING AND PAINTING

6.1 All frames shall be thoroughly cleaned to remove weld slag, spatter, grease, rust and mill scales.

6.2 Cleaned frames shall be coated with two coats of paint as Indicated below:

- a) Primary coat of red oxide zinc chrome prior with 25 Microns minimum coating thickness conforming to IS 2074.
- b) Finish coat of synthetic enamel long oil alkyd to IS 2932 with minimum 20 microns thickness of smoke grey shade.

### 7.0 IDENTIFICATION AND PACKING

7.1.1 In all the frame part top and bottom, the following details shall be stenciled in white paint and stenciled details covered with one coat of transparent varnish.

Sub-Contractor's code  
Work order number  
D. U. No.  
Weight  
Sl. No.

7.1.2 For frame part middle :-

The following shall be stenciled on five frame part middle piece in each packing. The stenciled details shall be covered with one coat of transparent varnish and the stenciling shall be clearly visible after packing.

Sub-contractor's code  
Work order number  
D. U. No.  
Weight

The above stenciling shall be done at two places on the packing also.

7.2 In addition to the above stenciling, in all the pieces of frame part top, middle and bottom the sub-contractor's code shall be punched. Punched details shall be bordered in white paint.

7.3 Finished frames shall be packed as per the respective packing drawing and the dispatched. All steel sections used for packing shall be painted yellow.

7.4 PACKING

All the frames shall be as per the packing drawing and then dispatched. All steel sections used for packing shall be painted yellow.

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BHEL  
RANIPET

STANDARD QUALITY PLAN FOR ESP (MECHANICAL)

REF.NO.

REVISION NO.

EFFECTIVE DATE

QP : ESP : 286

00

20 06 98

TITLE

: (a) RAPPING SHAFT, (B) FOUNDATION BOLTS &  
(c) LIFTING HOLDERS

SIGNATURE

PREPARED BY

: A ELANGO VAN / QA

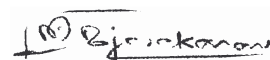


REVIEWED BY

: K NITHIANANDAM / QA



: P RAJASEKARAN / QC OLI



: T GNANAPRAKASAM/AQCS



APPROVED BY

: H ANANTHANAYANAN / QA



ISSUED & CONTROLLED BY

: QUALITY ASSURANCE, BHEL, RANIPET-632406

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BHEL STANDARD QUALITY PLAN FOR ESP (MECHANICAL)  
RANIPET

-----  
REF.NO. REVISION NO. EFFECTIVE DATE  
-----  
OP : ESP : 286 00 20 06 98  
-----

TITLE : EMITTING ELECTRODES

-----  
RECORD OF REVISION  
-----

REF DETAILS OF REVISION DATE AMENDED/  
REVISED

-----  
REVISION 00 TOTALLY REVIEWED AND 20 06 98  
SQP:ESP 263, 271, 273 AND  
ISSUED AS SQP : ESP : 286  
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PC FILE :D:\KNM\ESPSQP\ESP286.SQP | PAGE 02 OF 11  
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MANUFACTURER'S NAME & ADDRESS: BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET - 632 406. (INDIA)  
 QUALITY ASSURANCE DEPARTMENT

MANUFACTURING QUALITY PLAN ITEM:  
 (a) RAPPING SHAFTS  
 (b) FOUNDATION BOLTS  
 (c) LIFTING HOLDERS

QP:ESP:286  
 REV : 00  
 DATE : 20 06 98  
 PAGE : 03 OF 11

STANDARD QUALITY PLAN

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0	RAW MATERIALS	BRIGHT BAR, ROUNDS	CHEMICAL & MECHANICAL PROPERTIES	MAJOR REVIEW OF TC/RANDOM TESTING	EACH LOT OR HEAT AS PER SPECIFICATION/RANDOM SAMPLE	RESPECTIVE MATERIAL SPECIFICATION AS PER DRAWING	TC	-	**M C E	RAW MATERIAL TAKES TO STOCK AFTER VERIFICATION OF TC/RANDOM TESTING.

(s) RAPPING SHAFTS

2.0	IN PROCESS CONTROL : MACHINING OF DIMENSIONS D)SHAFT ENDS AND FINISH ii)KEY WAY iii)DRILLING OF HOLES	MAJOR MEASUREMENT	100%	DRAWING	DRAWING	DRAWING	R	P	W	HOLES ARE TO BE DRILLED IN RELIANT JIC.
3.0	FINAL INSPECTION: OVERALL DIMENSIONS, FINISH, STRAIGHTNESS	MAJOR VISUAL & MEASUREMENT	100%	DRAWING	DRAWING	DRAWING	R	P	W	

LEGEND: \* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.  
 \*\* M:MANUFACTURER/SUB-CONTRACTOR;C:CONTRACTOR/NOMINATED INSPECTION AGENCY;B:CUSTOMER.  
 R:REPORT;IR:INSPECTION REPORT;"P" PERFORM;"W" WITNESS AND "V" VERIFICATION AS APPROPRIATE.  
 TC:TEST CERTIFICATES;"CHP"(CUSTOMER HOLD POINT);CUSTOMER SHALL IDENTIFY IN COLUMN "E"

MANUFACTURER'S NAME & ADDRESS MANUFACTURING QUALITY PLAN QP:ESP:286  
 BHARAT HEAVY ELECTRICALS LTD ITEM : REV : 00  
 BOILER AUXILIARIES PLANT (a) RAPPING SHAFTS DATE : 20 06 98  
 RANIPET - 632 406. (INDIA) (b) FOUNDATION BOLTS PAGE : 04 OF 11  
 QUALITY ASSURANCE DEPARTMENT (c) LIFTING HOLDERS

STANDARD QUALITY  
PLAN

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	4	5	6	7	8	9	10	11	REMARKS
			TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY				
1	2	3	4	5	6	7	8	9	D*	10	11	**M C E

(b) FOUNDATION BOLTS:

2.0 INPROCESS CONTROL

2.1	MACHINE	1) MAJOR DIA	CRITICAL	MEASUREMENT	100%	DRAWING / STANDARD	R	R	P	W		
		2) LENGTH OF MACHINING FOR THREAD CUTTING	MAJOR	MEASUREMENT	100%	DRAWING	R	R	P	W		
		3) THREAD CUTTING	MAJOR	MEASUREMENT BY GO/NOGO GAUGE	100%	DRAWING / STANDARD	R	R	P	W		
		4) LENGTH OF FOUNDATION BOLT	MAJOR	MEASUREMENT	100%	DRAWING	R	R	P	W		
		5) SIDE LUGS	MAJOR	VISUAL	100%	DRAWING	R	R	P	W		

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TC: TEST CERTIFICATES; "CHP" (CUSTOMER HOLD POINT); CUSTOMER SHALL IDENTIFY IN COLUMN "E"

MANUFACTURER'S NAME & ADDRESS  
 BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET - 632 406. (INDIA)  
 QUALITY ASSURANCE DEPARTMENT

MANUFACTURING QUALITY PLAN  
 ITEM :  
 (a) RAPPING SHAFTS  
 (b) FOUNDATION BOLTS  
 (c) LIFTING HOLDERS

QP:ESP:286  
 REV : 00  
 DATE : 20 06 98  
 PAGE : 05 OF 11

STANDARD QUALITY PLAN

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
2.2	WELDING	1)PROCEDURE QUALIFICATION	MAJOR	REVIEW OF DOCUMENTS	100%	PRE QUALIFIED WELDING PROCEDURE AS PER AWS D1.1		R	P W	K7018 ELECTRODE SHALL BE USED
2.2.1	WELD INSPN.	WELD QUALITY SIZE & FINISH	MAJOR	REVIEW OF VISUAL LPI DOCUMENTS	100%	AS PER AWS D1.1		R	P W	10%LPI (LIQUID PENETRANT INSPN.) ON FILLET WELDS OF BOLT WITH PLATES/LUGS
3.0	FINAL INSPN.	COMPLIANCE TO DIMENSION & STRAIGHTNESS	MAJOR	MEASURE MENT & VISUAL	100%	DRAWING	DRAWING	R	P W	
3.1.1	ASSY OF FOUNDATION BOLTS & NUT	COMPLIANCE	MAJOR	VISUAL GRADE OF NUT	100%	DRAWING	DRAWING	R	P W	

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BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET - 632 406. (INDIA)  
 QUALITY ASSURANCE DEPARTMENT

ITEM :  
 (a) RAPPING SHAFTS  
 (b) FOUNDATION BOLTS  
 (c) LIFTING HOLDERS

REV : 00  
 DATE : 20 06 98  
 PAGE : 06 OF 11

STANDARD QUALITY  
 PLAN

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
3.2.1	SURFACE CLEANING	CLEANING	MAJOR	VISUAL	100%	DRAWING	DRAWING	R	P W	THREADED AREA TO BE PROTECTED WHILE CLEANING
3.2.2	PRESERVATION OF RUST PREVENTIVE ON THREADED REGION	APPLICATION OF RUST PREVENTIVE ON THREADED REGION	MAJOR	VISUAL	100%	DRAWING	DRAWING	R	P W	NOTE:THREADED AREA OF BOLT SHALL BE COATED WITH RUST PREVENTIVE FLUID AND COVERED BY TAR IMPREGNATED GUNNY CLOTHS.
3.3	PACKING AND DESPATCH	PROTECTION OF THREADED AREA, IDENTIFICATION OF WORK ORDER, DU NO, ETC...	MAJOR	VISUAL	100%	DRAWING	DRAWING	R	P W	

LEGEND: \* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

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TC:TEST CERTIFICATES,"CHP"(CUSTOMER HOLD POINT):CUSTOMER SHALL IDENTIFY IN COLUMN "E"

MANUFACTURER'S NAME & ADDRESS MANUFACTURING QUALITY PLAN QP:ESP:286  
 BHARAT HEAVY ELECTRICALS LTD ITEM : REV : 00  
 STANDARD QUALITY PLAN  
 BOILER AUXILIARIES PLANT (a) RAPPING SHAFTS DATE : 20 06 98  
 RANIPET - 632 406. (INDIA) (b) FOUNDATION BOLTS PAGE : 07 OF 11  
 QUALITY ASSURANCE DEPARTMENT (c) LIFTING HOLDERS

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11

(c) LIFTING HOLDERS

2.0 INPROCESS CONTROL

2.1 MACHINING AND THREAD CUTTING MAJOR DIA,, PITCH MAJOR MEASURE 100% DRAWING / STANDARD R P W  
 MENT AND CHECKING WITH GAUGE (CO & NOGO)

2.2 HIT FORMING IN FIXURE RADIUS OF REND,FORMING TEMPERATURE MAJOR MEASURE 100% DRAWING R P W  
 MENT

2.3 NDE LIQUID PENET RANT INSPN MAJOR LPI 100% IN BEND PORTION AWS D1.1 R P W

LEGEND: \* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

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TC:TEST CERTIFICATES,"CHP"(CUSTOMER HOLD POINT):CUSTOMER SHALL IDENTIFY IN COLUMN "E"

MANUFACTURER'S NAME & ADDRESS MANUFACTURING QUALITY PLAN QP:ESP:286  
 BHARAT HEAVY ELECTRICALS LTD ITEM : REV : 00 STANDARD QUALITY  
 BOILER AUXILIARIES PLANT (a) RAPPING SHAFTS DATE : 20 06 98 PLAN  
 RANIPET - 632 406. (INDIA) (b) FOUNDATION BOLTS PAGE : 08 OF 11  
 QUALITY ASSURANCE DEPARTMENT (c) LIFTING HOLDERS

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS
										**M C E	
1	2	3	4	5	6	7	8	9	D*	10	11

3.0 DIMENSION CONTROL

OVERALL DIMENSIONS, THREADED LENGTH, THREADINGS, BOOK RADIUS  
 MAJOR CHECK IN LAYOUT & THREAD GAUGE (CO & NO CO).  
 100% DRAWING DRAWING DRAWING

4.0	FINAL, INSPN SURFACE CLEANING & PAINTING	MARKING AND MAJOR PRESERVATION	VISUAL	100%	DRAWING, PAINTING SCHEDULE, PR:QA:590	R	P	W			
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TC:TEST CERTIFICATES,"CHP"(CUSTOMER HOLD POINT):CUSTOMER SHALL IDENTIFY IN COLUMN "E"

NOTE : 1.0 GENERAL REQUIREMENTS :

- 1.1 Any additional requirement for a specific contract shall be referred separately.
- 1.2 Raw materials used shall confirm to the grades specified in the drawing and GMS.
- 1.3 Fabricators shall check all the supplied raw material for dimensions, bend etc.,straightning wherever necessary must be carried out before start of production.
- 1.4 Raw materials shall be free from harmful visual defects like cracks, seams, laps, laminations, heavy pittings etc.
- 1.5 Substitution of materials shall be done with the prior approval of EDC/AQCS.
- 1.6 Fabricator to impose sufficient process control, necessary stage inspection so that the components made are consistant in quality and conforms to the drawings and specifications.
- 1.7 Plates for foundation bolts shall be preferably machine, gas cut. Cut edges shall be dressed smooth to remove all the undulations. Gas cut notches is any shall be filled up and dressed. The edges shall be straight and square.
- 1.8 All the low hydrogen electrodes used shall be dried in baking oven between 260 - 427 deg C for two hours and held at 100 deg C until they are used. Welders employed shall be qualified as per AWS D1.1 latest. Welders qualified to other codes may also be permitted to carry out welding at the discretion of inspection Engineers.
- 1.9 Fillet and butt welds shall be done with a minimum of two layers, ensuring complete root fusion. Sequence of welding shall be so chosen as to minimise the distortion.
- 1.10 Arc strike shall not be done straight on the job. Welder shall have a separate piece for striking the arc.
- 1.11 Weld procedures and welder's qualification are detailed out in SIP:NP:07 (Latest) shall be followed.

NOTE 2.0 INPROCESS CONTROL :

- 2.1 Rapping shafts, Foundation bolts / Lifting holders and the plates shall be made out of single piece. No joint is permitted to make up the length/size.
- 2.2 Rods for Rapping shafts, Foundation bolts / Lifting holders and plates shall be marked and cut to size by saw cutting or flame cutting. Flame cut edges shall be cleaned to remove slag. Uneven edges shall be dressed by grinding.
- 2.3 Rapping shaft's holes and key way shall be drilled/made with relevant jigs, the orientation and dimensions shall be maintained as per the drawing.

- 2.4 Threading of foundation bolt to be carried out prior to welding.
- 2.5 E 7018 electrode shall be used for welding in case of Foundation bolts. The plate shall be perpendicular to the foundation bolt.
- 2.6 One face of side lugs shall be machined to give a square face and the same shall be placed upwards while welding with the foundation bolt. Setting and tack welding shall be done on a fixture. The top of the lugs shall be in same level. Any minor error in the length of the side lugs shall be adjusted at the bottom.
- 2.7 While full welding the side lug to the bolt, welding shall be started 5mm away from the top of the side lugs. All the three rods shall be in the same axis. LPI shall be carried out on welds to ensure soundness of welding of lugs and foundation bolts.
- 2.8 Foundation bolt shall be straight after welding. If required, straightening to be done. Two mm Maximum out of straightness shall be allowed. Length of side lug shall +/- 1mm and off-set of side lugs and bolt shall be +1.00/-0.0mm. The total length & threaded length of foundation bolt shall be within +/- 5.0mm. Maximum level difference of side lugs at the top should be within +/- 1mm.
- 2.9 Care shall be taken to avoid OVERHEATING / BLOWING / MELTING during hot forming of radius / bend of Lifting Holders. Heated zone can be visually controlled by maintaining CHERRY RED COLOUR.
- Orange or Bright yellow indicates overheating which is to be avoided. Heated area shall be checked with THERMO CHALK with in 600 deg +50 deg C. Heated area shall be allowed to cool naturally. No sudden cooling with water or any other liquid is allowed.
- 2.10 Lifting holder shall be straight and the total & threaded length shall be within +/- 5mm.

#### NOTE 3.0 CLEANING

- 3.1 All The Rapping shaft, foundation bolts and lifting holders shall be cleaned by wire brush (or) by mechanical means to remove burrs, rust, grease, oil and other foreign materials.
- 3.2 Foundation bolt's thread portions along with nuts shall be coated with rust preventive component WICOL' and shall be covered by tar impregnated gunny cloth to prevent transit and handling damages and to be packed in boxes/crates before despatched.

- 3.3 Lifting holder thread portions shall be coated with rust preventive as per the painting schedule.
- 3.4 Other portions of Foundation bolts & Lifting holders shall be coated with two coats of paint as indicated below:
- 1) A primary coat of red oxide zinc chrome primer conforming to IS 2074 with minimum coating thickness of 25microns shall be applied.
  - 2) A finish coat of synthetic enamel long oil alkyd conforming to IS 2932 ( smoke grey shade ) with minimum coating thickness of 20 microns shall be applied.
- Adequate drying time is to be allowed between each coat.
- 3.5 All lifting holder's thread portions shall be covered with gunny cloth to avoid transit/handling damages.

NOTE 4.0 MARKING

- 4.1 Following shall be stenciled in white paint and stencilled details covered with one coat of transparent varnish.

Sub contractor's code :  
Work order :  
Du no :  
Weight :  
Project :  
No of pieces in the :  
packing :

In addition to this, sub contractor's code shall be punched and bordered in white paint.



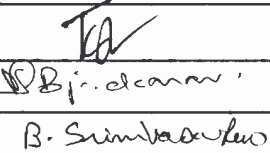
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QUALITY DEPARTMENT		
AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )		
QWI NO: QP:ESP:287	REV 00	DATE : 20 06 98
AMENDMENT NO. A 1		DATE : 18.09.00
<u>DESCRIPTION:</u> INNER ARM & OUTER ARM, SHOCK BARS, VERTICAL STAY, VERTICAL BEAM, SUPPORT BEAM AND HAND RAILS, RIDGES AND SHOCK BEAM.		
DETAILS		
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT/ REMARKS
Note 3.4	This clause note3.4 is Added for Transver ridges: Transverse ridges (7X - X43) - only one joint in each member of the ridges is allowed after obtaining prior approval from engg.	Feed back from engg. (CTQ mom dt:29-4-200)
Prepared by	Reviewed by	Approved by
	Engg/AQCS	
	QC/OLI	
	QA	

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QUALITY DEPARTMENT		
Amendment to Quality Work Instructions (SQP)		
QWI NO: SQP:ESP:287	REV:00	DT. 20/06/98
Amendment no: A 2		DT. 25/01/2001
Description: Inner arm & Outer arm, Shock Bars, Vertical Stay, Vertical Beam, Support Beam, Hand Rails, Ridges and Shock Beam.		
Details of Amendment		
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT
Note 4.1.1	E 6013 electrode shall be dried in baking oven at 120-130°C until they are used, if the packing were found to be damaged or the electrodes were kept exposed to atmosphere for prolonged period.	Feed back of CTQ MOM dt:12/10/2000
Prepared by	Reviewed by	Approved by
	Engg/AQCS	
	QC/OLI	
	QA	
	 B. Srinivasulu	

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BHEL RANIPET	STANDARD QUALITY PLAN FOR ESP(MECHANICAL)	
REF.NO.	REVISION NO.	EFFECTIVE DATE
QP:ESP:287	00	20 06 98
<p>TITLE : INNER ARM &amp; OUTER ARM,SHOCK BARS,VERTICAL STAY, VERTICAL BEAM,SUPPORT BEAM AND HAND RAILS,RIDGES AND SHOCK BEAM.</p> <p>SIGNATURE</p> <p>PREPARED BY : A ELANGOVA/QA <input type="text" value="A Elango"/></p> <p>REVIEWED BY : K NITHIANANDAM/QA <input type="text" value="K Nithianandam"/></p> <p>: P RAJASEKARAN/QC-OLI <input type="text" value="P Rajasekaran"/></p> <p>: T. GNANAPRAKASAM/AQCS <input type="text" value="T. Gnanaprakasam"/></p> <p>APPROVED BY : H ANANTHANAYANAN/QA <input type="text" value="H Ananthanayan"/></p>		
ISSUED & CONTROLLED BY : QUALITY ASSURANCE, BHEL, RANIPET-632406		
DOCUMENT STATUS	<input type="checkbox"/>	INFORMATION COPY
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BHEL RANIPET	STANDARD QUALITY PLAN FOR ESP(MECHANICAL)	
REF.NO.	REVISION NO.	EFFECTIVE DATE
QP:ESP:287	00	20 06 98
TITLE : INNER ARM & OUTER ARM,SHOCK BARS,VERTICAL STAY, VERTICAL BEAM,SUPPORT BEAM AND HAND RAILS,RIDGES & SHOCK BEAM		
RECORD OF REVISION		
REF	DETAILS OF REVISION	DATE AMENDED/ REVISED
REVISION 00	TOTALLY REVIEWED. MERGED SQP:ESP 264, 267,268,270 & 275 ISSUED AS SQP:ESP:287	20 06 98
PC FILE :D:\KNM\ESPSQP\ESP287.SQP		PAGE 02 OF 11

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN		QP:ESP:287					STANDARD QUALITY PLAN	
		BHARAT HEAVY ELECTRICALS LTD		ITEM : INNER ARM & OUTER ARM		REV : 00						
		BOILER AUXILIARIES PLANT		SHOCK BARS, VERTICAL STAY,		DATE: 20 06 98						
		RANIPET - 632 406. (INDIA)		VERTICAL BEAM, SUPPORT BEAM,		PAGE: 03 OF 11						
		QUALITY ASSURANCE DEPARTMENT		HAND RAILS, RIDGES & SHOCK BEAM								
S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS
									M	C	E	
									**			
1	2	3	4	5	6	7	8	9	D*	10		11
1.0	RAW MATERIALS PLATES/ANGLES/ SQ. HOLLOW/ TUBES/CHANNEL BEAMS.	CHEMICAL AND MECHANICAL PROPERTIES	MAJOR	REVIEW OF TC/RANDOM TESTING	EACH HEAT /LOT AS PER SPECI FICATION	RESPECTIVE MATERIAL SPECIFICATION AS PER THE DRAWING.		TC			V	RAW MATERIALS ARE TAKEN TO STOCK ON VERIFICATION OF TCs/RANDOM TESTING
2.0	IN PROCESS CONTROL											NOTE: (1) IN THE CASE OF SHOCK BARS (2) VERTICALITY OF VERTICAL BEAMS SHALL BE VERIFIED AND CONTROLLED WITHIN THE LIMITS.
2.1	FLAME CUTTING END TRIMMING & FACING	LAMINATION, CRACKS, DIS- CONTINUITIES & END SQUARENESS ON CUT	MAJOR	VISUAL	100%	AS PER AWS D1.1, DRAWING NO CRACKS & LAMINATIONS ARE PERMITTED		R		P	V	HOLLOW OF VERTIC AL BEAM NO JOINT IS PERMITTED FOR LENGTH BUILT UP OF ANGLE/PLAT.
2.2	PRESSING/ MARKING/DRILL ING/MACHINING	LENGTH, PROFI LE, RADIUS, HO LES LOCATION, SIZE, ORIENTA TION, PITCHES	MAJOR	MEASURE MENT/VERI FICATION IN FIXTURE VERIFICATI ON OF CHARACTERI CS (HAND RAILS)	100%	DRAWING		R		P	V	

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 \*\* M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR/NOMINATED INSPECTION AGENCY, E: CUSTOMER.  
 R: REPORT, IR: INSPECTION REPORT "P" PREFORM "M" MANUFACTURER AND "V" VERIFICATION OF APPROVALS

S.No.		COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS	
1		2	3	4	5	6	7	8	9	D*	10		11	
		2.3	WELDING	a) PROCEDURE QUALIFICATION	MAJOR	REVIEW OF DOCUMENTS	100%	PRE QUALIFIED WELDING PROCEDURE AS PER AWS D1.1	R	P	V	V		
				b) PERSONNEL QUALIFICATION	DO	DO	100%	AWS D1.1	R		P	V	V	
		2.4	NDT	[I] BUTT WELDS ON STRUCTURES SUPPORT BEAM	DO	LPI	#20% RANDOM	AWS D1.1	R		P	V	V	# IN CASE OF DEFECTS %AGE SHALL BE INCREASED  NOTE: @ BUTT JOINTS ON TUBES TO BE KING WELDED & THEN TO BE FLUSH GROUND
				@ & ii) FILLET WELDS BETWEEN TUBES IN CASE OF PLAIN HAND RAILS	DO	LPI	#10% RANDOM	AWS D1.1	R		P	V	V	
				[II] i) FILLET WELDS ON STRUCTURES	DO	LPI	#10% RANDOM	AWS D1.1	R		P	V	V	
				& ii) BUTT WELDS ON PLAIN HAND RAILS	DO	LPI	100%	AWS D1.1	R		P	V	V	

MANUFACTURER'S NAME & ADDRESS: BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT RANIPET - 632 406. (INDIA)  
 QUALITY ASSURANCE DEPARTMENT  
 MANUFACTURING QUALITY PLAN  
 ITEM : INNER ARM & OUTER ARM SHOCK BARS, VERTICAL STAY, VERTICAL BEAM, SUPPORT BEAM, HAND RAILS, RIDGES & SHOCK BEAM  
 QP: ESP: 287  
 REV : 00  
 DATE: 20 06 98  
 PAGE: 04 OF 11  
 STANDARD QUALITY PLAN

LEGEND: \* RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.  
 \*\* M: MANUFACTURER/SUB-CONTRACTOR, C: CONTRACTOR/NOMINATED INSPECTION AGENCY, E: CUSTOMER,  
 R: REPORT, IR: INSPECTION REPORT, "P" PERFORM, "W" WITNESS AND "V" VERIFICATION IS APPROPRIATE.  
 TC-TEST CERTIFICATES "CHP"(CUSTOMER HOLD POINT): CUSTOMER SHALL IDENTIFY IN COLUMN "P"

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN		QP:ESP:287		STANDARD QUALITY PLAN				
		BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET - 632 406, (INDIA) QUALITY ASSURANCE DEPARTMENT		ITEM : INNER ARM & OUTER ARM SHOCK BARS, VERTICAL STAY, VERTICAL BEAM, SUPPORT BEAM, HAND RAILS, RIDGES & SHOCK BEAM		REV : 00 DATE: 20 06 98 PAGE: 05 OF 11						
S.No.	COMPONENT OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS
									M	C	E	
1	2	3	4	5	6	7	8	9	10			11
2.4	CONTD.	FINISH AND SIZE	MAJOR	VISUAL & MEASUREMENT	100%	DRAWING		R	P	V	V	
2.5	HEAT TREATMENT & HARDNESS HAMMER AND PLATE	HARDNESS	MAJOR	MEASUREMENT	AS PER IS 2500 PART I IL - III, AQL - 4%	DRAWING		R	P	V	V	
3.0	DIMENSIONAL CONTROL	TUBE & THICKNESS, OVERALL DIMENSIONS OF ASSY, HOLE'S LOCATION, SIZE, ORIENTATION AS PER DRG. TWIST, BEND, STRAIGHTNESS	CRITICAL	MEASUREMENT, VERIFICATION IN FIXTURE/LAYOUT DEPENDING UPON THE CASE	100%	DRAWING		R	P	V	V	##: VERIFY FRAME ANGLE (θ) (W.R.T FIXING PLATE) IN THE CASE OF HAND RAILS DURING FITUP ASSY

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 TC: TEST CERTIFICATES, "CHP" (CUSTOMER HOLD POINT): CUSTOMER SHALL IDENTIFY IN COLUMN "E"

S.No.		COMPONENT OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS
1		2	3	4	5	6	7	8	9	10	11
		MANUFACTURER'S NAME & ADDRESS BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET - 632 406. (INDIA) QUALITY ASSURANCE DEPARTMENT		MANUFACTURING QUALITY PLAN ITEM : INNER ARM & OUTER ARM SHOCK BARS, VERTICAL STAY, VERTICAL BEAM, SUPPORT BEAM, HAND RAILS, RIDGES & SHOCK BEAM		QP: ESP: 257 REV : 00 DATE: 20 06 98 PAGE: 06 OF 11		STANDARD QUALITY PLAN			
3.0	CONTD..	STRESS RELIEF MAJOR	TEMPERATURE CONTROL	100%	DRAWING	R	P	V	V	IN THE CASE OF SHOCK BARS OF PLAT TYPE	
	IN THE CASE OF INNER ARM:										
	MACHINING/ DRILLING	DIMENSIONS/ FINISH #	MAJOR MEASUREMENT	100%	DRAWING	R	P	V	V	\$-WITH TEMP PLATE #:-SMALLER & BIG ER HOLES SHALL BE MACHINED KEEPING TWO HALVES TOGETHER BRAND DRILLING SHALL BE DONE IN FUTURE	
	DIMENSION	OVERALL DIMN OF ASSY	MAJOR DO	AS PER IS 2500 PART I II-III, AQL 4%	DRAWING	R	P	V	V		
4.0	FINAL INSPECTION, SURFACE CLEANING AND PAINTING	MARKING AND PRESERVATION	MAJOR VISUAL	100%	DRAWING, PAINTING SCHEDULE RPO674199 LATEST, PRQA:590	R	P	V	V		
5.0	PACKING	STURDINESS OF PACKING, GROSS WEIGHT, NO OF PIECES INDICATION	MAJOR VISUAL	100%	AS PER PACKING DRAWING	R	P	V	V		

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1.0 NOTE.1.0 GENERAL REQUIREMENTS

- 1.1 Any additional requirement for a specific contract shall be referred separately.
- 1.2 Raw materials used shall conform to the grades specified in the drawing & GMS.
- 1.3 Raw material shall be free from harmful visual defects like cracks, seams, laps, laminations, heavy pittings etc.
- 1.4 Fabricators shall check all the supplied raw materials for dimensions, bend, camber etc., Straightening wherever necessary must be carried out before assy and welding.
- 1.5 Substitution of materials and Joints (For Support Beam) shall be done with the prior approval of EDC/AQCS.
- 1.5.1 No joint is permitted on the angle or flat to make up length in the case of shock bar. No joint is permitted to make up the length in the case of vertical beam and stay also.
- 1.6 Fabricator to impose sufficient process control, necessary stage inspection so that the components made are consistent in quality and conforms to the drawing and specification. It is the responsibility of the fabricator to adopt sufficient measures to avoid Non conformances.
- 1.7 Plates having deviations like bend, out of flatness etc shall be corrected before taking up for fabrication.

NOTE 2.0 INPROCESS CONTROL.

- 2.1 The general requirements for process control during fabrication are as detailed in QCP:002 (Latest) read along with amendment 1.

NOTE 3.0 MARKING, CUTTING AND PREPARATION

- 3.1 Angles, tubes, sheets, hollows, Channels, Plates and sheets shall be preferably machine or gas cut. Cut edges shall be dressed smooth to remove all the undulations. Gas cut notches if any shall be filled up and dressed. The edges shall be straight and square.
- 3.2 SHOCK BARS: Holes on angle meant for fixing huck bolt shall be marked correctly. Orientation, location of first hole ref back mark and pitches shall be verified in advance. In the plates holes shall be located at the centre of the plate. Centre of all holes in the angle shall be in one line. Holes can either be punched or drilled.
- 3.3 Profiles meant for fixing hand rail tubes shall be marked correctly. The profiles of the Ends of the Railings for joints shall be edge prepared with 45o correctly.

NOTE 4.0. WELDING REQUIREMENTS & WELD INSPECTION

- 4.1 Electrodes : E6013 Electrodes shall be used for Welding.
- 4.1.1 E6013 electrodes shall be dried in backing ovens at temperature 100o C , until they are used, If the packing were found to be damaged or the electrodes were kept exposed to atmosphere for prolonged period.
- 4.2 Pre qualified welding procedure as per AWS D 1.1 (Latest) shall be used.
- 4.3. Welders employed shall be qualified as per AWS D 1.1 latest . Welders qualified to other codes may also be permitted to carryout welding at the discretion of Inspection Engineers.
- 4.4 Fillet and butt welds shall be done with a minimum of two layers ,and 6mm fillet or less can be done in single run ensuring complete root fusion.
- 4.5 Sequence of welding shall be so chosen to balance applied heat and to minimise the distortion.
- 4.6 NDT as required shall be carried out on splice joints before cover plate welding.
- 4.7 Arc strike shall not be done straight on the job. Welder shall have a separate piece for striking the arc.
- 4.8 Weld procedures and welder's qualification are detailed in SIP:NP:07 (Latest)
- 4.9 All welds shall undergo thorough visual examination to detect the weld defects like undercuts, non-uniform beading, overlaps, excessive concavity or convexity etc.
- 4.10 Welds shall be neither undersize nor excess than specified, shall be as per drg. Smooth contour shall be maintained.
- 4.11 Only BHEL approved brands of electrodes shall be used.
- 4.12 Cleaning of the items shall be thoroughly examined before painting.

NOTE 5.0 FABRICATON AND TOLERANCES

1.) VERTICAL BEAM

- 5.1 The holes in the square tube shall be drilled right through in one setting.
- 5.2 The welding of angles with the square tube shall be done carefully maintaining perpendicularity. Welds of the angles with the square hollows shall be ground flush.

- 5.3 In the square hollows of 80x80 for vertical beams, the fabricator shall exercise proper care to ensure that the drilling is done on the sides where there is no weld seam.
- 5.4 The beam shall be straight throughout the length. Maximum out of straightness permitted 3mm, which is to be checked in the fixture.
- 5.5 Maximum twist permitted in the vertical beam shall be 2mm.
- 5.6 Hole pitches: within  $\pm 1.0\text{mm}$

#### 2.) SUPPORT BEAM

- 2.1a) All the dimensions like hole pitches and positions of lifting brackets shall be maintained with reference to the centre of the beam. Transverse centre line (Vertical axis) of the beam as well as centrelines of each bracket shall be punched.
- 2.2b) Supporting beam shall be straight throughout the length. Camber or bow permitted 0.5mm/metre length limited to 5mm max.
- 2.3c) The hole dia shall be within  $\pm 0.5\text{mm}$ .
- 2.4d) Position of holes on Web, with reference to flange shall not deviate more than  $\pm 1\text{mm}$  from Specified.
- 2.5e) The total length of beam shall be within  $\pm 3\text{mm}$ .
- 2.6f) The deviation on hole pitches must not Exceed  $\pm 1\text{mm}$ .

#### 3) SHOCK BARS

Following tolerances shall be applicable on different dimensions of the shock bar (Angle type)

- a) Out of alignment of centre of the hole shall be max. 2mm
- b) Shock bar angles shall be straight. Out of straightness shall be within 3mm (Max)
- c) No twist is permitted.
- d) Shock bar slots to be checked with templates for ensuring gap, width and length between flats (Flat type).

#### 4) VERTICAL STAY

Following tolerances shall be applicable on different dimensions of the VERTICAL STAY

- a) Length :  $+0.0/-2.0\text{mm}$ .
- b) Both the ends of the vertical stay shall be in the same axis. Maximum out of alignment of the ends shall be within 2.0mm.
- c) Out of straightness 1mm/metre limited to 3mm Max.
- d) Both the ends shall be square to the tube axis.

5) PLAIN HAND RAILS

Following tolerances shall be applicable on different dimensions of the plain hand rails.

a) Length  $\pm 3.0$ mm, b) Bow 2mm/metre. and c) Notwist is permitted.

NOTE 6.0 CLEANING, PAINTING AND MARKING

6.1 All the finished products shall be thoroughly cleaned to remove burrs, weld slag, spatters, rust, grease and other foreign materials.

6.2 Cleaned products except plain hand rails shall be coated with two coats of paints as indicated below.

1. A primer coat of red oxide zinc chrome primer confirming to IS 2074 shall be applied. Minimum coating thickness of 1st coat 25 microns.

2. A finish coat of synthetic enamel long oil alkyd confirming to IS 2932 (smoke grey shade) shall be applied. Minimum coating thickness of the 2nd coat 20 microns.

6.2.1 Cleaned plain hand rails shall be coated with two coats of paints as indicated below.

1. A primer coat of red oxide zinc chrome primer confirming to IS 2074 shall be applied. Minimum coating thickness of 1st coat 25 microns.

2. A finish coat of black enamel over the primer confirming to IS 2932 shall be applied. Minimum coating thickness of the 2nd coat 20 microns.

Adequate drying time is to be allowed between each coat.

6.3 **MARKING**

6.3.1 Each piece shall have the following details stenciled: Stenciling shall be covered with one coat of transparent varnish.

1. Sub-Contractors Code
2. W.O. Number
3. DU Number
4. Gross weight of the packing
5. SI, No

NOTE 7.0 PACKING & PRESERVATION

7.1 All the products shall be packed as per the packing drawing mentioned in GMS.

7.2 Adequate support has to be provided during storage to avoid bending/sagging of vertical beams.

7.3 In each packing the following details shall be legibly stenciled at two places.  
wo no:            project:            du no:           Qty in packing:  
weight of packing:            Fabricator's code:


In addition to the above, sub contractor's code shall be welded/punched and bordered in white paint.


\*\*\*\*\*

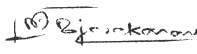



BHEL RANIPET	STANDARD QUALITY PLAN FOR ESP (MECHANICAL)	
REF. NO	REVISION NO.	EFFECTIVE DATE
QP: ESP :288	00	20.06.98


TITLE : INSULATOR HOUSING

PREPARED BY : A ELANGO VAN / QA SIGNATURE  


REVIEWED BY : K NITHIANANDAM / QA 

: P RAJASEKARAN / QC OLI 

: T GNANAPRAKASAM / AQCS 

APPROVED BY : H ANANTHANAYANAN / QA 

ISSUES & CONTROLLED BY : QUALITY ASSURANCE, BHEL, RANIPET - 632406

DOCUMENT STATUS

ISSUED TO : -----  
Mr ----- INFORMATION COPY

DEPARTMENT : ----- CONTROLLED COPY NO -----  
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| BHEL | STANDARD QUALITY PLAN FOR ESP ( MECHANICAL)  
| RANIPET |

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| REF.NO. | REVISION NO. | EFFECTIVE DATE

-----  
| QP : ESP 288 | 00 | 20. 06. 98

-----  
| TITLE : | INSULATOR HOUSING

-----  
RECORD OF REVISION

-----  
| REF | DETAILS OF REVISION | DATE AMENDED/REVISED

-----  
REVISION 00 | TOTALLY REVIEWED AND  
QCP E 028 ISSUED AS  
SQP : ESP : 288. | 20 . 06. 98

MANUFACTURER 'S NAME & ADDRESS    MANUFACTURING QUALITY PLAN    QP NO : ESP 288

BHARAT HEAVY ELECTRICALS LTD    ITEM : INSULATOR HOUSING    REV : 00  
 BOILER AUXILIARIES PLANT    DATE : 20.06.98    STANDARD QUALITY  
 RANIPET-632 406 (INDIA)    PAGE : 03 OF 07    PLAN  
 QUALITY ASSURANCE DEPARTMENT SUB SYSTEM :-

S.NO. COMPONENT & CHARACTERISTICS CLASS TYPE OF    QUANTUM    REFERENCE ACCEPTANCE FORMAT OF  
 AGENCY    REMARKS

OPERATION    CHECK OF CHECK    DOCUMENT    NORMS    RECORDS

\*\*M |C|E|

1    2    3    4    5    6    7    8    9    10    11

1.0 RAW MATERIAL CHEMISTRY & MAJOR REVIEW    100 %    AS PER MATL AS PER MATL    MILL    P    V -  
 RAW MATERIALS ARE

MECHANICAL  
 TAKEN TO STOCK  
 PROPERTIES

SPECN IN    SPECN IN    TC

DRG    DRG    DRG    ON

VERIFICATION    OF MILL TC.

2.0 INPROCESS CONTROL

2.1 PRESSING SHAPE    MAJOR MEASURE    100 %    DRAWING    DRAWING    R

SHEET METAL TO SHAPE  
 1) PROCEDURE

WELDING P W    MAJOR REVIEW    100 %    PREQUALIFIED    PREQUALIFIED

QUALIFICATION    QUALIFICATION    OF DOCUMENTS    WELDING    WELDING  
 AS PER    AS PER

P	W	2) PERSONNEL	MAJORREVIEW	AWS D1.1 100 %	AWS D1.1	AWS D1.1	R	
		QUALIFICATION						

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TC: TEST CERTIFICATES, "CHP" (CUSTOMER HOLD POINT) : CUSTOMER SHALL IDENTIFY IN COLUMN "E"

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MANUFACTURER 'S NAME & ADDRESS    MANUFACTURING QUALITY PLAN QP NO: ESP 288  
 BHARAT HEAVY ELECTRICALS LTD    ITEM : INSULATOR HOUSING    REV : 00    STANDARD QUALITY  
 BOILER AUXILIARIES PLANT    DATE : 20 06 98    PLAN  
 RANIPET - 632 406. (INDIA)    PAGE : 04 OF 07  
 QUALITY ASSURANCE DEPARTMENT    SUB SYSTEM :----

S.NO. COMPONENT & CHARACTE    CLASS TYPE OF    QUANTUM    REFERENCE    ACCEPTANCE    FORMAT OF AGENCY  
 REMARKS  
 OPERATION    RISTICS    CHECK OF CHECK    DOCUMENT    NORMS    RECORDS    \*\*M | C |

1    2    3    4    5    6    7    8    9    D\*    10

P    V    FINISH &    MAJOR VISUAL &    100 %    DRG & AWS D1.1    R  
 NOTE: KEROSENE LEAK  
 SIZE    MEASUREM    TEST ON ALL

2.3    DIMENSION    JNSIDE    MAJOR MEASURE    100 %    DRAWING    R    WELDS SHALL BE  
 WITNESSED    CONTROL    ENT    MEASUREMENT &    VISUAL    P    V

WHERE BOTH SIDE    WIDTH/    LENGTH    HEIGHT    WELDING  
 OF JOINT    VISUAL    IS NOT

CARRIED OUT    LOCATION OF    BUSHING,  
 PCDF OF    FLANGE    CIRCULAR  
 HOLE PIT-    CHES ON

3.0 FINAL INSPECTION & PRESERVATION  
FLANGE. OUT OF FLATNESS ON COVER TOP  
APPEARANCE CRJ VISUAL 100 %  
TICAL PAINTING SCHEDULE R P W  
RPO674199 RPO674199

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#### NOTE 1.0 GENERAL REQUIREMENTS

- 1.1 Any additional requirement for a specific contract shall be referred separately.
- 1.2 Raw materials used shall conform to the grades specified in the drawing & Gms.
- 1.3 Fabricators shall check all the supplies raw material for dimensions, bend etc. straightening wherever necessary must be carried out before assy and welding.
- 1.4 Raw materials shall be free from harmful visual defects like cracks, seams, laps, laminations, heavy pittings etc.,
- 1.5 Substitution of materials shall be done with the prior a approval of EDC/AQCS.
- 1.6 Fabricator to impose sufficient process control, necessary stage inspection so that the components made are consistant in quality and conforms to the drawings and specification.
- 1.7 Raw materials shall be preferably machine / gas cut. cut edges shall be dressed smooth to remove all the updulations. . Gas cut notches if any shall be filled up and dressed. The edges shall be straight and square.
- 1.8 Structural / Tubes / Plates shall be cut carefully to the required size and profile and dressed square.

#### NOTE 2.0 IN PROCESS CONTROL

- 2.1 The general requirements for process control during fabrication are as detailed in QCP 002 (LATEST) read along with amendment 1.
- 2.2 The number of joints shall be as approved by designs on a case to case basis.

#### NOTE 3.0 WELDING REQUIREMENTS & WELD INSPECTION

- 3.1 Electrodes : E6013 for thickness upto & inclusive of 20mm.
  - 3.1.1 E 6013 electrodes shall be used for CARBON STEEL welding . Before use all the electrodes (F XX 13) shall be dried in baking oven at 100 deg c until they are used, if the packings were found to be damaged or the electrodes were kept exposed to atmosphere for prolonged period.

- 3.1.3 Minimum gauged electrodes shall be used for the welding of sheets in cover sheet casing.
- For cover : 2 mm /2.5 mm electrodes
- and for sheet casing : 2.5 mm / 3.15 mm electrodes
- 3.2 Welders employed shall be qualified as per AWS D1.1 latest. Welders qualified to other codes may also be permitted to carryout welding at the descretion of inspection Engineers.
- 3.3 Fillet and butt welds shall be done with a minimum of two layers, ensuring complete root fusion.
- 3.4 splice joints shall be completed prior to the welding of cover plate.
- 3.5 Sequence of welding shall be so chosen as to minimise the distortion.
- 3.6 NDT as required shall be carried out on splice joints before cover plate welding.
- 3.7 Arc strike shall not be done straight on the job. Welder shall have a separate piecefor striking the arc
- 3.8 Weld procedure and welder's qualification are detailed in SIP: NP: 07 (Latest)
- 3.9 Only BHEL approved brands of electrodes shall be used.
- 3.10 Size of weld shall be as per drawing.
- 3.11 Any shall be removed first.
- 3.12 Ensure kerosene leak test if full welding is done in one side only.
- 4.0 WORKMANSHIP AND TOLERANCES
- 4.1 Inside width and length of the insulator housing shall be within plus or minus 5 mm
- 4.2 Height within plus or minus 5 mm.
- 4.3 Location of bush, bushing etc within plus or minus 5 mm.
- 4.4 P C D of flange within plus or minus 1 mm.
- 4.5 Hole pitches ( Circular) of flange within +/- 1 mm.
- 4.6 Out of flatness of cover at the top within 5 mm max and also no water shall stagnate when tested by pouring water over it.

4 . 7 Seating of cover on sheet casing (through the packing rope) shall complete. No gap shall be allowed. This shall be checked by placing the insulator housing with the cover in position on a raised level and viewing from inside the sheet casing.

4 . 8 Free movement of cover for opening and closing be ensured.

#### 5 . 0 CLEANING AND PAINTING

5 . 1 All insulator housing shall be thoroughly cleaned to removed weld slag, spatter, oil, grease etc.

5 . 2 Cleaned insulator housings shall be coated with two coats of paint as indicated below.

a) Primary coat of red oxide zinc chrome primer with 25 microns minimum coating thickness conforms to IS 2074.

b) Finish coat of synthetic enamel long oil alkyd to TS 2932 within minimum 20 microns thickness of smoke grey shade.

#### 6 . 0 IDENTIFICATION AND PACKING

6 . 1 In all the insulator housings the following details shall be stencilled in white paint and stencilled details shall be covered with one coat of transparent varnish.

Sub-contractors ' s code :

Work order no :

D U Number :

Weight :



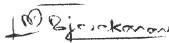


Serial Number :

6 . 2 In addition to the above stencilling subcontractor' s code shall also be punched. Punched details shall be bordered in white paint.

BHEL | STANDARD QUALITY PLAN FOR ESP (MECHANICAL)  
RANIPET |

REF.NO. | REVISION NO | EFFECTIVE DATE  
Q P :ESP:289 | 00 | 20 06 98

TITLE : EXPANSION JOINT ( TYPE )

		SIGNATURE
PREPARED BY	: A ELANGO VAN / QA	
REVIEWED BY	: K NITHINANDAM	
	: P RAJASHEKHARAN / QA	
	: T GNANAPRAKASHAM / QC OLI	
APPROVED BY	: H ANANTHANARAYAN / Q	

ISSUED & CONTROLLED BY : QUALITY ASSURANCE , BHEL , RANIPET - 632406

DOCUMENT STATUS

ISSUED TO : ----- INFORMATION

Mr

DEPARTMENT : ----- CONTROLLED COPY NO -----

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PC FILE : D : \ KNM \ ESPSQP \ ESP 289. SQP

PAGE 01 OF 05

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BHEL  
MECHANICAL )  
RANIPET

STANDARD QUALITY PLAN FOR ESP (

-----  
REF. NO.  
DATE

REVISION NO.

EFFECTIVE

-----  
QP : ESP : 289

00

20 06 96

-----  
TITLE : EXPANSION JOINTS ( BELLOW TYPE )

-----  
RECORD OF REVISION

-----  
REF  
AMENDED/

DETAILS OF REVISION

DATE  
REVISED

-----  
REVISION 00  
20 06 98

ESP : 256 REV 01

IS RENUMBERED  
AS ESP : 289 AND

ISSUED .

-----  
PC FILE : D : \KNM \ESPSQP \ESP 289 . SQP  
PAGE 02 OF 05  
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2.4 WELDING 1.PROCEDURE MAJOR REVIEW OF 100% PRE QUALIFIED WELDING R P  
 V ELECTRODE E7016/ QUALIFICATION DOCUMENTS AS PER AWS D1.1 R P V  
 E7018 FOR CORTEN- A MATERIAL. PROCEDURE AS PER AWS D1.1

2.PERSONNEL MAJOR DO 100% AS PER AWS D 1.1 R P V  
 QUALIFICATION

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 TC : TEST CERTIFICATES, "CHP" ( CUSTOMER HOLD POINT ) : CUSTOMER SHALL IDENTIFY IN COLUMN " E " .

MANUFACTURER'S NAME & ADDRESS MANUFACTURING QUALITY PLAN QP NO : ESP289  
 BHARAT HEAVY ELECTRICALS LTD ITEM : EXPANSION JOINTS REV : 00  
 BOILER AUXILIARIES PLANT ( BELLOW TYPE) DATE : 20 06 98

STANDARD QUALITY RANIPET - 632 406 .(INDIA) PAGE : 05 OF 05 PLAN  
 QUALITY ASSURANCE DEPARTMENT SUB SYSTEM : --

S.NO. COMPONENT CHARACTER CLASS TYPE OF QUANTUM REFERENCE ACCEPTANCE FORMAT  
 OF AGENCY REMARKS RISTICS CHECK OF CHECK DOCUMENTS NORMS  
 RECORDS M | C | E

1 2 3 4 5 6 7 8 9 D\* 10  
 11

2.5 WELD INSPN SIZE & FINISH MAJOR VISUAL 100% DRAWING & SIP : NP : 06 R P W

2.6 WELD NDE SOUNDNESS MAJOR KEROSENE LEAK TEST 100% PRQA : 076 R P W

3.0 W	DIMENSIONAL OVERALL DIMN MAJOR CONTROL	LENGTH , WIDTH ETC ...	MEASUREM - ENT	100%	DRAWING	R	P
4.0 W	FINAL INSPN: WELDING SURFACE CLEANING AND PAINTING / PRESERVATION	FINISH AND APPEARANCE	MAJOR VISUAL	100%	DRAWING PAINTING SCHEDULE RP 0674199 (LATEST)	R	P

LEGEND : \* RECORDS IDENTIFIED WITH "TICK" ( ) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION .

\*\*M : MANUFACTURER / SUB - CONTRACTOR , C : CONTRACTOR / NOMINATED INSPECTION AGENCY , E : CUSTOMER .

R : REPORT , IR : INSPECTION REPORT , "P" PERFORM , "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE .

TC : TEST CERTIFICATES , "CHP" ( CUSTOMER HOLD POINT ) : CUSTOMER SHALL IDENTIFY IN COLUMN " E " .



MANUFACTURER'S NAME & ADDRESS  
**BHARAT HEAVY ELECTRICALS LTD**  
**BOILER AUXILIARIES PLANT**  
**RANIPET-632 406 (INDIA)**

STANDARD QUALITY PLAN  
 ITEM: ESP  
 Sub system: SCREEN SHEET

QP NO  
 SQP: ESP 290  
 REV NO 02  
 DATE 12 07 07  
 PAGE NO 01 of 04

Sl No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency		Remarks
								M	B	
1.0	Raw Material:	Chemistry Mechanical properties	Review of TC/ Random testing	100%	Respective Mat Spec as per col 2	MILL TC	P	V		Raw material are taken to stock on verification of TCs /random testing
2.0	In process Control:									
2.1	Punching /drilling of holes	Size, pitch, location	Measure	100%	Drawing	R	P	V		
2.2	Pressing/Rolling of sheets to shape	Shape, profile	Measurement with template	100%	Drawing	R	P	V		
2.3	Dimensional control	Overall length, width section depth, and straightness	Measurement	100%	Drawing	R	P	W		

LEGENDS:  
 M - Manufacturer / Subcontractor,  
 B - BHEL /BHEL Authorized Inspection Agency,  
 C -Customer, P - perform, V - Verification of Reports - W-Witness, TC - Test certificate,  
 DR - Dimensional report, CHP-Customer Hold point

Prepared by *[Signature]*

Reviewed by

QA  
 QC-OLI  
 ENGG  
*[Signatures]*

Approved by *[Signature]*



MANUFACTURER'S NAME & ADDRESS		STANDARD QUALITY PLAN		OP No		SQP:ESP 290				
Ranipet BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET-632 406 (INDIA)		ITEM: ESP Sub system: SCREEN SHEET		Rev No		02				
				Date		12 07 07				
				Page		02 of 04				
SI No	Component & operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Form at Of Records	Agency	Remarks	
1	2	3	4	5	6	7	8	M B	10	
2.4	Welding	1. Procedure Qualification 2. Personnel Qualification	Review of documents -do-	100% 100%	Pre-qualified welding procedure as per AWS D1.3 Drawing & AWS D1.3		R R	P P	V V	* Percentage shall be increased in case defects.
2.5	Welding NDE	Butt welds of screen sheets	LPI	10%*	AWS D1.1		R	P	W	
2.6	Final inspection:	Painting & preservation Packing	Visual Visual	100% 100%	Drawing & painting schedule as per PROQA 590 -do-		R	P	W	

**LEGENDS:**

M – Manufacturer / Subcontractor, B - BHEL /BHEL Authorized Inspection Agency, C -Customer, P - perform, V - Verification of Reports W - Witness, TC - Test certificate, DR – Dimensional report, CHP-Customer Hold point

**NOTE 1.0 GENERAL REQUIREMENT:**

- 1.1.1 Maximum number of permitted joints in screen sheet is 6.
- 1.1.2 Minimum length of joint in screen sheet is 1200mm.
- 1.1.3 For last piece of screen sheet joints, if below 1200mm length ENGG clearance may be obtained through TCN
- 1.2 Any deviation w.r.t joints/material shall be done with prior approval of EDC/AQCS.
- 1.3 As far as possible aesthetic appearance shall not be sacrificed in accommodating splicing.

**NOTE 2.0 IN PROCESS CONTROL:**

**2.1 FABRICATION:**

**2.1.1 MARKING, CUTTING AND PREPARATION:**

- 2.1.2 Raw material shall be marked and cut to size by shearing.
- 2.1.3 Layout for size and shape shall be marked before cutting (for other than CNC applications)  
The tolerance for marking shall be maintained with in +2mm unless otherwise specified.  
The diagonal difference shall be within 3mm.
- 2.1.4 The marking shall be punched at convenient intervals.
- 2.1.5 The prepared sheets shall be visually inspected.

**2.2 FORMING:**

- 2.2.1 All formed components shall be checked for orientation, angle, and other dimension as per drg. All formed parts shall have smooth finish and shall be free from bends, folds and sudden transitions.
- 2.2.2 Tolerance for formed components when not specified in DRG. Shall be as follows
  - a) Straigh length bow bend – 5mm max.  
Side bend -- 5mm max.
  - b) Squareness : 1 mm max

2.3 WELDING CONSUMABLES:

2.3.1 E6013 Electrodes shall be used for welding.

2.3.2 All electrodes shall be dried at 100 deg. C for 1 hour min. and held at 100 deg.C till use.

2.4 FIT UP:

2.4.1 Proper fit up shall be ensured before welding as per Drawing. Tack welding or mechanical clampings shall be used to maintain the fit up requirements before and during welding.

2.4.2 Parts to be joined by butt welds shall be properly aligned. An offset not exceeding 10% of the thickness of the thinner part joined can be permitted, but in no case more than 2 mm, is permitted.

2.5 WELD REPAIRS:

2.5.1.0 Defective welds/base metal shall be repaired by removing or/and rewelding .

2.5.1.1 For weld porosity, slag inclusions & lack of fusion remove defective portions & reweld

NOTE 3.0 NON-DESTRUCTIVE TESTING:

3.1 Visual inspection and LPI shall be performed.

3.2 All NDE shall be carried out by qualified personnel as per BHEL NDT procedures.

NOTE 4.0 MARKING:

4.1 The following details shall be stenciled with white paint and the stenciled details covered with one coat of transparent varnish..

Sub-contractor code

Work order No.

DU No.

Weight

Project

4.2 In addition of the above stenciling, the following details shall also be punched and bordered in white paints.

Sub-contractor's code

Work Order No.

DU No.

NOTE: 5.0 PACKING:

All the screen sheets shall be packed as per the packing drawing referred in GMS. All steel section used for packing shall be painted yellow.



Ranipet

**MANUFACTURER NAME AND ADDRESS:**  
M/S BHEL / QUALITY DEPARTMENT/  
BAP / RANIPET  
TAMIL NADU-632 406

ITEM/SUB SYSTEM:  
**Air cylinders**

**STANDARD QUALITY PLAN**

Doc. Ref. No	QP.GAT.449
Rev. No	00
Date	28 02 2012
Page No	Page 1 of 2

Sl no	Component & Operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Agency		Remarks
							M	B	
1	1	3	4	5	6	7	9	8	10

**I. RAW MATERIAL**

1.1	Barrel - pipe	Surface defect, finish	Visual	100%	Approved drawing	Approved drawing	P	-	
		Chemical properties	Chemical test	1/heat	drawing /manufacturing	/manufacturing drawing	P	V	
		Mechanical properties	Mechanical test	1/heat	drawing		P	V	
1.2	Piston rod	Chemical properties	Chemical test	1/heat/lot	Approved drg./Mfg.	Approved drg./Mfg.	P	V	
		Mechanical properties	Mechanical test	1/heat/lot	drg./ASTM/A	drg./ASTM/A	P	V	
		Surface defect, finish	Visual test	100%			P	V	
		Internal defects	UT>50	100%	388/A 745	388/A 745	P	V	
1.3	Piston and End covers	Surface defect	Visual	100%	Approved drawing	Approved drawing	P	-	
		Dimensional	Measurement	100%	drawing /manufacturing	/manufacturing drawing	P	-	
		Mechanical	Tensile	1/heat	drawing		P	V	
		Chemical	Chemicals	1/heat			P	V	
1.4	Seals	Visual	Visual	100%	Approved drawing	Approved drawing	P	V	
		Dimensional	Measurement	100%	drawing /manufacturing	/manufacturing drawing	P	V	
		Hardness	Shore hardness	10%	drawing		P	V	

**II . INPROCESS INSPECTION**

2.1	Machining of components	Dimensional Conformity	Visual	100%	Approved /manufacturing drawing	Approved /manufacturing drawing		P	
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Ranipet

**MANUFACTURER NAME AND ADDRESS:**  
**M/S BHEL / QUALITY DEPARTMENT/ BAP / RANIPET TAMIL NADU-632 406**

ITEM/SUB SYSTEM:  
**Air cylinders**

## STANDARD QUALITY PLAN

Doc. Ref. No **QP.6AT.449**  
 Rev. No **00**  
 Date **28 02 2012**  
 Page No **Page 2 of 2**

Sl no	Component & Operation	Characteristics	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Agency		Remarks
							M	B	
2.1	Barrel - pipe	Inside finishing	Measurement	100%	Mfg drg./std	Mfg. drg./std/approved drawing	P	V	Refer. note:2
		Soundness	Hydro test	1/lot	2xworking Pr Or 1.5Xdesign Pr whichever is higher	No leakage	P	V	
		Inside coating thickness	Measurement	100%	Approved drawing /data sheet /mfg drg	Approved drawing /data sheet /mfg drg.	P	V	
2.3	Piston rods	Hard chrome plating thickness (as applicable)	Measurement	100%	Approved drawing /data sheet /mfg drg	Approved drawing /data sheet /mfg drg	P	V	

### III. FINAL INSPECTION

3.1	Operational test	Operation (10cycles)	Movement /cushion	100%	Approved drawing /data sheet /mfg drg.	Satisfactory performance	P	W
	Leakage test	Leakage at 150 PSI &Working pressure	Leakage test with compressed air	100%	Approved drawing /data sheet /mfg drg	Approved drg.	P	W
	Dimension	Measurement	Measurement	100%	Approved /mfg. drawing	Approved /mfg. drawing	P	W
	Stroke length	Measurement	Measurement	100%	Approved /mfg. drawing	Approved /mfg. drawing	P	W

- When back wall echo (BWE) set to 100% full screen height (FSH), a defect echo > 20% FSH in not acceptable. Also loss of BWE > 20% is not acceptable.
- For barrels where hydro test report of mother pipe is not available  
All materials /information shall be as per approved drawing data sheet. In case not mentioned in the approved drawing /data sheet, then manufacturing drawing /data sheet shall be applicable
- All reports shall be submitted along inspection clearance.

#### LEGENDS:

M - MANUFACTURER / SUBCONTRACTOR B - BHEL / AUTHORISED INSPECTION AGENCY. P - PERFORM ED. V - VERIFICATION, W - WITNESS, R - REPORT  
 TC - TEST CERTIFICATE .C. - CUSTOMER

 (Verma)	 (K Rajadurai)	 (R Arunachalam)
Prepared by	Reviewed by	Approved by

**BHARAT HEAVY ELECTRICALS LIMITED  
TIRUCHIRAPPALLI 620 014 INDIA**

**QUALITY CONTROL PROCEDURE FOR  
MANUFACTURE OF NON PRESSURE PARTS**

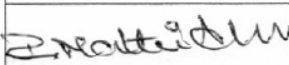
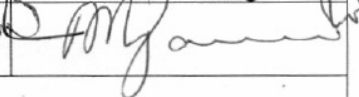
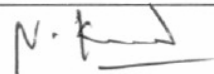
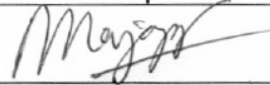

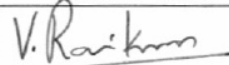
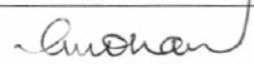
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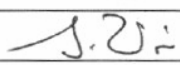
Page 1 of 14

Prepared by  
Quality Assurance

G S N Murthy



Reviewed by	Signature	
	Engineering	Structures
		
OP & C		
Manufacturing	Shops	Ancillary Development
		
Quality Assurance		
Quality Control	RM Area	OLI
		

Revision No.	Date	Approved by	Signature
00	01/04/93	SM / QA	-sd-
01	01/01/95	SM / QA	-sd-
02	24/04/04	SDGM /QA	

**Proprietary Data - For Internal Use Only**

**RECORD OF REVISIONS**

Rev No...	Clause No	Details of revision
00	--	This document consolidates all the general requirements and technical disciplines covered in the various previous
01	--	All amendments issued has been regularized and editorial correction made for better clarity. Scope of machining added in this document.
02		<b>Shaded clauses are Revised /added</b>

## 1.0 SCOPE

- 1.1 This procedure details out the process control and quality requirements for manufacture of Non Pressure Parts.

## 2.0 REFERENCE DOCUMENTS

- 2.1 AWS D.1.1, D1.6, IS 7215 and CE: M&P 5.11.1.1, 5.11.2.1 & 5.11.2.2 as guidelines.

## 3.0 MATERIALS

- 3.1 CLASSIFICATION OF MATERIALS (commonly used):

<u>P No. Group</u>	<u>Specifications</u>
P1 - Group 1 - 515 Gr 60.	Carbon steel IS 2062 Gr A & B, IS 1239, IS 1161, A 36, SA
P1 - Group 2 - IS 8500.	H.Strength CS :SA105, SA 515 Gr 70, SA 299, SA 516 Gr 70,
P4 - Alloy Steel	SA 387 Gr 11 & Gr 12, SA 182 Gr F 11 & F 12.
P5 – Gr A,	SA 387 Gr 22, SA 182 Gr F 22
P6 -	SA 240-410,429
P8 - Stainless steel	SA 240 - 304 ,309,310, 316, 321, 347

Any other materials as specified in the drawings.

- 3.2 Raw materials used shall conform to the relevant specification as given in drawings and applicable TDC/PO. Any substitution of materials shall be done only with prior approval of engineering through applicable documents. Where subcontractors procure the raw materials, the same shall have valid test certificates.
- 3.3 Raw materials shall be free from visual defects like cracks, seams, laps, laminations, heavy pitting etc. When defects are noticed in visual inspection the same shall be confirmed using appropriate NDE techniques and repaired using applicable approved process .
- 3.4 All materials are procured with permitted dimensional tolerances of the material specifications and / or TDC. Wherever required, the raw materials shall be corrected prior to fabrication to achieve the required product tolerances.
- 3.5 Customer supplied materials are to be verified as per SP 0626.
- 3.6 The requirements of material traceability shall be as indicated in the respective drawings.
- 3.6.1 Product Attest "P" items indicated as in drawings are traceable to the test certificates and identified with material Specification, grade and melt number by stamping.
- 3.6.2 CERTIFIED items indicated as "C" in drawings are traceable to material Specification / grade only and identified by stamping / engraving / stenciling / painting.
- 3.6.3 Raw materials not covered by the above shall be identified by its W.O.No / material code / Specification / grade by painting / stenciling / engraving.
- 3.6.4 All subdeliveries shall be identified by its material code by painting or through name plates / tags.

3.7 When materials ( including stock) are to be upgraded for special contract requirements QC shall ensure that the respective specification / contract TDC ( as applicable) are complied..

#### 4.0 FABRICATION

##### 4.1 MARKING, CUTTING AND PREPARATION

4.1.1 Raw material shall be marked and cut to size by shearing, machining, saw cutting , flame or plasma (for SS materials) cutting. Flame cut edges shall be cleaned to remove slag. Uneven edges shall be dressed by grinding. Gas cutting notches shall be filled up by welding using compatible electrodes and ground before taking up for further fabrication.

4.1.2 Wherever raw materials supplied / available are not sufficient for the sizes required, the same can be built up using the splicing instructions given in the respective SQPs/ Drawings (Incl. Production Notes) / DCN.

4.1.3 Layout for size and shape shall be marked before cutting (for other than CNC applications) The tolerance for marking shall be maintained within + 2mm unless otherwise specified. The diagonal difference shall be within 3 mm.

4.1.4 The markings shall be punched at convenient intervals and bordered with white paint.

4.1.5 Stainless Steel (SS) materials shall be cut using plasma cutting or shearing only. Any further dressing/ grinding of cut surfaces should be done with separate and clean abrasive wheels.

4.1.5.1 The cut edges should be smoothly ground.

4.1.5.2 Notches above 3 mm or 20 % 'T' shall be thoroughly cleaned and welded by using a qualified WPS and examined visually and by LPI . The repaired surfaces are to be cleaned to bright metal surface.

4.1.6 Clip / Cleat angles above 10mm thick used for beam connections which are sheared to length shall require heat treatment.

4.1.7 Heat treatment shall be done after shearing for P4 materials  $t > 12.5\text{mm}$  and for P5 materials  $t > 10\text{mm}$ .

4.1.8 The requirements of preheat for gas cutting are as follows:

Carbon steel	$t \leq 50\text{mm}$ :	: Nil
Carbon steel	$t > 50\text{mm}$ :	: 100 ° C.min.
Alloy steel (P4)	$t \leq 25\text{mm}$ :	: Nil
Alloy steel (P4)	$t > 25\text{mm}$ :	: 150 ° C
Alloy steel (P5)	All	: 150 ° C
Stainless steel	Not applicable	

4.1.8.1 Stress relieving for gas cut edges shall be as follows.

Material	Thickness	Heat treatment cycle
P1	> 50 mm	600 ° - 650 ° C for 30 minutes . Furnace cool (Alternatively, the cut surface can be ground / machined upto 3 mm to remove HAZ)
P4	> 16 mm	650 ° – 700 ° C for 30 minutes . Furnace cool
P5	All	680 ° - 730 ° C for 30 minutes . Furnace cool
SS (plasma)	Any	Not required

4.1.9 The prepared plates shall be visually inspected and repaired if required as per SIP:NP:06.

4.1.10 The raw materials after cutting shall be identified with relevant WO No., DU No., Part No. and Material Spec / Grade (transferred).

## 4.2 FORMING

4.2.1 Forming shall be done using proper tooling free from damages. Method of forming and work centre shall be identified in OPS / relevant QWI referred in PO.

4.2.2 Forming operations of sheets / plates shall be done by rolling / pressing. Circularity of rolled shells shall be checked using templates (of length > ¼ of ID).

4.2.3 Suitable nonmetallic padding shall be provided while forming of stainless steels to avoid contamination.

4.2.4 All formed components shall be checked for orientation, angle, and other dimensions as per drg. All formed parts shall have smooth finish and shall be free from bends, folds and sudden transitions.

4.2.5 Minimum thickness after forming shall be ensured whenever specified in drg.

4.2.6 Tolerances for formed components when not specified in drg. Shall be as follows

- a) St.Length / Dia, : + 1 mm / M, 5 mm Max  
Width & Height
- b) Verticality : 1 mm / M, 5 mm Max
- c) Squareness : 1 mm / M of length / Dia
- d) Straightness : 1 mm / M, 5 mm Max
- e) Radius : + 5 mm
- f) Bend Angle : + 2°
- g) Ovality : 1%
- h) E.P Angle : + 5° / - 2.5°
- i) Diagonal diff : 3 mm

## 4.3 WELDING

### 4.3.1 WELDING CONSUMABLES

4.3.1.1 Welding consumables conforming to the qualified welding procedures shall be used. However the following guide lines are provided.

4.3.1.2 Only Basic coated electrodes shall be used in the following cases:-

- a. All Strength welds like welds in main ceiling girders, flange butt welds in other beams, columns etc.
- b. For all structural welds, or when thickness of any one member of the weld joint is > 12 mm (unless otherwise indicated in the drawings / Qualified WPS).
- c. For welding of high tensile steels like IS 8500, SA299, SA515 Gr.70, SA516 Gr.70.

4.3.1.3 Rutile electrodes may be used for other weld joints.

4.3.1.4 All low hydrogen electrodes (EXX 16 & EXX 18) shall be dried in the baking oven at 350 deg.C for 2 hours and the electrodes shall be held at 100 deg.C until they are used.

- 4.3.1.5 All rutile electrodes (EXX 13) shall be dried at 100 deg. C for 1 hour min. and held at 100 deg.C till use.
- 4.3.1.6 Fluxes for SAW shall be dried at 200 deg.C for 1 hour min. before use. Height of flux bed while drying in pan or oven, shall not be more than 100mm.

4.3.1.7 Unless otherwise specified, SS consumable shall be baked as per Electrode manufacturer's recommendations and stored at 120 ° - 150 ° C until use.

#### 4.3.2 FIT UP

- 4.3.2.1 Proper fit up shall be ensured before welding as per Drawing. Tack welding or mechanical clampings shall be used to maintain the fit up requirements before and during welding. Bridge pieces used during fit up shall be of ferritic for ferritic materials and stainless for stainless steel materials.
- 4.3.2.2 Dimensions of the cross sections of groove welded joint shall be within the following tolerances w.r.t. drawing requirements:

	Root not back gouged	Root back gouged
1. Root face of joint(land)	± 2 mm	Not limited
2. Root opening of joint (with out backing)	± 2 mm	+ 2 mm - 3 mm
Root opening of joint* with backing)	+ 6 mm - 2 mm	Not Applicable
3. Groove angle of of joint	+ 10° - 5°	+ 10° - 5°

\*(NOTE): Root opening wider than permitted by above tolerances but not greater than twice the thickness of the thinner part or 19mm, whichever is less may be corrected by edge buildup to acceptable dimensions prior to welding. Such build up edge shall be MPI / LPI checked.

4.3.2.3 For C. S. fillet welds, the parts shall be as close as practicable and gap shall be limited to 5 mm (If gap exceeds 2 mm, the leg of fillet shall be increased by the amount of gap but in no case shall exceed 4.8 mm). For thickness 75 mm and above gap up to 8 mm can be permitted provided suitable backing is used.

4.3.2.4 For S. S. fillet welds, the parts shall be as close as practicable. Gaps 2 mm and above upto 5mm are acceptable if the fillet size is increased by an amount equal to the gap.

4.3.2.4 Parts to be joined by butt welds shall be properly aligned. An offset not exceeding 10% of the thickness of the thinner part joined can be permitted, but in no case more than 3.2 mm, is permitted.

#### 4.3.3 PRE HEATING

4.3.3.1 Pre heating requirements for welding shall be as per Clause 4.6.7 and controls shall be exercised as detailed below. No preheating is required for stainless steels.

4.3.3.2 Preheating shall be maintained during the entire process of welding.

- 4.3.3.3 Preheating is to be done using gas burner or induction / resistance heating. The temperature must be uniform and verified using thermal chinks or thermocouples prior to start of welding as well as during welding for a width of 't' (maximum) or 75 mm whichever is less.
- 4.3.3.4 Where interpass temperature control is required during welding, the temperature must be ensured using thermal chinks / thermocouples. Inter pass nitrogen / air cooling can be adopted to maintain inter pass temperature in case of stainless steels.
- 4.3.3.5 Wherever post heating is specified, the preheating shall be continued after welding till attaining the post heat temperature and maintained for the required time and cooled slowly by wrapping suitable insulating blankets like asbestos.
- 4.3.4 Welding shall be performed using qualified procedures and qualified personnel. Edge preparation and welding details shall be as per drawing.
- 4.3.5 For items to be manufactured at subcontractor's works, for requirements of qualification of procedure and personnel as per SIP:NP: 07 shall be followed.
- 4.3.6 When double bevel welding is adopted, back gouging and grinding is to be done. Back gouged groove shall be checked with PT / MT before welding from second side.
- 4.3.7 Proper sequence of welding shall be adopted to minimise distortion. The distortion of the finished jobs, if any may be corrected by mechanical means / hot correction.
- 4.3.7.1 For welding of SS extreme care is to be taken in weld sequencing to minimize the weld distortion and shrinkage. For complex weldments a weld sequence instructions may be prepared by contractor prior to work commencement. Weld joints likely to have high shrinkage should be welded ( with minimum restraints) before welding other joints providing allowance for shrinkage.
- 4.3.7.2 While cutting long web plates suitable camber may be required to compensate for the distortion during cutting and welding.
- 4.3.8 All butt welds of divider plate and guide vanes in ducts shall be flush ground inside.
- 4.3.9 The use of jigs and fixtures is recommended where ever practicable. Suitable allowances shall be provided for weld shrinkage. Proper sequence of welding shall be followed to control the distortion during welding.
- 4.3.10 All temporary attachments shall be welded with the required preheat. After their removal welded spots shall be ground flush and LPI checked.
- 4.3.11 Groove welds shall preferably be made with minimum reinforcement unless and otherwise specified in drawing / SQP. In case of butt welds, reinforcement shall not exceed 3.2 mm. and shall have gradual transition to the plane of the base material surface.
- 4.3.12 The surface of the welds shall be free from coarse ripples, overlaps, undercuts and abrupt ridges to avoid stress raisers.
- 4.3.13 Where parts of different thicknesses are welded or surface offset is more, the transition shall be made gradual by grinding / machining with 1: 2.5 taper.
- 4.3.14 Stray arcs shall be avoided to the extent possible. Arc spots if noticed shall be ground and checked by LPI / MPI. Thickness requirements shall be ensured after grinding.

#### 4.4 WELD REPAIRS

- 4.4.1 Removal of defective weld / portions of the base material may be done by machining, grinding, chipping, gas cutting, oxygen gouging or carbon arc gouging. Defective portions of the weld shall be removed without substantial removal of sound base metal.
- 4.4.2 For under sized welds additional weld metal shall be deposited using an electrode preferably smaller than that used for making original weld limited to 4mm in diameter. The surfaces shall be cleaned thoroughly before deposition.
- 4.4.3 Defective welds/base metal shall be repaired by removing or/and rewelding as follows:
- 4.4.3.1 Overlap / excess weld metal shall be removed by grinding.
- 4.4.3.2 For excess concavity, crater, undersize & undercuts, deposit additional weld metal after cleaning the weld surface.
- 4.4.3.3 For Cracks in weld or base metal, ascertain the extent of crack by suitable NDE / acid etching, remove the crack to sound metal upto each end of the crack by arresting the ends for further propagation and reweld.
- 4.4.3.4 For weld porosity, slag inclusions & lack of fusion remove defective portions & reweld

#### 4.5 HOT CORRECTION

- 4.5.1 Members which require hot correction are to be supported at suitable locations and mark the locations for heating.
- 4.5.2 Heat the locations marked by using neutral flame. Torches used for heating shall be moved continuously & uniformly over selected area to avoid localised over heating.
- 4.5.3 For Carbon steels the maximum temperature shall not exceed 650 ° C and shall be ensured using thermal chalks / thermocouples.

For alloy steels P4 – 705° C , P5 – 735° C temperatures are to be maintained for hot corrections

- 4.5.3.1 For Austenitic stainless steels the maximum temperature shall not exceed 430 ° C and shall be made known to inspection authorities . Otherwise , after hot correction solution annealing at 1050 – 1100 deg C is to be done.
- 4.5.3.2 For Ferritic/Martensitic/Duplex stainless steels the maximum temperature shall not exceed 315° C and shall be made known to inspection authorities . The temperature shall be ensured using thermal chalks / thermocouples.
- 4.5.4 Additional dead weights may be placed over the positive side of the bend depending upon the requirement to accelerate hot correction.
- 4.5.5 Allow for natural cooling. Accelerated cooling shall not be adopted. Remove the dead weights used after cooling.
- 4.5.6 Wherever the correction for distortion affects the weld joints, applicable NDE shall be repeated after the correction.

#### 4.6 POST WELD HEAT TREATMENT (PWHT)

- 4.6.1 The process controls ( temperature control and recording) for heat treatment shall cover the activities before, during and after heat treatment.

- 4.6.2 The weldment shall be cleaned to free of grease, oil etc. prior to heat treatment.
- 4.6.3 PWHT shall be done in a furnace or by local heating a band ( including the entire weld and adjacent area of the base metal) .
- 4.6.4 The thermocouples and recording instruments shall be calibrated as per applicable standards and records maintained. The furnace shall have been qualified and calibrated.
- 4.6.5 All materials to be heat treated in furnace shall be loaded in such a way that they shall not be subjected to direct flame impingement. Jobs shall be preferably loaded on raised plat forms so that no material projects into the plane of burners. Alternatively flame deflectors may be provided in front of the burners to avoid direct flame impingement. Ensure loading of test coupons wherever applicable. **The furnace temperature shall not exceed 315 ° C at the time of loading material / weldment.**
- 4.6.6 Number of thermocouples and their location shall be decided covering maximum and minimum thickness and covering all the zones. **The temperature variation within 5 meters shall not exceed 140 ° C during heating period ( above 315 ° C).**
- 4.6.7 The **temperature requirements** for Pre heating, Post Weld Heat Treatment(PWHT) & temperatures are as below.( Unless otherwise specified.)

Material	Thickness	Pre heating	PWHT Temp.	Remarks
P1 Gr 1&2	t < 38	Nil	600 – 650 ° C	a) For all butt welds in plate welded girders when t > 50mm.
	T= 39-62	100 ° C		
	t > 63	150 ° C		
P4 Gr 1&2	All	150 ° C	680 – 700 ° C	a)All butt welds in tension member b)All fabricated components when t > 16mm(Note1)
P5 Gr 1&2	All	150 ° C (Note2)	680 – 730 ° C	All welds (Note 3)
P8	300 type	120 ° C	-	
	400type	205 ° C	-	

Note 1 All fabricated structural components of P4 materials with any member above 16mm thickness, the entire assembly shall be post weld heat treated. However when size of fillet weld is less than 12 mm, PWHT is not required for non load carrying members.

Note 2 All welds on P5 material shall be post heated at 250 ° C for 2 hrs or 150 ° C for 4 Hrs, immediately following welding.

Note 3 All welds of P5 material shall be post weld heat treated. In case where the size of fillet is less than 12 mm, PWHT is not required for non load carrying members.

4.6.7.1 The **soaking time** shall be as follows:

- For P1 materials the soaking time shall be 1 hr/inch of thickness(t) (2.5 mts / mm) upto 2" and 2 hrs + 15 minutes for each additional inch for t > 2".
- For P4 & P5 materials the soaking time shall be 1 hr/inch of thickness (2.5 mts / mm) upto 5" and 5 hrs + 15 minutes for each additional inch for t > 5".

- c. For combination cycles mentioned above, calculate the minimum soaking time for individual components as 2.5 minutes/mm of the thickness of weld/material whichever is applicable. Soaking time selected for the cycle shall not exceed the limits given below:

Material	Thickness (mm)	Max. soaking time (minutes)
P1 (A,B,C), P4, P5A,	Up to 25 mm	125
P1 (A,B) + P4, P4 + P5A	26 - 50 mm	200
	51 - 80 mm	250
	81 - 150mm	375
P1C + P4, P1 + P3	Up to 25 mm	65
	26 - 50 mm	125

4.6.7.2 Unless otherwise specified, in case of mixed loads of materials not covered under simulation HT, the following heat treatment temperatures shall be followed. In such cases, guidelines for soaking can be taken from Clause 4.6.9.

For components having butt joint between P1 & P4, or P3 & P4, the cycle shall be 630 - 670° C.

Where a component has a butt joint between P4 & P5A, the cycle shall be 680 - 710° C.

Where a component has a butt joint between P1 & P3, the cycle shall be 620-660 ° C

For P1+P5A material combination, follow the WPS requirements

The following jobs shall not be combined in the same cycle during PWHT.

Separate jobs of P1 and P4      Separate jobs of P4 and P5

- 4.6.8 The following rules shall apply to establish the thickness to be used in determining the soaking time for PWHT.
- 4.6.8.1 For Butt welds, the thickness shall be the thickness of the material at the weld. For bar stock, the thickness shall be the diameter.
- 4.6.8.2 For fillet welds, the thickness shall be the throat thickness. If a fillet weld is used in conjunction with a groove weld, the thickness shall be the greater of the depth of the groove or the throat thickness.
- 4.6.8.3 For partial penetration branch welds, the thickness shall be the depth of the groove prior to welding.
- 4.6.8.4 For repairs, thickness shall be the depth of the groove as prepared for repair welding.
- 4.6.8.5 For combination of different welds in a component, maximum thickness of weld shall govern.
- 4.6.9 Requirements of Rate of Heating (ROH) above loading temperature 315 ° C and Rate of Cooling (ROC) are as given below. During heating and cooling, variation in temperature between thermocouples shall be 85 ° C maximum, unless otherwise specified.

Thickness	ROH / ROC (Max) Above / upto 315 ° C
Up to 25mm	220 ° C / hour
26 - 50 mm	95 ° C / hour
50 – 75 mm	70° C / hour
Above 75 mm	55 ° C
For S.S Matl	200 ° C / hour min (Forced air cooling)

- 4.6.10 In case of interruption during Heat treatment the following action has to be taken depending on the stage of occurrence:

Type of Heat treatment	Stage of interruption	Action
Annealing & stress relieving	Heating	Heat treat subsequently as specified
	Soaking	Heat treat subsequently for balance soaking
	Cooling	If the ROC during interruption period meets the specified rate, cool subsequently at required rate upto 400° C. Otherwise, reheat to the soaking temperature, hold for 15 minutes and then cool at the specified rate
Normalising(N) Tempering (T) & Soln. annealing (S)	Heating	Heat treat subsequently as specified
	Soaking	Heat treat subsequently for full soaking(N,S) / Balance soaking (T)
	Cooling	Not applicable

- 4.6.11 Local heat treatment can be carried out by Resistance heating or Induction heating. For local heat treatment of weld joints, width of the heated band on either side of the weld must be at least 3 times the width of the weld groove of the thickest part or 3 times the highest section thickness, whichever is greater.
- 4.6.11.1 The width of the insulation band beyond the heating band shall be at least twice the total width of the heating band.
- 4.6.11.2 A minimum of three thermocouples shall be placed such that at least one is on the weldment and the other two on the base material on either side of the weldment.
- 4.6.11.3 The winding arrangement shall be established to attain the required temperature. The initial rate of heating shall be minimum such that it stabilises at the required rate of heating before reaching 400 deg C.
- 4.6.12 After heat treatment, the charts shall be correlated with the job and cleared by QC. The chart shall contain cycle no, Date, W.O and DU details. Temperature, ROH, ROC and soaking time shall be calculated, entered in the chart and signed off by QC.
- 4.6.13 Wherever applicable the test coupons shall be tested and reports obtained to complete the clearance of heat treatment operation.

## 5.0 NON-DESTRUCTIVE TESTING

- 5.1 The requirement of NDE, extent and type of examination shall be as per respective product SQP and / or CQP .Wherever product SQP is not existing the following requirements shall apply.
- 5.2 Visual inspection shall be performed as per SIP:NP:06
- 5.3 RADIOGRAPHY.
- All Butt welds of Carbon steel for thickness  $t \geq 32\text{mm}$
  - All butt welds of alloy steels for thickness  $t > 12.0\text{mm}$  for P5 and  $T > 16\text{mm}$  for P4.
  - All butt welds in monorails.
  - SS butt welds of  $T > 16\text{mm}$  unless otherwise specified.

- 5.3.1 All radiographic films shall possess Firm code , RT agency, Cust. No, Part No, RT reference No. and weld location reference no. The job shall be numbered with Radiograph no.
- 5.4 MPI / LPI BEFORE PWHT
- a. All flame cut edges of Carbon steel for  $t > 37.5$  mm and alloy steels for  $t > 12$ mm.
  - b. All butt welds joining plate members in which one of the plate member is over 25 mm thick for Carbon steel and over 12 mm thick for alloy steel.
  - c. All fillet welds between tension flange and web.
  - d. All fillet welds joining plate members in which both the plate members are over 25 mm thick for Carbon steel and over 12 mm thick for alloy steel.
  - e. For all butt welds of CS & AS weld groove after back chipping prior to welding from second side.
  - f. All main fillet welds for SS require LPI
  - g. MPI/LPI for all fillet welds & HAZ of SA387 Gr.22 materials after HT.
- 5.5 All NDE shall be carried out by qualified personnel as per BHEL NDT procedures. Where subcontractors use their own procedures for NDE the same shall have the approval of BHEL NDTL.

## 6.0 MACHINING

### 6.1 GENERAL

- 6.1.1 Ensure of raw material identification throughout the machining process. Traceability to the contract shall be ensured by stamping or marking / painting or by tags( WO No.and DU / Part no.)
- 6.1.2 Where the material identification is likely to be removed during cutting or machining , the transfer of material identification shall be ensured.
- 6.1.3 In case of components / part processed items received from Subcontracting / other shops, ensure the completeness and clearance by QC / Customer Inspector through Inspection Reports / OPS.
- 6.1.4 Proper care shall be taken during handling of materials at all stages of manufacture. Items stored in the shop floor shall be properly identified and preserved to prevent mixup and damages / rusting / warpages.
- 6.1.5 All Machined surfaces shall be properly protected and stored. Wherever long storage is envisaged, they shall be preserved with grease / rust preventive oils and protected suitably with polythene / gunny bag or plastic peel off coatings.

### 6.2 MARKING

- 6.2.1 The marking on machined components shall be in such a location which will not be detrimental to the surface finish requirements of the component.
- 6.2.2 Purpose of marking is to:
- 1. Ensure availability of machining allowance.
  - 2. Identify locations for machining.
  - 3. Provide reference for setting and inspection.

### 6.3 PROCESS CONTROLS

6.3.1 The following shall be ensured for selection of work centers, tools, jigs and fixtures:

- a The work centre for machining shall be identified in OPS / loading sheet based on the process capability of the machine or Machine accuracy established to suit the tolerances.
- b Test hardware (Jigs, Fixtures and Templates) used as a means of inspection / process control shall have been qualified through first off trials and shall be regulated through valid number. The same shall be reflected in the OPS / loading sheet .
- c Softwares used in case of CNC / NC machines shall have been validated through trials or inspection of similar components produced and accepted.
- d All cutting tools shall have been ensured for its correctness before use. In case of regrinding of tools they shall be verified after regrinding.

6.3.2 The following shall be ensured before setting the job on the machine, during processing and after completion of machining:

- a Ensure the verticality and flatness of the job after clamping by using the reference markings or dialing the surfaces. Ensure the adequacy of clamping.
- b Ensure proper clamping of the correct tool in to the tool holders.
- c After machining the machined surfaces shall be cleaned and all corners shall be deburred. After removing from the machine they shall be properly stored.
- d Before starting reaming ensure proper material allowance for finish operation.
- e During drilling, reaming and tapping the removal of chips shall be done periodically to prevent clogging of chips. For deep drilling ensure that run out and drill travel are verified in free condition and ensure proper clamping of the tools.

### 6.4 INSPECTION

6.4.1 Ensure completeness of all final machining operations. Dimensional inspection shall be done with relevant drawings. Ensure use of calibrated instruments / gauges.

6.4.2 Unless otherwise specified in the drawing or SQP, the following tolerances can be used for untoleranced dimensions.

#### 1.Linear Tolerance (:millimeters) - Medium

PERMISSIBLE DEVIATIONS FOR BASIC SIZE RANGE						
Up to 6	From 6 TO 30	from 30-120	From 120-400	From 400-1000	From 1000-2000	Above 2000
± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2.0

#### 2. Angular Tolerance

- a. Assembly characteristics ± 0.5°
- b. Other characteristics ± 1°

**7.0 FINAL INSPECTION**

7.1 All dimension shall be inspected as per relevant drawings. Tolerances for fabricated items when not specified in drawings shall be as per clause 4.2.6.

**8.0 CLEANING AND PAINTING**

8.1 All the temporary cleats, bridge pieces shall be removed carefully so as to avoid damage to parent material. Temporary tack welds shall be ground smooth. Complete assembly shall be cleaned to remove mill scales, spatter, slag, rust, oil or grease. Surfaces shall be prepared and painted as per SIP:PP:22 (latest). Site EPs shall be applied with weldable primer. All site EP shall be protected suitably from mechanical damage.

8.2 All temporary stiffeners / attachments used for transportation and handling that are removed after site assembly shall be painted with yellow paint.


8.3 Match marking and flow direction for applicable components shall be as per the respective product SQP./Drawing

8.4 The following details shall be clearly marked with relevant details by paint, bordered and covered by one coat of transparent varnish

Project Name :  
Work order number :  
Component / Assly. Designation :  
DU Number :  
Weight :  
Sub-contractor Name / Code :

8.5 Tension flanges in girders are to be identified by hard punching indicating 'TENSION FLANGE'.

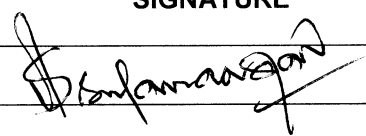
8.6 For subcontracted items the firm code shall be punched and bordered with white paint.

	<b>QUALITY ASSURANCE</b>	QCP : E : 002
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		DT. 30.05.2013


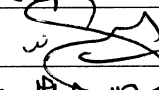
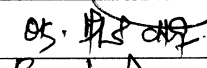
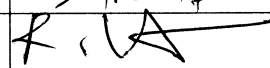
## QUALITY CONTROL PROCEDURE

**FOR SPLICING NORMS FOR SHEETS / PLATES / STRUCTURALS APPLICABLE TO  
ESP COMPONENTS FABRICATION**

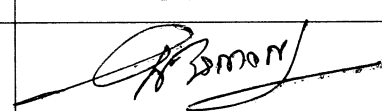
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OUT SOURCING	N. Nandagopal Sr.Mgr/OS	
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**APPROVED BY**

DEPARTMENT	NAME & Designation S/Shri	SIGNATURE
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	<b>QUALITY ASSURANCE</b>	<i>QCP : E : 002</i>
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		<i>DT. 30.05.2013</i>

03	30.05.2013	Amendment A1 merged. Feedback from OS and Engg (AQCS) Splicing Norms with applicable Drawing for carbon steel materials and SS Liner Sheet were added and re-issued.
02	03.03.2000	Feedback from MSA and Engg were included and re-issued.
01	16.06.1999	All amendments were merged, feedback from Engg and MSA were included and re-issued.
00	30.10.1985	Original Issue
<b>REV. NO.</b>	<b>EFFECTIVE DATE</b>	<b>REVISIONS MADE</b>

### HISTORY OF RECORD OF REVISIONS

#### 1.0 SCOPE

- 1.1 This Quality Control Procedure (QCP) specifies the requirements for splicing of sheets / plates / structural which may warrant joints to make the required length / width in order to achieve the final product as per drawing.
- 1.2 This QCP is applicable to Sheets / Plates / Structural – Angles, Beams of all types, Sections of Rolled / Built up, Rounds, Pipes and Tubes.
- 1.3 The splicing norms dealt in this QCP is applicable to following ESP components ;
- 1.3.1 7X-X42 Outer Roof Assy
  - 1.3.2 7X-X44 Hopper Upper & Middle
  - 1.3.3 7X-X45 Hopper Lower with SS Liner Sheet
  - 1.3.4 7X-X46 Insulator Support Panels
  - 1.3.5 7X-X47 Inner Roof Panel Assy
  - 1.3.6 7X-X49 Casing Shell Panels
  - 1.3.7 7X-X50 Inlet / Outlet Funnel
- 1.4 This QCP covers both Carbon Steel and SS Liner Sheet materials applicable to ESP Components.

#### 2.0 SPLICING NORMS - GENERAL POLICY

- 2.1 The fabricator or OS cutting plan section shall categorically try to avoid joints as much as possible with the supplied raw materials.
- 2.2 Further to explain the point no. 2.1 – the fabricator and OS cutting plan section shall try to make the supplied raw materials without any joints to cover up the loaded quantities – Eg., Out of 10 Nos of casing shell Panels loaded - maximum no. of panels shall be accommodated without any joints by fabricator and only to reduce the material wastage the balance quantity of casing shell panels shall be made with permitted joints as applicable.



## QUALITY ASSURANCE

### QUALITY CONTROL PROCEDURE FOR SPLICING NORMS FOR SHEETS / PLATES / STRUCTURALS APPLICABLE TO ESP COMPONENTS FABRICATION

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#### 2.3 The joints permitted are considered with a following view only

- 2.3.1 To reduce the material wastage
- 2.3.2 To make the best use of supplied raw materials sizes without prejudice to appearance and quality of final product as applicable
- 2.3.3 Aesthetic appearance shall not be sacrificed in accommodating the splicing norms.
- 2.3.4 Splicing Joints shall be avoided where a cross member is meeting or on bolt hole region. This is to be strictly adhered by fabricator and shall study the drawing fully with all the matching components.

#### 2.4 ESP Components where joints are not permitted

- 2.4.1 Shock Beam
- 2.4.2 Rapping Shaft
- 2.4.3 Vertical Beam
- 2.4.4 Foundation Bolt
- 2.4.5 Suspension Rod
- 2.4.6 Emitting Frame Top, Middle and Bottom
- 2.4.7 Collecting Suspension Arrangements
- 2.4.8 Lifting Holder
- 2.4.9 Vertical Stay
- 2.4.10 Shock bar

### 3.0 SPLICING NORMS – SPECIFIC TO RAW MATERIALS

#### 3.1 SHEETS / PLATES (CARBON STEEL)

- 3.1.1 The preparation of joints shall be staggered one so that formation of ( + ) plus type joint is avoided. The minimum offset (staggering) to avoid the plus type joint shall be minimum 100mm.
- 3.1.2 For a surface area including 2 Mtr X 2 Mtr and less - the permitted smallest dimension of any piece shall be minimum 400 mm ( either length wise or breadth wise) and the same will be 600mm minimum for more than 2 Mtr X 2 Mtr surface area – Refer sketch - S1
- 3.1.3 The distance between nearest stiffener and the joint parallel to it shall be minimum 50mm – Refer sketch – S1
- 3.1.4 The vertical joint is permitted on the taper portion. However the distance between meeting of the vertical joint with the horizontal joint shall be minimum 100mm – Refer sketch – S1
- 3.1.5 Butt weld reinforcement shall be ground flush wherever stiffeners cross them.
- 3.1.6 When bending of the plate is done before welding, the parallel joints shall be minimum 100 mm away from the bend line. The weld quality shall be ensured by



## QUALITY ASSURANCE

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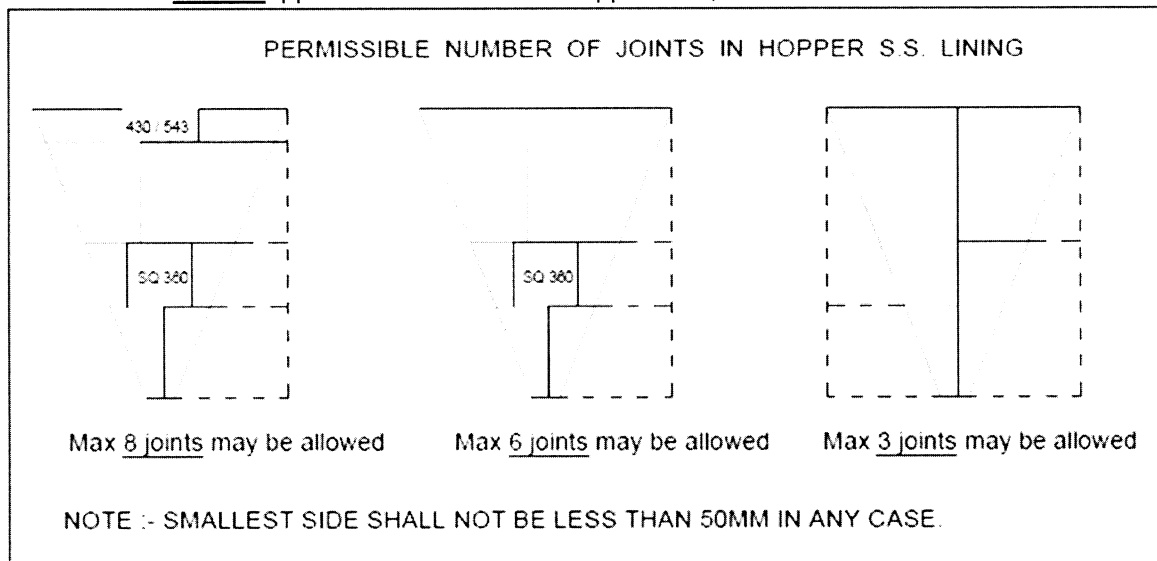
MPI / LPI. If the weld joint is subjected to bend, the weld shall be checked by LPI subsequent to bending.


3.1.7 The maximum number of permitted joints shall be as given below for carbon steel sheets / plates

SI. No.	Surface Area in Sq. Mtr	Maximum No. Of joints permitted put together both axis (X & Y)
1	Less than & Up to 2	1
2	More than & Up to > 2 < 5	3
3	More than & Up to > 5 < 10	6
4	More than & Up to > 10 < 15	7
5	More than & Up to > 15 < 20	9
6	More than & Up to > 20 < 25	11
7	More than & Up to > 25 < 30	13
8	More than > 30	15

**NOTE:** The above permitted joints supersedes the maximum no. of joints given in clause no. 4.13 & 4.14 of SQP:ESP:284 Rev.01 Dtd.06.06.2007

3.1.8 The maximum number of permitted joints shall be as given below for **SS Liner sheets** applicable to ESP Lower hopper area;



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**3.2 ANGLES, CHANNELS, BEAMS (BOTH ROLLED / BUILT UP - INCLUDING NPB&UB) APPLICABLE TO ESP ROOF BEAMS & SUPPORTING COLUMNS 7X-X28 and 7X-X81, 82, 83 & 84**

- 3.2.1 The splicing norms for Angles, Channels and Beams (both rolled / built-up) shall be strictly followed as per the drawing no.1-79-081-02331 Rev.00.
- 3.2.2 Any change other than given in above referred drawing shall be approved by Engg (AQCS) and the request for the same shall be forwarded by cutting plan section of OS Dept.
- 3.2.3 Only one joint is permitted on the transverse roof beams.

**3.3 “ H “ BEAMS APPLICABLE TO CASING STRUCTURE COLUMNS – 7X-X48 (BOTH ROLLED / BUILT UP)**


- 3.3.1 The splicing norms for “H” Beams shall be strictly followed as per the drawing no. 4-79-000-00763 Rev.00.
- 3.3.2 Maximum two joints i.e., one for shop and another for site / field shall be permitted for a maximum length of 16.5 Mtr of section considering ODC constraints.
- 3.3.3 Joints on flange shall be staggered by minimum 300 mm avoiding falling of joint on the same side of the built up sections.
- 3.3.4 The splice plate provided for web joints shall not foul with the gusset plates provided on the “H” beams and a minimum clearance of 50 mm shall be maintained.
- 3.3.5 The minimum distance permissible between a joint and the nearest gusset / bracket location shall be 200mm.

**3.4 RODS, ROUNDS, PIPS AND TUBES**

- 3.4.1 No joint is permitted if the length of rod is 2 M or less.
- 3.4.2 Minimum length for splicing using sleeve shall be 500mm for tubes
- 3.4.3 Only one joint is permitted for Tie Rods / Strut

**4.0 EDGE PREPARATION, WELDING, WELD NDE DETAILS :**

- 4.1 Check for material specification of plates / sections which are to be joined to avoid mix up of material. TCN to be obtained for change of material.
- 4.2 Electrode selection shall be as per the respective WPS.

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- 4.3 Welding shall be followed with suitable methods of sequence and controls to minimize the weld distortion.
- 4.4 Weld over joint shall be avoided and minimum distance between stiffeners parallel to weld joint is 50mm.
- 4.5 Wherever, back grinding is not feasible due to location of the plate / sheet, root welding to be carried out with 3.15mm electrode and LPI to be carried out after thorough cleaning and repeat LPI after final welding.
- 4.6 Following are the guidelines for Edge Preparation (EP) if not specified in drawing;
- a) **Plates / Sheets up to 5mm** : No EP required. Provide 2 to 3 mm root gap, weld on both sides. MPI to be conducted after final welding.
  - b) **Plates of 6 mm** : No EP required. Weld shall be with square butt with 2 to 3 mm gap. Weld from first side and turn the plate for back grinding and conduct root LPI. Complete the weld and conduct the final MPI.
  - c) **Plates of 7 & 8 mm** : Single "V" , 60° EP, Weld from V side and turn the plate, back grind and conduct LPI, complete the Weld. Final MPI.
  - d) **Plates above 8 mm** : Double "V" , 60° EP, Weld one side, Carryout back grind and conduct LPI to ensure sound metal and weld from other side. Final both side MPI after completion of weld.
  - e) **For Structural (Angle, Channel, Beam)** : Single "V" , 60° EP, Weld from V side and back grind and conduct LPI. Complete the weld, conduct final LPI before splice plate setting.

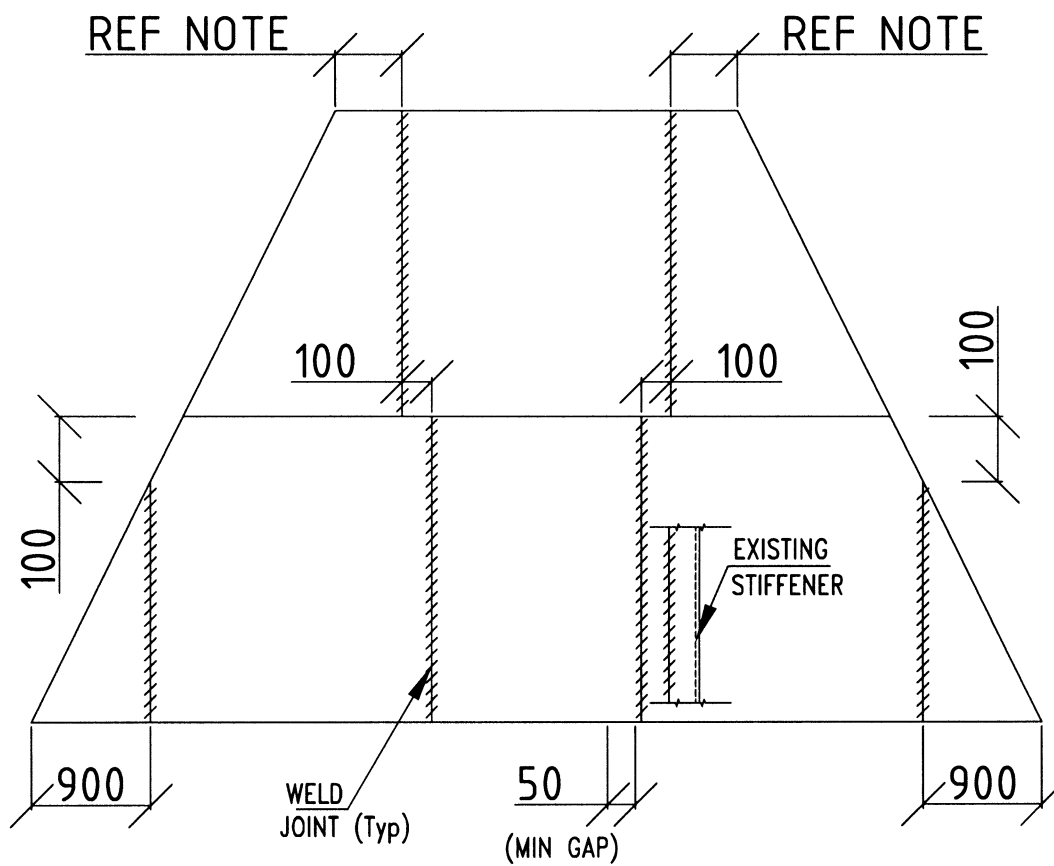
Note:

1. Splice plate details shall be taken from relevant fabrication Engg drawing.
2. Splice Joint shall be avoided where a cross member is meeting.
3. The weld should be ground flush and smooth and the proper splice plate is placed & welded.

!!!@@@###

QUALITY CONTROL PROCEDURE FOR SPLICING OF SHEETS,  
PLATES AND OTHER STRUCTURAL ITEMS

SKETCH FOR CLAUSES 3.1.2 TO 3.1.4



NOTE : MINIMUM DIMENSION OF SPLICED PLATE = 200 MM FOR  
DUCT WALL OF ANY SIZE

ALL DIMENSIONS ARE IN MM



BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET - 632406  
NON - DESTRUCTIVE TESTING

BHE:NDT:RP:MT:01  
REVISION : 02  
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**PROCEDURE**  
**FOR**  
**MAGNETIC PARTICLE EXAMINATION**  
**OF**  
**FERRITIC MATERIALS AND WELDED COMPONENTS**

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Effective Date: 14.08.03

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NON - DESTRUCTIVE TESTING

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### RECORD OF REVISION

Rev.No.	Date of revision	Reason for revision
01	28 07 99	Revision in entirety
02	14 08 03	Clause 14.0,19.44,18.1and23.0 added Clause 15.1.1,21.2,21.3,22.2 and22.3 modified



## 1.0 SCOPE

- 1.1 This procedure describes the method, techniques and acceptance standards for Magnetic particle Examination of all shapes of ferromagnetic product forms in Boiler components, Boiler Auxiliaries, pressure vessels, Heat Exchangers and Structural.
- 1.2 The examination shall include all Gas cut openings, attachment welds with a throat thickness over 6mm and on finished surface of welds as required by referencing code/section. The examination includes base material 13mm on each side of the welds.

## 2.0 REFERANCE

- 2.1 ASME Section V,I & VIII (Division 1 & 2) – 2002 Addenda
- 2.2 ASME B 31.1 ( 2001 )
- 2.3 ANSI / AWS D 1.1 ( 2002 )

## 3.0 EQUIPMENT

- 3.1 Equipments generating half-wave rectified alternating current employing prods at the end of magnetizing cables shall be used for examination by circular magnetization method.
- 3.2 Direct / Alternating current electromagnetic yokes shall be used to detect discontinuities that are open to the surface of the part by longitudinal magnetization method and to examine the surface where arcing is not permitted or prod method is not practicable.

## 4.0 EXAMINATION MEDIUM

- 4.1 The ferromagnetic particles used as examination medium shall be either wet or dry. Wet particles shall be non – fluorescent type.
- 4.2 Dry magnetic particles black, gray or red in color shall be used as examination medium for examination of welds and other product forms to provide adequate contrast with the surface being examined. The surface temperature of the part examined with dry particles shall not exceed 315°C.
- 4.3 Non fluorescent wet particles will be black or reddish brown in color that provide adequate contrast with the surface being examined. Wet particles shall be suspended in kerosene for application to the test surface by flowing or spraying. Suitable conditioning agents shall be added to the water to provide proper wetting and corrosion protection for the parts being examined.
- 4.4 The temperature of the wet particle suspension and the surface of the part being examined shall not exceed 57°C.



4.5 The bath concentration shall be determined by measuring the settling volume through the use of pear-shaped centrifuge tube. The settling volume shall be within 1.2 ml to 2.4 ml for non- fluorescent particles.

## 5.0 SURFACE CONDITIONING

### 5.1 Preparation

5.1.1 As welded, as rolled, as cast or as forged surface is generally acceptable provided the surface irregularities will not mask the indication due to discontinuities. Otherwise surface preparation by grinding or machining may be necessary. Undercuts, Overlaps or abrupt ridges and valleys in the welds and opening shall be smoothly merged with the parent metal.

5.1.2 Prior to magnetic particle examination, ensure that the surface to be examined and adjacent area within at least 25mm of the area of interest shall be dry and free of any dirt, grease, lint, scale, welding flux, spatter, oil or other extraneous matter that would interfere with the examination.

5.1.3 Cleaning may be accomplished by detergents, organic solvents, descaling solution and paint removers, sand or grit blasting method.

5.1.4 Thin nonconductive coating such as painting will not normally interfere with the formation of indications. They must be removed at all points where electrical contact is to be made for direct magnetisation.

### 5.2 Surface contrast Enhancement

5.2.1 When coating are applied temporarily to enhance particle contrast or if coating are left on the part being examine, it must be demonstrated that indications can be detected through the enhanced coating thickness on a test plate with machined grooves as in 16.0

5.2.2 If indications of required sensitivity could not be detected, the coating shall be removed.

## 6.0 METHOD OF EXAMINATION

6.1 Examination shall be made by continuous method.

### 6.1.1 Dry continuous magnetisation method

6.1.1.1 The magnetizing current remains on while the examination medium (Dry particle) is being applied and while the excess of the examination medium is being removed.



### 6.1.2 Wet continuous magnetisation method

6.1.2.1 The magnetic particle application involves bathing the surface of the part with examination medium and terminating the bath application immediately prior to cutting off the magnetizing current with two or more shots given to the part. The duration of the magnetizing current is typically on the order of  $\frac{1}{2}$  seconds.

## 7.0 TECHNIQUES

7.1 One of the following magnetization techniques shall be used.

- a) Prod Technique
- b) Yoke Technique

## 8.0 TYPE OF CURRENT FOR MAGNETISATION

8.1 Single phase half -wave rectified current (HWAC) / (HWDC) shall be employed for testing with prod techniques.

8.2 The amperage required with single - phase Half-wave rectified current shall be verified by measuring the average current during the conducting half cycle only.

8.3 For Yokes, the current shall be either AC or DC.

## 9.0 CALIBRATION

9.1 Ammeter of magnetizing equipment shall be calibrated as per NDT: WI:004 at least once a year, or after each time it has been subjected to major electrical repair, periodic overhaul or damage. If equipment has not been in use for a year or more, calibration shall be done prior to first use.

### 9.2 Lifting power of yokes

9.2.1 The magnetizing force of yokes shall be checked at least once a year or whenever a yoke has been damaged. If a yoke has not been in use for a year or more, a check shall be done prior to first use.

9.2.2 Each alternating current electromagnetic yoke shall have a lifting power of at least 4.5 kg and direct current / permanent magnetic yoke shall have a lifting power of 18.kg, at the maximum pole spacing that will be used or the pole distance shall be the spacings at which the yoke lifts the stipulated weight.

9.2.3 Each weight shall be weighed with a scale from a reputable manufacturer and stenciled with the applicable nominal weight prior to first use. A weight need only be verified again if damaged in a manner that could have caused potential loss of material.



## 10.0. EXAMINATION

### 10.1 Direction of magnetization

10.1.1 At least two separate examination shall be carried out on each area. During the second examination the prods/poles are spaced so that the lines of flux are approximately perpendicular to those used during the first examination. A different technique for magnetization may also be used for the second examination

### 10.2 Examination Coverage

10.2.1 Examination shall be made with sufficient overlap to assure 100% coverage of testing.

## 11.0 PROD TECHNIQUE: (Fig. 1,2&3)

### 11.1 Magnetizing procedure

11.1.1 The prod electrodes are pressed firmly against the surface in the area to be examined. In order to avoid arcing a remote control switch shall be built in to the prod handles, to permit the current to be turned on after the prods have been properly positioned and to be turned off before they are removed.

### 11.2 Magnetising current

11.2.1 The current shall be 100 to 125 (maximum) amperes/25mm of prod spacing for sections 19mm thick or greater.

11.2.2 For sections less than 19mm thick, the current shall be 90 to 110 amperes / 25mm of prod spacing.

### 11.3 Prod spacing

11.3.1 Prod spacing shall not be less than 75mm nor exceed a maximum of 200mm.

11.3.2 The prod tips shall be kept clean and dressed and the contact areas of the test surface shall be free from dirt, scale, oil etc, to minimize electrical arcing. In the open circuit voltage of the magnetizing current is greater than 25 volts, Lead, steel or Aluminum rather than copper tipped prods shall be preferred to avoid copper deposits on the part being examined.

## 12.0 YOKE TECHNIQUE

12.1 The pole spacing shall be between 100mm to 150mm. The field indicator will be used to check the direction of the part magnetization.



### 13.0 APPLICATION OF DRY PARTICLES

13.1 The dry particles shall be applied in such a manner that a light uniform dust-like coating settles on the surface of the area being examined. The application technique shall be such that the particles are suspended in air and reaches the examination surface in a uniform cloud with a minimum forces, using a hand powder applicators (Squeeze bulb) or specially designed mechanical blower or by a spray nozzle.

13.1.1 Dry particles shall not be applied to a wet surface nor when there is excessive wind. The particles shall not be applied by pouring, throwing, or spreading with fingers.

13.1.2 Any excess powder shall be removed while the magnetization current is on and shall be with a gentle air stream without removing or disturbing particles attracted by a leakage field that may prove to be a relevant indication.

### 13.2 APPLICATION OF WET PARTICLES

13.2.1 The application of wet particles involves the bathing of the area to be examined, by spraying or flowing during the application of magnetizing current.

13.2.2 Two or more shots shall be applied, but the last shot shall be applied while the bath still remains on the area to be examined and after the particles flow has been stopped. Care shall be taken to cut off the bath application before removing the magnetic field, to prevent high-velocity particle flow that wash away or remove fine or weakly held indications.

### 14.0 MAGNETISING FIELD ADEQUACY AND DIRECTION

14.1 By using one or more of the following three methods, the magnetizing field adequacy and direction may be verified.

14.1.1 Pie shaped Magnetic Field Indicator, artificial flaw shims and Hall effect Tangentisl Field probe.

### 15.0 LIGHTING

#### 15.1 Visible Light Intensity

15.1.1 The examination and evaluation of indications shall be performed under minimum light intensity of 100 fc (1000 lx).

### 16.0 SYSTEM PERFORMANCE CHECK (Fig. 4)

16.1 For prod magnetization with HWAC, performance sensitivity shall be checked at least once in a shift before start of the examination on a test plate that contains machined grooves to different depths. The indication of a groove at 3mm depth from the surface of the test plate will indicate adequate sensitivity.



- 16.2 If the part is to be tested with contrast coat, the sensitivity shall be checked with the contrast coat on the surface of the test block.
- 16.3 For electromagnetic yokes, the adequacy or direction of the magnetizing force shall be verified by positioning the 'Magnetic Field Indicator' on the surface to be examined. The pattern in the indicator should be clearly developed on the surface of the block.
- 17.0 DEMAGNETISATION**
- 17.1 No demagnetization will be done after the test except specifically required.
- 18.0 EVALUATION OF INDICATION**
- 18.1 Mechanical discontinuity at the surface would be indicated by the retention of the powder or medium.
- 18.1.1 All the indication are not necessarily discontinuity indications since certain metallurgical discontinuities and magnetic permeability variation may produce similar unacceptable discontinuity indication. These non-relevant indications shall be reexamined by any other suitable NDT methods such as Liquid penetrant or macro etching.
- 18.2 Relevant indications are those which result from unacceptable mechanical discontinuities.
- 18.2.1 Linear indications are those indications in which length is greater than three times the width.
- 18.2.2 Rounded indications are circular or elliptical with the length equal to or less than three times the width.
- 19.0 ACCEPTANCE STANDARDS AS PER ASME (SEC I,VIII Div 1&2 and B 31.1) AND OTHERS**
- 19.1 Welds and Materials**
- 19.2 An indication of an imperfection may be larger than the imperfection that causes it: however, the size of the indication is the basis for acceptance for evaluation.
- 19.3 Only indications with major dimension greater than 1.6mm shall be considered relevant.
- 19.4 All surface to be examined, except as mentioned in 19.5, 19.6 and 19.7 shall be free of
- 19.4.1 Relevant linear indications.



19.4.2 Relevant rounded indication greater than 4.8mm

19.4.3 Four or more relevant rounded indications in a line separated by 1.6mm or less edge to edge.

19.4.4 Ten or more rounded indications in any 3870 mm<sup>2</sup> (6 inch<sup>2</sup>) of surface with the major dimension of this area not to exceed 150mm with the area taken in the most unfavourable location relative to the indication being evaluated.

19.5 Cut edges and openings:

19.5.1 All surface to be examined shall be free of

(a) Cracks

(b) Laminations exceeding 25mm in length.

19.6 In welds joining nipples to drums, spheres or headers, all slag or porosity indications shall be investigated to assure that no leak - path exists.

19.7 In attachment welds of non-load carrying class, indications from crack or due to material separation are unacceptable.

## 20.0 ACCEPTANCE STANDARD FOR STRUCTURAL COMPONENTS AS PER AWS

20.1 The magnetic particle acceptance criteria is based on the size of the actual discontinuity and not the size of the discontinuity as indicated by the magnetic particle inspection medium. Where discontinuity cannot be visually seen (with magnification if required) after removal of the indicating medium, evaluation shall be based on size and nature of the magnetic particle indication.

### 21.0 Statically loaded Non tubular connections

21.1 Cracks, Lack of Fusion, and Incomplete penetration are not acceptable.

21.2 **Undercut**-for material with thickness less than 25mm undercut shall not exceed 1.0mm, except that a maximum 2.0 mm is permitted for a accumulated length of 50mm in any 300mm. For material equal to or greater than 25.0 mm thick, undercut shall not exceed 2.0 mm for any length of weld.

21.3 **Porosity** - a complete joints penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no visible piping porosity. For all other groove welds and for fillet welds, the sum of the visible piping porosity 1.0mm or greater in diameter shall not exceed 10mm in any linear 25mm of weld and shall not exceed 20mm in any 300mm length of weld.



## 22.0 Cyclically Loaded Non tubular Connections

22.1 **Undercut** - In primary members, undercut shall be no more than 0.25mm deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall not be more than 1.0mm deep for all other cases.

22.2 **Porosity** - The frequency of piping porosity in fillet welds shall not exceed one in each 100 mm of weld length and the maximum diameter shall not exceed 2.5mm. Exception : for fillet connecting stiffeners to web, the sum of the diameter of the piping porosity shall not exceed 10mm in any linear 25mm of weld and shall not exceed 20mm in any 300 mm length of weld.

22.3 Complete joint penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity.

22.3 **PIPING POROSITY** - (General) is elongated porosity whose major dimension lies in a direction approximately normal to the weld surface. Frequently referred to as pin holes when the porosity extends to the weld surface.

## 23.0 EDGE DISCONTINUITIES IN CUT MATERIALS

23.1.1 No crack is acceptable.

23.1.2 Mill induced discontinuity

23.1.3 Length 25mm and less- Acceptable

23.1.4 Length over 25mm and depth up to 3mm- Acceptable

23.1.5 Length over 25mm and depth between 3mm and 25mm - indications to be removed.

23.1.6 Length over 25mm and depth greater than 25mm - indications to be removed to a depth up to 25mm.

## 24.0 REPAIR AND RE-EXAMINATION

24.1 Whenever an imperfection is repaired by chipping or grinding or and subsequent repair by welding is not required, the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners.

24.2 After a defect is thought to have been removed and prior to making weld repairs, the area will be examined by suitable method to ensure that the defect has been removed or reduced to an acceptable size of an imperfection.



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24.3 where welding is required after repair of an imperfection the area shall be cleaned and repair carried out. After repairs have been made the repaired area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners.

24.4 After repairs have been made, the repaired area shall be re-examined by methods of examination that were originally required for the affected area.

#### 25.0 PERSONNEL QUALIFICATION

25.1 All personnel carrying out the examination and evaluation shall be qualified to minimum Level - I as per ASNT:SNT - TC -1A.

#### 26.0 FINAL CLEANING

26.1 When the inspection is concluded, the magnetic particles shall be removed by any suitable means, leaving the product in a dry and clean condition.

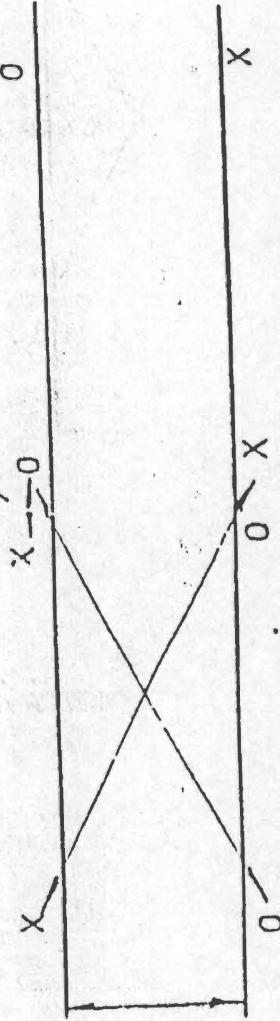
#### 27.0 REPORT

27.1 Copies of the report in a standard format R 49-719-B or equivalent duly signed by a minimum Level - II personnel shall be issued after the test.



X - PROD POSITION 1  
O - PROD. POSITION 2.

OVERLAP



WELD  
GROUND  
AREA

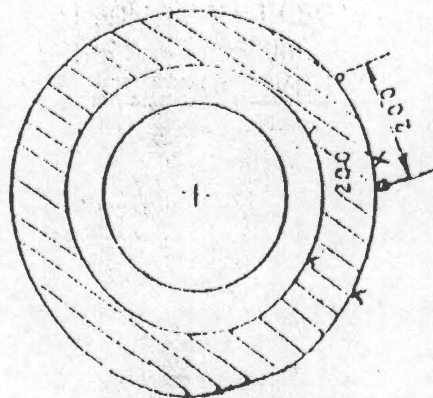
FIG. (1) TECHNIQUE FOR EXAMINATION OF LONG SEAMS &  
CIRCUMFERENTIAL SEAMS.

NOTE:

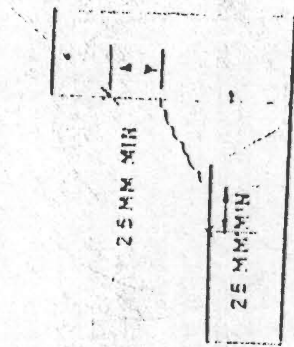
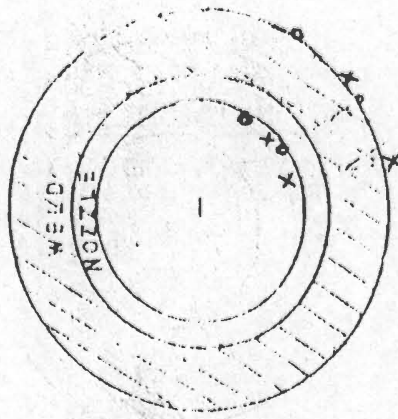
1. SUCCESSIVE SHOTS SHALL OVERLAP A MINIMUM OF 10% OR 20 MM
2. EXAMINATIONS ON O.D. AND I.D. OF THE SEAM SHALL BE CARRIED OUT IN THE SAME MANNER.
3. PRODS MUST BE PLACED ON DRUM / VESSEL PERPENDICULAR TO PLATE SURFACE.



LONGITUDINAL INDICATIONS



TRANSVERSE INDICATIONS



O - PROD POSITION . 1  
 X - PROD POSITION . 2

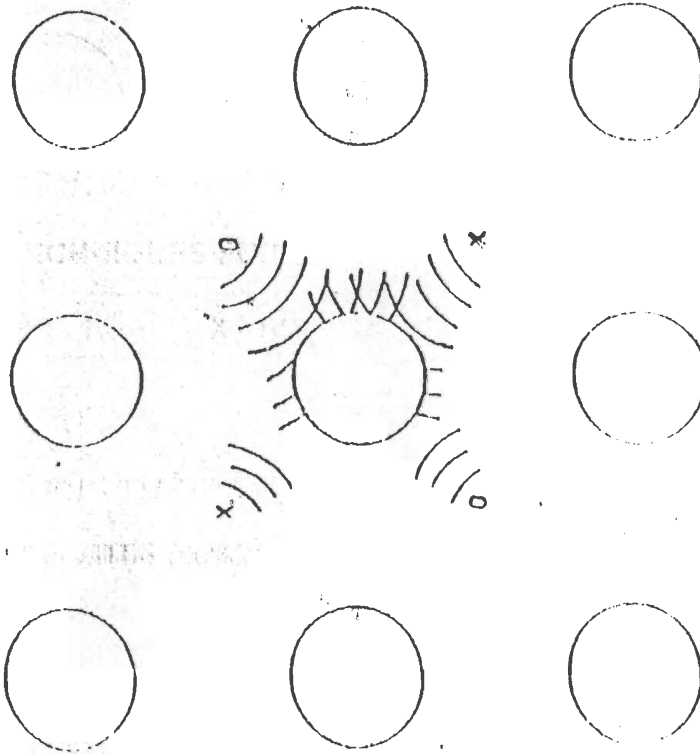
FIG. (2) TECHNIQUE FOR EXAMINATION OF CORNER JOINTS

1. PROD LOCATION AT TOP OF WELD  
 ALL THE WAY AROUND & AT THE  
 BOTTOM ALL THE WAY AROUND
2. O, X - 10% OVERLAP BETWEEN SHOTS

- PROD LOCATED AT LEAST 25MM UP ON  
 NOZZLE ± 25MM OUT ON DRUM / VESSEL
- 10% OVERLAP (15MM) BETWEEN SHOTS

NOTE:

PRODS MUST BE PLACED ON DRUM / VESSEL / NOZZLE  
 PERPENDICULAR TO PLATE SURFACE.



**FIG (3) TECHNIQUES FOR EXAMINATION OF FILLET WELDS**

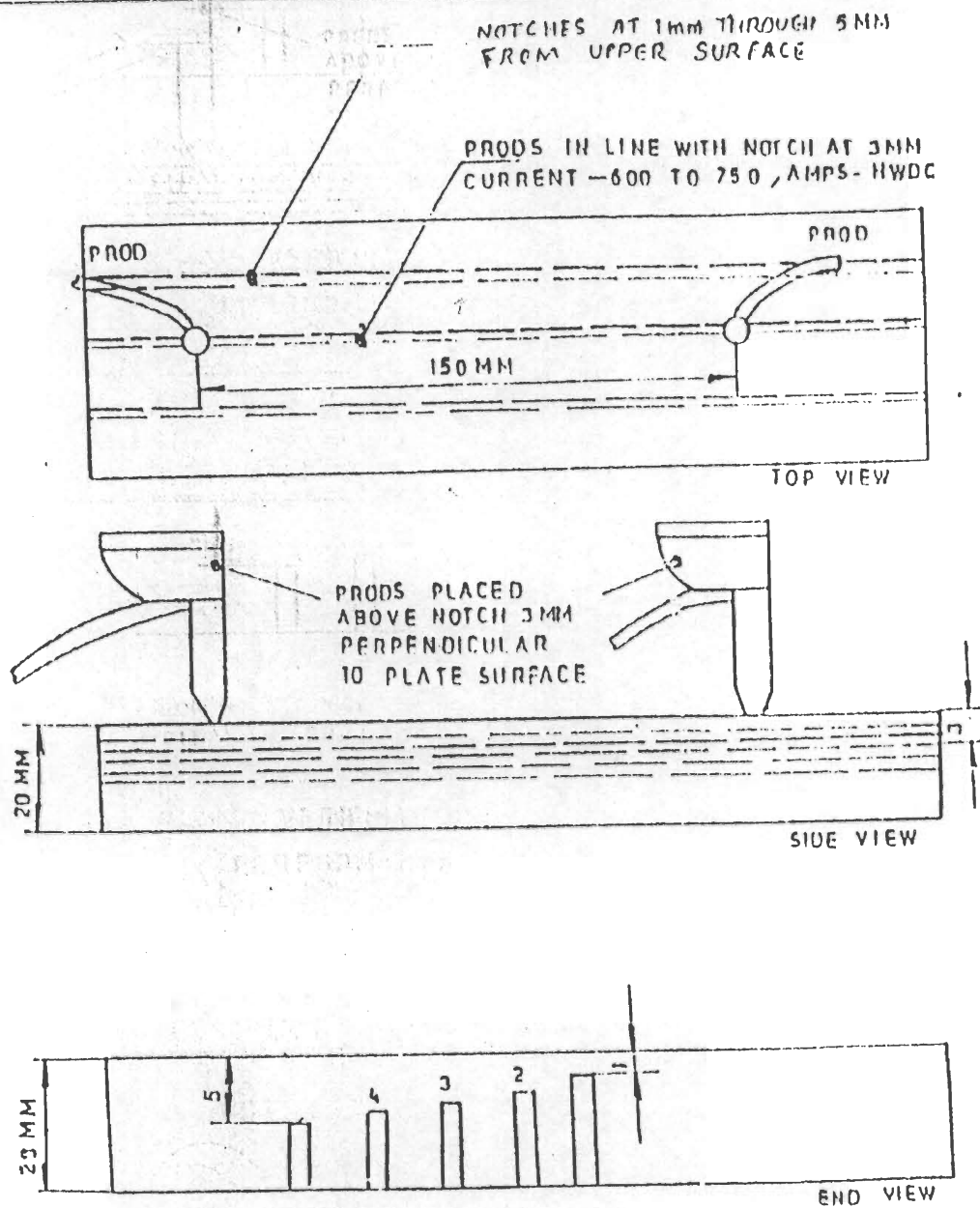
**O - POSITION - 1**

**X - POSITION - 2**

**ARC BREAK LOCATION**

**NOTE :**

- 1) PRODS must be placed on drum / header perpendicular to plate surface.
- 2) Inspection will be 100% of weld for each shot.



PERFORMANCE CHECK - EQUIPMENT AND DRY POWDER COMBINATION PRIOR TO TEST

FIG (4)

VERIFICATION OF SYSTEM  
PERFORMANCE FOR PROD TECHNIQUE



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## PROCEDURE FOR LIQUID PENETRANT EXAMINATION

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### RECORD OF REVISION

Revision No.	Date of revision	Reason for revision
01	28 07 99	Revision in entirety
02	14 08 03	Clause 2.1, 2.2, 2.3, 12.1.2.2, 12.1.3.1, 12.1.3.2 and 13.1.2.1 modified  Clause 8.2 added



## 1.0 SCOPE

1.1 This procedure defines the method, techniques and acceptance standards for Liquid penetrant Examination of all shapes of ferrous and Non-ferrous product forms in Boilers, Boiler Auxiliaries, pressure vessels, Heat Exchangers and structural.

1.2 In pressure vessels the Examination shall include all welds around openings, attachment welds with a throat thickness over 6mm and on finished surfaces of welds as required by referencing code. The examination includes base material 13mm on each side of the weld.

## 2.0 REFERENCE

2.1 ASME Section V, I & VIII (Division 1 & 2) -2002 Addenda

2.2 ASME B 31.1 / 2001

2.3 ANSI / AWS D 1.1 / D1.1M: 2002

## 3.0 EQUIPMENT

3.1 The term 'penetrant materials' as used in the procedure is intended to include all liquid penetrants, solvents (penetrant removers) or cleaning agents, developers etc used for 'Liquid penetrant Examination'.

3.2 Penetrant used shall be of solvent removable type and have a color contrast, which can be seen, readily in daylight or under normal interior illumination.

3.3 The cleaner used for the surface cleaning shall be an organic chemical such as Acetone or Trichloro Ethylene.

3.4 Developer shall be of non-aqueous suspendible type. When the developer dries, it shall form a white coating of fine powder on the part.

3.5 The Chemicals used for the examination of austenitic stainless steel or nickel base alloys shall be analysed for sulphur and total halogens. The residual amount of total sulphur and chlorine content shall not exceed 1% by weight.

## 4.0 SURFACE PREPARATION

4.1 In general satisfactory results may be obtained when the surface is as welded, as rolled, as forged or as cast condition. When the surface irregularities might mask the indications of unacceptable discontinuities, the surface shall be prepared by grinding or machining or any other suitable method.



- 4.2 The surface to be examined and all adjacent areas within at least 25mm shall be dry and free of any dirt, grease, lint, scale, welding flux, weld spatter, rust, paint, oil or any other extraneous matter that could obscure surface openings or otherwise interfere with the examination by preventing the penetration.
- 4.3 Shot blasting may close discontinuities at the surface and should not be used before conducting penetrant examination. If the component is shot blasted, the surface is to be etched before conducting penetrant examination.
- 4.4 Prior to the application of the penetrant, the surface is recleaned with typical industrial cleaning agents such as Acetone.
- 5.0 DRYING AFTER PREPARATION
- 5.1 After cleaning, drying of the surface shall be accomplished by normal evaporation and ensure that the cleaning solution has evaporated. The minimum time required for the cleaner to dry from the surface is 20 to 30 seconds depending on the position.
- 6.0 TECHNIQUES
- 6.1 Color contrast (visible) penetrant shall be used with solvent removable penetrant process.
- 6.1.1 The temperature of the penetrant and the surface of the part shall not be below 10°C and not above 52°C throughout the examination period. Local heating or cooling is permitted provided the part temperature remains in the range of 10°C to 52°C during the examination.
- 6.2 TECHNIQUE RESTRICTIONS
- 6.2.1 Intermixing of penetrant materials from different families or different manufacturers is not permitted.
- 7.0 EXAMINATION
- 7.1 Penetrant Application
- 7.1.1 The penetrant shall be applied by brushing, spraying or dipping after the surface is dried. For spraying a handpump or an aerosol spray cans will be used.



## 7.2 Penetration time

7.2.1 The penetrant shall be allowed to remain wet on the part for a minimum period for 10 minutes. (dwell time).

7.2.2 If the penetrant has completely dried up during the dwell time, then the surface shall be recleaned and reexamined.

## 7.3 REMOVAL OF EXCESS PENETRANT

7.3.1 After the required dwell time has elapsed, the excess penetrant remaining on the surface shall be removed by wiping with a lint free cloth, repeating the operation until most traces of penetrant have been removed. Final left out penetrant shall be remove by wiping with a clean cloth moistened with the solvent. Excessive application of the cleaner shall be avoided to prevent the possibility of removing the penetrant from discontinuities causing a decrease in the sensitivity of the test. FLUSHING THE MATERIAL SURFACE WITH THE SOLVENT FOLLOWING THE APPLICATION OF PENETRANT AND PRIOR TO DEVELOPING IS PROHIBITED.

### 7.3.2 Drying after excess penetrant removal.

7.3.2.1 After the removal of excess penetrant the surface shall be dried by normal evaporation. The minimum time required for the surface to get dried by normal evaporation is 20 seconds.

## 7.4 DEVELOPING

7.4.1 The developer shall be applied by spraying to provide uniform coating as soon as possible to the dry surface after the removal of excess penetrant. Insufficient coating thickness may not draw penetrant out of discontinuities. Excessive coating thickness may mask indications.

### 7.4.2 WET DEVELOPER APPLICATION

7.4.2.1 Prior to applying suspension type wet developer to the surface the developer must be thoroughly agitated too ensure adequate dispersion of suspended particles. The developer shall be applied by spraying using spray pump or aerosol spray can. The developer shall be applied over the surface in such a manner to assure complete coverage of the part with a thin, uniform film of developer. Drying of developer shall be by normal evaporation.



#### 7.4.3 DEVELOPMENT TIME

7.4.3.1 The surface shall be closely observed during the application of the developer to monitor the behavior of the indication, which tends to bleed-out. Developing time for final interpretation begins as soon as a wet developer coating is dry. The minimum developing time shall be 7 minutes.

#### 8.0 INTERPRETATION

8.1 Final interpretation shall be made within 7 to 60 minutes after the wet developer coating is dry. If the bleed - out does not alter the examination results longer periods are permitted.

8.2 The surface shall be examined in increments if the surface to be examined is large enough to complete the inspection within the prescribed time.

8.3 A minimum light intensity of 50 foot candle (500 lux) is required to ensure adequate sensitivity during the examination and evaluation of indications, which can be achieved by a hand lamp or torch light positioning at a distance of 300mm.

#### 9.0 EVALUATION

9.1 Flaws at the surface will be indicated by bleed out of the penetrant. However localized surface irregularities such as machining marks or other surface conditions may produce false indications. Broad areas of pigmentation which would mask indications are not acceptable and such areas shall be cleaned and reexamined.

9.2 Welds made to ASME Boiler and pressure vessel code

9.2.1 An indication of an imperfection may be large than the imperfection that causes it: however, the size of the indication is the basis for acceptance evaluation.

9.2.2 Relevant indications are those which result from mechanical discontinuities (imperfection).

9.2.3 Only indications with major dimension greater than 1.6mm shall be considered relevant.

9.2.4 Any indication which is believed to be non-relevant shall be regarded as a defect until the indication is either eliminated by surface conditioning or it is evaluated by other non - destructive testing and proved to be non - relevant.



- 9.2.5 Linear indications are those indications in which the length is more than three times the width.
- 9.2.6 Rounded indications are those which are circular or elliptical with the length equal to or less than three times the width.
- 9.2.7 Any questionable or doubtful indications shall be reexamined to determine whether they are relevant, or not.
- 10.0 ACCEPTANCE STANDARD (as per ASME Sec I and VIII Div 1&2)
- 10.1 Cut edges and openings
- 10.1.1 All surfaces to be examined shall be free of
- (a) Cracks
  - (b) Non laminar discontinuities (having length not parallel to the material surface).
  - (c) Laminations exceeding 25mm in length.
  - (d) Laminations under 25mm in length and adjacent to each other within 25mm shall be considered as one defect.
- 10.2 Welds and Materials
- 10.2.1 All surfaces to be examined shall be free of
- a) Relevant linear indications.
  - b) Relevant rounded indications greater than 4.8mm.
  - c) All relevant indications shall be investigated to assure that no leak-path exists in welds joining nipples to drums, dished – ends and headers.
- 10.2.2 Four or more relevant rounded indications in a line separated by 1.6mm or less edge to edge.
- 10.2.3 Ten or more rounded indication in any 3870mm<sup>2</sup> (6 inch<sup>2</sup> ) of surface with the major dimension of this area not exceed 150 mm with the area taken in the most unfavorable location relative to the indication being evaluated.



- 10.2.4 In attachment welds of non-load carrying class, indications from cracks or due to material separation are unacceptable.
- 11.0 WELDS MADE TO STRUCTURAL WELDING CODE ANSI / AWS D 1.1
- 11.1 For statically and cyclically loaded non-tubular connections made to AWS code the acceptance of any discontinuity shall be based upon a visual examination of the discontinuity after the removal of developer medium and evaluated for its nature and size. Where the discontinuity cannot be seen after removal of the developer medium either directly or using magnifying glass evaluation shall be based on the size and nature of liquid penetrant indication.
- 12.0 ACCEPTANCE STANDARD (AS PER AWS)
- 12.1 Statically loaded non-tubular connections.
- 12.1.1 Indications from cracks, lack of penetration and lack of fusion are not acceptable.
- 12.1.2 Porosity.
- 12.1.2.1 Complete joint penetration groove welds in butt joints transverse to the computed tensile stress shall have no visible piping porosity.
- 12.1.2.2 For all other groove welds and for fillet welds, the sum of the visible piping porosity of 1.0 mm or greater in diameter shall not exceed 10 mm in any linear 25 mm of weld and shall not exceed 20 mm in any 300 mm length of weld.
- 12.1.3 Undercut
- 12.1.3.1 For material less than 25 mm thick, undercut shall not exceed 1.0 mm except that a maximum 2.0 mm is permitted for an accumulated length of 50 mm in any 300 mm
- 12.1.3.2 For material equal to or greater than 25 mm thick undercut shall not exceed 2.0 mm for any length of weld.
- 13.0 Cyclically loaded non-tubular connections.
- 13.1 Indications from Cracks, Lack of penetration and lack of fusion are not acceptable in any welds.



### 13.1.2 Porosity

13.1.2.1 Complete joint penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 100mm of length and the maximum diameter shall not exceed 2.5 mm.

13.1.2.2 The Frequency of piping porosity in fillet welds shall not exceed one in each 100mm of weld length and the maximum diameter shall not exceed 2.5mm. EXCEPTION for fillet welds connecting stiffeners to web, the sum of the diameter of piping porosity shall not exceed 10mm in any linear 25mm of weld and shall not exceed 20mm in any 300mm length of weld.

### 13.1.3 Undercut.

13.1.3.1 In primary members, undercut shall not be more than 0.25mm deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall not be more than 1mm deep for all other cases.

## 14.0 REPAIR AND RE-EXAMINATION

14.1 Whenever an imperfection is repaired by chipping or grinding the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners.

14.2 After a defect is thought to have been removed and where welding is required after repair, the area shall be examined for removal of defects, area cleaned and repair carried out. The repaired area shall be blended into the surrounding surface as in 14.1 and re-examined by the liquid penetrant or any other NDT methods originally required for the affected area.

## 15.0 PERSONAL QUALIFICATION

15.1 Wherever penetrant examination is required by the referencing code, the same shall be conducted and evaluated by a personnel qualified to minimum, Level – I as per ASNT SNT-TC-1A.



BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET 632406  
NON-DESTRUCTIVE TESTING

BHE:NDT:RP:PT:01  
REVISION :02  
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#### 16.0 POST CLEANING

- 16.1 After the examination and evaluation is completed all penetrant testing material shall be removed from the surface, so that it will not interfere with the subsequent processing or service requirements.

#### 17.0 REPORTING

- 17.1 Where penetrant test is mandatory, a copy of the report signed by personnel certified to minimum Level II will be issued in the format R49-720B or equivalent, after the completion of the examination.

\*\*\*\*\*



**MANUFACTURER'S NAME & ADDRESS**  
**M/S BHEL / BAP / RANIPET 632 406**

**STANDARD QUALITY PLAN**

**ITEM/SUB SYSTEM:**

**Cleaning device Assy.**

**Doc. No** SQP APH 110

**Rev. No** 00

**Date** 22 06 06

**Page No** 1 of 2


Sl no	Component & operation	Characteristics	Type Of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format Of Records	Agency	Remarks
1	2	3	4	5	6	7	8	9	10

<b>1.0</b>	<b>Raw Material</b>								
1.1	Plates, Tubes Casting,	Chem. & Mech Properties	Chem & Tensile Test	Each Heat	Respective material Spec.		TC	P	All material shall be as per GMS
1.2	Swivel Joint Casting	Soundness	RT	100%	TDC: RTA: 416/Latest Catalogue		TC	P	
1.3	Sub deliveries (Motor, Worm & Worm wheel assy. Reducer)	Compliance to PO	Verification	100%			CC	P	
2.0	<b>In process Control</b>								
2.1	Welding	Weld Size and Finish	Visual	100%	Drawing		DR	P	W
2.2	Base plate for Fixing Motor reducer, Worm & worm wheel assy.	Dimension check of Hole size and pitch	Measurement	100%	Drawing		DR	P	W

**LEGENDS:**

- M - Manufacturer, (BHEL Shop / Subcontractor,)
- B - BHEL QC/ Authorized Inspection agency,
- CC - Compliance certificate, P - Performed By,
- V - Verification Of Reports/Records, R- report,
- W - Witness T C - Test Certificate.

<b>Prepared by</b>	Srinivas		<b>APPROVED BY:</b>
	QA	B. Srinivasulu	
<b>Reviewed by</b>	QC	[Signature]	(Head/QA)
	MSA	[Signature] 22/06/06	


 <b>MANUFACTURER'S NAME &amp; ADDRESS</b> <b>M/S BHEL / BAP / RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b> <b>ITEM/SUB SYSTEM:</b> <b>Cleaning device Assy.</b>		<b>Doc. No</b> <b>Rev. No</b>		<b>Doc. No</b> <b>00</b>		<b>Format Of Records</b> <b>2 of 2</b>		<b>Agency</b> <b>M B</b>		<b>Remarks</b> <b>10</b>			
				<b>Date</b> <b>22 06 06</b>		<b>Page No</b> <b>7</b>		<b>Reference Documents</b> <b>6</b>		<b>Quantum of Check</b> <b>5</b>		<b>Type Of Check</b> <b>4</b>		<b>Characteristics</b> <b>3</b>	

2.3	Assembly check	a) Run test (Motor, Worm & Worm wheel assy. Reducer, Swivel assembly) b) Dimension of the swivel arm from center of swivel to the erection joint after welding c) Trial operation (With Arm and limit switch)	Smooth run	100%	Drawing	DR	P	W	
3.0	<b>Final Inspection</b>		1) Angular sweep of the ARM. 2) Cut off of limit switch 3) Smooth movement of Arm.	100%	Drawing	DR	P	W	
3.1	Painting & Preservation.	Painting Coating thickness and Packing	Measurement & Visual	10%	PRQA: 590/latest	-	P	V	

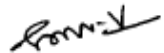
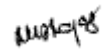

**General Notes.**


1. Ensure the oil level in the Gear box and Grease in the Worm and worm wheel assembly as per drawing and Oil/Grease specification shall be as per manufacturer's specification or as specified in the drawing.
2. Gearbox oil shall not be drained after the run test.

\*\*\*\_\*\*\*\_\*\*\*

 <b>Ranipet</b>	<b>QUALITY ASSURANCE</b> <b>M/S BHEL / BAP / RANIPET</b> <b>TAMIL NADU-632 406</b>	<b>STANDARD QUALITY PLAN</b>		
		<b>ITEM/SUBSYSTEM:</b>  <b>Heating Element Basket Assembly</b>	<b>Doc. No</b>	<b>SQP: APH: 107</b>
			<b>Rev No</b>	<b>02</b>
			<b>Date</b>	<b>15 02 2010</b>
		<b>Page No</b>	<b>01 of 04</b>	

SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	TYPE OF CHECK 4	QUANTUM OF CHECK 5	REFERENCE DOCUMENTS 6	ACCEPTANCE NORMS 7	FORMAT OF RECORDS 8	AGENCY		REMARKS 10
								M	B	
								9		
<b>1.0</b>	<b>RAW MATERIAL</b> Sheets /Coils IS 513GrDD CORTEN A (or) EQUIVALENT Flats, plates & Rods to IS 2062 or CORTEN A	Chemical and Mechanical Properties	Chemical & Mechanica I	As per TDC/ melt wise	Respective specification	Material	TC	P	V	Material are taken to stock after verification of TC
<b>2.0</b>	<b>In Process Control</b> Basket Fabrication. (with out elements)	WELDERS ARE QUALIFIED TO AWS D1.1 and PROCEDURES ARE PRE QUALIFIED,								
2.1	Welding									
2.1.1	Weld Quality	Weld finish & size	Visual	100%	Refer note 1.0 to 1.4		Records	P	W	10 % Random surveillance check by QC and 100 % by Task Performer (Sub Contractor)
2.2	Basket Dimension	Measurement	Go/No go check	10%	Refer note 2.0 to 2.3.3		Records	P	W	
2.3	Identification & preservation	Proper Preservation & Identification	Visual	100%	Refer note 3.0 to 6.0		-----	P	W	

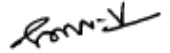
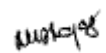
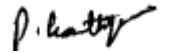
<b>LEGENDS:</b> M - MANUFACTURER / SUBCONTRACTOR, B - BHEL /BHEL AUTHORISED INSPECTION ,P - PERFORM, V - VERIFICATION, W - WITNESS, T C - TEST CERTIFICATE, DR -DIMENSIONAL REPORT.	Prepared By		 <b>APPROVED BY:</b>
	Reviewed By		

 <b>Ranipet</b>	<b>QUALITY ASSURANCE</b> <b>M/S BHEL / BAP / RANIPET</b> <b>TAMIL NADU-632 406</b>	<b>STANDARD QUALITY PLAN</b>		
		<b>ITEM/SUBSYSTEM:</b> <b>Heating Element Basket</b> <b>Assembly</b>	<b>Doc. No</b>	<b>SQL: APH: 107</b>
			<b>Rev No</b>	<b>02</b>
			<b>Date</b>	<b>15 02 2010</b>
		<b>Page No</b>	<b>02 of 04</b>	

SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	TYPE OF CHECK 4	QUANTUM OF CHECK 5	REFERENCE DOCUMENTS 6	ACCEPTANCE NORMS 7	FORMAT OF RECORDS 8	AGENCY		REMARKS 10
								M	B	
								9		

3.0	Basket Assembly (With Elements)									
3.1	Elements	No. of pairs	Verification of No. of Pairs	100% (See Remarks)	As per drawing / contract / PO Ref. Note 7.0 & 8.0	Record	P	W	10% Random surveillance check by QC and 100% by task performers.	
4.0	Basket assembly	1 Dimensional Measurement	Go gauge / Visual	100%	As per drawing / contract / & Note 9 & 10	Record	P	W		
		2 Weight	Measurement	Random	-Do-	Record	P	W		
5.0	Final inspection	3 weld Quality	Visual	100 %	Ref. Note 1.1, & 1.2	--	P	W		
		5.1 Identification & preservation	Proper preservation & identification	Visual	100 %	(Ref. Note 5.0, 6.0 & 11.0 12.0)	--	P		W

Record of revision	Rev 00 / DTD 18 10 02	Original Issue
	Rev 01 / DTD 11 02 10	Revised based on Shop and Quality feed back.
	Rev 02/ DTD 15 02 10	Revised due to typographical in clause 2.3.1.

<b>LEGENDS:</b> M - MANUFACTURER / SUBCONTRACTOR, B - BHEL /BHEL AUTHORISED INSPECTION ,P - PERFORM, V - VERIFICATION, W - WITNESS, T C - TEST CERTIFICATE, DR -DIMENSIONAL REPORT.	Prepared By		 <b>APPROVED BY:</b>
	Reviewed By		

## **1.0 Welding**

- 1.1 All welds shall be examined visually for defects like cracks, crater, and fillet size shall be checked with fillet gauges.
- 1.2 For Carbon steels E6013 electrodes can be used for all welding in baskets where thickness of the items is  $\leq 20$  mm and for thickness above 20 mm E7018 electrodes only shall be used. For other material respective WPS to be followed for selection of electrode.
- 1.3 Fabricator shall use suitable fixture for assembly and welding to ensure dimensional stability of baskets. Proper welding sequence to be adopted to avoid / to minimize distortion. Distortion if any is to be corrected to meet drawing requirement
- 1.4 All the bends in the sheet metal are to be free from cracks on the line of bend at the ends to avoid cracking. Bending shall be done perpendicular to the rolling direction (rolling direction is along the length of the sheet).

## **2.0 Inspection Tolerance for Empty basket**

- 2.1 Inside gap between holding bars shall be within  $-0$  to  $+1$  mm of inside dimension given in drawing.
- 2.2 Dimensions are to be checked by gauge and recorded at top, middle & bottom.
- 2.3 Full fabricated baskets are to be checked with go and no go gauges. The dimensions of gauge are as follows:
  - 2.3.1 For '**GO GAUGE**' the inside dimension of the go gauge shall be  $-2$  mm to nominal dimensions of the baskets.
  - 2.3.2 For '**NO GO GAUGE**' the inside dimension of the no go gauge shall be  $-4$  mm to nominal dimensions of the baskets.
  - 2.3.3 Go and No go gauges shall be identified by punching / paint stenciling of the drawing number of the corresponding basket.

## **3.0 Cleaning**

- 3.1 All baskets shall be thoroughly cleaned of weld slag, spatters, and rust before painting.

## **4.0 Painting**

- 4.1 The cleaned basket shall be painted as per PRQA: 590 latest revision.

## **5.0 Identification**

Stenciling shall be carried out outside of the basket face and outside of the cover so that the identification is visible even after filing the element. The baskets are to be identified with following details:

- |  |  |
|--|--|
| a) WO No.  | d) Sub-contractor code : as applicable |
| b) Drawing No.   | e) IR No.: as applicable               |
| c) Type of baskets (to be punched (punch size 12) & stenciled) |  |

## **6.0 Transportation to BHEL**

6.1 Finished baskets shall be transported to BHEL carefully to avoid any damages.

**7.0** ELEMENTS shall be made from coils of the specified width and thickness.

8.0 No. of pairs of the elements shall be in line with the drawing / PO requirements.

9.0 The finished basket shall be inspected with **TEMPLATE**, the tolerance for the template shall be - 0 to + 1 mm of nominal size of the baskets. Baskets do not answer to the template shall not be accepted.

9.1 Template shall be inserted to the baskets at both ends to a length of 50 mm.

10.0 Wt of Basket Assembly shall be -2% to +8% of the GMS weight (or)As per P O Specification

## **11.0 Preservation**

11.1 The basket assembly shall be dipped in rust preventive fluid. Refer PRQA 522 Latest. It shall be ensured that heating elements are completely coated with rust preventive oil. Take out the baskets and allow sufficient drain time.

11.2 Visually check to see rust preventive coating in all heating element area.

## **12.0 Packing** (for heating elements which are sent to site as separate DU)

12.1 The basket assembly shall be packed in wood / steel crates as per packing plan.

12.2 If wooden box are used for packing, ensure the following:

- The box shall be made without any gap in any side and shall be lined on the inside with polythene bonded Hessian cloth.
- Silica gel packets shall be placed inside in the every container.
- After nailing down the top cover, the corner shall be closed by polythene bonded Hessian cloth.
- The baskets shall be placed inside the wooden box and supported from all sides to avoid movement by providing wooden logs.

12.3 Steel crates are used for packing, the above points are not applicable except silica gel packets inside the every container.

BHARAT HEAVY ELECTRICALS LIMITED  
BOILER AUXILIARIES PLANT  
RANIPET 632 406

QUALITY ASSURANCE & CONTROL DEPARTMENT

QCP : E: 009/00  
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QUALITY CONTROL  
PROCEDURE FOR

MANUFACTURING OF PACKING  
FRAMES AND ANGLE IRONS FOR  
WIDE COLLECTING ELECTRODE  
PACKING

EFFECTIVE DATE

05-10-88

ACCEPTED BY

DEPARTMENT

DATE


AQCS



OP&C



SC-SA



PRODUCTION



QUALITY CONTROL



QUALITY ASSURANCE

1.0 SCOPE :

1.1 This Quality Control Procedure details the quality requirements for packing frames and angle irons for packing wide collecting electrodes.

2.0 MATERIALS

2.1 Raw materials used shall conform to the steel grades Specified in the packing drawing.

- 2.2 No Substitution of material shall be done without the Concurrence of AQCS.
- 2.3 Raw material used shall be free from harmful defects like Cracks, laminations, laps, serious pittings, etc.
- 3.0 FABRICATION  
-----
- 3.1 It is the responsibility of the fabricators to impose adequate process control and necessary stage inspection so that the packing frames and angle irons are consistent in Quality and conform to this specification and drawing.
- 3.2 All components of packing frames and angle irons shall be free from bend and twist. Straightening wherever necessary shall be carried out on individual numbers before assembly / fabrication.
- 3.3 All Flame cut edges shall be dresses smooth and square by grinding.
- 3.4 Wherever necessary, welding and drilling fixtures to be used by the fabricators for repeatability and conformance to the requirements.
- 3.5 E-6013 electrodes of BHEL approved brands only shall be used.
- 3.6 All Weld profiles shall have workman like finish and sizes of the welds shall be as indicated in the drawing.
- 4.0 WORKMANSHIP AND TOLERANCES  
-----
- 4.1 Inside dimensions of frames
  - a) 768 (plus or minus 2mm)
  - b) 1060 (plus or minus 2mm)
- 4.2 Bolt hole locations ( plus or minus 1.5 mm)
- 4.3 Wherever holes are envisaged, all the corresponding , items shall be matched properly.
- 4.4 Framing members to be maintained square/parallell as per the drawing.

5.0 CLEANING AND PAINTING  
-----

- 5.1 All packing frames shall be thoroughly cleaned to remove Weld slag and spatter.
- 5.2 Cleaned frames and angles shall be coated with one coat of Zinc chromate red oxide primer conforming to IS 2074.
- 5.3 Painting must not be done over the fasteners.  
-----
- 5.4 Fastening shall be done only after the painting of frames and angles.  
-----
- 5.5 To prevent from rusting, the fasteners should be given rust preventive coating with CHEMTECH  
-----  
-16 or CORROSTOP -SP7 or equivalent to facilitate easy removal of fasteners during assembly  
-----  
at shop.  
-----
- 5.6 All the packing frames and angles must be dry before putting the fasteners at proper places.  
-----

6.0 IDENTIFICATION  
-----

- 6.1 All the frames and angles shall be identified by Stencilling the following details :

Sub-contractor's code number :  
Work Order Number :  
Frame identification No. (1,2,3, or 4) :  
Weight :  
Drawing Number :

BHEL  
RANIPET

MASTER COPY

QUALITY DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q.C.P)

Q.W.I.NO:E 018

REV: 00

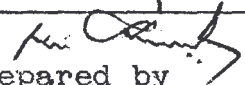
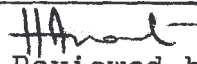

AMENDMENT SL NO:

A 2 ✓

DESCRIPTION: Grip Coupling

DATE: 28/1/95

DETAILS

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
3.4	Defects detected shall be rectified as per QCP 002 (latest).	QCP 2:5:013 withdrawn.
Prepared by 	Reviewed by 	Approved by 

Distribution: As per standard distribution list.

BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET 632 406

QUALITY DEPARTMENT

BAP:QA:93:9835  
5th jul 93

QCP Ref: E:018

Grip coupling of ESP

Amendment No. 01

Effective date:7/7/93

The following amendments are issued against the referred QCP under the respective clause numbers instead of existing therein.

Clause No	Title	Amended as
2.0	References	1) AWS D1.1 2) AA 041 1401 Corporate standard for welding based on IS 2553. 3) Structural QCP 2:5:013
3.1		Raw-materials used shall conform to the design specifications. Steel grades generally specified are SA 105, IS 2062.
3.4		Defects detected shall be rectified as per QCP 2:5:013.
5.2		Welders shall be qualified as per AWS D1.1. Welders qualified to any other code may also be permitted at the discretion of Inspection engineers.
5.3.3		PR:QA:020 shall be followed for baking and drying of electrodes. Oven used for baking of electrodes shall be maintained in good working conditions.

Kindly acknowledge receipt of this amendment.

  
Sr Manager (QA)

**Distribution**

As per controlled distribution list

**BHEL**  
**RANIPET**



BHARAT HEAVY ELECTRICALS LTD.  
BOILER AUXILIARIES PLANT  
RANIPET 632 406

QCP:E:018  
PAGE 01 OF 06

QUALITY DEPARTMENT

QUALITY CONTROL PROCEDURE FOR	GRIP COUPLING OF ESP		
EFFECTIVE DATE	30 04 92		
DEPARTMENT	ACCEPTED BY	SIGNATURE	DATE
EDC/AQCS	B BHARATHARAJAN	<i>Bharatharajan</i>	29/4/92
ANCILLARY DEVELOPMENT GR	VENKATRAMAN	<i>Venkatraman</i>	29/4/92
QUALITY CONTROL	HBN MURTHY	<i>HBN Murthy</i>	29/4/92
QUALITY ASSURANCE	PH TAMBAKHE	<i>PH Tambakhe</i>	29/4/92
QUALITY SURVEILLANCE	G THIRUNAVUKKARASU	<i>G Thirunavukkarasu</i>	29/4/92

ISSUED BY : QUALITY ASSURANCE  
REVISION : NIL  
DATE : 30 04 92

QUALITY CONTROL PROCEDURE FOR GRIP COUPLING OF ESP ITEM

1.0 SCOPE:

This Quality Control procedure details the quality requirements to be adhered with respect to GRIP COUPLING of ESP.

2.0 References

- i) AWS D1.1.
- ii) AA041-1401 Corporate standard for welding  
Based on IS 2553-1984
- iii) Structural QCP 2:5:013/08.

3.0 Raw Materials

- 3.1 Raw material used shall conform to design specifications. Generally SA 105, IS 226 and IS 2062 grades are used.
- 3.2 In case of material substitution, prior approval from Engineering to be obtained.
- 3.3 Raw material shall be free from harmful visual defects such as Cracks, seams, laps, laminations, heavy pittings etc.
- 3.4 Defects detected shall be rectified as per QCP 2/5/013/08. (clause 5.1.4)
- 3.5 Plates having deviations like bend, out of straightness, twist, etc., shall be corrected before taking up for fabrication, by cold treatment.

Straightening under hot stage shall be resorted to only under specific permission from quality control

4.0 FABRICATION

4.1 FLAT BAR:

- 4.1.1 After gascut of flat bar following dimensions are to be ensured.

LENGTH to be maintained within plus or minus 2mm

WIDTH within plus or minus 1mm

FLATNESS within plus or minus 1mm

Ensure centre line marking/punching of the flat bar in longitudinal direction prior to pressing. No deviation permitted on centerline marking/punching.

**4.1.2 PRESSING**

Pressing of the flat bar can be carried out either by cold/hot formation. In case of hot formation temperature of the flat shall be maintained within 600-650 degree centigrade during the entire operation. Air cooling only as permitted after pressing.

Pressing shall be carried out across the rolling direction of the plate only.

Following deviations should be avoided.

1. Twist
2. Band Line Crack
3. Tool marks.

Pressed flat bar shall be checked with TEMPLATE for profile, flatness.

**5.0 WELDING**

5.1 Pre qualified welding procedure as per section 5 of AWS D1.1. latest shall be used.

5.2 Welders shall be qualified as per AWS D1.1. welders qualified to any other code may also be permitted at the discretion of inspecting engineer.

**5.3 ELECTRODE**

5.3.1 E 6013 electrode to be used.

5.3.2 Only BHEL (GRICHY/RANIPET) approved brands of electrode shall be used.

5.3.3 PRQA:020 shall be followed for baking and drying of electrodes. Oven used for baking of electrodes shall be maintained in good working condition.

5.3.4 Size of weld shall be as per drawing.

**6.0 TOLERANCES**

Length of flat bar	+ or - 2mm.
Height of flat bar	+ or - 2mm.
Bore of the coupling	+ 0.025
Width of the key way	+ 0.021

Offset of keyway centre with respect to flat bar centre shall be maintained within plus or minus 0.5 mm. TWIST NOT PERMITTED

**6.0 TOLERANCES**

Length of flat bar	+ or - 2mm.
Height of flat bar	+ or - 2mm.
Bore of the coupling	+ 0.025 - 0.000
Width of the key way	+ 0.021 - 0.021

Offset of keyway centre with respect to flat bar centre shall be maintained within plus or minus 0.5mm.

Twist not permitted.

**7.0 NDT REQUIREMENTS**

7.1 100% LPI on the fillet welds.

**8.0 TRIAL ASSEMBLY**

Trial assembly of the matching sets shall be carried out as per the following combinations to suit site requirements.

MOTOR SIDE	RAPPING SHAFT SIDE
TYPE 01 DIA 40	DIA 50
TYPE 02 DIA 45	DIA 50
TYPE 03 DIA 50	DIA 50

After fabrication, each piece will be taken and checked in the fixture for straightness and proper alignment. Firm to ensure proper, equal as well as simultaneous contact on both the limbs. This is to ensure equal loading on both the limbs. 100% bearing contacts of the limbs are to be ensured by scrapping/grinding in all the four different contact positions. Subsequently, both the pieces will be punch marked legibly with the same match number along with firm code, tied together and despatched to site in pairs. Mix-up between different pairs to be avoided.

***BHEL***  
***RANIPET***

QCP:E:018  
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9.0 CLEANING AND PAINTING

9.1.1 All items shall be cleaned for loose mill scale, rust and foreign materials before painting. Journal bearing area should be protected with rust preventive oil only.

9.1.2 Following details shall be legibly stenciled and covered with one coat of transparent varnish.

PROJECT NAME :

W.O.NUMBER :

D.U.NUMBER :

VARIANT NO. :

WEIGHT :

SUB.CONT.CODE:

The above details shall be punched and the punched details shall be bordered with white paint.

**BHEL**  
**RANIPET**

QCP:E:018  
PAGE 06 OF 06

**CHECK LIST**

- 1) **RAW MATERIAL**  
Visual, Verification of MIV for substitution if any  
and identification of appropriate welding procedures.
- 2) **ELECTRODE**  
Specification, ISI Mark etc.,
- 3) **PAINT**  
Specification IS or equivalent Mark etc.,
- 4) **WELD**  
Size, Visual
- 5) **DIMENSION**  
Length, height, twist, centreline punching.  
Surface finish.
- 6) **PAINTING**  
Visual for Aesthetic appearance.
- 7) **Calibrated tape, instruments.**

\*\*\*\*\*

PC FILE:D:\ESP\QCPE018


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MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				STANDARD QUALITY PLAN						
M/S BHEL / BAP / RANIPET TAMIL NADU-632 406		ITEM/SUBSYSTEM: PIN WHEEL ASSY	QP:NO: SQP:ESP:201 REV: NO:00 DATE: 28/01/2001 PAGE: 01 OF 06									
SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	CL 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE FORMS 8	FORMAT OF RECORDS 9	AGENCY 10			REMARKS 11
									M	C	V	
1.0	RAW MATERIALS											Raw Mats are taken to stock on verification of TC / Random testing.
1.1	ROUNDS AND PLATES ROUND FOR HUB	Chemistry & Mechanical	M	Review of TC*	Each Heat / Lot	As per Matl. Specn		TC	P	V		
1.2		Internal Soundness	M	UT	100 %	TDC:RTG:057(latest)		R	P	V		
2.0	IN PROCESS CONTROL											
2.1	FLAME CUTTING	Lamination & Crack	M	Visual	100 %	As per AWS D1.1			P	V		
2.2	WELDING	a) Procedure Qualifn. b) Personnel Qualifn.	M	Review of documents	100 %	.do.		R	P	V		


LEGENDS:  
M - MANUFACTURER / SUBCONTRACTOR , C - CONTRACTOR(BHEL) / AUTHORISED INSPN AGENCY  
CL - CLASS (M - MAJOR C - CRITICAL) P - PERFORM , V - VERIFICATION, W - WITNESS, R - REPORT TC - TEST CERTIFICATE

PREPARED BY	REVIEWED BY	APPROVED BY
	ENGG (AQCS)	
	QC (OLI)	
	QA	


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		<b>MANUFACTURER'S NAME &amp; ADDRESS</b> M/S BHEL / BAP / RANIPET TAMIL NADU-632 406		<b>MANUFACTURING QUALITY PLAN</b>			<b>STANDARD QUALITY PLAN</b>				
		<b>ITEM :</b> PIN WHEEL ASSY		<b>QP-NO: SQP-ESP-201</b> <b>REV: NO:00</b> <b>DATE: 20/01/2001</b> <b>PAGE: 02 OF 05</b>							
<b>SL NO</b> <b>1</b>	<b>COMPONENT &amp; OPERATION</b> <b>2</b>	<b>CHARACTERISTICS</b> <b>3</b>	<b>CL</b> <b>4</b>	<b>TYPE OF CHECK</b> <b>5</b>	<b>QUANTUM OF CHECK</b> <b>6</b>	<b>REFERENCE DOCUMENTS</b> <b>7</b>	<b>ACCEPTANCE FORMS</b> <b>8</b>	<b>FORMAT OF RECORDS</b> <b>9</b>	<b>AGENCY</b> <b>10</b>		<b>REMARKS</b> <b>11</b>
									M	C	
2.3	PIN: Machining and case hardening	a) O D (before & after case hardening) b) Depth of case hardening  c) Surface Hardness	M	Measurement	100 %	Drawing  Refer Note & Drg. Case depth shall be 0.8 to 1.0mm		R	P	V	@ One sample per HT batch of carburisation shall be checked for case depth.
			C	-do-	See @ Remarks		R	P	W		
			C	-do-	100 %	Hardness HRC 58 to 62	R	P	W		
2.4	PIN WHEEL - I										
2.4.1	Flange drilling (Flange ring to be drilled in a fixture)	Hole dia	M	Measurement	100 %	Drawing		R	P	V	
2.4.2	SUB-ASSY OF PIN & FLANGE (Pin Wheel Ring)	Fillet welding of Pin & Flange  Note: 1. Sequential Welding to be followed as per drg 2. Straighten the ring immediately after welding before it gets cooled. 3. Pin Wheel ring to be divided after cooling	M	Visual & LPI	10 %	AWS D1.1.  Drawing & Notes		R	P	V	
			M	Measurement		Straightness within 1 mm		R	P	V	

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		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				STANDARD QUALITY PLAN			
		M/S EHEEL / BAP / RANIPET TAMIL NADU-632 406		ITEM/SUBSYSTEM: PIN WHEEL ASSY	QP:NO: SQP-BEP-201 REV: NO:06 DATE: 28/01/2001 PAGE: 03 OF 06						
SL. NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	CL 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE CRITERIA 8	FORMAT OF RECORDS 9	AGENCY 10		REMARKS 11
									M	C	
2.4.3	SUB ASSY OF HUB & FLANGE PLATE	Fillet Welding of Hub & Flange plate with stiffness Note: After welding of hub, divide it as per drg, but before drilling.	M	LPI	10 %		AWS D1.1	R	P	V	
2.4.4	Drilling, Bore & Key way	Hole dia 100mm & 50mm Note: Use 0.1 mm shims - 3 nos while drilling dia 50. Bore & Keyway with threaded holes M12	M	Measurement	100 %		Drawing	R	P	V	
			M	Measurement	100 %		.do.	R	P	V	
2.4.5	ASSY OF PIN WHEEL - I	Match Drilling of 8 holes dia 17.5 of Pin Wheel ring sub-assy with sub-assy of Hub & flange plate.	M	-do-	100 %		-do-	R	P	V	

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		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				STANDARD QUALITY PLAN			
		M/S EHEL / BAP / RANIPET TAMIL NADU-632 406		ITEM : PIN WHEEL ASSY	QP: NO: SQP: ESP: 201	REV: NO: 00	DATE: 26/01/2001				PAGE: 04 OF 06
Sl. No 1	Component & Operation 2	Characteristics 3	CL 4	Type of Check 5	Quantum of Check 6	Reference Documents 7	Acceptance Criteria 8	Format of Records 9	Agency 10		Remarks 11
									M	C	
2.5	PIN WHEEL - II										
2.5.1	Flange Plate drilling (Flange ring to be drilled in a vendor made fixture)	Hole dia	M	Measurement	100 %	Drawing		R	P	V	
2.5.2	Flange Plate and Pin	Fillet welding of Pin & Flange Plate Note: 1. Sequential Welding to be followed as per dwg 2. Straighten the ring immediately after welding before it gets cooled.	M	Visual & LPI	100 %	AWS D1.1.		R	P	V	
			M			Drawing & Notes					
			M	Measurement	100 %	Straightness within 1 mm		R	P	V	

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SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	CL 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE CRITERIA 8	FORMAT OF RECORDS 9	AGENCY 10		REMARKS 11
									M	C	
2.5.3	HUB & FLANGE PLATE WELDING	Fillet Welding of Hub & Flange plate with stiffeners Note: After welding of hub, divide it as per drg, but before drilling.	M	LPI	10 %		AWS D1.1	R	P	V	
2.5.4	Drilling, Bore & Key way	Drilling of Hole dia 40 & 15mm Note: Use 0.1 mm shims - 3 nos while drilling dia 40. Bore & Keyway with threaded holes M12	M	Measurement	100 %		Drawing	R	P	V	
2.5.5	ASSY OF PIN WHEEL - II	Match Drilling of Dia 6 for Cylindrical Pin after assy of Pin Wheel - II and fillet weld	M	-do-	100 %		-do-	R	P	V	



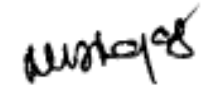
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SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	CL 4	TYPE OF CHECK 5	QUANTITY OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE CRITERIA 8	FORMAT OF RECORDS 9	AGENCY 10		REMARKS 11
									M	C	
3.0	FINAL INSPECTION FOR PIN WHEEL ASSY - I & II	Pin Wheel Assy - @ completeness and overall dimensions  Surface Cleaning, Painting & preservation	M	Measurement	100 %	Drawing & Notes		R	P	W	© The parting line of Position 1 and that of Position 4 to be at 90 degree as per diag for Pin Wheel Assy - I
			M	Visual	100 %	BHEL standard painting schedule RP 067 41 99			P	V	

**NOTE :**

1. Case Depth checking of pin shall be done by destructive testing of one sample per each HT batch at BHEL approved labs.
2. For welding E 7018 electrodes shall be used. These electrodes shall be purchased in hermetically sealed containers. Immediately after opening the hermetically sealed container, electrodes shall be stored in oven held at a temperature of at least 120°C.
3. Electrodes exposed to atmosphere for periods more than four(4) hours shall be baked for at least two(2) hours between 260 to 430°C and held at 120°C until they are used.

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		BHEL: BAP:RANIPAT TAMIL NADU - 632 406  QUALITY DEPARTMENT		<b>STANDARD QUALITY PLAN</b>				QP:No : <b>FAN 302</b> Rev: No: 01 Date : 09 02 10 <b>Page 01 Of 14</b>			
				<b>RVC ASSY</b>		NAME OF CONTRACT PACKAGE					<b>STANDARD</b>
SL NO	COMPONENT & OPERATION	CHARACTERISTI CS	TYPE OF CHECK	CLASS	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	Agency		REMAR KS
1	2	3	4	5	6	7	8	9	M	B	11
									10		
1.0	MATERIALS										
1.1	RAW MATERIALS										
1.1.1	PLATES,STEELS RODS	CHEM&MECH PROPERTIES	MAJOR	VERIFICA TION	100%	RESPECTIVE MATERIAL SPECIFICATION		TC	P	V	
1.2	BOUGHT OUTY ITEMS										
1.2.1	DRY BUSH,DIAL PLATES,ECCENT RIC BUSH,FIXED BRG	COMPLIANCE TO P.O.	MAJOR	VERIFICA TION	100%	PURCHASE SPEC		TC/DR	P	V	
<b>LEGENDS:</b> <b>M-MANUFACTURER /SUBCONTRACTOR</b> <b>B- BHEL/BHEL AUTHORISED INSPECTION AGENCY</b>  <b>P- PERFORM, V- VERIFICATION, W-WITNESS</b> <b>R-REPORT TC-TEST CERTIFICATE</b> <b>LPI:LIQUID PENETRANT INSPECTION</b> <b>MT:MAGNETIC PARTICLE INSPECTION</b>				<b>PREPARED BY :</b>  <b>( KRajadurai )</b> <b>DM/QA</b>				<b>REVIEWED &amp; APPROVED BY:</b>  <b>( M G Rajashankar,DGM/QA)</b>			

Rev 00 dt 12 12 2000

ORIGINAL ISSUE

: REV 01 DT 10 02 10 REVISED BASED ON THE SITE ISSUES FROM PARLI & REVIEWED WITH ENGG-FES & QC-OLI



BHEL: BAP:RANIPAT  
TAMIL NADU - 632 406

QUALITY DEPARTMENT

**STANDARD QUALITY PLAN**

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SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTI CS 3	TYPE OF CHECK 4	CLASS 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency		REMAR KS 11
									M	B	
									10		
2.0	INPROCESS INSPECTION										
2.1	GAS CUTTING/ SHEARING	SHAPE &SIZE	MAJOR	MEASURE MENT	100%	DRAWING NOTE 3		DR	P	W	
2.2	OUTER CONE ASSY										
2.2.1	ROLLING/ FORMING	ID,OD,HEIGHT PROFILE FLANGE DIMENSIONS	MAJOR	-DO-	100%	DRAWING NOTE 2		DR	P	W	
2.2.2	WELDING										
2.2.3	WELD SOUNDNESS	WELD SIZE & FINISH	MAJOR	-DO-	100%	DRAWING & NOTE 1		-	P	W	
		WELD SOUNDNESS.	MAJOR	PT	100%	BHE:NDT:RP:PT01/LATEST		NDT REPORT	P	W	



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									M	B	
									10		
2.2.4	MACHINING	PCD,HOLE DIA BUSH HOLE ORIENTATION FLANGE HOLES MATCHING, HT OF THE CONE, CIRCULARITY OF THE CONE, CONCENTRICITY OF INLET CONE W.R. TO FLANGE PCD OF FLANGE, HEIGHT OF CONE.	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2			P	W	
2.3	INNER CONE ASSY										
2.3.1	ROLLING/ FORMING	ID,OD,HEIGHT OF CONE, SHELL ID, OD, HEIGHT	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2		DR	P	W	
2.3.2	WELDING	WELD SIZE &FINISH	MAJOR	VISUAL	100%	DRAWING & NOTE 1		-	P	W	
		WELD SOUNDNESS	MAJOR	PT	100%	BHE:NDT:RP:PT01/LATEST		NDT REPORT	P	W	



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									M	B	
									10		

2.3.3	MACHINING	DRILL HOLES PCD, HOLES DIA BUSH HOLE ORIENTATION FLANE FACING SHELL ID.	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2			P	W	
2.4	BLADE ASSY										
2.4.1	PRESSING/ FORMING	SHAPE &SIZE	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR		P	W	
2.4.2	WELDING	FIT UP OF STRIP WIH BLADE	MAJOR	VISUAL	100%	ORIENTATION FOR CW/ ACW/ W.R. TO ROTATION.	DR		P	W	
		SIZE WELD FINISH	MAJOR	VISUAL	100%	DRAWING & NOTE 1	-		P	W	



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SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTI CS 3	TYPE OF CHECK 4	CLASS 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency		REMAR KS 11
									M	B	
									10		

2.5	OPERATING/ REGULATING RING										
2.5.1	ROLLING/ FORMING	ID,OD,HEIGHT, CONE ID, RING ID, OD	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR	P	W		
2.5.2	WELDING	WELD SIZE FINISH& SOUNDNESS	MAJOR	VISUAL	100%	DRAWING NOTE 1 BHE:NDT:RP:PT01/LATEST	DR	P	W		
2.5.3	MACHINING	RING OD THICKNESS FACE OUT DRILL HOLE ORIENTATION PCD, DIA LOCATIN OF RING & DRILLED HOLES ,PITCH DISTANCES	MAJOR	VISUAL	100%	DRAWING & NOTE 2	DR	P	W		

		BHEL: BAP:RANIPAT TAMIL NADU - 632 406  QUALITY DEPARTMENT		<b>STANDARD QUALITY PLAN</b>				QP:No : <b>FAN 302</b> Rev: No: 01 Date : 09 02 10 <b>Page 06 Of 14</b>			
				<b>RVC ASSY</b>		NAME OF CONTRACT PACKAGE					<b>STANDARD</b>
SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTI CS 3	TYPE OF CHECK 4	CLASS 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency M   B 10		REMAR KS 11

2.6	EXTENSION ASSY										
2.6.1	ROLLING	SHELL ID, OD HEIGHT & FLANGE DIMENSIONS	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR	P	W		
2.6.2	WELDING	WELD SIZE & SHAPE	MAJOR	MEASURE MENT	100%	DRAWING NOTE 1	DR	P	W		
2.6.3	MACHINING	DRILL HOLE PCD, ID & ORIENTATION OF RING, STEP MACHINING,PIT CH DISTANCE & VERITICALITY OF HOLES ,	MAJOR	MEASURE MENT	100%	DRAWING & NOTE 2	DR	P	W		



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									M	B	
									10		

2.7	ACUATING SHAFT ASSY										
2.7.1	MACHINING	OD,LENGTH,KEY WAY DIEMSIONS ,KEY OFFEST,THRED SIZE CHECKING BY GAUGE,STEP OD	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR	P	W		
2.8	CONTROL LINK ASSY										
2.8.1	WELDING	WELD SIZE	MAJOR	VISUAL	100%	DRAWING & NOTE-1	DR	P	W		
2.8.2	CONTROL LINK ASSY	LENGTH, PERPENDICULAR ITY,	MAJOR	MEASURE MENT		DRAWING NOTE 2	DR	P	W		

		BHEL: BAP:RANIPAT TAMIL NADU - 632 406  QUALITY DEPARTMENT		<b>STANDARD QUALITY PLAN</b>				QP:No : <b>FAN 302</b> Rev: No: 01 Date : 09 02 10 <b>Page 08 Of 14</b>			
				<b>RVC ASSY</b>		NAME OF CONTRACT PACKAGE					<b>STANDARD</b>
SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTI CS 3	TYPE OF CHECK 4	CLASS 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency		REMAR KS 11
									M	B	
									10		

2.9	ACTUATING LEVER ASSY										
2.9.1	GAS CUTTING	SHAPE & SIZE	MAJOR	MEASURE MENT	100%	DRAWING & NOTE 3	DR	P	V		
2.9.2	WELDING	WELD SIZE	MAJOR	VISUAL	100%	DRAWING & NOTE-1	DR	P	W		
2.9.3	MACHINING CLEVIS	LENGTH, ,DEPTH, HOLE ORIENTATION AND DIA, BORE DIA, KEY WAY DIMENSIONS ,SURFACE FINISH	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR	P	W		
2.10	INNER SPINDLE										
2.10.1	GAS CUTTING	SHAPE & SIZE	MAJOR	MEASURE MENT	100%	DRAWING &NOTE 3	DR	P	V		



BHEL: BAP:RANIPAT  
TAMIL NADU - 632 406

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									M	B	
									10		

2.10.2	INNER SPINDLE MACHINING	OD,LENGTH, SLOT LENGTH & DEPTH,HOLE DIA ,PIN DIMENSIONS, LEVER BOSS DIMENSIONS, LEVER PLATE ORIENTATION W.R.T SLOT	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR	P	W	
2.10.4	WELDING	WELD SIZE & WELD QUALITY	MAJOR	VISUAL& DP	100%	BHE:NDT:RP:PT:01/LATEST	REPORT	P	V	
2.11	OUTER SPINDLE		MAJOR	VISUAL	100%	DRAWING & NOTE-2	DR	P	W	
2.11.2	MACHINING CLEVIS	LENGTH,SLOT WIDTH,DEPTH, HOLE ORIENTATION AND DIA, THREAD SIZE CHEKING BY RING GAUGE, END BLOCK THRED CHECK BY PLUG GAUGE,	MAJOR	MEASURE MENT	100%	DRAWING NOTE 2	DR	P	W	

SL NO		COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	CLASS	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	Agency		REMARKS						
1	2									M	B							
											<b>BHEL: BAP:RANIPAT</b> <b>TAMIL NADU - 632 406</b> <b>QUALITY DEPARTMENT</b>		<b>STANDARD QUALITY PLAN</b>				<b>QP:No : FAN 302</b> <b>Rev: No: 01</b> <b>Date : 09 02 10</b> <b>Page 010 Of 14</b>	
<b>RVC ASSY</b>							<b>NAME OF CONTRACT PACKAGE</b> <b>STANDARD</b>											
3.0	FINAL INSPECTION																	
3.1	RVC ASSY *	OVERALL DIMENSIONS, ASSY OF ALL COMPONENTS OPERATION BLADE OPENING AND CLOSING BLADE TO BLADE CLOSING GAP. ANGLE OF OPEN AND CLOSE. BLADE TO INNER CONE 7BLADE TO OUTER CONE GAP. DIRECTION OF OPENING	MAJOR	MEASUREMENT	100%	DRAWING& NOTE 4	DR	P	W	<b>* OPENING &amp; CLOSING OPERATION SHALL BE DONE SAME AS THAT OF SITE ASSY CONDITION.</b>								
3.2	PAINTING PRESERVATION IDENTIFICATION	IDENTIFICATION OF WO NO. DU NO.	MAJOR	VISUAL	100%	PRQA 590/LATEST	DR	P	W									

REV: 00 DATE 12 12 2000 ORIGINAL ISSUE ; REV: 01 DT 23 01 2010 TOTALLY MODIFIED.

		BHEL: BAP:RANIPAT TAMIL NADU - 632 406  QUALITY DEPARTMENT		<b>STANDARD QUALITY PLAN</b>				QP:No : <b>FAN 302</b> Rev: No: 01 Date : 09 02 10 <b>Page 011 Of 14</b>			
				<b>RVC ASSY</b>		NAME OF CONTRACT PACKAGE					STANDARD
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NOTE 1 (a) WELD PROCEDURES AND WELDERS SHALL BE QUALIFIED AS PER AWS D.1.1

(b) ALL THE ELECTRODES HAVING LOW HYDROGEN COVERING SHALL BE PURCHASED IN HERMATICALLY SEALED CONTAINERS IMMEDIATELY AFTER OPENING THE HERMETICALLY SEALED CONTAINER, ELECTRODES SHALL BE STOCKED IN OVENS HELD AT TEMP OF ATLEAST 120 DEG C. ELECTRODES THAT HAVE BEEN WET SHALL BE NOT BE USED.

(c) ELECTRODES EXPOSED TO ATMOSPHERE FOR PERIODS OVER THAN 4 HRS SHALL BE BACKED FOR ATLEAS TWO HOURS HOURS BETWEEN 260 TO 430 AND HELD AT 120 DEG UNTIL THEY ARE USED.

(d) FUTILE COATED ELECTRODES SHALL BE DRED AT 120 DEG TO 130 DEG C FOR ONE HOUR BEFORE USE.

(e) IF THE ELECTRODES ARE EXPOSED FOR MORE THAN 4HRS TO THE ATMOSPHERE. THESE SHALL BE RE BAKED AND DRIED IN THE SAME MANNER

(f) WELDS SHALL BE CLEANED THOROUGHLY TO REMOVE THE SPATTER & SLAG  
ALL BUTT JOINTS SHALL BE BACKGROUND TO REMOVE ALL SLAG, UNFUSED AREA ETC. AND LPI CHECKED BEFORE FURTHER WELDS.

NOTE 2 CIRCULAR FLANGE & CONES

(a) PITCH DISTANCES FOR TWO CONSECUTIVE HOLES SHALL BE WITH +/- 1MM

(b) DEVIATION ON FLATNESS SHALL NOT EXCEED 3MM.

(c) INCASE OF CIRCULAR FLANGES THE DIAMETRICALLY OPPOSITE HOLE DISTANCES SHALL NOT EXCEED 1.5MM

(d) HOLES OFFSET WITH REFERANCE TO CENTER LINE OF PCD SHALL NOT EXCEED +/-1MM

(e) FOR UNTOLERANCED DIMENSIONS PRQA 500/LATEST SHALL BE REFERRED.

(f) SEPARATE DIEMSIONAL REPORT AGAINST EACH ITEM AS PER QP SHALL BE FOR ITEMS LIKE INNER SPINDLE, OUTER SPINDLE, LEVER, LINKAGE ASSY, ROLLER, REGULATING RING, LEVER ASSY, BLADES, EXTENSION ASSY, INNER CONE, OUTER CONE SWIVEL PIN, STUDS ETC. AND ALL THE REPORT VERIFIED DURING FINAL INSPECTION

NOTE -3


(a) GAS CUTTING NOTCHES EXCEEDING 0.8 MM DEPTH SHALL BE REPAIRED BY WELDING AND GRINDING.

(b) GAS CUT EDGES SHALL BE GROUND SMOOTH BEFORE WELDING.

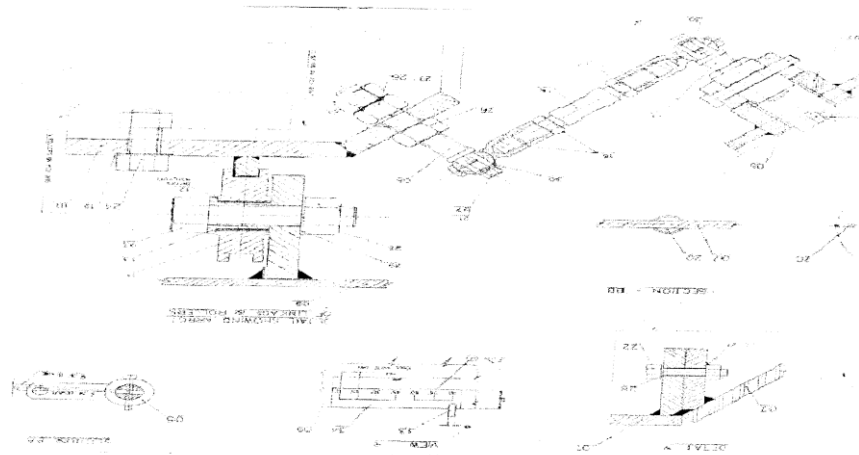
NOTE-4

OPENING & CLOSING SHALL BE DONE IN SAME SITE ORIENTATION, NO FOULING OF LINKAGE ASY WITH INNER SPINDLE ASSY IS ALLOWED. BLADE OPENING & CLOSING GAPS & DIRECTIONS SHALL BE VERIFIED.




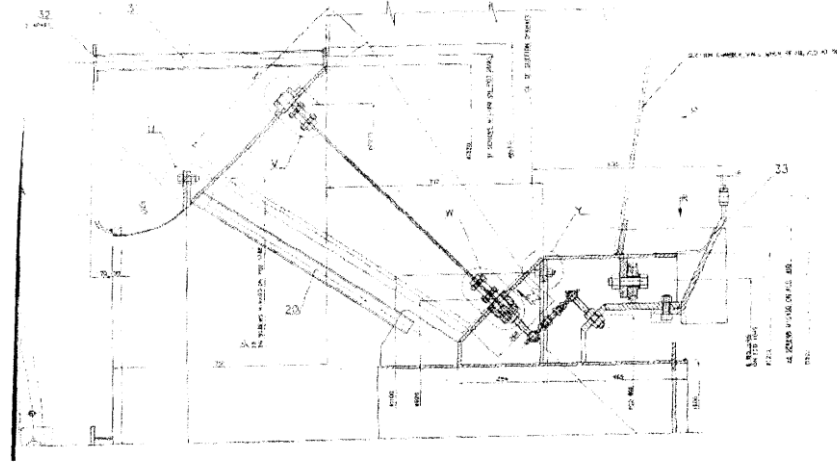
		BHEL: BAP:RANIPAT TAMIL NADU - 632 406  QUALITY DEPARTMENT		<b>STANDARD QUALITY PLAN</b>				QP:No : <b>FAN 302</b> Rev: No: 01 Date : 09 02 10 <b>Page 013 Of 14</b>		
				<b>RVC ASSY</b>		NAME OF CONTRACT PACKAGE				
SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	TYPE OF CHECK 4	CLASS 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency M   B 10	REMARKS 11

**Perpendicularity swivel pin with rod end assy .Roller contact with regulating ring & rotation during operation in site orientation-Axis horizontal**



**Identical orientation of lever for a given blade position .**

		BHEL: BAP:RANIPAT TAMIL NADU - 632 406  QUALITY DEPARTMENT		<b>STANDARD QUALITY PLAN</b>				QP:No : <b>FAN 302</b> Rev: No: 01 Date : 09 02 10 <b>Page 014 Of 14</b>		
				<b>RVC ASSY</b>		NAME OF CONTRACT PACKAGE				
SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTI CS 3	TYPE OF CHECK 4	CLASS 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency M   B 10	REMAR KS 11



**Vane opening & closing angles as per drg & ease of operation shall be ensured . No fouling of linkage with each other is allowed**

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 BAR FOR SERTIGATION

OF CONTRACT PACKAGE  
 STANDARD

Q.P. No. FAN324  
 REV. No. 01  
 DATE 15/1/93  
 PAGE 01 of 01

PREPARED BY: *B. Srinivas Rao*

REVIEWED BY:



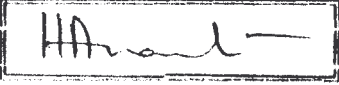
APPROVED BY: *HP*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	INTEGRAL TEST BAR GZ-CU-Sn-7Zn-Pb	CHEMISTRY	CRIT-CAL	ANALYSIS	EACH HEAT		DIN 1705	T.C	GOVT APPD. LAB	V @
2.0.	-DO-	MECHANICAL	-DO-	TENSILE TESTING	-DO-		-DO-	T.C	-DO-	
				HARDNESS*	-DO-		-DO-	T.C	-DO-	* HB 10/100
3.0.	BUSH	DIMENSIONS	-DO-	MEASURE-MENT	100%		DRAWING	DIMEN-SIGNAL REPORT	VQCD	VQCD-VENDOR QUALITY CONTROL DEPT
		FINISH	MAJOR	CHECK WITH COMPARATOR	100%		DRAWING	-DO-	-DO-	
		FREEDOM FROM VISUAL DEFECTS	MAJOR	VISUAL	100%		DRAWING	-DO-	-DO-	CHP @
		HARDNESS IDENTIFICATION	MAJOR	HARDNESS CHECKING VISUAL	RANDOM 100%		DIN 1705	T.C	-DO-	
		##	##	START FROM 001 AND CONTINUE UP TO 999, IRRESPECTIVE OF THE F.O						

NOTE: ONE MORE INTEGRAL TEST BAR SHALL BE CAST ALONGWITH EACH CAST LOT AND SENT TO M/S BHEL ALONG WITH COSINGMENT

@ V : VERIFICATION OF CERTIFICATES  
 @ CHP : CUSTOMER HOLD POINT

**MASTER COPY**

<b>BHEL RANIPET</b>	<b>STANDARD QUALITY CONTROL PLAN FOR PISTON WITH ADJUSTING DISC ASSY</b>	
<b>REF.NO.</b>	<b>REVISION NO</b>	<b>EFFECTIVE DATE</b>
FAN:327	01	28 09 96
<b>PREPARED BY</b>	<b>: B SRINIVASA RAO, DM/QA</b>	
<b>REVIEWED BY</b>	<b>: V SUBRAMANIAN, SM/QC</b>	
<b>APPROVED BY</b>	<b>: H ANANTHANARAYANAN, DGM/QA</b>	
<b>ISSUED &amp; CONTROLLED BY</b>	<b>:: QUALITY ASSURANCE BHEL, RANIPET-632 406</b>	
<b>DOCUMENT CONTROL NO:</b>		
<b>ISSUED TO SHRI</b>	<b>:</b>	
<b>PAGE NO: 01 OF 05</b>		

<b>BHEL RANIPET</b>	<b>RECORD OF REVISIONS</b>		<b>QP.NO:FAN:327 REV.NO:01 PAGE 02 OF 05</b>
<b>REV NO:</b>	<b>CLAUSE NO</b>	<b>REVISIONS MADE</b>	<b>DATE</b>
<b>00</b>	<b>--</b>	<b>FRESH ISSUE</b>	<b>22 11 93</b>
<b>AMENDMENT-A1</b>	<b>--</b>	<b>REFERENCE DOCUMENTS SHALL BE OF LATEST REVISION ONLY</b>	<b>13 01 94</b>
<b>01</b>	<b>--</b>	<b>1)AMENDMENT A1 INCLUDED 2) FORMAT MODIFIED</b>	<b>28 09 96</b>

ISSUED BY QUALITY ASSURANCE BHEL, RANIPET-6

STANDARD QUALITY PLAN FOR

PISTON WITH ADJUSTING DISC ASSY

OPND: PANT  
 REV. No: 01  
 DATE: 280996  
 PAGE 03 OF 05

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	
1.0	<u>MATERIALS</u>									
1.1	RAW MATERIALS									
1.1.1	FLANGE	CHEM & MECH PROPERTIES	MAJOR	VERIFICATION OF TEST CERTIFICATES	100%	RESPECTIVE TDC		TEST CERTIFICATES	QC/PROC	
1.1.2	SPINDLE	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	
1.1.3	ADJUSTING DISC	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	
1.2	<u>SUBDELIVERIES</u>									
1.2.1	FASTENERS	COMPLIANCE TO PURCHASE ORDER	MAJOR	VERIFICATION OF COMPLIANCE CERTIFICATE	100%	PURCHASE ORDER		*C. CERT	QC/SID	
2.0	<u>INPROCESS INSPECTION:</u>	NOTE1)RMA NO, SPEC. SWELT NO. SHALL BE VERIFIED IN CASE OF ATTESTED MATERIALS								
2.1.	ROUGH MACHINING ID, OD, I/P OF FLANGE		2) SPEC. SHALL BE VERIFIED IN CASE OF CERTIFIED MATERIALS							
2.2.	SPINDLE WELDING		MAJOR MEASUREMENT		100%	DRG APPQA: 500/LATEST			MOCD	
QC/SD: QUALITY CONTROL, SUBDELIVERY, QC/PROC: QUALITY CONTROL, PROCUREMENT, NDT: NONDESTRUCTIVE TESTING LABORATORY, C. CERT: COMPLIANCE CERTIFICATE										

QUALITY CONTROL PLANS FOR

PISTON WITH ADJUSTING DISC ASSY

QPN0: PAN: 327  
 REV. No: 01  
 DATE: 280996  
 PAGE 04 OF 05

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	
2.2.1	SPINDLE WITH FLANGE WELDING (PISTON ASSY)	SOUNDNESS	MAJOR	MT	100%	BHE: NDT: RP: MT: 01 / LATEST PR: QA: 337 / LATEST		NDT REPORT	NDTIL	
2.3.	STRESS RELIEF OF PISTON ASSY	COMPLIANCE TO STRESS RELIEF CYCLE	MAJOR	VERIFICATION OF HEAT TREATMENT CHART	100%	BAP: HT: 001 / LATEST		H.T CHART	MOCTD	
2.4.	MACHINING OF PISTON ASSY (Before chrome plating)	ID, OD, GROOVE LENGTH, STEP BORE LENGTH CONCENTRICITY DRILL HOLE SIZE, LOCATION HOLES PITCH, THREAD SIZE	MAJOR	MEASUREMENT	100%	MANUFACTURING DRAWING		--	MOCTD	

ISSUED BY QUALITY ASSURANCE BHEL, RANIPET-6

QUALITY CONTROL PLANS FOR

PISTON WITH ADJUSTING DISC ASSY

QPN0:FAN:327  
 REV.No:01  
 DATE:280996  
 PAGE 05 OF05

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	
2.5	CHROME PLATING OF PISTON ASSY.	CHROME PLATING THICKNESS & OD	MAJOR	-DO-	100%	-DO-	-DO-	-	MOCD	
2.6	MACHINING OF PISTON ASSY AFTER CHROME PLATING	-DO- & CONCENTRICITY	MAJOR	-DO-	100%	-DO-	-DO-	DR	MOCD	
2.7	ADJUSTING DISC M/CING	ID, OD, STEP DIA, LENGTH, HOLES PITCH & THREAD SIZE	MAJOR	-DO-	100%	-DO-	-DO-	-	MOCD	
2.8	PISTON WITH ADJUSTING DISC ASSY	PROPER ASSY & SOWELLING	MAJOR	VISUAL	100%	DRAWING&PR:QA:312/LATEST	-	-	MOCD	
2.9	DYNAMIC BALANCING	RESIDUAL UNBALANCEMENT	CRITICAL	UNBALANCE COMPENSATION	100%	DRAWING&PR:QA:306, 307, 314 & 338-LATEST	-	HISTORY CARD	MOCD	
3.0	IDENTIFICATION	PROPER IDENTIFICATION	MAJOR	VISUAL	100%	GMS	-	-	MOCD	

ISSUED BY QUALITY ASSURANCE BHEL RANIPET-6

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RANIPET

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QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)				
Q.W.I.NO: FAN329      REV: 00      AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table>			A	1
A	1			
DESCRIPTION: AP IMPELLER COVER PLATE      DATE: 13 01 94				
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
GENERAL	ALL DOCUMENTS REFERRED IN COLUMN 6&7 SHALL BE OF LATEST REVISION.	REVISION STATUS IS NOT MENTIONED IN THE DOCUMENTS REFERRED		
Prepared by <i>B. Sundararaj</i>		Approved by <i>[Signature]</i>		

Distribution: As per standard distribution list.

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET 632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLANT  
 RP TRIPPELLER COVER PLATE

NAME OF CONTRACT PACKAGE  
 STANDARD

QP NO : EAM329  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 01 OF 01

PREPARED BY: *B. Srinivasan*

REVIEWED BY: *S. Inam*

APPROVED BY: *f*

S NO	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACCPY STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1.0	MATERIAL	VERIFICATION	100%	MELT NO.; SPEC RMA NO:	RMA CARD	QC	QC	—	RMA CARD	
1.1	RING COVER W/CHG	MEASURE-MENT	100%	ID, OD,	DRG SERO: 500/ LATEST	QC	QC	VENNIER CALIPER	LOG	
1.2	COVER PLATE WELDING	HT	100%	WELD SOUNDNESS	BHE:NDT:RF:HT	NDT	NDT	NPT MACHINE	NDT REPORT	
1.3	COVER PLATE MACHINING	MEASURE-MENT	100%	ID, OD, HEIGHT, STEP DIAMETERS, DRILL HOLE DIMENSIONS	DRG:RQA: 500/ LATEST	QC	QC	VENNIER, STEEL TAPE	LOG	
1.4	IDENTIFICATION	VISUAL	100%	SRNO, NO. NO,	QPS	QC	QC	—	—	

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RANIPET

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QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)				
Q.W.I.NO: FAN330      REV: 00      AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table>			A	1
A	1			
DESCRIPTION: AP HUB WITH SUPPORTING ASSY      DATE:13 01 94				
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
GENERAL	ALL DOCUMENTS REFERRED IN COLUMN 6&7 SHALL BE OF LATEST REVISION.	REVISION STATUS IS NOT MENTIONED IN THE DOCUMENTS REF- ERRED		
Prepared by <i>B. Sundararaj</i>		Approved by <i>[Signature]</i>		

Distribution: As per standard distribution list.

PREPARED BY: *B. Srinivasulu*

REVIEWED BY: *S. Vinay*

APPROVED BY: *M. Anand*

COMPONENT & OPERATION	TYPE OF CHECK	QUANTITY OF CHECK	CHARACTERISTICS	REF STD	ACPT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
ASSY OF SUPPORT BODY & HUB	VERTICALITY	100%	CONCENTRICITY OF HUB AND SUPPORT BODY	—	—	QC	CONCENTRICITY CHECKING GAUGE	—	—
DRILLING OF DOMEL PIN HOLE	-DO-	-DO-	SIZE OF HOLE	DRG APPROX: 500	—	-DO-	ID MIC	—	—
MACHINING OF HUB AND SUPPORT BODY (LINE BORING)	MEASURE-MENT	-DO-	BORE DIAMETERS & LENGTHS.	DRG APPROX: 500	—	-DO-	ID MIC, CONCENTRICITY CHECKING GAUGE	HC	—
BALANCING	UNBALANCE VERTICA-TION	-DO-	UNBALANCE COMPENSATION	-DO-	—	QC	BALANCING MACHINE	HC	—
PRESERVATION	VERTICA-TION	-DO-	SURFACE PROTECTION BY TEMPORARY RUST PREVENTIVE	—	—	QC	—	—	—

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BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET 632 406 (INDIA) QUALITY ASSURANCE DEPT.	QUALITY CONTROL PLAN FOR  BLADE SHAFT	NAME OF CONTRACT PACKAGE STANDARD  QP NO : P&H 332 REV NO: 01 DATE : 20 06 94 PAGE : 01 OF 01
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PREPARED BY: *B. Srinivasulu*   
 REVIEWED BY: *S. Vijay*   
 APPROVED BY: *H. Anand*

S No	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACCP STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0	MATERIAL	VERIFICATION	100%	MELT NO, SPEC		T C	QC	--	--	
1.1.0	BLADE SHAFT ROUGH M/CING	MEASUREMENT	100%	OD, LENGTH, RADIUS, THREAD SIZE, GROOVE DIMENSIONS, GRINDING ALLOWANCE, PIP DIMENSIONS	DRG. PRQA:500/ LATEST & OPS		QC	VERNIER, OD MIC, DEPTH VERNIER, THREAD RING GAUGE, DIAL GAUGE	LOG	
1.1.1	BLADE SHAFT MACHINING	MEASUREMENT	100%	OD, LENGTH, RADIUS, THREAD SIZE, GROOVE DIMENSION, HOLE DIA & PCD, SURFACE FINISH, KEY WAY DIMENSIONS, & OFFSET, R/O& P/O IDENTIFICATION BY S/NO.	DRG&PRQA:500/ LATEST		QC	VERNIER, OD MIC, DEPTH VERNIER, DIAL GAUGE WITH STAND, SURFACE FINISH COMPARATOR, SLIP GAUGES	HC	HISTORY CARD
1.1.2	IDENTIFICATION	VERIFICATION	100%			--	QC	--	DR	
1.3	NDT	NT	100%	SURFACE PERFECTION	BRE:NDT:RP:NT2/ LATEST		NDT	WET METHOD (FLOURESENT) MPI MACHINE, SLIP GAUGES	NDT REPORT	
2.0	PRESERVATION	VISUAL	100%	PROPER PRESERVATION	TEMPORARY RUST PREVENTIVE SHALL BE SPRAYED SO THAT NO M/CED SURFACE IS EXPOSED.		QC	--	---	

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QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)				
Q.W.I.NO: FAN333	REV: 00	AMENDMENT SL NO: <table border="1" style="display: inline-table;"><tr><td style="width: 20px; text-align: center;">A</td><td style="width: 20px; text-align: center;">1</td></tr></table>	A	1
A	1			
DESCRIPTION: CYLINDER ASSEMBLY		DATE: 13 01 94		
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
GENERAL	ALL DOCUMENTS REFERRED IN COLUMN 6&7 SHALL BE OF LATEST REVISION.	REVISION STATUS IS NOT MENTIONED IN THE DOCUMENTS REFERRED		
Prepared by <i>B. Srinivasan</i>		Approved by <i>HA</i>		

Distribution: As per standard distribution list.

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RAMIPET 632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 CYLINDER ASSEMBLY

NAME OF CONTRACT PACKAGE  
 STANDARD

QP NO : FAN 333  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 01 OF 03

PREPARED BY: *B. Srinivas Rao*

REVIEWED BY: *Har...*

APPROVED BY: *Har...*

S No	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACPT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0	CYLINDER ASSY									
1.1	CYLINDER MACHINING	MEASURE-MENT	100%	BORE DIA, LENGTH STEP BORE DIA, BUSH BORE DIA WITH STEP. SURFACE FINISH FLATNESS, RUN OUT & FACE OUT	DRG & PRQA: 500		QC	VERNIER, DEPTH VERNIER ID MIC, SUR- FACE FINISH COMPA- RATOR STRAIGHT EDGE DIAL GAUGE WITH STAND	DR	ONE COMMON REF TO BE ARRANGED FOR LINE BORING DURING ASSY MACHINING
1.1.1	CYLINDER DRILLING	MEASURE-MENT	-DO-	DRILL HOLE DIA, ORI- ENTATION, PCD THREAD ED HOLE SIZE		-DO-	-DO-	VERNIER, THREAD PLUG GAUGE, DEPTH VERNIER	-DO-	
1.2	COVER MACHINING	MEASURE-MENT	-DO-	STEP DIA BUSH BORE DIA WITH STEP GROOVE ON STEP, FLAT NESS OF FLANGE. RUNOUT, FACEOUT, SUR FACE FINISH		-DO-	QC	VERNIER, DEPTH VERNIER, DIAL GAUGE WITH STAND SURFACE FINISH COMPARATOR	-DO-	-DO-

QUALITY CONTROL PLAN FOR

CYLINDER ASSEMBLY

QP NO : PAN 333  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 02 OF 03

S No	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACCPY STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.2.1	COVER DRILLING	VERIFICATION & MEASUREMENT		DRILL HOLE DIA, PCD, ORIENTATION, OIL LEAK HOLE DETAILS, THREADED HOLE SIZE	DRG& PROA:500		QC	VERNIER, DEPTH VERNIER, THREAD PLUG GAUGE	DR	
1.3	CYLINDER ASSY	VERIFICATION PRE-SSURE TEST (HYD)	100%	LEAK TEST AT 40 KG/CM <sup>2</sup> FOR 30 MTS	-DO-		SHOP/ QC	SUITABLE HYD TEST SYSTEM WITH PR. GAUGE HYD PUMP 100 KG/CM <sup>2</sup>	DR	NO LEAK PERMITTED
1.4	CYLINDER ASSY DISMANTLING	VERIFICATION	-DO-	CLEANLINESS	---		SHOP	---	---	---
1.4.1	NITRIDING OF CYLINDER ASSY OF BUSHES IN CYLINDER & COVERS	VERI. OF REPORT	-DO-	CASE DEPTH & HARDNESS SEATING OF BUSHES	DRAWING		QC	---	R	---
1.4.2	BUSHES IN CYLINDER & COVERS	-DO-	-DO-				-DO-	FEELER GAUGE		
1.4.3	ASSY OF COVER & CYLINDER ASSY	-DO-	-DO-	DOVEL PIN FIXING TIGHTNESS OF FASTENERS	DRG&PROA:312		QC	TORQUE WRENCH		

QUALITY CONTROL PLAN FOR

CYLINDER ASSEMBLY


QP NO : FAN 333  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 03 OF 03

PREPARED BY:

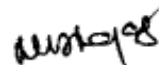

REVIEWED BY:


APPROVED BY:

S NO	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACFT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1										
1.4.4	CYLINDER ASSY FINE BORING	MEASURE- MENT	100%	CONCENTRICITY OF BUSH BORE WITH CYLINDER ID/OD BUSH ID	DRG BRQA-500		QC	ID MIC DIAL GAUGE WITH STAND	DR	REF POINT 1.1 & 1.2 FOR REMARKS
1.4.5	CYLINDER ASSY DYNAMIC BALANCING	UNBALANCE VERTICA- TION	-DO-	UNBALANCE VALUE	-DRG-		-DO-	BALANCING M/C	E.C	
1.4.6	CYLINDER ASSY	IDENTIFI- CATION & PRESER- VATION	-DO-	SL NO REF PRESER- VATION WITH TEMPERA- -RY RUST PREVENTIVE	QPS		QC	-	E.C	

 Ranipet		MANUFACTURER'S NAME & ADDRESS <b>M/S BHEL / BAP /  RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b>						
				ITEM/SUB SYSTEM: <b>AP HUB DISC</b>			Doc. No		FAN 334	
							Rev. No		01	
							Date		16 02 10	
				Page No		01 OF 02				
SI no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Acceptance Norms 7	Format Of Records 8	Agency 9		Remarks 10
								M	B	

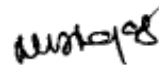

1.0	Material	Mat spec., heat no, RMA NO.	Verification	100%	RMA card	RMA card	P	W	
1.1	Hub machining	Outside diameter, inside diameter, taper bore, surface finish, shape groove depth	measurement	100%	DRAWING	DR/LOG	P	W	
1.2	Hub drilling	Pitch distance , chord distance, hole size,threadedv hole size&orientatti on	measurement	100%	DRAWING	DR/LOG	P	W	


<b>LEGENDS:</b> M - Manufacturer,(BHEL Shop / Subcontractor, ) B - BHEL QC/ Authorized Inspection agency, CC -Compliance certificate P - Performed By, V - Verification Of Reports/Records W - Witness T C - Test Certificate R- report,		REVIEWED & APPROVED BY :  
	PREPARED BY	
		

 Ranipet		MANUFACTURER'S NAME & ADDRESS <b>M/S BHEL / BAP /  RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b>						
				ITEM/SUB SYSTEM: <b>AP HUB DISC</b>			Doc. No	FAN 334		
							Rev. No	01		
							Date	16 02 10		
			Page No	01 OF 02						
SI no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Acceptance Norms 7	Format Of Records 8	Agency 9		Remarks 10
								M	B	

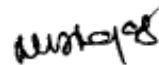

1.3	Hub Disc balancing	Unbalance compensation	Verification/w itnessing	100%	DRAWING	DR		P	W	
1.4	Identification	Wo.no,sl.no, BAL ref NO.	Visual verification	100%	OPS/GMS	--		P	W	


FOR UNTOLERANCED DIMENSIONS PRQA 500/LATES SHALL BE REFERRED.

LEGENDS: M – Manufacturer,(BHEL Shop / Subcontractor, ) B - BHEL QC/ Authorized Inspection agency, CC -Compliance certificate P - Performed By, V - Verification Of Reports/Records W - Witness T C - Test Certificate R- report,				REVIEWED & APPROVED BY : 	
		PREPARED BY			
					
Revision No	Date	Details			
00	-	Original issue			
01	16 02 10	TOTALLY MODIFIED			

 Ranipet		MANUFACTURER'S NAME & ADDRESS <b>M/S BHEL / BAP / RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b>						
				ITEM/SUB SYSTEM: <b>AP FAN BEARING COVER</b>			Doc. No		FAN 335	
							Rev. No		01	
							Date		16 02 10	
				Page No		02 OF 02				
SI no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Referenc e Documen ts 6	Acceptanc e Norms 7	Format Of Records 8	Agency 9		Remarks 10
								M	B	

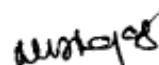

1.0	BRG cover half machining	Surface level, surface finish, half height	Measurement	100%	DRAWING	LOG	P	W	Incase cover is single piece CL.1.0 not applicable
1.0.1	BRG cover drilling	Drill hole size, position orientaion,taper, pin hole size(dowelling) Torque, surface cotact,level	Measurement	100%	DRAWING	DR/LOG	P	W	
1.1	BRG cover assy.	Torque & surface contact level	Visual measurement	100%	DRAWING & PRQA:312/LATEST	DR/LOG	P	W	
1.1.1	Cover assy machining	OD,ID,groove depth, step depth,thickness,step dia groove width run out & face out	measurement	100%	DRAWING	DR	P	W	

<b>LEGENDS:</b> M – Manufacturer,(BHEL Shop / Subcontractor, ) B - BHEL QC/ Authorized Inspection agency, CC –Compliance certificate P - Performed By, V - Verification Of Reports/Records W - Witness T C - Test Certificate R- report,	PREPARED BY		REVIEWED & APPROVED BY : 
			

 Ranipet	<b>MANUFACTURER'S NAME &amp; ADDRESS</b> <b>M/S BHEL / BAP / RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b>								
			<b>ITEM/SUB SYSTEM:</b> <b>AP FAN BEARING COVER</b>				<b>Doc. No</b>		<b>FAN 335</b>		
							<b>Rev. No</b>		<b>01</b>		
							<b>Date</b>		<b>16 02 10</b>		
<b>Page No</b>		<b>02 OF 02</b>									
SI no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Acceptance Norms 7	Format Of Records 8	Agency 9		Remarks 10	
								M	B		

1.1.2	Cover assy. milling	Position, orientation of slots Position,orientation ,tered holes ,thermometer threaded holes Fixing of seals	Measurement	100%	DRAWING	LOG	P	W	
1.1.3	Cover assy. drilling	Inside dia. of seal run out & face out	Measurement	100%	DRAWING	LOG	P	W	
1.2	Assy. of labyrinth seal Seal assy.	Fixing of seals	visual	100%	DRAWING	LOG	P	W	
1.2.1	machining	Inside dia of seal ,run out & face out	measurement	100%	DRAWING	LOG	P	W	


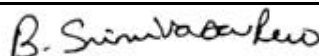
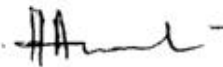
FOR UNTOLERANCED DIMENSIONS PRQA 500/LATEST SHALL BE REFERRED.

<b>LEGENDS:</b> M – Manufacturer,(BHEL Shop / Subcontractor, ) B - BHEL QC/ Authorized Inspection agency, CC –Compliance certificate P - Performed By, V - Verification Of Reports/Records W - Witness T C - Test Certificate R- report,		REVIEWED & APPROVED BY : 	
	PREPARED BY		
			

Revision No	Date	Details
00	-	Original issue
01	16 02 10	TOTALLY MODIFIED

<b>QUALITY DEPARTMENT</b>	
<b>Amendment to Quality Work Instructions (SQP)</b>	
<b>QWI NO:SQP FAN 336 REV: 00</b>	<b>DT. 22 11 93</b>
<b>Amendment no: A 2</b>	<b>DT. 11 04 08</b>
<b>Description : Impeller hub+ Blade brg assy.</b>	

<b>Details of Amendment</b>		
<b>Note Sl.no.</b>	<b>Amended As</b>	<b>Basis For Amendment</b>
1	Clause No 1.0.6 : 1.0.6 a) Column no 6 & 7 as Drg /PRQA 331/Latest 1.0.6 b) Minimum 3 nos of any blades of same family shall be Assembled progressively and checked for free movement of blades without fouling with hub as well as among the Blades.	<b>PRQA No 082</b> <i>is replaced by</i> <b>PRQA 331</b> <b>Included</b> <b>Based on</b> <b>the shop</b> <b>practice</b>
2	1.0.07 column no 6&7 shall be read as packing drg & PRQA 590/Latest	

<b>Prepared by</b>	<b>Reviewed By</b>	<b>Approved By</b>
		

~~BIEL~~  
RANIPET

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QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)				
Q.W.I.NO: FAN336	REV: 00	AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table>	A	1
A	1			
DESCRIPTION: IMPELLER HUB+BLADE BEARING ASSY		DATE: 13 01 94		
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
GENERAL	ALL DOCUMENTS REFERRED IN COLUMN 6&7 SHALL BE OF LATEST REVISION.	REVISION STATUS IS NOT MENTIONED IN THE DOCUMENTS REF- ERRED		
Prepared by <i>B. Srinivasa Rao</i>		Approved by <i>[Signature]</i>		

Distribution: As per standard distribution list.

**BEHART HEAVY ELECTRICALS LTD**  
**BOILER AUXILIARIES PLANT**  
**RANIPET 632 406 (INDIA)**  
**QUALITY ASSURANCE DEPT.**

**QUALITY CONTROL PLAN FOR**  
**IMPELLER+BLADE BEARING ASSY**

**NAME OF CONTRACT PACKAGE**  
**STANDARD**

**CP NO : FAN 336**  
**REV NO: 00**  
**DATE : 22 11 93**  
**PAGE : 01 OF 03**

**PREPARED BY: B. Srinivasulu**

**REVIEWED BY: S. D. V. Srinivasulu**

**APPROVED BY: M. M. M. M.**

S No	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACPT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0	IMPELLER AFTER LINE BORING	VERIFICATION	100%	DIRT, SL NO, PREVIOUS STAGES CLEARANCE	DRG & OPS		QC			
1.0.1	ASSY COMPONENTS LIKE IMPELLER BLADE SHAFTS DISTANCE RING BUSH, STEEL BALLS, OIL SEALS, LOCK NUTS, LEVER BRGS, LIBRICANT ETC	VISUAL & VERIFICATION		DIMENSIONS, CLEANLINESS, SHARP EDGES REMOVAL, QUANTITY	DRG & DR		-DO-			
1.0.2	ASSY OF BLADE BRG ASSEMBLY	VISUAL	-DO-	PROPER FIT, LOCATION TIGHTNESS	OCF:1600011529 (4)		-DO-	TORQUE WRENCH, VERNIER DEPTH GAUGE	LOG	
1.0.2.1	HYDRAULIC TEST AT 10 BAR	VISUAL	-DO-	PRESSURE DROP			QC	PRESSURE GAUGE, HYDRAULIC PUMP	LOG	AFTER 30 MIN PRESSURE DROP MAX. 1BAR PERMITTED
1.0.2.2	TORQUE TEST	-DO-	-DO-	TORQUE VALUE ON A PARTICULAR LOAD			-DO-	HYDRAULIC PUMP, TORQUE WRENCH	-DO-	

QUALITY CONTROL PLAN FOR

BLADE BEARING ASSEMBLY

OF NO : FAN 336  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 02 OF 03

PREPARED BY:		REVIEWED BY:				APPROVED BY:				
S NO	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACFT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.2	HUB TO BLADE .3 SHAFT DISTANCE	MEASURE- MENT	100%	DEPTH, RADIAL DISTANCE FROM CENTER.	-DRG-	-DRG-	QC	VERNIER DEPTH GAUGE	LOG	
1.0.2	LEVER ASSY .4	VISUAL TORQUE	-DO-	POSITION, TIGHTENING OF SCREW	DRG & PROQ: 312	DRG & PROQ: 312	-DO-	TORQUE WRENCH	-	
1.0.3	BLADE BEARING ASSEMBLY	VISUAL	-DO-	OIL FILLING	-DRG-	-DRG-	QC	OIL CAN WITH MEASUREMENT	-	
1.0.4	COVER FLATE ASSY,	VIUSAL	-DO-	FIXING THE COVER PLATE WITH IMPELLER	DRG & PROQ: 312	DRG & PROQ: 312	QC	TORQUE WRENCH	-	
1.0.5	BALANCING OF IMPELLER ASSY	UNBALANCE COMPENSAT -ION	-DO-	UNBALANCE VALUE	-DRG-	-DRG-	-DO-	BALANCING MACHINE	IK	

QUALITY CONTROL PLAN FOR

BLADE BEARING ASSY


QP NO : PAN 336  
 REV NO: 00  
 DATE : 22 11 93  
 PAGE : 03 OF 03

PREPARED BY:

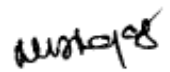

REVIEWED BY:


APPROVED BY:

S NO	COMPONENT & OPERATION	TYPE OF CHECK	QUANTUM OF CHECK	CHARACTERISTICS	REF STD	ACPT STD	AGENCY	INSTRUMENTS REQUIRED	FORMAT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.6	ROTOR/INPELLER ASSY	VISUAL TORQUE STROKE	100	STROKE, SYNCHRONISE MOVEMENT IF 2 STAGE	DRG/RQA 082/LATEST		QC	WITNESSING	HC	
1.0.7	IDENTIFICATION/PRESERVATION-STORAGE/PACKING	VISUAL	-DO-	NO. NO. , P. NO, PROPER PRESERVATION & PACKING	PACKING DRG & RP0674199/LATEST		QC			

 Ranipet	MANUFACTURER'S NAME & ADDRESS <b>M/S BHEL / BAP / RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b>							
			ITEM/SUB SYSTEM: <b>SUPPORTING BODY</b>				Doc. No	FAN 338		
							Rev. No	01		
							Date	16 02 10		
				Page No	01 of 02					
Sl no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Acceptance Norms 7	Format Of Records 8	Agency 9		Remarks 10
								M	B	

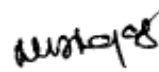

1.0	Material verification	SPEC: RMA NO: MELT NO:	Verification of attestation details	100%	RMA card	RMA card	P	W	
1.1	Marking for machining	Hole position ,center of the hole,MATL for machining allowance.	Verification of attestation details	100%	DRAWING	--	P	W	
1.2	Rough machining & final machining	position ,center of the bore, step diameter od,radii,width,run cut, face out	measurement	100%	DRAWING	LOG/DR	P	W	

<b>LEGENDS:</b> M – Manufacturer,(BHEL Shop / Subcontractor, ) B - BHEL QC/ Authorized Inspection agency, CC –Compliance certificate P - Performed By, V - Verification Of Reports/Records W - Witness T C - Test Certificate R- report,		REVIEWED & APPROVED BY : 	
	PREPARED BY		
			

 Ranipet	MANUFACTURER'S NAME & ADDRESS <b>M/S BHEL / BAP / RANIPET 632 406</b>		<b>STANDARD QUALITY PLAN</b>								
			ITEM/SUB SYSTEM: <b>SUPPORTING BODY</b>				Doc. No		FAN 338		
							Rev. No		01		
							Date		16 02 10		
				Page No		01 of 02					
SI no 1	Component & operation 2	Characteristics 3	Type Of Check 4	Quantum of Check 5	Reference Documents 6	Acceptance Norms 7	Format Of Records 8	Agency 9		Remarks 10	
								M	B		


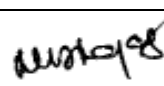
1.2.1	Machine of holes in horizontal boring M/C	Diameter and depth of holes, run out, face out, surface roughness	Measurement	100%	DRAWING	LOG/DR	P	W	
1.2.2	Support body drilling tapping	Pitch distance, threads, position of threaded holes, orientation of holes	Measurement	100%	DRAWING	LOG/DR	P	W	
1.2.3	Identification & preservation	WO NO, SL NO, preservation with rust preventive coat	Measurement	100%	OPS/GMS	-	P	V	

For all untoleranced dimensions, PRQA 500/Latest shall be referred for tolerances.

<b>LEGENDS:</b> M – Manufacturer, (BHEL Shop / Subcontractor, ) B - BHEL QC/ Authorized Inspection agency, CC –Compliance certificate P - Performed By, V - Verification Of Reports/Records W - Witness T C - Test Certificate R- report,				RE3VIEWED & APPROVED BY :  	
		Prepared by			
					
Revision No	Date	Details			
00	-	Original issue			
01	16 02 10	TOTALLY MODIFIED			

<b>QUALITY DEPARTMENT</b>		
<b>Amendment to Quality Work Instructions (SQP)</b>		
<b>QWI NO: SQP FAN 345 REV: 00</b>	<b>DT. 19 08 97</b>	
<b>Amendment no: A 2</b>	<b>DT. 15 12 09</b>	
<i>Description: RADIAL FAN IMPELLER ASSY.</i>		

<b>Details of Amendment</b>		
<b>Note Sl.no.</b>	<b>Amended As</b>	<b>Basis For Amendment</b>
1	2.4.2  LPI shall be done on the shaft with flange welds in addition to MPI	<i>Included based on PCM decision dt 08 12 09</i>

<b>Prepared by</b>	<b>Reviewed By</b>	<b>Approved By</b>
	<i>B. Srinivasulu</i>	

**BHEL**

**RANIPET**

QUALITY DEPARTMENT					
AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )					
Q.W.I.NO:FAN345		REV: 00	AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table>	A	1
A	1				
DESCRIPTION:RADIAL FAN SHAFT OF TUBE WITH END PIN DESIGN		DATE:19 08 97			
DETAILS					
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS			
QP NO ON PAGE 2 OF5 2.3.1 COL.7&8	FAN345 PR:QA:337 REPLACES PR:QE:017	EDITORIAL CORRECTION REVISION OF DOCUMENT			
2.3.2 COL.3	WELD SOUNDNESS AFTER S.R FOR CARBON STEEL SHAFTS AND BEFORE AND AFTER FOR ALLOY STEEL SHAFTS.	ALLOY STEEL WELDS ARE LIKELY TO DEVELOP CRACKS WITHIN 48 Hrs OF WELDING.HENCE MPI IS REQUIRED BEFORE S.R .			
COL 7&8	BHE:NDT:RP:MT01/LATEST	EDITORIAL CORRECTION			
3.1 COL 7&8	PR:QA:590 FOR PAINTING PR:QA:341 FOR PRESERVATION & PACKING	REVISION OF DOCUMENTS			
NOTE 8	BAKING SHALL BE DONE BETWEEN 370 -430°C FOR 2Hrs AND HELD AT 120 -150°C BEFORE USE.	REVISION OF DOCUMENTS			
Prepared by <i>B. Srinivasan</i>		Reviewed by <i>Antony</i>	Approved by <i>H. Anand</i>		

Distribution: As per standard distribution list.

PAGE 01 OF 01

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BHARAT HEAVY ELECTRICALS LTD BOILER/AUXILIARIES PLANT RANIPET-632 406 (INDIA) QUALITY ASSURANCE DEPT.	QUALITY CONTROL PLAN FOR RADIAL FAN SHAFTS OF TUBE WITH END PIN DESIGN	NAME OF CONTRACT PACKAGE STANDARD	QP.No. FAN345 REV.No. 00 DATE 060794 PAGE 01 of 05
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PREPARED BY: B. Srinivasan | REVIEWED BY: [Signature] | APPROVED BY: [Signature]

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIALS	CHEM & MECH PROPERTIES	MAJOR	REVIEW OF TCs	100%	RESPECTIVE MATERIAL SPECIFICATION		TC	QC-PROCUREMENT	
	a) SHAFT TUBE									
	b) SHAFT PINS									
	c) SHAFT FLANGE									
	d) RINGS									
1.2.	INTERNAL QUALITY									
1.2.1	a) SHAFT TUBE	INTERNAL	MAJOR	REVIEW OF UT CERTIFICATE	100%		-DO-	-DO-	-DO-	
	b) SHAFT PINS	SOUNDNESS								
	c) FLANGE									
	d) RINGS									
2.0.	INPROCESS CONTROL									
2.1.	VERIFICATION OF MATERIAL SPECIFICATION									
2.1.1	a) SHAFT TUBE	VERIFICATION OF RMA, MELT	MAJOR	-DO-	100%		RMA CARD	RMA CARD	MOCD	
	b) SHAFT PINS									
	c) SHAFT FLANGE	NO MATL SPEC.								
	d) RINGS									
2.2.	MACHINING									
2.2.1	FLANGE	OD, ID, DRILL HOLES DIA, PCD, CHORD & EP*	MAJOR	MEASUREMENT	100%	DRAWING & FR: QA-500/LATEST & NOTE 1		DR	-DO-	
2.2.2	RINGS	ID & OD	MAJOR	-DO-	100%		-DO-	-DO-	-DO-	*EDGE PREPARATION



11

QUALITY CONTROL PLAN FOR  
 RADIAL FAN SHAFTS OF TUBE WITH END PIN DESIGN

Q.P.NO.345  
 REV.NO.00  
 DATE:060794  
 PAGE:02OF05

1	2	3	4	5	6	7	8	9	10	11
2.2.3	SHAFT TUBE	OD, ID&LENGTH	MAJOR	MEASURE -MENT	100%	DRAWING& PRQA:322/ LATEST	DRAWING & NOTE 2	DR	MOCD	
2.3.	WELD QUALITY									
2.3.1	WELDING OF* TUBE+RING +FLANGE	WELD SIZE& FINISH	MAJOR	VISUAL& MEASURE- MENT	100%	DRAWING, PRQE:017/LATEST AND NOTE 3&8		—	MOCD	*REFER PRQA317/LATES INCASE OF BUTTERING
2.3.2	-DO-	WELD SOUNDNESS BEFORE&AFTER STRESS RELIEF	CRITI- CAL	MT	100%	BHE:NDT:MT01/LATEST		INDT REPORT	MOCD	
2.4.	STRESS RELIEF									
2.4.1	SHAFT TUBE +RING+FLANGE	COMPLIANCE TO MAJOR HEATTREATMENT CYCLE	MAJOR	TIME & TEMPERATURE CHART	100%	BAP:HT:001/LATEST &NOTE4		HT CHART	MOCD	
2.5.	MACHINING	CHECK FOR THE FACE OUT OF THE FLANGE BEFORE MACHINING WHICH SHALL BE WITHIN 2 MM.								
2.5.1	SHAFT TUBE ASSY	BORE DIA. LENGTHS OF CC RING, FINISH	MAJOR	MEASURE- MENT	100%	DRAWING PRQA:500/LATEST		DR	MOCD	
2.5.2	PINS	OD&LENGTH, FINISH, OIL HOLE SIZE	-DO-	-DO-	100%	DRAWING		DR	MOCD	
2.6.	TUBE +PIN ASSY	PROPER ASSY WITH INTERFERENCE	MAJOR	-DO-	100%	DRAWING &NOTE 5&8		DR	MOCD	
2.7.	FINAL MACHINING	JOURNAL DIA, OD, FLANGE GROOVE OD, ID LENGTHS, KEY WAY SIZE&OFFSET, END TAPPINGS, THRUST COLLAR. GROOVE DIA&WIDTH	CRIT	-DO-	100%	DRAWING &PRQA:500/LATEST &NOTE 6		DR	MOCD	
										DR: DIMENSIONAL REPORT

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QUALITY CONTROL PLAN FOR

Q.P.NO.FAN345

REV.NO.00

DATE:060794

PAGE:04OF05

RADIAL FAN SHAFTS OF TUBE WITH END PIN DESIGN

1 2 3 4 5 6 8 9 10 11

NOTE 1: 1) WHEREVER JIG IS NOT ENVISAGED THE SAME SHALL BE MARKED FOR DRILLING AND INSPECTED AND THEN ONLY TO BE DRILLED

NOTE 2: THE SHAFT TUBE SHALL BE CHECKED FOR STRAIGHTNESS.THE MAXIMUM DEVIATION SHALL BE 1MM/M SUBJECT TO THE MAXIMUM OF 3 MM.

NOTE 3: THE WELDERS AND WELDING PROCEDURES SHALL BE QUALIFIED AS PER ASME SEC IX TO 3 G POSITION.

ii) WELDS SHALL BE FREE FROM UNDERCUTS EXCEEDING 0.5 MM DEPTH AND OTHER INJURIOUS DEFECTS .UNACCEPTABLE UNDERCUTS SHALL BE REPAIRED BY WELDING

iii) WELDS SHALL BE CLEANED IN BETWEEN PASSES AND FURTHER WELDING SHOULD BE CONTINUED AFTER ENSURING COMPLETE REMOVAL OF DEFECTS. -ING!

iv) WELDING OF FLANGE TO TUBE SHALL NOT BE CARRIED OUT INVERTICAL CONDITION .IT SHALL BE DONE ON ROLLERS WITH PIPE AXIS HORIZONTAL.

NOTE 4: ALL SHAFT TUBES WELDED WITH FLANGE & RINGS SHALL BE STRESSRELIEVED. STRESSRELIEF SHALL BE COMPLETED BEFORE BORE FINISHING & END PIN INSERTION.

ii) SR SHALL NOT BE CARRIED ON THE SHAFTS WITH PIN INSERTED.

iv) PROPER STIFFENERS SHALL BE PROVIDED ON THE FLANGE TO AVOID DISTORTION DURING WELDING.

v) THE SHAFT SHALL BE PROPERLY POSITIONED TO AVOID DISTORTION

NOTE 5: i)THE ACTUAL MACHINED DIMENSIONS OF END PIN OD AND HOLLOW SHAFT ID SHOULD BE VERIFIED AND RECORDED BEFORE PIPE IS HEATED FOR SHRINK FIT.

ii) HOLLOW TUBE SHALL BE HEATED ONLY BY PRODUCER GAS .OXYACETYLENE FLAME SHOULD NOT BE USED.

iii) THE PIN SHOULD BE INSERTED IN THE PIPE IN VERTICAL POSITION ONLY.

THE PIN AXIS SHOULD NOT BE INCLINED WITH REFERENCE TO PIPE AXIS .PIN INSERTION SHALL BE COMPLETED BEFORE PIPE TEMPARATURE FALLS DOWN FROM 300 DEG C.

NOTE 6: i) THE RELATIVE DISTANCE BETWEEN THE BEARING SEATS WITH REFERENCE TO FLANGE SHALL BE STRICTLY AS PER DRAWING.

ii) KEYWAY OFFSET PERMITTED SHALL BE AS PER TABLE SHOWN BELLOW.

DIA OF SHAFT IN MM	10-22	22-38	38-65	65-110	100-150
OFFESEET PERMITTED IN MM	0.1	0.16	0.2	0.3	0.4

QUALITY CONTROL PLAN FOR

RADIAL FAN SHAFTS OF TUBE WITH END PIN CONSTRUCTION

Q.P.NO.FAN345

REV.NO.00

DATE:060794

PAGE:05OF05

1	2	3	4	5	6	7	8	9	10	11
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- iii) OIL HOLES OF PINS SHALL BE CHECKED FOR LENGTHS ,DIA &THREASIZES (IF APPLJCABLE)
- iv) ALWAYS DIMENSIONS SHALL BE MEASURED FROM ONE END ONLY AND ALL TOLERANCES ARE NON CUMULATIVE
- v) SURFACE FINISH AT BEARING SEATING AREAS FLANGES,THRUST COLLAR SURFACES AND THRUST COLLAR SEATING AREAS ARE CRITICAL, AND SHALL BE AS PER DRAWINGS.

NOTE 7: i) KEY SHALL BE ASSEMBLED TO THE SHAFT AND SCREWED.

ii) WO.NO,DU NO,PRODUCT NO,SUBCONTRACTOR FIRM CODE SHALL BE PUNCHED AND PAINTED ON THE SHAFT TUBE

NOTE 8: 1)WELDERS & WELD PROCEDURES SHALL BE QUALIFIED AS PER ASME SEC IX TO 3 G POSITION.

LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR 2 Hrs AT 350 DEG C' AND DRIED AND SHALL BE KEPT AT 150 DEG C' BEFORE WELDING.

2)ELECTRTODES OPEN TO ATMOSPHERE MORE THAN 5 MINUTES SHALL BE REBAKED.



MANUFACTURERS NAME & ADDRESS:  
 BOILER AUXILIARIES PLANT  
 BHEL, RANIPET  
 PIN - 632406

MANUFACTURING QUALITY PLAN  
 ITEM: SOLID SHAFTS  
 OF RADIAL FANS

QP NO : FAN: 346  
 REV NO : 01  
 DATE : 23 04 2001  
 PAGE NO : 01 OF 05

NAME OF THE CONTRACT &  
 PACKAGE  
**STANDARD**

S.N	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARK	
1	2	3	4	5	6	7	8	9	M	B	11
1.0	MATERIALS	CHEM & MECH PROPERTIES	MAJOR	REVIEW OF TCS	100%	RESPECTIVE MATERIAL SPECIFICATION & TDC		TC	P	V	
1.1	a) SHAFT-ROUND b) FLANGE										
1.2	<b>INTERNAL QUALITY</b>										
1.2.1	a) SHAFT-ROUND b) FLANGE	INTERNAL SOUNDNESS	MAJOR	REVIEW OF UT CERTIFICATE	100%	TDC		TC	P	V	
2.0	<b>INPROCESS CONTROL</b>										
2.1	VERIFICATION OF MATERIAL SPECIFICATION										
2.1.1	a) SHAFT-ROUND b) FLANGE	VERIFICATION OF RMA MELT NO & MATL SPEC.	MAJOR	-DC-	100%	RMA CARD		RMA CARD	P	V	

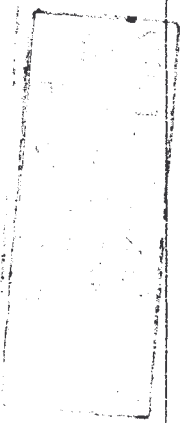
**RECORD OF REVISIONS**

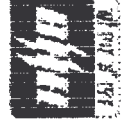
REV:00 DT 31/01/95 ORIGINAL ISSUE  
 REV:01 DT 23/04/2001 HEAT TREATMENT ADDED UNDER CLAUSE NO.2.4 & PROQA NOS ARE CHANGED IN CLNO 2.3.1 2.6.3.1 UNDER COLUMN NO 8

PREPARED BY: (Signature)  
 (K.RAJADRAJ)  
 REVIEWED BY: (Signature)  
 B. SRINIVASA RAO  
 D KRISHNASWAMY

APPROVED BY: (Signature)  
 (HANANTHANARAYANAN)

LEGEND: M: MANUFACTURE/SUB CONTRACTOR, B: BHEL/BHEL AUTHORISED INSPECTION AGENCY





MANUFACTURERS NAME & ADDRESS:  
 BOILER AUXILIARIES PLANT  
 BHEL, RAIPUR  
 PIN - 632406

MANUFACTURING QUALITY PLAN  
 ITEM: SOLID SHAFTS  
 OF RADIAL FANS  
 QP NO : FAN: 345  
 REV NO : 01  
 DATE : 23 04 2001  
 PAGE NO : 02 OF 05

NAME OF THE CONTRACT &  
 PACKAGE  
**STANDARD**

S.N	COMPONENT & OPERATION	CHARACTERISTIC S	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
2			4	5	6	7	8	9	M B	11
2	<b>MACHINING</b>		MAJOR	MEASUREMENT	100%	DRAWING PRQA 500 LATEST		DR	P	W
2.2.1	SHAFT-ROUND	OD & LENGTHS	MAJOR	-DO-	100%	DRAWING & PRQA 500 LATEST & NOTE 1		DR	P	W
2.2.1	FLANGE	OD, ID, DRILL HOLES DIA, PCD, CHORID WIDTH EDGE PREPARATION								
2.3	<b>WELD QUALITY</b>	( Applicable only for shafts with flange welded type)								
2.3.1	WELDING OF SHAFT +FLANGE	WELD SIZE & FINISH & WELD SOUNDNESS	MAJOR	MEASUREMENT		DRAWING, PRQA:337 LATEST AND NOTE 2		DR	P	W
			CRIT	MT		EHE:NDT:RP:MT 1/LATEST		NIDT REPORT	P	W



MANUFACTURERS NAME & ADDRESS:  
 BOILER AUXILIARIES PLANT  
 BHEL, RAJAPET  
 PIN - 532406

MANUFACTURING QUALITY PLAN  
 ITEM: SOLID SHAFTS  
 OF RADIAL FANS

QP NO : FAN: 346  
 REV NO : 01  
 DATE : 23 04 2001  
 PAGE NO : 03 OF 05

NAME OF THE CONTRACT &  
 PACKAGE  
 STANDARD

S.N	COMPONENT & OPERATION	CHARACTERISTIC S	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY		REMARKS
									M	B	
224	HEAT TREATMENT STRESS RELIEF HEAT TREATMENT OF SHAFT WITH FLANGE	COMPLIANCE TO SR CYCLE.	MAJOR	VERIFICATION OF HT CHART	100%	BAP:HT:005/LATEST		HT CHART	P	V	
224.1											
225	MACHINING	CHECK FOR THE FACE OUT OF THE FLANGE BEFORE MACHINING WHICH SHALL BE WITHIN 2MM OR AS PER DRAWING WHICHEVER IS LOWER IN CASE OF WELDED DESIGN	CRIT	-DO-	100%	DRAWING & PRGA:500/LATEST & NOTES		DR	P	W	
225.1											



MANUFACTURERS NAME & ADDRESS:  
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 PIN - 632406

MANUFACTURING QUALITY PLAN  
 ITEM: SOLID SHAFTS  
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 QP NO : FAN: 346  
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NAME OF THE CONTRACT &  
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**STANDARD**

Sl. No.	COMPONENT & OPERATION	CHARACTERISTIC S	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS	
6	DYNAMIC BALANCING	RESIDUAL ** UN BALANCEMENT	MAJOR	UNBALANCE COMPENSATI ON	100%	DRAWING & P.R.O.A:309/LATEST & P.R.O.A:314 / LATEST P.R.O.A:321/LATEST		BLNG. REPORT	P	W	** P.R.O.A:309 APPLICA BLE ONLY TO BHEL BAP SHOPS
10	FINAL INSPECTION										
11	PRESERVATION IDENTIFICATION & PACKING	PROPER PRESERVATION, IDENTIFICATION & PACKING	MAJOR	VISUAL	100%	RP 067/4199/LATEST ,PACKING DRAWING & NOTE 4 P.R.O.A:341/LATEST			P	W	



MANUFACTURERS NAME & ADDRESS:  
 BOILER AUXILIARIES PLANT  
 BHHEL, RANUPPET  
 PIN --- 632406

MANUFACTURING QUALITY PLAN  
 ITEM: SOLID SHAFTS  
 OF RADIAL FANS  
 QP NO : FAN: 346  
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NOTE 1: 1) WHEREVER JIG IS NOT ENVISAGED THE SAME SHALL BE MARKED FOR DRILLING AND INSPECTED AND THEN ONLY TO BE DRILLED.

NOTE 2) WELD PROCEDURES AND WELDERS SHALL BE QUALIFIED AS PER ASME SEC IX TO 3 G POSITION MIN. UNDERCUTS SHALL BE REPAIRED.

(b) ALL THE ELECTRODES HAVING LOW HYDROGEN COVERING SHALL BE PURCHASED IN HERMETICALLY SEALED CONTAINERS. IMMEDIATELY AFTER OPENING THE HERMETICALLY SEALED CONTAINER, ELECTRODES SHALL BE STOCKED IN OVENS HELD AT TEMP OF ATLEAST 120 DEG C. ELECTRODES THAT HAVE BEEN WET SHALL NOT BE USED.

(c) ELECTRODES EXPOSED TO ATMOSPHERE FOR PERIODS MORE THAN 5 MINUTES SHALL BE BAKED FOR ATLEAST TWO HOURS BETWEEN 260 & 430 AND HELD AT 120 DEG C UNTIL THEY ARE USED.

(d) WELDS SHALL BE CLEANED THOROUGHLY TO REMOVE THE SPATTER & SLAG

(e) STIFFENERS MAY BE PROVIDED ON THE FLANGE TO AVOID DISTORTION DURING WELDING.

(e) THE SHAFT SHALL BE PROPERLY POSITIONED TO AVOID DISTORTION DURING STRESS RELIEF.

(f) WELD TOES SHALL BE GROUND TO MAXIMUM DEPTH OF 0.6 MM AND SMOOTHLY MERGED.

NOTE: 3 i) THE RELATIVE DISTANCE BETWEEN THE BEARING SEATS WITH REFERENCE TO FLANGE SHALL BE STRICTLY AS PER DRAWING IN CASE OF FLANGE DESIGN.

ii) KEY WAY OFFSET PERMITTED SHALL BE AS PER TABLE SHOWN BELOW.

DIA OF SHAFT IN MM	10-22	22-38	38-65	65-110	>110
OFF SET PERMITTED IN MM	0.1	0.16	0.2	0.3	0.4

iii) BLUE MATCH SHALL BE ATLEAST 85% THROUGHOUT TAPER PORTION.

iv) OIL HOLES OF SHAFTS SHALL BE CHECKED FOR LENGTH, DIA & THREAD SIZE (if applicable)

v) SURFACE FINISH AT BEARING SEATING AREAS IS CRITICAL AND SHALL BE AS PER DRAWING

NOTE: 4 i) KEY SHALL BE ASSEMBLED TO THE SHAFT AND SCREWED

ii) W/O. NO. DU. NO. PRODUCT NO. SUBCONTRACT CODE SHALL BE PUNCHED ON THE SHAFT FACE / OD

BBARAT HEAVY ELECTRICALS LTD	STANDARD QUALITY PLAN FOR	NAME OF CONTRACT PACKAGE	QPNo. PAN348
BOILER AUXILIARIES PLANT		STANDARD	RRV.No.00
RAMPPT-632 406 (INDIA)	AP. PAN HOUSINGS (SINGLE & DOUBLE)		DATE 100696
QUALITY ASSURANCE DEPT.	STAGE I AND HIGH FRONT PART		PAGE 01 of 09

PREPARED BY: B. Sunita REVIEWED BY: A. K. Srinivas APPROVED BY: HA

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0	IN PROCESS INSPECTION									
1.1.	MARKING & GAS CUTTING	SHAPE & SIZE	MAJOR	VISUAL MEASUREMENT	100%	DRAWING & PRQA: 500/LATEST		--		MQCD
1.2.	HOUSING SHELL/HOUSING COATING									
1.2.1	ROLLING OF HOUSING SHELL AND FLANGES	ID, OD OVALITY	MAJOR	-DO-	100%	DRAWING & PRQA: 500/LATEST		--		MQCD
1.2.2	MACHINING	EDGE PREPARATION	MAJOR	-DO-	100%	DRAWING & PRQA: 500/LATEST		--		MQCD
	a) FLANGES	DRILLING				NOTE 20&21				
	b) DRILLING	SIZE OF HOLES								
	THREADING OF PARTING FLANGES	THREADING	MAJOR	MEASUREMENT	100%	DRAWING & PRQA: 500/LATEST		--		MQCD
	c) LOCATING PINS	THREAD SIZE, LENGTH & OD	-DO-	-DO-	100%		-DO-	--		MQCD
	d) EXTENSION FOR FLOW MEASURING DEVICE	THREAD SIZE & LENGTH	-DO-	-DO-	100%		-DO-	--		MQCD
	e) FOOT PLATE DRILLING	THREAD SIZE & HOLE SIZE	-DO-	-DO-	100%		-DO-	--		MQCD

MASTER COPY



## STANDARD QUALITY PLAN FOR

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AP PAN HOUSING ASSY

REV.NO.00

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1	2	3	4	5	6	7	8	9	10	11
1.3.4	WELDING OF 1) CORE DRILL 2) CONE & FLANGES 3) BEARING SEATING FLANGES	WELD SIZE & SHAPE	MAJOR	VISUAL & MEASUREMENT	100%		DRAWING & NOTE 1, 3, 4, 10 18, 23	--		MQCD
1.3.5	DIMENSIONS	ID, OD, HT & CONCENTRICITY R/O, P/O	MAJOR	-DO-	100%		DRAWING & PRQA: 500/LATEST CONCENTRICITY SHALL BE WITHIN 3 MM	--		MQCD
1.3.6	MARKING FOR PROFILE PIECE OPENING AND OPENING FOR THERMOCOUPLES OR THERMOMETER LEADS & GAS CUTTING OF OPENINGS	ORIENTATIONS SIZE	MAJOR	VISUAL & MEASUREMENT	100%		DRAWING & PRQA: 500/LATEST NOTE 18	--		MQCD
1.4.	HOB FRONT PART									
1.4.1	GAS CUTTING OF FLANGES CONES PARTING FLANGES	SHAPE & SIZE	MAJOR	-DO-	100%		DRAWING & PRQA: 500/LATEST NOTES 15, 16, 17, 18	--		MQCD
1.4.2	ROLLING OF CONES	ID, OD, & CONCENTRICITY	MAJOR	-DO-	100%		DRAWING & PRQA: 500/LATEST	--		MQCD
1.4.3	MACHINING OF a) FLANGES b) PARTING FLANGES	ID, OD, DRILL HOLES DIA, THREAD SIZE	MAJOR	-DO-	100%		-DO- & NOTE 20, 21, 22 -DO-	--		MQCD
1.4.4	WELDING OF 1) CONES 2) FLANGES 3) PARTING FLANGES 4) LIFTING EYE	WELD SIZE & SHAPE	MAJOR	VISUAL	100%		DRAWING & PRQA: 500/LATEST NOTES 1, 3, 4, 19, 23	--		MQCD
1.4.5	MARKING FOR MACHINING	ID, OD, & CONCENTRICITY	MAJOR	-DO-	100%		-DO-	--		MQCD
1.4.6	FINAL	ID, OD, HEIGHT	MAJOR	VISUAL &	100%		DRAWING & PRQA: 500/LATEST	--		MQCD

STANDARD QUALITY PLAN FOR

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1	2	3	4	5	6	7	8	9	10	11
		THREADED HOLE								
		SIZE,R/O&P/O								
1.5.	PROFILE PIECE									
1.5.1	CUTTING OF PLATES,CUTTING OF TUBESA BRNDING & EDGE PREPARATION	SHAPE&SIZE	MAJOR	VISUAL& MEASURE MENT	100%	DRAWING & PRQA:500/LATEST NOTES 15,16,17,18	--		MQCD	
1.5.2	WELDING OF TUBE WITH BENT PLATES & WELDING OF PLATES	WELD SIZE & SHAPE	MAJOR	-DO-	100%	DRAWING&PR:QA500/LATEST NOTES 1,3,4,19,23	--		MQCD	
1.5.3	FINAL DIMENSIONS	LENGTH	MAJOR	-DO-	100%	DRAWING, PR:QA:500/LATEST	--		MQCD	
1.6.	GUIDE VANES (FOR 2 STAGE FAN ONLY)									
1.6.1	SHEARING OF PLATES/GAS CUTTING	OVERALL DIMENSIONS	MAJOR	MEASURE- MENT	100%	DRAWING & PRQA:500/LATEST NOTE 15,16,17,18	--		MQCD	
1.6.2	EDGE MACHINING	LENGTH AND ORIENTATION	MAJOR	-DO-	100%	DRAWING&PR:QA:500/LATEST	--		MQCD	
1.6.3	NOT PRESSING	PROFILE GAP & PROFILE DIRECTION	MAJOR	-DO-	100%	DRAWING&PRQA:326/LATEST	LOG		MQCD	
1.7.	MAN HOLE DOOR	LENGTH,WIDTH	MAJOR	VISUAL& MEASURE- MENT	100%	DRAWING & PRQA:500/LATEST	--		MQCD	
		RADIUS,HOLE SIZE,WELD SIZES&QUALITY								
1.8.	HOUSING ASSY WELDING									
1.8.1	WELDING OF CORE/BULLET/HUB WITH HOUSING, STIPPENERS& PROFILE PIECES	WELD QUALITY & SIZE AND ORIENTATION OF STIPPENERS, PROFILE PIECES	MAJOR	-DO-	100%	DRAWING&PRQA:500/LATEST NOTE,1,3,4,19,23	--		MQCD	
1.8.2	WELDING OF DRAIN TUBE ASSY	WELD SOUNDNESS & SIZE	MAJOR	PT	100%	DHE:NDT:RP:PT01/LATEST NOTE,3,4,19,23,25	NDT	NDTI, REPORT		

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1	2	3	4	5	6	7	8	9	10	11
1.8.3	WELDING OF GUIDE VANES IN CASE OF 2 STAGE FAN HOUSING	WELD SIZE & ORIENTATION OF VANES	MAJOR	VISUAL & MEASURE MENT	100%	DRAWING: PRQA:500/LATEST & NOTE 3,4,13,19,23	--			MQCD
1.8.4	HYDRAULIC TEST OF DRAIN LINE	LEAK PROOFNESS	MAJOR	HYDRO TEST	100%	NOTE 5	--			MQCD
1.8.5	WELDING OF FOOT SUPPORT AND FOOT PLATE	WELD QUALITY	MAJOR	PT/WT	100%	DUE: NDT: RP: PT01/LATEST DUE: NDT: RP: MT01/LATEST NOTE 3,4,19,23	NDT		NDT	NDT
1.8.6	DIMENSIONAL INSPECTION OF HOUSING	HOUSING ID. & FLANGE OD, DEPTH OF CORE FROM HSG FACE DEPTH OF BRG SEATING FLANGES AT FROM HSG. FACE IN BETWEEN DISTANCE OF BRG SEATING FLANGES RUN OUT & FACE OUT, CONCENTRICITY BETWEEN HUB, HOUSING AND BRG SEATING FLANGES BOTH ENTRY & EXIT SIDE FOOT PLATE TO HOUSING CENTRE DISTANCE	MAJOR	MEASURE- MENTS	100%	DRAWING: PR: QA:500/LATEST	--			MQCD
1.9.0	STRESS RELIEF OF HOUSING ASSEMBLY.	COMPLIANCE TO CRIT STRESS RELIEF -CAL CYCLR.		VERIFICA- TION DT CHART	100%	SAP: HT: 001/LATEST		U T		MQCD
1.1.0	FULL WELDING OF BRARING SEATING SHAPE FLANGES & FOOT PLATES	WELD SIZE &	MAJOR	VISUAL & MEASURE- MENT	100%	DRAWING & NOTE 3,4,19,23	--			MQCD

## STANDARD QUALITY PLAN FOR

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1	2	3	4	5	6	7	8	9	10	11
(a)										
1.1.1	SPLITTING OF HOUSING ASSY AND WELDING OF PARTING FLANGES SHAPE IN CASING& CORE/BULLET	WELD SIZE&	MAJOR	-DO-	100%		DRAWING	--	MQCD	
							NOTE 2,3,4,19,22&23			
b)	GRINDING OF PARTING FLANGES	FLATNESS OF PARTING FLANGES AFTER FLOSH GRINDING	MAJOR	VISUAL	100%		-DO-	--	MQCD	
c)	ASSY OF HOUSING HALVES	GAP BETWEEN HALVES	MAJOR	MEASURE- MENT	100%		DRAWINGS	--	MQCD	
1.1.2	MARKING FOR MACHINING	MACHINING ALLOWANCES	MAJOR	MEASUR- MENT	100%		DRAWING	--	MQCD	
1.1.3	ASSY OF THERMOCOUPLE PASSAGE	PROPER ASSY	MAJOR	VISUAL	100%		DRAWING	--	MQCD	
2.0.	MACHINING OF HOUSING ASSY	ID OF HSG. STRP OF OGV SEATING FLANGE DISTANCE OF BRG HSG. SEATING FLANGE TO EXIT FLANGE OF HOUSING, BETWEEN DISTANCE OF BRG HSG. SEATING FLANGES, OD&ID OF HUB, HUB FACE TO HOUSING FACE, ID, DEPTH, PCD & THREAD SIZE OF SCREEN PLATE SEATING AREA, ID, PCD, F/O, R/O OF BRG. HSG, SEATING FLANGES, HOLE SIZE MATCH DRILLING OF OGV SEATING FLANGES,	MAJOR	-DO-	100%		DRAWING	DR/ HISTORY CARD	MQCD	
							NOTE 6,7,8,14			

STANDARD QUALITY PLAN FOR

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AP FAN HOUSING ASSY

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		FOOT								
		TO HOUSING								
		CENTRE HEIGHT								
		FOOT HOLE DIA								
		&DISTANCES								
		R/O&P/O OF								
		HOUSING								
		HUB OD,								
		TOTAL HT								
		FOOT PARALLISIM								
		&FLATNESS OF								
		INDIVIDUAL								
		FOOT								
3.0.	FINAL INSPECTION									
3.1.	PAINTING	VERIFICATION	MAJOR	VISUAL	100%	PRQA:590/LATEST,CMS			MQC	
	PRESERVATION					NOTE 26				
	IDENTIFICATION									
	NOTE:									
	1 :	a) SPIDER SHALL BE USED WHILE WELDING THE HOUSING SHELL WITH FLANGE AND STIFFENERS								
		b) DIVIDING FLANGES SHALL BE MATCH DRILLED AND TO BE TACK WELDED .								
		c) DIVIDING ON CIRCULAR FLANGES SHALL NOT BE DONE BEFORE STRESS RELIEF								
		d) BULLET & CASING AFTER SR SHALL BE PLACED ON LAYOUT FOR CORRECT ASSY AND STIFFENERS/PROFILE PIECE SHALL BE WELDED								
		e) BULLET FLANGES (HEARING HOUSING SEATING) SHALL BE TACK WELDED BEFORE SR AND SHALL BE WELDED ONLY AFTER ASSY WITH HOUSING .								
		f) BEFORE FINAL WELDING OF BULLET WITH CASING ALL THE FIT UP, CONCENTRICITY, DIMENSIONS SHALL BE CHECKED								
	2 a)	AFTER DIVIDING, THE DIVIDING FLANGE FACES SHALL BE GROUND FOR FLATNESS AND SHALL BE ASSEMBLED.								
		b) THE GAP BETWEEN THE FLANGES SHALL BE CHECKED AT FREE CONDITION AFTER PLACING THE MACHINED WASHER & TOP HALF OF HOUSING (BEFORE TORQUE TIGHTENING)								
		c) THE MAXIMUM GAP VARIATION SHALL NOT EXCEED 0.5 MM. IN FREE CONDITION								
		d) THICKNESS OF WASHER SHALL BE BETWEEN 4 TO 6 MM.								
	3:	a) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR ATLEAST 2 HOURS AT 260 TO 430 DEG C AND HELD IN HOLDING OVENS AT 120-150 DEG C BEFORE USE.								
		IF THE ELECTRODES ARE EXPOSED FOR MORE THAN 4 HOURS TO THE ATMOSPHERE THESE SHALL BE REBAKED AND DRIED IN THE SAME MANNER								
		b) ROTILE COATED ELECTRODES SHALL BE DRIED AT 120 130 DEG C FOR 1 HOUR BEFORE USE.								

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6

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

- 4: PROPER WELDING SEQUENCE SHALL BE ADOPTED TO MINIMISE DISTORTION .
- 5: THE DRAIN TUBE ASSY SHALL BE HYDRAULIC TESTED AT 20 BAR FOR 30 MIN.  
A DROP OF MAXIMUM 1 BAR MAY BE ALLOWED&NO LEAK IS PERMITTED.
- 6: 1)THE BEARING HOUSING SEATING FLANGES SHALL BE DRILLED WITH JIG ONLY. AND WHILE DRILLING THE HOUSING SHALL BE CHECKED FOR FLATNESS. AND THE DRILL HOLES SHALL BE CONCENTRIC.FOR CORRECT LOCATION OF DRILL JIGS A LINE CAN BE MADE IN THE MACHINE ITSELF WHILE MACHINING ID.
- 7: REFERENCE LINE MARKING SHALL BE DONE BEFORE MACHINING AND AVAILABILITY OF MACHINING ALLOWANCE AT ALL LOCATION SHALL BE ENSURED. ASSEMENT OF RESIDUAL THICKNESS AND PUNCHING OF CENTRE LINE ON CASING FLANGE AND BEARING HOUSING SEATING FLANGE SHALL BE DONE.
- 8) OGV MATCH DRILLING SHALL BE VERIFIED BY ASSEMBLING
- 9 ----VACANT-----
- 10 BULLET WELDS SHALL BE FLOSD GROUND AND SMOOTHLY MERGED ON OUT SIDE.
- 11 ----VACANT-----
- 12 DRAIN TUBE ASSY WELDING SHALL BE DONE AFTER STRESS RELIEF
- 13a)CARR SHALL BE TAKEN FOR SETTING THE FIRST VANE WHICH SHALL NOT COINCIDE WITH THE DIVIDING AXIS.  
AND WELDING SHOULD NOT BE DONE ON THE MILLED PORTION OF THE VANES. -REFER DRAWING.
- b) SPRCIAL FIXTURE SHALL BE USED FOR BLADE SETTING.THE VANE SHOULD SEAT PROPERLY OON THE FIXTURE AND EXIT OF VANE SHOULD COINCIDE WITH THE MARKING ON HOUSING.CHECK FOR DIRECTIONS OF VANES.
- c) LOCATION OF FIRST VANE SHOULD BE SET IN SUCH A WAY THAT EXIT EDGE OF VANE IS AWAY FROM MACHINE AXIS.
- 14 WHILE MACHINING THE PCD LINE CAN BE MARKED BY A LIGHT GROOVE .SO THAT SAME CAN BE USED FOR DRILLING HOLES .
- 15:MATERIALS SHALL BE AS PER GMS, AND ANY ADDITIONAL JOINTS SHALL BE APPROVED BY ENGG
- 16 )PLATES TO BE CUT TO SIZE BY SHEARING /GAS CUTTING.
- 17 )CARBON STEELS THICKER THAN 50 MM SHALL BE PREHEATED TO 100°C AND ALLOY STEELS ABOVE 25 MM THICK SHALL BE PREHEATED TO 150 DEG°C BEFORE GAS CUTTING.
- 18 )GAS CUT NOTCHES SHALL BE DRESSED BY GRINDING AND NOTCHES SHALL BE FILLED UP BY WELDING AND GROUND BEFORE TAKING UP FURTHER FABRICATION.
- 19 )WLDERS AND WELD PROCEDURES EMPLOYED SHALL BE QUALIFIED ASPER AWS D1.1 LATEST.
- 20 ) FOR CIRCULAR FLANGES TOLERANCES ARE AS GIVEN BELOW

BOLT SIZE	BOLT SIZE in MM	TOLERANCE	
		FOR PCD	FOR HOLE
M16	19	±0.70	±0.5
M20	24	±0.70	±0.5
M24	28	±1.0	±0.8
M30	34	±1.0	±0.8
M36	40	±1.0	±0.8
M42	46	±1.0	±0.8

QUALITY CONTROL PLAN FOR

Q.P.NO.FAN348

AP FAN HOUSINGS

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- 21) PITCH DISTANCE OF ANY TWO CONSECUTIVE HOLES SHALL BE WITHIN 11 MM.
- 22) OUT OF FLATNESS SHALL NOT EXCEED 3 MM.
- 23) a) GROOVE WELDS SHALL BE PREPARABLY MADE WITH MINIMUM REINFORCEMENT UNLESS OTHERWISE SPECIFIED.  
IN THE DRAWING AND IN CASE OF BUTT WELDS REINFORCEMENT SHALL NOT EXCEED 1.2 MM.  
b) SURFACE OF WELDS SHALL BE FREE FROM RIPPLES ,OVERLAPS & UNDER CUTS AND ANNOPT RIDGES .  
c) BUTT WELDS SHALL BE BACKGOUDED TO REMOVE ALL SLAG, UNFUSED AREA ETC. WELDED ON  
OTHER SIDE .  
d) WELD SHALL BE FREE FROM SPATTER AND SLAG.
- 24 ) ---VACANT---
- 25) WELD NECK FLANGES FOR DRAIN PIPE SHALL BE FULLY WELDED APTER INSERTION OF DRAIN PIPE IN TO HOUSINGS  
AND TO BULLET .
- 26) HOUSING SHALL BE IDENTIFIED WITH  
NO.NO, DUNO, PRODUCT NO AND SUBCONTRACTORS CODES IF ANY.

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 SHAFT WITH BEARING ASSY  
 (TUBULAR TYPE)

NAME OF CONTRACT PACKAGE : OF NO: FAN352  
 STANDARD  
 REV. No: 00  
 DATE: 13/11/95  
 PAGE 01 OF 4

PREPARED BY: *[Signature]*

REVIEWED BY:

*[Signature]*

APPROVED BY:

*[Signature]*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	
1.0.	MATERIAL									
1.1.	RAW MATERIALS									
1.1.1	BEARING HOUSING	CHEMMECH PROPERTIES	MAJOR	VERIFICATION OF TCS	100%		TDC:RTF:314	TC	QC-PROC	
1.1.2	PLATESSHEETS		MAJOR		100%		IS 2062	TC		
1.1.3	SHAFT FORGING		MAJOR		100%		TDC:RTF:308	TC		
1.2.	SUBDELIVERIES	COMPLIANCE TO P.O	MAJOR		100%		PURCHASE ORDER	TC		
1.2.1	BEARINGS									
1.2.2	EYE BOLTS									
1.2.3	LOCK NUTWASHER									
1.2.4	FASTENERS.									
1.2.5	BEADED PLUGS.									
1.2.6	SEALING RING.									
1.2.7	KEY									

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QUALITY CONTROL PLAN FOR

SHAFT WITH BEARING ASSY (TUBULAR)

DE. NO: FAN352  
 REV. NO: 00  
 DATE: 13/1/95  
 PAGE 03 OF 04

1	2	3	4	5	6	7	8	9	10	11
2.2.2	BEARING HSG. COVER ASSY	BORR GROOVE ID&WIDTH OD, STEP OD, STEP DEPTHS, HEIGHT, DRILL, HOLES DIA, PCD ORIENTATION, FINOUT, FACE OUT	MAJOR	MEASURE- MENT	100%	DRAWING & PROQA500 NOTE 1		DR	MOCD	
2.2.3	SHAFT	JOURNAL DIA STEP OD, LENGTH THREAD SIZE, KEY WAY LENGTH WIDTH&OFFSET RUN OUT, FACE OUT COUPLING SEATING DIAS	MAJOR	-FO-	100%	-DC-		DR	MOCD	
2.3	BALANCING \$\$									\$S IF CALLED FOR IN DRG.
2.3.1	SHAFT	IMBALANCE CORRECTION	MAJOR	DYNAMIC BALANCING	100%	DRAWING & ISO1940		BALANCING REPORT	MOCD	
2.4	ASSEMBLY									
2.4	ASSY OF SHAFT WITH BRGS. COVER ACCESSORIES	PROPER ASSY, F/O ON BEARINGS OVERAL DIMENSIONS	MAJOR	MEASURE- MENT	100%	DRAWING & PROQA312 NOTE 1		DR	MOCD	



BHEL  
RANIPET

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QUALITY DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )

Q.W.I.NO:SQP:FAN353/01  
Dt 09 12 95

AMENDMENT SL NO: 

A	1
---	---

Dt:15 02 2000

DESCRIPTION:CONTROL ROD/CONTROL SLIDE/CONTROL SLEEVE

DETAILS

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
1.1.1	EN10084 IS TO BE READ INPLACE OF DIN 17210	DIN 17210 IS OBSOLETE
1.1.2	STANDARD DIN 1691& 1693 ARE DELETED.	DIN 1691& 1693 ARE OBSOLETE

QUALITY DEPARTMENT  
RANIPET  
Q.W.I.No:- FAN353/01  
DATE TO GIVE: 15/02/2000  
*D. Venkatesh*  
*M. J. A.*

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B. Sundararajan  
Prepared by

*H. Anand*  
Approved by

Distribution: As per standard distribution list.

SHARAJ HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 PANJIBET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

CONTROL ROD & CONTROL SLIDE/  
 CONTROL SLEEVE

NAME: [ ]  
 STA: [ ]  
 ID: [ ]

CONTRACT PACKAGE  
 OP. NO.: FAN353  
 REV. NO.: 01  
 DATE: 09/29/95  
 PAGE 01 OF 03

PREPARED BY: *S. Srinivasan*  
 REVIEWED BY: *P. Ramkrishnaiah*  
 APPROVED BY: *H. H. [ ]*

S.NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC.	AGENCY	REMARKS
1.0.	MATERIAL									
1.1.	RAW MATERIALS									
1.1.1	CONTROL ROD	CHEMISTRY	MAJOR	ANALYSIS	MELT WISE	169M17-56 OF DIN17210/ * 590M17 OF BS970 PART 1		TC	SUPPLIER	TC SUPPLIER
1.1.2	CONTROL SLIDE/ CONTROL SLEEVE	CHEMISTRY	MAJOR	CHEMMECH TESTS	MELTWISE	** 6625 OF DIN1691/ 1-62260 OF IS 210 OR 66640 OF DIN 1693 PART 1/ 56 400/15 OF IS 1865		TC	SUPPLIER	TC SUPPLIER ** REFER DRAWING OR P.D.O FOR APPLICABLE MATL. SPEC

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CONTROL COPY NO:- Q1W1DD1  
 ISSUED TO SHRI. D. K. [ ]



QUALITY CONTROL PLAN FOR

CONTROL ROD AND CONTROL SLIDE/CONTROL SLEEVE

QP.NO:FA563  
 REV.NO:01  
 DATE:091295  
 PAGE 03 OF 03

1	2	3	4	5	6	7	8	9	10	11
2.2.	CASE HARDENING									
2.2.1	CONTROL ROD	CASE DEPTH HARDNESS ON SIMULATED TEST PIECE	MAJOR	MEASURE- MENT	ONE FOR EACH BATCH OF CASE HARDENING		DRAWING	TC	SUPPLIER VERIFICATION OF T.C.	
3.0.	FINAL INSPECTION									
3.1.1	IDENTIFICATION PRESERVATION PACKING	VERIFICATION	MAJOR	VISUAL	100%		NOTE 2	—	SUPPL	DOCUMENT IN TRIPPLICATE
4.0.	DOCUMENT* PACKAGE	VERIFICATION OF RECORDS ASPER COLUMN 9 OF CL. 1.1 .1.2&2.2	MAJOR	VERIFICA- TION	100%		QP:FA563/LATEST	DOCUMENT PACKAGE	SUPPL	DOCUMENT IN TRIPPLICATE SHALL BE SUBMITTED TO BHEL
<p>NOTE 1:a) EDGES SHALL BE CHAMFERED BY .2 MM X45DEG.                  b) CONTROL EDGES SHALL BE SHARP AND FREE FROM BURRS                  c) ALL RADIUS AND GROOVE DIMENSIONS SHALL BE CHECKED.                  d) OIL HOLES THROUGNESS SHALL BE CHECKED IN CASE OF CONTROL ROD.</p> <p>NOTE 2:a) THE MACHINED SURFACES SHALL BE APPLIED WITH RUST PREVENTIVE OIL AND OVER THAT PLASTIPEEL COATING SHALL BE DONE.                  b) CONTROL ROD AND CONTROL SLIDE SHALL BE IDENTIFIED WITH TAG AND PACKED SUITABLY BEFORE DESPATCH.</p>										

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QUALITY DEPARTMENT		
AMENDMENT TO QUALITY WORK INSTRUCTIONS (SQP)		
QWI NO: SQP:FAN:354	REV 00	DATE : 03 02 96
AMENDMENT NO. A 1		DATE : 05 12 2000
<u>DESCRIPTION:</u> RADIAL FAN ROTOR ASSY		
<u>DETAILS</u>		
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT/REMARKS
3.0	Following added. Under Ref & Acceptance standard  <u>Note 2:</u> Direction of rotation to be painted on the impeller and to be verified with reference to drawings.	CTQ Recommendation
Prepared by <i>Lewis</i>	Reviewed by <i>B. Scimato de Leon</i>	Approved by <i>HA</i>

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 RADIAL FAN ROTOR ASSEMBLY.

NAME OF CONTRACT PACKAGE  
 STANDARD

QPN0: FAN354  
 REV.No:00  
 DATE:030296  
 PAGE 01 OF01

PREPARED BY: *[Signature]*  
 REVIEWED BY: *B. Srinivasan*  
 APPROVED BY: *[Signature]*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1										
2										
	NOTE: (1) This Q.P is applicable in case of drawing calls for ROTOR ASSY. (2) For Impeller Assy and Conical Cover Plates refer SQP:FAN317/Latest. (3) For Shafts refer SQP:FAN345/Latest and FAN346/Latest as applicable.									

1.0.	MATERIAL									
	a) FASTENERS	COMPLIANCE TO PURCHASE ORDER	MAJOR	VERIFICATION OF TC'S	100%	PURCHASE ORDER		TC	QC/PROC	
	b) WASHERS	-DO-	MAJOR	VERIFICATION OF DR	100%	-DO-		DR	QC/OLI	
2.0.	INPROCESS INSPECTION									

2.1.	SHAFT+ IMPELLER+ CC PLATES	PROPER ASSY TORQUE TIGHTNESS	MAJOR	VISUAL	100%	PROQA:312/LATEST			QC/PROC	** PROQA061, 306, 307, 309 ARE APPLICABLE FOR BHEL
2.2.	DYNAMIC BALANCING OF ROTOR ASSY	RESIDUAL UNBALANCEMENT	CRITICAL	UNBALANCE COMPENSATION	100%	DRG&PROQA:061, 306, 307, 309 314, 323/LATEST	**	BALANCING REPORT	QC/PROC	SHOPS ONLY.

3.0.	FINAL INSPECTION									
	PAINTING PRESERVATION IDENTIFICATION PACKING	COATING THICKNESS OF PAINT, PROPER PACKING, PRESERVATION & CORRECTNESS OF IDENTIFICATION	MAJOR	MEASUREMENT VISUAL	RANDOM FOR PAINTING & 100% FOR OTHERS	PROQA590 & PROQA512@ PROQA512@ PACKING DRAWINGS & GMS, NOTE 1			QC/PROC	@PROQA:512 IS APPLICABLE FOR SUBCONTRACTING ONLY
										NOTE 1: IDENTIFICATION OF ITEMS SHALL BE WITH WO. NO, DUNO, PRODUCT NO. VENDOR CODE IF APPLICABLE

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 BOILER AUXILIARIES PLANT  
 RANIPET-632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 HUB WITH FLANGE

NAME OF CONTRACT PACKAGE  
 STANDARD

QP.No.FAN355  
 REV.No.00  
 DATE 260496  
 PAGE 01of02

PREPARED BY: *B. Srinivasan*      REVIEWED BY: *D. Infrant*      APPROVED BY: *H. Infrant*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	MATERIAL									
1.1.	HUB FORGING ROUND	CHEMICAL & MECHANICAL	MAJOR	VERIFICATION OF TCS	100%	APPLICABLE MATL STANDARD AND TDC.		TC	QC-RMS	
1.2.	FLANGE	UT -DO-								
1.3.	ARRESTING RING	-DO-								
2.0.	INPROCESS CONTROL NOTE: ATTESTATION/CERTIFICATION TRANSFER SHALL BE ENSURED.									
2.1.	MACHINING									
2.1.1	ROUND FORGING	ID, OD, EP	MAJOR	MEASUREMENT	100%		DRAWING -DO-	DR CR	QCQD	
2.1.2	FLANGE	ID, EP, HOLES PCD, HOLE DIA	MAJOR	-DO-	100%					
2.1.3	ARRESTING RING	ID, OD, If applicable THICKNESS, HOLES DIA, PCD THREAD SIZE	MAJOR	-DO-	100%		-DO-	DR	QCQD	
2.2.	WELDING									
2.2.1	HUB-FLANGE WELDMENT		WELD SOUNDNESS	MAJOR	UT RPTMT FOR BUTT JOINTS & MT FOR FILLET WELDS	100%	SHE:NDT:PB:MT01/LATEST SHE:NDT:PB:UT02/LATEST AND NOTE 1	NDF REPORT	NDTL	
2.3.	STRESS RELIEF	COMPLIANCE TO HT CYCLE	MAJOR	VERIFICATION OF STRESS RELIEF CYCLE	100%	SHE:HT:001/LATEST		HT CHART	QCQD	

QCQD: MANUFACTURER'S QUALITY CONTROL DEPARTMENT, NDTL: NONDESTRUCTIVE TESTING, DR: DIMENSIONAL REPORT  
 HT: HEAT TREATMENT CYCLE, TC: TEST CERTIFICATE

QUALITY CONTROL PLAN FOR

HUB-FLANGE

QP.NO: FAN355  
 REV.NO: 00  
 DATE: 26 04 96  
 PAGE 02 OF 02

1	2	3	4	5	6	7	8	9	10	11
2.4.	FINAL MACHINING									
2.4.1	HUB+FLANGE (HUB ASSY)	ID, OD, PCD, THREAD SIZE, THREAD HOLE DEPTH, KEY WAY WIDTH, DEPTH, OFFSET TOTAL LENGTH, FLANGE OD, STEP DIA, DEPTH, FACE OUT, RUN OUT	MAJOR MEASURE- MENT	100%	DRAWING: SPRQAS500/LATEST NOTE 3	DR	MQCD			
2.5.	DYNAMIC BALANCING	RESIDUAL UNBALANCEMENT	MAJOR UNBALANCE COMPENSATION	100%	DRAWING & NOTE 2	BLNG REPORT	MQCD			
2.5.1	HUB ASSY									
3.0.	FINAL INSPECTION	PAINTING PRESERVATION PACKING	MAJOR VISUAL	100%	DRAWING SPR:QA:590/LATEST		MQCD			

NOTE 1: FULL PENETRATION GROOVE WELDS SHALL ALSO BE UT, RT & MPI TESTED. PARTIAL PENETRATION GROOVE WELDS SHALL BE RT EXAMINED. IN CASE OF ALLOY STEELS NONDESTRUCTIVE EXAMINATIONS (NDE) SHALL BE CONDUCTED AFTER +6 HRS AFTER COMPLETION OF WELDS. NDE SHALL BE CONDUCTED BEFORE & AFTER STRESS RELIEF.

NOTE 2: BALANCING SHALL BE CARRIED ON MANDREL SHAFT AS PER DRAWING P.O REQUIREMENT. MANDREL SHALL BE BALANCED TO A GRADE BETTER THAN HUB ASSY.

NOTE 3: KEY WAY OFFSET PERMITTED SHALL BE AS PER TABLE SHOWN BELOW.

DIA OF SHAFT IN MM	OFFSET PERMITTED IN MM
>10UP TO 22	0.1
>22UP TO 38	0.16
>38UP TO 65	0.20
>65UP TO 110	0.30
>110UP TO 150	0.4

HHARAT HEAVY ELECTRICALS LTD	QUALITY CONTROL PLAN FOR	NAME OF CONTRACT PACKAGE	QP.NO:FAN356
BOILER AUXILIARIES PLANT			REV.No:01
RANIPET-632 406 (INDIA)	OUTLET GUIDE VANE ASSY	STANDARD	DATE:100696
QUALITY ASSURANCE DEPT.			PAGE 01 OF 05

PREPARED BY: *B. Srinivasulu* | REVIEWED BY: *[Signature]* | APPROVED BY: *[Signature]*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	
1.0.	INPROCESS CONTROL									
1.1.	OGV SHELL									
1.1.1	GAS CUTTING OF OVERALL SHELL, FLANGES, LIFTING LOGS	DIMENSIONS	MAJOR	MEASURE- MENT	100%	DRAWING & PR:QA:500/LATEST NOTES 2,3,4,5,11			MQCD	
1.1.2	ROLLING OF SHELL&FLANGES &EDGE PREPARATION	ID,OD&EP	MAJOR	DO	100%	DRAWING & PR:QA:500/LATEST NOTE 9			MQCD	
1.1.3	WELDING OF SHELL, FLANGES & LIFTING LOGS	WELD SIZE & ID	MAJOR	DO	100%	DRAWING & PR:QA:500/LATEST NOTE 6,10,13,14,16			MQCD	
1.2.	OGV CORE									
1.2.1	GASCUTTING OF CORE, FLANGES, ANGLES	OVERALL DIMENSIONS	MAJOR	DO	100%	DRAWING, PR:QA:500/LATEST NOTE 2,3,4,5,11			MQCD	
1.2.2	ROLLING OF CORE FLANGES & EDGE PREPARATION	ID,OD,EP	MAJOR	DO	100%	DRAWING, PR:QA:500/LATEST NOTE 9			MQCD	
1.2.3	DRILLING/ THREADING OF HOLES	SOLE SIZE	MAJOR	DO	100%	DRAWING & PR:QA:500/LATEST NOTE 7,8,9			MQCD	

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QUALITY CONTROL PLAN FOR

QP.NO: PAN356

OUTLET GUIDE VANE ASSY

REV.NO: 01

DATE: 100696

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1	2	3	4	5	6	7	8	9	10	11
1.2.4	WELDING OF CORE & FLANGES	SIZE & ID	MAJOR	MEASURE- MENT	100%	DRAWING & PR: QA:500/LATEST	NOTE 6, 10, 13, 14, 16	--	MQCD	
1.3.	GUIDE VANES									
1.3.1	GAS CUTTING	OVERALL DIMENSIONS	MAJOR	-DO-	100%	DRAWING & PR: QA:500	NOTE: 2, 3, 4, 5, 11	--	MQCD	
1.3.2	EDGE MACHINING	ORIENTATIONS LENGTH	MAJOR	-DO-	100%	DRAWING & PR: QA:500/LATEST		--	MQCD	
1.3.3	HOT PRESSING OF VANES	PROFILE GAP & PROFILE DIRECTION	MAJOR	-DO-	100%	DRAWING & PR: QA:326/LATEST		100%	MQCD	
2.0.	OGV ASSY									
2.1.	WELDING									**
2.1.1	WELDING OF OGV SHELL WITH FINISH CORE VANES	WELD SIZE	MAJOR	VISUAL & MEASURE- MENT	100%	DRAWING & **	NOTE 16, 6, 10, 13, 14, 16, 17	--	MQCD	VANES SHALL BE SET BY FIXTURE AND 1ST VANE SETTING
2.1.2	DIMENSIONS	ID OF SHELL OD OF CORE OD OF FLANGE DEPTH OF VANE CONCENTRICITY R/O, P/O	MAJOR	MEASURE- MENT	100%	DRAWING & PR: QA:500/LATEST		--	MQCD	SHALL BE INSPECTED AS PER DRG.
2.2	STRESS RELIEF	COMPLIANCE TO S.R. CYCLE	MAJOR	VERIFICA- TION OF HT CHART	100%	DAP: HT:001/LATEST		HT CHART	MQCD	

QUALITY CONTROL PLAN FOR

OUTLET GUIDE VANE ASSY

QP.NO: FAN356

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DATE: 100696

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2.3.	SPLITTING OF OGV ASSY & WELDING OF PARTING FLANGES	WELD SIZE & FINISH 1ST VANE LOCATION	MAJOR	VISUAL & MEASURE- MENT	100%		DRAWING NOTE 1a,6,9,10,12,13,14	--		MQCD
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2.4.	ASSEMBLY OF OGV HALVES WITH WASHERS ,PACKING ROPE FIT BOLTS & FASTENERS	PROPER ASSY & ID OF OGV	MAJOR	-100-	100%		DRAWING PR:QA:500/LATEST	--		MQCD
------	--	----------------------------	-------	-------	------	--	--------------------------	----	--	------

2.5.	MACHINING OF OGV ASSY	FLANGE OD, ID OF CORE FLANGE, ID OF SCREEN COVER SKATING FLANGE &DEPTH FROM CASING FLANGE DEPTH OF CORE FROM CASING FLANGE, DEPTH OF VANES FROM CORE PACK. TOTAL BRIGBT PCD, HOLES MATCH DRILLING, SIZE R/O, P/O. PCD & THREAD SIZE.	MAJOR	100%	MEASURE- MENT	DRAWING & PR:QA:500/LATEST NOTE 7,8,15 & 18			HISTORY MQCD CARD
------	--------------------------	--	-------	------	------------------	--	--	--	----------------------

3.0.	PAINTING PRESERVATION IDENTIFICATION	VERIFICATION	MAJOR	VISUAL	100%	PR:QA:590/LATEST GMSNOTE19	--		MQCD
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QUALITY CONTROL PLAN FOR

QP.NO: PAN356

OUTLET GUIDE VANE ASSY

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1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11

NOTES:

1. a) DIVIDING FLANGES SHALL BE MATCH DRILLED AND TO BE TACK WELDED.

b) OGV CASING SHELL AND CORE SHALL BE PLACED ON LAYOUT FOR CORRECT ASSEMBLY .  
AND VANES SHALL BE TACK WELDED USING FIXTURE.

2. MATERIAL SHALL BE AS PER GMS AND ANY ADDITIONAL JOINTS SHALL BE APPROVED BY ENGINEERING.

3. PLATES SHALL BE CUT BY SHEARING OR GAS CUTTING.

4. CARBON STEELS THICKER THAN 50 MM SHALL BE PREHEATED TO 100°C AND ALLOY STEELS MORE THAN 25 MM THICK SHALL BE PREHEATED TO 150 °C BEFORE GAS CUTTING.

5. GAS CUT NOTCHES SHALL BE DRESSED BY GRINDING AND NOTCHES SHALL BE FILLED UP BY WELDING AND GROUND BEFORE TAKING UP FURTHER FABRICATION.

6. WELDERS AND WELD PROCEDURES EMPLOYED SHALL BE QUALIFIED AS PER AWS D1.1 LATEST.

7. FOR CIRCULAR FLANGES TOLERANCES ARE AS GIVEN BELOW

BOLT SIZE	HOLE SIZE in MM	TOLERANCE	
		FOR PCD	FOR HOLE
M16	19	±0.70	±0.5
M20	24	±0.70	±0.5
M24	28	±1.0	±0.8
M30	34	±1.0	±0.8
M36	40	±1.0	±0.8
M42	46	±1.0	±0.8

QUALITY CONTROL PLAN FOR

Q.P.NO.PANJ56

OUTLET GUIDE VANE ASSY

REV.NO.01

DATE:100696

PAGE:050P05

1	2	3	4	5	6	7	8	9	10	11
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8. PITCH DISTANCE OF ANY TWO CONSECUTIVE HOLES SHALL BE WITHIN ±1 MM.
9. DEVIATION ON FLATNESS OF FLANGES SHALL NOT EXCEED 3 MM.
10. a) GROOVE WELDS SHALL BE PREFERABLY MADE WITH MINIMUM REINFORCEMENT UNLESS OTHERWISE SPECIFIED IN THE DRAWING AND IN CASE OF BUTT WELDS REINFORCEMENT SHALL NOT EXCEED 3.2 MM.  
 b) SURFACE OF WELDS SHALL BE FREE FROM RIPPLES, OVERLAPS & UNDER CUTS AND ABRUPT RIDGES.  
 c) BUTT WELDS SHALL BE BACKGROUGED TO REMOVE ALL SLAG, UNFUSED AREA ETC. WELDED ON OTHER SIDE.  
 d) WELD SHALL BE FREE FROM SPATTER AND SLAG.
11. GAS CUT EDGES SHALL BE DRESSED BY GRINDING
12. a) AFTER DIVIDING, THE DIVIDING FLANGE FACES SHALL BE GROUND FOR FLATNESS AND SHALL BE ASSEMBLED.  
 b) THE GAP BETWEEN THE FLANGES SHALL BE CHECKED AT FREE CONDITION AFTER PLACING THE MACHINED WASHER (TOP HALF OF HOUSING) BEFORE TORQUE TIGHTENING)  
 c) THE MAXIMUM GAP VARIATION SHALL NOT EXCEED 0.5 MM. IN FREE CONDITION  
 d) THICKNESS OF WASHER SHALL BE BETWEEN 4 TO 6 MM.
13. a) LOW HYDROGEN ELECTRODES SHALL BE BAKED FOR ATLEAST 2 HOURS AT 260 TO 430 DEG C AND HELD IN HOLDING OVENS AT 120-150 DEG C BEFORE USE.  
 IF THE ELECTRODES ARE EXPOSED FOR MORE THAN 4 HOURS TO THE ATMOSPHERE THESE SHALL BE REBAKED AND DRIED IN THE SAME MANNER  
 b) RUTILE COATED ELECTRODES SHALL BE DRIED AT 120 - 130 DEG C FOR 1 HOUR BEFORE USE.
14. PROPER WELDING SEQUENCE SHALL BE ADOPTED TO MINIMIZE DISTORTION
15. OGV SHALL BE MATCH DRILLED WITH HOUSING
16. PLATES MAY BE PRESENT BEFORE WELDING.
17. a) CARE SHALL BE TAKEN FOR SETTING THE FIRST VANE WHICH SHALL NOT POUL WITH THE DIVIDING AXIS. AND WELDING SHOULD NOT BE DONE ON THE MILLED PORTION OF THE VANES-SEE DRAWING.  
 b) SPECIAL FIXTURE SHALL BE USED FOR BLADE SETTING. VANE SHOULD SEAT PROPERLY ON THE FIXTURE AND EXIT OF VANE SHOULD COINCIDE WITH THE MARKING ON THE FIXTURE. CHECK FOR DIRECTION OF VANES.  
 c) LOCATION OF FIRST VANE SHOULD BE SET IN SUCH A MANNER THAT THE EXIT EDGE OF VANE IS AWAY FROM MACHINE AXIS.
18. WHILE MACHINING THE PCD-LINE CAN BE MARKED BY A LIGHT GROOVE .SO THAT SAME CAN BE USED FOR DRILLING HOLES .
19. OGV ASSY SHALL BE IDENTIFIED WITH NO.NO, DUIDO, PRODUCT NO, AND SUBVENDOR CODE IF ANY.

M/S BHEL:BAP  
RANIPET 632 406  
TAMIL NADU

STANDARD QUALITY PLAN FOR  
STEEL COMPENSATING  
WEIGHT OF AP FAN

NAME OF CONTRACT  
PACKAGE  
STANDARD

QP NO : FAN:357  
RE :00  
DATE : 05 12 2000  
PAGE 01 OF 03

SL NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANT UM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF RECORDS	AGENCY		REMARKS
									M	C	
1			4	5	6	7	8	9			11
1.0 1.1	MATERIAL PLATES/ FORGINGS	CHEMICAL & MECHANICAL PROPERTIES	MAJOR	VERIFIC ATION OF TCS	100%	RESPECTIVE MATT. SPEC.	RESPECTIVE MATT. SPEC	T C	P	V	
2.0	INPROCESS * INSPECTION										
2.1	WELDING (AS APPLICABLE)	WELD SIZE SOUNDNESS	MAJOR	VISUAL PT/M T	100%	DRAWING BHE:NDT:RP-P T:01/LATEST BHE:NDT:RP: MT:01/LATEST	DRAWING BHE:NDT:RP-P T:01/LATEST BHE:NDT:RP: MT:01/LATEST	REPORT	P	W	* WELDERS SHALL BE QUALIFIED AS PER AWS D1.1

LEGEND

P : PERFORMED BY, V : VERIFIED BY, W : WITNESSED BY  
M : MANUFACTURER/SUBCONTRACTOR  
C : BHEL/AUTHORISED INSPECTION AGENCY

PREPARED BY  
(K Rajadurai)  
REVIEWED BY

QA

B Srinivasa Rao

QA

P Rajasakaran

QC

APPROVED BY

HANANTHANARAYANAN)

*(Signature)*

MANUFACTURER'S NAME & ADDRESS:  
 M/S BHEL:RAP  
 RANIPET 632 406  
 TAMIL NADU

STANDARD QUALITY PLAN FOR  
 STEEL COMPENSATING  
 WEIGHT OF AP FAN

NAME OF CONTRACT  
 PACKAGE  
 STANDARD

QP NO: FAN:357  
 RE :00  
 DATE : 05 12 2000  
 PAGE 02 OF 03

SL.NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUAN TUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF RECORDS	AGENCY		REMARKS
									M	C	
1	2	3	4	5	6	7	8	9	10	10 **	11
2.2	MACHINING	WELD SURFACE DEFECTS AFTER MACHINING	MAJOR	PT	100%	BHE:NDT-RP-PT 01/LATEST	BHE:NDT-RP-P T01/LATEST	REPORT	P	W	
2.2.1	SURFACE DEFECTS	WELD SURFACE DEFECTS AFTER MACHINING	MAJOR	PT	100%	BHE:NDT-RP-PT 01/LATEST	BHE:NDT-RP-P T01/LATEST	REPORT	P	W	
2.2.2	DIMENSIONS	BORE SIZE DRILL HOLES DIA,PITCH DISTANCE, THICKNESS OF THE LEVERPLATES, LENGTH, OUTSIDE DIA MATCHING OF HALVES	MAJOR	MEASURE MENT	100%	DRAWING& NOTE 1	DRAWING & NOTE 1	DR	P	W	
2.2.3	WEIGHING	WEIGHT OF EACH PIECE	MAJOR	WEIGHING	100%	DRAWING	DRAWING	DR	P	W	
3.0	PANTING, IDENTIFICATION & PRESERVATION	VERIFICATION OF IDENTIFICATION OF W.O.NO,DU NO , WT ,PAINTING & PRESERVATION	MAJOR	VISUAL	100%	GMS& RP 0674199	GMS& RP 0674199	--	P	W	

MANUFACTURER'S NAME & ADDRESS:  
M/S RHEI:RAP  
RANIPET 632 406  
TAMIL NADU

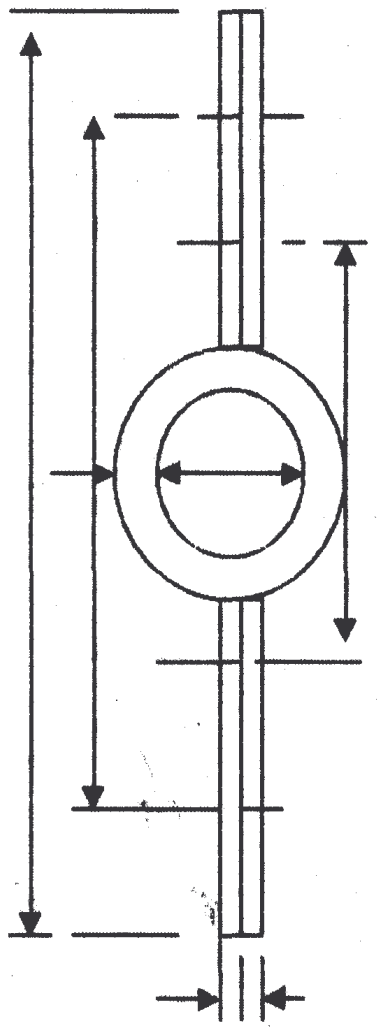
STANDARD QUALITY PLAN FOR  
STEEL COMPENSATING  
WEIGHT OF AP FAN

NAME OF CONTRACT  
PACKAGE  
STANDARD

QP NO: FAN:357  
RE :00  
DATE : 05 12 2000  
PAGE 03 OF 03

NOTE. 1

- 1) EDGE PREPARATION OF THE PLATES SHALL BE ENSURED
- 2) WELDS SHALL BE FLUSH GROUND AS SHOWN IN DRAWING
- 3) SHIM SHALL BE USED FOR MACHINING AS SHOWN IN DRG
- 4) THE THICKNESS OF THE PLATES AFTER MACHINING SHALL BE ENSURED
- 5) THE HALVES SHALL BE MATCH DRILLED
- 6) PROPER TIGHTENING SHALL BE ENSURED BEFORE MACHINING
- 7) MISMATCHING OF HALVES SHALL BE AVOIDED.
- 8) WT OF THE STEEL COMPENSATING WEIGHT SHALL BE AS CALLED FOR IN THE DRAWING.



4

M/S BHEL:RAP  
RANIPET 632 406  
TAMIL NADU

STANDARD QUALITY PLAN FOR  
AP FAN LEVER

NAME OF CONTRACT  
PACKAGE  
STANDARD

QP NO : FAN:358  
RE : 06  
DATE : 05 12 2000  
PAGE 01 OF 02

SL NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORM AT OF RECORDS	AGENCY		REMARKS
									M	C	
1		3	4	5	6	7	8	9			11
1.0 1.1	MATERIAL FORGING/CASTING	CHEMICAL & MECHANICAL PROPERTIES	MAJOR	VERIFICATION OF TCS	100%	RESPECTIVE MATL SPEC.	RESPECTIVE MATL SPEC	T C	P	V	
2.0	INPROCESS INSPECTION										
2.1	LEVER M/CING	HOLE CENTRE TO PIN DIA CENTRE DISTANCE, BORE DIA, KEY WAY WIDTH, OFFSET HEIGHT	MAJOR	-DO-	100%	DRAWING NOTE A	DRAWING NOTE A	DR	P	W	

LEGEND  
P: PERFORMED BY, V: VERIFIED BY, W: WITNESSED BY  
M: MANUFACTURER/SUBCONTRACTOR  
C: BHEL/AUTHORISED INSPECTION AGENCY

PREPARED BY (K Rajadurai)  
REVIEWED BY  
B Srinivasa Rao  
D Krishnaswamy  
P Rajasekaran

APPROVED BY  
(HANAYTHANARAYANAN)  
H Hanaythanan

QA  
QC  
QC- OIT  
P Rajasekaran

MANUFACTURER'S NAME & ADDRESS:  
 M/S REEL:RAP  
 PANIPET 632 406  
 TAMIL NADU

STANDARD QUALITY PLAN FOR  
 AP FAN LEVER

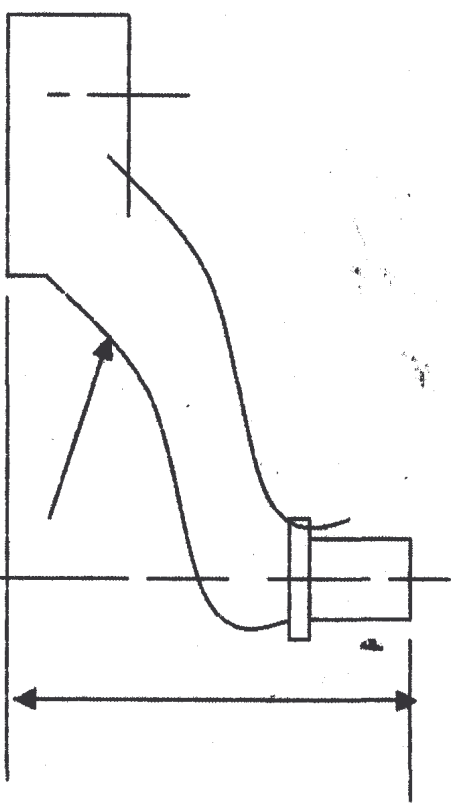
NAME OF CONTRACT PACKAGE  
 STANDARD

OP NO: FAN:358  
 RE :00  
 DATE : 05 12 2000  
 PAGE 02 OF 02

SL.NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE STANDARD	FORMAT OF RECORDS	AGENCY		REMARKS
									M	C	
1	2	3	4	5	6	7	8	9	10**		11
3.0	FINAL INSPECTION	VERIFICATION OF IDENTIFICATION OF W.O.NO,DU NO PAINTING & PRESERVATION	MAJOR	VISUAL	100%	GMS& RP 0674199	GMS& RP 0674199	DR	P	W	
3.1	PANTING, IDENTIFICATION & PRESERVATION	VERIFICATION OF IDENTIFICATION OF W.O.NO,DU NO PAINTING & PRESERVATION									

NOTE .A

- 1 MACHINING FIXTURE SHALL BE USED FOR MACHINING THE LEVER.
- 2 THE LEVER SHALL BE PLACED ON THE FIXTURE. THE PROFILE OF THE LEVER SHALL MATCH WITH FIXTURE PROFILE.
- 3 AFTER PRE DRILLING THE LEVER BORE , THE CENTRE OF PIN W.R.T BORE SHALL BE ENSURED IN FIRST OFF PIECE.
- 4 PROPER CLAMPING SHALL BE ENSURED.
- 5 THE LEVER SHALL BE CHECKED WITH GAUGE MADE FOR LOCATING THE BORE, PIN AND KEYWAY.
- 6 THE HEIGHT OF PIN TOP TO BORE BOTTOM SHALL ALSO BE ENSURED.



-----  
QUALITY DEPARTMENT  
-----

AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q C F)  
-----

Q. W. I. NO : 2 : 4 : 271

REV : 00

AMENDMENT SL NO : A 1


DESCRIPTION : IGV ASSY ( ND TYPE FANS )

DATE: 22/8/94  
-----

DETAILS  
-----

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
3.6	AWS D1. 1. 75 shall be read as AWS D1.1 latest.	Document referenced Is to be latest.
4.3 & 4.4	For intoleranced dimensions, refer PR : QA : 500 / latest for tolerances.	PR : QA : 500 is the document for intoleranced dimensions.
6.30	History card shall be read as Dimensional report	Dimensional report is in vogue.
7.2	Painting shall be as per Rp0674199/latest	Painting schedule RP0674199.

-----  
Prepared by : B. Srinivasan  
-----

Approved by : 

-----  
Distribution : As per standard distribution list.



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QUALITY ENGINEERING

QCP : 2:4: 271  
PAGE 1 OF 6

QUALITY CONTROL

INLET GUIDE VANE UNIT  
ASSEMBLY  
( FOR ND TYPE FANS )

PROCEDURE FOR

EFFECTIVE DATE

18-5-81

*h*

ACCEPTED BY

DEPARTMENT

DATE

ENGINEERING AND  
DEVELOPMENT CENTRE

*[Signature]*

BOILER PRODUCTION

*[Signature]*

OPERATION, PLANNING  
AND CONTROL

*[Signature]*

QUALITY ASSURANCE  
AND CONTROL

*S. Vinayakam*  
*[Signature]*

ISSUED BY  
QUALITY ENGINEERING

REVISION NO :  
DATE :

00-00  
18-5-81

## 1.0 SCOPE

-----

- 1.1. This procedure specified the quality requirements for manufacture of inlet Guide Van Unit Assembly for ND type fans.
- 1.2 This procedure is valid only for those products which are under the inspection purview of BHEL or its authorized agencies.
- 1.3 Special requirements if any shall be specified separately.

## 2.0 MATERIALS:

-----

- 2.1 Materials used shall be as per the drawing requirement.

## 3.0 WORKMANSHIP :

-----

- 3.1 The product made for this procedure shall have workman like finish. Also it will be the responsibility of the fabricator to organise to produce a quality product.
- 3.2 Any deviation in Engineering and material preparation joint shall have prior approval of BHEL product engineering department.
- 3.3 Plates and sheets shall be cut to size by shearing, machine cutting or flame cutting. Flame cut edges shall be cleaned to remove slag, and uneven edges shall be dressed by grinding. Gas cutting notches shall be filled up by welding and ground before taking up for further fabrication.
- 3.4 Ensure drying of electrodes.
- 3.5 Ensure correct selected of electrodes.
- 3.6 Welders employed in the production shall be qualified as per AWS D 1.1.75. The finished product shall be completely free from defects which are injurious to the component strength or to the appearance.
- 3.7 Proper welding sequence shall be adopted to minimize distortion.

4.0. DIMENSION AND OTHER DETAILS :

-----

- 4.1 All dimensions shall be as per the latest production drawing concerned.
- 4.2 Wherever tolerances have been indicated in the drawing the same shall be strictly followed.
- 4.3 For untoleranced dimension, the following tolerances shall be followed for fabrication (DIN 7168)

Nominal Size (mms)	Tolerance (mms)
Upto 315	+/- 1.0
Over 315 to 1000	+/- 2.0
Over 1000 to 2000	+/- 3.0
Over 2000 to 4000	+/- 4.0
Over 4000 to 8000	+/- 5.0
Over 8000 to 12,000	+/- 6.0
Over 12,000 to 16,000	+/- 7.0
Over 16,000 to 20,000	+/- 8.0

- 4.4 For untoleranced dimension, the following tolerance shall be followed for machining (DIN 7168).

Nominal Size (mms)	Tolerance (mms)
Over 0.5 to 3	+/- 0.10
Over 3 to 6	+/- 0.10
Over 30 to 120	+/- 0.20
Over 120 to 315	+/- 0.30
Over 315 to 1000	+/- 0.50
Over 1000 to 2000	+/- 0.80
Over 2000 to 4000	+/- 1.20
Over 4000 to 8000	+/- 2.00
Over 8000 to 12,000	+/- 3.00
Over 12,000 to 16,000	+/- 4.00
Over 16,000 to 20,000	+/- 5.00
	+/- 6.00

- 4.5 The parting flanges shall all be in the same Plane. also the flanges shall be free from bend, distraction and out of squareness.
- 4.6 The deviation from the flatness of flanges shall be 1 mm/metre or part thereof subject to a maximum of 3 mm.
- 4.7 For circular flanges, the centre distance of diametrically, opposite bolt holes shall not exceed +/- 1.5 mm.
- 4.8 Pitch distance of two consecutive holes shall be within +/- 1 mm.

4.9 The deviations from flatness of contact faces shall not exceed 3 mm. (wherever not shown in the drawing).

5.0 WELDING :

-----

- 5.1 Welds shall be free from burn through.
- 5.2 Welds shall be free from slag, spatter and the tacks shall be ground off.
- 5.3 Welds shall be checked for its size and appearance.
- 5.4 Undercuts and all defects shall be repaired. Notches or burning of metal more than 0.8 mm shall be termed as under cuts.
- 5.4 The individual component shall be free from skew or twist.

5.0 MANUFACTURE :

-----

- 6.1 The input guide vane assembly unit shall be fabricated as per the latest drawing.
- 6.2 The ovality of the housing shall be checked and shall not be more than 3 mm.
- 6.3 The diagonal, height of the housing shall be checked as per the drawing.
- 6.4 The bush hole diameter on the housing shall be checked as per the drawing.
- 6.5 The distance between the bushes shall be checked after welding. Care shall be exercised during welding to minimise distortion, and also for proper positioning of grease nipple hole in bush.
- 6.6 Ensure that the axis of the bush and housing centre are in one line.
- 6.7 Check for the blade profile and straightness.
- 6.8 The blade/shaft dimension profile and straightness.
- 6.9 The assembly of the blade shaft shall be checked.
- 6.10 Ensure shaft centre and the blade edge (longitudinal) are in one line.
- 6.11 The soundness of the rivet in the shaft assembly shall be checked by hammer test.
- 6.12 Ensure proper fit of cast Iron bush with steel bush welded on to the housing.
- 6.13 Ensure proper fixing of screw for locking between cast Iron bush and steel bush.
- 6.14 Check the free movement of the IGV shaft assembly in the bush without any shake.
- 6.15 Check whether the centreline of the blade edge coincides with the Housing centre. (in open position)
- 6.16 Care shall be exercised for styles during assembly of regulating ring.

- 6.17 Check for the free movement of regulating ring with rollers without any shake. Care shall be should be taken to ensure proper dwelling for regulating
- 6.18 Ensure movement of angular joint without any shake, (separately)
- 6.19 Ensure full opening and full closing of guide vanes, by manual operation.
- 6.20 Check for control lever position, tightness of all fasteners.
- 6.21 Overlapping between two blades shall be as per drg. the gap at the overallaping shall not exceed 2 mm.
- 6.22 Ensure proper gap between inside diameter of housing and edge of the blades.
- 6.23 The circle diameter at the centre of the housing shall be checked after full closing of the blades.
- 6.24 The position of the control lever and the articulated piece with repsect to style shall be checked during assembly of control lever.
- 6.25 The free movement of the control lever without any lateral shake shall be checked.
- 6.26 The angular displacement of the control lever at full opening shall be checked with respect to centerline of the housing.
- 6.27 Ensure proper tightness of all fasteners.
- 6.28 The position of stoppers and dial plate for full opening and full closing shall be checked as per the drawing
- 6.29 Ensure proper greasing of all bushe is and lever assembly.
- 6.30 The completed assembly of the Inlet Guide Vane Unit shall be checked and recorded in the History Card.  
No : 49 - 391.
- 6.31 Ensure assembling of split cottar pin in the control lever assembly.
- 6.32 Check the free rotation of the roller in the roller assembly without any shake.
- 7.0 PAINTING AND PRESERVATION :  
-----
- 7.1 The Inlet Guide Vane Assembly unit shall be thoroughly

cleaned to remove spatter, slag, rust oil or grease or any other foreign materials.

7.2 The Inlet Guide Vane Assembly unit shall be painted as per the painting schedule. BPS : 027601 - 7601.

7.3 All the machined surfaces shall be given one coat of rust preventive oil.

7.4 The component shall be clearly identified with the following details.

Work Order Number

DU Number

Product number

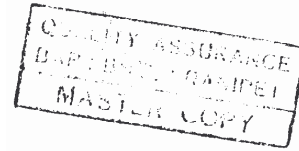
8.0 PACKING AND DESPATCH :

-----

8.1 The Inlet Guide Vane unit assembly shall be suitably despatched to avoid transit damage.

8.2 Transport stoppers shall be provided for regulating ring to arrest the movement of the regulating ring.

BHEL  
RANIPET



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QUALITY DEPARTMENT  
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AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q C P)  
-----

Q.W.I.NO:2:4:272

REV:00

AMENDMENT SL NO: A 1

DESCRIPTION:TGV ASSY (AN TYPE FANS)

DATE: 22/8/94

-----  
DETAILS  
-----

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
3.6	AWS D1.1.75 shall be read as AWS D1.1 latest.	Document referred is to be latest.
4.3 & 4.4	For intoleranced dimensions, refer PR:QA:500/latest.	PR:QA:500 is the document for intoleranced dimensions.
6.11.18	History card shall be read as Dimensional report.	Dimensional report is in vogue.
7.2	Painting shall be as per RP0674199/latest	Painting schedule RP0674199

-----  
Prepared by

*B. Srinivas Rao*

Approved by

*[Signature]*

-----  
Distribution:

As per standard distribution list



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QCP:2:4:272  
PAGE 1 OF 9

QUALITY CONTROL  
PROCEDURE FOR

INLET GUIDE VANE UNIT ASSEMBLY  
(FOR AN TYPE FANS)

EFFECTIVE DATE:

18-5-81 *Am*

ACCEPTED BY

DEPARTMENT

DATE

ENGINEERING AND  
DEVELOPMENT CENTRE

*V. V. Chinnappa*

BOILER PRODUCTION

OPERATION, PLANNING  
AND CONTROL

*Am*

QUALITY ASSURANCE  
AND CONTROL

*S. J. ...*  
*...*

ISSUED BY  
QUALITY ENGINEERING

REVISION NO.:  
DATE :18-5-81

*Am*  
*Am*

QUALITY CONTROL PROCEDURE FOR INLET GUIDE VANE

---

UNIT ASSEMBLY (FOR AN TYPE FANS)

---

- 1.0 SCOPE:  
-----
- 1.1. This procedure specifies the quality requirements for manufacture of Inlet Guide Vane Unit Assembly for AN type fans.
- 1.2. This procedure is valid only for those products which are under the inspection purview of BHEL or its authorised agencies.
- 1.3. Special requirements if any shall be specified separately.
- 2.0 MATERIALS:  
-----
- 2.1 Materials used shall be as per the drawing requirement.
- 3.0 WORKMANSHIP:  
-----
- 3.1 The product made for this procedure shall have workman like finish. Also it will be the responsibility of the fabricator to organise, to produce a quality product.
- 3.2. Any deviation in Engineering and material preparation joint shall have prior approval of BHEL product Engineering department.
- 3.3. Plates and sheets shall be cut to size by shearing, machine cutting or flame cutting. Flame cut edges shall be cleaned to remove slag and uneven edges shall be dressed by grinding. Gas cutting notches shall be filled up by welding and ground before taking up for further fabrication.
- 3.4. Ensure drying of electrodes.
- 3.5. Ensure correct selection of electrodes.

3.6 Welders employed in the production shall be qualified as per AWS D 1.1.75. The finished product shall be completely free from defects which are injurious to the component strength or to the appearance.

3.7 Proper welding sequence shall be adopted to minimise distortion.

4.0 DIMENSION AND OTHER DETAILS:  
-----

4.1 All dimensions shall be as per the latest production drawing concerned.

4.2 Wherever tolerances have been indicated in the drawing the same shall be strictly followed.

4.3 For untoleranced dimension, the following tolerances shall be followed for fabrication (Din 7168)

Nominal size (mms) -----	Tolerance (mms) -----
Upto 315	+/- 1.0
Over 315 to 1000	+/- 2.0
Over 1000 to 2000	+/- 3.0
Over 2000 to 4000	+/- 4.0
Over 4000 to 8000	+/- 5.0
Over 8000 to 12000	+/- 6.0
Over 12000 to 16000	+/- 7.0
Over 16000 to 20000	+/- 8.0

4.4 For untoleranced dimension, the following tolerances shall be followed for machining (DIN 7168)

Nominal size (mms) -----	Tolerance (mms) -----
Over 0.5 to 3	+/- 0.10
Over 3 to 6	+/- 0.10

Over 6 to 30	+/- 0.20
Over 30 to 120	+/- 0.30
Over 120 to 315	+/- 0.50
Over 315 to 1000	+/- 0.80
Over 1000 to 2000	+/- 1.20
Over 2000 to 4000	+/- 2.00
Over 4000 to 8000	+/- 3.00
Over 8000 to 12000	+/- 4.00
Over 12000 to 16000	+/- 5.00
Over 16000 to 20000	+/- 6.00

- 4.5 The parting flanges shall all be in the same plane. Also the flanges shall be free from bend, distortion and out of squareness.
- 4.6 The deviation from the flatness of flanges shall be 1 mm/metre for part there of subject to a maximum of 3 mm.
- 4.7 For circular flanges, the centre distance of diametrically opposite bolt holes shall not exceed +/- 1.5 mm.
- 4.8 Pitch distance of two consecutive holes shall be within +/- 1 mm.
- 4.9 The deviation from flatness of contact faces shall not exceed 3 mm. (wherever not shown in the drg.).
- 5.0 WELDING:  
-----
- 5.1 Welds shall be free from burn through
- 5.2 Welds shall be free from slag, spatter and the tacks shall be ground off.
- 5.3 Welds shall be checked for its size and appearance.

- 5.4. Undercuts and all defects shall be repaired. Notches or burring of metal more than 0.8mm shall be termed as undercut.
- 5.5. The individual components shall be free from skew or twist.
- 6.0. MANUFACTURE:  
-----
- 6.1. The inlet Guide Vane Assembly Unit shall be fabricated as per the latest drawing.
- 6.2. The ovality of the housing shall be checked and shall not be more than 3mm.
- 6.3. The diameter, height of the housing shall be checked as per the drawing.
- 6.4. The pitch distance between the shaft hole shall be checked.
- 6.5. Ensure dowelling of parting flanges of housing.
- 6.6. The blade shaft hole diameter on housing and also the axis shall be checked as per the drawing.
- 6.7. Ensure correct dimension of grooves (bearing pedestal seating area) as per drawing.
- 6.8. The location of studs for bearing pedestal fixing shall be checked as per drawing.
- 6.9. Check for the blade profile and straightness.
- 6.10. The blade shaft shall be checked as per the drawing.

6.11 BEARING ASSEMBLY:  
-----

- 6.11.1 Check for proper location of cap springs, nylon ring, bearings, spring plate, soagar ring.
- 6.11.2 Ensure the tightness of the bearing pedestal assembly with IGV assembly to the required torque as given in the drawing.
- 6.11.3 Check the location and position of guide suspension holes on housing as per drawing.
- 6.11.4 Check the free movement of angular joint (separately) without any shake.
- 6.11.5 The ovality of the regulating ring and other dimension shall be checked as per the drawing.
- 6.11.6 The position of the angular joint fixing with regulating ring shall be checked as per the drawing.
- 6.11.7 The guide roller assembly (suspension assembly) shall be checked for position as per the drg. care shall be exercised for hard and soft suspensions holes.
- 6.11.8 Ensure shaft centre and blade edges are CO-axial on blade and shaft assembly.
- 6.11.9 Ensure proper sorewing of blade to the blade shaft. Check for the free movement of the IGV shaft assembly in the bearing pedestal assembly without any shake.

- 6.11.10 Check Whether the centerline of the blade edge with the housing centre are in one line.
- 6.11.11 Care shall be exercised for styles during assembly of regulating ring.
- 6.11.12 Ensure proper fixing of brackets with guide suspension assembly.
- 6.11.13 Check for the free movement of regulating with rollers without any shake. Care shall be exercised to ensure proper dowelling of the joint.
- 6.11.14 Ensure proper contact of rollers with IGV casing during bracket assembly.
- 6.11.15 The position of the angular joint, lever guide suspension shall be checked as per the drawing.
- 6.11.16 Ensure dowelling of guide roller bracket.
- 6.11.17 Ensure full opening and full closing of inlet guide vanes.
- 6.11.18 Overlapping of the blades shall not exceed 2 mm.
- 6.11.19 Ensure proper gap between inside diameter of housing and edge of the blades.
- 6.11.20 The core circle diameter at the centre of the housing shall be checked after full closing of the blades.
- 6.11.21 The position of the lever and articulated piece with respect to style shall be checked during assembly of control lever.

- 6.11.22 The free movement of the lever without any lateral shake shall be checked.
- 6.11.23 The lever axis shall be as per drawing at 0 deg position.
- 6.11.24 Ensure proper tightness of all
- 6.11.25 Ensure greasing of bearing pedestal openings to avoid dust collection.
- 6.11.26 Ensure greasing of guide suspension assembly.
- 6.11.27 The position of stoppers and dial plate for full opening and full closing shall be checked as per the drawing.
- 6.11.28 The completed assembly of the Inlet Guide Vane Unit shall be checked and recorded in the History card No. 49-391,
- 6.11.29 Before parting the assembly, transport stiffeners shall be provided in the assembled condition and also areas the movement of the regulating ring by suitable method, and
- 6.11.30 Check the rotation of the roller in the fork shaft assembly without any shake.
- 7.0 PAINTING AND PRESERVATION:
- 7.1 The Inlet Guide Vane Assembly unit shall be thoroughly cleaned to remove spatter, slag, rust, oil or grease or any other foreign material.

7.2 The Inlet Guide Vane Assembly shall be painted as per the painting schedule. BPS:027601 - 7601.

7.3 All the machined surfaces shall be given one coat of rust preventive oil.

7.4 The component shall be clearly identified with the following detail.

Work Order Number.

DU Number

Product Number.

8.0 PACKING AND DESPATCH.  
-----

8.1 The Inter Guide Vane Unit assembly shall be suitably despatched to avoid transit damage.

8.2 Transportation stopper shall be provided for regulating ring to arrest the movement of the regulating ring.

BHEL  
RANIPET

QUALITY DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (Q C P)

Q.W.T.NO:2:4:273

REV: 00

AMENDMENT SL NO: A 1

Amendment dt 13/3/86

DESCRIPTION: AN FAN STATIC PARTS

DATE: 22/8/94

DETAILS

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
3.6	AWS D1.1.75 shall read as AWS D1.1 latest.	Document referred is to be latest.
4.3 & 4.4	For untoleranced dimensions, PR:QA:500/latest shall be referred for tolerances.	PR:QA:500 is the document for untoleranced dimensions.
6.1.3 6.2.4 6.6.6 6.7.7	History card shall be read as Dimensional report	Dimensional report is in vogue.
6.3	QCP No is 2:4:272	Editorial correction
9.2	Painting shall be as per RP0674199/latest	Painting schedule RP0674199.

Prepared by *B. Srinivasan*

Approved by *H.A. [Signature]*

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-----  
QA&C  
-----

BAP:QA&C:6:  
13-03-86

Sub: Amendment to QCP 2:4:273  
"QCP for AN Fan static  
parts (KKK Design)

-----

The following amendments are incorporated in the  
QCP 2:4:273 "QCP for AN Fan static parts (KKK Design)

"Clause 3.4  
Existing: Ensure drying of electrodes.

As amended: Low hydrogen electrodes shall be baked for  
atleast tow hours between 230 deg C to 260 deg C and dried at  
110 deg C and held in holding ovens at this temperature  
before use. If the electrodes are exposed for more  
than 4 hours to the atmosphere these shall be rebaked  
and dried in the same manner".

In addition a new clause is added as under:-

"Clause 3.8

All butt joints shall be back gouged to remove all slag,  
unfused areas etc before second side welding.

The amendment comes into immediate effect.

PH. TAMBAKHE

(PH. TAMBAKHE)  
Dy. Manager/QA

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Shri K Ponnambalam, Manager/Production  
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BHARAT HEAVY ELECTRICALS LTD.  
TIRUCHIRAPALLI - 14  
QUALITY ENGINEERING

QCP:2:4:273  
PAGE 1 OF 10

QUALITY CONTROL  
PROCEDURE FOR

AN FAN STATIC PARTS  
(KKK DESIGN)

EFFECTIVE DATE:

18 05 81

ACCEPTED BY

DEPARTMENT

DATE

ENGINEERING AND  
DEVELOPMENT CENTRE

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ISSUED BY  
QUALITY ENGINEERING

REVISION NO.:  
DATE:

*4*  
*5/11/81*

QUALITY CONTROL PROCEDURE FOR AN FAN STATIC

-----  
PARTS (KKK DESIGN)  
-----

- 1.0. SCOPE
- 1.1. This procedure specifies the quality requirements for manufacture of AN fan static parts of KKK design.
- 1.2. This procedure is valid only for those products which are under the inspection purview of BHEL or its authorised agencies.
- 1.3. Special requirements if any shall be specified separately.
- 2.0. MATERIALS  
-----
- 2.1. Materials used shall be as per the drawing requirements.
- 3.0. WORKMANSHIP:  
-----
- 3.1 The product made to this procedure shall have workman like finish. Also it will be the responsibility of the fabricator to organise to produce a quality product.
- 3.2 Any deviation in engineering and material preparation joins shall have prior approval of BHEL Product Engineering Department.
- 3.3. Plates and sheets shall be cut to size by shearing, machine cutting or flame cutting. Flame cut edges shall be cleaned to remove slag, and uneven edges shall be dressed by grinding. Gas cutting notches shall be filled up by welding and ground before taking up for further fabrication.
- 3. Ensure drying of electrodes.
- 3.5. Ensure correct selection of electrodes.

3.6. Welders employed in the production shall be qualified as per AWS D1.1.75. The finished product shall be completely free from defects which are injurious to the component strength or to the appearance.

3.7. Proper welding sequence shall be adopted to minimise distortion.

4.0. DIMENSIONS AND OTHER DETAILS  
-----

4.1. All dimensions shall be as per the production drawing concerned.

4.2. Wherever tolerances have been indicated in the drawing the same shall be strictly followed.

4.3. For untoleranced dimensions the following tolerances shall be followed for fabrication (DIN 7168)

Nominal Size (mms) -----	Tolerance (mms) -----
Upto 315	+/- 1.0
Over 315 to 1000	+/- 2.0
Over 1000 to 2000	+/- 3.0
Over 2000 to 4000	+/- 4.0
Over 4000 to 8000	+/- 5.0
Over 8000 to 12000	+/- 6.0
Over 12000 to 16000	+/- 7.0
Over 16000 to 20000	+/- 8.0

4.4. For untoleranced dimension, the following tolerance shall be followed for machining. (DIN 7168)

Nominal size (mms)	Tolerance (mms)
Over 0.5 to 3	+/- 0.10
Over 3 to 6	+/- 0.10
Over 6 to 30	+/- 0.20
Over 30 to 120	+/- 0.30
Over 120 to 315	+/- 0.50
Over 315 to 1000	+/- 0.80
Over 1000 to 2000	+/- 1.20
Over 2000 to 4000	+/- 2.00
Over 4000 to 8000	+/- 3.00
Over 8000 to 12000	+/- 4.00
Over 12000 to 16000	+/- 5.00
Over 16000 to 20000	+/- 6.00

- 4.5 The parting flanges shall all be in the same plane. Also, the flanges shall be free from bend, distortion and out of squareness.
- 4.6. The deviation from flatness of flanges shall be 1mm/metre or part there of subject to a maximum of 3mm.
- 4.7. For rectangular flanges, the centreline of the bolt holes on opposite faces shall be parallel within a limit of +/- 1.5mm
- 4.8. For circular flanges, the centre distance of diametrically opposite bolt holes shall not exceed +/- 1.5 mm
- 4.9. Pitch distance of two consecutive holes shall be within +/- 1mm. However in case of rectangular flanges, the maximum cumulative variation in hole pitch shall not exceed +/- 2mm.
- 4.10. The deviation from flatness of contact faces shall not exceed 3mm. (Wherever not shown in the drawing.)

5.0. IMPORTANT CHARACTERISTICS:  
-----

- 5.1. Development to respective shapes as per drg. of individual parts shall be checked.
- 5.2. No projection shall be allowed inside the static parts after assembly in the air flow direction.
- 5.3. Welds shall be free from burn through.
- 5.4. The welds shall be free from slag, spatter and the tacks shall be ground off.
- 5.5. Welds shall be checked for its size and appearance.
- 5.6. Undercuts and all defects shall be repaired. Notches or burning of metal more than 0.8mm shall be termed as undercut.
- 3.7. The individual component shall be free from skew or twist.

6.0. MANUFACTURE  
-----

6.1 SUCTION CHAMBER:  
-----

- 6.1.1 The suction chamber shall be fabricated as per the latest drawing.
- 6.1.2 The individual dimension of the circular and square section of the suction chamber shall be checked before jointing.
- 6.1.3 The dimension of the completed suction chamber shall be checked and recorded in the History Car No. 49-813.
- 6.1.4 Ensure the centreline marking of the shaft axis in the suction chamber.

- 6.1.5 The suction chamber foot shall be checked as per the drawing after completing the machining.
- 6.1.6 The location of the suction chamber foot on to suction chamber shall be marked and checked as per the drawing.
- 6.1.7 Check the horizontally of shaft axis.
- 6.1.8 While fixing support for shaft protection tube ensure parting is vertical for FD application and horizontal for ID application (Viewed from suction side.)
- 6.2. SUCTION NOZZLES (TRANSITIONS I&II)  
-----
- 6.2.1 The suction nozzles (Transition I&II) shall be fabricated as per latest drawing.
- 6.2.2. The roundness of the flange shall be checked.
- 6.2.3. The height of the suction nozzles shall be checked after welding.
- 6.2.4. The dimensions of the completed suction nozzles shall be checked and recorded in the History Card No. 49-373.
- 6.3. INLET GUIDE VANE UNIT ASSEMBLY  
-----  
Refer QCP No. 2:4:
- 6.4. HOUSING (IMPELLER)  
-----
- 6.4.1 The impeller housing shall be fabricated as per the latest drawing.

- 6.4.2. The ovality of the impeller housing shall be checked after welding.
- 6.4.3. Care shall be exercised in providing machining allowances during fabrication to maintain the height of the impeller housing and inside diameter.
- 6.4.4. Check the location of the outlet blade and ensure smooth grinding of gas cut opening for proper clearance between outlet blade and cut out in the housing for assembly, as given in the drawing. For ID application and also check the welding between black and the core in case of F.D. application.
- 6.4.5. The housing foot shall be checked as per the latest drawing.
- 6.4.6. The height of the housing shall be checked after welding and machining the foot.
- 6.5. HOUSING CORE:  
-----
- 6.5.1. The housing core shall be fabricated as per the latest drawing.
- 6.5.2. The ovality of the housing core shall be checked after welding.
- 6.5.3. Care shall be exercised in providing machining allowance during fabrication to maintain the dimension.
- 6.6. OUTLET GUIDE VANES: (EXCHANGABLE VANES)  
-----
- 6.6.1. The outlet guide vanes shall be checked and fabricated as per the latest drawing.
- 6.6.2. The profile of the outlet guide vanes shall be checked as per the drawing with template.
- 6.6.3. The position of exchangeable vanes (outlet blades) w.r.t. cut out on housing and hole in the core shall be as per drg. in the case of ID application. The position of outlet blades w.r.t. housing to the core shall be as per drawing for FD application.

- 6.6.4. Care shall be exercised that there is no gap between outlet blade and housing core outside diameter for ID application.
- 6.6.5. The concentricity between housing core and housing shall be checked and also ensure proper machining allowance on all mating faces.
- 6.6.6. The dimensions of the completed impeller housing shall be checked and recorded in the history Card No. 49-367.
- 6.7. DIFFUSER ASSEMBLY:  
-----
- 6.7.1. The diffuser assembly shall be manufactured as per the latest drawing.
- 6.7.2. The roundness of the diffuser core shall be checked after welding.
- 6.7.3. The location of the man hole door cut out in the diffuser shall be checked.
- 6.7.4. The width of the mono rail in the diffuser core, shall be checked as per the drawing.
- 6.7.5. The wedge shall be manufactured as per the latest drawing.
- 6.7.6. The dimension of the wedge shall be checked.
- 6.7.7. The completed dimension of the diffuser shall be checked and recorded in the History Card No. 49-362.

7.0. TRIAL ASSEMBLY

-----

- 7.1. Trial assembly suction chamber with suction nozzle I (Transition I) and ensure match mark to take care of parting flange position and also ensure transfer of drilled holes.
- 7.2. Trial assembly suction nozzle I (Transition I) with inlet guide vane unit assembly and ensure match mark to take care of parting flange position and also the position of Inlet guide vane unit lever as given in the drawing.
- 7.3. Trial assembly Inlet guide vane unit assembly with suction nozzle II (transition II) and ensure match mark to take care of parting flange position and also ensure transfer of drilled holes.
- 7.4. Trial assemble suction nozzle II (Transition II) with impeller housing and ensure match mark to take care of parting flange position and also ensure transfer of drilled holes.

8.0. DIFFUSER TRIAL ASSEMBLY

-----

- 8.1. Trial assembly diffuser core with wedge and check the angle of wedge with core and also with housing. Care shall be exercised in providing proper space for insulation at diffuser core, wedge entry, diffuser.
- 8.2. Trial assemble core with wedge and also with diffuser and check for concentricity, height angle of cut out, location of man-hole entry.
- 8.3. Trial assembly the above diffuser assembly with the Impeller housing and ensure match mark to take care of parting flange position and also ensure transfer of drilled holes.

9.0. PAINTING AND PRESERVATION  
-----

- 9.1. The components shall be thoroughly cleaned to remove spatter, slag, rust, oil or grease or any other foreign materials.
- 9.2. The inside and outside surface of the static parts of AN Fans shall be painted as per the BPS:027601-7601.
- 9.3. All the machined surface and weld edge preparation shall be given one coat of rust preventive oil.
- 9.4. The component shall be clearly identified with the following details.

WORK ORDER NUMBER

DU NUMBER

PRODUCT NUMBER

MATCH MARKS.

10.0. PACKING AND DESPATCH  
-----

- 10.1. All the components shall be suitably despatched to avoid transit damage.
- 10.2. The diffuser core and wedge shall be removed from the above assembly and proper temporary transport stiffeners shall be provided.

BHEL  
RANIPET

QUALITY DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS ( Q C P )

Q.W.I.NO:2:4:274

REV:00

AMENDMENT SL NO: A 1

Amendment date 14/3/86

DESCRIPTION: AP FAN STATIC PARTS

DATE: 22 / 8 / 94

DETAILS

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
3.6	AWS D1.1.75 shall be read as AWS D1. 1 latest.	Document referred is to be latest.
4.3 & 4.4	For untoleranced dimensions, PR:QA:500/latest shall be referred for tolerances	PR:QA:500 is the document for untoleranced dimensions.
6.0 6.2.6	History card shall be read as Dimensional report	Dimensional report is in vogue.
6.3.4	History card nos shall be read as R-036,R-009, R-013	History cards updated With Ranipet formatting.
6.4.7	History card number shall be read as R- 026.	-do-
7.2	Painting shall be as per RP 0674199/latest.	Painting Schedule RP0674199.

PREPARED BY

*B. Srinivasan*

Approved by

*A. H. K.*

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Sub: Amendment to QCP 2:4:274  
“QCP for AP fan static  
Parts (KK) Design”.

.....

The following amendments are incorporated in  
the QCP 2:4:274 “QCP for AP Fan Static Parts( KKK  
design)”.

“Clause 3.4

Existing : Ensure drying of electrodes

As amended: Low hydrogen electrodes shall be baked for atleast two hours between 230 degree C  
to 260 degree C and dried at 110 degree C and held in holding ovens ovens at this temperature  
before use. If the electrodes are exposed for more than 4 hours to the atmosphere these shall be  
rebaked and dried in the same manner.”

In addition a new clause is added as under:-

“Clause 3.8

All butt joints shall be back gouged to remove all slag, unf used areas etc., and then welded on  
the other side.

The amendment comes into immediate effect.



(P.H.TAMBAKHE)  
DY.MANAGER (QA)

DISTRIBUTION:

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QCP:2:4:274  
PAGE 1 OF 8

QUALITY CONTROL  
PROCEDURE FOR

AP FAN STATIC PARTS  
( KKKDESIGN)

EFFECTIVE DATE:


18 05 81

ACCEPTED BY

DEPARTMENT

DATE

ENGINEERING AND  
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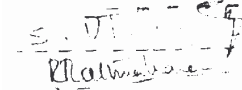
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OPERATION, PLANNING  
AND CONTROL



QUALITY ASSURANCE  
AND CONTROL



ISSUED BY  
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REVISION NO: - 00  
DATE: 18 05 81

QUALITY CONTROL PROCEDURE FOR AP FAN STATIC

-----  
PARTS ( KKK DESIGN )  
-----

1.0 SCOPE:  
-----

- 1.1 This Procedure specifies the quality requirements for manufacture of AP fan static parts of KKK design.
- 1.2 This procedure is valid only for those products which are under the inspection purview of BHEL or its authorised agencies.
- 1.3 Special requirements if any shall be specified separately.

2.0 MATERIALS  
-----

- 2.1 Materials used shall be as per the drawing requirement.

3.0 WORKMANSHIP  
-----

- 3.1 The product made to this procedure shall have workman like finish. Also it will be the responsibility of the fabricator to organise to produce a quality product.
- 3.2 Any deviation in Engineering and Material Preparation joints shall have prior approval of BHEL product Engineering department.
- 3.3 Plates and sheets shall be cut to size by shearing, machine cutting or flame cutting. Flame cut edges shall be cleared to remove slag, and uneven edges shall be dressed by grinding, Gas cutting notches shall be filled up by welding and ground before taking up for further fabrication.
- 3.4 Ensure drying of electrodes.
- 3.5 Ensure correct selection of electrodes.

3.6 Welders employed in the product shall be qualified as per AWS D1.1.75. The finished product shall be completely free from defects which are injurious to component strength or to the appearance.

3.7 Proper welding sequence shall be adopted to minimise distortion.

4.0 DIMENSIONS AND OTHER DETAILS

4.1 All dimensions shall be as per the production drawing concerned.

4.2 Wherever tolerances have been indicated in the drawing the same shall be strictly followed.

4.3 For untoleranced dimension the following tolerance shall be followed for fabrication ( DIN 7168 )

Nominal size (mm)	Tolerance (mm)
Upto 315	+/- 1.0
Over 315 to 1000	+/- 2.0
Over 1000 to 2000	+/- 3.0
Over 2000 to 4000	+/- 4.0
Over 4000 to 8000	+/- 5.0
Over 8000 to 12000	+/- 6.0
Over 12000 to 16000	+/- 7.0
Over 16000 to 20000	+/- 8.0

4.4 For untoleranced dimension, the following tolerance shall be followed for machining ( DIN 7168 )

...../-

Nominal size (mm)			Tolerance (mm)
-----			-----
Over 0.5	to	3	+/- 0.10
Over 3	to	6	+/- 0.10
Over 6	to	30	+/- 0.20
Over 30	to	120	+/- 0.30
Over 120	to	315	+/- 0.50
Over 315	to	1000	+/- 0.80
Over 1000	to	2000	+/- 1.20
Over 2000	to	4000	+/- 2.00
Over 4000	to	8000	+/- 3.00
Over 8000	to	12000	+/- 4.00
Over 12000	to	16000	+/- 5.00
Over 16000	to	20000	+/- 6.00

- 4.5 The parting flanges shall be in the same plane. Also the flanges shall be free from bend, distortion and out of squareness.
- 4.6 The deviation from flatness of flanges shall be 1 mm/metre or part ther of subject to a maximum of 3 mm/( wherever not shown in he drawing).
- 4.7 For rectangular flanges, the centreline of the bolt holes on opposite faces shall be parallel within a limit of +/- 1.5 mm.
- 4.8 For circular flanges, the centre distance of diametrically opposite bolt holes shallnot exceed +/- 1.5 mm.
- 4.9 Pitch distance of two consequitive holes shall be within +-1 mm. However, in case of rectangular flanges, the maximum cumulative varia-tion in hole pitch shall not exceed +- 2 mm.

...../-

- 4.10 The deviation from flatness of contact faces shall not exceed 3 mm ( for unma-chined faces)

5.0 IMPORTANT CHARACTERISTICS  
-----

- 5.1 Development to respective sha-pes as per drawing of individual parts shall be checked.
- 5.2 No projection shall be allowed inside the static parts after assembly in the air flow direction.
- 5.3 Welds shall be free from burn through
- 5.4 The welds shall be free from slag, spatter and the tacks shall be ground off.
- 5.5 Welds shall be checked for its size and appearance.
- 5.6 Undercuts and all defects shall be repaired. Notches or burning of metal more than 0.8 mm shall be termed as undercut.
- 5.7 The individual component shall be free from skew or twist.

6.0 MANUFACTURE:

6.1 SUCTION CHAMBER

- 6.1.1 The suction chamber shall be fabricated as per the latest drawing,
- 6.1.2 The individual dimension of the circular and square section of the suction chamber shall be checked before joining.
- 6.1.3 The dimension of the completed suction chamber shall be checked and recorded in the History card NO. 49-372(AP1 16/11, AP1 18/11, AP1 17/12 ).

...../-

- 6.1.4 Ensure the centreline marking of the shaft axis in the suction chamber.
- 6.1.5 The suction chamber foot shall be checked as per the drawing.

- 6.1.6 The location of the suction chamber foot on to the suction chamber shall be marked and checked as per the drawing.
- 6.1.7 Check the horizontality of the shaft axis after welding the foot.
- 6.1.8 The height of the suction chamber shall be checked.
- 6.1.9 While fixing support for shaft protecting tube ensure parting is vertical 1 for FD application ( View from suction side. ).
- 6.2 SUCTION MOUTH WITH HUB.
- 6.2.1 Individual piece shall be checked for its profile after bending.
- 6.2.2 During fabrication of bullet assembly, care shall be exercised for position of bearing support plate with reference to bigger end of the bullet, with proper machining allowance.
- 6.2.3 Maintain uniform gap between the parting flange of the bullet.
- 6.2.4 During trial assembly of bullet ( Hub 1100/1200) the concentricity of the bullet centre with suction mouth shall be checked. Also the projection of bullet ( hub 1100/1200) bigger end with proper machining allowance shall be ensured.

...../-

- 6.2.5 Ensure machining allowance at the foot of suction mouth with hub after assembly.
- 6.2.6 The completed assembly of the suction mouth with hub shall be checked after machining

the foot and the dimensions shall be recorded in the History sheet No.49-370 ( AP1 16/11, AP1 18/11, AP1 17/12 ).

6.3 IMPELLER CASING;

6.3.1 The impeller housing shall be fabricated as per the latest drawing,

6.3.2 The Ovality of the impeller housing shall be checked after welding.

6.3.3 Care shall be exercised in providing machining allowances during fabrication to maintain the height of the impeller housing and inside diameter.

6.3.4 Trial assemble impeller casing, suction mouth with hub and suction chamber and the inside diameter shall be checked after inside machining as per drawing and record the dimension in the History Card No. 49-363.

6.4 DIFFUSER:  
-----

6.4.1 The outlet blades shall be checked as per the latest drawing,

6.4.2 The location of the outlet blades shall be checked as per the drawing.

6.4.3 The outlet blade welding shall be checked and care shall be exercised during welding to minimize distortion.

...../-

6.4.4 The dimension of the diffuser foot shall be checked as per the drawing.

6.4.5 The location of the diffuser foot shall be checked as per the drawing.

- 6.4.6 The height of the diffuser foot shall be checked as per the drawing.
- 6.4.7 The completed diffuser dimensions shall be checked and recorded in the History Card No. 49-363.

7.0 PAINTING AND PRESERVATION.  
-----

- 7.1 The component shall be thoroughly cleaned to remove spatter, slag, rust, oil or grease or any other foreign materials.
- 7.2 The inside and outside surface of static parts of AP Fan shall be painted as per the BPS: 027601-7601
- 7.3 All the machined surfaces and wold edge preparations shall be given one coat of rust preventive oil.
- 7.4 The component shall be clearly identified with the following details:  
WORK ORDER NUMBER  
DU NUMBER  
PRODUCT NUMBER  
MATCH MARKS

8.0 PACKING AND DESPATCH  
-----

- 8.1 All the components shall be suitably despatched to avoid transit damage.
- 8.2 Proper temporary stiffeners shall be provided to avoid damage.


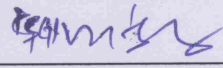


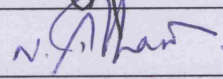
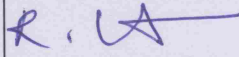
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Quality Department

Q.W.I.No. F: 002 (Rev: 02)

Date: 05.12.2012

**FAN DIFFUSER ASSEMBLY**

Prepared by	Reviewed by	Signature	Approved by
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	Part Processing		
	QC-SHOP		
	Quality Assurance		
ISSUED BY QUALITY ASSURANCE – BAP/ BHEL RANIPET			

Quality Department

Q.W.I.No. F: 002 (Rev: 02)

Date: 05.12.2012

**FAN DIFFUSER ASSEMBLY**

1.0 SCOPE

- 1.1 This procedure specifies the Quality requirements for manufacture of diffuser assembly (Axial Fan static parts)
- 1.2 This procedure is valid only for those products which are under the inspection purview of BHEL or its authorized agencies. Special requirements if any shall be specified separately.

2.0 MATERIALS

- 2.1 Materials used shall be as per the drawing requirement/GMS.

3.0 Manufacturing

- 3.1 The product made to this drawing shall have workman like finish. Also it will be the responsibility of the fabricator to organize to produce a quality product.
- 3.2 The number of joints for the diffuser cover and cone should be restricted to minimum.
- 3.3 The job should be proceeded only after getting cutting plan approval from Outsourcing Department.
- 3.4 **In any case, less than 500 mm joints should not be allowed.**
- 3.5 In all joints, 10% random LPI should be carried out.
- 3.6 Considering the availability of minimum size of the plate (PL.6x1250x6300 & PL.6x1510x6300) and existing rolling capacity, the maximum radial and axial joints are allowed as follows.

SL.NO	PROJECT	MAXIMUM RADIAL JOINTS	MAXIMUM AXIAL JOINTS	APPLICATION
01	210 MW	1	8	FD, PA
02	500 MW & above	2	9	FD, PA
03	660 MW & above	3	13	ID

- 3.7 **If number of joints are more than the above norms**, the layout should be approved by Engineering, subject to feasibility of design requirements.

## FAN DIFFUSER ASSEMBLY

- 
- 3.8 Plates and sheets shall be cut to size by shearing machining or flame cutting. Flame cut edges shall be cleaned to remove slag and uneven edges shall be dressed by grinding. Gas cut notches shall be filled by welding and ground before taking up further fabrication.
  - 3.9 Welder employed in the production shall be qualified as per AWS:D.1.1. (latest)
  - 3.10 The finished product shall be completely free from defect which is injurious to the component strength or the appearance.
  - 3.11 Proper welding sequence shall be adopted to minimize distortion.
  - 3.12 Weld reinforcement surface should be flush ground only on the inner side of the diffuser shell (on flow path).
  - 3.13 Weld seams should not cross minimum distance should be at least 100mm.
  - 3.14 Stiffener location should be away from the joints by about 50 mm. Radial stiffner length shall be minimum 1 meter.
  - 3.15 Weld joint should be at least 30mm away from drill holes of flanges.
  - 3.16 Plus joint is not allowed.
  - 3.17 Gap between vertical joints shall be equal to or more than 500mm.
  - 3.18 The offset distance between two axial joints shall be equal or more than 500 mm.
  - 3.19 Flange: Length shall be minimum 1 meter subjected to number of joints as below in the Table

Diameter (in meter)	Number of Joints
2 to 3	4
3 to 4	6
4 to 5	7
5 to 6	9

## Quality Department

Q.W.I.No. F: 002 (Rev: 02)

Date: 05.12.2012

### FAN DIFFUSER ASSEMBLY

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#### 4. Dimensional and other details.

- 4.1 All dimensions shall be as per the production drawing concerned. Wherever tolerances have been indicated in the drawing, the same shall be strictly followed.

For untoleranced dimensions PR: QA: 500 latest shall be referred for tolerances.

- 4.1 For circular flanges the centre distance of diametrically opposite bolt holes shall be as per annexure 1. Holes shall be drilled.
- 4.2 Pitch distance of the consecutive holes shall be within  $\pm 1$ mm. However in case of rectangular flanges the max. Cumulative variation in hole pitch shall not exceed  $\pm 2$ mm.
- 4.3 After rolling the diameters of core and cover should be measured. The variation in diameter should not exceed  $\pm 3$ mm.
- 4.4 The setting of the diffuser cover and core for assembly should be done on a leveled surface. The distance between the diffuser cover and core should be measured at every  $45^{\circ}$  and it should be maintained equally at top and bottom respectively. The surface of the diffuser core should be perpendicular to the leveled surface when the assembly is being done. The concentricity between the cover and core should be maintained within  $\pm 3$ mm.

#### 5. Important Characteristics

- 5.1 Development to respective shapes as per drawing of individual parts shall be checked.
- 5.2 **No projection shall be allowed inside the static parts after assembly in the flow direction.** Welds shall be free from burn through.
- 5.3 The weld shall be free from slag, spatter and the tacks shall be suitably removed.
- 5.4 Welds shall be checked for its size and appearance. Undercuts and all defects shall be repaired.  
Notches or burning of metal more than 0.8 mm shall be termed as undercuts.
- 5.5 The ID of the diffuser cover at the bigger end and ID of the cylindrical piece to be welded to this piece should be same and within the specified tolerances.
- 5.6 Diffuser feet shall be welded on to diffuser maintaining level and height as per drawing.

## **FAN DIFFUSER ASSEMBLY**

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- 5.7. If the flanges are made from segments, joints and edge preparations are to be made as per standard issued by OP & C / EDC.
- 5.8 Shell dimension to be checked and any variation in dimension to be corrected before Proceeding further assembly.
- 5.9 Core is to be checked for the dimension, ovality etc.
- 5.10 The outlet blades shall be checked and care should be exercised during welding of blade to minimize distortion.
- 5.11 The dimension of the diffuser foot shall be checked as per the drawing. The location and the height of the diffuser foot shall be checked as per the drawing. The completed diffuser dimensions shall be checked and recorded in the history card. Weld "T" rail in core in position.
- 5.12 Before checking final dimension, the flange warpage, water level, plumb out are to be corrected.
- 5.13 All the handles, required washers, taper washers are to be placed in position before dispatch.
- 5.14 All drilled holes are to be clear from the weld and proper space to be available for nut or bolt.
- 5.15 Ensure that all the transport stiffeners are welded and identified in yellow color. These should be welded without stress.

### 6.0 Painting and preservation.

- 6.1 The component shall be thoroughly cleaned to remove spatter, slag, rust, scale, oil or grease or any other foreign materials.
- 6.2 The inside and outside surfaces shall be painted as per applicable painting schedule.
- 6.3 All the machined surfaces and weld edge preparation shall be given one coat of rust Preventive oil.
- 6.4 The component shall be clearly identified with the following details.

Quality Department

Q.W.I.No. F: 002 (Rev: 02)

Date: 05.12.2012

**FAN DIFFUSER ASSEMBLY**

WO No.  
DU No.  
Product No.  
IR No.  
Match marks  
NCR No. (if any)  
Weight.  
Quantity.  
Drawing No.

7.0 Packing and Dispatch.

7.1 All the components shall be suitably dispatched to avoid transit damage. Proper stiffners shall be provided to avoid damage as shown in drawing.

ANNEXURE -1

Bolt size	Hole Dia.	Tolerance for pitch circle	Tolerance for Hole
M16	19	± 1 .00	± 0 .5
M20	24		
M24	28	± 1 .00	± 0 .8
M30	35		
M35	40		
M42	46		

Quality Department

Q.W.I.No. F: 002 (Rev: 02)

Date: 05.12.2012

**FAN DIFFUSER ASSEMBLY**

**REVISION HISTORY**

**I) Following amendments were carried out in Amendment A1 of Rev.00**

Clause No.	Amended As	Basis for Amendment / Remarks
3.4	AWS D1.1.83 shall be read as AWS D1.1 latest	Document referred is to be latest.
4.1	Following is added. "For intoleranced dimensions PR:QA:500/ latest shall be referred for tolerances:  Annexure -1 is withdrawn.	PR: QA:500 is the document for intoleranced dimensions.
6.2	Painting shall be done as per RP 0674199/latest	Painting schedule RP 0674199

**II) Following amendments carried out in Amendment A2 Rev.00**

Clause No.	Amended As	Basis for Amendment / Remarks
5.7	Diffuser feet shall be welded on to diffuser maintaining level and height as per drawing.	Machining of Diffuser foot is not envisaged.
4.1	Annexure on tolerances is with drawn.	Editorial correction.

**III) Following amendments carried out in Rev.01**

Clause No.	Amendments carried out	Basis for Amendment / Remarks
3.2	Considering the availability of minimum size of Pl.6x 1250 width, the no. of radial and axial joints are altered for 210MW & 500 MW.	RND of meeting held on 12.08.11 to finalize the no. of joints in fan diffuser assy..
3.7	Flush grinding on both sides was amended as flush grinding only on inner side of the diffuser shell.	

Quality Department

Q.W.I.No. F: 002 (Rev: 02)

Date: 05.12.2012

**FAN DIFFUSER ASSEMBLY**

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**IV) Following amendments carried out in Rev.02**

Clause No.	Amendments carried out	Basis for Amendment / Remarks
3.6	Considering the availability of minimum size of Pl.6x 1250 width , the no. of radial and axial joints are altered for 210MW, 500MW & above & 660MW and above MW	RND of meeting held on 04.12.2012
3.14	Radial stiffner length introduced.	
3.16	Plus joint not allowed.	
3.17	Gap between vertical joints Introduced	
3.18	Offset distance between two axial joints Introduced	
3.19	Table for flange length Introduced	
Annexure	Tolerance on PCD amended as $\pm 1.00$	



QUALITY DEPARTMENT

AMANDMENT TO QUALITY WORK INSTRUCTION (Q C P)

Q. W. I. NO: F: 007

REV: 00

AMENDMENT SL NO : A 1

DESCRIPTION: AN FAN SUCTION CHAMBER

DATE: 20 / 8 / 94

DETAILS

CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS
3.4	AWS D1. 1. 83 shall be read as AWS D1.1 latest .  Annexure for untoleranced dimensions is replaced by PR : QA : 500/ latest	Document referred is to be latest . 4.1  PR : QA : 500 is the document for tolerances of untoleranced dimensions.
6.2	“ painting shall be done as per RP 0674199 / latest	painting schedule RP0674199

Prepared by

*B. Srinivas Reddy*

Approved by

Distribution: As per standard distribution list .

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BHARAT HEAVY ELECTRICALS LIMITED  
BOILER AUXILIARIES PLANT  
RANIPET 6324506  
QUALITY ASSURANCE & CONTROL DEPT

QCP: F: 007  
PAGE 01 OF 04

QUALITY CONTROL PROCEDURE FOR

AN FAN SUCTION  
CHAMBER

EFFECTIVE DATE

16 - 05 - 1988

ACCEPTED BY

DEPTT

SIGNATURE

V. ALAGAPPAN

EDC / FANS



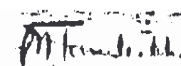
R. RATHNAKARAN

QC



P. H. TAMBAKHE

QA



R. MUTHUKUMARASWAMY

PRODN



P. S. RAO

QP & C



ISSUED BY: QA

REV. NO. NIL  
DATE 16- 5 -1988



MASTER COPY

QUALITY CONTROL PROCEDURE FOR AN

- 1.0 SCOPE
- 1.1 This procedure specifies the quality requirements for the manufacture of AN SUCTION CHAMBER .
- 1.2 This procedure is valid only for those products which are under the inspection purview of BHEL or its authorised agencies . special requirements if any shall be specified separately.
- 2.0 MATERIALS
- 2.1 Materials used shall be as per the GMS reqts.
- 3.0 MANUFACTURING
- 3.1 The product made to this drg shall have workman like finish . Also it will be the responsibility of the fabricator to organise to produce a quality product.
- 3.2 The no. of joints made should be restricted to min. if than 3 joints for than 4 joints in 500 MW and more than 3 joints for 210 MW the layout should be got approved by EDC.
- 3.3 Plates and sheets shall be cut to size by shearing machine or flame cutting . Flame cut edges shall be cleaned to remove slag and uneven edges shall be dressed by grinding. Gas cut notches shall be filled up by welding and ground before taking up further fabrication .
- 3.4 Welding employed in the production shall be qualified as per AWS D1.1.83 .
- 3.5 The finished product shall be completely / from defects which are injurious to the component strength or to the appearance .
- 3.6 Proper welding sequence shall be adapted to minimise distortion .
- 3.7 Surface should be flush ground on both sides of joints after welding .

3.8 Weld seams should not cross, min distance should be atleast 100 mm .

3.9 Stiffener location should be away from the joints by about 50 mm.

3.10 Weld joint should be atleast 30 mm away from dell holes of flanges .

#### 4.0 DIMENSIONAL AND OTHER DETAILS

4.1 All dimensions shall be as per the production drawing concerned. Wherever tolerances have been indicated in the drawing the same shall be strictly followed .  
SEE ANNEXURE FOR UNTOLERANCED DIMNS.

4.2 For circular flanges the centre dist. of diametrically opposite bolt holes shall be as per the annexure .

4.3 Pitch distance of the consecutive holes shall be within  $\pm 1$  mm However in case of rectangular flanges the max cumulative variation in hole pitch shall not exceed  $\pm 2$  mm.

4.4 The deviations on the flatness of the circular or rectangular flanges should not exceed 1.5 mm .

4.5 After rolling the diameters should be measured. The variation in diameter should not exceed  $\pm 3$  mm.

#### 5.0 IMPORTANT CHARACTERISTICS

5.1 Diagonals at the square entry to be checked and recorded.

5.2 Diameter at the circular outlet to the be checked in 4 places.

5.3 Assy to be done on levelled surface.

5.4 The flanges at rectangular section to be levelled by water level within 2 mm and plumb to be dropped from 4 points of the circular section flange . The circular flange level should be within 2 mm. Check during tack welding and final welding.

5.5 Development of the items shall be as per drawing

5.6 Ensure that all transport stiffeners are welded and pained in yellow colour . Transport stiffeners should be welding without stress .

5.7 During assly stage after levelling etc., the centre of the square section at the entry should be projected on the levelled surface and the distance upto the circular flange at the exit must be checked .

6.0 PAINTING AND PRESERVATION

6.1 The component shall be thoroughly cleaned to remove spatter , slag , rust , scale , oil or grease or any other foreign materials .

6.2 The inside & outside surface shall be painted as per TP 0674199.

6.3 All the machined surfaces shall be given one coat of rust preventive oil .

6.4 The component shall be clearly identified with the following details : --

WO No.  
DU No.  
Product No.  
Match marks

IR No.

7.0 PACKING AND DESPATCH

7.1 All the components shall be suitably despatched to avoid transit damage . Proper temporary stiffeners shall be provided to avoid damage .

<b>QUALITY DEPARTMENT</b>		
<b>Amendment to Quality Management Instructions (QMI)</b>		
QWI NO: SQP:FAN 312	REV: 01	DT. 08 03 06
<b>Amendment no: A 1</b>		<b>DT. 24 04 06</b>
Description: Lub oil system for Fans.		

Details of Amendment		
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT
General guide lines : Instrumentation, cables & routings  Cables up to junction box shall be routed through flexible conduits shall be read as	<b>Cables up to junction box shall be routed through cable trays or flexible conduits.</b>	Based supplier & engineering feed back.

<b>Prepared by</b>	<b>Reviewed by</b>	<b>Approved by</b>



**MANUFACTURER'S NAME & ADDRESS**  
**M/S BHEL: BAP: RANIPET**  
**TAMIL NADU-632 406**

**MANUFACTURING QUALITY PLAN**  
 Item/subsystem:  
**LUB OIL SYSTEM FOR FANS**

Project & package: **Standard**  
 OP: No: **5QP 312**  
 Rev No: **01**  
 Date: **08 03 06**  
 Page: 1 OF 3

Format of Record: 9  
 Agency: 10  
 M C B  
 Remark: 11

Sl No	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency	Remark
1	2	3	4	5	6	7	8	9	10	11

10	<b>SUBDELIVERIES</b> (BOIs)		MAJOR	AS PER COLUMN 3	100%	RESPECTIVE PO SPEC		TC	P V V	
1.1	L T MOTOR, COOLER, FILTER, FLEXIBLE HOSE, LEVEL SWITCH, PRESSURE GAUGE/SWITCH, TEMPERATURE GAUGE, DP GAUGE/ DP SWITCH, VALVES, PUMP.	RESPECTIVE TESTS AS PER RESPECTIVE P.O SPEC.								
2.0	INPROCESS INSPECTION	a) WELD** QUALITY	MAJOR	PT@	100%	#ASTM E 165		REP	P	V
2.1	TANK FABRICATION	b) DIMENSIONS	MAJOR	MEASURE- MENT VISUAL	100%	DRAWING		REP	P	V
2.2	TANK WATER FILL TEST	SOUNDNESS	MAJOR		100%	NO LEAK IS PERMITTED		REP	P	V

BHEL free supply items like Lub Oil pressure regulator, Pressure control valve, Over flow valve shall be verified for their assy /fittings as per approved P&I drawing& P.O requirements.

**LEGENDS:**  
 M - Manufacturer / Sub vendor  
 C - Vendor  
 B - BHEL /BHEL Authorized Inspection Agency/  
 W - Witness, TC - Test certificate, DR - Dimensional report  
 C/P - Customer Hold Point  
 by contractor. V - VERIFICATION OF TEST REPORTS.

Prepared by	Reviewed by	Approved by
<i>[Signature]</i>	<i>B. Subramanian</i>	<i>[Signature]</i>




**MANUFACTURER'S NAME & ADDRESS**  
**M/S BHEL: BAP: RANIPET**  
**TAMIL NADU-632 406**

**MANUFACTURING QUALITY PLAN**  
 Item/subsystem:  
**LUB OIL SYSTEM FOR FANS**

**Project package: Standard**

QP: No: **SQP 312**  
 Rev No: **01**  
 Date: **08 03 06**  
 Page: 2 OF 3

SL NO 1	COMPONENT & OPERATION 2	CHARACTERISTICS 3	Class 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENTS 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	Agency 10			REMARKS 11
									M	C	B	
3.0	<b>FINAL INSPECTION</b>											
3.1(a)	ROUTING & ASSY OF COMPONENTS	VERIFICATION & DIMENSIONS	MAJOR	VISUAL & MEASUREMENT	100%	DRAWING		REP	P	W		
3.1 (b)	PERFORMANCE TEST AT RATED PRESSURE	a) MEASURE- MENT OF DISCHARGE b) SMOOTH OPERATION c) VERIFICATION OF SET POINTS OF PRESSURE & DP SWITCHES d) VERIFICATION OF SET POINTS OF RELIEF VALVE (FD&PA FANS) e) VERIFICATION OF LEAKAGE	MAJOR	MEASURE-MENT	100%	BHEL PUR SPEC		REP	P	W		
			MAJOR	VISUAL	100%	-DO-		REP	P	W		
			MAJOR	VISUAL	100%	-DO-		REP	P	W		
3.1(c)	LEAKAGE TEST AT 1.5 TIMES WORKING PRESSURE	a) VERIFICATION OF LEAKAGE	MAJOR	VERIFICATION	100%	NO LEAK		REP	P	W		
3.2	PAINTING & PACKING	VERIFICATION OF LEAKAGE	MAJOR	VISUAL	100%	BHEL PUR SPEC		REP	P	W		

		<b>MANUFACTURER'S NAME &amp; ADDRESS</b> <b>M/S BHEL: BAP: RANIPET</b> <b>TAMIL NADU-632 406</b>			<b>MANUFACTURING QUALITY PLAN</b>			<b>Project &amp; package: Standard</b>			
<b>Sl NO</b> 1		<b>COMPONENT &amp; OPERATION</b> 2		<b>CHARACTERISTICS</b> 3		<b>Item/subsystem:</b> <b>LUB OIL SYSTEM FOR FANS</b>		<b>Qp. No: SQP 312</b> <b>Rev No: 01</b> <b>Date: 08 03 06</b> <b>Page: 3 OF 3</b>		<b>FORMAT OF RECORD</b> 9	
<b>Class</b> 4		<b>TYPE OF CHECK</b> 5		<b>QUANTUM OF CHECK</b> 6		<b>REFERENCE DOCUMENTS</b> 7		<b>ACCEPTANCE NORMS</b> 8		<b>Agency</b> 10 M    C    B	
<b>REMARKS</b> 11											

**GENERAL GUIDE LINES**

- **Tank inside paint:** Blast cleaning to sa2 1/2
- Surface preparation: Epoxy zinc rich primer – 40 µm min.
- Primer coating : Epoxy zinc rich primer – 40 µm min.
- Finish coating: Epoxy glossy finish paint (oil resistant type) 35 µm min.

**Tank outside paint( unless specified otherwise following paint shall be adopted)**

- Primer: Red oxide zinc phosphate paint to IS 127/44 – DFT 25 µm min.
- Finish paint: Synthetic enamel paint to IS 2932 – smoke gray – shade 692 of ISS – DFT - 20 µm min.
- Total DFT shall be 45 microns minimum.


**PIPES AND FITTINGS**

- Acid clean the pipes by filing the pipes with 10% V/V orthophosphoric acid after plugging one end suitably.
- Keep the solution for about three hours.
- Prepare a neutralizing solution with washing soda (sodium carbonate) and water (500 gms of washing soda for 10 liters of water). Rinse the acid cleaned pipelines with neutralizing solution several times. After neutralization, dry the tubes by compressed air. Then rinse with lubricating oil.

**INSTRUMENTS, CABLES AND ROUTINGS.**

- Ensure the proper alignment between motor and pump during the assembly with coupling.
- Ensure the correct wiring in the junction boxes meant for instrument control latching and power control cabling as per wiring diagram.
- Cables up to junction box shall be routed through flexible conduits.
- Support the cables in cable trays.
- All the control cabinets into junction boxes shall be identified with tags.
- All indicating instruments and switches with their respective root valves shall be mounted on a common panel on the tank.
- The nameplates of the respective components indicating the make, model number etc., shall be available in the respective equipment.
- An analyzed plate showing the hub oil system drawing shall be provided on the tank.
- Verify for the current drawn at operating pressure.
- Indicate the direction of fluid on the pipelines.
- **PACKING AND PRESERVATION**
- Lubricating oil system shall be properly packed as per applicable packing drawing.
- Painting shall indicate the lifting location.
- Provides sufficient amount of silica gel in the packing box.
- Mark the identification details of the system on the oil tank.

Rev 00	dt 12 01 01	Original issue
Rev 01	dt 08 03 06	Totally modified based on COA feedback.

 Ranipet	<b>PRQA</b> FOR <b>REQUIREMENTS OF BALANCING MANDREL</b>  <b>Product: FAN</b>	Doc Ref: <b>PRQA:302</b>
		Rev.No. <b>01</b>
		Date: <b>03 02 03</b>
		Page No <b>01 of 01</b>

## 1.0 Scope

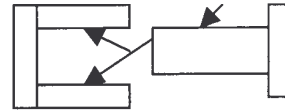
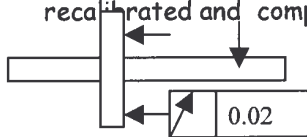
1.1 This procedure details out the requirements of the mandrels used for balancing of fan components.

## 2.0 Reference documents:

2.1 ISO 1940

## 3.0 Requirements:



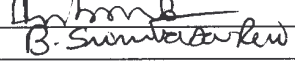
- 3.1 The mandrel shall be fully machined from a solid piece or shaft and flange welded and machined type.
- 3.2 The run out and face out of the mandrel journal area and other mating / coupling areas shall be within 0.02 mm (refer sketch given below)
- 3.3 The journal area and coupling / mating surface of the mandrel shall be completely free from dents and projects due to damages (refer sketch- given below)
- 3.4 The mandrel shall be dynamically balanced to grade one of ISO 1940.
- 3.5 The mandrel and the matting / coupling surface of the components shall be in H7 / k6 fit.
- 3.6 The mandrel shall be preserved by applying rust preventive after use to avoid any rusting on the journal / mating surfaces.
- 3.7 The mandrel shall be periodically calibrated once in every 12 months and the unbalancement value shall be verified within the allowance limit and records shall be maintained. In case, the mandrel usage is not frequent as above, the calibration shall be done before use .
- 3.8 Any addition/removal of mass in mandrel for unbalancement shall not affect the assy of the components balanced with mandrel.
- 3.9 Any alteration made in the mandrel for assembly of components shall be recalibrated and comply with all the points referred above. (3.1 to 3.8)




Run out and face out of the mandrel shall be  
Within 0.02mm

Fit shall be H7/K6

*No, dent ,scoop,damages shall be allowed.*

Prepared by 	Reviewed by	signature	Approved by  (Head/QA)
	QC		
	QA	B. Suresh Babu	
Issued by		QUALITY ASSURANCE	
Rev No	clause	Revision made	Date
00	--	ORIGINAL ISSUE	18 10 01
01	-	Totally modified	03 02 03

	<b>PRQA</b> <b>FOR</b> Re blading / repair of CZECK type Axial impellers & AN impellers <b>Product:FAN</b>	Doc Ref:	<b>PRQA:304</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>01 of 05</b>

**1.0 SCOPE:**

This procedure details out the re blading / repair of CZECK type Axial impellers & AN impellers

**2.0 REFERENCE DOCUMENTS**

Drawing .

**3.0 Procedures**

**3.1 REMOVAL OF DAMAGED PARTS**

3.1.1 Check for removal of defective parts by gas cutting with 5mm projection for removal by grinding.

3.2 Ensure for no removal of parent metal during grinding.

3.3 Check by MPI on the above prepared hub on its entire surface -both sides including raw material portion & examine the locations where the blades were located by LPI also.

**4.0 GAS CUTTING AND WELDING**

4.1 Verify the raw material attestation with RMA card and transfer the attestation details In to cut pieces and hard stamp with inspector seal.

4.2 Check the Gas cut blades, ring, root stiffener, cone for the following Requirements as applicable

4.2.1 Grinding off the gas cut notches.

4.2.2 Edge preparation (incase of root stiffeners& blades EP shall be done only during blade fit up after suiting the blade to hub by trial and error method.)

4.2.3 Check blades profile on the checking fixture before fit up.



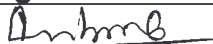
**4.2.4 VERIFICATION FIT UP & WELDING**


4.2.5 Check fit up dimensions& orientation ,profile as applicable with respect to drg,& check for square ness also in case of ring fit up

4.2.6 Mark for identification on the hub for blade setting. (The blade shall be located in between the already removed blades)


4.2.7 Check for EP & the root gap for max. 2 mm maximum & use of electrode E 7018.

4.2.8 Check for the Back grinding of weld root LPI.

<b>Prepared by</b> 	<b>Reviewed by</b>	<b>signature</b>	<b>Approved by</b>  (Head/QA)
	QC		
	QA	B. Srinivasulu	
<b>Issued by</b>		<b>QUALITY ASSURANCE</b>	

	<p style="text-align: center;"><b>PRQA</b> FOR Re blading / repair of CZECK type Axial impellers &amp; AN impellers Product:FAN</p>	Doc Ref:	<b>PRQA:304</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>02 of 05</b>

- 4.2.9 Mark for identification on the hub for blade setting. (The blade shall be located in
- 4.2.10 verify for Tack welding of suitable temporary stiffeners to avoid distortion
- 4.2.11 check for excess weld which will interfere with face of root stiffener and ensure proper size of the finished weld shall be ensured
- 4.2.12 Verify for through dressing of the weld on root stiffener side. Look for any undercuts at both sides along the length & correct as required(Undercuts shall not exceed 0.8mm). carry MPI on welds and ensure no defects
- 4.2.12 Verify the suiting of the root stiffener and suit to the parent blade. Cutting ,if required ,shall be done at the lower radius edge. The gap between parent metal of blade and root stiffener shall not exceed 1 mm.
- Note: a) Root shall made minimum 3 holes of dia 10 as per drg.  
b) If the original weld hampers fit up of root stiffener ,this weld can be suitably ground to facilitate proper fit up .
- 4.2.13 After welding check for the plugging of holes of root stiffener by welding leaving one of the centre plug hole.
- NOTE::A length of 10x 10 mm weld shall be left un welded at one corner to facilitate venting for trapped gas.*
- 4.2.14 Carry out cleaning and grinding and conduct MPI.
- 4.3.0 HEATTREATMENT
- 4.3.1 Verify the stress relieve cycle of impeller as at 530 -580 °C for Hub/Blade materials of P355NH and & for IS 2062 materials stress relief at 600 -650°C ( refer BAP:HT:001/Latest for other details)
- 4.3.2 The soaking shall not exceed 90 min in case P355NH material. The rate of heating and rate of cooling shall be 100 °C / Hr Max . Impeller loading and unloading from furnace shall not be done when the furnace temperature more than 300°C .(soaking time 1 Hr / 25 mm thickness of weld.)
- 4.3.3 Verify for the blasting cleaning of the impeller and painting with one coat of red oxide primer leaving the un welded portion. Complete the 10 mm length left out welding in cone and root stiffener & plugging of the centre hole left out on the root stiffener.
- 4.3.4 Ensure flush grinding of welds and removal of all the temporary stiffeners
- 4.4 Blade profile checking:
- 4.4.1 Check the blade profile by using the checking fixture and the gap shall within the limit given in the table-1
- 4.4.2 Cross check the chord length already checked.
- 4.4.3 Blade profile shall be thermally corrected after heat treatment wherever Required The variation allowed shall be as per table 1.

	<b>PRQA</b> FOR Re blading / repair of CZECK type Axial impellers & AN impellers <b>Product:FAN</b>	Doc Ref:	<b>PRQA:304</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>03 of 05</b>

- 4.4.4 Carry out profile checking with the help of checking fixture which is fixed in the corresponding distance to the impeller center on base plate. The impeller is carried on a pivot (centre) as shown in fig.1
- 4.4.5 Axial Fan impellers are of welded design. The correct form and the location of the impeller blades can be corrected on the completed (finish work) impellers by the application of heat with proper blow pipes (gas torches).
- 4.4.6 The following measurements are made, where the bearing surfaces of the checking template should lie (fit) against the blade.  
 Gaps between the impeller blade and the checking template on location of the blade. (Refer Figure 2).
- 4.4.7 1) Entry (after the entry radius), 2) Middle, 3) Exit (Refer figure 2,3).  
 For the evaluation, the outer section is used. The measurement at the inner section serve merely the information and interpretation when large deviations are present at the outer section.
- 4.4.8 Carry out MPI on welds.

#### **4.5 MACHINING**

- 4.5.1 Check the impeller setting on the machine true to the hub bore and face.  
*Note: Machine the blade tip OD as per drawing and inspect.( P.O shall be referred in case of spare orders for any specific remarks on OD)*
- 4.5.2 Check the dimensions of first side and after setting the second side check for the second side for the run out and face out .

#### **4.6 BALANCING**

- 4.6 Remove by grinding/add mass by welding to bring the unbalance within the PRU values as per drawing & inspect
- 4.7 Check for the unbalancement as per drg.

#### **5.0 IDENTIFICATION & PRESERVATION**

- 5.1 Apply one coat of synthetic enamel finish paint to IS 2932 shade smoke grey. Machined areas shall be applied with temporary rust preventive.
- 5.2 Impeller shall be identified with W.No.DU No., DU sl.No. by paint and number punching.


	<b>PRQA</b> FOR Re blading / repair of CZECK type Axial impellers & AN impellers <b>Product:FAN</b>	Doc Ref: <b>PRQA:304</b>
		Rev.No. <b>01</b>
		Date: <b>03 02 03</b>
		Page No <b>04 of 05</b>

Table-1

**FAN SIZE**  
**Allowable aver**

	Allowable parallel Gap(mm)	Allowable deviation from parallel gap	Allowable average parallel gap	Allowable deviation from parallel gap
> 1300- <1800	4	2	4	1.5
>1800 - <2000	5	2.5	5	2
>2000- < 2100	6	3	6	2
>2100 < 2200	6	3	6	2
>2200 < 2500	7	3.5	7	2.5
>2500 < 2800	8	4	8	2.5
2800 < 3000	8	4	8	2.5
>3000 < 3100	8	4	8	2.5
>3100-< 3300	9	4.5	9	3

FIG-1

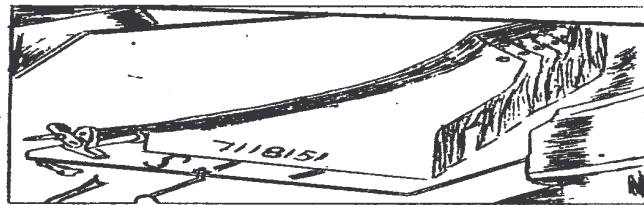


FIG-6

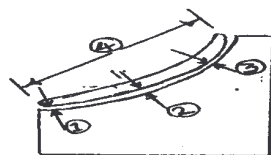


FIG-7



FIG-9

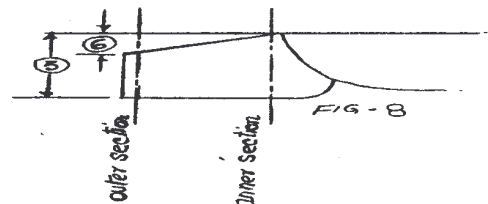


FIG-8



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**PRQA**  
FOR

Re blading / repair of CZECK type Axial impellers  
& AN impellers

Product:FAN

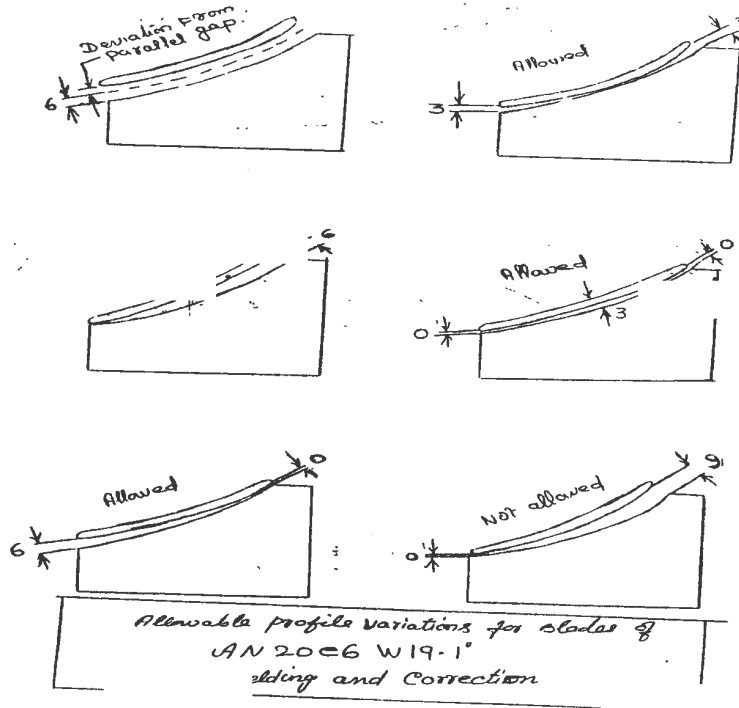
Doc Ref: **PRQA:304**

Rev.No. **01**


Date: **03 02 03**

Page No **05 of 05**

FIG-2



Rev No	Clause revised	Revision made	Date
00	-	ORIGINAL ISSUE	13 11 01
01	-	Totally modified	03 02 03

	<b>PRQA</b> <b>VERIFICATION PERFORMANCE OF</b> <b>BALANCING</b> <b>MACHINE WITH MASTER ROTOR</b>	Doc Ref:	<b>PRQA:314</b>
		Rev no:	<b>06</b>
		Date	<b>24/10/2012</b>
		Page no:	<b>01 of 02</b>

## 1.0 SCOPE

This procedure details out the verification of performance of balancing machine with master rotor (proving Rotor)

## 2.0 REFERENCE DOCUMENTS:

Drawing

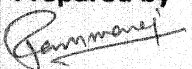
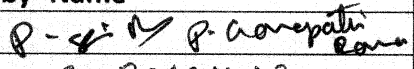
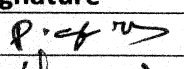
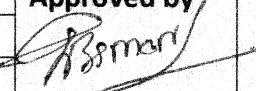
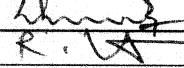
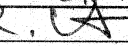
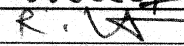
## 3.0 GENERAL CHECKS :


- 3.1.1. Rotor journals & rollers surface should be free from dent, projections and rollers should have proper curvature to have line contact with journal area.
- 3.1.2. Ensure the proper tightening of pedestal/carriage bolts and diagonal difference within 5 mm.
- 3.1.3. Coupling mating surface should be free from mechanical damages.

## 4.0 PREPARATION:

- 4.1.1 The test masses shall be in the form of bolts studs etc. for attachment in the proving rotor test Planes. Prepare two sets of test masses (ie one set=2 test masses having equal weight-Allowed variation shall be  $\pm 1$  g for weights up to 50g. and  $\pm 2$  g. for weights more than 50g. )
- 4.1.2 Verify for the supports roller centre distance from the test planes of either side. The distance should be equal or greater than the half of the distance of test planes of the proving rotor.

$$\text{ie } A \geq B/2 \quad ; \quad C \geq B/2$$

Prepared by	Reviewed by -Name		Signature	Approved by
 RAM MANOJ	M & S			 (Head/QA)
	QC	G. PRABAKAR		
	QA	R.  R. ARUNACHALAM		
	Issued by		QUALITY ASSURANCE	

	<b>PRQA</b> <b>VERIFICATION PERFORMANCE OF</b> <b>BALANCING</b> <b>MACHINE WITH MASTER ROTOR</b>	DOC Ref:	<b>PRQA:314</b>
		Rev.No.	<b>06</b>
		Date:	<b>19/05/12</b>
		Page No	<b>02 of 02</b>

### **5.0 Procedure**

- 5.1.1 Check the PRU values of the master rotor against the required values as called for in respective formats of M&S for the balancing machines.
- 5.1.2 Turn the universal coupling shaft 180 deg apart and check the Machine read out.
- 5.1.3 conduct trials and record unbalance read out amount and angles reading as per the enclosed formats pertaining to H70, R73, R43, H10 & H30.
- 5.1.4 The trial weight and speed shall be inline with relevant format as applicable.
- 5.1.5 Run the rotor at different speeds viz lower & higher speeds.
- 5.1.6 Calculate the percentage by which the machine indications are differing from the actually added values.
- 5.1.7 Variation of machine read out with respect to added mass and angles shall be within  $\pm 10\%$  and  $\pm 7$  degree respectively. Out of six trials one can deviate beyond the limits.
- 5.1.8 If the variation in the machine indication is more than stated in Cl. 5.1.7. recalibration is to be done.
- 5.1.9 Verification shall be deemed valid for a period of 12 months. QC shall maintain verification records against respective machines.

Rev No	Clause revised	Revision made	Date
Rev 00	...	ORIGINAL ISSUE	11 08 93 16 12 94 28 12 98
01	...	Totally modified	13 02 03
02	...	Totally modified	
03	...	Totally modified	11 10 03
04	...	CLAUSE MODIFIED & ANNEXURES MADE	05 01 09
05	...	Totally modified	
06	...	C.I.5.1.6,5.1.3,5.1.1,4.1.1, 3.1.1,3.13,2.0 revised..	24 10 12



Ranipet

REPORT ON  
**VERIFICATION OF BALANCING MACHINE**  
**WITH MASTER ROTOR**  
**(M&S)**

MACHINE	<b>H70V CAB 690</b>
Date:	
Page No	<b>01 OF 01</b>

<b>MACHINE:</b> <b>H70V CAB 690</b>		PROVING ROTOR DRG NO: 1-RT-50-00130		WEIGHT: 526.904 kg		PRU VALUE: 1575 g.mm/Plane	
A:		B: 380mm		C:		RL: 190mm RR: 190mm	
RESIDUAL UNBALANCEMENT		LEFT PLANE:		RIGHT PLANE:			
INDEXING UNIVERSAL COUPLING BY 180°		LEFT PLANE:		RIGHT PLANE:			
TRIAL WEIGHT : 40 g (+/-10 %)				RPM: 1000 +/- 50 rpm			
LEFT PLANE				RIGHT PLANE			
ADDED		RESULT (READOUT)		ADDED		RESULT (READOUT)	
Wt in g..	Angle	Wt in g.	Angle	Wt in g	Angle	Wt in g.	Angle
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		
TRIAL WEIGHT : 280 g (+ / - 10 %)							
LEFT PLANE:				RIGHT PLANE:			
RL:		RR:		RPM: 305 +/- 50 rpm			
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		
Allowable Error in magnitude: +/- 10% Angle Variation: +/-7 degrees							
Performance : Next Calibration Due On:				M&S		QC	
Verification done inline with PRQA 314/Latest							



Ranipet

REPORT ON  
**VERIFICATION OF BALANCING MACHINE WITH  
 MASTER ROTOR  
 (M&S)**

MACHINE	MACHINE: R73CAB590
Date:	
Page No	<b>01 OF 01</b>

<b>MACHINE: R73CAB590</b>	PROVING ROTOR DRG NO: 1-RT-50-00130	WEIGHT: 526.904 kg	PRU VALUE: 1575 g.mm/Plane
-------------------------------	--	--------------------	-------------------------------

A:	B: 380mm	C:	RL: 190mm	RR: 190mm
----	----------	----	-----------	-----------

RESIDUAL UNBALANCEMENT	LEFT PLANE:	RIGHT PLANE:
------------------------	-------------	--------------

INDEXING UNIVERSAL COUPLING BY 180°	LEFT PLANE:	RIGHT PLANE:
-------------------------------------	-------------	--------------

TRIAL WEIGHT :40 g (+/-10 %)	RPM: 805 +/- 50 rpm
------------------------------	---------------------

LEFT PLANE				RIGHT PLANE			
ADDED		RESULT (READOUT)		ADDED		RESULT (READOUT)	
WT in g.	Angle	WT in g.	Angle	WT in g.	Angle	WT in g.	Angle
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		

TRIAL WEIGHT : 280 g (+/- 10 %)
---------------------------------

LEFT PLANE:	RIGHT PLANE:
-------------	--------------

RL:	RR:	RPM: 396 +/- 50 rpm
-----	-----	---------------------

	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		

Allowable Error in magnitude: +/- 10% Angle Variation: +/-7 degrees Performance : Satisfactory & Acceptable  Date of calibration :  Next Calibration Due On	M&S	QC
---	-----	----

Verification done inline with PRQA 314/Latest



Ranipet

**VERIFICATION OF BALANCING MACHINE WITH  
MASTER ROTOR  
(M&S)**

MACHINE	MACHINE: R43 Soft Bearing
Date:	
Page No	<b>01 OF 01</b>

<b>MACHINE: R43 SOFT BEARING</b>	PROVING ROTOR DRG NO: 1-RT-50-00236	WEIGHT: 167 kg.	PRU VALUE: 417.5 grmm.
--------------------------------------	---	-----------------	------------------------

PRQA:314/Latest		RL: 130mm	RR:130mm
RESIDUAL UNBALANCEMENT	LEFT PLANE.	RIGHT PLANE:	
INDEXING UNIVERSAL COUPLING BY 180°	LEFT PLANE:.	RIGHT PLANE.	


TRAIL WEIGHT:18 g.(+/-10%)      RPM: 1000 +/- 50 rpm


LEFT PLANE				RIGHT PLANE			
ADDED		RESULT (READOUT)		ADDED		RESULT (READOUT)	
WT in g.	Angle	WT in g	Angle	WT in g.	Angle	WT in g.	Angle
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		


LEFT PLANE:				RIGHT PLANE: °			
RL: 50 g +/- 10 %		RR: 50 g +/- 10 %		RPM: 670 +/- 50 rpm			
WT in g.	Angle	WT in g	Angle	WT in g.	Angle	WT in g.	Angle
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		

Allowable Error in magnitude: +/- 10% Angle Variation: +/-7 degrees Performance :	M&S	QC
Date of calibration : Next Calibration Due :		

Verification done inline with PRQA 314/Latest

 Ranipet	<b>Report on  VERIFICATION OF BALANCHING  MACHINE WITH MASTER ROTOR  (M&amp;S)</b>				Machine		Machine:ABRO H10 – K MP102(B)		
					Date:				
					Page No.		<b>01 OF 01</b>		
Machine:ABRO H10 – K MP102(B)		Proving Rotor Drawing No. 1-RT-50-00130				Weight 526.904kg.		PRU VALUE: 1575 gmm/ Plane	
A:		B: 380 MM		C:		RL: 190 MM		RR: 190 MM	
Residual unbalacement				Left plane:			Right plane:		
INDEXING UNIVERSAL COUPLING BY 180°				Left plane:			Right plane:		
TRIA WEIGHT: 30 gr (+10%)					RPM: 900 +/- 50 RPM				
LEFT PLANE					RIGHT PLANE				
Added		Result (Readout)			Added		Result (Readout)		
Wt. in g.	Angle	Wt.in g.	Angle	Wt.in g.	Angle	Wt.in g.	Angle	Wt.in g.	Angle
	0°				90°				
	0°				180°				
	0°				270°				
	90°				270°				
	180°				270°				
	270°				0°				
Trial Weight: 300 gr (+/- 10%)									
LEFT PLANE:					RIGHT PLANE:				
RL:205 mm			RR: 205 mm			RPM: 305 +/- 50 RPM			
	0°				90°				
	0°				180°				
	0°				270°				
	90°				270°				
	180°				270°				
	270°				0°				
Allowable Error in magnitude +/- 10%									
Angle Variation : +/- 7 degrees									
Performance:									
Next Calibration Due on:					M & S		QC		
Verification done inline with PRQA: 314/ latest									

 <b>Ranipet</b>	<b>REPORT ON          VERIFICATION OF BALANCING MACHINE          WITH MASTER ROTOR          (M&amp;S)</b>			Machine	MACHINE: H30 (SP) MP 102 (B)		
				Date:			
				Page No.	01 of 01		
MACHINE: H30 (SP) MP 102 (B)		PROVING ROTOR DRG NO: 3-RT- 050-01913		WEIGHT: 17.4 kg	PRU VALUE: 43.5 gr.mm/Plane		
A:	B: 120	C:		R <sub>L</sub> :	R <sub>R</sub> :		
RESIDUAL UNBALANCEMENT	LEFT PLANE:			RIGHT PLANE:			
INDEXING UNIVERSAL COUPLING BY 180°	LEFT PLANE:			RIGHT PLANE:			
TRIAL WEIGHT : 8 g +/- 10%		RPM: 1000 +/- 50 rpm		MODE : ADDITION			
LEFT PLANE				RIGHT PLANE			
ADDED		RESULT (READOUT)		ADDED		RESULT (READOUT)	
Wt. in g.	Angle	Wt. in g	Angle	Wt. in g.	Angle	Wt. in g.	Angle
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		
TRIAL WEIGHT : 40 g +/- 10%		RPM: 300 +/- 50 rpm		MODE : ADDITION			
LEFT PLANE				RIGHT PLANE			
ADDED		RESULT (READOUT)		ADDED		RESULT (READOUT)	
Wt. in g..	Angle	Wt. in g..	Angle	Wt. in g...	Angle	Wt. in g.	Angle
	0°				90°		
	0°				180°		
	0°				270°		
	90°				270°		
	180°				270°		
	270°				0°		
Allowable Error in magnitude: +/- 10% Allowable Angle Variation: +/- 7 degrees Performance : Satisfactory and acceptable Next Calibration Due On:				M&S		QC/FANS	
Verification done inline with PRQA:314/latest							

	<b>Procedure for unbalance correction by mass removal in Servomotor Cylinder, Piston Assy, Hub Disc, Solid Shafts and AP Shafts—Dynamic balancing</b>	Doc Ref:	<b>PRQA:321</b>
		Rev.No.	<b>04</b>
		Date:	<b>26 02 07</b>
		Page No	<b>Page 1 of 2</b>

### 1.0 SCOPE

1.1 This procedure specifies the methods of unbalance correction by removing the mass by drilling / milling/grinding or by suitable combination of these methods for solid shafts, servomotor cylinders, hub discs, piston assy. and AP fan shafts.

### 2.0 Reference:

2.1 Respective drawings

### 3.0 PROCEDURE:

#### 3.1 General

- 3.1.1 Balancing speeds shall be as per PRQA 309 latest.
- 3.1.2 Cleanliness of roller supports of balancing M/c shall be ensured before balancing
- 3.1.3 Balancing reference numbers shall be punched on the component at suitable location
- 3.1.4 Balancing details shall be documented in history card
- 3.1.5 Balancing machine rollers shall be covered suitably during grinding on the component for unbalancement correction

#### 3.2 Method


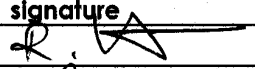
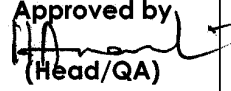
##### 3.2.1 For Servomotor Cylinder

**Table 1**

Weight removal in gm per plane	Method
up to and including 100	By drilling in identified place (refer table2)
more than 100 & up to and including 500	By grinding on the inner circumference(refer sketch-1) of cylinder /cover. Depth of grinding shall not be more than 5mm (app) at any place
more than 500 & upto and including 1500	By milling and grinding on the inner circumference(refer sketch-1) of cylinder/cover to a maximum depth of 5mm. In addition the rib can also be milled to a depth of 10 mm subject to 1/3 rd the length of the rib. Grinding may be done for fine balancing
More than 1500	Refer to QA & Engg

##### 3.2.2 For solid shafts, Hub discs and Piston assy:

- 3.2.2.1 Drilling and grinding only. Pl ref Table 2 for drill hole size.
- 3.2.2.2 Ligament thickness shall not be less than 5 mm.
- 3.2.2.3 Wherever applicable balancing key shall be fitted during balancing operation,

Prepared by 	Reviewed by QC	signature  B. Srinivasan	Approved by  (Head/QA)
	QA		
Issued by <b>QUALITY ASSURANCE</b>			



**Procedure for unbalance correction by mass removal in servomotor cylinder, piston assy, hub disc, solid shafts and AP shafts-Dynamic balancing**

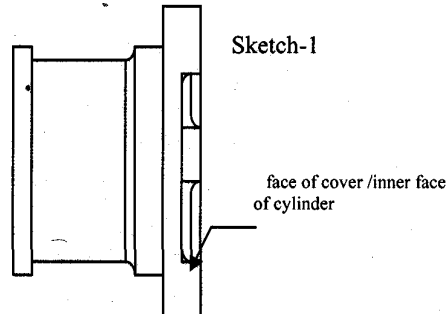
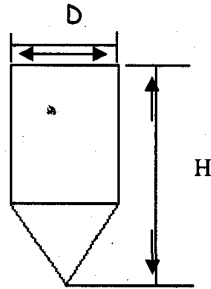
Doc Ref:	<b>PRQA:321</b>
Rev.No.	<b>04</b>
Date:	<b>26 02 07</b>
Page No	<b>Page 2 of 2</b>

**Table 2**  
Hole size in mm & mass removed in gm


Drill Dia 'D' in mm	8	10	12	15	18
Wt in gm	Height 'H' in mm				
1	4.1	3.5	--	--	--
2	6.6	5.2	4.6	--	--
3	9.1	6.8	5.7	5.0	--
4	11.7	8.4	6.8	5.8	5.5
5	14.2	10.0	7.9	6.5	6.0
6	16.7	11.7	9.0	7.2	6.5
7	19.3	13.3	10.2	7.9	7.0
8	21.8	14.9	11.3	8.6	7.5
9	24.3	16.5	12.4	9.3	8.0
10	26.9	18.1	13.6	10.0	8.5
11	32.0	21.4	15.8	11.5	9.5
12	37.0	24.6	18.0	13.0	10.5

Note:

1. The above table shows the drill hole depth (H)(see sketch below) for the standard drill diameter 'D' (OD) for equivalent weight in grams.
2. For maximum drill hole depth and dia refer to the individual component drawing .



Rev No	Clause revised	Revision made	Date
00	--	Original issue	11 07 94
01	-	Revised to include cylinder assy, piston assy ,hub disc& shafts	17 09 00
02	3.4	Clause modified to include servomotor cylinder rib drilling	16 12 00
03	-	Totally modified	03 02 03
04		Modified to include method of correction wrt unbalance amount .	26 02 07

	<b>PRQA</b> <b>FOR</b> Assembly and functional test <b>shaft with Bearing assembly</b> of non tubular /non tubular type.  <b>Product: FAN</b>	Doc Ref: <b>PRQA:329</b>
		Rev.No. <b>01</b>
		Date: <b>03 02 03</b>
		Page No <b>01 of 04</b>

1.0 SCOPE

This procedure specifies the requirements for the Assembly and functional test of NDFV fan shaft with Bearing assembly of non tubular /non tubular type.

2.0 REFERENCE DOCUMENTS  
drawing

3.0 PROCEDURE

3.1 PREASSEMBLY AND ASSEMBY CHECKS:

Ensure that all component parts are available before commencing the assembly. Check the general condition of all the parts.

3.1.2 ensure through cleanliness of surfaces and verify for e any trace of rust on the surface/face of shaft or other parts especially at sealing areas.

*Note : All the parts shall be thoroughly cleaned. Use of Undried Compressed air is not permissible. Burrs are to be removed, if present, Check and verify that no clips are left in the drilled holes (blind/through)*


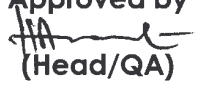
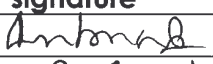
3.1.3 verify the radial and axial clearance of the before mounting


3.1.4 Measure the clearance between angular ring and roller bearing by placing the angular ring on roller bearing . If the clearance exceeds the drawing Limit, grind the angular ring portion as shown in the sketch (i)

- a) Measure the depth of angular ring (Y)
- b) Measure the depth of bearing to top face of inner ring (X).  
Clearance is  $X - Y = C$

If the clearance 'C' is less than drawing limit grind the face of the angular ring.

3.2.3 Check the history cards of all the parts of the bearing assembly to ensure their dimensional compliance. Counter check at random some of the parts.

Prepared by 	Reviewed by	signature	Approved by  (Head/QA)
	QC		
	QA	B. Sankar Reddy	

 Ranipet	<b>PRQA</b> FOR Assembly and functional test <b>shaft with Bearing assembly</b> of non tubular /non tubular type.  <b>Product: FAN</b>	Doc Ref:	<b>PRQA:329</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>02 of 04</b>

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### 3.3 ASSEMBLY PROCEDURE

#### 3.3.1 IMPELLER SIDE OF SHAFT

3.3.1.1. Ensure the Pushing of the distance ring (13) on the shaft & . Heating of the Spacer (20) to about 80 to 90 degree C in oil and assemble on the shaft (Ref fig -1).

3.3.1.2. Ensure the Heating of angular contact ball bearing (3) in the oil to about 80 to 90 Degree C and mounting of the same on the shaft.

3.3.1.3. Ensure Heating of the distance ring (14) and the inner race of the Cylindrical roller bearing (2) in oil about 80 to 90 Degree C and mounting on the shaft. As shown in sketch.

3.3.1.1. Verify the Assembly of the angular ring , (4) , lock washer (7) and Tightening of the lock nut (5) Folding of the lock nut only when It reaches room temperature.

#### 3.3.2 COUPLING SIDE OF SHAFT

3.3.2.1. On the coupling side first mount the distance ring (13)


3.3.2.2. Ensure Heating of the inner race with the rollers of the cylindrical roller bearing (1) to about 80 to 90 Degree Celsius and mounting it on to the shaft.

3.3.2.3. Ensure Assembly of the lock washer (8) and the screw the lock nut (6) and tighten the same. (Refer cl 3.3.23) Fold the lock washer after cooling down to room temperature.

3.3.3. Verify Mounting of the outer race of cylindrical roller bearing(1\_in the housing by means of mounting fixtures till makes complete contact with circlip (15). Cooling of bearing below the ambient temperature will facilitate easy assembly.

3.3.5. Ensure the Mounting of the spacer (21) in the housing.

3.3.8. Ensure Placing of the distance ring (16) and put the grub screw to lock it with the housing. Mount the outer race with the rollers of the Bearing (2). In the housing Cooling of bearing below ambient temperature will facilitate easy mounting.

 Ranipet	<b>PRQA</b> <b>FOR</b> Assembly and functional test <b>shaft with Bearing assembly</b> of non tubular /non tubular type.  <b>Product: FAN</b>	Doc Ref:	<b>PRQA:329</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>03 of 04</b>

- 3.3.11 verify the Assembly of the angular ring (4) ,lock washer , (7) Locknut, (5) and assemble the labyrinth end cover (10) and tighten the screws.
- 3.3.12 Check the axial float by means of fixing a dial gauge On the shaft as given below.  
Mount the dial gauge on magnetic stand as shown in Fig 3. Lift the shaft vertically upwards. Note the maximum dial deflection. Lower the shaft and note the minimum dial deflection. The difference between the above renders the axial gap between the bearing roller and angular ring. While doing this, slowly rotate the shaft. Repeat this test a few times to ensure consistency of dial readings.
- 3.3.15 Check the radial clearance of bearings (1) & (2) by means of feeler gauge and record it.
- 3.3.16 Mount a dial gauge on the shaft and find out the face out Of outer race of bearings (1) and (2) as shown in fig 2. The dial reading from top and bottom and right to left should not vary more than 0.04 mm.
- 3.3.17 Reassemble the angular ring , lock washer and lock Nut. Tighten locknut by using tool for tightening locknut and using 2 LB hammer for tightening. Tighten the labyrinth end covers ( 9& 10 ) to housing with suitable gasket to prevent the oil leakage.
- 3.3.18 This assembly should be done in clean room to avoid Any dust , dirt & foreign material.
- 4.0 **FINAL INSPECTION**
- 4.1 Fill with servoprime17/turbine oil 17 to the level.
- 4.2 Ensure free rotation of shaft
- 4.3 Ensure painting & preservation. Ref.PR:QA:590 for the Same
- 4.4 Shaft with bearing assy shall be suitably packed to avoid transit damage.



Ranipet

# PRQA

FOR

Assembly and functional test  
shaft with Bearing assembly  
of non tubular /non tubular type.

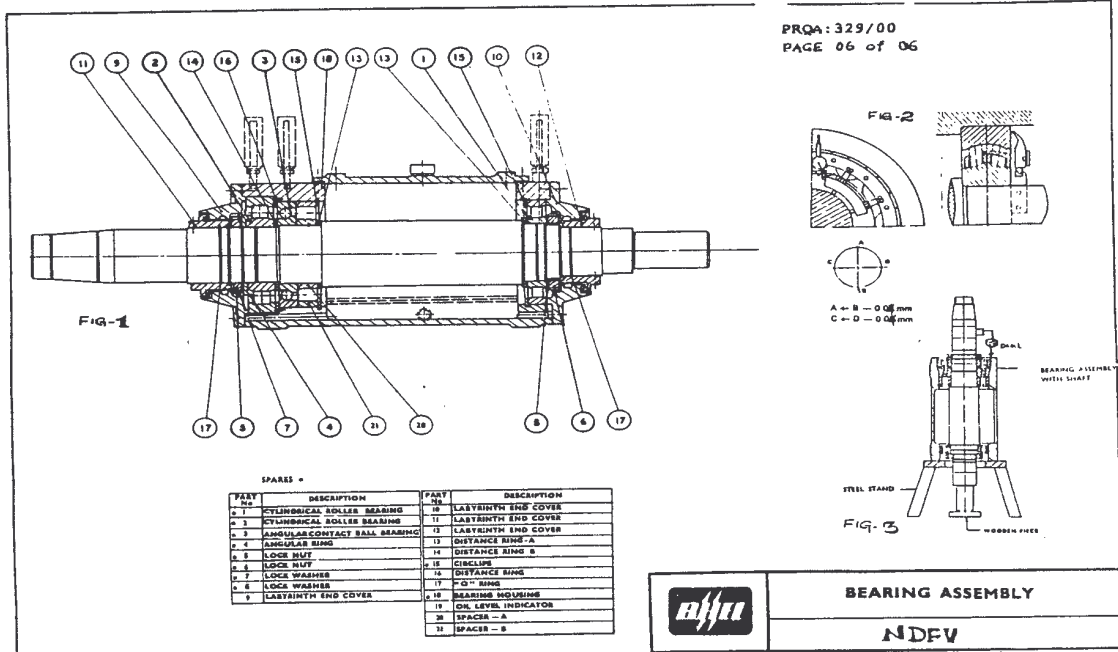
Product: FAN

Doc Ref: PRQA:329

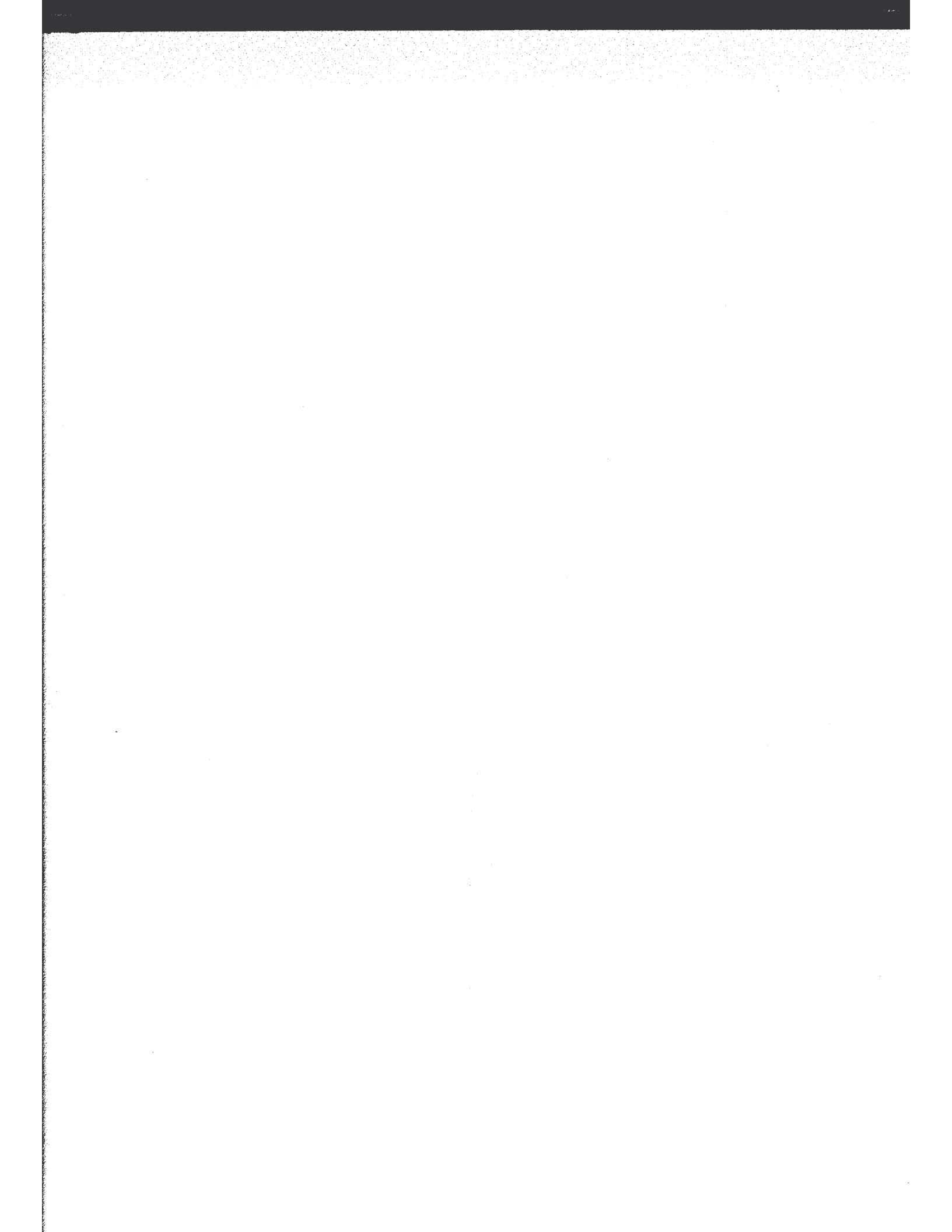
Rev.No. 01


Date: 03 02 03

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Rev NO	Clause revised	Revision made	Date
Rev 00	--	ORIGINAL ISSUE	02 02 96
01	-	Totally Modified	03 02 03



 <b>Ranipet</b>	<b>PRQA</b> <b>FOR</b> <i>ENSURING SPECIFIED INTERFERENCE FIT IN CASE OF  DEVIATION IN SHAFT TUBE BORE</i> <b>Product :FAN</b>	Doc Ref:	<b>PRQA:333</b>
		Rev.No.	<b>01</b>
		Date:	<b>03 02 03</b>
		Page No	<b>01 of 01</b>

1.0 Scope

1.1 This procedure details out the machining of shaft pins, in case of deviation in shaft tube bore, to ensure the specified interference fit.

2.0 REFERENCE DOCUMENTS

2.1 Respective drawings.

3.0 PROCEDURE

3.1 Measure the bore of the shaft tube.

3.2 The ovality and the taper shall be within the tolerances as given in table 1.

3.3 Check the surface finish and ensure the same as per drawing.

3.3 The maximum deviation of the shaft tube bore shall not exceed  $\pm 1.5$  mm from the nominal bore size specified in drawing.

3.4 Production will furnish the tube bore details to OP & C.



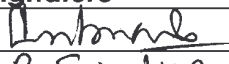
3.4 OP & C will release OPS with details of pin diameter to be machined to achieve the require interference.

3.6 Machine the pin to the dimensions as indicated in the OPS.

3.7 Ensure the correctness of fit between shaft tube & pin before pin insertion.

Note: This procedure is applicable for all Fan shaft tube and pin irrespective of indication of this PRQA No. in the drawing.

Bore Dia in mm	Ovality/Taper in mm
80 - 120	0.035
120 - 180	0.04
180 - 250	0.046
250 - 315	0.052
315 - 400	0.057
400 - 500	0.063
500 - 630	0.07
630 - 800	0.08
800 - 1000	0.09

<b>Prepared by</b> 	<b>Reviewed by</b>	<b>signature</b>	<b>Approved by</b>  <b>(Head/QA)</b>
	QC		
	QA	<i>B. Srinivasan</i>	
<b>Issued by</b> QUALITY ASSURANCE			

Rev No	Clause revised	Revision made	Date
Rev	--	<b>ORIGINAL ISSUE</b>	05 12 00
01	--	Totally modified	03 02 03

	<b>Procedure for Preservation &amp; Packing of Fan shafts / Rotor Assembly</b>	Doc. No	<b>PRQA:341</b>
		Rev	<b>03</b>
		Date	<b>16 07 04</b>
		Page NO	<b>01 of 01</b>

## 1.0 Scope

1.1 This procedure details out the preservation and packing methodology for Fan shafts and Rotor assemblies.

## 2.0 Procedure

2.1 Before starting of preservation, clean the machined surfaces thoroughly with a cloth dipped in **TOLUOL**. Then clean the surface with white spirit. Presence of corrosion spots are not allowed.

2.2 Cleaned surface shall be dried in air for 20 to 30 minutes and only after that shafts should be preserved.

2.3 Cleaned surfaces shall not be touched by hands.

2.4 Apply one coat of TRP 1706 (specification number AA 55155 and Material code AA 5510055308 of Corporate R & D ) followed by two coats of TRP 1710 ( specification No. AA 55154 and matl code AA 5510054000 of Corporate R & D).

2.5 Drying time shall be min 12 Hrs for each coat .After complete drying up of coating, machined surfaces shall be wrapped with **bitumen** paper which shall be suitably fixed with adhesive tapes at the ends.

2.6 Then journal shall be wrapped with rubber sheet of 2 to 3 mm thickness followed by wrapping with aluminum foil of 0.05 mm to 0.1 mm thickness. These shall be finally tightened with adhesive tape.

2.7 Journals shall be covered with wooden boxes.

2.8 Shafts shall be stored in covered area at BAP shipping or at site.

2.9 Preservation shall be examined once in a month.

### **Source for supply of rust preventives**

Shri K Nandy, **Ph:0755-2506594, e-mail:knandy@bhelbpl.co.in**

DGM (Coils and Insulation Sales-CIS)


Annexe Block No.6,

First Floor,

Central Wing ,

BHEL,Bhopal

<i>Revision Number/Date</i>	<i>Changes made</i>
00/17 07 96	Original issue
01/03 02 03	Totally modified
02/03 05 04	Revised based on site feedback
03/ 16 07 04	Drying Time included.

Prepared By	Reviewed By	Approved BY
	B. Sumitranaidu	H. Anand
<b>Issued by</b> Quality Assurance		

**BHARAT HEAVY ELECTRICALS LIMITED**  
Tiruchirappalli - 620 014



**BHEL Standard Painting Scheme**

**Applicable for Fossil Boiler Orders of 125 / 210/ 250 / 500 MW  
including Industrial Boilers (FB) & Associated valve Components**

**Working under Normal Environment**

**PAINTING SCHEME DOCUMENT: SIP: PP: 22 -A**

Rev	Date	Prepared	Reviewed	Approved
05	June 10, 2008	<p align="center"><i>[Signature]</i> Deputy Manager/ Plant Lab</p> <p align="center"><i>[Signature]</i> Deputy Manager/ PE (FB)</p>	<p align="center"><i>[Signature]</i> DGM/Plant Lab</p> <p align="center"><i>[Signature]</i> SDGM/PE (FB)</p> <p align="center"><i>[Signature]</i> SDGM/QA</p> <p align="center"><i>[Signature]</i> AGM/QC</p>	<p align="center"><i>[Signature]</i> GM / WRI &amp; LABS.</p>

**RECORD OF REVISIONS**

<b>Rev. No.</b>	<b>Date</b>	<b>Details of revision</b>	<b>Remarks</b>
00	15.07.96	PR: QE: 104/05 was revised totally and renamed as SIP: PP: 22. Content of PR: QE: 185 /00 is also merged with this document.	
01	16.07.98	The document has been revised to incorporate service condition oriented painting selection scheme for components PGMA wise. SIP: VS: 09 and SIP: VS: 18 are merged with this document.	
02	02.08.99	Editorial changes in several clauses based on feedback. Annexure - VI & VIII of Revn 01 removed. Annexure VII added. Clauses renumbered. Sub clauses added in CL. 5.0 based on feedback. Annexure- III painting schemes changed.	
03	23.04.03	Completely modified	
04	07.05.07	Completely modified; A Standard Painting Scheme for normal environment for indigenous orders developed, covering a fairly comprehensive PGMA list of all capacity FB Units.	
05	10.06.08	Painting scheme for Valves added & editorial corrections made in Cl. 2.1 & Notes. Piping Centre PGMA's deleted. Painting schemes modified in SI.No. 2.4 & 3.5.	Feed back from QA and task performers. & Galvanization of floor grills based on ED's approval note BHE: QC: 2008 Dt. 03.01.2008

## **1.0 SCOPE**

- 1.1 This procedure covers the requirements of Surface preparation and application of primer, intermediate and finish paints for manufactured and subcontracted components of FB and Valves based on normal environmental service conditions.
- 1.2 As these standard painting schemes have evolved well over the years, and the performance of these paint systems have been satisfactory in many sites, these schemes will be offered to the customers during the tender stage. The use of standard painting scheme has several advantages including the avoidance of certain time consuming surface preparations and also the use of the proven techno-economic options for painting of the products.
- 1.3 In case of special contract requirements, wherein the customer is specific about having a painting scheme different from the above, then these special contractual requirements will be addressed through a Contract Specific Document, which will be initiated by the concerned Engineering/ Commercial/ Marketing group and further details filled in by Plant Laboratory. The linkage will be provided in the CQP issued by QA.

## **2.0 GENERAL**

- 2.1 This procedure specifies the painting requirements to a) provide adequate surface protection of components under good storage conditions at Site b) temporary protection for components coming inside the boiler in flue gas path till they are erected inside the boiler and c) protection for a reasonable time till completion of erection for components continuously exposed to atmospheric environment.
- 2.2 The scheme is based on the site practice of need-based touch-up / re-preservation program based on the duration of storage and the condition.
- 2.3 For bought-out items, the painting scheme shall be as specified in Engineering Drawing / Specification. Wherever it is not specified, the vendor's standard practice has to be followed. Manufactured items for bought-out items shall be as per the painting scheme of the applicable PGMA in this document..
- 2.4 All currently active PGMAs are covered. Requirements for Missing / new PGMA s can be obtained from Engineering & Plant Lab.

## **3.0 PAINTING SCHEME**

- 3.1 The surface preparation, primer coat, intermediate coat and finish coat requirements for various painting schemes are given as part of this document.
- 3.2 Good Painting Practices, which will be of assistance to task performers, has been prepared as a reference material and it is available as SIP: PP: 22 Annexure-I: Good Painting Practices.
- 3.3 The Paints envisaged as per this document are indicated in this document under the caption 'Painting Scheme-Details for procurement & application purposes'.

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu$ m (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
1.1	1AC	Drum (Except Internals) <b>04</b> – 114, 116, 118, 124, 126, 128, 210, 212, 214, 270	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30 $\mu$ m per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ m per coat	International Orange Shade No: 592 of IS 5	70
1.2	1AC	Drum Suspension <b>04</b> -142, 144, 146, 148	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30 $\mu$ m per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ m per coat	International Orange Shade No: 592 of IS 5	70
1.3	5	Drum Internals <b>04</b> – 134, 136, 138  Other Machined Components: <b>43</b> – 101, 102, 103, 104, 105, 106, 107	SSPC-SP1 or SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04	1 DFT=20 $\mu$ m per coat	--	--	--	--	--	20
1.4	1AE	Drum Transport Structures <b>04</b> - 194, 196, <b>35</b> - 391, 810	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu$ m per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu$ m per coat	Yellow Shade No: 356 of IS 5	70
2.1	11	Foundation Materials and Pin: <b>35</b> - 010, 011, 012, 013, 020, 030, 190 <b>38</b> – 010 <b>39</b> - 010, 011, 012, 020, 030, 040 48 – 019 & Columns below “ 0 ” level of PG 35,36, 38 & 39	--	No Paint	--	--	--	No Paint	--	--	--

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
2.2	1A	<p>Buck Stays and Structural Items:</p> <p>Buck stays  <b>08</b> – 001, 003, 006, 007, 101, 104, 107, 111, 380, 382, 400, 500, 501, 503, 700, 900, 901, 904, 907, 910</p> <p>Boiler Supporting Structures</p> <p><b>35</b> – 100, 110, 111, 112, 120, 121, 122, 130, 131, 132, 133, 134, 135, 136, 140, 141, 142, 143, 144, 150, 151, 152, 153, 160, 161, 162, 171, 172, 173, 174, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 210, 211, 212, 213, 214, 220, 221, 222, 230, 231, 232, 240, 250, 310, 311, 312, 320, 321, 322, 330, 331, 332, 340, 341, 342, 350, 351, 352, 360, 361, 362, 380, 381, 382, 383, 390, 392, 410, 420, 430, 440, 441, 442, 443, 451, 452, 453, 461, 462, 463, 471, 472, 473, 481, 482, 483, 500, 510, 511, 512, 513, 514, 520, 521, 522, 523, 524, 530, 531, 532, 533, 540, 541, 542, 550, 551, 552, 561, 562, 563, 571, 572, 573, 581, 582, 583, 591, 592, 593, 594, 595, 596, 597, 598, 599, 610, 612, 613, 710, 711, 712, 713, 715</p> <p><b>36</b> – 110, 120, 130, 150, 200, 210, 211, 212, 220, 221, 222, 230, 231, 232, 240, 241, 242, 250, 251, 252, 260, 261, 262, 270, 271, 272, 280, 281, 282, 290, 291, 292, 300, 301, 302, 310, 311, 312, 313, 314, 315, 316, 320, 321, 322, 323, 324, 325, 326, 327, 330, 331, 332, 333, 334, 335, 340, 341, 342, 343, 344, 345, 346, 347, 348, 350, 351, 352, 353, 354, 355, 360, 361, 362, 363, 370, 371, 372, 380, 381, 382, 383, 390, 391, 392, 393, 394, 395, 396, 397, 410, 420, 430, 490, 491, 492, 510, 520, 610, 612, 620, 621, 630, 631, 632</p> <p><b>38</b> – 110, 120, 130, 210, 211, 299, 310, 311, 380, 381, 390, 410, 510, 511, 512, 513, 521, 522, 610, 611, 612, 620, 710, 712, 720, 730</p> <p><b>39</b> - 100, 101, 102, 110, 120, 121, 130, 140, 141, 142, 143, 150, 160, 200, 210, 300, 301, 303, 304, 305, 306, 311, 312, 323, 390, 391, 392, 393, 901</p> <p>Duct Supports  <b>48</b> – 005, 015, 025, 045, 055, 065, 085, 105, 115, 125, 145, 155, 185, 195, 200, 205, 215, 225, 235, 245, 255, 265, 275, 295, 305, 315, 325, 335, 345, 355, 365, 375, 385, 415, 425, 435, 445, 455, 465, 475, 485, 495, 665, 805, 815, 825, 845, 855, 865, 875, 885, 995</p> <p>Piping Centre: 80-800 to 882, 920 to 933, 940</p>	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu\text{m}$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu\text{m}$ per coat	Smoke Grey Shade No: 692 of IS 5	70

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
2.3	1A	Hangers: <b>36</b> - 740, 741, 742, 743, 744	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu\text{m}$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu\text{m}$ per coat	Smoke Grey Shade No: 692 of IS 5	70
2.4	6	Floor grills, Guard plate** <b>35</b> – 811 <b>36</b> - 010, 810, 811, 812, 813, 814, 815, 816, 840 <b>38</b> - 810, 811 <b>39</b> – 810, 811, 840, 841	Floor Grills : Hot dip Galvanizing to a coating weight of 610 gm per sq.m (minimum) and to a coating thickness of 85.0 microns (minimum).  ** Guard plates will be painted as given in Sl. No. 2.2.								
2.5	1AB	Hand Rails & Posts <b>35</b> - 850, 851 <b>36</b> - 850, 851, 852, 853 <b>38</b> - 850, 851 <b>39</b> - 850, 851	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu\text{m}$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu\text{m}$ per coat	Black	70
2.6	1AB	Ladders & Stairs <b>35</b> – 820, 821, 822, 823 <b>36</b> – 820, 821, 822, 823 <b>38</b> – 820, 821 <b>39</b> – 820, 830, 831 <b>48</b> - 466	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu\text{m}$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20 $\mu\text{m}$ per coat	Black	70

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3.1	10	Components >95° C <u>Un-insulated</u> other than components coming in Gas Path <b>09</b> - 001, 002, 003 <b>21</b> - 800, 850, 875, 997 <b>24</b> - 120, 160, 173, 180, 185, 190, 195, 220, 260, 273, 280, 285, 290, 320, 345, 360, 373, 380, 385, 390, 395, 420, 460, 480, 485, 490, 495, 520, 560, 573, 580, 585, 590, 660, 680, 685, 690, 820, 860, 880, 885 <b>28</b> - 220 <b>42</b> - 300, 318, 328, 348, 358 <b>48</b> - 380	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =15 microns)	--	--	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =15 $\mu\text{m}$ per coat)	Aluminium	30
3.2	3	Components >95° C <u>Insulated</u> <b>05</b> - 137, 139, 147, 153, 154, 155, 158, 159, 175, 188, 195, 220, 227, 229, 231, 236, 241, 246, 251, 265, 281, 283, 296, 330, 340, 341, 350, 493, 879, 900 <b>07</b> - 101, 102, 104, 106, 107, 108, 109, 200, 201, 202, 203, 204, 211, 212, 214, 215, 216, 217, 218, 221, 222, 223, 225, 226, 229, 231, 232 <b>10</b> - 100, 120, 122, 135, 136, 140, 141, 151, 170, 174, 178, 179, 180, 191, 195, 218, 220, 222, 235, 236, 240, 241, 251, 270, 274, 278, 279, 280, 283, 284, 291, 295, 315, 687 <b>15</b> - 136, 138, 147, 174, 177, 192, 193, 236, 238, 274, 279, 292, 293, 999 <b>17</b> - 138, 177, 776, 807, 900, 903 <b>18</b> - 001, 002, 003, 010, 020 <b>19</b> - 701, 702, 753, 903 <b>21</b> - 600 <b>24</b> - 100, 115, 175, 200, 215, 275, 295, 300, 315, 375, 475, 500, 568, 600, 620, 675, <b>42</b> - 020, 021, 025, 030, 031, 032, 033, 036, 037, 038, 128, 150, 153, 158, 159, <b>48</b> - 035, 135, 202, 204, 207, 208, 212, 214, 217, 221, 222, 224, 227, 228, 229, 232, 234, 242, 244, 252, 254, 261, 262, 264, 267, 272, 274, 276, 282, 284, 292, 294, 302, 304, 307, 308, 309, 311, 312, 314, 318, 319, 322, 324, 332, 334, 342, 352, 362, 364, 372, 374, 381, 382, 384, 386, 388, 389, 392, 412, 414, 422, 424, 426, 432, 434, 438, 439, 442, 444, 452, 454, 462, 464, 467, 468, 469, 472, 474, 482, 484, 486, 487, 488, 489, 491, 492, 494, 496, 497, 498, 499, 602, 612, 622, 632, 646, 652, 654, 656, 662, 664, 666, 667, 668, 669, 676, 686, 696	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30 $\mu\text{m}$ per coat	-	--	--	--	Red Oxide	60

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3.3	2	Heat Exchanger Coils: (SH, RH & Economiser Coils) <b>11</b> - 036, 037, 038, 074, 077, 078, 095, 135, 136, 138, 170, 174, 175, 178, 179, 235, 236, 237, 238, 248, 250, 251, 271, 272, 274, 275, 277, 278, 279, 280, 336, 337, 338, 340, 342, 356, 358, 370, 374, 377, 378, 395, 585, 587, 591, 606, 608, 616, 618, 682, 683, 684, 685, 686, 687, 688, 691, 694, 716, 717, 718, 767, 768, 769, 787, 791, 882, 883, 884, 885, 887, 916, 917, 918, 967, 968, 969, 986, 987, 988, 991, 994, 999 <b>12</b> - 135, 136, 170, 174, 178, 184, 187, 335, 395, 495, 515, 535, 551, 619, 800, 803, 805, 850, 851, 852, 900, 901, 903, 906, 914, 917, 924, 927, 928, 944, 948, 954, 968, 988, 999 <b>16</b> - 077, 079, 132, 235, 236, 237, 238, 256, 275, 277, 279, 281, 377, 379 <b>19</b> - 001, 104, 105, 114, 124, 184, 802, 814, 824, 884, 914, 924, 984	SSPC – SP2 or SSPC – SP3 Hand tool / Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	1 DFT= 35 $\mu\text{m}$ per coat	--	--	--	--	--	35
3.4	3	Components coming in Gas Path other than Coils <b>06</b> - 033, 036, 037, 041, 043, 046, 047, 052, 054, 089, 090, 091, 092, 093, 094, 130, 133, 136, 137, 141, 143, 146, 147, 152, 154, 189, 190, 191, 192, 193, 194, 231, 331, 350, 400, 430, 466, 467, 500, 530, 609, 611, 613, 614, 616, 620, 621, 623, 624, 630, 631, 633, 634, 636, 637, 639, 640, 641, 643, 644, 646, 647, 649, 650, 651, 652, 653, 654, 655, 657, 658, 659, 670, 689, 690, 691, 692, 693, 694, 695, 709, 713, 714, 715, 716, 720, 723, 730, 731, 733, 734, 737, 740, 741, 743, 744, 747, 749, 750, 751, 753, 755, 789, 790, 830, 840, 850, 851, 857, 895, 896, 897 <b>10</b> - 182, 183, 184, 185 <b>16</b> - 988, 999 <b>19</b> - 703, 704, 708, 763, 783, 850, 851, 900, 988, 999 <b>30</b> - 010, 104, 105, 211, 212, 216, 217, 218, 219, 220, 223, 227, 228, 233, 235, 993, <b>31</b> - 101, 102, 103, 104, 105, 108, 301, 993 <b>32</b> - 001, 002, 005, 006, 007, 008, 009, 010, 011, 012, 021, 022, 023, 024, 025, 026, 027, 031, 033, 041, 042, 043, 044, 050, 055, 061, 073, 110, 120, 210, 310, 410, 510, 520, 610, 620, 710, 720, 810, 910, 993 <b>42</b> - 129	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30 $\mu\text{m}$ per coat	- -	--	--	--	Red Oxide	60
3.5	8A	Uninsulated Fuel Pipes <b>47</b> - 229, 265, 266, 267, 268, 269 Duct for Tube Mill: <b>48</b> - 802, 804, 812, 814, 817, 822, 824, 832, 834, 842, 844, 852, 854, 857, 862, 864, 867, 872, 874, 882, 884,	SSPC-SP3/ Power Tool Cleaning	General purpose Aluminium paint to IS 2339	2	--	--	--	--	Alumunum	40

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
4	15	Constant Load and Variable Load Hangers (CLH / VLH) <b>(See NOTE 14)</b> <b>07</b> - 400, 401, 402, 403, 404, 405, 410, 420, 431 <b>10</b> - 200 <b>17</b> - 904, 906, 919, 929 <b>19</b> - 901, 904, 905, 906, 907 <b>24</b> - 346, 351	Abrasive blast cleaning to Sa 2 1/2 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1 DFT=40 $\mu\text{m}$ / coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min) t	1 DFT=30 $\mu\text{m}$ per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1A	Miscellaneous and Casing Sheets: <b>07</b> -500, 501, 600, 601, 997, 999, <b>19</b> - 101, 102, <b>21</b> - 601, 987, <b>24</b> - 101, 125, 130, 135, 140, 201, 225, 230, 235, 240, 301, 325, 335, 340, 350, 370, 374, 400, 401, 425, 430, 435, 440, 470, 471, 473, 501, 525, 535, 540, 570, 601, 625, 635, 640, 800, 801, 815, 825, 987, 989, 996, 998 <b>35</b> - 994, 995, <b>36</b> - 613, 903, 999, <b>37</b> - 010, 110, 210, 310, 410, 510, 610, <b>39</b> - 302, 924 Fuel Firing: <b>41</b> - 100, 110, 200, 310, 320, 330, 340, 350, 390, 410, 420, 430, 450, 460, 470, 997 Steam Blowing Piping: <b>42</b> - 002, 003, 005, 010 <b>42</b> - 040, 045, 050, 055, 060, 065, 070, 111, 112, 113, 114, 118, 119, 120, 121, 122, 123, 124, 130, 131, 132, 151, 152, 154, 155, 156, 157, 160, 165, 170, 176, 180, 195, 196, 989, 997, 998 <b>43</b> - 000, 001, 002, 003, 004, 005, 006, 007, 008, 997, 999 <b>45</b> - 050, 120, 160, 161, 180, 181, 220, 221, 260, 261, 321, 325, 326, 401 <b>47</b> - 121, 122, 123, 124, 125, 129, 140, 141, 142, 143, 144, 145, 146, 149, 161, 162, 163, 164, 165, 169, 180, 181, 182, 183, 184, 185, 189, 200, 201, 202, 203, 204, 205, 209, 221, 222, 223, 224, 225, 241, 242, 243, 244, 245, 246, 247, 248, 249, 261, 262, 263, 264, 647, 648, 649, 650, 746, 953, 959, 963 Duct Plates and Expansion Joints: <b>48</b> - 002, 004, 007, 011, 012, 014, 017, 018, 022, 024, 028, 032, 034, 040, 042, 044, 052, 054, 062, 064, 066, 072, 074, 082, 084, 092, 094, 102, 104, 107, 112, 114, 116, 122, 124, 132, 142, 144, 152, 154, 162, 172, 182, 184, 192, 194 Coal Handling: <b>65</b> - 051, 060, 070, 260, 402, 403, 460, 724, 736, 738, 786 <b>67</b> - 204, 251, 256, 261, 266, 271, 272, 276, 277, 283, 286, 400, 801, 802, 803, 804, 999 <b>99</b> - 201, 299	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu\text{m}$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20	Smoke Grey Shade No: 692 of IS 5	70
5.2	3	Erection Materials and Commissioning Components: <b>04</b> - 988, <b>05</b> -993, <b>06</b> -993, <b>07</b> - 988, 993, <b>12</b> -993, <b>24</b> - 993, <b>28</b> - 993, <b>35</b> - 993, <b>36</b> - 993, <b>37</b> - 993, <b>38</b> - 993, <b>39</b> - 993, <b>48</b> - 988, 993, <b>65</b> - 988, <b>97</b> -585, <b>99</b> - 045, 099, 501, 502	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30 $\mu\text{m}$ / coat	--	--	--	--	Red Oxide	60

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT $\mu\text{m}$ (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
6.1	10	Cast carbon steel valves (Conventional) Cast alloy steel valves (Conventional) All API valves, QCNRV, SV & SRV Silencers, Water Level gauge HP / LP system 22-101,889	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.I	2	--	--	--	--	--	40
6.2	--	Forged valves	Phosphating	coating weight of 1500 mg per sq.ft.	--	--	--	--	--	--	--
6.3	1AS	Soot Blower components 20-001,003,004,021,051,054,201,204,301,304,331,511,794,801,821,831,962,972	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30 $\mu\text{m}$ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20	Verdigris Green Shade No. 280 of IS5	70
6.4	36	On Shore OFE Components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50 $\mu\text{m}$ per coat	2	--	--	Chlorinated Rubber Based Finish Paint DFT= 30 $\mu\text{m}$ per coat	2	French Blue Shade No: 166 of IS 5	160
6.5	35	Off Shore Components	SSPC-SP3/ Power Tool Cleaning	High Build Epoxy Mastic Aluminium Primer-	1 DFT= 100 $\mu\text{m}$ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT=30 $\mu\text{m}$ per coat	French Blue Shade No: 166 of IS 5	130
6.6	8A	Hand Wheels	SSPC-SP3/ Power Tool Cleaning	General Purpose Aluminium Paint to IS 2339	2 DFT= 100 $\mu\text{m}$ per coat	--	--	--	--	--	40

PS for Arrows shall be as per valves and the final shade will be 'Post Office Red- Shade No. 538 of IS 5

## NOTES:

1. This painting scheme covers a comprehensive list of PGMA's being used in 125 / 210 / 250 / 500 MW and Industrial Boilers under Fossil Boilers working in normal environment, in an effort to standardise the painting scheme. Therefore, the entire list of PGMA's will not be applicable for any specific project and only those PGMA's applicable for the project may be used, while choosing the painting scheme applicable.
2. Rust Preventive coating should be given on HSFG Bolt and Nut threads.
3. All threaded & machined surfaces and retainers are to be applied with a coating of Temporary Rust Preventive oil.
4. All surfaces of foundation materials, insulation pins, Anchor channels, Sleeves shall be coated with Temporary Rust Preventive Fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
5. PGMA's under Sub-Vendor items are not indicated. Please refer respective Engineering Document for all sub-vendor items. Wherever it is not specified, it shall be as per the painting scheme of the applicable PGMA.
6. No painting is required for Aluminium, Stainless Steel components and galvanized items. Abrasive blast cleaning to SSPC-SP6 ( Sa 2) grade shall be done to prepare the surface of hot worked pipes prior to application of primer.
7. Wherever **inside surfaces** of components under PGMA 48 – XXX, need protection till erection, and all running meter items for spares and main item two coats of Red-oxide zinc phosphate primer paint to IS12744 to a DFT of 60 microns shall be applied, after power tool cleaning. For items meant for Spares and subcontracting where no further processing is involved, the painting scheme selected shall be the same as that of similar product configuration/ description.
8. The Temporary Rust Preventive coating that has already been applied on any component, tubes, pipes etc., shall be visually inspected for good adherence. If the coating is intact, direct coating of alkyd based red oxide paints over the coating is permitted. In case, the coating has peeled off over a large area, then the coating is to be removed by suitable solvents / heating to 350 –400 °C for an hour before primer paint application –but, in this case, it should be ensured that the minimum surface cleanliness required for primer paint application shall be SSPC – SP2 (equivalent – Hand Tool cleaning).
9. All currently active PGMA's are covered. Requirements for Missing / new PGMA s will be included under the relevant section, following the appropriate paint logic.
10. Ground shade/colour finish paints & identification tag/ band for equipments, piping, pipe service, boiler supporting structures and other boiler components shall be followed as per tender.
11. In components, wherever plates/sheets of thickness less than or equal to 5 mm, tubes/ rods/drain pipe are used, power tool /hand tool cleaning to SSPC-SP3/ SSPC-SP-2 shall be followed and the painting shall be done as described in SI no: 5.1.
12. Touch-up painting of damaged areas shall be carried out as per clause applicable painting scheme.
13. Only weldable primer shall be applied on surfaces, which require to be welded subsequently at site. At those locations no other paint shall be applied.
14. DUs coming under Constant Load Hangers (CLH) shall be painted as per the system - **PS 15** indicated in SI. No. 4 of the table. However, for DUs coming under Variable Load Hangers (VLH), the painting shall be as per Painting Scheme PS 1A indicated in SI. No. 5.1 of the table. (i.e., one coat of Red Oxide Zinc Phosphate Primer followed by two coats of Synthetic Enamel Paint –shade smoke grey, total DFT – 70 microns)
15. For internal protection of Pipes, tubes,headers and other pressure parts, Volatile Corrosion Inhibitor (VCI) pellets shall be put ( after sponge testing/ draining/ or drying ) and subsequently end capped. The dosage of VCI pellets shall be approximately 100 gm/ Cu..m. For tubes typically 4 – 5 tablets per end are to be put. For C & I items the dosage of self indicating Silica Gel ( colourless) shall be 250 gm/ cu.m. ( About 2 to 3 bags weighing approximately 100 grams each) . **VCI pellets shall not be used for stainless steel components and its composite associates.**
16. All threaded components of spring assemblies and turnbuckles shall be galvanized and achromatized to 15 microns minimum thickness.

**Painting Scheme – Details for procurement & application purposes**


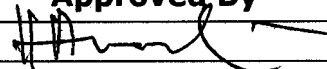
Sl. No.	Material Code of Paint	Generic nature of paint	Theoretical Covering Capacity Sq. m per Litre	No. of pack	Volume solids, % (min) **	DFT in microns (min) per coat	Shade	Shade No. to IS5	Mode of appln .	Over coating interval, Hrs.
1	120016131800	Heat Resistant Aluminium paint to IS 13183 Grade I	10	1	-	-	Aluminium	--	Brush / Spray	24
2	120011111900	Red oxide Zinc Phosphate primer paint to IS 12744	10	1	--	--	Red Oxide	--	Brush / Spray	12
3	120011121900	Red oxide Zinc Phosphate Dip coat primer paint to PR: CHEM: 09-03	10	1	--	--	Red Oxide	---	Dip	12
4	120011311200	Long oil alkyd synthetic enamel finish paint to IS2932	10	1	--	--	Reqd. shade	Corrpdg. Shade no.	Brush / Spray	12
5	120011140000	Temporary Rust preventive fluid to PR: CHE: 09 – 04	10	1	--	--	Amber	--	Brush / Spray	12
6	120012141700	Epoxy Zinc rich primer to IS14589 Gr. II	8	2	35	40	Grey	--	Spray	24
7	120013310200	Aliphatic acrylic polyurethane paint to IS13213	10	2	40	30	Phirozi – Blue./French Blue	176/166	Spray	24
8	120017101800	De Oxy Aluminate Weldable Primer- Colour Aluminium	10	1	--	--	Aluminium	--	Brush / Spray	24
9	120014111700	HB CR Based Zinc Phosphate Primer	10	1	40	50	Grey	--	Brush / Spray	12
10	120014300100	CR Based Finish Paint	10	1	30	30	French Blue	166	Brush / Spray	12
11	12001213800	High Build Epoxy Mastic Aluminium Primer-	8	2	80	100	Aluminium	---	Spray	24

The covering capacity of paints specified is only approximate.

The paints and Rust Preventive fluid shall be procured from BHEL's approved suppliers. \*\* Values are indicative.

<b>QUALITY DEPARTMENT</b>	
<b>Amendment to Quality Work Instructions (HT Schedule)</b>	
QWI NO: BAP:HT:001 REV:05	DT. 11 07 96
Amendment no: A 3	DT. 27 01 07
Description : Heat Treatment schedule	

Details of Amendment		
Note Sl.no.	Amended As	Basis For Amendment
<b>3.1.2(c) and 3.2.1 (B)&amp;(D)</b>  <b>3.2.1(C)</b> <b>Table-1 ( C.1-I,J)</b>  <b>4.3.1( b)</b>	<ul style="list-style-type: none"> <li>• Rate of heating : Maximum 5600 divided by the maximum metal thickness in millimeters, subject to the minimum of 55 °C /hr and maximum of 220 °C /hr</li> <li>• Rate of cooling maximum 260°C /hr divided by maximum metal thickness in inches subject to minimum 55°C /hr and maximum of 260°C /hr</li> <li>• Soaking Temperature: : 600 °C - 650 °C</li> <li>• IS 2062,ASTM A36 -Soaking temperature 600 °C - 650 °C</li> </ul> <p style="text-align: center;">Soaking temperature: For bearing housing(A216)-600 °C-650°C &amp;Hub disc requirements are deleted.</p>	Revised based on the revision of AWS.D1.1

<b>Prepared by</b>	<b>Reviewed By</b>	<b>Approved By</b>
	B. Srinivas Rao 27/1/07	

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No	
Issued to Shri	

QUALITY DEPARTMENT

Amendment to Quality Work Instructions (HT Schedule)

QWI NO: BAP:HT:001 REV:05

DT. 11 07 96



Amendment no: A 2

DT. 11 03 2005

Description : Heat Treatment schedule

Details of Amendment

Note Sl.no.	Amended As	Basis For Amendment
4.1.5	<p>Following is added:</p> <p>Lug plates for APH module assembly made of Corten / Naxtra 70 material shall be stress relieved as per following cycle.</p> <ul style="list-style-type: none"><li>• Soaking temperature - 530 to 580 degree centigrade</li><li>• Soaking time - 30 minutes minimum</li><li>• Rate of heating and rate of cooling - shall be as per clause 3.2.1</li></ul>	

Prepared by	Reviewed By	Approved By
	B. Srinivasan	

Controlled Copy No	
Issued to Shri	



BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET-632 406  
QUALITY ASSURANCE

BAP:HT:001  
Page 01 of 12

HEATTREATMENT SCHEDULE

EFFECTIVE DATE :: 11 07 96

PREPARED BY : DY.MGR/QA

*B. Srinivas Rao*

REVIEWED : MANAGER/WTC

*[Signature]*

AND : DGM /QA

*[Signature]*

APPROVED BY : DGM/OP&C

*[Signature]*

REVISION NO ::

05

ISSUED BY ::

QUALITY ASSURANCE

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ISSUED TO SHR1	

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- 1.0 GENERAL NOTES
- 1.1 This Schedule is prepared with the guide lines of KKK Work Standards, ASME SEC.VIII, AWS D1.1 and Material Standards for FAN components and of AWS D1.1 for AIRPREHEATER components, ELECTROSTATIC PRECIPITATOR components, STRUCTURES, WIND ELECTRIC GENERATOR components and DEFENCE JOBS.
- 1.2 Whenever the specified hot working temperature range is exceeded, the components shall be normalised/normalised and tempered/hardened and tempered at the appropriate cycles as that of the receipt condition of the material.
- 1.3 Whenever not specified, the soaking time shall be as follows:
- |                                      |       |                            |
|--------------------------------------|-------|----------------------------|
| Hot working, normalising & Annealing | ....  | 1 mt/mm<br>(15 mts.min)    |
| Tempering and Stress relieving       | ..... | 2.4 mts/mm<br>(30 mts.min) |
- 1.4 The following rules shall apply to establish the thickness to be used in determining the soaking time for stress relieving.
- 1.4.1 For butt welds the thickness shall be the least of the following :
- a) Thickness of material
  - b) Thinner of sections being joined
  - c) Thickness of weld
- 1.4.2 For fillet welds, the thickness shall be the throat thickness.

- 1.4.3 For partial penetration branch welds, the thickness shall be the depth of the groove prior to welding.
- 1.4.4 For repairs, the thickness shall be the depth of the groove as prepared for repair welding.
- 1.4.5 For combination of different welds in a component, the maximum thickness shall govern.
- 1.4.6 In case of groove welds, thickness shall be depth of groove.
- 1.4.7 If fillet weld is used in conjunction with groove weld, weld thickness shall be depth of groove or throat of fillet whichever is greater.
- 1.4.8 For determining the soaking time for hot forming, the thickness shall be thickness of material for pipes, plates and dished ends. For bar stock, the same shall be diameter.
- 1.5 All materials to be heat treated shall be placed in the furnace in such a manner that they shall not be subjected to flame impingement. They shall be preferably loaded on raised platforms so that no material is in the plane of the burners.
- 1.6 Autographic recorders shall be provided to record the temperature.
- 1.7 Soaking time shall be reckoned from the time the temperature of the load crosses the minimum of the recommended cycle to the time it leaves the minimum of the recommended cycle.
- 1.8 Tolerance band should lie within the temperature range indicated for any heat treatment.
- 1.9 The recorders shall be calibrated periodically.
- 1.10 The heat treatment charts shall be serially numbered and identified with components. These shall be filed in serial numberwise for easy retrieval and reference.

- 1.11 When it is impractical to stress relieve at the cycles indicated, the operation may be carried out at a lower temperature as given below:

Decrease in Temperature below minimum specified temperature Deg.C	Minimum holding time at decreased temperature Mts./mm	Remarks
28	5	--
56	10	--
84	25	)Only )for )carbon steels (P1 Gr 1 & 2)
112	50	

- 1.12 For inter-BHEL unit products and customer supplied products, heat treatment procedures issued by the respective agencies shall be followed.
- 1.13 In case of power failure during heat treatment, PR:QA:502/latest shall be referred.
- 1.14 In case of mixed loads the rate of heating and rate of cooling shall be the least of the rates of heating or cooling of various components .  
e.g. If a heat treatment consists of ROH/ROC of impeller as 100 °C/hr Maximum, rotor post as 55°C/hr maximum and guide bearing housing as 120°C/hr maximum, ROH&ROC to be followed is 55°C/hr maximum.(That of rotor post)
- 1.15 If components of different soaking temperature and soaking times are to be combined in a single heat treatment, cl. 1.11 along with appropriate clauses of this schedule shall be referred .In case of doubt consult QA .

2.0 FURNACE DETAILS

DETAILS	F1 BAY	A3 BAY
Work Centre No.	1522	1543
Location No.	0108	0065
Capacity (MT)	10	30
Make	Vulcan	Vulcan
Furnace Size (mm)		
L	4050	7800
B	3800	5300
H	2075	2900
Max. charge Temp. Deg.C	800	800

3.0 STRESS RELIEF CYCLES

3.1 FAN ROTATING PARTS

3.1.1 Temperature of furnace at the time of loading of jobs shall not exceed 315°C and at the time of discharging temperature shall not be more than 200°C.

3.1.2

- a) Rate of heating in the furnace above 315°C and rate of cooling in the furnace upto 200°C shall not be more than 100°C/hour for WStE355 materials and its combination with other materials.
- b) Rate of heating in the furnace above 315°C shall not be more than 100°C /hour and rate of cooling in the furnace up to 200°C shall be minimum 200°C/hour incase of NAXTRA70 or equivalent materials.
- c) Rate of heating above 315°C and rate of cooling up to 200°C for materials other than above shall be as follows.

RATE OF HEATING: Maximum 200°C/hr divided by thickness of thickest part in inch subject to minimum of 55°C/hr and maximum of 200°C/hr.

RATE OF COOLING: Maximum 260°C/hr divided by thickness of thickest part in inch subject to minimum of 55°C/hr and maximum of 260°C/hr.

- 3.1.3 Soaking time shall be 2.4 minutes per mm upto 50 mm. Above 50mm Soaking time is 120 minutes plus 15 minutes for each additional 25 mm over 50 mm.
- 3.2 FAN STATIC PARTS AND COMPONENTS OTHER THAN FANS
- 3.2.1 A) Temperature of furnace at the time of loading :: 315°C Max
- B) Rate of heating above 315°C :: Maximum 200°C/hr/thickness of thickest part in inch. Subject to Minimum 55°C/hr. and maximum 200°C/hour
- C) Soaking Temperature :: 595 - 650°C
- D) Rate of cooling upto 315°C :: Maximum 260°C/hr/thickness of thickest part in inches. Subject to Minimum 55°C/hour and maximum 260°C./hour
- E) Cooling below 315°C :: In still air
- 3.2.2 Soaking time shall be 2.4 minutes per mm upto 50mm. Above 50mm, soaking time is 120 minutes plus 15 minutes for each additional 25mm over 50mm.
- 3.2.3 Thickness for soaking time shall be computed as per clause 1.4 unless otherwise specified.
- 3.2.4 \*In case of mixed loads, soaking time selected for the cycle shall not exceed the limits given below .

SL.NO.	Weld / Matl.thickness in mm	Max. soaking time in minutes
1	Up to 25	125
2	26 to 50	200
3	51 to 80	250
4	81 to 150	375

\* NOT APPLICABLE FOR FAN ROTATING PARTS

**HEAT TREATMENT SCHEDULE**

- 4.0 FAN COMPONENTS  
4.1 Rotating Parts
- 4.1.1 Heat treatment cycle for rotating parts such as shafts, impellers shall be as per clause 3.1. Soaking temperature shall be as per Table 1. Thickness for soaking time shall be computed as per clause 1.4.
- 4.1.1.1 Minimum soaking time for shaft +flange [hub+flange weldment] shall be 120 minutes.
- 4.1.2 Total soaking time for materials of DIN17102 such as WStE 355, WStE 460, StE 500 shall not exceed 150 mts. When soaking time exceeds 90 minutes, soaking temperature shall be aimed at 530 °C. However, in no case temperature shall go below 530°C.
- 4.1.3 Soaking time for RQT 701 & DILLIMAX 690E shall not exceed 120 minutes.
- 4.1.4 Soaking temperature shall never exceed the limit specified in table 1.
- 4.1.5 Stress relief temperatures for various components shall be as per Table 1 as shown below:

**TABLE - 1**

S.No	Component	Material	Soaking Temp. °C	Basis
A.0	AP Fans			
A.1	Impeller hub	WStE 355	530-580	Material Standard
A.2	Piston Assembly	SA 105 + WStE 355	530-580	-do-
A.3	Shaft Assembly	StE500 + WStE 355	530-580	-do-
B.0	AN FANS			
B.1	Impeller Assembly	a) WStE 355	530-580	-do-
		b) WStE 460	530-580	-do-
B.2	Shaft Pin + flange	CK 35 + WStE 355	530-580	-do-

S.No	Component	Material	Soaking Temp. °C	Basis
C.0	RADIAL FANS			
C.1	Impeller Assembly	A) WStE 355 B) NAXTRA 70 C) RQT701 D) WELDOX 700E E) DILLIMAX 690E F) WELTEN 780A G) SA517 Gr..F H) SA 592Gr.F I) IS2062 J) ASTM A36	530-580 -do- 550-580 550-580 -do- -do- -do- -do- 595-650 595-650	Material Standard -do- -do- -do- -do- -do- ASME SEC VIII -do- -do- -do-
C.2	Damper Shaft	X20Cr 13 V80 + BMC 16	650 -700	Material standard
C.3	a)Shaft tube assy.	a)ST 37/SA 106Gr.B + WStE 355 b)SA 335 P12/ 13 CrMo44 + SA 387 Gr.12 c)15Mo3+WStE 355	530-580 680-720 530-580	-do- -do- -do-
	b)Shaft tube with buttering layer	13 Cr Mo44/SA 335 P12 + E7018-A1 weld overlay	600-700	Material Standard and ASME Sec.VIII
	c)Shaft tube assy	13 CrMo44/SA 335 P12 with buttering layer + WStE 355	530-580	Material Standard

4.2 STATIC PARTS

4.2.1 Heat treatment cycle for static parts such as Fan housings, OGVs etc. shall be as per clause 3.2.

4.2.2 Clause 4.1.2 shall referred for Soaking time restriction for materials on DIN 17102.

4.2.3 When stress relief is for dimensional stability e.g. stress relief of Fan housings, suction moth with hub, OGV, soaking time shall be computed based on thickness of thickest part.

4.2.4 When stress relief is for relaxation of stresses e.g. stress relief of bearing pedestals, base frame and T-bolts, soaking time shall be computed based on weld thickness as explained under 1.4.

4.3 ARTIFICIAL AGEING

4.3.1 Artificial ageing of bearing housings and hub discs shall be carried out as per the cycles given below:

	Bearing Housing	Hub Discs
a) Material	ASTM A 216	GS17CrMoV511/DIN17245
b) Soaking temperature	595-650°C	660-700°C

Rate of heating, cooling and soaking time shall be as per Clause 3.1. Thickness for computing soaking time shall be maximum thickness of the part.

5.0 AIRPREHEATER COMPONENTS

5.1 (a) Part Name : Support bearing housing cover, Guide brg spool assembly, Guide bearing housing, Support bearing housing, Conventional rotor post, Sector Plate, Cold end and hot end stationary spool assemblies, Rotor post and Centre section for R-type heaters

(b) Stress Relief Cycle: As per clause 3.2

6.0 ELECTROSTATIC PRECIPITATOR COMPONENTS

6.1 Part Name : Shock bar (old type & plate type)

6.2 Stress relief cycle : As per clause 3.2.

7.0 STRUCTURES

7.1 Above 50mm thickness, stress relief shall be done as per clause 3.2.

8.0 WIND ELECTRIC GENERATOR COMPONENTS

8.1 Part Name : Nacelle Structure, Bearing Housing

8.2 Stress relief cycle : As per clause 3.2.

9.0 DEFENCE JOBS

9.1 Part Name : Launcher Post, Pedestal

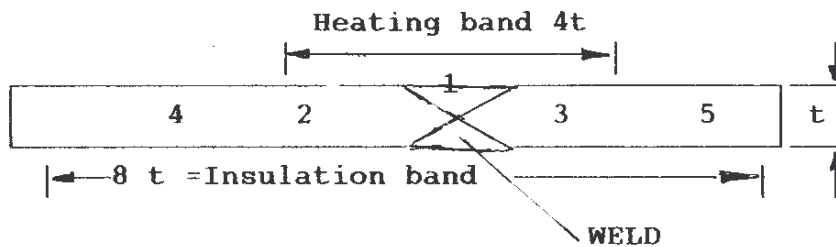
9.2 Stress relief cycle : As per clause 3.2

**10.0 LOCAL STRESS RELIEF**

- 10.1 To conduct local stress ,weldment and adjacent areas shall be throughly cleaned.
- 10.2 Refer fig -1 for thermocouple location.
- 10.3 Heating elements shall be wound around the weld, heat affected zone and the parent metal. Heating band shall extend beyond the weld atleast two times the thickness of thicker plate.(see fig-1)
- 10.4 Sufficient insulation shall be provided to ensure that temperature of weld and heat affected zone is not less than specified temperature.
- 10.5 In addition adjacent portion of material outside the heated zone shall be protected by thermal insulation . Minimum width of such a insulation shall be 8 times the thickness of thicker member on the both sides of weld (see fig .1)
- 10.6 Ref. 3.0. for stress relief cycle.
- 10.7 Heattreatment chart shall be maintained sl no wise. cycle.

**FIG -1**

1,2,3,4,5 are thermocouple location



PR:QA:502

PAGE 01 OF 02

PROCEDURE FOR

RESTARTING OF FURNACE  
DURING THE RUNNING OF  
HEAT TREATMENT CYCLE  
IN CASE OF POWER FAILURE OR  
DISRUPTION OF FUEL SUPPLY

EFFECTIVE DATE

21-04-93

PREPARED BY

B. Srinivas Rao

REVIEWED BY

*[Signature]*

APPROVED BY

ISSUED BY:  
QA

REV. NO. :  
00

CONTROL NO

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**PROCEDURE FOR RESTARTING OF FURNACE DURING THE RUNNING OF HEATTREATMENT CYCLE IN CASE OF POWER FAILURE OR DISRUPTION OF FUEL SUPPLY**

**1.0 Scope**

This procedure specifies the steps to be followed in case of power failure or disruption of fuel supply herein after called power failure.

**2.0 Procedure**

**2.1 Incase of power failure during heating up:**

2.1.1 Follow the original heat treatment cycle from the temperature at which power returns.

**2.2 Incase of Power failure during soaking:**

2.2.1 Repeat original heat treatment cycle for all materials except for WStE355 material. In case of wstE 355 ensure the following

2.2.2 Determine the time of soaking prior to power failure

2.2.3 Subtract this soaking time from total soaking time. This is balance soaking time.

2.2.4 Follow the original heat treatment cycle from the temperature at which power returns except for soaking where the soaking time shall be balance soaking time.

**2.3 In case of Power Failure during cooling down**

2.3.1 Repeat original heat treatment cycle for all materials except WStE355 material. In case of WStE355, no reheat-treatment shall be done.

BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET

QUALITY DEPARTMENT

PR:QA:504  
REV: 00  
Date: 27 05 93  
Page: 01 of 05

Procedure for

Seaworthy packing  
of Components for  
Export Contracts.

Effective Date

27 05 93

	NAME	DATE	SIGNATURE
Prepared by	V. JAYARAMAN	27 05 93	<i>V. Jayaraman</i>
Reviewed by	N. BABU	27 05 93	<i>N. Babu</i>
Approved by	N. MISRA	27 05 93	<i>N. Misra</i>

ISSUED BY

SR MGR/QUALITY ASSURANCE

*V. JAYARAMAN, MANAGER/QA*

CONTROLLED COPY No.:

*1/1*

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PROCEDURE FOR SEAWORTHY  
PACKING FOR  
EXPORT CONTRACTS  
-----

- 1.0 SCOPE: This procedure lays down methods to be adopted for SEAWORTHY PACKING OF COMPONENTS FOR EXPORT CONTRACTS.
- 2.0 WOOD TO BE USED:
- 2.1 FIR, CHIR, CHEMICALLY TREATED MANGO WOOD May be used for packing wood for the Seaworthy packing. The wood specification SPEC:Packwood:01/DT:080593 SHALL BE USED.
- 2.2 Mango wood if used shall be chemically treated.
- 3.0 CONSTRUCTION OF WOODEN BOXES:
- 3.1 Slides: They are used at the bottom of boxes. They are also called as runners.
- 3.2 The quantity of slides/runners are selected depending upon the weight and over all dimension of the load, to be carried. Table 1 and 2 details out the number of slides, length & cross section of slides to be provided with their carrying capacity.
- 3.3 BOTTOM FRAME: The construction of bottom frame is as shown in Fig.2. (Annexure)
- 3.4 TOP FRAME: The construction of top frame is as shown in Fig.3. (Annexure).
- 3.5 Thickness of sheathing for top, sides and end. Thickness of the boards used for sheathing for the top, sides and end panels shall be 25 mm.

- 3.6 The top of box consists of beam supported on top travers bar and sheathing as shown in Fig.3.
- 3.7 The dimension of items 1,2 of Fig.3 shall be as per table 3. (Annexure)
- 3.8 The dimensions of the end and lateral panels shall be calculated according to the over-all dimensions of items to be packed.
- 3.9 Diagonal braces shall be used in packing cases with height exceeding 600 mm as shown in Fig.4.
- 3.10 The angle between the lower or upper horizontal supports and diagonal braces shall be in the range of 30' to 60' and if possible this angle preferably be kept at 45°
- 3.11 If the height of the box exceeds more than 1400 mm, the diagonal braces shall cross each other and when this dimension exceeds 1800 mm additional horizontal support shall be provided as shown in Fig.5 and Fig.6. (Annexure)
- 3.12 Intermediate supports shall be used in such a way that the diagonal braces when fixed are inclined at 45'. The distance between two intermediate supports shall not be more than 1.7 and less than 0.6 of the height of the box.
- 3.13 Size of upper and lower horizontal supports and vertical supports shall be as per table 4. Refer Figures 7,8,9 & 10 for the arrangements.
- 3.14 For compact fitting the diagonal braces be cut according to the shape of the place.
- 3.15 Selection of bottom boards and traverse bars.

- 3.16 The bottom of the box consists of slides fixed with traverse bars and bottom boards.
- 3.17 In case of central loading (when the load is not fixed on slides) carrier traverse bars shall be used to fix the load.
- 3.18 The cross section of end traverse bar (item 1) and thickness of bottom boards (item 2) shall be as per table 5. (Annexure)
- 3.19 25mm thickness of bottom board is allowed to be used for concentrated load upto 1000 kgs when the load is fixed on cross bar or slides.
- 3.20 All boxes measuring more than 600mm height shall be constructed by assembling end, side and top shooks on a bottom forming a complete enclosed box Refer Fig.11. (Annexure)
- 3.21 All smaller boxes shall be constructed by assembling sides on ends and then the bottom planks are fixed connecting the sides. Then the slides or runners are provided over the bottom clamps by nailing.
- 3.22 Angle iron cleats shall be used for strengthening the joints as indicated in Fig.12. (Annexure)
- 4.0 Weather Proof lining:
- 4.1 Alkathene film of sufficient thickness shall be used wherever weather<sup>p</sup> proof packing is <sup>o</sup> needed.
- 5.0 Cushioning Material:  
Felt shall be used for cushioning and padding wherever cushioning is required.

6.0 Moisture Absorbent:

6.1 Silicagel in 1/2kg cloth bags shall be used for Moisturè absorption inside the packing.

7.0 Steel crating:

The boxes shall be crated with 'C' clamps as per Fig.13. (Annexure)

8.0 Nails:

8.1 Nails used shall be made up of wires as per IS:280/1962 with a strength UTS of 550 MPa.

8.2 The Nails shall be procured as per IS:6732 & IS:6733.

9.0 Sling Plates:

These shall be provided as per the packing case drawings.

10.0 Arrangement of small boxes:

For arrangement of small boxes refer Fig.15. (Annexure)

11.0 Despatch Details:

11.1 Despatch details such as consignor/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one of the sides of the boxes.

11.2 One copy of the packing slip shall be neatly folded inside a polythene bag and nailed near the arrow marking.

11.3 One copy of the packing slip shall be kept inside the box at a prominent place. Refer Fig.17. (Annexure)

MI. & SPEC. FOR  
EXPORT PACKING

DESPATCH DETAILS




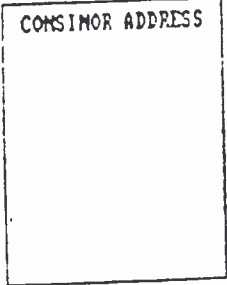
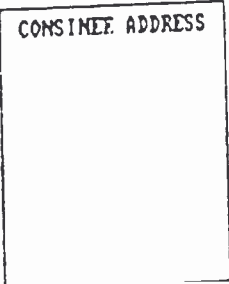
INDICATION MARKS		PACKING SLIP	UP
			
CONSIGNEE ADDRESS	CONSIGNEE ADDRESS	CONTRACT NUMBER	
		CASE NUMBER	
		NET WEIGHT IN KGS.	
		GROSS WEIGHT IN KGS.	
		DIMENSION LXBXH IN CMS	
COUNTRY OF ORIGIN			
PORT OF DESPATCH			
PORT OF DISCHARGE			

Fig.17

# TOP FRAME ARRANGEMENT

ANNEXURE TO PR:QA:504/Rev.00

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Dt: 27-05-93

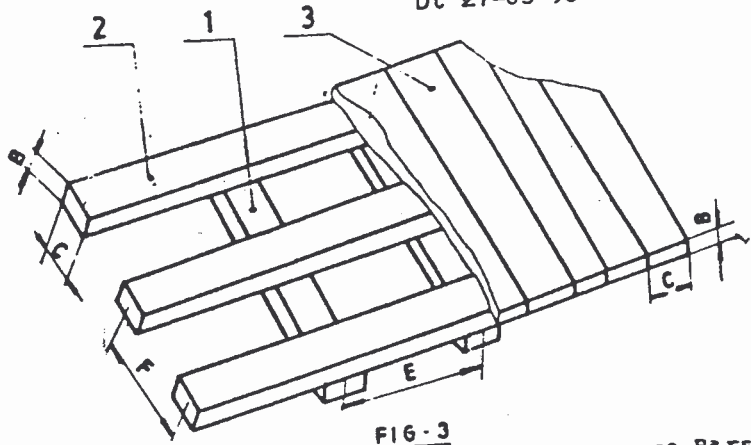


FIG-3

- 1 - Transverse Bars
- 2 - Horizontal Scans
- 3 - Top Board

# PROVISION OF DIAGONAL BRACING ARRANGEMENT

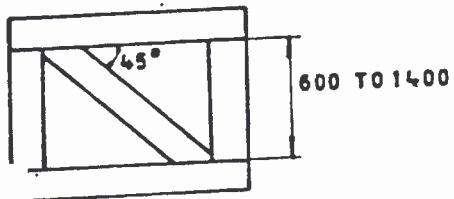


FIG-4

# ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

Annexure to PR:QA : 504/Rev 00/

Dt 27-05-93 .

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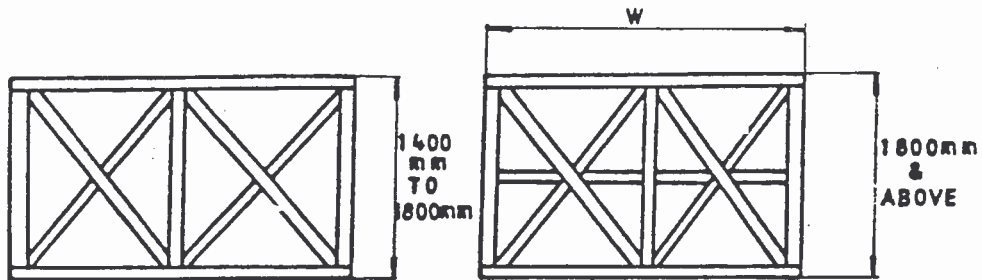


FIG : 5

FIG : 6

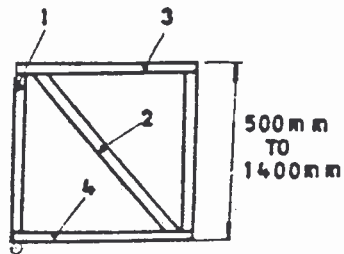


FIG:7

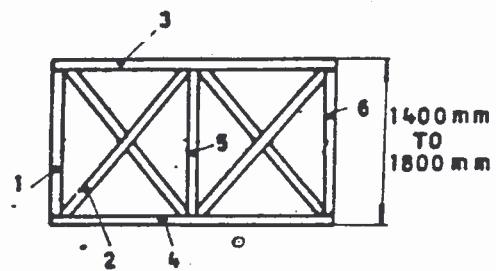


FIG:8

- 1- Vertical Support
- 2- Diagonal Bracing
- 3- Upper Horizontal Support
- 4- Lower Horizontal Support

- 1, 5, 6 - Vertical Support
- 2 - Diagonal Bracing
- 3 - Upper Horizontal Support
- 4 - Lower Horizontal Support

ARRANGEMENT OF DIAGONAL BRACING AND  
HORIZONTAL SUPPORT

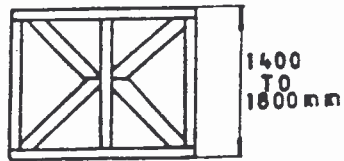


FIG:9

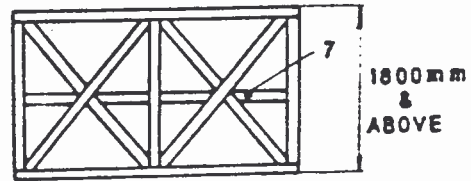
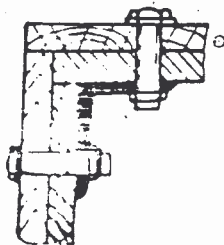
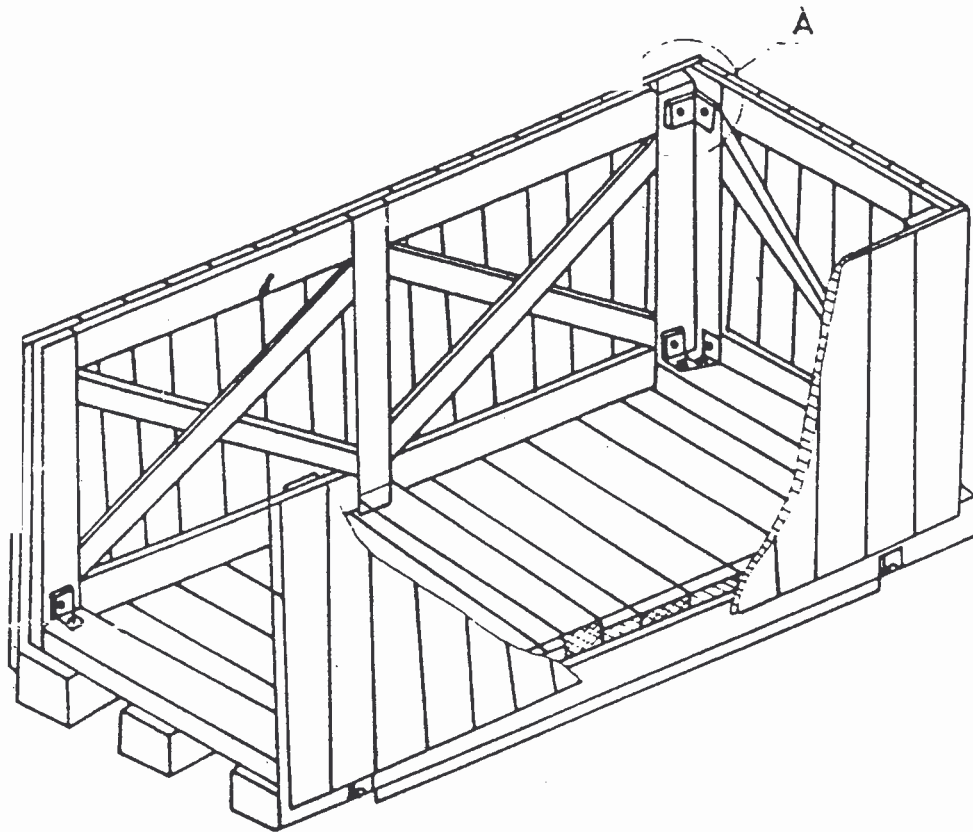


FIG:10

7- Middle Horizontal Support

ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER  
MUST CONFORM  
TO BOLT DIA

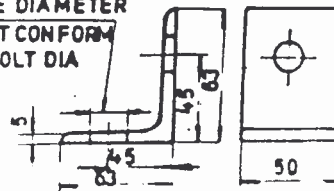


FIG 11

ARRANGEMENT OF ANGLE IRON CLEATS

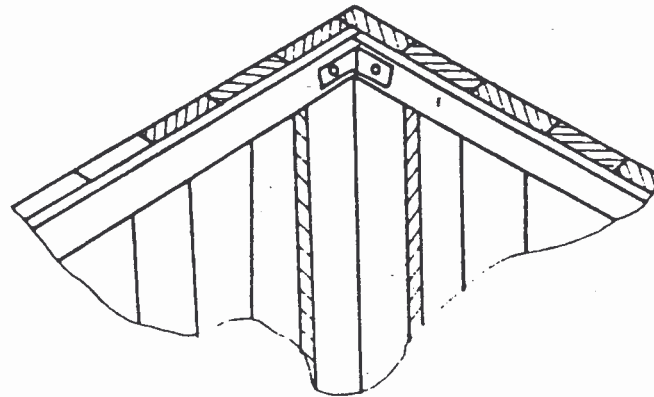


FIG :12

ARRANGEMENT OF C-CLAMPS AROUND CASES

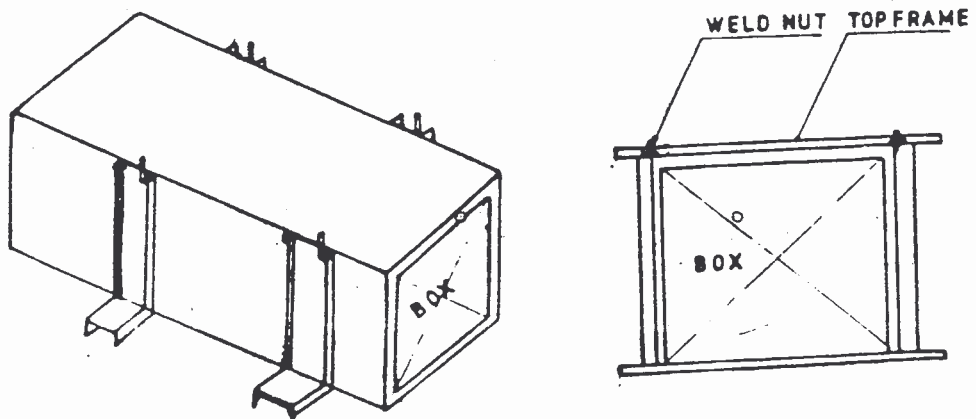
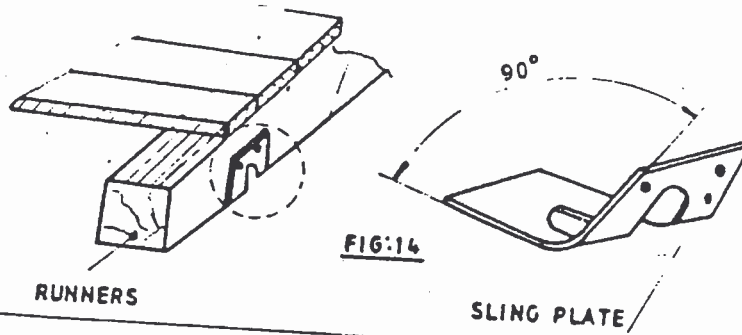


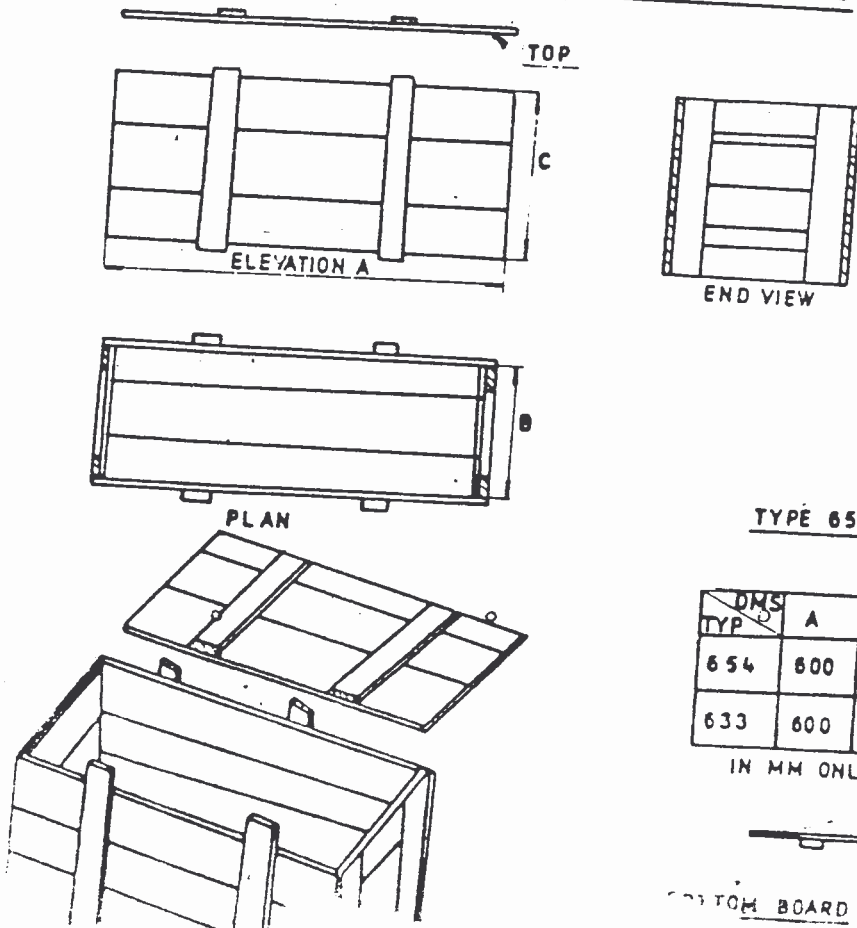
FIG:13:

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ARRANGEMENT OF SLING - PLATE ON  
CASES



ARRANGEMENT OF SMALL CASES



TYPE 654, 633

DIMS TYP	A	B	C
654	600	500	400
633	600	300	300

IN MM ONLY



CUSTOM BOARD

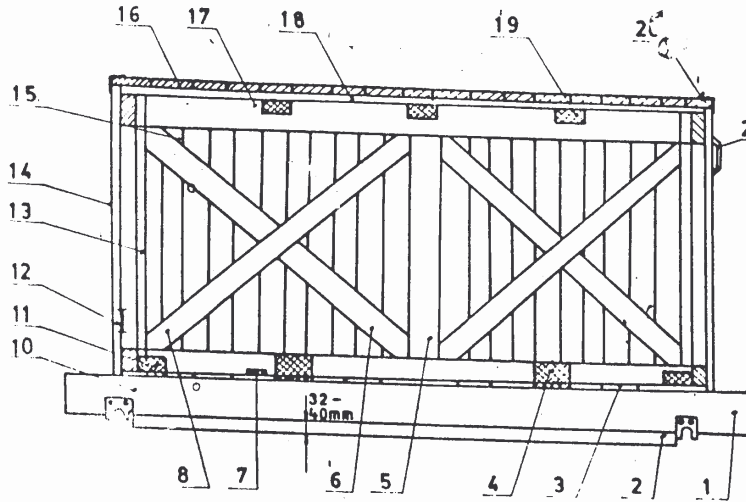


FIG-1

NOMENCLATURE OF PARTS OF PACKING CASES

- 1.SLIDE
- 2.LONGITUDINAL UNDER SLIDE BOARD
- 3.BOTTOM BOARD
- 4.CARRIER TRAVERSE BAR
- 5.INTERMEDIATE VERTICAL SUPPORT
- 6-DIAGONAL BRACING
- 7.DRAINAGE HOLES
- 8.BATTEN
- 9.SLING PLATE
- 10-NUT, BOLT, WASHER
- 11.END TRAVERSE BAR
- 12.WATER PROOF LINING OF BITUMANISED PAPER
- 13.VERTICAL SUPPORTS
- 14.END SHEATING BOARD
- 15.SIDE SHEATING BOARD
- 16.TOP SHEATING BOARD
- 17.LONGITUDINAL SUPPORT
- 18.TOP HORIZONTAL BEAM
- 19 TOP SHEATING BOARD
- 20.TOP CORNER STRIPS (FOR STRENGTHENING)
- 21.OUT SIDE DOCUMENTS CONTAINER.

ANNEXURE TO PR:QA:504/REV 00/  
 Dt 27-05-93  
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BOTTOM FRAME ARRANGEMENTS

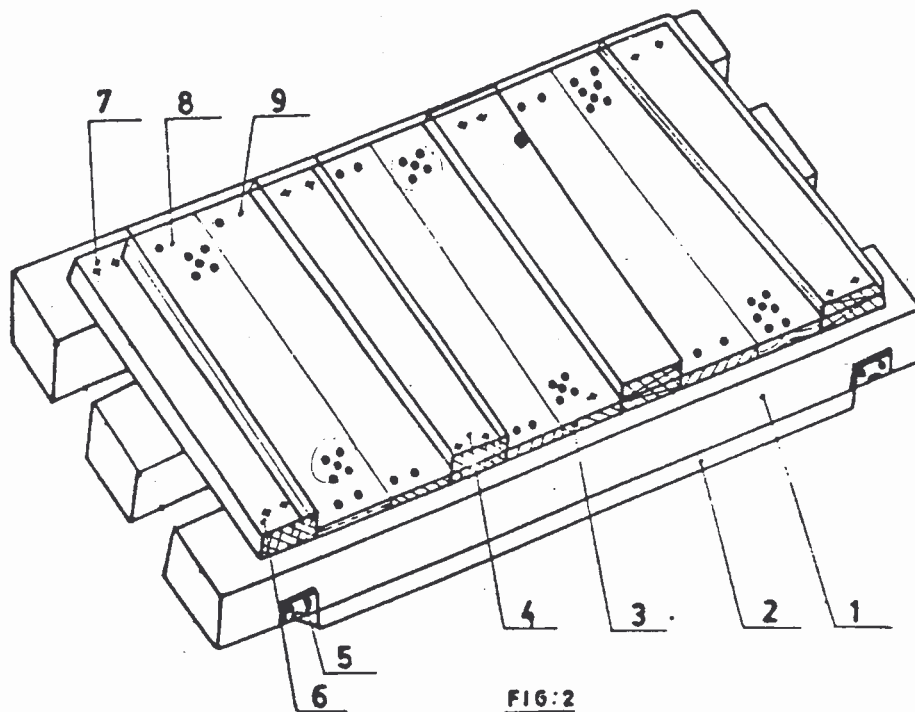


FIG:2

- 1. SLIDE
- 2. UNDER SLIDE BOARD
- 3. BOTTOM BOARD
- 4. CARRIER TRANSVERSE BAR
- 5. SLIDING PLATE
- 6. TRANSVERSE BAR
- 7. BOLT, NUT & WASHER
- 8. DRAINAGE HOLES
- 9. NAILS .



TABLE-5

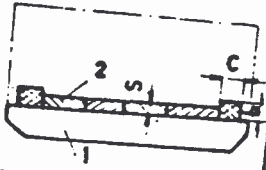
BOTTOM TRAVERSE	CROSS SECTION OF END TRAVERSE BAR ITEM 1 FIG. X AND THICKNESS OF BOTTOM BOARD (ITEM 2)			
	LOAD IN KG	WIDTH OF BOX	CROSS SECTION	S
	UP TO 3000	ABOVE 1000mm	100 X 100	25

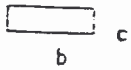
Table 1

No. of Slides	Length of Slides	Weight in kgs.	Type of Loading
2	600 - 1800mm	0 - 1000	Two slides for central loading near the ends or uniformly distributed load
3	1801 - 2500mm	1001 - 5000	Three slides with load concentrated near the end or uniformly distributed load

Table 3

Distance between top horizontal scans in mm	Distance between the axes of the traverse bar dimension E in Fig. 3				
	500	600	700	800	900
	Size b x c				
700 - 1000 MM	30x100	30x100	30x100	30x100	30x100

**Table 2**

Load	Length of Slides						
	600	800	1000	1200	1300	1500	2000
	Cross Section b x c						
							
500	50 x 100	50 x 100	50 x 100	50 x 100	75 x 100	75 x 100	100 x 100
800	50 x 100	50 x 100	75 x 100	75 x 100	75 x 100	75 x 100	100 x 100
1000	75 x 100	75 x 100	75 x 100	100 x 100	100 x 100	100 x 110	100 x 150
1500	75 x 100	75 x 100	100 x 100	100 x 100	100 x 100	100 x 150	100 x 150
2000	75 x 100	100 x 100	100 x 100	100 x 150	100 x 150	100 x 150	150 x 150
2500	75 x 100	100 x 100	100 x 150	100 x 150	100 x 150	150 x 150	150 x 150
3000	100 x 100	100 x 150	150 x 150	150 x 150	150 x 150	150 x 150	



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BHARAT HEAVY ELECTRICALS LIMITED  
BOILER AUXILIARIES PLANT  
QUALITY ASSURANCE & CONTROL DEPT

PR:QA:507  
REV NIL  
DATE : 5.7.93  
PAGE NO:01/03  
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PROCEDURE FOR LOCALISED HEAT TREATMENT  
ON STRUCTURAL WELD JOINTS

-----  
EFFECTIVE DATE: 05.07.93  
-----

NAME & DESIGN. SIGN & DATE

H A KERKETTA  
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-----

CHECKED BY: V JAYARAMAN  
DY MANAGER/QA  
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APPROVED BY: P H TAMBAKHE  
SR MANAGER/QA  
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ISSUE DATE: 2-7-93  
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SR MANAGER/QA  
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PR:QA:507  
REV.NIL  
DATE:5.7.93  
PAGE NO. 02/03

PROCEDURE FOR LOCALISED HEAT TREATMENT ON STRUCTURAL WELD JOINTS

1.0 SCOPE:

1.1 This procedure details the requirements for local heat treatment  
(stress relieving) on structural weld joints.

1.2 This procedure is applicable for components fabricated at BHEL's sub  
contractors works

2.0 PROCEDURE:

2.1 The weldments and adjacent areas shall be thoroughly cleaned and made free from grease, oil chloride and sulphur bearing components

2.2 The heating elements shall be wound around the weld heat affected zone and the parent metal

2.3 The heating band shall extend beyond the weld atleast two times the thickness of the thicker plate.

2.4 Sufficient insulation shall be provided to ensure that the temperature of the weld and the heat affected zone is not less than that specified in the QCP TGH :001 AMEND:02 dated 04:12:92 temperature at the edges of the heated band is not less than half the peak temperature.

2.5 In addition the adjacent portion of the material outside the heated zone shall be protected by means of thermal insulation to avoid sharp temperature gradient. The minimum width of such insulation shall be 8 times the thickness of the thicker member.

2.6 The entire heating operation shall be controlled through electrical controls so that uniform rise in temperature is achieved.

2.7 Above 300 degree centigrade the rate of heating per hour shall not exceed 220 degree centigrade divided by maximum metal thickness in inches.

2.8 During the heating period, the differences of temperature as recorded by the thermo couples shall not be more than 150 degree centigrade within any 4500 mm interval under heating)

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2.9 When the portion heated has attained the stress relieving temperature (620 degree centigrade) the temperature shall be held constant for a period of one hour for every one inch thickness. During this holding period there shall not be any significant variation in temperature throughout the heated portion.

2.10 The rate of cooling per hour the holding temperature shall not be more than 260 degrees centigrade divided by maximum metal thickness in inches. Further cooling below 300 degrees centigrade can be done in still air.

3.0 RECORDS:


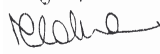
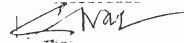

3.1 The following records shall be furnished alongwith the temperature chart.

- a) Time of starting the heating operation
- b) Time of reaching the holding temperature
- c) Time when cooling started
- d) Time when the temperature recorder was cut off.
- e) Calibration and validity of thermocouples and temperature recorder.
- f) Sketch showing the locations of thermocouples and their representation on the chart.

BHEL : BAP : RANIPET  
QUALITY DEPARTMENT

Procedure for Blast cleaning  
of Boiler Auxiliaries components.

PR : QA : 508  
REV NO. 02  
Dt. 31-03-98  
Page 01 of 05

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Reviewed :	DGM/M&S	
	DGM/OP&C	
Approved :	H ANANTHANARAYANAN DGM / QA	

Issued by : DGM / QA

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REV NO	CLAUSE REVISED	REASON FOR REVISION
00	FRESH ISSUE	-----
01	CL 3.0,4.0 MODIFIED.C1 4.3.ADDED TABLE UNDER C1 4.4 REVISED. C1 5.0 MODIFIED. ANNEXURE I PARAMETER CARD REVISED. ANNEXURE II MODIFIED. ANNEXURE III MODIFIED.	INCORPORATED SAND BLASTING IN ALL CLAUSES.
02	CL 4.4 TOTALLY REVISED SPLITTING INTO CL 4.4.1 & 4.4.2	SURFACE CLEANLINESS & SURFACE ROUGHNESS REQUIREMENTS REFINED.

- 1.0 Scope
- 1.1 This procedure details out the nozzle blast cleaning process, its equipment, the controls exercised and qualification and training of the personal using the process.
- 2.0 Qualification and Training of the blast cleaning personal.  
-----
- 2.1 The personnel shall be trained and qualified to do the blast. Cleaning process. To this effect the blast shop/vendor should have a 'Training / Qualification record' for each blast cleaning personal with identify. (sample form enclosed in Annexure III)
- 3.0 Equipment  
-----
- The blast cleaning equipment, viz. the compressed air line, the silo, the valves, the abrasive, jet nozzels shall all be of such material as to give consistently same surface finish for the same set of process parameters viz, nozzle, air pressure, grit/shot/sand particle size distribution and the nozzle distance from the job.
- 4.0 Quality of shots/grits/sand  
-----
- 4.1 Where shot blasting is called for the shots shall be spherical and near spherical and shall meet. Us Screen  
-----  
Size S330 or S390 made of chilled iron shots. With a cleaning rate of 0.72/0.67 sq. ft per minute at 80 psj gauge pressure and 5/16" diameter nozzle.
- 4.2 where crushed iron grits are used at : 80 psj gauge pressure and 5/16" dia nozzle SAE grit G 50 or a combination of  
-----  
10% G50 and 90% misccl small grits. The cleaning rate shall  
-----  
be 1.56/1.38 sq. ft per minute.  
-----
- 4.3 where sand blasting is required to be done the sand shall be river sand with not less than 95% silica sand. The sand should have low chloride content ( not more than 0.03% by weight). The grain size of sand shall he between 1 mm and 0.7 mm with linear sharp edges and sharp corners.

4.4 Testing the area cleaned  
-----

4.4.1 The vendor/blasting shop shall qualify the grit/shot/sand pressure nozzle dia combination by actually doing blast cleaning on a medium rested steel test plate of 1'x1' square. The cleanliness of the surface shall be matching the surface cleanliness standard to be prepared for Sa2, Sa2.5 and Sa3 separately and kept as reference standard. QA shall certify the above surface cleanliness standard.

4.4.2 Where surface roughness measurement is also a requirement of the contract the same shall be checked. The roughness of the surface after blasting shall be compared visually against a standard test coupon. Whose roughness is measured by a surface roughness tester and fixed.

4.4 The vendor shall prepare a 'certificate for Qualification  
-----  
of Blast cleaning process' duly signed by process. (sample form enclosed in Annexure IV)

5.0 Parameter Card:  
-----

The vendor/production bay shall maintain a parameter card as given in Annexure I after each qualification and do the blasting as per the parameter card. The inspector in the bay shall do periodic surveillance to verify and record in a register the satisfactory functioning of the sand/shot/grit blasting process as per the parameter card. The parameter card shall be prepared reviewed and approval by competent personal in the prodn. shop/vendor incorporating all the process variables actually used.

6.0 Maintenance of log book of work  
-----

The blast shop/vendor shall maintain a log book of all  
-----  
operations duly verified and signed by the inspector in the bay/vendor's works and kept as a record of operations carried out.

7.0 Identification of job

-----

The blast shop/vendor shall attach and identity card duly and firmly attached to the job indicating OPS NO., WO N0./PGMA/DU ( in the case of shop) PO No. and who No./OGMA/DU ( in the case of vendor)

Annexure - I

-----

Annexure to PR : QA : 508 : Rev.02/31-03-98

-----

PARAMETER CARD

---

Process : sand/shot/grit blasting  
Nozzle type & size :  
Pressure of air :  
Sand/shot/grit size :  
Certificate reference :  
Equipment Name :

Prepared  
by

Reviewed  
by

Approved  
by

ANNEXURE II  
PR : QA : 508/REV 02/ 31-03-98

BLAST CLEANING GRIT NUMBERS AND SCREENING TO TOLERANCES  
PERCENT OF TOTAL SAMPLE BY WEIGHT FO EACH PERTINENT SCREEN

SEA NO SYSTEM	HIGH LIMIT GRIT RETAINED % MAX	SCREEN SCREEN NO & APERTURE	NOMINAL GRIT RETAINED % MAX	SCREEN SCREEN ON & APERTURE	LOW LIMITS CRIT RETAINED % MAX	SCREEN SCREEN APERTURE
C-10	0	7 (.111)	80	10 (.0787)	10	12(.0661)
C-12	0	8 (.0937)	80	12 (.0661)	10	14(.0555)
C-14	0	10 (.0787)	80	14 (.0555)	10	16(.0469)
C-16	0	12 (.0661)	75	16 (.0469)	15	18(.0394)
C-18	0	14 (.0555)	75	18 (.0394)	15	25(.0280)
C-25	0	16 (.0469)	70	25 (.0280)	20	40 (.0165)
C-40	0	18 (.0394)	70	40 (.0165)	20	50 (.0117)
C-50	0	25 (.0280)	65	50 (.0117)	25	80 (.0070)
C-80	0	40 (.0165)	65	80 (.0070)	25	120(.0049)
C-120	0	50 (.0117)	60	120(.0049)	30	200(.0029)
C-200	0	80 (.0070)	55	200(.0029)	35	325(.0017)
C-325	0	120(.0049)	20	325(.0017)	-	-----

BLAST CLEANING SHOT NUMBERS AND SCREENING TO TOLERANCES  
PERCENT OF TOTAL SAMPLE BY WEIGHT FOR EACH PERTINENT SCREEN

SEA NO SYSTEM	HIGH LIMIT GRIT RETAINED % MAX	SCREEN SCREEN NO & APERTURE	NOMINAL CRIT RETAINED % MAX	SCREEN SCREEN ON & APERTURE	LOW LIMITS CRIT RETAINED % MAX	SCREEN SCREEN APERTURE
S-1320	0	4 (.187)	85	6 (.132)	5	7 (.111)
S-1110	0	5 (.157)	85	7 (.111)	5	8 (.0937)
S-930	0	6 (.132)	85	8 (.0937)	5	10(.0787)
S-780	0	7 (.111)	80	10 (.0787)	10	12(.0661)
S-660	0	10(.0787)	80	12 (.0661)	10	14(.0555)
S-550	0	12 (.0661)	80	14 (.0555)	10	16(.0469)
S-460	0	14 (.0555)	75	16 (.0469)	15	18(.0394)
S-390	0	16 (.0469)	75	18 (.0394)	15	20(.0331)
S-330	0	18 (.0394)	75	20 (.0331)	15	30(.0232)
S-230	0	20 (.0331)	70	30 (.0232)	20	40(.0165)
S-170	0	30 (.0232)	70	40 (.0165)	20	50(.0117)
S-110	0	40 (.0165)	65	50 (.0117)	25	80(.0070)
S-70	0	50 (.0117)	65	80 (.0070)	25	120(.0049)

ANNEXURE -II  
(PR : QA : 508/REV 02/31-03-98)

CERTIFICATE OF QUALIFICATION / EXPERIENCE  
FOR BLAST CLEANING PERSONAL

Name : Blasting }  
 -----  
 Technique }  
 -----  
 Used }  
 -----

Id No. :  
 -----

Experience in sand } Blast cleaning }  
 -----  
 blasting } Equipment used }  
 -----

Experience in grit / } Nozzles used }  
 -----  
 Shot blasting }  
 -----

This is to certify that ..... Id. No.....  
 -----  
 has worked on blast cleaning using .....  
 -----  
 for .....years and can satisfactorily perform  
 -----  
 blast cleaning on the equipment mentioned above. He is  
 -----  
 qualified to do blast cleaning.  
 -----

SIGNATURE & RUBBER STAMP/SEAL  
 -----  
 OF CONTRACTOR / SHOP-IN -CHARGE  
 -----

Annexure - IV

CERTIFICATE FOR QUALIFICATION OF BLAST  
 CLEANING PROCESS  
 (P 1 refer C 1. 4. 4. of PRQA : QA : 508 : REV .02/ 31-03-98)  
 -----

Certificate No.  
-----

Process : Shot/grit/Sand blasting  
-----

Pressure :  
-----

Nozzle size / type :  
-----

Hose size / classification :  
-----

Sand / grit / shot / particle size :  
-----

Test coupon size :  
-----

Time required for cleaning }  
-----

Test coupon }  
-----

Area cleaned per hour }  
-----

surface finish achieved : Sa2 / Sa2 1/2 / Sa3  
-----

(compare against standard  
-----

reference coupon)  
-----

Certified that the sand / shot / grit blasting process is qualified  
-----

for the parameter combination specified above.  
-----

OP & C / MSA / M & S  
-----


QA  
-----



QUALITY ASSURANCE  
PRQA

PR:QA:510  
Rev: 01  
Date: 10.03.2012  
Page 01 of 07

Procedure for	MEASUREMENT OF INTERNAL AND EXTERNAL KEY WAY DIMENSION	
	Department	Signature
Prepared by	P.SEKAR Senior Engineer QC / Metrology	
Reviewed by	R.EKAMBARAM Dy. Manager QC/Metrology	
	R.ARUNACHALAM Manager QA / Mechanical	
Approved by	G.BALASUBRAMANIAN SDGM Head QA	
Revision No:	01	
Issued by	QUALITY ASSURANCE	
Controlled copy No:		
Issued to:		

	<b>QUALITY ASSURANCE PRQA</b>	<b>PR:QA:510</b> <b>Rev: 01</b> Date: 10.03.2012
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RECORD OF REVISION

Rev.No	Date	Details of Revision
00	10.06.2002	Original issue
01	10.03.2012	Fully revised to incorporate all features like key way length, Symmetry / Offset and Parallelism

## 1.0 SCOPE

1.1 This procedure details out the methods of measuring the external and internal keyway dimensions like width, length, depth, shift from the axis (offset) and parallelism

## 2.0 REFERENCE DOCUMENTS

2.1 Drawings and IS 2043 - 1983

## 3.0 INSPECTION

### 3.1 KEY WAY WIDTH

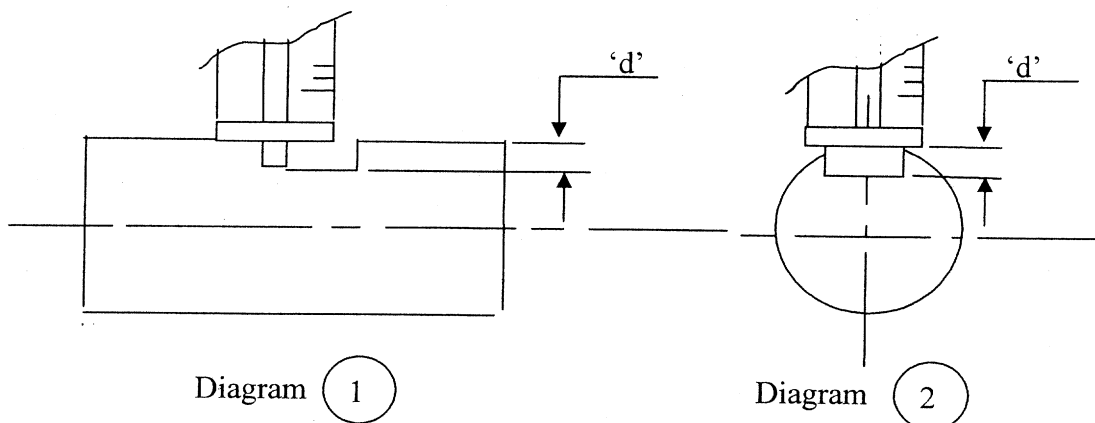
3.1.1 Use slip gauges for checking the width of the key way. Select required sizes of slip gauges and insert into the width and it should answer tightly. The total value of the slip gauges used is the width of the key way.

### 3.2 KEY WAY LENGTH

3.2.1 Use the internal measuring jaws of the Vernier Caliper for taking measurements.

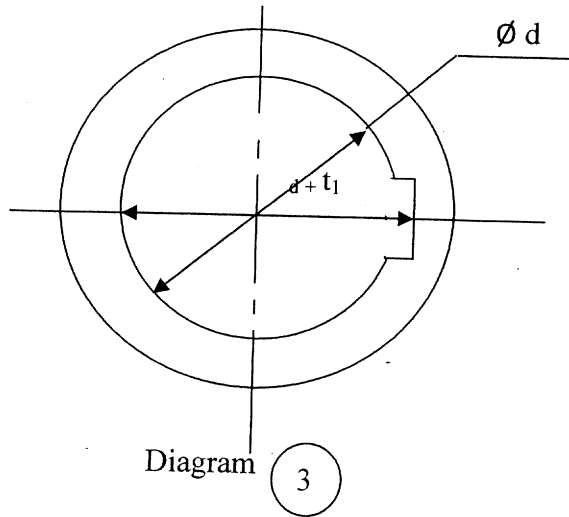
### 3.3 KEY WAY DEPTH

3.3.1 FOR SHAFT: Key way depth for shaft shall be measured by using Vernier Caliper / Depth Micrometer. The measurement shall be taken from the maximum point of the diameter as shown in diagram 1:



Do not measure the depth across the key way as shown in the diagram 2.

3.3.2 FOR BORE: Use Vernier Caliper / Internal Micrometer / Bore Dial gauge to measure the key way depth of the bore as shown in the diagram 3



3.4 SHIFT FROM AXIS / OFFSET:

3.4.1 Shift from the axis / offset is also called symmetry and this plays a vital role during assembly. If the symmetry / offset of the key way are beyond the permissible limit, shaft and bore cannot match.

3.4.2 Closeness between the centre line of key way (A-A) and the axis of the bore / shaft (X-X) is called symmetry.

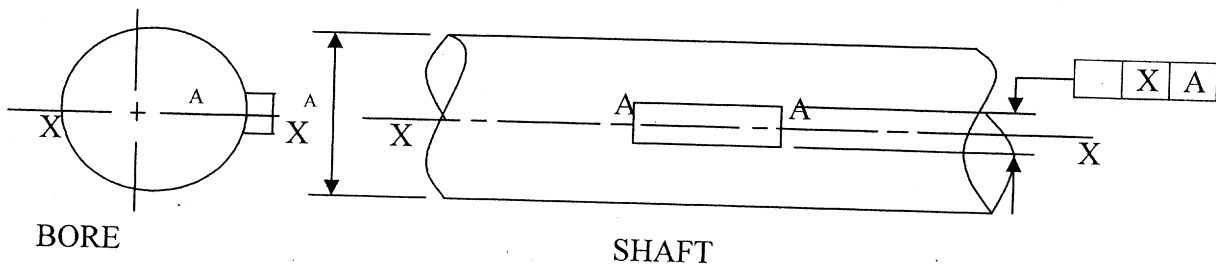
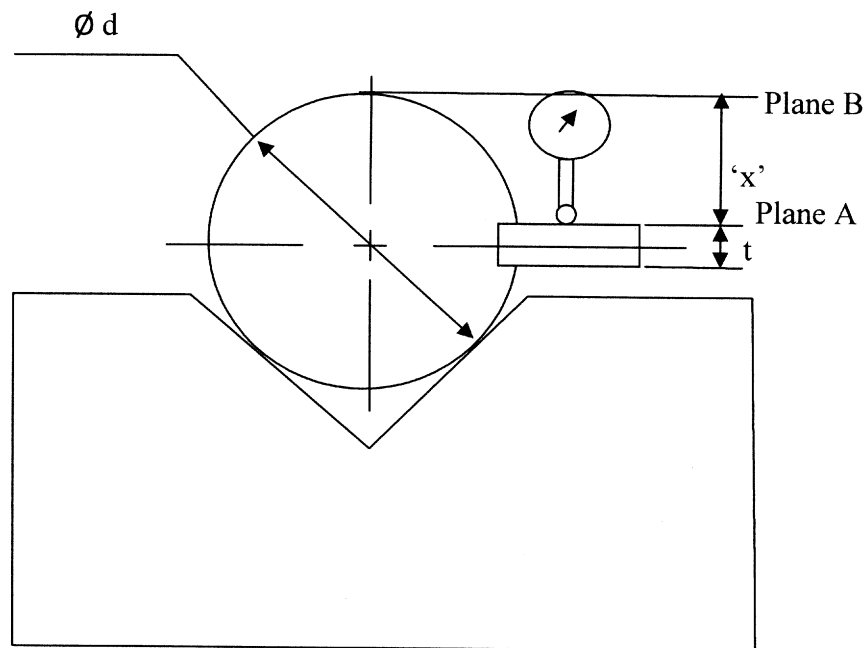


Diagram 4

3.5 SHAFT

3.5.1 Keep / hold the shaft on a V – Block / between centers / machine centers. Insert required gauge blocks into the key way with tight fit. Align the top surface of the projected gauge blocks parallel to the horizontal plane by using Vernier Height Gauge and Dial Indicator as shown in the diagram 5. Note the reading (A) in the Vernier Height Gauge. Take another reading (B) on the maximum point of the shaft diameter. The difference between the two readings (B-A) say 'x' and plus half of the key way width (t/2) will be the centre line of the key way with respect to the diameter (d). The difference between half of the diameter (d/2) of shaft and (x+t/2) will be the deviation of symmetry or offset of the key way with respect to the shaft axis.

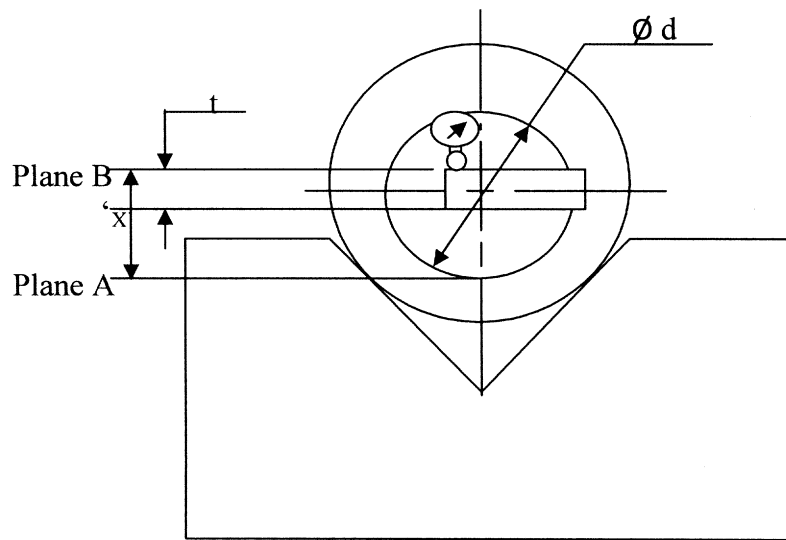


$$\text{Off Set} = [d/2 - (x + t/2)]$$

Diagram 5

### 3.6 BORE

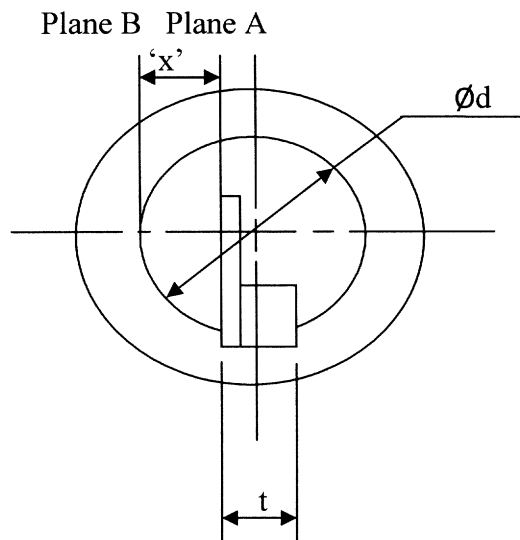
- 3.6.1 For smaller size components, keep the component on a V-Block in a surface table. Insert required gauge blocks into the key way with tight fit. Align the top surface of the projected gauge blocks parallel to the horizontal plane by using Vernier Height Gauge and dial indicator (Pin type) as shown in the diagram 6. Note the reading (B) in the height gauge. Take another reading (A) on the minimum point of the bore. The difference between the readings (B-A) say 'x' and minus half of the key way width (t/2) will be the centre line of the key way with respect to the bore diameter (d). The difference between half of the diameter (d/2) of bore diameter and (x-t/2) will be the deviation of symmetry or offset of the key way with respect to the bore axis.



$$\text{Off set} = [d/2 - (x-t/2)]$$

Diagram **6**

3.6.2 For bigger size bores, insert the gauge blocks in the key way with tight fit. Use lengthy gauge blocks / parallel blocks which shall protrude beyond the axis of the bore. Measure the gap (B-A) say 'x' between the long gauge block / parallel block and the maximum point of the bore by using Vernier Caliper / Bore Dial Gauge / Internal Micrometer (Stick type) as shown in the diagram 7. The difference between half of the diameter (d/2) and (x+t/2) will be the deviation of symmetry or offset of the key way with respect to the bore axis.



$$\text{Off set} = [d/2 - (x+t/2)]$$

Diagram **7**

### 3.7 ERROR OF PARALLELISM

3.7.1 The two opposite side planes of the key way width shall be contained within the permissible limits with respect to the datum surface / axis of the bore / shaft as shown in the diagram 8:

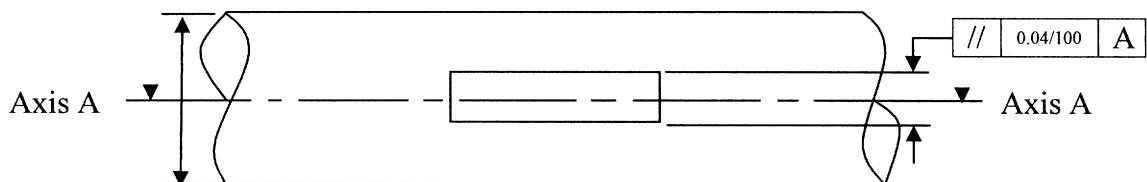

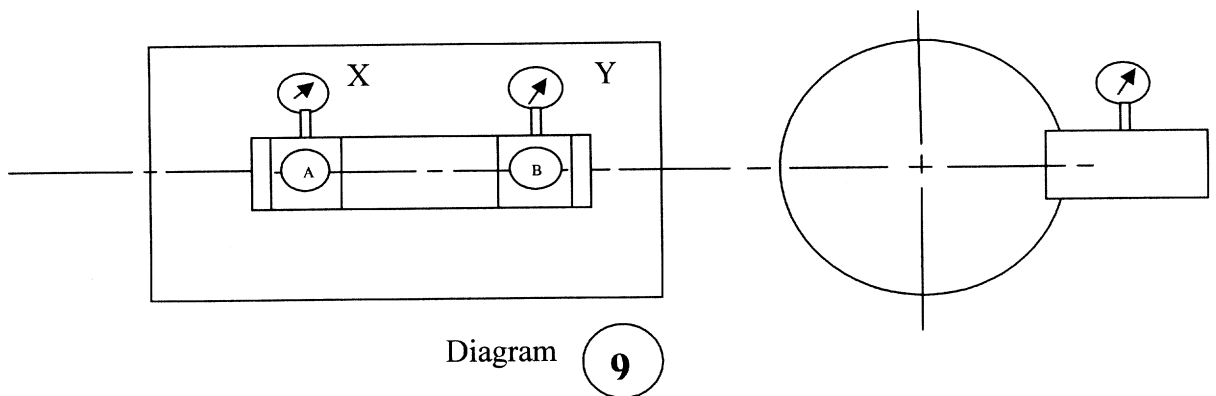


Diagram **8**

Diagram

	<b>QUALITY ASSURANCE PRQA</b>	<b>PR:QA:510</b> <b>Rev: 01</b> Date: 10.03.2012 Page 07 of 07
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- 3.7.2 If the component is smaller keep the component on a V block. Insert two sets of required gauge blocks on both ends of the key way with tight fit. Align the top surfaces of the gauge blocks parallel to the horizontal plane as shown in the diagram 9.
- 3.7.3 Measure the difference between the two top surfaces of the gauge blocks at X & Y by using Vernier height gauge with dial indicator and this will be the parallelism error with respect to the axis.
- 3.7.4 For bigger size shaft repeat the procedure 3.7.2 & 3.7.3 by holding the shaft in between centres / machine centres.
- 3.7.5 For bigger size bores insert two sets of required gauge blocks on both ends of the key way with tight fit. Use long gauge blocks / parallel blocks which shall protrude beyond the axis of the bore. Measure the gap between the parallel block and the maximum point of the bore at both ends. The difference between these two readings will be the parallelism error.



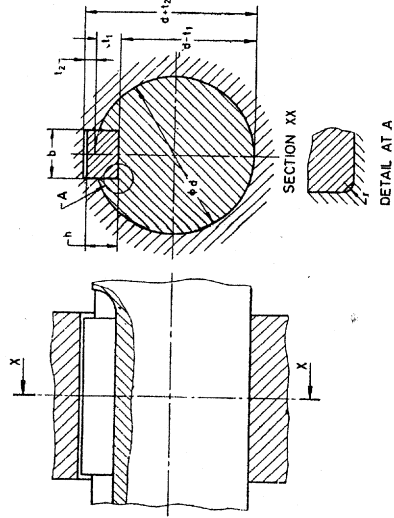
4.0 PERMISSIBLE ERROR:

- 4.1 Key way width & depth : (Table 3 of IS: 2048 – 1983) : Annexure: A
- 4.2 Key way length : (Clause 5 of IS: 2048 – 1983): Annexure: B
- 4.3 Symmetry/Offset and Parallelism : (Clause 6 of IS: 2048 – 1983) : Annexure: C

ANNEXURE: A

TOLERANCES ON KEY WAY WIDTH & DEPTH

TABLE 3 DIMENSIONS FOR KEYWAYS  
(Clause 3.2)  
All dimensions in millimetres.



Range of Shaft Dia $d$	Key $b \times h$	Keyway										Keyway for Machine Tools Application				
		Running fit		Light drive fit		Force fit Shaft and Hub Pg	$t_1$	Tol on $t_1$	$t_2$	Tol on $t_2$	M/in	Max	$t_1$	Tol on $t_1$	$t_2$	Tol on $t_2$
		Shaft H9	Hub D10	Shaft N9	Hub JS9											
6	8	+0.025	+0.060	-0.004	+0.012 5	-0.006	1.2	1.2	0.08	0.16	0.16	3	3	1.1	+0.1	0
8	10	0	+0.060	-0.029	-0.012 5	-0.031	1.8	1.8	0.08	0.16	0.16	3	3	1.1	+0.1	0
10	12	0	+0.078	0	+0.015 0	-0.012	2.5	2.5	0.16	0.25	0.25	3	3	1.3	0	0
12	17	0	+0.030	-0.030	-0.015 0	-0.042	3.5	3.5	0.16	0.25	0.25	4	4	1.7	0	0
17	22	0	+0.036	0	+0.018 0	-0.015	4.0	4.0	0.16	0.25	0.25	5	5	1.7	0	0
22	30	0	+0.040	-0.035	-0.018 0	-0.051	5.0	5.0	0.25	0.40	0.40	6	6	2.1	0	0
30	38	0	+0.043	0	+0.021 5	-0.061	5.5	5.5	0.25	0.40	0.40	6	6	2.1	0	0
38	44	0	+0.052	0	-0.043	-0.061	6.0	6.0	0.25	0.40	0.40	7	7	2.6	0	0
44	50	0	+0.052	0	0	-0.061	7.0	7.0	0.25	0.40	0.40	8	8	3.1	0	0
50	58	0	+0.052	0	0	-0.061	7.5	7.5	0.40	0.60	0.60	8	8	4.1	0	0
58	65	0	+0.052	0	0	-0.061	9.0	9.0	0.40	0.60	0.60	10	10	4.1	0	0
65	75	0	+0.052	0	0	-0.061	9.0	9.0	0.40	0.60	0.60	10	10	4.1	0	0
75	85	0	+0.052	0	0	-0.061	10.0	10.0	0.40	0.60	0.60	11	11	5.1	0	0
85	95	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
95	110	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
110	130	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
130	150	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
150	170	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
170	200	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
200	230	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
230	260	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
260	290	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
290	330	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
330	380	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
380	440	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0
440	500	0	+0.052	0	0	-0.061	11.0	11.0	0.40	0.60	0.60	13	13	5.2	0	0

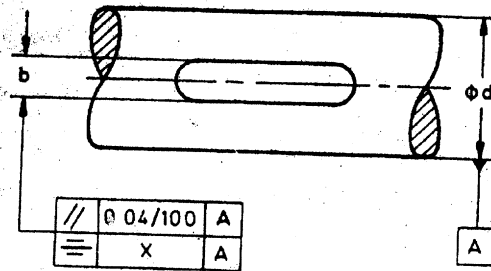
## ANNEXURE: B

### TOLERANCES ON LENGTH OF KEY AND KEYWAYS

Length of Key mm	Tolerance on	
	Key length mm	Keyway length mm
Up to 28	- 0.2	+ 0.2
32 to 90	- 0.3	+ 0.3
90 and above	- 0.5	+ 0.5

## ANNEXURE: C

### ERROR OF SYMMETRY AND PARALLELISM



Diameter of Shaft	Above	10	12	17	22	30	38	44	50	58	65	75	85	95	110	130
	Up to	12	17	22	30	38	44	50	58	65	75	85	95	110	130	150
b		4	5	6	8	10	12	14	16	18	20	22	25	28	32	36
X		0.1			0.16		0.2			0.3			0.4			

BHARAT HEAVY ELECTRICALS. LTD  
BOILER AUXILIARIES PLANT  
QUALITY DEPARTMENT

PR:QA: 514/03  
Date: 24/07/99  
Page: 01 of 04

-----  
PROCEDURE FOR

COLOUR COATING FOR  
RAW MATERIALS

-----  
EFFECTIVE DATE

24 07 99  
-----

-----  
NAME SIGNATURE DATE  
-----  
PREPARED BY: V. JAYARAMAN, M/QA *V. Jayaraman* 24/7/99  
-----  
REVIEWED & BY: H. ANATHANARAYANAN, DGM/QA *HA*  
APPROVED  
-----

-----  
ISSUED BY:

QUALITY ASSURANCE  
-----

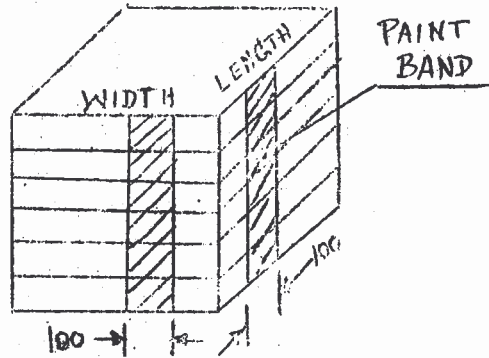
**MASTER COPY**



MATERIAL TYPE                      COLOUR                      COLOUR PAINTING LOCATION &  
 MODE ON THE RAW MATERIAL

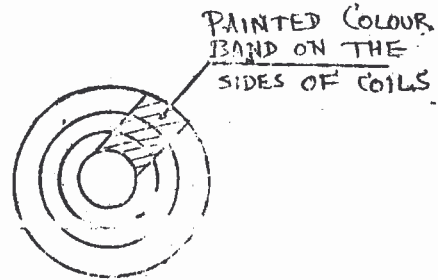
I PLATE & SHEETS

- |                             |        |
|-----------------------------|--------|
| 1. P 355 NH                 | BLACK  |
| 2. NAX TRA 70 OR EQUI       | WHITE  |
| 3. XAR-400                  | ORANGE |
| 4. COR-TEN A)<br>COR-TEN B) | YELLOW |
| 5. IS 2062/EQUI             | GREY   |



II COILS A (APH)



















- |                                 |           |
|---------------------------------|-----------|
| 1. CORTEN A                     | YELLOW    |
| 2. IS 513 Gr DD/(CR)<br>OR EQUI | WHITE     |
| 3. IS 513 Gr D (CR)             | RED OXIDE |
| 4. IS 513 Gr '0' (CR)           | BLACK     |
| 7. IS 1079 Gr DD (HR)           | BLUE      |



LEGEND : CR - Cold Rolled  
 HR - Hot Rolled

MATERIAL TYPE                      COLOUR                      COLOUR PAINTING LOCATION & MODE ON THE RAW MATERIAL

III ROUNDS & RODS

1. X20 Cr 13	WHITE & BLACK		→	
2. IS 2062	GREY			
3. SA 105	BLACK			
4. SA 105 BRIGHT BAR	WHITE		→	
5. SA 193 B7	RED			
6. BMCQ 45	YELLOW & BLACK		→	
7. CORTEN A	YELLOW			
8. En 36B	GREEN		→	
9. En 36C	GREEN&BLUE			
10. 2C 357 N	YELLOW & BLUE		→	
11. STE 500	GREEN & RED			
12. AISI 450	RED & BLACK		→	
13. AISI 420	BLACK & WHITE			
14. ASTM A 564-XM25	RED & VIOLET		→	
<b>GENERAL</b>				
15. ATST 304 AISI 304T	RED&WHITE RED & WHITE & BLACK DOT		→	
16. ATST 316 AISI 316T	RED & YELLOW RED & YELLOW & BLACK DOT		→	
17. ASTM- GR 12/P12/T12/F12	ALUMINIUM PAINT		→	
18. ASTM- GR 22/P22/T22/F2	BLUE		→	

PCPTI.FNAME: PRQA514.03

DHEL:BAP:RANIPET  
QUALITY DEPARTMENT

PRODUCT NCR CAUSE CODES

PR:0A:516  
REV NO 00  
DT: 24-04-95  
PAGE 01 OF 06

EFFECTIVE DATE 24-04-95

PREPARED BY V JAYARAMAN  
REVIEWED BY H ANANTHANARAYANAN  
APPROVED BY H ANANTHANARAYANAN

ISSUED BY : QUALITY ASSURANCE

QUALITY ASSURANCE  
DHEL:RANIPET  
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CONTROLLED COPY NO:

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BAP: DHEL: RANIPET  
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BHEL :: BAP :: RANIPET  
 QUALITY DEPARTMENT  
 PRODUCT NCR CAUSE CODES

PR : QA:: 516  
 REV NO :: 00  
 Dt :24/04/95  
 PAGE NO : 02 OF 06

This procedure gives guide lines for filling PRODUCT NCR CAUSE CODES on PRODUCT NCRs while filling them.

SL NO	OPERATOR FAULTS ( 100 SERIES )	CAUSE CODE	REMARKS
01	NOT UNDERSTOOD DRAWING REQUIREMENT	101	
02	WRONGLY OPERATED THE MACHINE	102	
03	DO NOT UNDERSTAND OPS REQUIREMENT	103	
04	USE OF DEFECTIVE TOOLS	104	
05	USE OF WRONG TOOLS	105	
06	LACK OF TRAINING	106	
07	STAGES IN THE PROCESS BYPASSED	107	
08	DRILLING SET UP ERRORS	108	
09	USAGE OF WRONG / INACCURATE INSTRUMENTS	109	
10	WRONG MEASUREMENTS	110	
11	UNQUALIFIED OPERATOR	111	
12	USE OF WRONG CONSUMABLES	112	
13	INPROPER CLEANING OF JOB	113	
14	DEFECTS DUE TO LACK OF APPLICATION OF TECHNIQUE	114	
15	WORK INSTRUCTIONS NOT FOLLOWED	115	
16	WRONG INTERPRETATION OF WORK INSTRUCTIONS	116	
17	UNCLASSIFIED	117	

PRODUCT NCR CAUSE CODES

PR : QA : 516  
REV NO :: 00  
Dt :: 24/04/95  
PAGE No: 03 OF 06

SL NO	MACHINE FAULTS ( 200 SERIES)	CAUSE CODE	REMARKS
01	MACHINE DOES NOT HAVE ADEQUATE PROCESS CAPABILITY	201	
02	TOOL BREAKDOWN	202	
03	SUDDEN BREAKDOWN	203	
04	BACK LASH ERROR	204	
05	ERROR CAUSED BY INEXPLICABLE MACHINE COMPONENT MOTION	205	
06	UNCLASSIFIED	206	

PRODUCT NCR CAUSE CODES

PR :QA :516  
REV No :00  
Dt :: 24/04/95  
PAGE No:04 OF 06

SL NO	MATERIAL FAULT ( 300 SERIES )	CAUSE CODE	REMARKS
01	MATERIAL HARDNESS HIGH / LOW	301	
02	CHANGE OF MATERIAL DUE TO DCN	302	
03	USE OF WRONG MATERIAL	303	
04	MATERIAL WAS CHANGED BUT WORK INSTRUCTION WAS NOT CHANGED	304	
05	UNCLASSIFIED	305	
06	MATERIAL WITH DEVIATION USED	306	

**PRODUCT NCR CAUSE CODES**

PR : QA : 516  
REV No : 00  
Dt : : 24/04/95  
PAGE NO :05OF 06

SL NO	PROCESS FAULT ( 400 SERIES)	CAUSE CODE	REMARKS
01	NO STOCK OF MATERIAL AVAILABLE	401	
02	PROCESS INADEQUATE	402	
03	UNCLASSIFIED	403	

**PRODUCT NCR CAUSE CODES**

PR : QA : 516  
 REV No : 00  
 Dt :: 24/04/95  
 PAGE No:06OF 06

SL NO	SUB DELY ITEMS ( 500 SERIES)	CAUSE CODE	REMARKS
01	MECHANICAL PROPERTIES NOT MEETING REQUIREMENT	501	
02	CHEMISTRY NOT MEETING REQMT.	502	
03	PLATING / COATING NOT OK	503	
04	P.O AMENDMENT NOT GIVEN BUT MATERIAL WAS AVAILABLE AT STORES.	504	
05	WRONG MATL CODE USED BY STORES	505	
06	WRONG DRAWING REFERRED IN P.O	506	
07	STANDARDS REFERRED IN P.O WERE WRONG	507	
08	PAINTING DEFECTS NOTICED ON RECEIPT OF MATL AT STORES	508	
09	NDT DEFICIENCIES NOTICES.	509	
10	H T DEFICIENCIES NOTICED.	510	
11	WELDING DEFECTS NOTICED.	511	
12	TESTS NOT GIVEN CLEARLY ON P.O	512	
13	TESTS AS PER P.O NOT CARRIED OUT	513	
14	DESIGN TECH SPECS DID NOT SPECIFY ALL REQUIREMENTS AS PER STDS.	514	
15	CALIBRATION OF TEST/MEASURING EQUIPMENT NOT EVIDENT.	515	
16	DIMENSIONAL DEVIATION	516	
17	UNCLASSIFIED	517	
18	PART NO & TYPE VARIATION	518	
19	DEVIATION IN ROUTINE REST RESULTS	519	
20	DEVIATION IN TYPE TEST RESULTS	520	



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BOILER AUXILIARIES PIANT  
QUALITY DEPARTMENT

PR:QA:521  
Page 01 of 05

PROCEDURE FOR

CODIFICATION OF SAs

EFFECTIVE DATE

31 08 95

PREPARED BY: V. JAYARAMAN

REVIEWED BY: H. ANANTHANARAYANAN

APPROVED BY: H. ANANTHANARAYANAN

REVISION NO

00

ISSUED BY:

QUALITY ASSURANCE

CONTROL NO:

ISSUED TO  
Shri

**MASTER COPY**

### SCOPE

This procedure gives guidelines for codifying the causes of nonconformances reported through Site Action Requests (SARs). Various common causes for SARs have been codified to facilitate SAR analysis to take corrective/preventive action.

### PROCEDURE

1. QA will forward the SARs to concerned departments. The departments will dispose the SARs. They will send disposed copies to QA for onward transmission to site. One copy of SAR will be retained by department for analysis and corrective/preventive action.
2. Departments while disposing the SAR, shall indicate the cause code also (pl refer Annexure I) in the QA copy of the SAR and department office copy and not in site copy.
3. Cause codes are planned in such away that area and cause are interlinked

Ex: Purchase  
Wrong Supply

Cause Code

404

4. List of SARs with cause code (as received from depts) will be sent to depts every month. Concerned departments will analyse the causes and take corrective and preventive action to eliminate the root cause of nonconformance. Copies of corrective and preventive action reports will be sent to QA for monitoring. These reports will be discussed in the Product Committee Meeting.

QUALITY DEPARTMENT

Annexure I (Annexure to PR:QA:521 Rev 00 Dt 31/8/95)

LIST OF CAUSE CODES FOR SARs

ENGG

1.	Drafting Error	101
2.	Qty Error	102
3.	Foundation Deviation Error	103
4.	Erection Manual Error	104
5.	Specification Error	105
6.	Error in Shipping List	106
7.	Error in GMS	107
8.	Interface problem	108
9.	Design Development	109
10.	Misc	110
11.	Customer Requirement	111

MANUFACTURING/INSPN

SHOP

1.	Fab Error	201
2.	Machining Error	202
3.	Use of wrong drawing	203
4.	Use of wrong QWI	204
5.	Improper Packing	205
6.	Inspection Error	206
7.	Improper Identification	207
8.	Malfunctioning	208
9.	Reserve	
10.	Misc	210

MSA

1.	Fab Error	301
2.	Machine Error	302
3.	Use of wrong drawing	303
4.	Use of wrong QWI	304
5.	Improper Packing	305
6.	Inspection Error	306
7.	Improper Identification	307
8.	Malfunctioning	308
9.	Reserve	
10.	Misc	310

PURCHASE

1.	Dimension Error	401
2.	Spec Error	402
3.	Short supply	403
4.	Wrong supply	404
5.	Packing Deficiency	405
6.	Malfunction	406
7.	Improper Identification	407
8.	Inspection error	408
9.	Reserve	410
10.	Misc	

COMML/SHIPPING

1.	Wrong Despatch	501
2.	Wrong Diversion	502
3.	Transit Damage	503
4.	Misc	510

ERECTION

1.	Wrong Erection	601
2.	Storage/Preservation	602
3.	Cannibalisation by site	603
4.	Misc	610

Standard Distribution List

<u>NAME/DESIG/DEPT</u>	<u>CONTROL NO.</u>
<u>Engineering</u>	
1. S.Srinivasan, SM/EDC/FANS	FA 1
2. B.Baratharajan, Mgr/EDC/AQCS	EA 1
3. S.Jayaprakasam, Mgr/EDC/AQCS	EA 2
4. P.Jayaraman, Mgr/EDC/APH	AN 9
<u>Commercial</u>	
1. T.Girinarasimhan, SM/COMML	AN 8
2. R.Kesavan, SM/COMML	AN 7
3. K.I.G.Vidhyasagar, SM/COMML	AN 6
<u>Shipping</u>	
1. Sankaranarayanan, SM/Shipping	AN, 5
<u>Purchase</u>	
1. Cyril Fernandez, Mgr/Purch/APH	AC 1
2. K.C.Madhavan, DM/Purch/Fans	FG 1
3. G.Balesubramanian, DM/Purch/ESP	AN 4
4. C.Netarajan, SPO/Purch/ESP	AN 3
5. K.Guruswamy, SM/Purch/WEG	AB 25
<u>Manufacturing Support Agency</u>	
1. S.Mohan, SM/MSA	AN 2
<u>Quality</u>	
1. V.Subramanian, SM/QC/Fans	Q/WI/22
2. K.Lakshmaiah, SM/QC/APH	AN 1
3. R.Varadhanarayanan, DM/QC/Proc	AB 2
4. H.A.Kerketta, DM/QC/OLI	AB 3
5. B.S.Rao, DM/QA	G 2
6. K.Nithyanandam, SIE/QA	AB 14
7. S.Anilkumar, DM/QA	G 3
8. V.Jayaraman, DM/QA	AB 10

**BHEL**  
**RANIPET**

QUALITY DEPARTMENT				
AMENDMENT TO QUALITY WORK INSTRUCTIONS ( SQP )				
Q.W.I.NO:SQP:FAN:308/02 Dt 13-06-94		AMENDMENT SL NO: <table border="1"><tr><td>A</td><td>1</td></tr></table> Dt:15 02 2000	A	1
A	1			
DESCRIPTION:PRESSURE ,DP GAUGES & PRESSURE,DP SWITCHES				
DETAILS				
CLAUSE NO	AMENDED AS	BASIS FOR AMENDMENT REMARKS		
1.1.2	IS 3624 SHALL READ IN PLACE OF BS 1780	BS 1780 BECOME OBSOLETE AND IS 3624 MEETS THE REQUIEMENTS		
<b>MASTER COPY</b>				
B. Sundararao Prepared by		H. Anand Approved by		

Distribution: As per standard distribution list.

BHARAT HEAVY ELECTRICALS LTD  
 BOILER AUXILIARIES PLANT  
 RANIPET - 632 406 (INDIA)  
 QUALITY ASSURANCE DEPT.

QUALITY CONTROL PLAN FOR  
 PRESSURE, DP SWITCHES AND  
 PRESSURE, DP GAUGES

NAME OF CONTRACT PACKAGE | QPNO. FAN308  
 REV.NO:02  
 DATE:130694  
 STANDARD | PAGE 01 OF 02

PREPARED BY : *hdm*

REVIEWED BY: *B Srinivasan*

APPROVED BY: *[Signature]*

S.NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	
1	2	3	4	5	6	7	8	9	10	11
1.0.	FINISHED PRODUCT									
1.1.	ROUTINE TEST									
		PHYSICAL & DIMENSIONAL CHECK INCLUDING PROCESS CONNECTION	MAJOR	PHY & MEASUREMENT	100%	BHEL PURCHASE SPEC.		TC	SUPPLR	CHP
1.1.2		CALIBRATION (ACCURACY, REPEATABILITY) AT 4 POINTS OVER THE RANGES	CRIT	100%	100%	BS1780 FOR GAUGES BS 6134 FOR SWITCHES		-DO-	-DO-	CHP
1.1.3		OVER PRESSURE TEST	CRIT	MECH	100%		-DO-	-DO-	-DO-	CHP
1.1.4		INSULATION RESISTANCE (TEST BEFORE AND AFTER H V TEST)	CRIT	ELEC	100%	PROCEDURE TO BE SUBMITTED BY SUPPLIER FOR BHEL APPROVED...		-DO-	-DO-	CHP
1.1.5		H.V. TEST AT 1.5 KV FOR 1 MINUTE	CRIT	ELEC	100%		-DO-	-DO-	-DO-	CHP
2.1.	TYPE TEST									
2.1.1		ENCLOSURE PROTECTION	CRIT	ENVIRVIRO-MENTAL		BHEL PUR SPEC./IS 2147		TC	REPUTED TEST HOUSE	CHP FOR TC REVIEW
		** ONLY FOR SWITCHES @ SWITCHES SHALL BE TESTED AT 1.5 TIMES THEIR FULL RANGE # TC SHALL NOT BE OLDER THAN 5 YEARS CHP: CUSTOMER HOLD POINT								

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QUALITY CONTROL PLAN FOR

Q.P.NO.FAN308  
 REV.NO.02  
 DATE:130694  
 PAGE:02OF02

PRESSURE ,DP SWITCHES  
 AND PRESSURE DP GAUGES

1	2	3	4	5	6	7	8	9	10	11
2.1.2		ENDURANCE TEST FOR PRESSURE AND DP SWITCHES	CRIT	MECH	TYPE TEST		BS 6134	TC	REPUTED CHP FOR TC#	TEST REVIEW HOUSE

<b>INDIAN ARMY ELECTRICALS LTD</b> <b>HEADQUARTERS PLANT</b> <b>RAJAPET-532 406 (HINDIA)</b> <b>QUALITY ASSURANCE DEPT.</b>	<b>QUALITY CONTROL PLAN FOR</b>  <b>FLOW SWITCHES</b>	<b>NAME OF CONTRACT PACKAGE</b> <b>STANDARD</b>	<b>ICED-50010</b> <b>ISS. NO. 70</b> <b>DATE 06/10/82</b> <b>ISSUE 01/01</b>
--	---	--	---

PREPARED BY: *B. Srinivasan* | REVIEWED BY: *[Signature]* | APPROVED BY: *[Signature]*

S.No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY (Of Components)	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	FORMAT OF REC	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1.0.	<b>FINISHED PRODUCTS</b>									
1.1.	ROUTINE TEST	a) CALIBRATION AT RISING & FALLING PARAMETERS INCLUDING REPEATABILITY ACCURACY & HYSTERESIS AT 4 POINTS b) H.V TEST c) I.R TEST d) OVER PRESS TEST (AT 150% OF DESIGN PROGRAMME)	MAJ	MECH	100%	SPEC/ONG 22.2-NO. 55/1957	T.C		SUPPLIER	CRP**
				ELEC		1.5KV FOR 1MIN NO FAILURE	T.C		-DO-	CRP**
				ELEC		5MEGA OHMS WITH 500V MEGGER	T.C		-DO-	
				MECH			T.C		-DO-	
1.2.	TYPE TEST	a) ENCL. PROGRAM TEST b) ENDURANCE TEST FOR SNAP SWITCH c) MATL. COMP FOR SENSING ELEMENT	CRIT	ENVIRONMENTAL	ONE OFF DESIGN	SPEC/IS2147/NEMA  CSA C22.2-55/1957-CL.74  SPECIFICATION	T.C		-DO-	CRP FOR TC REVIEW
							T.C		-DO-	
				CHEM/MECH			T.C		-DO-	

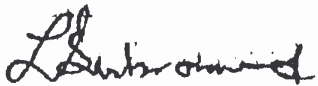






\*\*: FOR INDIGENOUSLY PROCURED ITEMS, ROUTINE TEST SUBJECT TO NEEDS OF CUSTOMER. FOR IMPORTED ITEMS SHALL BE SUBMITTED

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QUALITY ASSURANCE

QCP : W - 001  
Rev .00  
Dt .20 07 96  
Page 01 of 07

QUALITY CONTROL PROCEDURE FOR WIND MILL STRUCTURE  
EFFECTIVE DATE 20 07 1996

S.NO	NAME	DEPT	SIGNATURE	DATE
01.	L. SUBRAMANIYAM	EDC / WEG		
02.	A.R. RAMAMURTHY	MSA		
03.	H.A. KERKETTA	OC / OLI		
04.	M. VIJAYA KUMAR	OP / C		
05.	V. JAYARAMAN	OA		
06.	N. SOWRIRAJAN	ERN SERVICES		
				

APPROVED BY DGM / QA

REVISION NO :: 00  
ISSUED BY :: QUALITY ASSURANCE

RECORD OF REVISION

---

REV NO	DATE	CLAUSE REVISED
00	20 07 96	FRESH ISSUE QCP WM - 01 / 01. QCP WEG - 01/00 AND PR : QA : 703 have been merged and renamed W - 001 / 00 Dtd . 20 07 96

---

QUALITY CONTROL PROCEDURE FOR WIND MILL STRUCTURE  
-----

1.0 SCOPE.  
-----

1.1 The QCP WM -01 / 01 , QCP WEG - 02 / 00 and PR : QA :703 /00 have been merged  
and renamed as w - 001 / Rev . 00

1.2 This Quality Control Procedure lays down Quality Control Criteria for the material , fabrication .  
checks and trial assembly of the Lattice towers of wind electric generator.

1.3 This procedure is applicable “ all sizes of lattice towers”  
-----

1.4 MATERIALS  
-----

2.1 The materials given in the drawing only shall be used. Whenever there is a change of material.  
concurrence of the Designs shall be obtained .

3.0 GENERAL  
-----

3.1 The Shop planning group / MSA planning group shall arrange for the required quantity and  
lengths of structural members since no joint is permitted in any member of the tower structure  
-----

3.2 The complete windmill structure shall behot dip qalvanised after fabrication and trial assembly  
with zinc coating weight 900 gm / sq. M and 120 micron average thickness. is 2629 and IS 4759  
/ 1979 may be used as Governing Standards for general requirements only . IS 2633 may be used  
for quality control of galvanising process . the bushes connecting the cross members shall be  
hot dip galvanised to 50 micron thickness .

3.3 Only high strength fasteners suitably electrogalvanised / cadmium plated shall  
be used for all bolted connections . the governing standard shall be IS 5358 . the OLI  
inspection group / External inspection agency / shop inspection group as the case may be ,  
must verify TCs of such fasteners before use in the wind mill structure . All fasteners  
used for assembly shall be of grade 8.8 or higher Only .

3.4 Wherever welds are required the welds shall be made using qualified welders as per AWS D .  
1. 1 and using prequalified welding procedures . for tower top - plates to side plates weld use  
E7018 electrodes only for side plates to side plate weld use E6013 electrodes .

3.5 The embedded structures the portion ( going inside concrete grout ) need not be hot dip galvanised as per clause 2. 3 and shall be subsequently cement washed as per the following 'cement wash' composition . Any ungalvanised portion not silicate primer ( inorganic zinc rich primer )

3.5.1 The permissible bend and twist on the rolled angles and channels shall be 3mm maximum respectively . If they are having more bend / twist they shall be corrected prior to hole drilling .

3.5.2 CEMENT : Fevicol : Water ratio be 10 kg : 350gm : 650CC .

CAUTION : The job shall be dry while applying the cement wash . The cement wash may be applied by brushing . avoid too much wash .

#### 4.0 DIMENSIONAL INSPECTION

4.1 The lattice tower assembly is joined by bolted connection only . Hence the bolt sizes and pitches shall not differ from the drawing. The inspector shall take extra care to check each hole marking on the angles and members Deviations in the linear dimensions permitted shall be qlmm maximum. Where tolerance is given in the drawing that shall be maintained as per drawing . drilling fixtures duly FOT tested may preferbiy be used .

4.2 For the corner chisels the chamfer 16x 45x shall be precisely maintained for the length specified in the drawing machining / grinding at chamfered end for reference to holes is required .

4.3 For the holes sized the tolerance be +0. 25 / - 0mm.

4.4 the length of corner chisels be Lq 1mm only .

4.5 The length of cross members shall be maintained at L q 1mm only .

#### 4.6 Tower top

4.6.1 The profiled plate shall be checked with a template for the radius R635

4.6.2 SEE ANNEXURE I The horizontal and vertical pitches of the holes on the sides of the tower

top shall be drilled using templates and checked for pitches and diameters . The pitch variations shall be limited to tolerance qlmm maximum .

- 4.6.3 The weld between top plate and side profiled plates shall be LPI tested ( 100% ) . other welds shall be 10% LPI tested . ( final weld Only . )
- 4.6.4 The ends of LPI all chisels and cross members shall be made square by gas cutting and grinding .
- 4.6.5 The top plate minimum thickness shall be maintained as per drawing . with respect to the central axis of the tower top the top plate shall be exactly perpendicular the planarity of top plate shall be within 0.4mm / Metre checked by Master levels .
- 4.6.6 100% MPI Shall be done for gas cut edges of plates > 50mm thickness .

#### 5.0 TRIAL ASSEMBLY OF BASE FRAME

-----

- 5.1 The base frame of the tower Shall be trial assembled in the vertical condition in the Shop / ancillary unit . for every new design / drawing .
- 5.2 Mark the axis of the tower on the layout in the shop on the floor which Shall be level . The levels of all the four bottom corners Shall be within 1mm .
- 5.3 Assembly the horizontal bracings and cross members one after another using same size black blots as used for the site assembly .
- 5.4 Measure the levels of the tops of the four corner chisels at the outside corner . This Shall be within 1mm
- 5.5 Please refer ANNEXURE IV . Measure the top side dimensions A-B, B-C, C-D AND D-A, they Shall be within qlmm.
- 5.6 Measure the bottom Side dimensions A-B, B-C, C-D AND D-A, they Shall be within qlmm .
- 5.7 Measure the diagonals at top from the outside of the corner chisels, A-C And B-D . Shall be within qlmm .
- 5.8 Measure the cross diagonals at top of a and bottom of C and between top of B and bottom of D . they Shall be within q1 . 5mm
- 5.9 Measure the opposite cross diagonals between bottom of A And top of C and between bottom of B and top of D . they shall also be within q1 . 5mm .

- 5.10 Record them in the history card XX annexed ( ANNEXURE IV ) to this QCP tower wize .
- 5.11 drop a plumb the tops of A, B, C and D, measure the distance between plumb tip to bottom chisel inside . all the four distances , a-a , b-b , and d-d Shall be equal record the readings
- 6.0 HORIZONTAL TRIAL ASSEMBLY OF TOWER WITHOUT BASE FRAME  
-----
- 6.1 The lattice tower Shall be horizontally trial assembled without the base frame for its full length . for every new design / drawing .
- 6.1.1 Bolts nuts and washers Shall be made available for the whole tower for trial assembly .
- 6.2 Fix the corner chisels and cross members of all the three tiers separately using ordinary bolts ( M24) and assemble the lattice tower in the horizontal condition .
- 6.3 With proper structural supports bring the axis of tower exactly horizontal .
- 6.4 Match mark each tier at the junction A-A and B-B bolt the tower top also after all the three tiers are joined.
- 6.5 Drop a plumb at the top plate of tower top to check any deviation from perpendicularly of tower top to the axis of tower .
- 6.6 Using THEODOLITE/WATER LEVELS find out the axis deviation if any . It Shall not exceed 2mm for the entire height of the tower .
- 6.7 On the corner chisels ; the cross members and matching areas marked A-A , B-B , the identification Shall be weld marked with 3mm high welds of letter size 50mm . Please See ANNEXURE II .
- 6.8 For cross member numbering please see annexure III .
- 6.9 Trial assembly of the top the tower with the tower top Shall be done .

7.0 Machining of tower top :

-----

Please Refer Annexure - ZZ

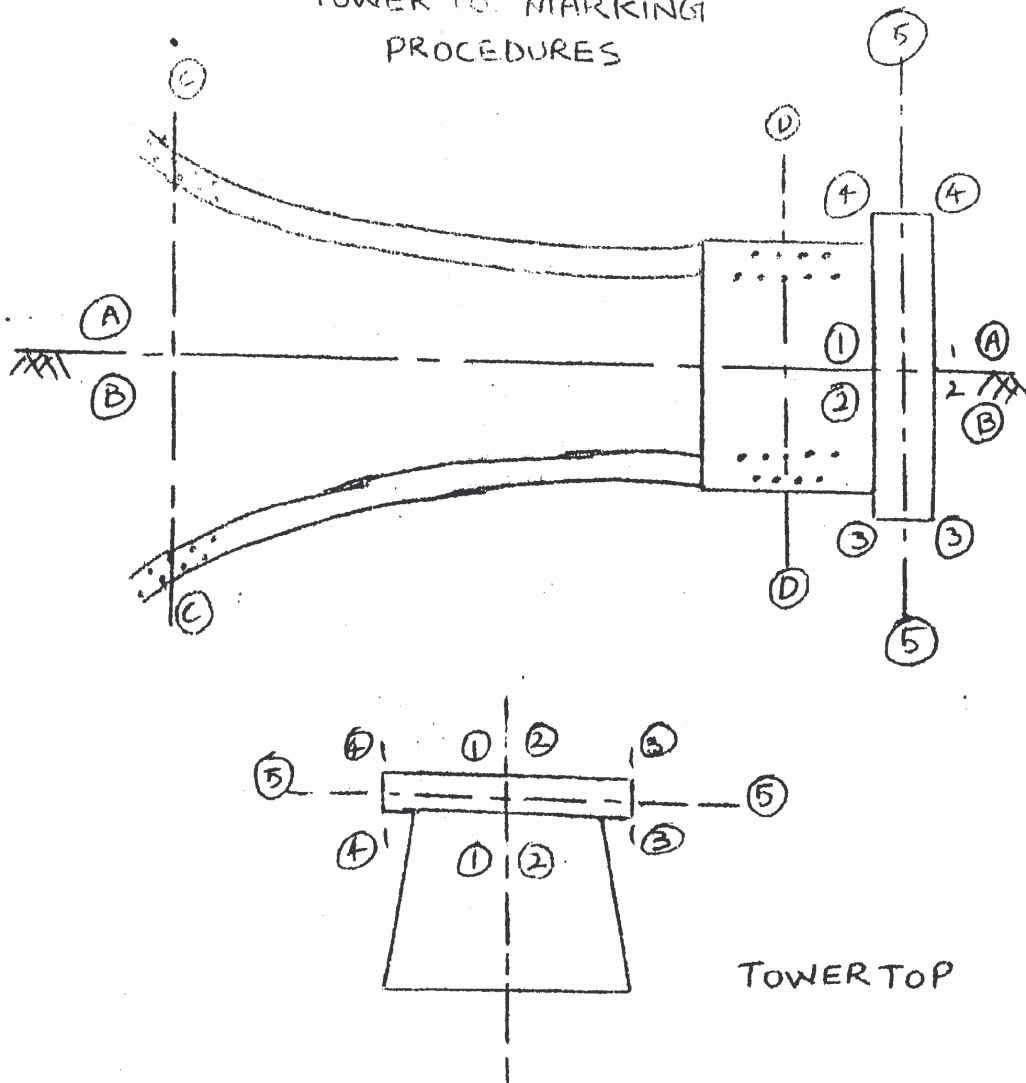
- 7.1 Level the top tier assy within 2 mm ( A-A, B-B )
- 7.2 Ensure the plumb - out of holes at top and bottom ( I . e . D. D and C . C )
- 7.3 Ensure the faceout of the tower top within 2 mm , If it is more than 2mm , grinding the tower top seating base and reset the flange .
- 7.4 Mark line 5-5 parallel to C. C on entire periphery of the flange .
- 7.5 Mark like 1-1 . 2-2 , 3-3 and 4-4 ad Shown in the thickness of the flange .

\*\*\*\*\*

PC : GB - 1 ( 81 ) FL - 215

ANNEXURE - ZZ

WIND ELECTRIC GENERATOR  
 TOWER TO MARKING  
 PROCEDURES



MARKING DETAILS

A-A } WATER LEVEL WITHIN 2 MM  
 B-B }

C-C } PLUMB POINT AT HOLES WITHIN 2 MM  
 D-D }

1-1 } JIG LOCATING  
 2-2 } MARKS  
 3-3 }  
 4-4 }

5-5 - MACHINING  
 REFERENCE  
 LINE

LINES C-C, D-D AND 5-5 SHOULD BE PARALLEL

ANNEXURE XX

HISTORY CARD FOR FIND ELECTRIC GENERATOR BASE FRAME ASSEMBLY  
CHECKS

---

aa	bb	cc	dd	AC1	AC2	BD1	BD2	X	Y
----	----	----	----	-----	-----	-----	-----	---	---

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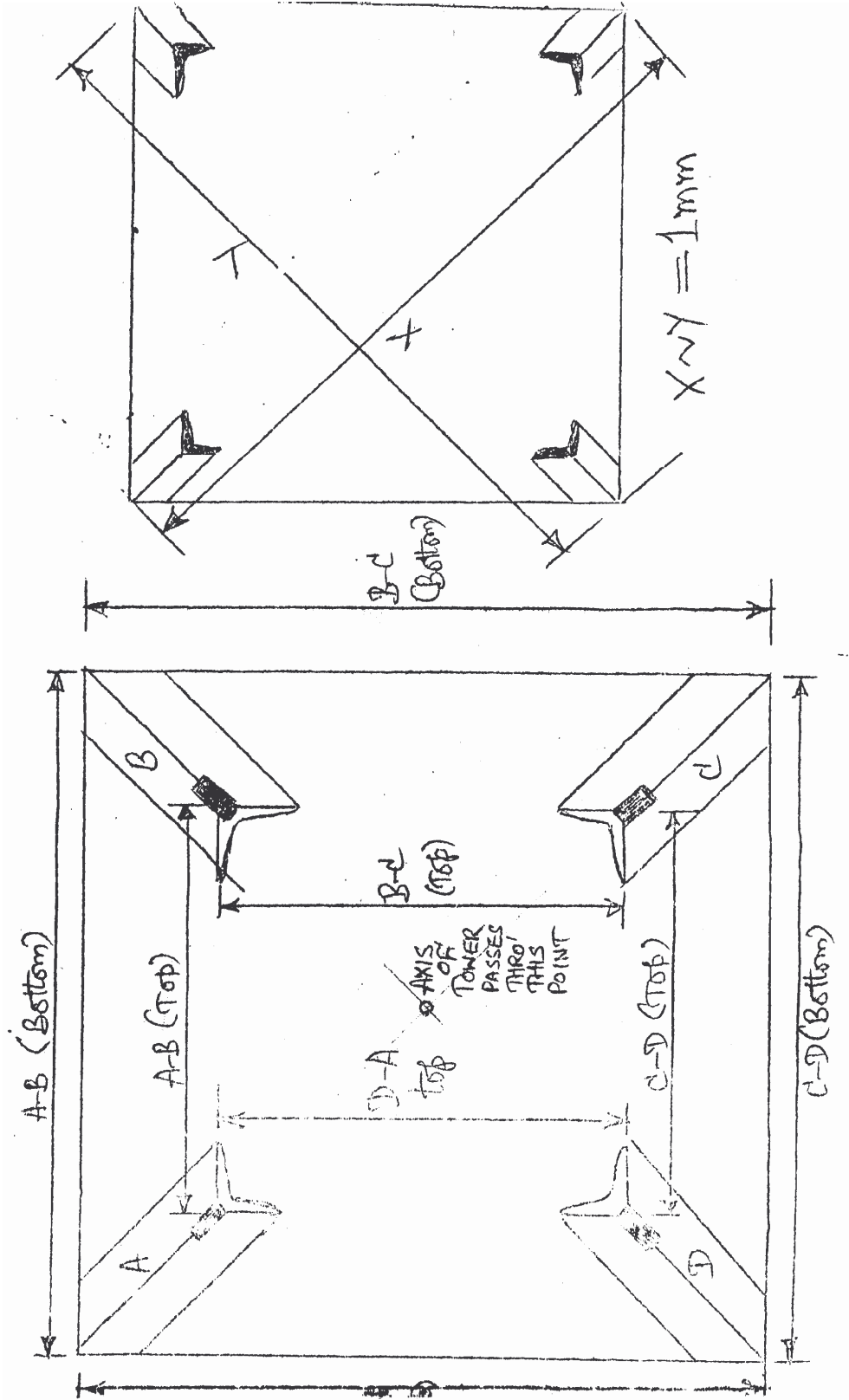
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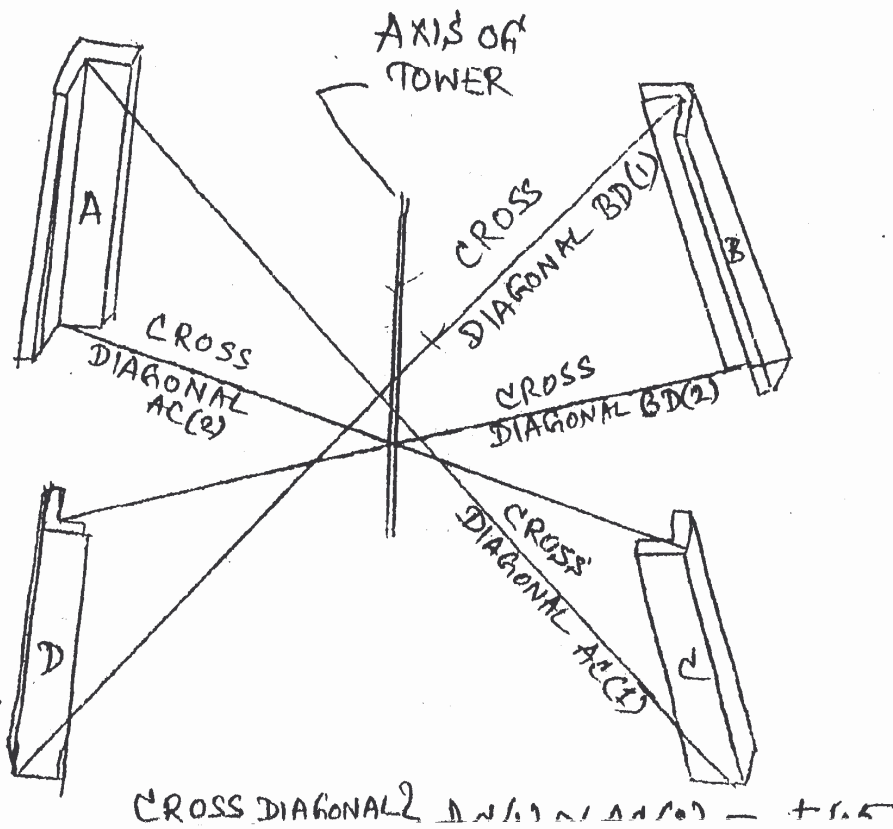
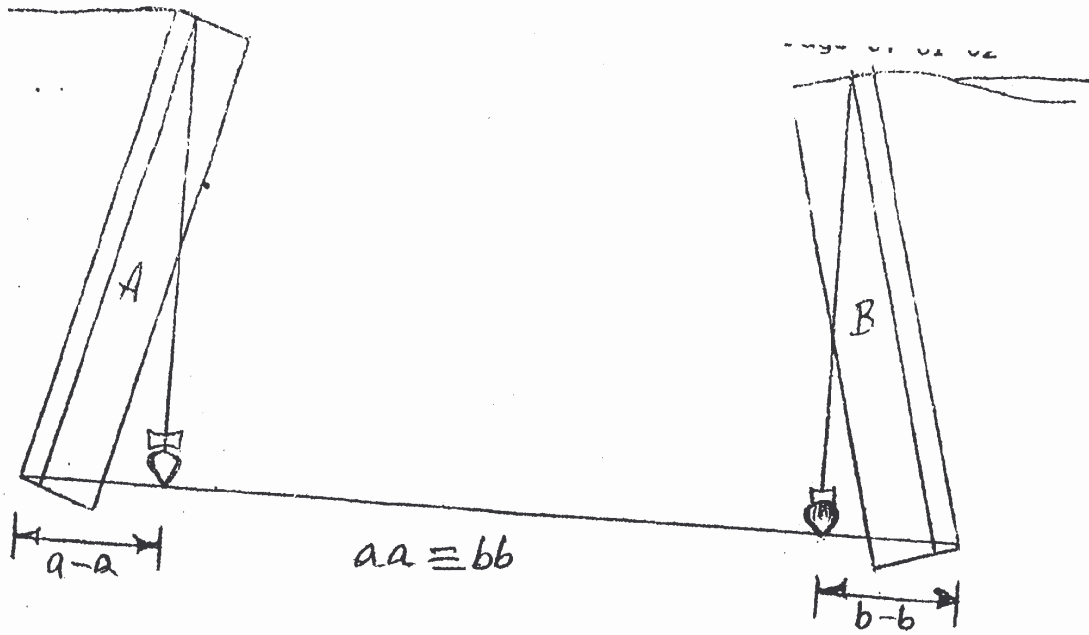
AB	AB	BC	BC	CD	CD	DA	DA
Top	Bot	top	Bot	top	Bot	top	Bot

---

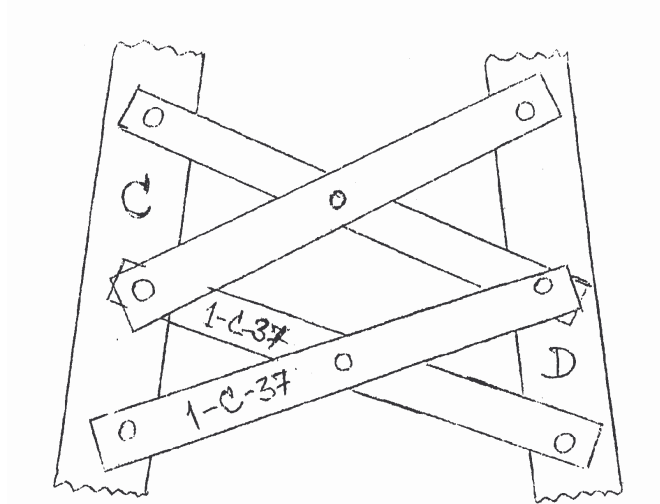
ANNEXURE IV

QCP : W - 001 / Rev 00  
 Dt 20 07 96  
 Page 02 of 02





CROSS MEMBER NUMBERING DETAIL



THE CORNER CHISELS ARE NAMED A,B,C & D. THE CROSS MEMBER DESIGNATION WILL BE AS FOLLOWS :

1- C --37

This means tower number

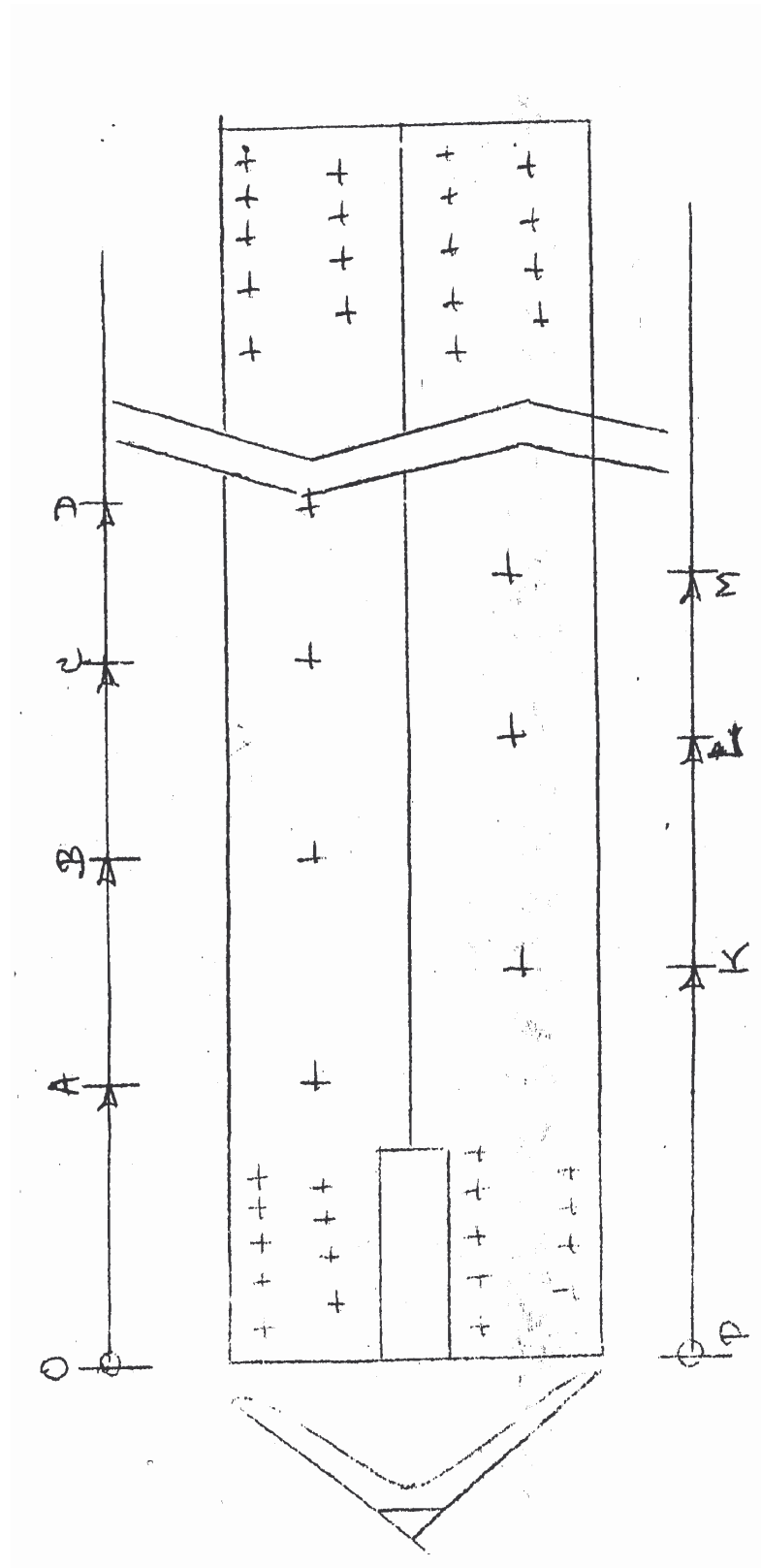
This means the corner chisel from which the cross member will be bolted

Cross member number as given in drawing

There will be two identical cross members bearing same designation as mentioned above . THE same shall be bolted as given in the Sketch above .

ANNEXURE II

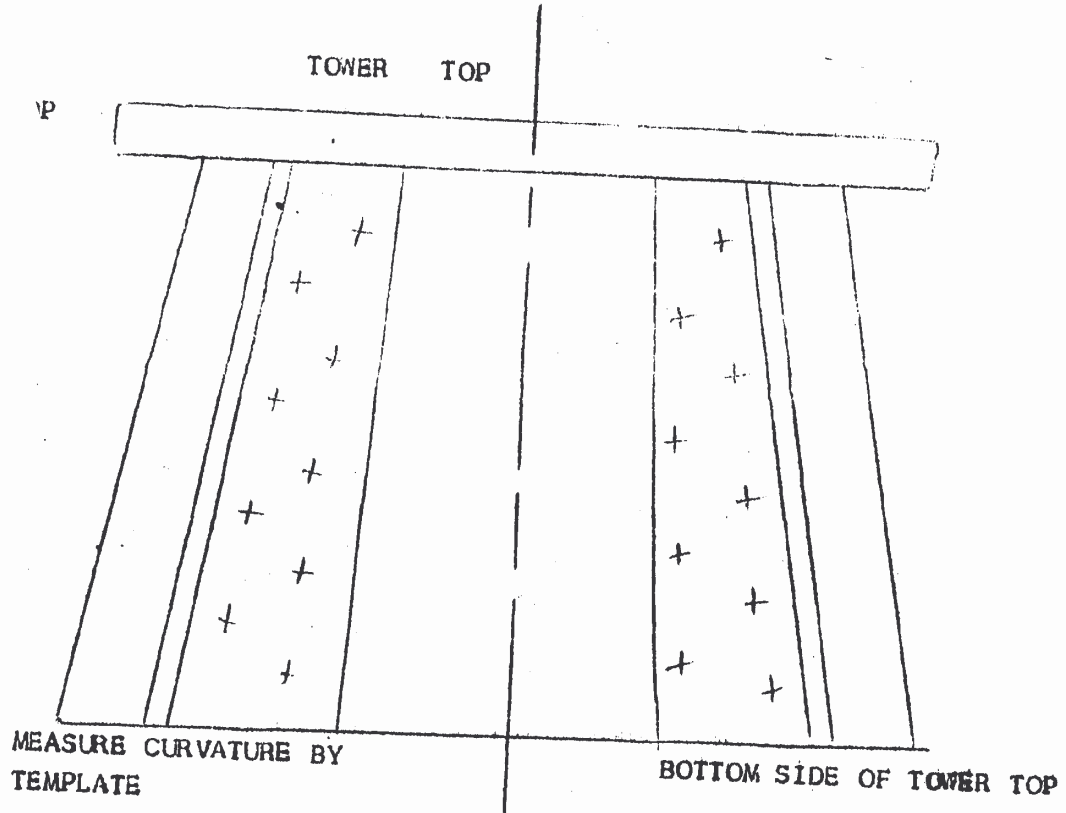
QCP : W -001 / Rev - 00  
Dt 20 07 96  
Page 01 of 01



- 1) MACHINE / GRIND FLATEN THIS SURFACE FOR REFERENCE OF CUMULATIVE PITCH OF ALL HOLES .
- 2) CHAMBER LENGTH SPECIFIED IN DRG . SHALL BE MAINTAINED .
- 3) CUMULATIVE PITCHES OA, OB, OC, OD ETC SHALL NOT VARY BEYOND = .1 MM
- 4) MATCH MARKS SHALL BE MADE BY WELDING 3MM HIGH WELDS OF LETTER SIZE 5
- 5) LATERAL DEVIATION OF BOLT HOLE LOCATIONS NOT PERMITTED .



TOWER TOP



01. MARK AND DRILL TOP HOLES .
02. DEVIATION FROM PLANARITY OF MACHINED TOP SURFACE OF TOP PLATE SHALL BE 0 . 4MM PER METER .
03. TRIAL ASSEMBLE WITH LATTICE TOWER AND DO IDENTIFICATION MARKING AS GIVEN IN PROCEDURE CL . 5 . 0

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RANIPET

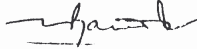



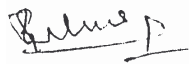
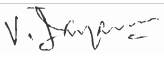
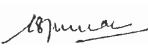

BHARAT HEAVY ELECTRICALS LIMITED  
RANIPET 632406

QUALITY DEPARTMENT

QCP : W : 003/ Rev 00  
15 /11 /94  
Page 01 of 04

-----  
QCP for NACELLE COVER ASSEMBLY  
-----

Effective Date 18 / 11 / 94  
-----

Name	Signature	Deptt	Date
M Ramananda Rao		EDC/WEG	
A R Ramamurthy		MSA	
D G Segar		Prodn	
G Subbaraju		QC	
M Velandi		Prodn	
V Jayaraman		QA	
M Vijayakumar		OP&C	
			

Mr. V. Jayaraman m/Qa.  
CONTROLLED COPY  
CONTROL NO: AB10.

APPROVED BY SM/QA Mr. V. Jayaraman m/Qa.  
-----

Issued By : QUALITY ASSURANCE  
QCP : W : 003/ Rev 00

## QCP FOR NACELLE COVER ASSEMBLY

### 1.0 SCOPE :

The Quality Control Procedure is covering in process quality checks that have to be carried out during manufacture of Nacelle Cover Assembly of Wind Electric Generators of Nordex Design .

### 2.0 GENERAL :

2.1 Any change of materials covered shall have the approval of WEG designs .

2.2 Welds shall be carried out by qualified welders and inspected by calibrated measuring instruments.

2.3 Any intoleranced dimension not covered either by this QCP or the standard QP WEG 01 or relevant drawings shall be controlled by the procedure PR : QA : 500 dt 16/1/93.

2.4 Welds shall be free from spatter , lack of fusion undercuts , slag inclusion and any other weld defects that will be detrimental to the strength of the weld. All welds shall be smoothly dressed by grinding and smoothly merged with adjacent metal.

2.5 Thickness less than 3 mm shall be welded by welders qualified as per AWS D. 1. 3 and appropriate WPS. Alternately Co2 welding duly prequalified can be used by using fcaw or suitable welding electrode.

### 3.0 PROCEDURE

3.1 Before pressing in a press the sheet metal shapes shall be checked according to the cutting plan dimensions and PR :QA : 500

3.2 Before final welding the pressed shapes shall be tacked in position and gaps should be exactly as per drawing fit up dimensions then only final welding clearance can be given

3.3 As the top half and bottom half of the nacelle cover assembly are made of sheet steel of 2 mm and 4 mm respectively all care shall be taken to avoid weld distortion. Especially selection and use of electrode sizes , are length and welding current shall be particularly checked and controlled as per WPS .

- 3.4 The fit up of hinges , door closers , door locks shall be particularly given attention as the Nacelle assembly cannot be brought down from 40 M height from service and repaired as often and easily . Their fit up may be preferable done after sand / shot blasting and painting.
- 3.5 SAND / SHOT BLASTING :
- 3.5.1 The finished and dimensionally cleared Nacelle cover top and bottom shall be shot/sand blasted as per PR : QA : 508/Rev 00 dt 7/7/93 to Sa 2 1/2 finish as per SIS 055900 ( Near white metal blast cleaning) and checked for profile against a reference (blasted) surface  
-----  
roughness specimen.  
-----
- 4.0 Acid cleaning of nacelle cover assembly :
- 4.1 The Nacelle cover assembly shall be acid cleaned if the following operations are not carried out. Shot blast the tank side walls before they are welded to the nacelle cover bottom. Weld them carefully with fillet welds care- this case acid cleaning is not required.
- 4.2 If the conditions of cl 4.1 cannot be fulfilled then do acid cleaning. Circulate 10 % v/v hydrochloric acid inhibited with antimony trichloride until the return liquid from the tank is free from any scale. debris. etc. Then circulate pure demineralised water using a pump until a blue lite paper shows no acidic reaction to the return liquid from the tank . Then circulate 2% solution of sodium carbonate through the tank. Then pass compressed air through the tank for 15 to 20 minutes and then close the tank inside with rubber caps.
- 5.0 PAINTING :
- 5.1 If there is a specific customer requirements for painting for a project then that shall be followed. otherwise C1 5.2 shall prevail.
- 5.2 The applicable painting schedule is given below. painting of (interior surface shall be with two pack Epoxy Zinc Rich Primer two coats of the paint shall be used to a total dry film thickness of 60 microns minimum. This shall be followed by minimum two coats of two pack Epoxy White Enamel paint after 6 hours to a total dry film thickness shall be 230 microns minimum.
- 5.3 The primer paint thickness shall be checked using an elcometer before applying the final epoxy white paint coating. After he finish coat dries the final coating thickness shall be checked and recorded on history card.

6.0 All vital dimensions of the Nacelle cover assembly shall be recorded in a history card which must incorporate dimensions , WPS No , blast cleaning clearance and paint film thickness.

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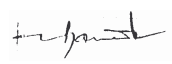


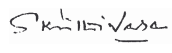



QCP:W:004  
DT: 17-07-96  
REV: 01  
PAGE: 01 OF 07

QUALITY CONTROL  
PROCEDURE FOR

ASSEMBLY OF NACELLES OF  
WIND ELECTRIC GENERATORS  
(NORDEX DESIGN) 250 KW/N29 AND  
200 KW/N27

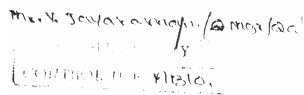
EFFECTIVE DATE :

17-07-96

NAME	DEPARTMENT	SIGNATURE	DATE
M. RAMANANDHA RAO	EDC/WEG		15/07/96
M. VIJAYAKUMAR	QP & C		11/07/96
A. KARNAN	PRODUCTION		15/07/96
S. KRITHIVASAN			15/07/96
K. LAKSHMIAH	QUALITY CONTROL		12/07/96
V. SUBRAMANIAN			12/07/96
V. JAYARAMAN	QUALITY ASSURANCE		10/07/96

APPROVED BY

  
DGM/QA

  
M. K. Senthil Kumar / M. K. Senthil Kumar  
CONTROL ENGINEER

ISSUED BY

: QUALITY ASSURANCE

RECORD OF REVISIONS

REV NO	DATE	CLAUSE REVISED
00	07-12-94	FRESH ISSUE
01	17-07-96	<ol style="list-style-type: none"><li>1) CL.2.2.Deleted.other clauses Renumbered.</li><li>2) CL.2.4.8,2.4.9 modified &amp; renumbered as 2.3.8 &amp; 2.3.9 respectively.</li><li>3) CL.2.4.3,2.6.4 modified &amp; renumbered as 2.3.3. &amp; 2.5.4 respectively</li><li>4) CL 3 modified.</li><li>5) CL 2.7.1 to 2.7.4 modified &amp; renumbered as 2.6.1 to 2.6.4</li><li>6) CL 2.8.1 modified &amp; renumbered as 2.7.1</li><li>7) CL 2.8.2 modified &amp; renumbered as 2.7.2</li></ol>

QUALITY CONTROL PROCEDURE FOR ASSEMBLY OF NACELLES OF WIND ELECTRIC  
-----  
GENERATORS (NORDEX DESIGN)  
-----

1.0 SCOPE  
-----

1.1 This Quality Control Procedure specifies Quality Checks to be carried out during the assembly of components in the Nacelle Assembly of Wind Electric Generators.

1.2 REFERENCE:  
-----

Largely the Quality Checks have been derived from M/S NORDEX'S Quality Control Procedures and checklists

1.3 A History Card maintained by QC/shop shall be filled up in full for every Wind Electric Generator Nacelle Assembly of Nordex design manufactured.

2.0 GENERAL:  
-----

2.1 Any change of material shall have the approval of Designs/WEG.

2.2 WELDING:  
-----

2.2.1 Only Qualified welders shall be used on all welds as per WPS using qualified procedures.

2.2.2. All welds shall be free from slag inclusions, blow holes and other deleterious defects. Fillets shall be checked with fillet gauges to ensure correct profile and throat as per drawing. Butt welds >6mm wide shall be MPI tested.

2.3 ASSEMBLY OF COUPLING ON GENERATOR:  
-----

2.3.1. Ensure that the inductive sensor is mounted on left bottom side when we look in front of the generator facing the shaft. Ensure use of loctite 648 and tightening of the bolt to 48 Nm (M10 bolts of bearing cover)

- 2.3.2. Ensure mounting of disk of conductive sensor on the coupling using bolts (MB X 20) using loctite 648 and tightened to torque 24Nm.
- 2.3.3. Ensure that the coupling half and distance bushing make full contact with the recess on  
-----  
the shaft. Coupling must make full contact with distance bushing.
- 2.3.4. The distance from outer edge of coupling to flange on the generator shall be maintained at 199 + or - 1MM.
- 2.3.5. Ensure tightening of bolts crosswise (Follow the mounting procedure for tightening elements viz I 201 -2 Torque tighten the bolts progressively from 40Nm, 80Nm, 110Nm & ultimately to final torque value of 125Nm.
- 2.3.6. Apply Hydraulic oil to tightening element and shaft to prevent rusting.
- 2.3.7. Ensure cl.11 of Nordexz Instructions procedure I 201-2 is fully followed for mounting shield & rubber pads.
- 2.3.8. Ensure fitting of the blower (fan) in the right direction (blades towards the generator) if not already fitted.
- 2.3.9. Ensure mounting of junction box in the shield & tighten with allen screws if not already mounted.
- 2.3.10. Ensure placement of cable anchors on generator and plate for sensor cables shall be mounted with rubber packing on the terminal box.  
-----

2.4 ASSEMBLY OF HUB ON MAIN SHAFT:  
-----

- 2.4.1. Uniformity in thickness of tightening elements shall be verified before mounting.
- 2.4.2. Ensure cleaning of the shaft and hub where tightening elements will be placed and application of hydraulic oil to the pressure surfaces of tightening elements.
- 2.4.3. Check for the careful mounting of hub on the main shaft and placement of tightening element in the recesses. Ensure that hub and tightening elements make full contact with recess on main shaft and hub respectively. Tightening of bolts shall be crosswise  
-----

(opposite bolts shall be tightened) in sequence.

- 2.4.4. Torque tightening to 230 Nm shall be ensured and recorded for the small tightening element.
- 2.4.5 Torque tightening to 325Nm shall be ensured and recorded for big tightening element using special extension for a final torque of 485Nm.
- 2.4.6 Mounting of distributor block at the end of mainshaft shall be ensured
- 2.4.7 Make sure that the cover with beading and eyebolts are mounted in the front of the hub.
- 2.4.8 All threaded holes shall be smeared with antiseize thread lubricant before fixing bolts.
- 2.4.9 Verify application of rust preventive on mainshaft and tightening elements and all machined surfaces.
- 2.5 MOUNTING OF GENERATOR OF GEARBOX:  
-----
- 2.5.1 Check the Name Plate details of the generator and ensure that appropriate generator only is mounted on the gearbox.
- 2.5.2 Ensure cleaning flange on gearbox and flange on generator with a scraper and solvent.
- 2.5.3 Generator bolt sizes and use of bushings as per Nordex Instruction I 201-4 shall be ensured.
- 2.5.4 Generator mounting on gearbox with care shall be witnessed if not already mounted. The bolt used for mounting generator in front of Terminal box will be shorter.

2.5.5. CHECK THE FOLLOWING: (if not fitted already to  
M/8 Nordex)

- 1) Mounting box of cable inductive sensor shall be mounted on terminal box of generator.
- 2) Inductive sensor shall be mounted on generator inlet. The Rubber packing between inductive sensor and terminal box shall be ensured.
- 3) Cables 11,13,14,15,25 & 43 and UVW shall be led on along the pipes to the terminal box on generator.
- 4) Cables 13,14,15,25, cable 11 and their routing shall be as per Instruction of Nordex I 201-4.
- 5) Ensure the location of holes & pitches for correctness of mounting of vibration sensor.

2.6 ASSEMBLY OF NACELLE BOTTOM:  
-----

- 2.6.1 The Nacelle bottom shall be mounted in position without damaging the paint coatings if not already mounted by M/S Nordex to avoid scratches. Rugs are used with fork lifts to avoid damage/scratch.
- 2.6.2 Mounting of Trap door shall be ensured at entrance hole if not already mounted by M/S Nordex.
- 2.6.3 Hoses and fittings connected to the tank shall be checked for use of loctite and check mounting of 'T' piece with hoses (if not already done by M/S Nordex).
- 2.6.4 Mounting of holder for brake lever shall be checked and ensured (if not already done by M/S Nordex. The holder is screwed on after smearing in loctite 648 (or equivalent).

2.7 ASSEMBLY OF NACELLE TOP:  
-----

- 2.7.1 After mounting the gear box, generator, coupling and hub on main shaft and properly fastening the Nacelle bottom, the Nacelle top is to be prepared for mounting on the Nacelle bottom (if not already done by M/S Nordex).
- 2.7.2 Check placement of the Nacelle along with all interiors on pedestals, if not done by M/S NORDEX already
- 2.7.3 Ensure that for fitting the Nacelle top on Nacelle the lifting eyes provided are only used.



BHEL : BAP : RANIPET  
QUALITY DEPARTMENT

AMENDMENT TO QUALITY CONTROL PROCEDURE (QCP)

QCP: I 001 / REV : 03

AMENDMENT : SL NO : A2  
DT: 27.12.2000

DESCRIPTION : QUALITY CONTROL PROCEDURE FOR IPP CHIMNEY

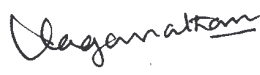
DETAILS

PAGE 01 OF 01

CLAUSE : NO	EXISTING	AMENDED AS
ANNEXURE TO QCP PAGE 3 OF 3 (SKETCH)	MATCH MARKS FOR SHELL TO SHELL INDICATED AS Z1 AND Z2 ON BOTH ENDS	Z1 , Z1 AT ONE END AND Z2 , Z2 ON THE OTHER END AS SHOWN IN THE REVISED SKETCH.

NOTE : THE ABOVE MENTIONED CHANGES WILL BE INCORPORATED IN  
THE RELEVANT W.I. DURING THE NEXT REVISION OF THE DOCUMENT.

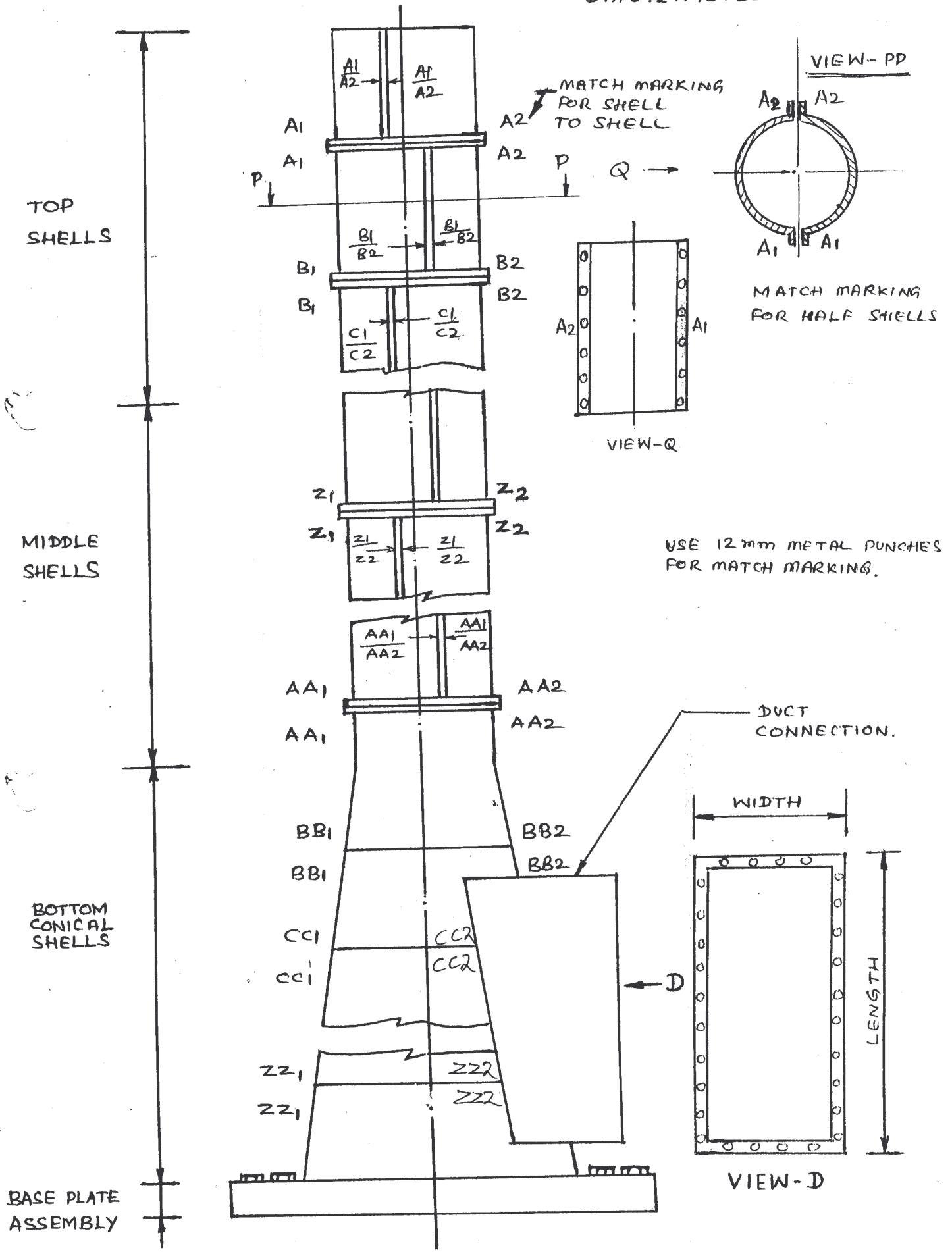
  
PREPARED BY

  
B. Srinivasulu  
REVIEWED BY

  
APPROVED BY

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**FIGURE-4**



BHEL:BAP:RANIPET

QUALITY ASSURANCE

AMENDMENT TO QUALITY CONTROL PROCEDURE (QCP)

Q.W.I.NO:QCP:I:001      REV:03      AMENDMENT SL:NO : A1


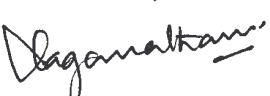

DESCRIPTION :QUALITY CONTROL PROCEDURE      DATE:28.11.2000  
FOR IPP CHIMNEY

DETAILS

PAGE 1 OF 1

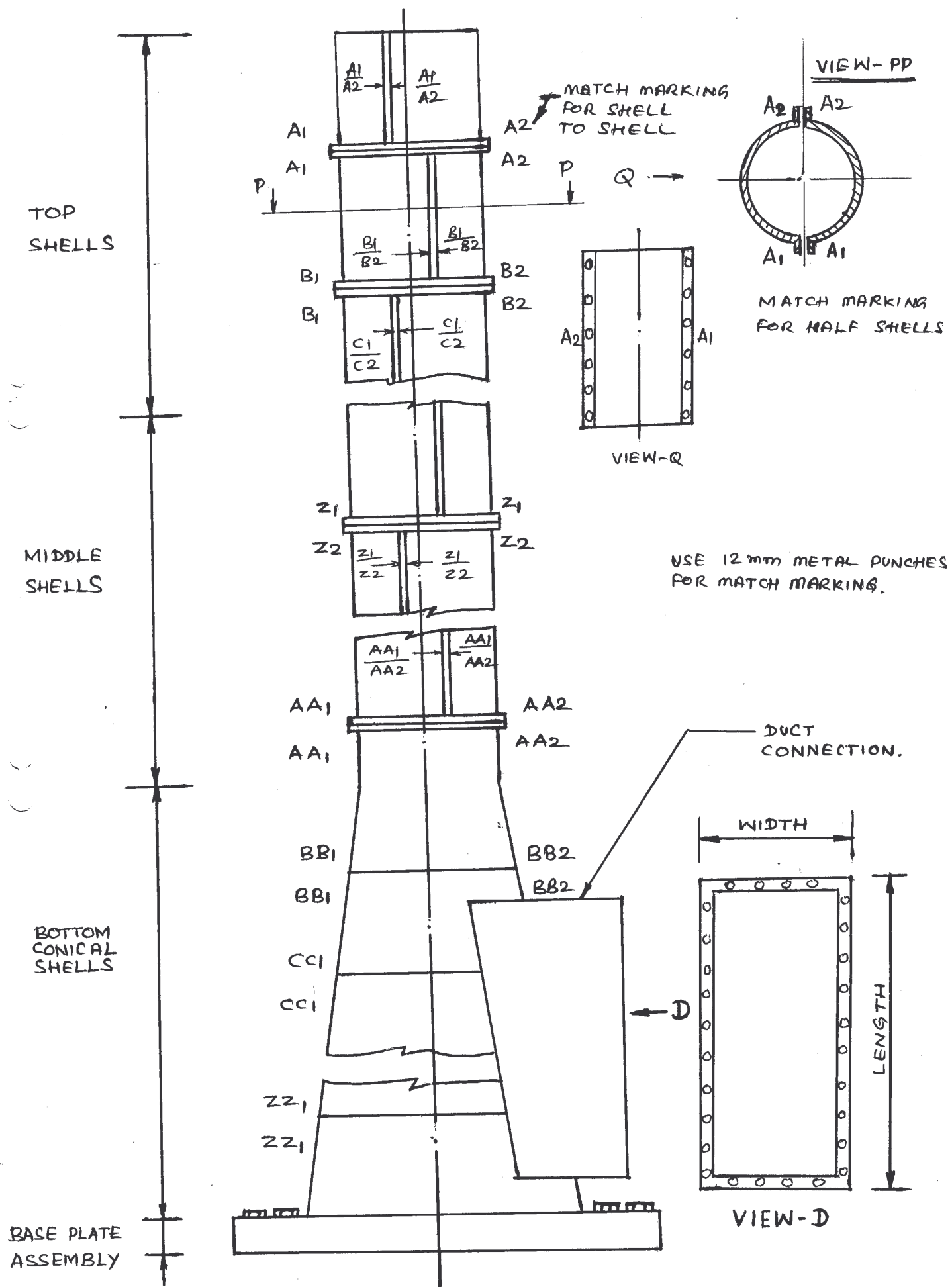
Clause No:	Amended as	Basis for amendment/Remark
Annexure to QCP page 3 of 3	Figure changed to include more number of match marks on shells. (refer fig:4)	To facilitate identification of match marks if more shells are involved.

Note : The above mentioned changes will be incorporated in the relevant  
W.I. during the next revision of the document.

Prepared by: 	Reviewed by :  B-Srinivasulu	Approved by: 
---	--	---

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FIGURE-4



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**BHEL : BAP : RANIPET  
QUALITY ASSURANCE**

QCP: I: 001  
REV. 03  
Page 1 of 7

QUALITY CONTROL PROCEDURE FOR **IFP CHIMNEYS**  
EFFECTIVE DATE **29/6/94**

Department	Name & Desgn.	Signature & Date
PRODUCTION	A KARNAN Manager	<i>[Signature]</i>
OP & C	P S NARASIMHAN Dy. Manager	<i>[Signature]</i>
ENGINEERING	V HARIHARAN SR MANAGER	<i>[Signature]</i>
QUALITY CONTROL	M RAVINDRA MANAGER	<i>[Signature]</i>
QUALITY ASSURANCE	V JAYARAMAN DY MANAGER	<i>[Signature]</i> 11/7/94

ISSUED BY \_\_\_\_\_ : QUALITY ASSURANCE

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PC File: QCPI001.3 in Floppy No. QA/244

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RECORD OF REVISIONS

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Rev.No.	Clause(s) Revised	Reason
01	1:0, 4:0, 5:8.1, 5:8.3, 5:9.1, 5:9.3, 5:9.5, 5:9.7, 6:2.6, 6:7, 8:4	To incorporate the requirements of newer chimney designs
02	Amendment 01: C1:5:9.1 and 5:9.2	Amendment-1 comments incorporated.
03	C1:3.5, 4:0, 4.1, 4.2, 5:9.1, 5:9.2, 5:9.4, 5:9.6, 5:9.7, 5:9.11, 7.1, 7.1.1, 7.1.2, 9.2, 9.3	To incorporate requirements of M/s.Reliance Inds., & ACC, Kymore requirements.

---

1.0 SCOPE

This quality control procedure gives the quality checks, stages and details of inspection that should be done on IPPD Chimneys Projects.

2.0 MATERIALS

2.1 The materials used in the manufacture shall be as per the drawing. Any change of material shall have the prior approval of Engineering.

3.0 WELDING

3.1 All welds shall be done by welders qualified for welding using the relevant procedure and in the relevant positions using relevant consumables and processes only with correct edge preparation and fit up.

3.2 Only E 7018 electrodes shall be used for all carbon steel welds. Where stainless steel welds are involved, E 309 type welding electrodes shall be used using prequalified welding procedures only. When carbon steel to stainless steel welding, WPS shall be the guiding procedure.

3.3 Welds shall be cleaned free of slags and spatter and shall be free from any defects. Permissible defect level shall be as per AWS D1.1. Fillets shall conform to the drawing requirements and shall be checked by fillet gauges by inspector at random.

4.0 NDT

4.1 All butt welds of thickness more than 6mm shall be double 'V' with back gouging/grinding and root MPI and final MPI.

4.2 Butt joint of base plates of thickness more than 50mm shall be UT/RT tested.

4.3 All Butt joints of shell welds shall be MPI/LPI tested.

5.0 CHECK OF LAYOUT OF STIFFENER PLATES BASE PLATES AND HALF SHELL PLATES (For conical portion of chimney)

5.1 Refer Figure 1. Check the radius of cut, and diagonals SL1 and SL2, A1, A2, A3, A4 and A5. SL1 SHOULD BE equal to SL2. A1 should be equal to A2=A3=A4=A5.

5.2 Refer Figure 2. Check the radius of cut AND diagonals SLA and SLB and lengths AA, AB, AC, AD and AE. SLA must be equal to SLB. AA must be equal to AB=AC=AD=AE. No deviations are permitted in the lay out.

5.4

Where joints on the plates are to be made, make the joints by butt joints with appropriate edge preparation and checks by NDT as per Clause 4.0. Check the diagonals and slant heights A1, A2, A3, A4 & A5 or AA, AB, AC, AD and AE as the case may be, tolerance are as per PRQA 500.

5.5

Inspect and clear if satisfactory (use only approved templates). Check the curved profile at narrow and broad ends. Trim the cut edges to profile and then edge prepare all four sides by gas cutting and grinding with correct angles and land. The workmanship shall be as per AWS D1.1.

5.6

Mark the ends of the slant line on the narrow and broad ends of the cut shell plate at equal intervals as shown in Figure-3 prior to rolling to ensure squareness of the rolled edges after rolling and to avoid twist of the conical half after rolling. Inspect and clear for rolling. Check for out of squareness of the vertical edges by waterlevels and plumbline after rolling the half conical shells. Check the cut out for inspection door for length, width correctness of location and diagonals and then clear.

5.7

Check stiffener segments positions for stitch welding as per drawing after proper fit up without gap.

5.8

#### BASE PLATE ASSEMBLY

5.8.1

Check the bottom and top plates of base plate assy for dimensions. Mark and check the pitch circle dia after tacking the two halves and top and bottom plates together. Match drill the plates. Enlarge bottom plate holes.

5.8.2

Check dimensions and profile of the gusset plate (stiffner plate) as per drawing.

5.8.3

Check the pitches of holes. check the position of stiffeners, weld size and root fusion. Check the concentricity of top plate and bottom plate holes.

5.9

#### TRIAL ASSEMBLY AND MATCH MARKING

5.9.1

All flanged shells will be trial assembled with its adjacent tier and despatched.

- 5.9.2 All unflanged shells shall be inspected for dimensions 100% and despatched. They shall not be trial assembled.
- 5.9.3 Permissible shell ovality is maximum 1.0% of diameter. Max. diameter difference should be within a difference of 10mm. However in the flange area, the adjacent pieces shall be matched perfectly during trial assembly.
- 5.9.4 Permissible deviation in gap between two half shells is 2mm. (where conical shell - half matching is required).
- 5.9.5 Permissible deviation in verticality between axis of individual shell top circle and that of bottom circle is to be within 3mm subject to a maximum of 5mm for the two shell assembly.
- 5.9.6 Water level variations between various diameters of the top of the shell when the bottom of the shells is levelled. Maximum shall be 3mm.
- 5.9.7 After the matching of the two halves of the shell, fit up and weld of the transport stiffeners inside the shell. Radius deviation shall be within ±2mm at any place.
- 5.9.8 Clearly punch the match marks and border with white paint.
- 5.9.9 While retaining the matched halves of the bottom shells in the matched condition using special roller type supports place the half shells of the next level and then check the squareness, ovality, levels and out of verticality.
- 5.9.10 Match mark them by punching as per Figure 4 and border the match marks by white paint.

6.0 MIDDLE AND TOP CHIMNEY SHELLS

- 6.1 Check the shell plates for dimensions and diagonal variations and edge preparation prior to rolling. After rolling check the shell for squareness and twist by water levels and plumbing.
- 6.2 Join the shell and check the fit up for even weld root gap and ovality and deviation from verticality of the axis. Correct if not satisfactory. Clear for welding. Permissible off-set from shell to shell is max.4mm.

- 6.3 Roll the angle stiffeners segments and check for squareness and twist and ovality prior to welding. Clear for welding if found satisfactory. Shell OD should be undersize to angle stiffener rings inside diameter by 3mm on diameter.
- 6.4 Follow the clause 6.3 for rolling of end flanges of the shell also. Tack the end flanges of the two adjacent shells and match drill the joining holes after marking the PCD and checking.
- 6.5 Clear for joining each shell to its adjacent shell after checking the water level, fit up, concentricity and out of verticality. Clear for welding.
- 6.6 Tack weld the match drilled flanges of the shell to the shell with the plate gussets positioned and tack welded. Check the stiffener location prior to welding.
- 6.7 Match adjacent shells and ensure that the match drilled flanges become matching flanges of the adjacent shells. In the matched condition check for out of squareness, concentricity and out of verticality of the matched shells. Correct prior to match marking.
- 6.8 Check for proper welding of transport stiffeners inside at 100mm from ends and then dismantle.
- 7.0 PAINTERS TROLLEY AND STAINLESS STEEL LINING (where applicable)
- 7.1 Use prequalified SS welding procedure as per Clause 3.2.
- 7.1.1 Guide for Trolley wheel :: Check ovality, concentricity with chimney axis, pitches of holes and curved profile at top and bottom.
- 7.1.2 Trolley Track:: Check for parallelism of the vertical limb of the trolley track with the axis of trolley track. CHECK for OVALITY of the TRACK. No ovality is permitted. Check pitches of holes for correct size and location. Check stiffener location and stiffener to track weld size.
- 8.0 DUCT CONNECTION (Where specified in the drawing)
- 8.1 Check the layout of the duct connection plates for dimensions and edge preparation for fit up. Clear for welding if satisfactory.
- 8.2 Check the duct flange plate for dimensions, diagonal deviations and hole pitches and hole sizes.

8.3 Weld flange plate with correct fit up to the duct connection.

8.4 Check the duct opening whether this is in site's scope. Inspect in the welded condition of this duct connection. Clear if satisfactory.

9.0 PAINTING

9.1 Unless otherwise specified, the chimney components shall be given one coat of red oxide zinc chrome primer paint to IS 2074 and two coats of heat resistant black bituminous paint.

9.2 Where specified in the contract, the painting scheme shall be specified in a separate procedure.

9.3 For the Reliance Industries stacks, Patalganqa and Hazira Projects, the procedure PR:QA:406 dt.07.06.94 shall be followed.

\*\*\*\*\*

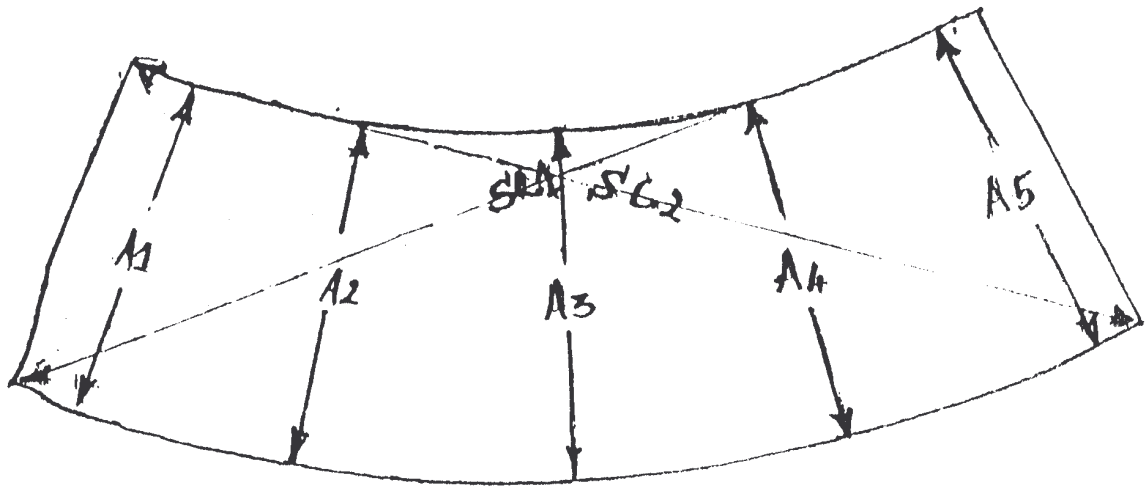


FIG-1

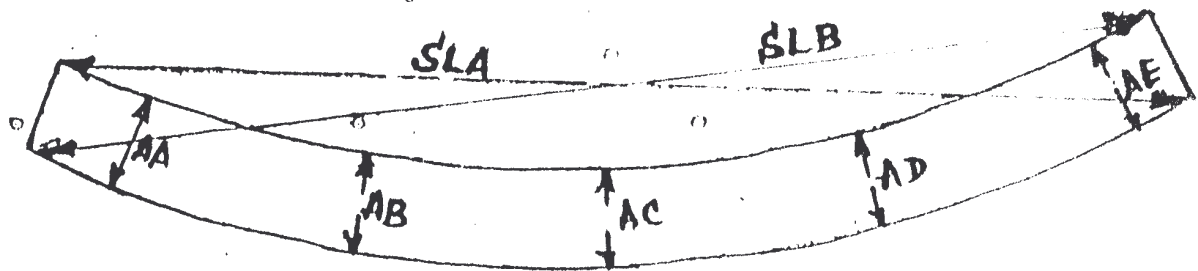
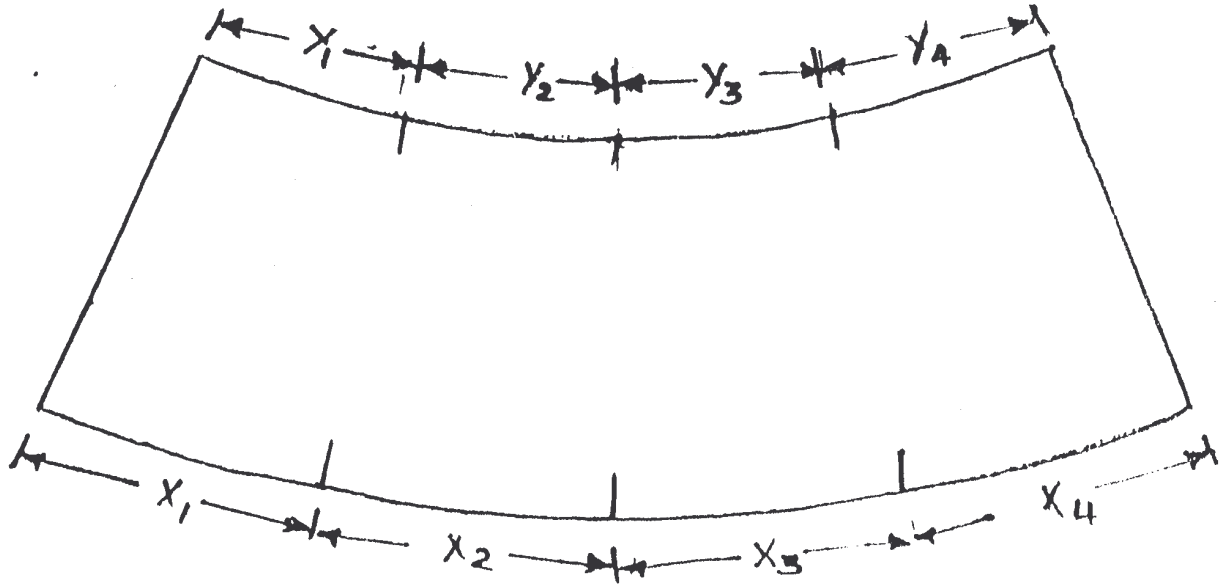
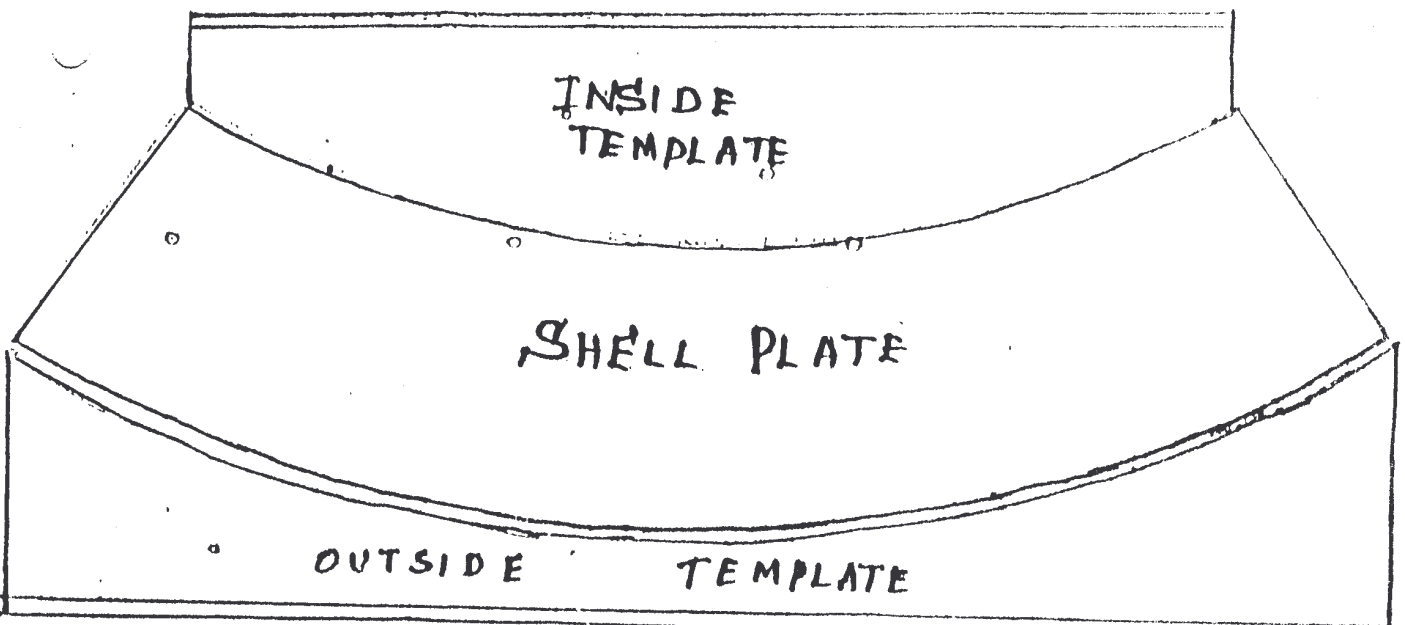


FIG-2



$$Y_1 = Y_2 = Y_3 = Y_4$$
$$X_1 = X_2 = X_3 = X_4$$

FIG-3



29-06-94

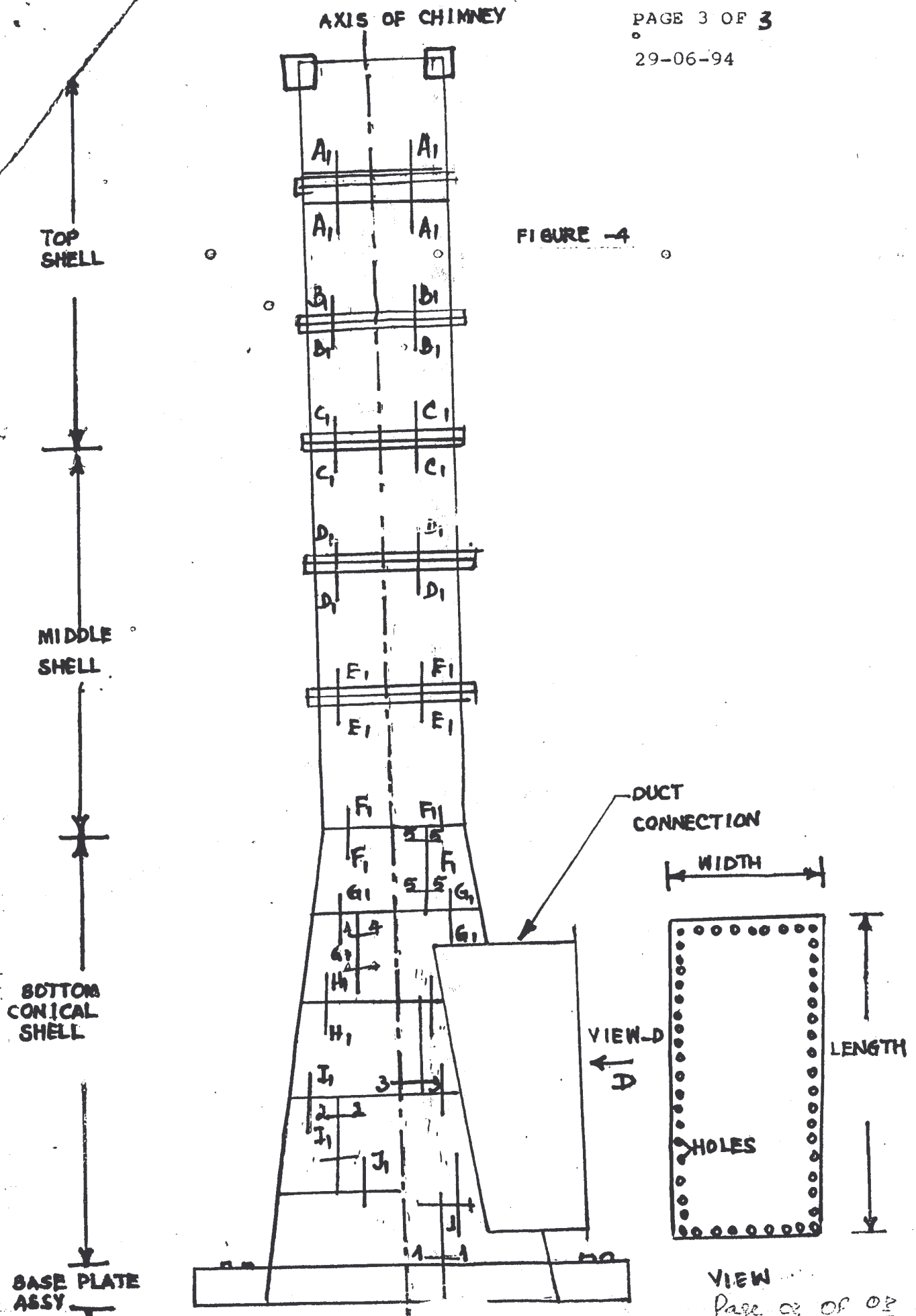


FIGURE -4

BHEL:BAP:RANIPET  
QUALITY DEPARTMENT

PR:QA:518  
REV:00  
Page 01 OF 03

PROCEDURE FOR SURFACE PREPARATION AND PAINTING  
OF WIND ELECTRIC GENERATOR TOWER  
AND NOCELLE ASSEMBLY.

EFFECTIVE DATE 27-05-95

	NAME	SIGNATURE & DATE
PREPARED BY	V JAYARAMAN	V. Jayaraman 28/5/95
REVIEWED BY	H ANANTHANARAYAN	HA

ISSUED BY : SM/QA

CONTROL COPY NUMBER

AB10

ISSUED TO: V. Jayaraman SM/QA

PC FILE NAME: PRQA518(FLOPPY NO:PRQA1)

**MASTER COPY**

BHEL:BAP:RANIPET  
QUALITY DEPARTMENT

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PR:QA:518  
REV:00  
DATE:27 05 95  
Page 02 OF 03

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1.0 SCOPE:

This procedure specifies the requirements of surface preparation and painting of WIND ELECTRIC GENERATOR Tower Structures and Nacelle Assembly.

2.0 Procedure:

2.1 All the Tower Components which are Hot Dip Galvanized shall be wiped clean with Cotton rags and if any oil or grease is seen on the surface it shall be cleaned by swabbing with cotton soaked in mineral Turpentine .

2.2 Wash Primer Application:

2.2.1 Thoroughly mix the contents of the two cans of the wash primer separately. Then mix them in the proportion given in the manufacturer's catalogue/datasheet. Thoroughly mix using a paddle stirrer.

2.2.2 Apply one coat of the wash primer by brushing. Allow to dry for atleast 12 hours.

2.3 Epoxy White Enamel Application:

2.3.1 Mix the contents of the two cans of the Epoxy Enamel paint. Mix the base and hardener in the proportion given in the supplier's catalogue. Do not mix too much paint. Just required paint only shall be mixed after calculating the area to be painted. The paint requirement can be calculated based on the nominal covering capacity of 7 sq mtrs/lit of the mixed paint.

2.3.2 Apply by brushing or Air spraying the mixed paint within 2 hours after mixing.

2.3.3 Do not remove the job for packing or despatch until 8 hours after the painting was done.

BHEL:BAP:RANIPET  
QUALITY DEPARTMENT

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PR:QA:518  
REV:00  
DATE: 2705 95  
PAGE:03 OF 03

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2.4 Nacelle Assembly:

2.4.1 Corp. R&D Design Nacelle Assembly cover

2.4.1.1 Surface preparation & cleaning:

Remove rust by rotary wire brush and cleaning by emery and compressed air. Apply Ruskil rust convertor over the surface allow to dry for 12 hours.

2.4.1.2 Then apply by spraying/brushing One coat of Epoxy Zinc rich primer on the interior followed by one coat of Epoxy white enamel paint. Total thickness shall be not less than (30+30) 60 microns.

2.4.1.3 Apply one coat of Red oxide Zinc chrome primer to is 2074 on the outside. After 18 hours apply one coat of Synthetic Enamel white paint to IS 2932 preferably by spray. Total thickness shall be not less than (25+25) 50 microns.

2.4.2 Nordex Design

Please refer QCP W-003, (Latest)

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PC:FILE:NAME:A:PRQA518(FLOPPY No:PRQA1)

**BHEL :: BAP :: RANIPET**


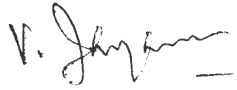

**QUALITY DEPARTMENT**

PR : QA : 542  
REV : 00  
DATE : 09/03/99  
PAGE No: 01 OF 02

**PROCEDURE FOR**

**TRIAL ASSEMBLY FOR CYLINDRICAL STEEL CHIMNEY SHELLS**

EFFECTIVE DATE :: 09/03/99

	NAME	DESIGN & DEPT	SIGNATURE
PREPARED BY	A ILANGO	INSPN ENGR/QA	
REVIEWED BY	V JAYARAMAN	MANAGER/QA	
APPROVED BY	H ANANTHANARAYANAN	DGM / QA	

ISSUED BY :: QA

ISSUED TO

CONTROLLED COPY NO

**MASTER COPY**

**BHEL :: BAP :: RANIPET  
QUALITY ASSURANCE**

**PR : QA :: 542  
REV :: 00  
DATE :: 09/03/99  
PAGE No : 02 OF 02**

---

**TRIAL ASSEMBLY PROCEDURE FOR CYLINDRICAL STEEL CHIMNEY SHELLS**

---

**01 SCOPE**

THIS PROCEDURE IS APPLICABLE FOR CONDUCTING THE TRIAL ASSEMBLY OF CYLINDRICAL, STEEL CHIMNEY SHELLS.

**02 PROCEDURE**

- 02.01** TRIAL ASSEMBLY WILL BE CARRIED OUT FOR FLANGED SHELLS AFTER DIMENSIONAL CHECK OF INDIVIDUAL SHELLS. FOR UNFLANGED SHELLS ONLY DIMENSIONAL CHECK IS APPLICABLE SINCE THEY ARE OF SAME THICKNESS
- 02.02** MATCH THE ADJACENT SHELLS IN LEVELLED HORIZONTAL SUPPORTS. THE FOLLOWING ARE TO BE ENSURED.
- (a) AXIS DEVIATION TO BE WITHIN 1/1000 OF SHELL HEIGHT.
  - (b) OUT OF SQUARENESS BETWEEN TWO ADJACENT SHELLS TO BE WITHIN LIMITS SPECIFIED IN THE DRAWING.
  - (c) ROOT GAP BETWEEN THE ADJACENT SHELLS TO BE WITHIN LIMITS SPECIFIED IN THE DRAWING.
- 02.03** AFTER TRIAL ASSEMBLY MARK MATCH MARKS ON THE ADJACENT SHELLS AS **A1-A1 ; B1-B1 ; C1-C1 ... etc.**
- 02.04** RECORD THE FIT UP OBSERVATION AND MATCH MARKS IN THE DIMENSIONAL REPORT / HISTORY CARD.

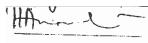
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QUALITY DEPARTMENT  
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QCP : D : 001  
REV : 00  
DT : 15 05 97  
PAGE 01 OF 06

QUALITY CONTROL  
PROCEDURE FOR

FABRICATION AND ASSEMBLY CHECKS  
-----  
ON DESALINATION PLANTS  
-----

PREPARED BY	V JAYARAMAN , MGR/QA	
REVIEWED	K LAKSHMAIAH , SM/QC_SHOP	
	M RAVINDRA , MGR/MSA	
	H A KERKETTA , MGR /QC - OL	
	M NATARAJAN , SPE/EDC-DESN	
	J T DURAIRAJ , DM/OP&C	
	D G SEKAR , DM/PRODN -A2	
APPROVED BY	H ANANTHANARAYANAN ,DGM/QA	

ISSUED BY DGM/QA

CONTROLLED COPY TO : V. JAYARAMAN, MSR/QA.

CONTROLLED COPY NO : AB10

RECORD OF REVISION

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REV .NO	DATE	CLAUSE REVISED	REASON
00	15 03 97	FRESH ISSUE	-----

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QUALITY CONTROL  
PROCEDURE FOR

FABRICATION AND ASSEMBLY CHECKS  
-----  
ON DESALINATION PLANTS \_  
-----

1.0 SCOPE :

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This Quality control procedure specifies visual inspection , fabrication checks , assembly checks and testing of Desalination plants.

2.0 MATERIALS:

-----  
All materials shall be procured from sources given in the approved vendor directory , all material shall be procured as per relevant standards/TDCs applicable and shall be taken into stock after verification of material test certificates.

Any change of material shall have the approval of EDC - Desalination.

3.0 WELDING:

-----  
3.1 Only qualified welding procedures shall be used for used for fabrication and welders with adequate experience and qualification in welding on the material combination Shall only be engaged for welding.

3.2 E7018 electrodes shall be used for welding of carbon steel material .

3.3 Where the WPS calls for low hydrogen electrodes these shall be baked and dried thoroughly as per shop procedures.

3.4 For stainless steel welding , root weld shall be done with TIG welding and other layers may be finished with MMAW (above 5mm thickness) / MAG(upto 5mm thickness) .

3.5 As the weld combinations are mostly AISI 316L material all welding electrodes shall be preferably AWS A5.22 E- 316 L16 or A-317 LT3, alternatively the electrodes may be AWS AWS A5.22 E- 309 MO - 16.

3.6 Post weld heat treatment is not required for any of the

-----  
Welds .  
-----

4.0 FABRICATION CHECKS:  
-----

- 4.1 All dimensions and tolerances shall be as per drawings.  
All untoleranced dimensions shall be as per PR : QA : 500 .
- 4.2 R.O Stack frame Assembly  
-----  
The marking of the position of all the stack angles drilling and slotting , slot pitches and sizes , shall be checked thoroughly . The foot holes sizes , pitches perpendicularity to the channel , all shall be thoroughly checked .
- 4.3 Ensure that the slotted face is facing top side on the slotted angles in every stack.
- 4.4 Ensure the soundness of weld and fillet sizes and LPI checks are done to ascertain the Quality of all the welds on the R.O Stack frame assembly.
- 4.5 Ensure that the bottom of support feet of the frame are on the same level and exactly on the same plane.
- 4.6 Check the diagonals of all the four sides of the frames and top and bottom diagonals are not varying beyond + or - 1.0mm .
- 4.7 Ensure that additional transport stiffeners are fitted on the top and bottom of the frame , to avoid distortion during transportation on the trailer/wagon.
- 4.8 All the welds of R.O stack frame shall be LPI tested after root welding and grinding and then final LPI testing shall be done before surface preparation and painting .
- 4.9 Thoroughly sand blast the frame to Sa 2 1/2 finish and cleanliness before applying one coat of marine epoxy paint at 50p per coat .
- 4.10 All pipe supports shall be appropriately edge trimmed before welding to the stack frame as per drawing. These shall be welded at site as per drawing.
- 4.11 Ensure that all pipe supports are checked with pin gauges or templates, to verify the correct position of the slots as per drawing.

4.12 These pipe supports also shall be sand blasted painted as per clause 4.8.

5.0 FEED PIPING AND BRINE PIPING  
-----

5.1 All stainless steel half couplings shall be checked with threaded plug gauges before fitting on to the headers. Mockup welding shall be carried out to check the distortion of threads. Suitable matching plugs shall be fitted before welding to control distortion. after welding all threads must be checked & corrected if required.

5.2 Weld all the piping as per drawing , checking layout , spatial orientation and lengths as per drawing.

5.3 Assemble the entire feed piping & brine piping as per orientation given in the drawing and match mark all the joint locations where pipes are to be dismantled for transportation. Please see Annexure I, II & III .

5.4 Do 100% LPI on the welds and 10% RT on the welds at random to ensure the soundness of the welded joints.

5.5 Using dummy plus at the pipe ends subject the feed piping assembly & brine piping assembly to hydro test pressure of 100 bars for not more than half an hour. For hydro test. the flanged valves may be removed and only welded valves may be retained in the piping.

5.6 Use the torque values , to tighten the fasteners on flanges of flanged joints as per drawing.

6.0 BRINE MANIFOLD IPE , FEED MANIFOLD PIPE , SS PIPING AT MEMBRANE  
-----

INLET AND SS BEND .  
-----

6.1 Check for the quality of the butt joints by root LPI and 10% random RT and final 100% LPI , after flesh grinding of the weld reinforcement .

6.2 Check for the socket groove size for all the socket welded T joints and weld nipples .

6.3 Ensure that on the brine manifold on the feed manifold T branch axes are on the same plane , deviation from planarity can be + or - 1 degree

6.4 Check the dimensions of the SS bend (inter) are as per drawing , the weld shall be as per clause 3.4 & 3.5 .

6.5 To prove the correct orientation and to do hydro test as an assembly , connect the SS feed piping and membrane in the .SS piping and do the hydro test as an assembly at 100 bar pressure for half an hour .

6.6 After welding , all threads shall be checked & corrected if required .

7.0 PACKING OF SS PIPING :

-----

7.1 All SS pipe assembly after dimensional checks , weld checks and position / orientation checks shall be dismantled after match marking and placed inside wooden boxes with adequate spacer supports to avoid any bend or transport distortion .

7.2 PAINT SUPPLIER LIST :

-----

Marine Epoxy Paint shall be bought from any one of the following paint suppliers .

( a ) M/S ASIAN PAINTS , MADRAS

( b ) M/S BERGER PAINTS , CALCUTTA

( c ) M/S BOMBAY PAINTS , BOMBAY

( d ) M/S JENSON & NICKHOLSON , CALCUTTA

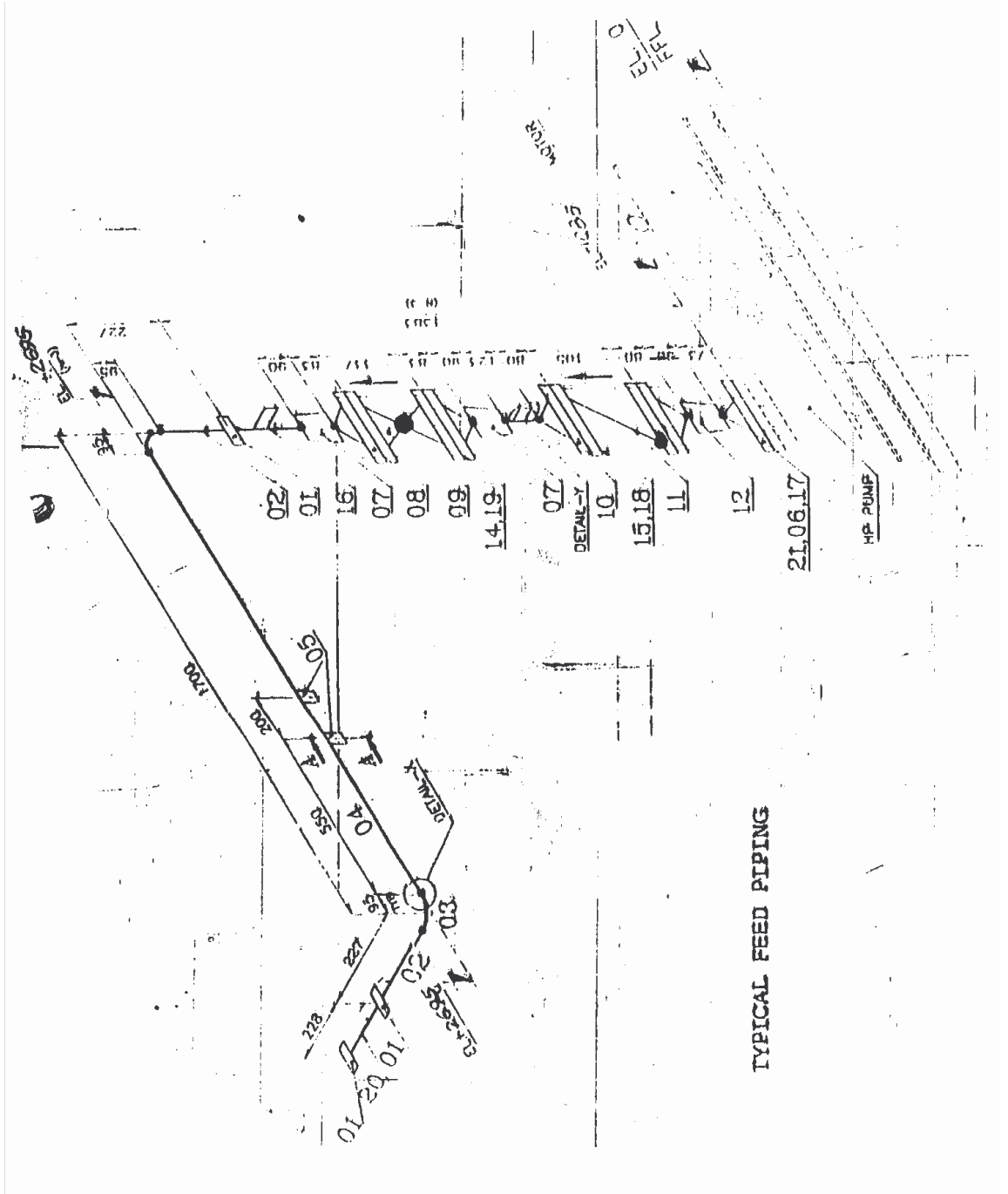
( e ) M/S SHALIMAR PAINTS , CALCUTTA

( d ) M/S WESTERN INDIA PAINT & COLOUR CO . , MADRAS .

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ANNEXURE - III

QCP : D : 001 / 00  
DT : 15 05 97  
Page 01 of 01



TYPICAL FEED PIPING







ANNEXURE - I  
TYPICAL R.O DESALINATION PLANT  
( COMPLETE ASSEMBLY ) \_




QCP : D : 001 / 00  
DT : 15 05 97  
Page 01 of 01

BHARAT HEAVY ELECTRICALS LIMITED  
TIRUCHIRAPALLI 620 014  
QUALITY ASSURANCE

SIP:NP:06/01

PAGE : 1 Of 6

**PROCEDURE FOR VISUAL INSPECTION OF NON PRESSURE PARTS**

REV.	DATE	PREPARED	REVIEWED	APPROVED
00	15/07/96	P.S.Narayanan	A.R.Reddy	V.Raghavendran
01	28/03/04	 A Francis	 G S N Murthy	 C R Raju

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REVISION STATUS  
-----

REVISION NO:	CLAUSE NO	DETAIL OF REVISION
00	----	1) PR:QE:021/02 renumbered as SIP:NP:06.  2) Editorial corrections for clarity.  3) Clause 3.1 modified.
01	3.1	Code related change
	3.2	For better clarity
	3.2.1	-do-
	3.2.3	Code related change
	3.2.5	For better clarity
	4.4	Code related change

## 1.0 SCOPE

1.1 This procedure details out the visual inspection of all base metal surfaces and weld joints of Non pressure parts.

## 2.0 REFERENCE DOCUMENTS

AWS D 1.1 & Relevant drawings

## 3.0 VISUAL INSPECTION OF GAS CUT EDGES

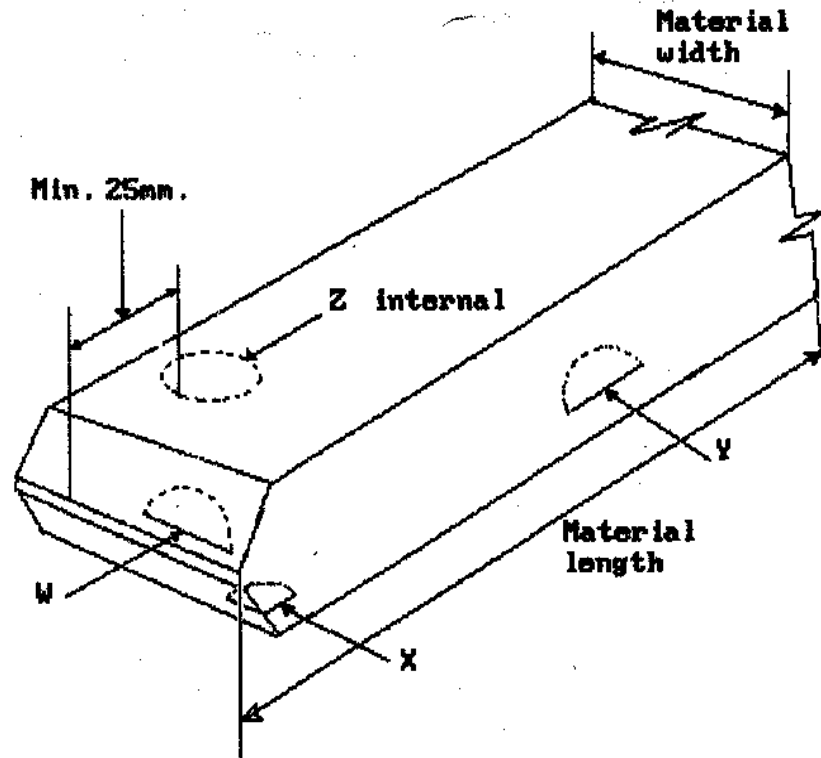
3.1 Acceptability and repair of mill induced laminar discontinuities in cut surfaces

Description of Discontinuity	Repair Required
Any discontinuity 25mm in length or less	No repair .
Any discontinuity over 25mm in length and 3mm max. depth (after grinding & confirmation of depth on 10% of total such locations)	No repair
Any discontinuity over 25mm in length with depth over 3mm but not greater than 6mm.	Remove by grinding and weld
Any discontinuity over 25mm in length with depth over 6mm but not greater than 25mm.	Completely remove and weld.
Any discontinuity over 25mm in length with depth greater than 25mm.	See Cl.3.2

3.2 For discontinuities over 25mm in length with depth greater than 25mm, discovered by visual inspection (and subsequent grinding for depth assessment) of plate cut edges/ bevel edges before welding or during examination of welded joints by radiography or ultrasonic inspection, following procedure shall be followed:

3.2.1 Prior to completing the weld joint, the discontinuities such as (W), (X) or (Y) shall be determined visually (for length) and by NDT (UT, and /or MPI) for depth and recorded for the size and shape of discontinuity as per Fig.1.

**Fig.1 EDGE DISCONTINUITIES IN CUT PLATE**



3.2.2 The repair of the discontinuity by welding shall be allowed in case area of discontinuity does not exceed 4% of the cut area with the following exceptions. If the width of the discontinuity or the aggregate width of discontinuities on any transverse section, as measured perpendicular to the plate length, exceeds 20% of the plate width, the limit of 4% area shall be reduced by percentage amount of the width exceeding 20% (e.g., if the discontinuity is 30% of plate width, the area of discontinuity cannot exceed 3.6% of the plate area). The discontinuity on the cut edge of the plate shall be gouged out to a depth of 25mm beyond its intersection of the surface by chipping, or carbon arc gouging, or grinding and blocked off by welding with manual shielded metal arc process in layers not exceeding 3mm in the thickness.

- 3.2.3 If discontinuity (Z) not exceeding the allowable area is discovered after the joint has been completed and is determined to be 25mm or more away from the face of the weld, as measured on the plate surface, no repair of discontinuity is required. If the discontinuity (Z) is less than 25mm away from the weld, it shall be gouged out to a distance of 25mm from the fusion zone of the weld by chipping, air carbon arc gouging or grinding. It shall then be blocked off by welding with low hydrogen SMAW process for at least four layers not to exceed 3mm thickness per layer. Submerged arc or other welding process may be used for remaining layers.
- 3.2.4 If the area of discontinuity (W), (X), (Y) or (Z) exceeds the allowable limits of Cl.3.2.2, the plate or sub-component shall be rejected.
- 3.2.5 The aggregate length of weld repair shall not exceed 20% of length of plate surface being repaired.

#### 4.0 VISUAL INSPECTION OF WELDS

- 4.1 Visual examination of welds shall be performed after completion of welding and subsequent cooling to room temperature. However for ASTM A514 and A517 steels visual examination of welds shall be performed only after 48 hours of completion of welding.
- 4.2 All welds shall be cleaned to remove slag, spatter etc. and visually examined for defects like crack, undercut, porosity, lack of fusion etc.
- 4.3 The welds shall also be examined for size, shape and reinforcement.

## 4.4 ACCEPTANCE CRITERIA AND DISPOSITION DETAILS ARE AS FOLLOWS

<u>Nature of defects</u>	<u>Acc. norms</u>	<u>Disposition</u>
1) Crack, Lack of fusion, Overlap	Not accepted	Confirm by LPI/MPI, repair and retest.
2) Crater (Except at the ends of stitch welds outside the required length)	Not accepted	Fill by weld deposit.
3) Undercut		
For T < 25.mm	Up to 1.0 mm accepted. (Upto 2.0 mm if within 50mm for any 300 mm weld Length.)	To be ground & merged/welded otherwise.
For T => 25.4 mm	Up to 2 .0 mm accepted.	>2.0mm to be ground and merged/welded
4) Porosity- Transverse Butt Welds	Piping porosity not permitted	
Porosity for other Butt/Fillet welds	One pore of <= 2.5 mm for Each 100 mm of Weld length is permitted. (*)	(*) Combined length of pores in fillet welds in web to stiffener: 10mm for 25 mm weld & 20mm for 300mm weld is however acceptable.
<u>Weld contour</u>		
1) Face of fillet	Flat or concave (meeting the throat) accepted. convexity is acceptable as below. 2mm for weld width <= 8mm 3mm for weld width > 8mm < 25 mm 5mm for weld width >= 25 m	
2) Size (Minimum)	As per drawing. Under size permitted as below (*) 2mm for nominal size < 5mm 2.5mm for nominal size 6mm 3mm for nominal size >= 8 mm * if undersized weld length is less than of 10% of the total weld length.	
3) Reinforcement (groove)	Max. 3 mm	

BHARAT HEAVY ELECTRICALS LIMITED

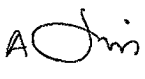

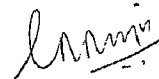


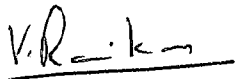
TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

QUALITY ASSURANCE

SIP: NP: 07/02

## WELDING/WELDER QUALIFICATION FOR STRUCTURAL APPLICATIONS

REV.	DATE	PREPARED	REVIEWED	APPROVED
00	15/07/96	P.S.Narayanan	A.R.Reddy	V.Raghavendran
01	13/10/03	 A Francis	 GSN Murthy	 C R Raju
02	25/11/09	 T. Palanisamy	 Bikramaditya Roy	 Ravikumar V

Revision no	Clause no	Revision details
00	--	--
01	--	1.PR:QE:172/00 Renumbered as SIP:NP:07 2.Editorial corrections for better clarity
02	--	1.Completely modified

## 1.0 SCOPE

1.1 This procedure details out the requirements of Welding procedure qualification/ Performance Qualification tests for welders and welding operators/ Welding procedure specification and maintenance of records for the same at sub Vendor works for structural application.

## 1.2 REFERENCE DOCUMENTS

1.2.1 AWS D1.1/D1.1M:2008.

## 2.0 WELDING PROCESS

- SMAW -Shielded Metal Arc Welding.
- SAW --Submerged Arc Welding.
- GMAW -Gas Metal Arc welding. (Note 1to3 to be strictly followed)

### #Note,

- Prior approval for GMAW to be obtained from BHEL/quality.
- Gas Mixture of 80% Argon & 20% CO2 to be ensured.
- All Production welds shall be done inside the closed shed only.

## 3.0 WELDING PROCEEDURE QUALIFICATION

3.1 Prepare draft WPS and get it approved by BHEL WTC.

3.2 Consumable selected for draft WPS shall be as per BHEL approved brand.

3.2.1 All NDE and pre treatment for plate before/after cutting & during/ after welding shall be as per the respective QCP & SQP.

3.3 Test plate of size 180x380mm of Specified thickness-2 nos for all butt (fig 5), corner (Fig 9) & fillet (fig 2) weld joints.

3.4 Minimum procedure qualification test requirement for Structural Fabrication : Carbon Steel to IS 2062 E250 GR A OR B.

Sl. NO	Process	PL. thick	Pre-heat	PWHT	Type of Jt.	Test-position	Position qualified
1	SMAW	25mm	NIL	NIL	Groove butt weld	1G	1G,1F
2	SMAW	40mm	YES 100deg.C	NIL	Groove butt Weld	2G	1G,2G,1F,2F
3	SMAW	56mm	Yes 100deg.C	Yes	Groove Butt weld	1G	1G,1F
4	SMAW	10mm	NIL	NIL	Corner weld	3G	3G, 3F
5	SMAW	*	NIL	NIL	Fillet	3F	3F
6	SAW	25mm	NIL	NIL	Butt weld	1G	1G,1F
7	SAW	25	Yes 100deg.C	NIL	Butt weld	1G	1G & 1F
8	SAW	56mm	YES 100deg.C	NIL	Corner weld	1G	1G & 1F
9	SAW	*	NIL	NIL	Fillet	1F	1F
10	SAW	*	NIL	NIL	Fillet	1F	1F
11	GMAW	10mm	NIL	NIL	fillet	3F	1F
12	GMAW	10mm	NIL	NIL	Groove butt weld	2G	1G,2G,1F,2F

Note:

1.0 \* Ref fig 8 for size of test plates for fillet welds.

- 2.0 For all other material combinations separate procedure to the relevant code/standard shall be qualified before start of production welds.
- 3.0 SAW corner groove weld qualification with  $15^{\circ}+30^{\circ}$  groove angle (ref fig9) shall be done along with plate groove butt weld.
- 4.0 For pipe WPS qualification Dia. 2 inch of schedule 80 and 6 inch of schedule 120 are to be welded in 5G & 2G position respectively. This qualifies for all sizes, positions and unlimited thickness of pipes and tubes.

3.5 Base material other than Carbon steel, applicable welding process is SMAW only. In such cases PQR shall be qualified as per AWS D.1.1.

3.6 Test shall be done in presence of BHEL/ QC or BHEL nominated AIA.

4.0 **BASE MATERIAL.**

4.1 Test plate base material shall match with drawing or other engineering Documents.

4.2 Test plate weld surface shall be ground smooth and free from Oil & scales.

5.0 **WELDING REQUIREMENT**

5.1 Weld groove configuration and dimensions shall be as shown in the Draft WPS, drawing or Sketch authorized by engineering for processing.

5.2 All Procedure qualification and production welds of SAW process shall be done in 1G/1F position only.

5.3 Details of process and consumable used for welding such as Preheat, consumable size, brand name, AWS classification for electrode, Wire and flux, Shielding gas etc shall be recorded and maintained.

5.4 Details of the welding parameters Such as Welding current, voltage, travel speed, wire feed, shielding gas mixture & gas flow rate etc shall be recorded and maintained.

5.5 Details of number of layers and passes of groove or fillet welds (fig6) shall be recorded.

5.6 Back gouge/grind the second side as applicable and ensure weld soundness by MT/PT before second side weld.

5.7 Complete the weld and ensure weld soundness by applicable NDE (MT, PT, and RT or UT).

5.8 Necessary PWHT (as per draft WPS) shall be done before marking the test Specimen for mechanical test.

5.9 The defective portion of the welds in the test plate shall be discarded and not repaired

## 6.0 Test plate Specimen & test requirement:

6.1 Test Specimen for butt welded test plate as per fig 5 and Fillet/ corner welded test plate as per fig 7 shall be punched with inspecting engineer's stamp before cutting the test specimen. (No. of test specimen shall be as per table-2)

6.2 WPS test specimen requirement for mechanical test are as follows:

**Table 2**

Test pl. thickness & dia. In mm	Reduced Section tensile	Bend test 4t, 180°			Macro	thick qualified		Dia. Qualified
		Root	face	Side		Min.	Max.	
T 3 to 10	2	2	2	*	--	3mm	2T	--
T>10 T < 25	2	--	--	4	--	3mm	2T	--
T25 & over	2	--	--	4	----	3mm	Unlimited	--
Dia. 50 & t6	2	2	2	-	--	3mm	20mm	Dia.20-100
Dia. 150 t12	2	2	2	-	--	5mm	Unlimited	Dia.>100mm
Corner/ fillet weld	--	--	--	--	3	5mm	Unlimited	--

\*For 10mm plate or wall thickness, a side bend test may be substituted for each of the required face- and root- bend tests.

## 7.0 Mechanical test

7.1 Prepare the test specimen as per AWS D1.1 and move to BHEL Lab or NABL accredited lab for mechanical testing.

7.2 Mechanical test to be done in presence of BHEL/QC or BHEL nominated AIA.

## 8.0 Preparation of PQR & WPS

8.1 Generate qualified WPS and PQR (as per the format enclosed in page 9 and 10) indicating all process parameters, Mechanical/ NDE test results, reports as applicable and submit to inspection engineer for verification and approval.

## 9.0 Welder/ Welding operator qualification (WQ)

9.1 The welder/ welding operators engaged for procedure qualification tests are automatically qualified for production welding.

9.2 Test material: for carbon and alloy steel respective materials shall be used for test.

9.3 Test plate size: 200x200x25 mm or 200x200 and respective plate thicknesses.

9.4 WQ Test and production position qualified are as follows.

**Table 3.**

Weld type	Test Position	Production position qualified
Plate Groove	3G	1G, 2G, 3G, 1F, 2F & 3F
Plate groove	1G	1G & 1F
Plate fillet	1F	1F
Plate Fillet	3F	1F, 2F & 3F
Pipe Groove	2G & 5G	All position.
Pipe fillet	4F	1F, 2F & 4F

**Note:** Additional position can be qualified if required. Only qualified personnel shall be engaged in respective positions for production weld.

9.5 WQ Test requirement: Two Nos of side bend tests or 100% RT for butt welded test piece. Macro examination at three faces for fillet welds as per fig 7.

9.6 On successful test results WQR (as per the format enclosed in page 8) to be prepared & countersigned by inspection engineer and maintained for verification.

9.7 **WQ period of effectiveness:**

Qualification is effective unless : 1) The operator or welder is not engaged in welding for a period exceeding six months or unless 2) There is a specific reason to question his ability.

10 **Documentation:**

10.1 Prepare consolidated list of qualified WPS, Welder and Welding operator qualification records and maintain.

11 **Qualification-Types & Limitations**

11.1 Requalification of WPS is required in the following cases

S1. No	Welding variable	SMAW	SAW	GMAW
1.	Change from Low hydrogen to non low hydrogen electrode	Yes	--	--
2.	Change from wire & flux combination	--	Yes	--
3.	Change in nominal filler metal diameter by	>0.8mm	Increase	yes
4.	>7% Change in voltage each dia. used	--	Yes	Yes
5.	% change in travel speed	--	>15	>25
6.	Change in position qualified	Yes	Yes	Yes
7.	A decrease in Groove angle	Yes	Yes	Yes
8.	A decrease in Root gap	Yes	Yes	Yes
9.	An increase in root face	Yes	Yes	Yes
10.	Addition or deletion of PWHT	Yes	Yes	Yes

12 **PQR/ WPS requirement for Different strength Base materials**

12.1 For dissimilar composition of Low strength to high strength welded connections separate PQR and WPS shall be qualified.

12.2 In such cases Low hydrogen electrodes shall only be used. (Preheat, Post heat and PWHT as per applicable SQP and draft WPS).

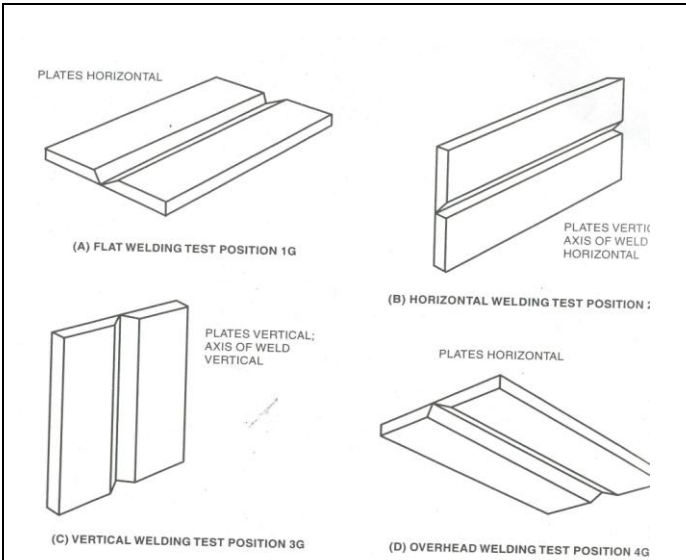


Figure 1

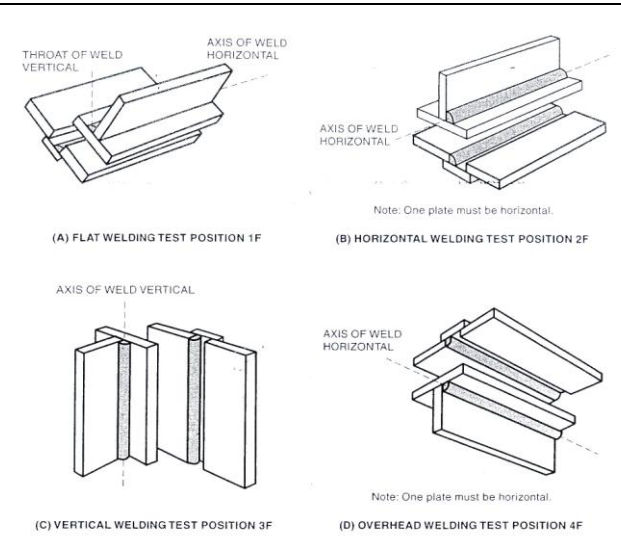


Figure 2

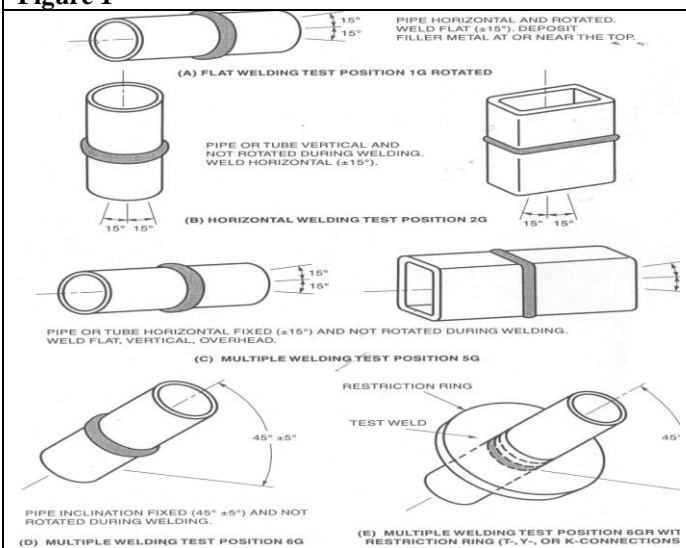


Figure 3

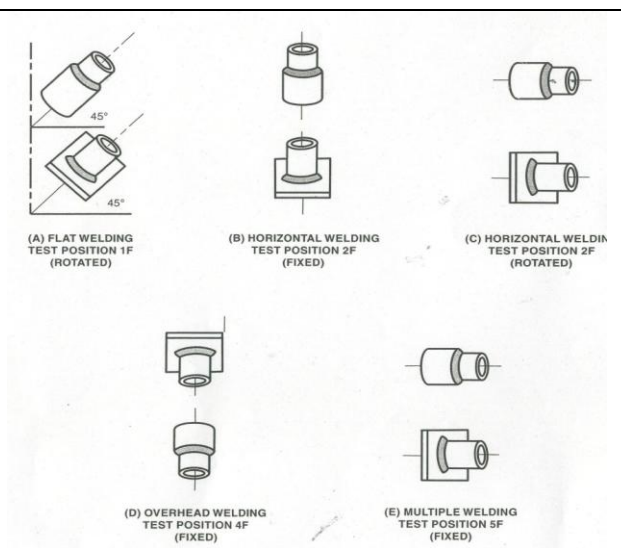


Figure 4

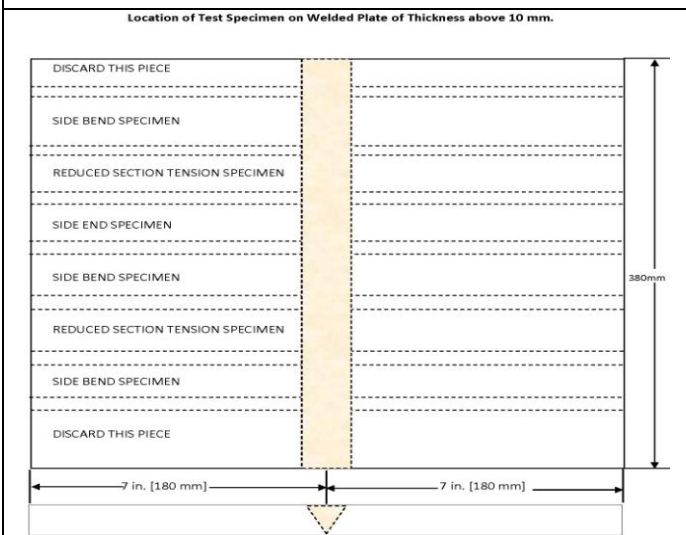
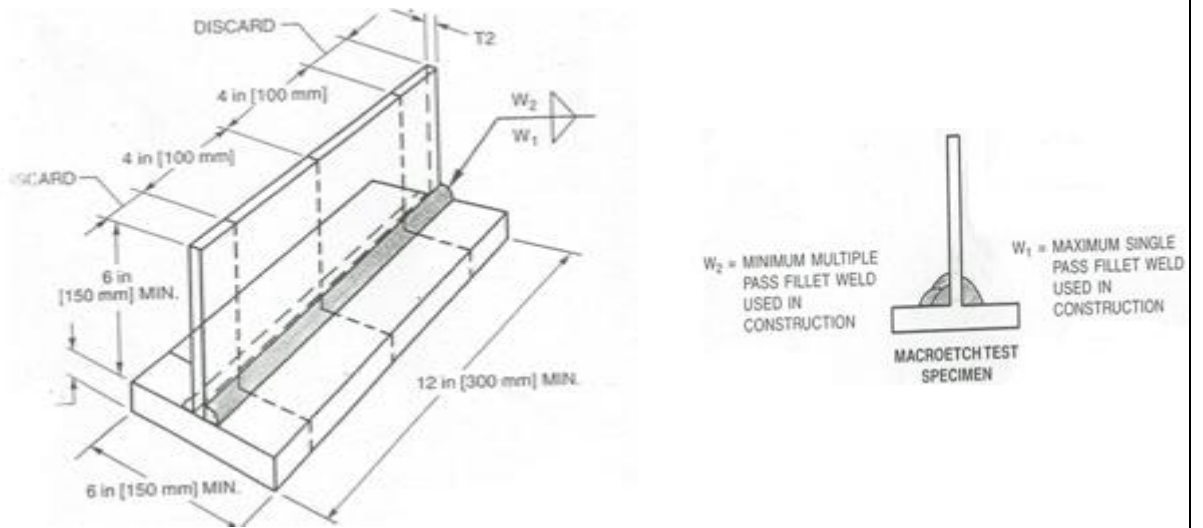


Figure 5

Fillet size	No. of layer	No. of Passes	Joint layer & passes
Up to 10mm	1	1	
12	1 2	1 2	
16	1 2 2	1 2 3	
20	1 2 3 3	1 2 3 4	
25	1 2 3 3 4 4 4 4	1 2 3 4 5 6 7	

Figure 6

**Figure 7 Fillet weld test specimen Details**

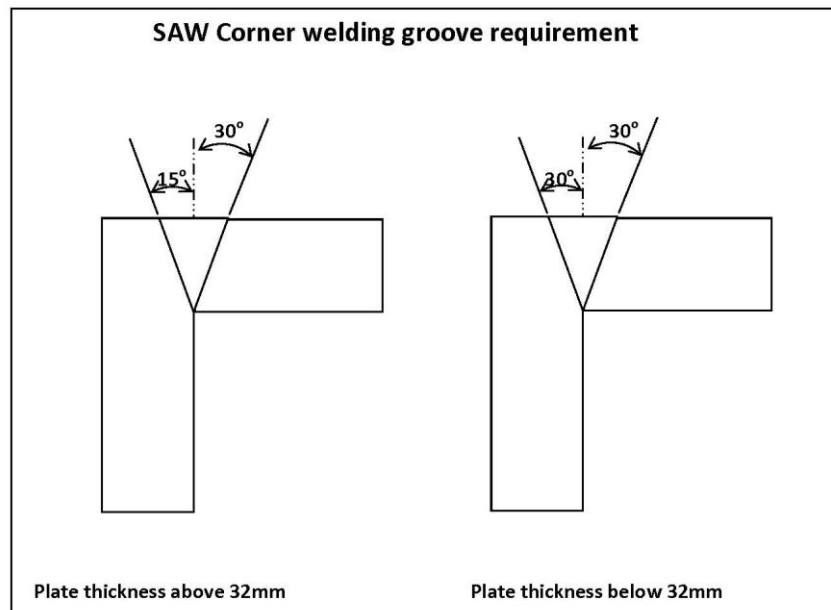


**Figure 8 Fillet weld Test plate Selection details**

Weld Size in mm	T1 minimum	T2 minimum
5	12	5
6	20	6
8	25	8
10	25	10
12	25	12
16	25	16
20	25	20
>20	25	25

Note: Where the maximum plate thickness used in Production is less than the value shown above, the Maximum thickness of the production plates may be Substituted for T1 & T2.

**Figure 9**



**WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD**

Type of Welder \_\_\_\_\_  
 Name \_\_\_\_\_ Identification No. \_\_\_\_\_  
 Welding Procedure Specification No. \_\_\_\_\_ Rev \_\_\_\_\_ Date \_\_\_\_\_

Variables	Record Actual Values Used in Qualification	Qualification Range
Process/Type [Table 4.12, Item (1)]	_____	_____
Electrode (single or multiple) [Table 4.12, Item (7)]	_____	_____
Current/Polarity	_____	_____
Position [Table 4.12, Item (4)]	_____	_____
Weld Progression [Table 4.12, Item (5)]	_____	_____
Backing (YES or NO) [Table 4.12, Item (6)]	_____	_____
Material/Spec.	_____ to _____	_____
Base Metal	_____	_____
Thickness: (Plate)	_____	_____
Groove	_____	_____
Fillet	_____	_____
Thickness: (Pipe/tube)	_____	_____
Groove	_____	_____
Fillet	_____	_____
Diameter: (Pipe)	_____	_____
Groove	_____	_____
Fillet	_____	_____
Filler Metal (Table 4.12)	_____	_____
Spec. No.	_____	_____
Class	_____	_____
F-No. [Table 4.12, Item (2)]	_____	_____
Gas/Flux Type (Table 4.12)	_____	_____
Other	_____	_____

<b>VISUAL INSPECTION (4.8.1)</b>			
Acceptable YES or NO _____			
<b>Guided Bend Test Results (4.30.5)</b>			
Type	Result	Type	Result
_____	_____	_____	_____
_____	_____	_____	_____
<b>Fillet Test Results (4.30.2.3 and 4.30.4.1)</b>			
Appearance _____	Fillet Size _____		
Fracture Test Root Penetration _____	Macroetch _____		
(Describe the location, nature, and size of any crack or tearing of the specimen.)			

Inspected by \_\_\_\_\_ Test Number \_\_\_\_\_  
 Organization \_\_\_\_\_ Date \_\_\_\_\_

<b>RADIOGRAPHIC TEST RESULTS (4.30.3.2)</b>					
Film Identification Number	Results	Remarks	Film Identification Number	Results	Remarks
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Interpreted by \_\_\_\_\_ Test Number \_\_\_\_\_  
 Organization \_\_\_\_\_ Date \_\_\_\_\_

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (\_\_\_\_\_) *Structural Welding Code—Steel*.  
 (year)

Manufacturer or Contractor \_\_\_\_\_ Authorized By \_\_\_\_\_  
 Form N-4 Date \_\_\_\_\_

**WELDING PROCEDURE SPECIFICATION (WPS) Yes**   
**PREQUALIFIED \_\_\_\_\_ QUALIFIED BY TESTING \_\_\_\_\_**  
**or PROCEDURE QUALIFICATION RECORDS (PQR) Yes**

Company Name \_\_\_\_\_  
 Welding Process(es) \_\_\_\_\_  
 Supporting PQR No.(s) \_\_\_\_\_

Identification # \_\_\_\_\_  
 Revision \_\_\_\_\_ Date \_\_\_\_\_ By \_\_\_\_\_  
 Authorized by \_\_\_\_\_ Date \_\_\_\_\_  
 Type—Manual  Semiautomatic   
 Machine  Automatic

**JOINT DESIGN USED**

Type:  
 Single  Double Weld   
 Backing: Yes  No   
 Backing Material: \_\_\_\_\_  
 Root Opening \_\_\_\_\_ Root Face Dimension \_\_\_\_\_  
 Groove Angle: \_\_\_\_\_ Radius (J-U) \_\_\_\_\_  
 Back Gouging: Yes  No  Method \_\_\_\_\_

**POSITION**

Position of Groove: \_\_\_\_\_ Fillet: \_\_\_\_\_  
 Vertical Progression: Up  Down

**BASE METALS**

Material Spec. \_\_\_\_\_  
 Type or Grade \_\_\_\_\_  
 Thickness: Groove \_\_\_\_\_ Fillet \_\_\_\_\_  
 Diameter (Pipe) \_\_\_\_\_

**ELECTRICAL CHARACTERISTICS**

Transfer Mode (GMAW) Short-Circuiting   
 Globular  Spray   
 Current: AC  DCEP  DCEN  Pulsed   
 Power Source: CC  CV   
 Other \_\_\_\_\_  
 Tungsten Electrode (GTAW)  
 Size: \_\_\_\_\_  
 Type: \_\_\_\_\_

**FILLER METALS**

AWS Specification \_\_\_\_\_  
 AWS Classification \_\_\_\_\_

**TECHNIQUE**

Stringer or Weave Bead: \_\_\_\_\_  
 Multi-pass or Single Pass (per side) \_\_\_\_\_  
 Number of Electrodes \_\_\_\_\_  
 Electrode Spacing Longitudinal \_\_\_\_\_  
 Lateral \_\_\_\_\_  
 Angle \_\_\_\_\_  
 Contact Tube to Work Distance \_\_\_\_\_  
 Peening \_\_\_\_\_  
 Interpass Cleaning: \_\_\_\_\_

**SHIELDING**

Flux \_\_\_\_\_ Gas \_\_\_\_\_  
 Composition \_\_\_\_\_  
 Electrode-Flux (Class) \_\_\_\_\_ Flow Rate \_\_\_\_\_  
 Gas Cup Size \_\_\_\_\_

**PREHEAT**

Preheat Temp., Min. \_\_\_\_\_  
 Interpass Temp., Min. \_\_\_\_\_ Max. \_\_\_\_\_

**POSTWELD HEAT TREATMENT**

Temp. \_\_\_\_\_  
 Time \_\_\_\_\_

**WELDING PROCEDURE**

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			

**Procedure Qualification Record (PQR) # \_\_\_\_\_**

**Test Results**

**TENSILE TEST**

Specimen No.	Width	Thickness	Area	Ultimate Tensile Load, lb	Ultimate Unit Stress, psi	Character of Failure and Location

**GUIDED BEND TEST**

Specimen No.	Type of Bend	Result	Remarks

**VISUAL INSPECTION**

Appearance \_\_\_\_\_  
 Undercut \_\_\_\_\_  
 Piping porosity \_\_\_\_\_  
 Convexity \_\_\_\_\_  
 Test date \_\_\_\_\_  
 Witnessed by \_\_\_\_\_

**Radiographic-ultrasonic examination**

RT report no.: \_\_\_\_\_ Result \_\_\_\_\_  
 UT report no.: \_\_\_\_\_ Result \_\_\_\_\_

**FILLET WELD TEST RESULTS**

Minimum size multiple pass	Maximum size single pass
Macroetch	Macroetch
1. _____ 3. _____	1. _____ 3. _____
2. _____	2. _____

**Other Tests**

**All-weld-metal tension test**

Tensile strength, psi \_\_\_\_\_  
 Yield point/strength, psi \_\_\_\_\_  
 Elongation in 2 in, % \_\_\_\_\_  
 Laboratory test no. \_\_\_\_\_

Welder's name \_\_\_\_\_

Clock no. \_\_\_\_\_ Stamp no. \_\_\_\_\_

Tests conducted by \_\_\_\_\_ Laboratory \_\_\_\_\_

Test number \_\_\_\_\_

Per \_\_\_\_\_

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (\_\_\_\_\_) *Structural Welding Code—Steel* (year)

Signed \_\_\_\_\_  
 Manufacturer or Contractor

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

SHARAT HEAVY ELECTRICALS LTD  
BOILER AUXILIARIES PLANT  
KANIPET-632 406 (INDIA)  
QUALITY ASSURANCE DEPT.

STANDARD QUALITY PLAN FOR WELDING

MASTER COPY

Q.P.No. SQM/01  
REV.No. NIL  
DATE 10-06-93  
PAGE 01 of 02

PREPARED BY: *V. Jayaram*

REVIEWED BY: *M. Tamil*

APPROVED BY: *M. Tamil*

No.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	FORMAT OF REC	AGENCY	REMARKS
2	3	4	5	6	7	8	9	10	11	
1	WELDING ELECTRODE/FLUXES	CHEMISTRY	M	LAB TEST	EACH BATCH	AWS A5.1, 5.7 5.5, 5.17 or 5.18	AWS A5.1.5.5 5.7, 5.17 or 5.18	TC	SUPPLIER	*T.C's WILL BE MAINTAINED BY WTC
2	STORAGE OF ELECTRODES/FLUXES IN STORES	METHOD OF STORAGE	MAJOR	VISUAL	100%	AS PER AWS 5.8, 5.17	A5.1, 5.5, 5.18 etc		STORES WTC	
3	ISSUE CONTROL	METHOD OF ISSUE	MAJOR	WQR	10%	AS PER WTC	DP&DI		WTC	
4	WELDER QUALIFICATION	WQR	MAJOR	LIST OF QUALIFIED WELDERS IN PRODN BAYS TO BE CHECKED	100%				WTC	VERIFICATION OF RECORD i.e, WQR
5	PROCEDURE QUALIFICATION	WPS	MAJOR	WPS TO BE VERIFIED FOR THE PARTICULAR MATL. COMBINATION	100%		ONLY THE QUALIFIED/PRE-QUALIFIED PROCEDURE FOR PARTICULAR MATERIAL COMBINATION AND POSITION METHOD SHALL BE USED		LIST OF QUALIFIED WELDER WTC	VERIFICATION OF RECORDS i.e, WPS
6	BAKING & DRYING OF LOW H2 ELECTRODES	DRYNESS OF LOW HYDROGEN ELECTRODES	MAJOR	VISUAL	RANDOM	WTC I:002/REV 02 DT. 15.7.93 AWS D.1.1 (LATEST)			LOG BOOK WTC	VERIFICATION OF RECORDS AT RANDOM

STANDARD QUALITY PLAN FOR  
WELDING

Q.P. SQW01  
REV. NO. NIL  
DATE 10.06.93  
PAGE 02 OF 02

1	2	3	4	5	6	7	8	9	10	11
7	PREHEAT, INTER PASS HEAT POST HEATING	TEMPERATURE OF JOB	MAJOR	BY THERMAL CHALK	RANDOM	PR:QA:/WPS/ OPS AND APPLICABLE	COLOUR CHANGE TO INDICATE CORRECT TEMP		PRODN/ QC	WITNESS AT RANDOM
8	ROOT WELDING OTHER WELDING	QUALITY OF WELD, INTER PASS CLEANING WIRE BRUSHING GRINDING	MAJOR	VISUAL	RANDOM	AS PER APPLI CABLE WPS, OPS, QCP, PR:QA	NO CRACKS ALLOWED		PRODN/ QC	WITNESS WELD REINFORCEMENT WELD UNDERCUT STANDARD REF. OF INSTRUMENT USED
9	NDE	QUALITY OF WELD	MAJOR	UT, RT PT, MT	AS PER APPLICABLE WI	AS PER APPLICABLE WORK INSTRUCTIONS		HC	QC	WITNESS
10	FILLET SIZES OF FILLET WELD	SIZE OF WELD	M	FILLET GAUGE CHECK	100%	AS PER DRAWING		HC	QC	WITNESS
11	POST WELD HEAT TREATMENT	CORRECTNESS OF SRT CYCLE	C	VERIFICA TION OF CYCLE AS PER PRODUCT HT CYCLE FROM HT SCHEDULE HT:001	100%	TEMPERATURE AT WHICH JOB LOADED IN FURNACE HEAT ING RATE SOAKING RATE SOAKING TIME COOLING RATE TEMPERATURE TO WHICH JOB TO BE FURNACE COOLED	AS PER SRT CYCLE IN HT:001 FOR THE PARTICULAR COMPONENT	HC	PRODN/ QC	VERIFICATION HT CYCLE