
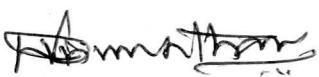
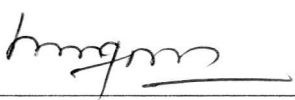


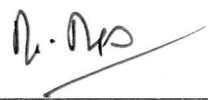



**BHARAT HEAVY ELECTRICALS LIMITED,  
TIRUCHIRAPPALI 620 014  
QUALITY ASSURANCE DEPARTMENT**

**STANDARD QUALITY PLAN FOR  
BOLTED STRUCTURES**

**SQP: NP: 27/03**

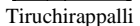
PREPARED BY QUALITY ASSURANCE (M.Jeyaram )	
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QUALITY ASSURANCE (R.Ramasamy)	

Revision No.	Date	Approved by	Signature
03	08/06/15	AGM / QA&BE	
02	17/02/15	AGM / QA&BE	-----
01	24/11/14	Tender purpose	-----

*Proprietary Data – For Internal Use only*

# RECORD OF REVISIONS

Rev. No.	Clause No.	Details of revision
01		The document released for tender purpose
02	Note-2 3.2	Post heating after welding details added.
	Note-5 10.a	Hole dimension value changed.
03	1.1	BSEN10025-4 S460N removed. TMCP condition added for E450BR/BSEN10025-4 S460M UT for $t \geq 10$ mm for TMCP plates added.
	3.1.5	Gas cut edges NDE requirement added
	3.1.6	Quantum of inspection changed from 100% to random, bevel edges thickness value added
	4.1	Welding consumables TC verification added.
	5.1	Quantum of inspection changed from 100% to random
	5.4	100% RT/UT added for ceiling girder welds
	6.2	100% for ceiling Girder welds
	7.0	specified for contract quality plan
	Note-1	TDC: 0:317 included for E450BR/BSEN10025-4 S460M
	Note-2&3	SA 299 Gr A material condition added.
	Note-4	PWHT requirement of E450BR/BSEN10025-4 S460M for TMCP condition added for welding and gas cutting. Ceiling girders specified
	Note-5	detail for machining added.
	Note-6	Table: 2 camber value added.
		10.a Fit bolts value added
	Note -7	SIP no.added for better clarity.

SL.  
NO.


### Columns (Box, Plus & I type), Beams, Bracings & Ceiling Girders

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[illegible]


1.0	Raw Material*	* The materials used shall be as per Drg.										
1.1	Plates & Rolled Sections. ASTM A36 , IS2062/ E250A&BR,E350C, E450 BR , BSEN10025-4/ S460M BSEN10025-2 / S355J2+N	Chemical &Mechanical Properties, Dimensions	A	Verification	100% \$	100%	TDC/Mtl.Spec. & Note 1	TC	√	V	V	\$ Raw.matl. correlated to TC for t > 40 mm on receipt. Further correlation to W.O. number&Matl Grade.  Plates of t >40mm shall be : a.100% furnace normalised for E250 BR and normalised rolling is acceptable for 40 > t ≤ 63 mm for E250 BR. b.100% furnace normalised for ASTM A36. IS 2062 E350C, E355J2/BSEN10025-2 shall be 100% furnace normalized condition only for all thickness. E450BR/ BS EN 10025- 4 S460M shall be 100% TMCP rolled condition only for all thickness.
		Soundness of plates	A	UT *	100%	100%	ASTM A435 / A578 Level A or B	TC	√	V	V	*UT for plates of ‘t’ ≥10 mm for TMCP plates and t>40mm for others

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					M	C			D	M	C	N			


<b>2.0</b>	<b>Qualification</b>												
2.1	Welding Control	Procedure Qualification	A	Review of documents	100%	100%	AWSD 1.1/ <a href="#">SIP:NP:07</a>	WPS/PQR	√	P	W		
2.2		Personnel Qualification	A	Review of documents	100%	100%	AWSD1.1/ <a href="#">SIP:NP:07</a>	WPQ	√	P	W		
2.3	NDE Personnel	Personnel Qualification	B	Review of documents	100%	100%	SNT-TC-1A, or Equiv.	Certificates	√	P	V		
<b>3.0</b>	<b>In process : Refer QCP :002 for process control</b>												
<b>3.1</b>	<b>Cutting Edge preparation , Fit up</b>												
3.1.1	Material Traceability	Transfer of Heat Number, Plate Number, Grade, DB. Number	B	Visual	100%	100%	Material Test certificates, Drawing	DB Report	√	P	W		Note 1
3.1.2	Material Marking	Marking	C	Review of documents	100%	Random	Drawing	Dim. Rec.	√	P	V		
3.1.3	Cutting , Punching, Drilling	Dimension	C	Visual, measurement	100%	Random	Drawing	Dim. Rec	√	P	V		
3.1.4	Preheating for gas cutting	Preheating Temperature	B	Visual	100%	100%	Note 2		√	P	W		Gas cut edges shall be free from slag and ground smooth.
3.1.5	Gas cut edges	NDE	B	MPI	100%* 10% #	Random	BHE:NDT:PB:MT-01(latest revision)	R	√	P	W		* $t \geq 38\text{mm}$ # $20 \leq t < 38\text{ mm}$
3.1.6	Edge Preparation (shop & site welds)	Groove Angle, Land & MPI	B	Visual, measurement & MPI	100%*	Random	Drawing / BHE:NDT:PB:MT-01(latest revision)	R	√	P	V		* bevel edges of $t \geq 20\text{ mm}$ .
<b>4.0</b>	<b>Welding</b>												
4.1	Welding consumables*	TC	B	Verification	100%	Batch / Lot	WCPI-207,417 (latest revision)		√	P	W		*For E450BR/ BS EN 10025-4 S460M and SA299
4.2	Fit Up	Root Gap, Groove angle , Mismatch	B	Visual & measurement	100%	Random	Drawing/WPS		√	P	V		
4.3	Welding Control	Preheating, Consumables, Welding	B	Measurement, Verification	100%	Random	WPS, Drawing, Preheating, Note-3		√	P	V		
4.4	Visual welds	Surface Quality, Profile	B	Visual	100%	100%	Drawing/ <a href="#">SIP:NP:06</a>		√	P	V		

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					M	C			D	M	C	N			

<b>5.0</b>	<b>NDE on Butt Welds</b>												
5.1	After back gouging	Weld Soundness	C	PT	100%	Random	BHE:NDT:PB:PT-01(latest revision)	R	√	P	W		
5.2	Finished Welds (Full penetration)- other than Ceiling Girders	Weld Soundness Plate Thickness. $\geq 32$ mm	B	RT/UT	100%	100% @	BHE:NDT:PB:PT-01(latest revision) BHE:NDT:PB:MT-01(latest revision) BHE:NDT:PB:RT-05(latest revision) BHE:NDT:PB:UT-31(latest revision)	R	√	P	W		@ Review of films/UT Witness.  #10% of joints per PGMA / Vendor
		Weld Soundness Plate Thickness. 25 mm<T<32 mm		RT & MT	10% & 100%	10% #		R	√	P	W		
		Weld Soundness Plate Thickness. T<25 mm		MT	10%	10%		R	√	P	W		
5.3	Partial Penetration Weld	Weld Soundness	B	MT/PT	100%	100%		R	√	P	W		
5.4	Ceiling Girder Flanges and webs	All thickness	B	RT/UT	100%	100% @	BHE:NDT:PB:RT-05(latest revision) BHE:NDT:PB:UT-31(latest revision)	R	√	P	W		@ Review of films/UT Witness.
<b>6.0</b>	<b>NDE on Fillet Welds</b>												
6.1	Finished Welds- other than Ceiling Girders	Weld Soundness	B	LPI/MPI	100%\$ /10% #	100%	BHE:NDT:PB:PT-01(latest revision) BHE:NDT:PB:MT-01(latest revision)	R	√	P	W		\$ when 't 'in both plate members is 25 mm and above # other fillet welds
6.2	Ceiling girder-flange ,web and stiffeners	Weld Soundness	B	MPI	100%	10%	BHE:NDT:PB:MT-01(latest revision)	R	√	P	W		
6.3	Lifting Hook	Weld soundness	B	MPI	100%	100%	BHE:NDT:PB:MT-01(latest revision)	R	√	P	W		
<b>7.0</b>	<b>Production Test Coupons (if specified in Contract Quality Plan)</b>												
7.1	For Butt Welds	Weld Soundness	B	RT and Mechanical Test (Tensile, Bend)	100%	100%	BHE:NDT:PB:RT-05(latest revision),	R	√	P	W		
7.2	Fillet Weld	Weld Soundness	B	Weld Fusion (Macro Etch)	100%	100%	AWS D 1.1	R	√	P	W		

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					M	C			D	M	C	N			

8.0	Post Weld Heat Treatment												
8.1	Post Weld Heat Treatment	Time and Temperature ROH, ROC	B	Verification of HT Chart	100%	100%	Note 4	R	√	P	V		
9.0	<b>End Plates/ Splice Joint Plates for bolted Connections</b>												
9.1	Machining/End milling	Surface finish, Squareness, Flatness	B	Measurement	100%	Random	Drawing	R	√	P	V		0.25 feeler gauge max. during assembly. Note-5 &Note7
9.2	Match Drilling	Dimension, Size and Pitch distance	B	Measurement	100%	Random	Drawing/ IS 7215	R	√	P	W		
10.0	<b>Final Inspection</b>												
10.1	Individual Piece	Dimension, Straightness (Camber & Sweep), Twist, Squareness and Orientation	B	Visual & measurement	100%	100%	Note -6	R	√	P	W		
10.2	Columns End	Dimension	B	Measurement	100%	100%	Note-6	R	√	P	W		
10.3	Marking identification of Parts	WO/DU Number Designation & S/c code	B	Visual	100%	100%	Drawing	R	√	P	V		
10.4	Trial Assembly of Columns,beams,bracings and Ceiling Girders & Grid Assembly	Overall Dimensions, Alignment, Elevation, Squareness and Match Marking	A	Visual & measurement	100%	100%	Trial Assembly Procedure /Drawing	R	√	P	W		Note-7
10.5	Surface Preparation and Painting	Surface finish, Shade, Dry film Thickness	B	Visual & measurement	100%	Random	Approved Painting scheme	R	√	P	W		
10.6	Verification of completion	Over all dimensions, compilations,marking,stencil ing,punching &dispatch clearance	B	Verification	100%	100%	All documents identified as 'R' in the D column			P	V		

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					M	C			D	M	C	N	

### Note 1

Material	Specification	TDC No.(latest revision)
Plates & Rolled Sections.	ASTM A36 , IS 2062/ E250A, E250 BR, E350C. E450 BR, BSEN10025-4/S460M, BSEN10025-2/S355J2+N	TDC:0:301 TDC: 0:317
Separate colour code to be maintained for BHEL material with separate storage area.		

### Note 2


Preheating for gas cutting

Material	Thickness (mm)	Preheat Temperature (minimum)
E350C	>50	100 <sup>0</sup> C
E450 BR, BSEN10025 /S460M&S355J2	>25	150 <sup>0</sup> C
SA299 Gr A	all thickness	150 <sup>0</sup> C

### Note-3

3.1 Preheating before welding (Unless specified otherwise in the WPS)

Material	Wall Thickness (mm)	Preheating Temperature ( <sup>0</sup> C)
E 350C	< 20	NIL Ensure freedom from water condensation
	>20	150
SA 299 Gr A	all thickness	150
E 450BR, BSEN10025 /S460M& S355J2	all thickness	220

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					M	C			D	M	C	

3.2 Post Heating after welding: (Unless specified otherwise in the WPS)

Material	Wall Thickness (mm)	Post heating Temperature (°C)
E 350C	< 20	NIL
	>20	150
SA 299 Gr A	all thickness	150
E 450BR, BSEN 10025/ S460M &S355J2	all thickness	220 -250

#### Note- 4

4.0 Post weld heat treatment (Stress relieving) shall be performed for:

- All welds when t>50 mm..... applicable for E250BR, E350C
- All welds for all thickness ..... applicable for SA299
- All welds when t>35 mm..... applicable for E 450BR, BSEN 10025 /S460M&S355J2

(Where t = plate thickness in case of butt welds and weld thickness in case of groove/fillet welds.)

The actual PWHT requirements shall be as per the BHEL approved WPS.

PWHT for all butt welds in ceiling girder flanges and webs.

- All gas cut edges of plates above 50mm thickness shall be stress relieved after cutting. In case of E450BR/S460M material, stress relieving shall be done after gas cutting for thickness above 35mm.Alternatively, the gas cut edges shall be ground/machined to 3mm width.

#### Note- 5


The machined/bolted surface shall be applied with rust preventive oil coating and the painting of that surface shall not be done.

All the machined and bolted surfaces should be suitably masked to avoid handling damages.

#### Legend:

M: Manufacturer / Sub- contractor, C : BHEL / Nominated Inspection agency. N: Customer/ Nominated Inspection agency. P: Perform, W: Witness, R –Records V: Verification of records for “W” Marked items  
TMCP : Thermo mechanical Controlled Process




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**Note:6 Tolerance**

**Table: 1 Individual Columns / Girders/Box Beams / Box Bracings**

Sl.No.	Structural Parts / Parameters	Tolerance in mm		
1	<b>Section Depth / width</b> upto and including 1.0 metre	+3 / -2 ( ± 1 at the joints)		
2	<b>Section Depth/Width</b> over 1.0 metre	+3 / -2 ( ± 2 at the joints)		
3	<b>Web Shift</b>	± 2		
4	Tolerance depending on length dimensions of structural items	Length Dimensions in mm		
		≤ 6000	> 6000 - ≤ 12000	> 12000
a	Columns	± 1	± 2	± 2.0
b	Built up beams	+0 / -2	+0 / -3	+0 / -4
c	Diagonal Bracings	+0 / -2	+0 / -2	+0 / -2
5	Bow in column Base Plate	1mm per metre of diagonal or 3mm whichever is greater		
6	<b>Camber</b>			
a	Column /Girder/ Built-up Beam	± L /2000 = 0.50 mm/ m where 'L' is overall length of column/ Beam / Diagonal Bracing subject to maximum of 5mm		
7	<b>Sweep</b>			
a	Column /Girder/ Built-up Beam	± L /2000 = 0.50 mm/ m where 'L' is overall length of column/ Beam / Diagonal Bracing subject to maximum of 5mm		
8	<b>Twist</b>	± a/3000 = ± 0.33mm/m, where 'a' is depth of member		
9	<b>Combined warpage</b>	W /100 or 3 mm whichever is greater where 'W' is the width of flange other than joint area		
10	<b>Drilled Holes for Bolts</b>			
a	Hole Dimension	+0.6 / -0 for others, +0.16/-0 for Fit bolts of TMG (Reaming required)		
b	Pitch distance of holes and distance between rows of holes	± 1		

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					M	C			D	M	C	N	

**TABLE: 2 Fabrication tolerances – Individual Beams & Bracings –Rolled Sections**

Sl.No.	Structural Parts / Parameters	Tolerance in mm
1	<b>Length</b>	
a	For members where ends are free	± 1mm / m subject to 5mm max.
b	For members connecting between two structural members	+0 / -3
2	<b>Deviation in straightness</b>	
a	<b>Sweep</b>	1mm/m upto 15m subject to max. of 10mm and for length over 15m : 10mm+1mm/m for the length in excess of 15m
b	<b>Camber</b>	5mm max.
3	<b>Twist</b>	± 1mm / metre or 6mm whichever is greater, where 'h' is depth of member
4	<b>Drilled Holes for Bolts</b>	
a	Hole Dimension	+0.6 , -0
b	Pitch distance of holes and distance between rows of holes	± 1

## 7.0 TRIAL ASSEMBLY

7.1 Trial assembly shall be performed by butting of ends (contact joints) without providing any gap. Variation in gap shall not be more than 0.25 mm for 80% of nominal contact area. Ensured by feeler gauge.

7.2 Alignment of centre line of all the pieces of flanges and webs water level deviation shall be within 2 mm.

7.3 As per Trial assembly procedure applicable SIP NP:018 & SIP NP:020.