


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 corrections made for better clarity.Latest applicable TDC numbers incorporated.
02		SIP numbers updated
	2.4.1 Deleted.	Cl.2.4.2 to 2.4.5 renumbered.
	Note 2	
	Note 3	Deleted. Consequently, Note 4 to Note 7 renumbered as Note 3 to Note 6.
	3.2 & 3.2.1 in Note 3	Modified in line with QCP:002
	4.1.7 in Note 4	Out of straightness revised in line with AWS D1.1 (2002 edition)
	4.1.7.10(7)	Twist included
03.	Note-1	Matl. IS 2062 Re-designated & IS 8500 replaced with new designation
	NOTE-3	3.2 & 3.2.1 is Re-worded
		3.2.3 Cl. Added
	Note-4	4.1.10 new sub clause no added.
	Note-5	Clause no. 5 SR Temp changed.
04.	Cl 2.1, 2.4.3,2.4.4	Latest revision of NDE procedures updated.
	Cl 2.3	RT/UT included
	Note-1	E350 material added.IS 8500 removed.
Note {	2.4.5	Material substitution details given.
	3.2.1	Removed
	3.1.1,3.2.3	10% scope added.
	3.1.2.3	Newly added.
	3.2.4	Newly added.
	4.1.9	Monorail trial assembly added. Amendment A1 incorporated
	5.1,5.2&5.3	SR details added.


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GENERAL STRUCTURALS - Welded Design													
SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	CI.	TYPE OF CHECK	Quantum	REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD	Agency *			REMARKS		
							D	M	c	n			

1.0	MATERIAL Plates, Sheets & Rolled Sections	Chemical & Mechanical Properties	A	Review of documents	100%	TDC/Matl. Spec. Note 1		TC	P	W		
2.0	INPROCESS CONTROL			(Refer QCP 002 for details)								
2.1	Marking, Cutting, Edge Preparation	Shape, Size, EP, Diagonal Straightness Gas cut edges	B	Measurement	100%	Drawings & Note 2		R	P	V		
				MPI/LPI	Note-3	BHE:NDT:PB:MT 01, latest, BHE:NDT:PB:PT 01, latest		R	P	W		
2.2	Welding	Procedure Qlfn. Personnel Qlfn.	A	Review of Documents	100%	BHEL Procedure SIP:NP:07 latest		WPS	P	V		
				Review of Documents	100%	SIP:NP:07 latest		R	P	V		

LEGEND : CI: Class (A: Critical B: Major , C: Minor) * M : Manufacturer C :BHEL QC/TPI N : CUSTOMER QC :Quality Control ND: NDT Lab., PL: Plant lab, R : Record

 Tiruchirappalli		QUALITY ASSURANCE					STANDARD QUALITY PLAN					QP NO. : SQP:NP: 07 REV.: 04				
							GENERAL STRUCTURALS –Welded Design					DATE : 23/09/16				
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SL.	COMPONENT AND OPERATION	CHARECTERISTICS	CI.	TYPE OF CHECK	Quantum	REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD	Agency *				REMARKS				
NO.								D	M	c	n					

2.3	Weld Inspection	Weld size & finish	B	Visual/ Measurement	100%	Drawing	-	P	W			
	Butt welds	Soundness		RT/UT	Note 3	SIP:NP:06 latest BHE:NDT:SS:RT 05 latest BHE:NDT:PB:MT	R	P	V*			*Review of films
	T.Butt Joints	Soundness		RT/UT	Note 3	01,latest, BHE:NDT:PB:PT 01,latest	R	P	V*			
	Fillet welds	Soundness		LPI/MPI	Note 3		R	P	W			
2.4	DIMENSIONAL INSPECTION											
2.4.1	Ladder	Length, Step position,Ends	B	Visual & Measurement	100%	Drawing	--	P	W			
2.4.2	Buck stay beams	Corner piece,plate,pin connection,link-arrangements. Dimns. Soundness	A	Visual & Measurement	100%	Drawings	R	P	W			
						NOTE-4						
						BHE:NDT:PB:MT	R	P	W			
						01,latest,BHE:NDT:PB:PT	R	P	W			
						01latest BHE:NDT:SS:RT	R	P	W			
						05 latest						
2.4.3	Roof beams: Profile beam / rolled section	Shape,Size,profile Straightness Verticality	B	Visual & Measurement	Note-3 100%							
2.4.4	Built up beams/bracings & Monorails	Shape,size , length, verticality Match mark, Straightness Soundness		Plumb measurement visual	100%	Drawing	R	P	W			
						Note 4, BHE:NDT:PB:MT01latest BHE:NDT:PB:PT01latest, BHE:NDT:SS:RT						
					Note-3	05,latest	R	P	W			

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GENERAL STRUCTURALS –Welded Design													
SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	CI.	TYPE OF CHECK	Quantum	REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD	Agency *			REMARKS		
							D	M	c	n			

2.5	POST WELD HEAT TREATMENT(PWHT)	Temp,soaking Time,ROH/ROC		Review of HT chart	100%	Note 5		R	P	V		
3.0	Final inspection	Alignment, Matching, Orientation, & Inclination		Visual Measurement/	100%	SIP:NP: 09 latest		R	P	W		
3.1	Trial assembly			Water level		Note 4 Drawing						
3.2	Match marking Reference line,	Identification		Visual Measurement	100%			R	P	V		
3.3	Identification	WO.No.,DU No.& S/C code		Visual	100%	Drawings &QCP 002 latest		-	P	V		
3.4	Painting and Preservation	Surface preparation, DFT		Visual	100%	SIP:PP:22 latest		R	P	W		
				Check	Random							
3.5	Packing and Protection	Stability Cover/Shimplates		Visual	100%	Drawings SIP:PP:22 latest& NOTE-6		-	P	V		

Refer SQP:NP:027 rev03 for bolted design structures

NOTE-1

MATERIAL	MATERIAL SPEC.	TDC No.
Rolled sections	IS 2062 E250A/BR, E350 A, BR, BO&C ASTM A36, BSEN10025	0:301. as per specification
Plates and sheets	IS 2062 E250A/BR, ASTMA36, E350A, BR, BO&C	P1 0:301, 0:318 as per specification
	DIN 17100 St 52.3	0:302
	SA387 Gr 12	-P4 0:202
	SA387 Gr 22	-P5 0:202
	SA 515 Gr 60&70	-P1 0:202

NOTE-2

2.0 MARKING

- 2.1 Wherever applicable the squareness shall be ensured by checking Diagonals and reference lines shall be marked and punched.
- 2.2 For Rolled Beams dimensional tolerances shall be as given below.

1) Depth of section

- a) Upto 1 M : ± 3 mm
- b) 1M to 2M : ± 4.5 mm
- c) Above 2 M : + 7.5 mm, - 4.5 mm
- 2) Flange width : ± 3 mm
- 3) Web shift : 2 mm
- 4) Length : 1 mm / M. Max.5mm

2.3 CENTER LINE MARKING

- 2.3.1 All I section columns/Beams shall be marked with center lines, one on flange and other on one side of web. Box section columns will be marked on the web side. L section column shall be marked on the middle of leg.
- 2.3.2 Flange center line shall be obtained by joining the center point of web thickness at both ends.
- 2.3.3 Web center line shall be obtained by joining the mid points of the section depth at both ends.
- 2.3.4 After marking, the center line shall be identified by legible center punching to the length of 25mm with 5 dots and of size of dia. 2mm at the interval of 2 meters. The punched portion of center line shall be bordered with white paint.

2.4 MARKING AND PREPARATION OF ATTACHMENT PLATES

- 2.4.1 The length/width variation shall be within ± 2 mm, diagonal difference within 3 mm.
- 2.4.2 The flatness shall be checked and shall not exceed 2mm for plate size 50mm & below and 3mm above 50mm.

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2.4.3 The bolt holes and grout holes shall be marked and drilled as per drawing. Wherever specified in the drawing, match drilling shall be done with the mating part. The tolerance for finished holes are as follows:

1. Hole dia for friction grip bolts :+0.5 /-0 mm
2. Hole dia for other holes :+1 mm /- 0 mm
3. Individual pitches :±1 mm max.
4. Cumulative pitch :±2 mm max.

2.4.4 Where splicing of rolled sections are envisaged, it shall be ensured that the rolled section is straightened and meets the requirements given below:

1. Out of Straightness : 5 mm max.
2. Splicing edge : Square to surface
3. Web centre line offset : 1.5 mm max

2.4.5 Shop joint for rolled sections/plates shall be followed as per drg No:3-35-110-00686-Latest, Production notes drg. No: 4-35-110-00347/latest, 3-35-110-00995/latest.

NOTE-3

3.0 TYPE AND EXTENT OF NDE unless additional NDE is specified in CQPs.

3.1 BUTT WELDS - MPI

3.1.1 100 % M P I. for thickness above 25 mm upto and Including 32 mm.
10 % MPI per DU for thickness less than 25 mm.

3.1.2.0 MPI ON FLAME CUT EDGES

3.1.2.1 100% MPI-P3,P4&P5 - Flame cut edges t>12 mm
10% MPI- P1 - Flame cut edges t>20mm and below 38mm
100% MPI-P1 - For all flame cut edges t>=38mm
100%MPI- All beveled edges for t> 20mm for all materials.

3.1.2.2 100% LPI- Root groove areas after back chipping prior to welding second side for all groove plate butt weld and all spliced joint for rolled section.

3.1.2.3 Wherever Heat treatment is applicable required MPI/LPI shall be done after HT.

3.2 BUTT WELDS -RT

3.2.1 100% RT for carbon steel for t>32 mm.
For P3,P4 if t > 16 mm
For P5 if t > 12 mm

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- 3.2.2 100% RT on flange butt joint for mono rail beams of all sizes.
- 3.2.3 10% RT per DU for web butt joint in all built up monorail beams.
- 3.2.4 Wherever RT is not feasible UT shall be carried out with the discretion of BHEL/QC.
- 3.3 FILLET WELDS
- 3.3.1 100 % MPI, if both plate thickness over 25 mm.
- 3.3.2 10% MPI/LPI per DU all other fillet welds.
- 3.3.3 100% MPI/LPI on fillet welds of spliceplates for all thickness built up beams and rolled sections
- 3.3.4 100% MPI on all fillet welds of mono rail beam.

NOTE-4

4.0 FABRICATION TOLERANCES

- 4.1 The tolerances for fabrication shall be as per the relevant product drawing. However the following tolerances can be adopted, where not specified.
- 4.1.1 Length:
- a) For members where ends are free: $\pm 1 \text{ mm/M}$ subject to 5mm max
 - b) Members connecting between : $+0 \text{ mm} - 3\text{mm}$
two structural members
- 4.1.2 Web shift : 2mm
- 4.1.3 Out of squareness : 2mm
- 4.1.4 Combined warpage and tilt of flange of welded beams shall not exceed 1/100 of total width of flange or 6 mm whichever is greater.
- 4.1.5 The twisting of the beams or members shall not exceed $0.005h / 5\text{M}$ length subject to a maximum of 10 mm.
(where "h" is the height of beam)
- 4.1.6 Out of Straightness
- Length upto 15 Mtr. : 1 mm/Mtr and max. 10mm.
 - Length over 15 mtr. : 10mm + 1mm/M for the
length in excess of 15M.
- 4.1.7 For Frames of General Structures the following tolerances shall apply:
- Length and width : $\pm 1.5 \text{ mm/M}$ max. 6 mm
 - Difference between diagonals : 2 mm/M max. 8 mm
 - Height : $+ 1.5 \text{ mm/M}$ max. 6 mm
 - Spacing of intermediate members : $\pm 3 \text{ mm}$
- 4.1.8 For handrails the variation permitted in length is $\pm 3\text{mm}$ and bow is $\pm 2\text{mm}$ per meter subject to a maximum of 10mm.

4.1.9 For monorail beams the following tolerances shall apply
(clause Nos. 1 & 2 applies for all other beams also)

1.Depth of section	:±3 mm
2.Flange width	:+/- 3 mm
3.Flange width	:+2 mm, for monorail (+2, -0mm)
4.Web shift	: 2 mm
5.Length:	
Runways connected in between two structures (Span upto 12m)	: +0 mm, -2 mm
6.Mono rails	: +/-5mm.
7.Combined Warpage and tilt	: 3 mm max.
8.Sweep/Camber	: 5 mm max.

Monorail beams shall be checked for trial assembly as per Clause 7.0 of SIP :NP:02

NOTE:5

PWHT shall be performed for:

5.1 **Butt welds/Groove welds**

P1	All butt welds when $t > 50\text{mm}$ and web stiffeners at end bearing locations along with stool plate (except web to flange fillet & groove weld)	600-650°C
P3	All butt welds in tension members and all welds when $t > 16\text{mm}$	620-650°C
P4	All butt welds in tension members and all welds when $t > 16\text{mm}$	650-680°C
P5	All welds	680-710°C

5.2 **Fillet welds**

P1-	Not required	
P3	-if throat thickness $> 13\text{mm}$	620-650°C
P4	-if throat thickness $> 13\text{mm}$	650-680°C
P5	-All thickness	680-710°C

Where t =plate thickness in case of butt welds and weld thickness in case of groove welds for P1 materials .In case of combination of groove and fillet welds both weld depth and throat thickness are to be considered.

The load carrying members shall be heat treated for flame cut edges prior to welding as per Table -2. Alternatively for flame cut edges, the cut edges shall be ground or machined upto 3mm to remove HAZ.

For Local PWHT, general guidelines shall be as per QCP:002 (latest) and SIP:NP:11 (latest) shall be followed.

Table -2

scope	Material	Thickness	Heat treatment cycle
Flame cut edges	P1	> 50 mm	600°- 650°C for 30 minutes.
	P3	> 16 mm	620°- 650°C for 30 minutes.
	P4	> 16 mm	650°- 680°C for 30 minutes.
	P5	all thickness	680°- 710°C for 30 minutes.
Shear cut edges	P1	> 50 mm	600°- 650°C for 30 minutes.
	P3	> 13 mm	620°- 650°C for 30 minutes.
	P4	> 13 mm	650°- 680°C for 30 minutes.
	P5	>10mm	680°- 710°C for 30 minutes.

For materials other than P5, this heat treatment may be clubbed with the final heat treatment of the product

5.3 The preheat for welding and gas cutting shall be followed as per table -3. Preheat and post heat temperature referred in Table-3 shall be followed unless otherwise specified in WPS

Table:3

Scope	Material	Preheat	Post heat
Welding	P1-IS2062	t>38mm, 150°C	-
	E250	t>63mm, 150°C	-
	P1-IS2062	t>25mm, 150°C	-
	E350		
	P3&P4	allthickness, 150°C	-
	P5	allthickness, 150°C	250°C for 2 hours
Flame cutting	P1	t>50mm, 150°C	-
	P3&P4	t>16mm, 150°C	-
	P5	t<13mm, 120°C	-
		t=13to25mm, 150°C	
		t>25mm, 200°C	

5.4 Refer QCP 002 for process controls and other details

NOTE-6

- 6.1 While stacking of beams, ensure that the flange portion of the beam is kept horizontal and parallel to the firm ground. Adequate supports shall be provided so as to avoid sagging or distortion.
- 6.2 Storage, preservation, shipping shall be as per the relevant packing instruction.