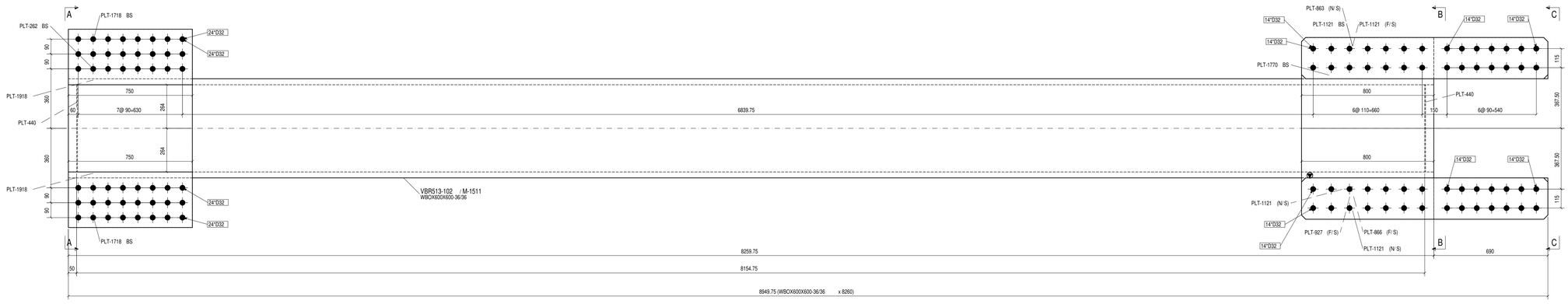
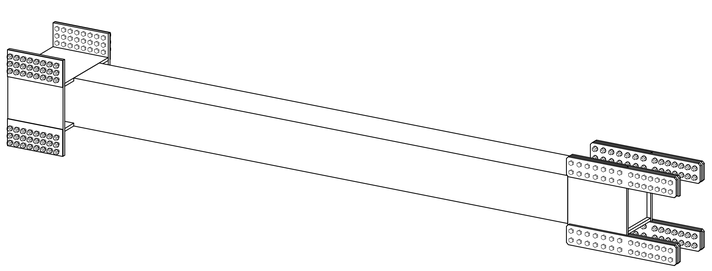
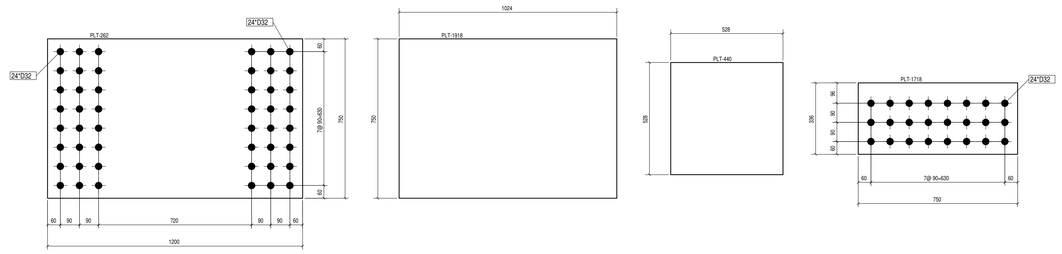
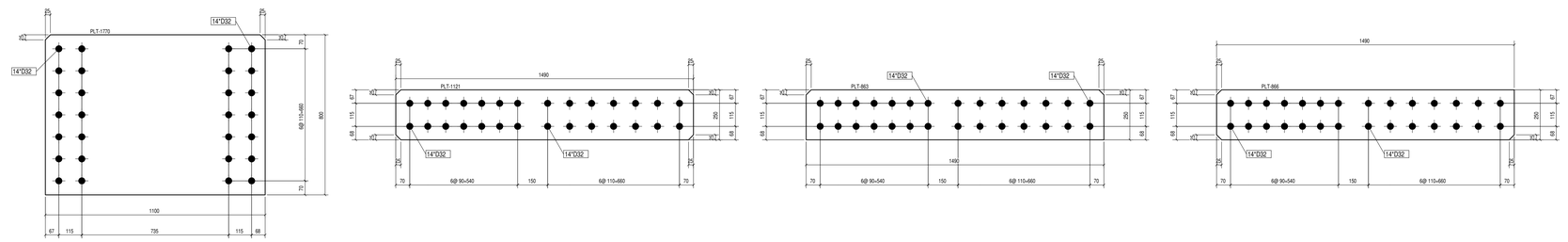
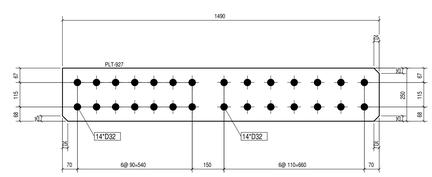
DRAWING NO. 0-35-513-27214

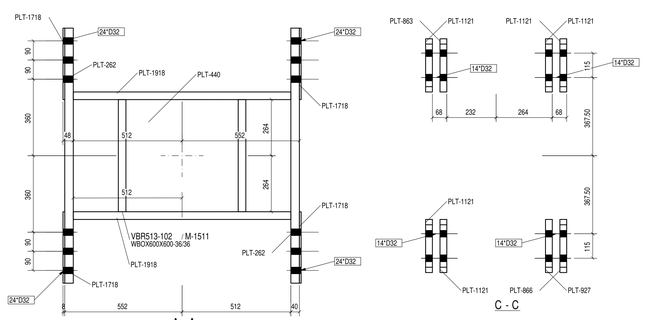












NOTES: —

FOR ASSEMBLY, REFER PRINCIPAL DRAWING MENTIONED IN GMS
FOR GA REFER DWG NO: 0-35-513-27229,0-35-523-27231,
0-35-533-27228.

	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER				KEEP	UNIT	UNIT WEIGHT		ZONE
					ITEM NO	MATERIAL CODE			QTY	QUANTITY		
					VAR NO	MATERIAL SPECN						
	14	PLATE-36 750.0x1024.0		PLT-1918		15-011-005 IS2062 E350BR			No	217.037		
	13	PLATE-36 800.0x1100.0		PLT-1770		15-011-005 IS2062 E350BR			No	248.511		
	12	PLATE-8 336.0x750.0		PLT-1718		15-011-193 IS2062 E350BR			No	15.826		
	11	PLATE-32 250.0x1490.0		PLT-1121		15-011-013 IS2062 E350BR			No	93.256		
	10	PLATE-32 250.0x1490.0		PLT-927		15-011-013 IS2062 E350BR			No	93.336		
	9	PLATE-32 250.0x1490.0		PLT-866		15-011-013 IS2062 E350BR			No	93.337		
	8	PLATE-32 250.0x1490.0		PLT-863		15-011-013 IS2062 E350BR			No	93.413		
	7	PLATE-8 528.0x528.0		PLT-440		15-011-213 IS2062 E250BR			No	10.942		
	6	PLATE-40 750.0x1200.0		PLT-262		15-011-008 IS2062 E350BR			No	282.600		
	5	PLATE-36 626X626		M-1511xWEB		15-011-005 IS2062 E350BR			No	1232.461		
	4	PLATE-36 600X626		M-1511xFL		15-011-005 IS2062 E350BR			No	1400.524		
	3	PLATE-36 600X626		M-1511xFL		15-011-005 IS2062 E350BR			No	1400.524		
	2	NUT HEX Gr.C M24				4130400024			No	0.110		
	1	BOLT HEX Gr.C M24x120.0				4122124120			No	0.526		

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TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

	NAME	SIGNATURE	DATE
DRN	SSR/KSP		20.12.2018
CHD	A.GANESAN		21.12.2018
APPD	M.SHANMUGAM		24.12.2018

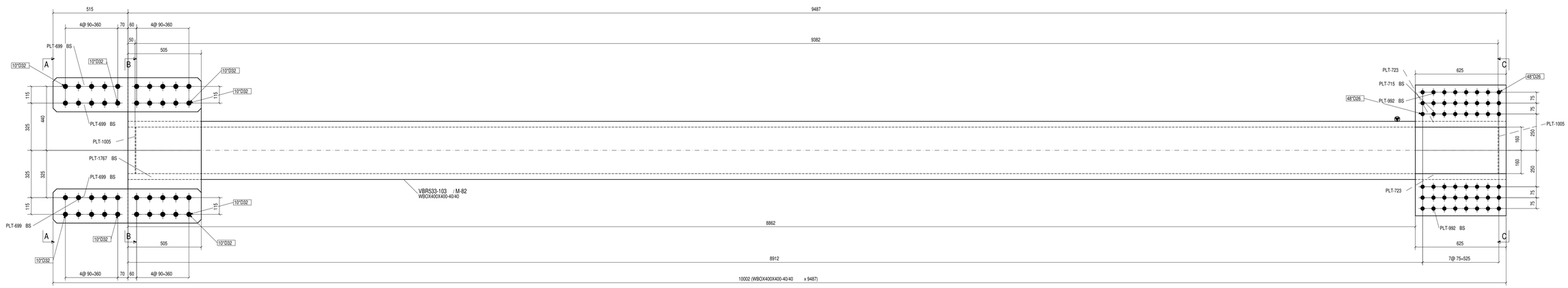
DEPT: ST
CODE: 122
ALL DIMENSIONS ARE IN MM
PROJECTION
SCALE: NTS
WEIGHT (Kg): 7068.371
REF TO ASSY / OLD DWG

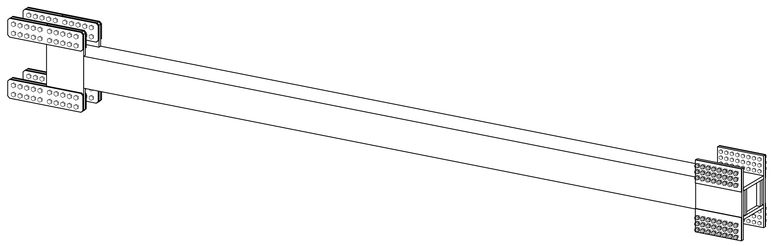
TITLE: VBR513-102
DRAWING NO.: 0-35-513-27214
REV

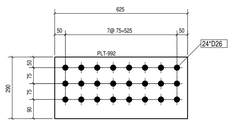
1 NUMBER REQUIRED AS DRAWN, MARKED VBR513-102

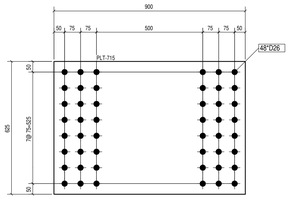
DRAWING NO. 0-35-533-27227

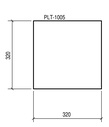
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO:TP 023 0299

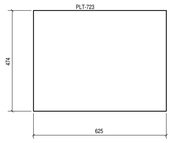


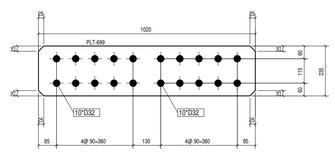


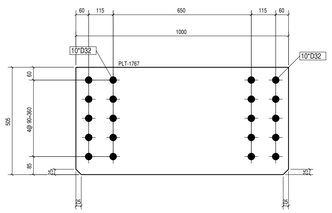


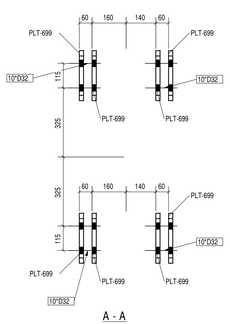


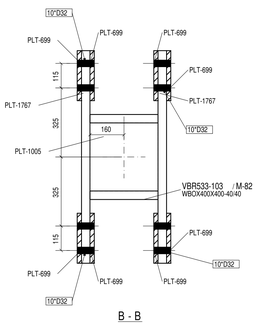


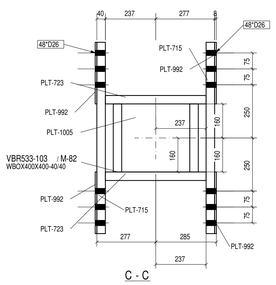












NOTES: –

FOR ASSEMBLY, REFER PRINCIPAL DRAWING MENTIONED IN GMS FOR GA REFER DWG NO: 0-35-513-27229,0-35-523-27231, 0-35-533-27228.

WMAP NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	KG/P	UNIT	UNIT WEIGHT	QC	ZONE
					VAR NO	MATERIAL SPECN		DI	QUANTITY		
	11	PLATE-40 505.0x1000.0		PLT-1767		15-011-028 IS2062 E350BO		No	158.374		
	10	PLATE-5 320.0x320.0		PLT-1005		15-011-213 IS2062 E250BR		No	4.019		
	9	PLATE-8 290.0x925.0		PLT-992		15-011-103 IS2062 E350BO		No	11.383		
	8	PLATE-40 474.0x925.0		PLT-723		15-011-028 IS2062 E350BO		No	93.003		
	7	PLATE-40 625.0x900.0		PLT-715		15-011-028 IS2062 E350BO		No	76.625		
	6	PLATE-20 235.0x1020.0		PLT-699		15-011-068 IS2062 E350BO		No	37.437		
	5	PLATE-40 320X9487		M-82xWEB		15-011-028 IS2062 E350BO		No	953.253		
	4	PLATE-40 400X9487		M-82xFL		15-011-028 IS2062 E350BO		No	1191.566		
	3	PLATE-40 400X9487		M-82xFL		15-011-028 IS2062 E350BO		No	1191.566		
	2	NUT HEX Gr.C M24				4130400024		No	0.110		
	1	BOLT HEX Gr.C M24x100.0				4122124120		No	0.526		
									16		

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TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

	NAME	SIGNATURE	DATE
DRN	SSR/KSP		20.12.2018
CHD	A.GANESAN		21.12.2018
APPD	M.SHANMUGAM		24.12.2018

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
ST			NTS	5215.069	

CODE: 122

TITLE: VBR533-103

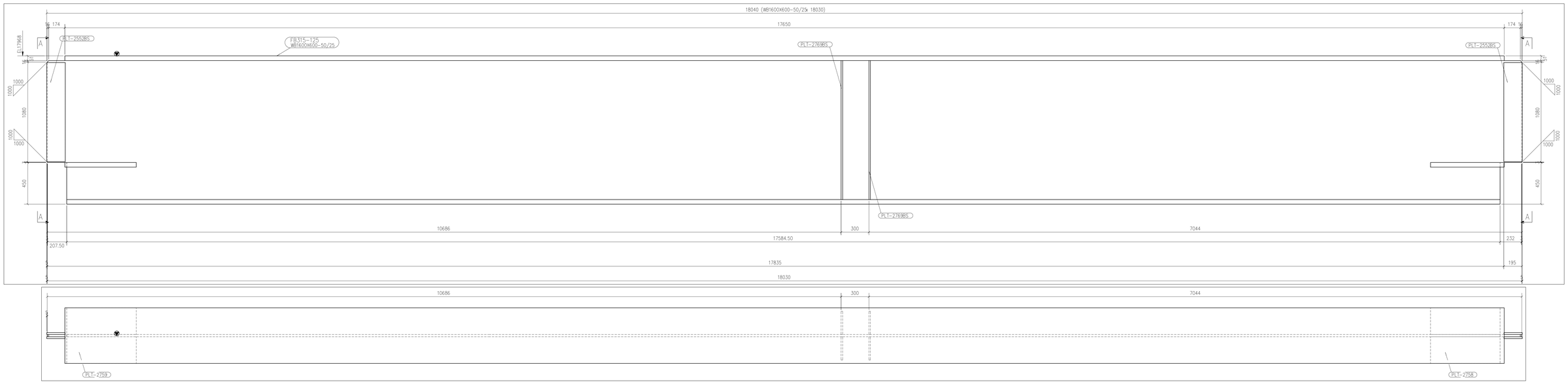
DRAWING NO.: 0-35-533-27227

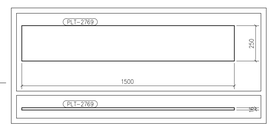
REV:

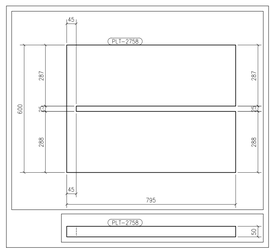
2 NUMBERS REQUIRED AS DRAWN, MARKED VBR533-103

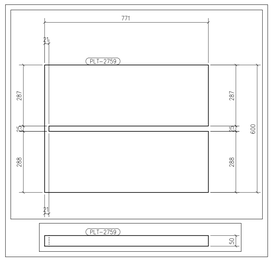
DRAWING NO: 0-36-315-24660

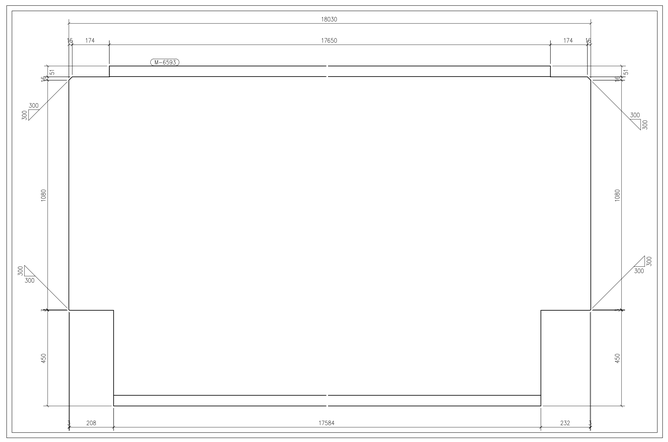
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299

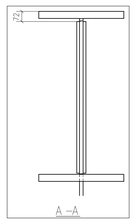












NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

	7	PLATE-16 250.0x1500.0		PLT-2769	15-011-026 IS2062E250A(Tx410W)	No	4	47.100		
	6	PLATE-50 600.0x771.0		PLT-2759	15-011-106 IS2062E250B(Tx410W)	No	1	174.107		
	5	PLATE-50 600.0x795.0		PLT-2758	15-011-106 IS2062E250B(Tx410W)	No	1	179.863		
	4	PLATE-20 200.0x1070.0		PLT-2552	15-011-150 IS2062E250A(Tx410W)	No	4	33.598		
	3	PLATE-25 1500x18030		M-6593xWEB	15-011-081 IS2062E250B(Tx410W)	No	1	1307.481		
	2	PLATE-50 600x17650		M-6593xTFL	15-011-106 IS2062E250B(Tx410W)	No	1	4156.575		
	1	PLATE-50 600x17584		M-6593xBFL	15-011-106 IS2062E250B(Tx410W)	No	1	4141.136		
DRAWING NUMBER / ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	A/U/P	UNIT	UNIT WEIGHT	QC	ZONE
				VAR NO	MATERIAL SPECN		QY	QUANTITY		

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TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

	NAME	SIGNATURE	DATE
DRN	KARTHIKEYAN		26.06.2018
CHD	PADMANABAN		27.06.2018
APPD	SARAVANAKUMAR		27.06.2018

355-052

DEPT: ST | CODE: 122 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE: NTS | WEIGHT (Kg): 14246.952 | REF TO ASSY / SUZ DWG

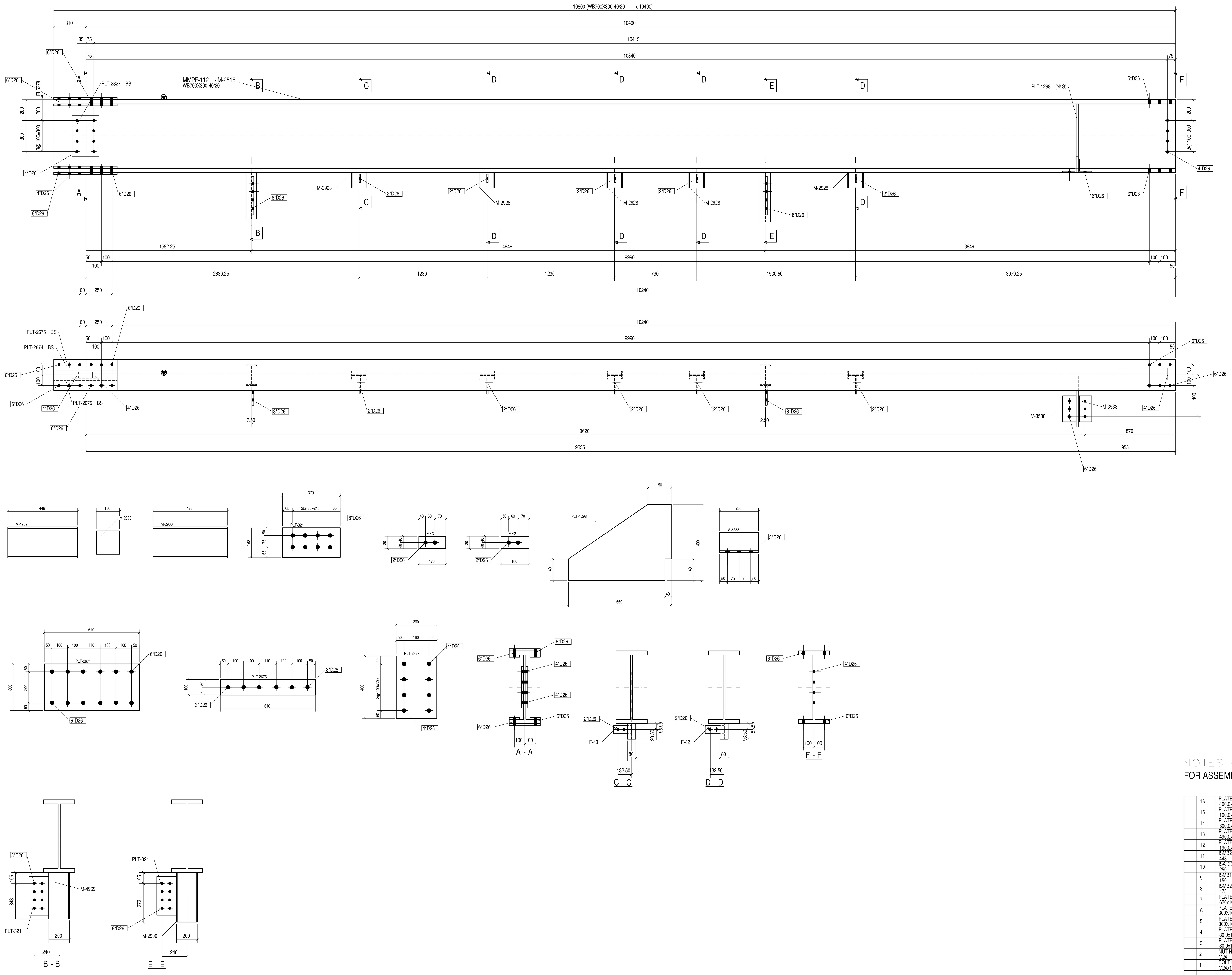
TITLE: FB315-125

DRAWING NO : 0-36-315-24660 | REV

1 No. REQUIRED AS DRAWN MARKED. FB315-125

0-38-410-03899 DRAWING NO

FOR TOLERANCES OF UNTOLERANCED
DIMENSIONS DURING MANUFACTURE
REFER PLANT STD. NO TP 023 0299



6 NUMBERS REQUIRED AS DRAWN, MARKED MMPF-112

NOTES: –
FOR ASSEMBLY, REFER PRINCIPAL DRAWING MENTIONED IN GMS

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/C/P	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	16	PLATE-20 400.0x260.0		PLT-2827		15-011-218 / IS2062 E250BR		No	16.328 / 2		
	15	PLATE-20 100.0x610.0		PLT-2675		15-011-218 / IS2062 E250BR		No	9.577 / 4		
	14	PLATE-20 300.0x610.0		PLT-2674		15-011-218 / IS2062 E250BR		No	28.731 / 2		
	13	PLATE-20 490.0x660.0		PLT-1298		15-011-218 / IS2062 E250BR		No	35.882 / 1		
	12	PLATE-16 190.0x370.0		PLT-321		15-011-217 / IS2062 E250BR		No	8.830 / 2		
	11	ISMB200 448		M-4969		15-009-012 / IS2062 E250A		No	11.379 / 1		
	10	ISA130X130X12 250		M-3538		15-013-171 / IS2062 E250A		No	5.875 / 2		
	9	ISMB150 150		M-2928		15-009-022 / IS2062 E250A		No	2.250 / 5		
	8	ISMB200 478		M-2900		15-009-012 / IS2062 E250A		No	12.141 / 1		
	7	PLATE-20 620x10490		M-2516xWEB		15-011-218 / IS2062 E250BR		No	1021.097 / 1		
	6	PLATE-40 300X10490		M-2516xTFL		15-211-008 / IS2062 E250BR		No	988.158 / 1		
	5	PLATE-40 300X10490		M-2516xBFL		15-211-008 / IS2062 E250BR		No	988.158 / 1		
	4	PLATE-12 80.0x173.0		F-43		15-211-003 / IS2062 E250BR		No	1.301 / 1		
	3	PLATE-12 80.0x180.0		F-42		15-211-003 / IS2062 E250BR		No	1.356 / 4		
	2	NUT HEX Gr.C M24				4130400024		No	0.110 / 8		
	1	BOLT HEX Gr.C M24x100.0				4122124100		No	0.455 / 8		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014
355-052

	NAME	SIGNATURE	DATE
DRN	SAD/GOKUL		30.11.2018
CHD	MUTHU		30.11.2018
APPD	VSRK		30.11.2018

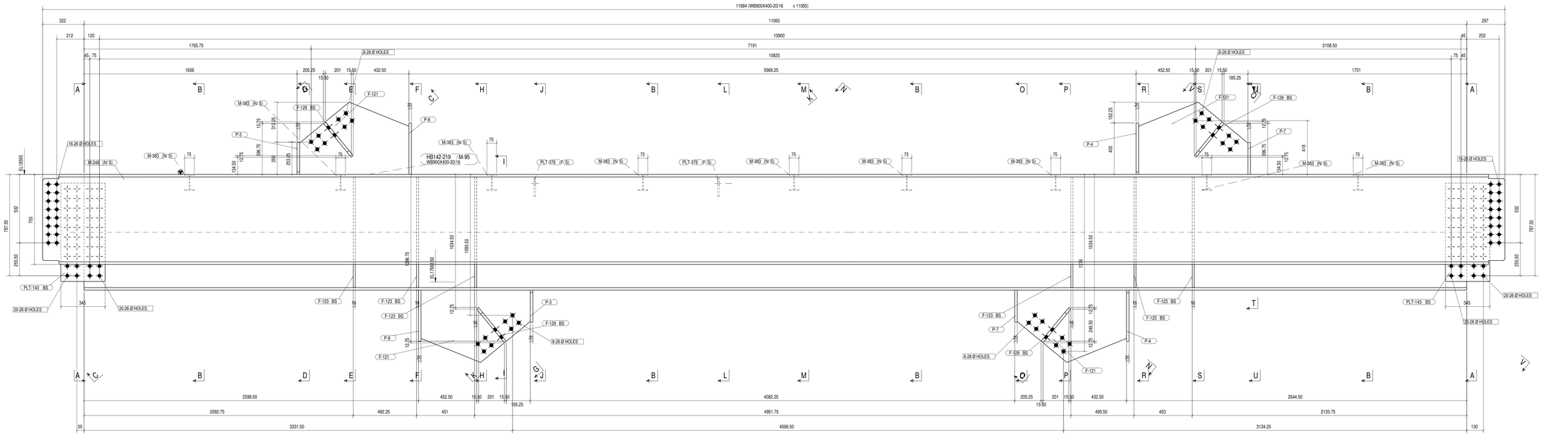
DEPT ST | CODE 122 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE NTS | WEIGHT (Kg) 3237.147 | REF TO ASSY / OLD DWG

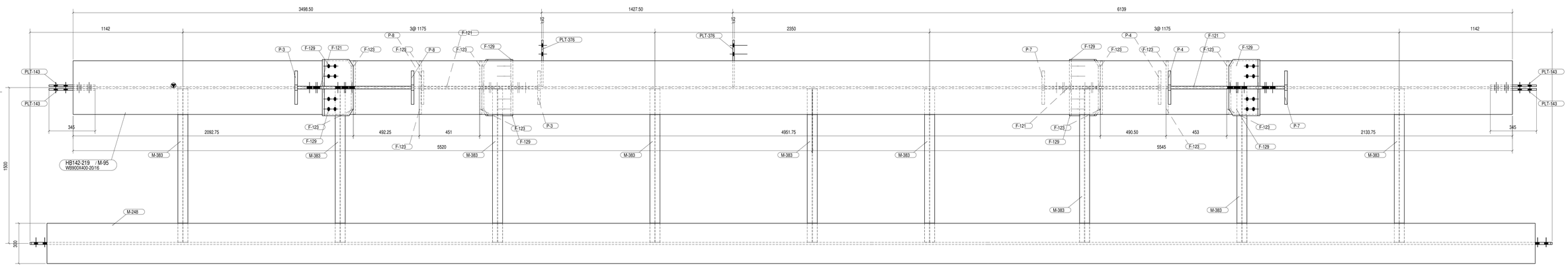
TITLE: MMPF-112

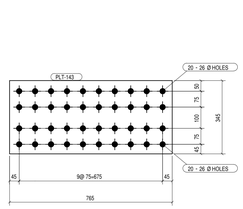
DRAWING NO : 0-38-410-03899 | REV

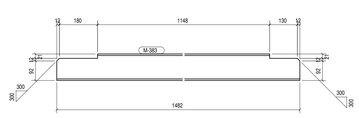
DRAWING NO: 0-39-142-10615

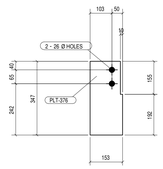
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP-322-0209

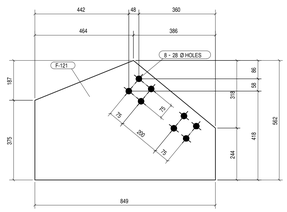


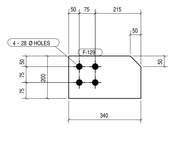


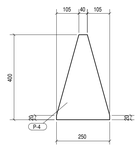


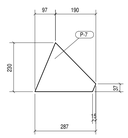


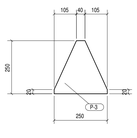


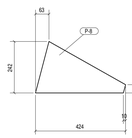


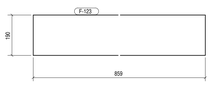


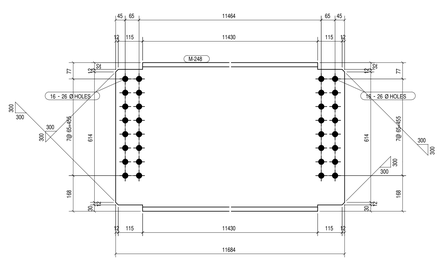












NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS
THIS DRAWING IS TO BE READ ALONG WITH DRG.No:0-39-142-10975

ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	KG/P	UNIT	UNIT WEIGHT	QTY	ZONE
18	PLATE-12 347.0x153.0		PLT-376	15-211-003		No	4.854	1		
17	PLATE-12 345.0x765.0		PLT-143	15-211-003		No	24.882	2		
16	PLATE-20 242.0x424.0		P-8	15-211-218		No	3.106	2		
15	PLATE-20 231.0x287.0		P-7	15-211-218		No	1.691	1		
14	PLATE-20 400.0x250.0		P-4	15-211-218		No	2.436	1		
13	PLATE-20 250.0x250.0		P-3	15-211-218		No	1.021	1		
12	ISMB125 1482		M-383	15-009-014		No	19.859	9		
11	PLATE-16 660x11684		M-248xWEB	15-211-217		No	968.557	1		
10	PLATE-20 300X11430		M-248xTFL	15-211-218		No	538.353	1		
9	PLATE-20 300X11430		M-248xBFL	15-211-218		No	538.353	1		
8	PLATE-16 660x11065		M-95xWEB	15-211-217		No	1195.197	1		
7	PLATE-20 400X11065		M-95xTFL	15-211-218		No	694.882	1		
6	PLATE-20 400X11065		M-95xBFL	15-211-218		No	694.882	1		
5	PLATE-20 200.0x040.0		F-129	15-211-218		No	10.480	4		
4	PLATE-16 190.0x859.0		F-123	15-211-217		No	20.499	2		
3	PLATE-20 582.0x849.0		F-121	15-211-218		No	58.526	4		
2	NUT HEX Gr.C M24			4130X0024		No	0.110	4		
1	BOLT HEX Gr.C M24x80.0			4122124080		No	0.384	4		

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

	NAME	SIGNATURE	DATE
DRN	S.SETHUPATHI		28.10.2018
CHD	P.SUBATHRADEVI		28.10.2018
APPD	V.SARAVANAKUMAR		28.10.2018

DEPT: ST | CODE: 122 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE: NTS | WEIGHT (Kg): 5543.781 | REF TO ASSY / OLD DWG

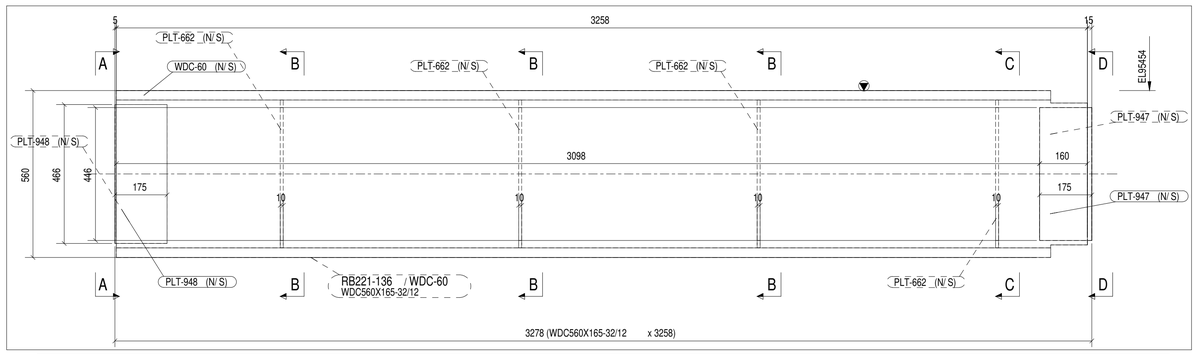
TITLE: HB142-219 (SH: 01 OF 02)

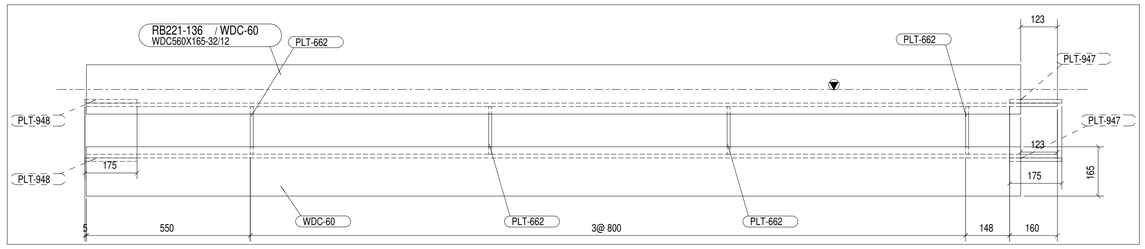
DRAWING NO.: 0-39-142-10615 | REV

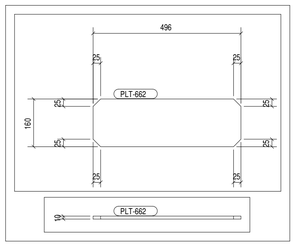
1 No. REQUIRED AS DRAWN MARKED. HB142-219

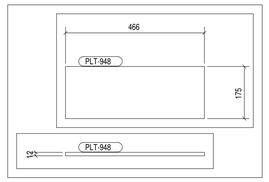
DRAWING NO: 1-35-221-28101

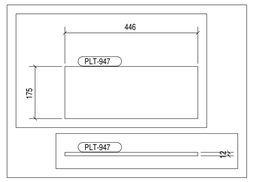
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299

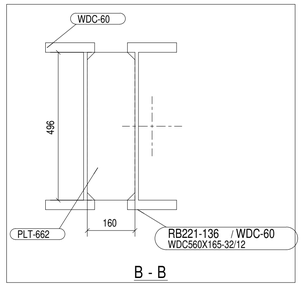


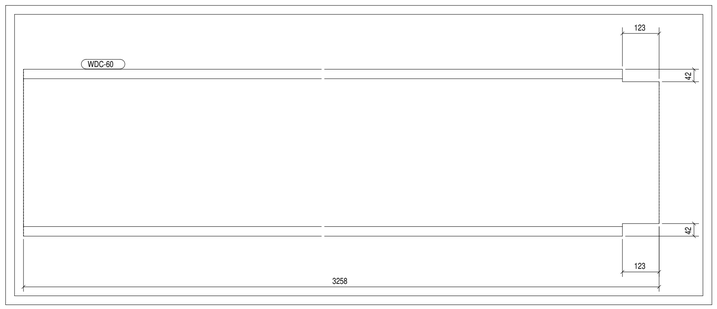


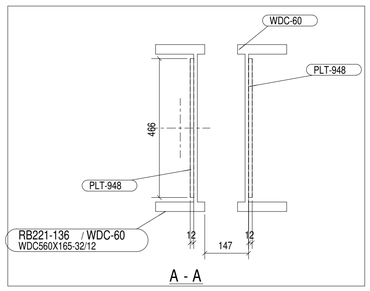


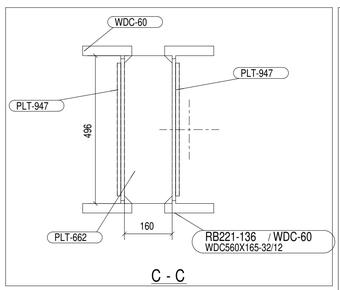


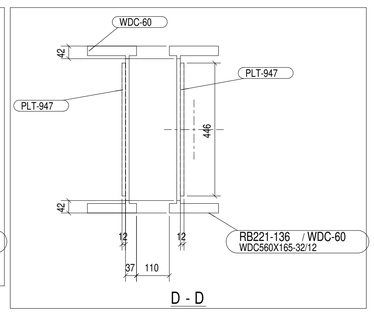












NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER							GS	ZONE
	6	PLATE-12 496X3258		WDC-60xWEB	ITEM NO	15-011-132 IS2062E250A(Fe410W)	A/C/P	No	152.224	2		
	5	PLATE-12 175.0x466.0		PLT-948	ITEM NO	15-011-132 IS2062E250A(Fe410W)	A/C/P	No	7.682	2		
	4	PLATE-12 175.0x446.0		PLT-947	ITEM NO	15-011-132 IS2062E250A(Fe410W)	A/C/P	No	7.352	2		
	3	PLATE-10 160.0x496.0		PLT-662	ITEM NO	15-211-098 IS2062E250A(Fe410W)	A/C/P	No	6.132	4		
	2	PLATE-32 165X3258		WDC-60xTFL	ITEM NO	15-011-130 IS2062E250B(Fe410W)	A/C/P	No	135.038	2		
	1	PLATE-32 165X3258		WDC-60xBFL	ITEM NO	15-011-130 IS2062E250B(Fe410W)	A/C/P	No	135.038	2		

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-052

	NAME	SIGNATURE	DATE
DRN	S.SETHUPATHI		26.02.2018
CHD	M.PADMANABAN		27.02.2018
APPD	M.SHANMUGAM		27.02.2018

DEPT: ST | CODE: 122 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE: NTS | WEIGHT (Kg): 878.338 | REF TO ASSY / OLD DWG

TITLE: RB221-136

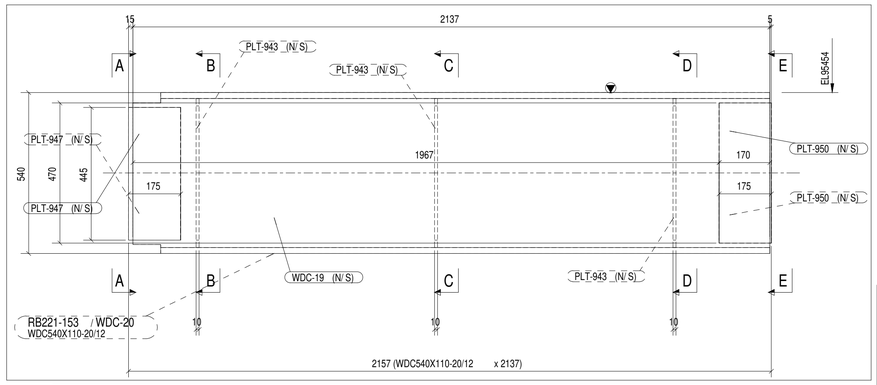
DRAWING NO : 1-35-221-28101

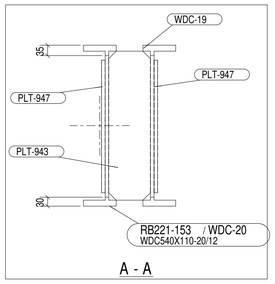
REV

1 No. REQUIRED AS DRAWN MARKED. RB221-136

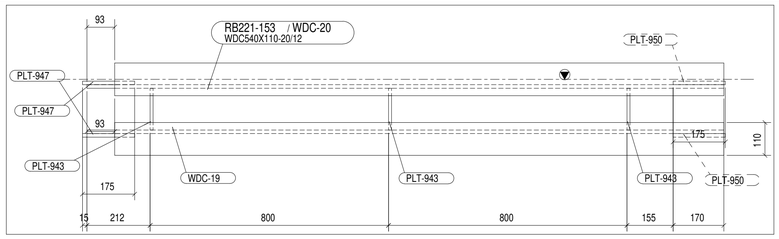
DRAWING NO: 1-35-221-28116

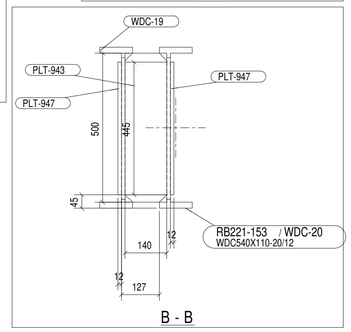
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299



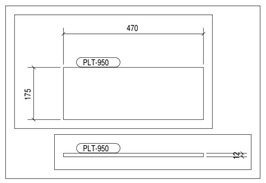


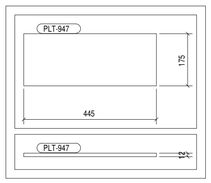
A - A

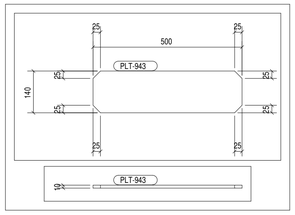


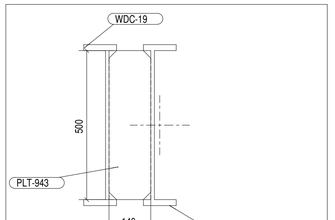


B - B

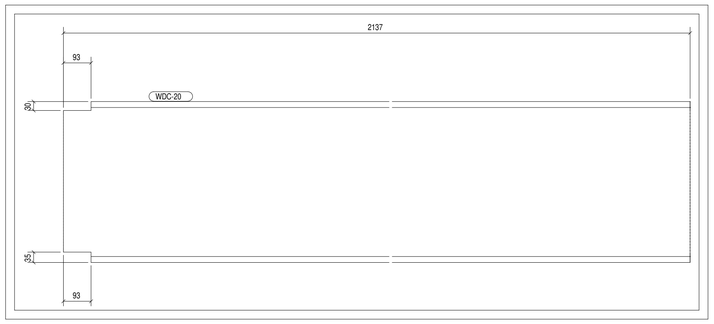


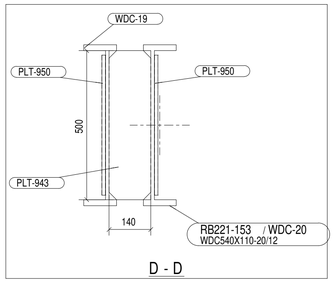




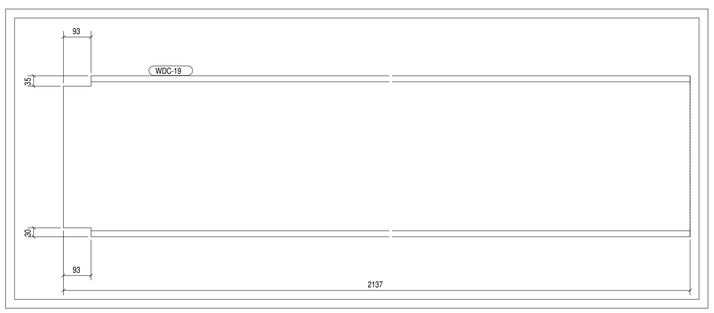


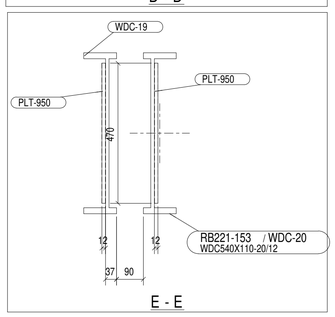
C - C





D - D





E - E

2 No's. REQUIRED AS DRAWN MARKED. RB221-153

NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER		MATERIAL CODE		UNIT	UNIT WEIGHT		
					ITEM NO					GS	ZONE
					VAR NO	MATERIAL SPECN	ACP	DI	QUANTITY		
	9	PLATE-12 500X2137		WDC-20xWEB		15-011-132 IS2062E250A(Fe410W)		No	100.653		
									1		
	8	PLATE-12 500X2137		WDC-19xWEB		15-011-132 IS2062E250A(Fe410W)		No	100.653		
									1		
	7	PLATE-12 175.0x470.0		PLT-950		15-011-132 IS2062E250A(Fe410W)		No	7.748		
									2		
	6	PLATE-12 175.0x445.0		PLT-947		15-011-132 IS2062E250A(Fe410W)		No	7.336		
									2		
	5	PLATE-10 140.0x500.0		PLT-943		15-211-098 IS2062E250A(Fe410W)		No	5.397		
									3		
	4	PLATE-20 110X2137		WDC-20xTFL		15-011-150 IS2062E250A(Fe410W)		No	36.906		
									1		
	3	PLATE-20 110X2137		WDC-19xTFL		15-011-150 IS2062E250A(Fe410W)		No	36.906		
									1		
	2	PLATE-20 110X2137		WDC-20xBFL		15-011-150 IS2062E250A(Fe410W)		No	36.906		
									1		
	1	PLATE-20 110X2137		WDC-19xBFL		15-011-150 IS2062E250A(Fe410W)		No	36.906		
									1		

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-052

	NAME	SIGNATURE	DATE
DRN	S.SETHUPATHI		26.02.2018
CHD	M.PADMANABAN		27.02.2018
APPD	M.SHANMUGAM		27.02.2018

DEPT: ST
CODE: 122
ALL DIMENSIONS ARE IN MM
PROJECTION
SCALE: NTS
WEIGHT (Kg): 388.425
REF TO ASSY / OLD DWG

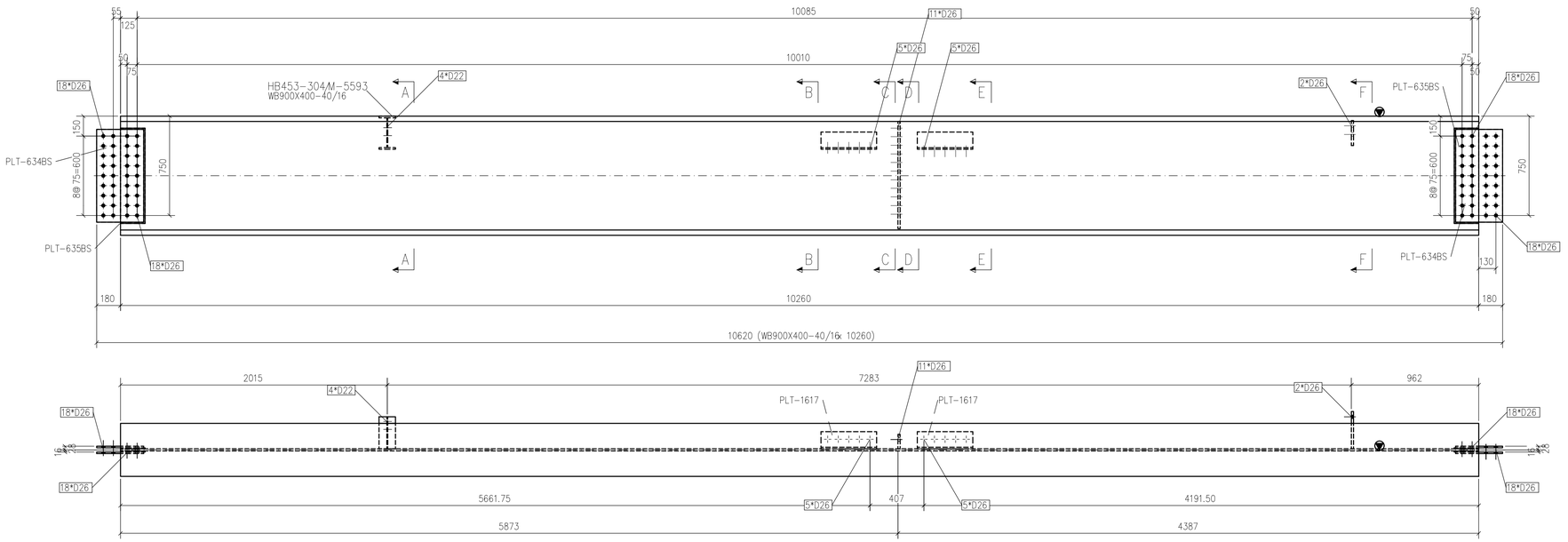
TITLE: RB221-153

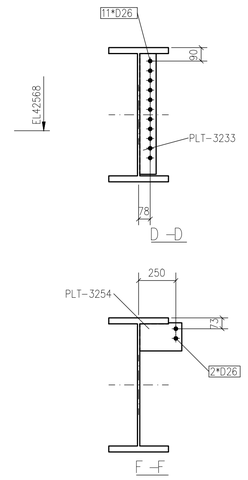
DRAWING NO : 1-35-221-28116

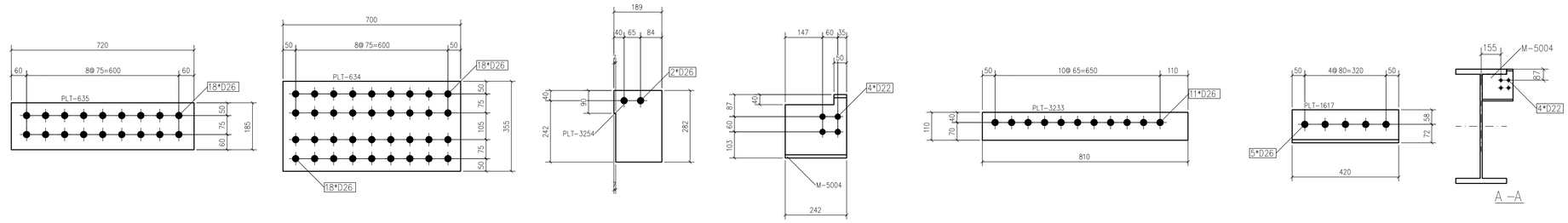
REV

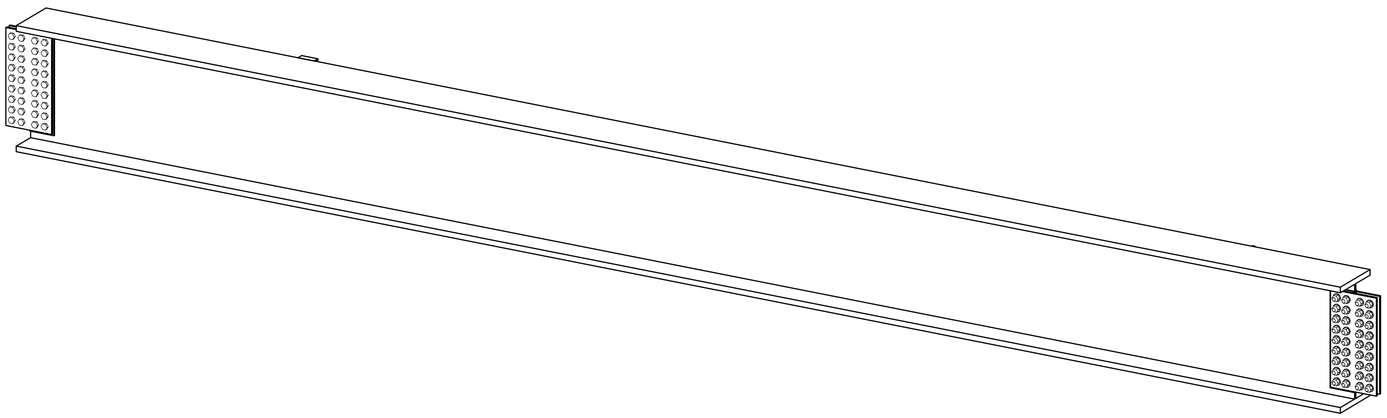
DRAWING NO: 1-35-453-32795

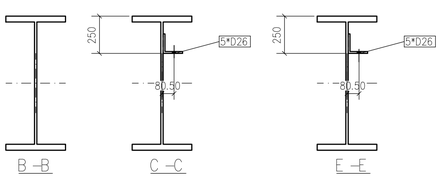
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299











NOTES:-
FOR ASSEMBLY, REFER PRINCIPAL DRAWING MENTIONED IN GMS
FOR GA REFER DWG.NO: 0-35-453-27205.

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/C/P / DI	UNIT	UNIT WEIGHT / QUANTITY	GS	ZONE
	11	PLATE-16 282.0x189.0		PLT-3254		15-011-217 IS2062 E250BR		No	6.525 1		
	10	PLATE-16 110.0x810.0		PLT-3233		15-011-217 IS2062 E250BR		No	11.191 1		
	9	ISA130X130X12 420		PLT-1617		15-013-171 IS2062 E250A		No	9.870 2		
	8	PLATE-8 185.0x720.0		PLT-635		15-011-215 IS2062 E250BR		No	8.365 4		
	7	PLATE-12 355.0x700.0		PLT-634		15-211-003 IS2062 E250BR		No	23.409 4		
	6	PLATE-16 820x10260		M-5593xWEB		15-011-217 IS2062 E250BR		No	1056.698 1		
	5	PLATE-40 400X10260		M-5593xTFL		15-211-008 IS2062 E250BR		No	1288.656 1		
	4	PLATE-40 400X10260		M-5593xBFL		15-211-008 IS2062 E250BR		No	1288.656 1		
	3	ISMB250 242		M-5004		15-009-011 IS2062 E250A		No	9.027 1		
	2	NUT HEX Gr.C M24				4130400024		No	0.110 4		
	1	BOLT HEX Gr.C M24x80.0				4122124080		No	0.384 4		

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

	NAME	SIGNATURE	DATE
DRN	SSR/KSP		26.12.2018
CHD	A.GANESAN		27.12.2018
APPD	M.SHANMUGAM		27.12.2018

355-052

DEPT ST | CODE 122 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE NTS | WEIGHT (Kg) 3809.564 | REF TO ASSY / OLD DWG

TITLE: HB453-304

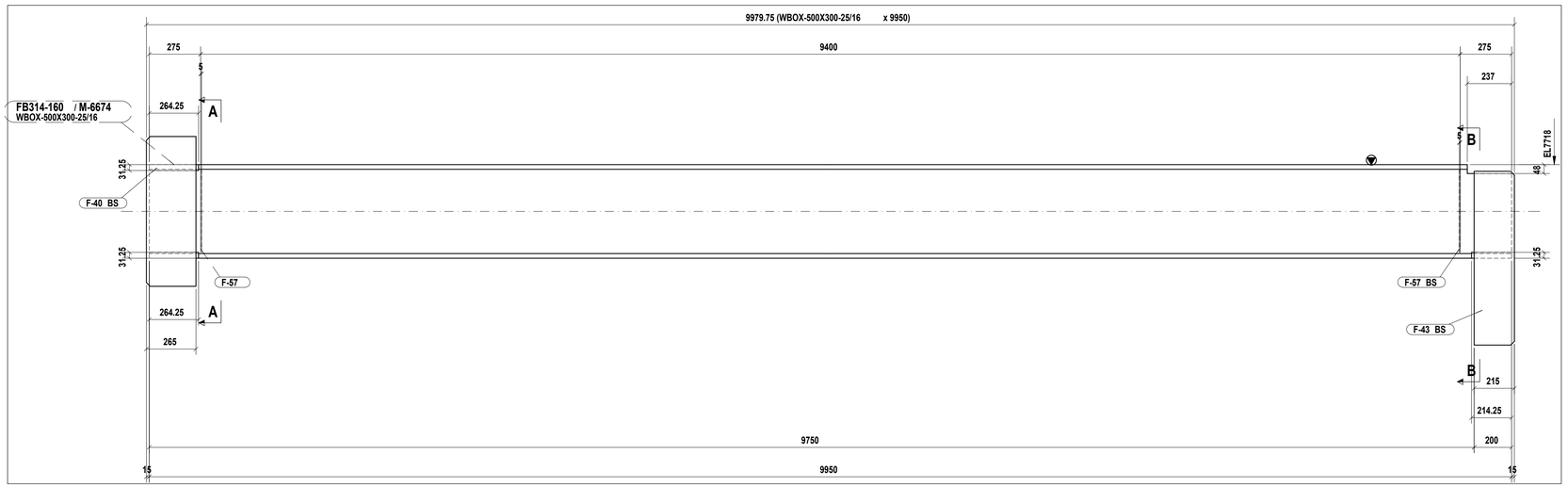
DRAWING NO: 1-35-453-32795

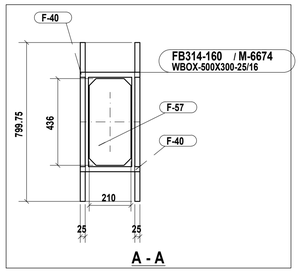
REV

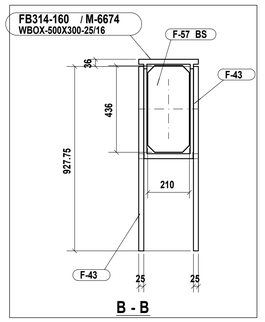
1 NUMBER REQUIRED AS DRAWN, MARKED HB453-304

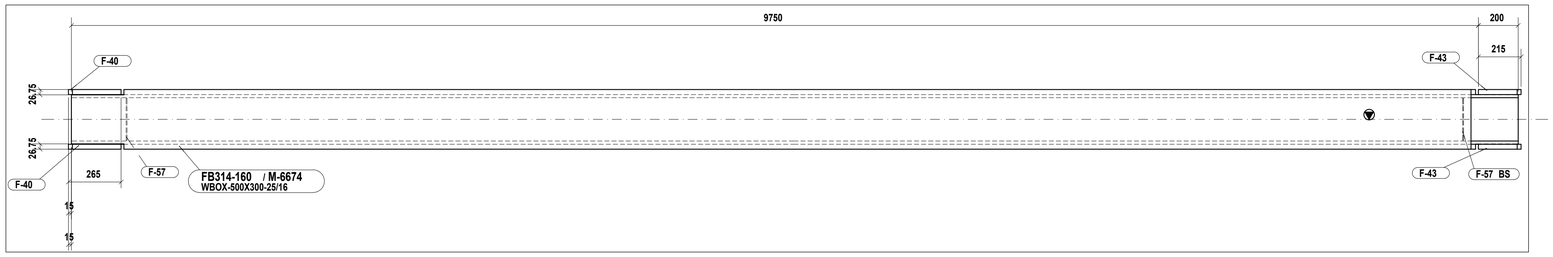
DRAWING NO: **1-36-314-27825**

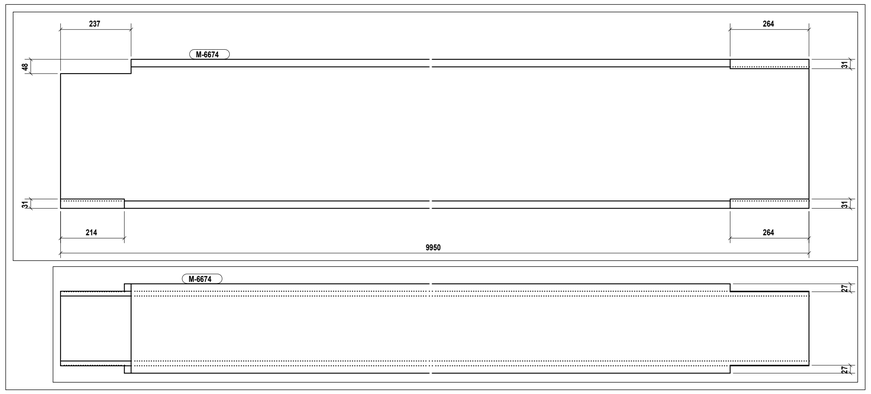
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299

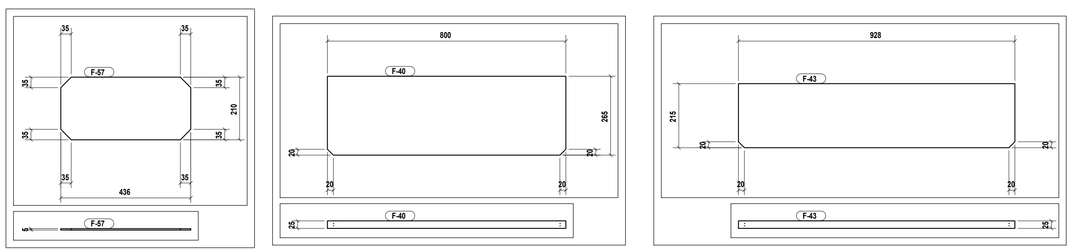












1 No. REQUIRED AS DRAWN MARKED. FB314-160

NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	ACP	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	6	PLATE-16 450X9950		M-6674xWEB		15-011-026 IS2062E250A(Fe410W)		No	562.374 2		
	5	PLATE-5 210.0x436.0		F-57		15-011-029 IS2062E250A(Fe410W)		No	3.498 3		
	4	PLATE-25 215.0x928.0		F-43		15-011-081 IS2062E250B(Fe410W)		No	39.156 2		
	3	PLATE-25 265.0x800.0		F-40		15-011-081 IS2062E250B(Fe410W)		No	41.605 2		
	2	PLATE-25 300X9950		M-6674xFL		15-011-081 IS2062E250B(Fe410W)		No	585.806 1		
	1	PLATE-25 300X9713		M-6674xFL		15-011-081 IS2062E250B(Fe410W)		No	571.852 1		

REV	DATE	ALTERED : M.PADMANABAN / KARTHIK
01	16-10-2018	CHD & APPD : V.SARAVANAKUMAR
ZONE 01	BOM DATA REVISED 1.ITEM NO 1 & 2 LENGTH CHANGED 2. ITEM NO 3 & 4 MATERIAL CODE CHANGED	

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014

355-052

	NAME	SIGNATURE	DATE
DRN	KARTHIKEYAN		21.06.2018
CHD	PADMANABAN		22.06.2018
APPD	SARAVANAKUMAR		22.06.2018

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
ST			NTS	2283.622	
CODE 122					

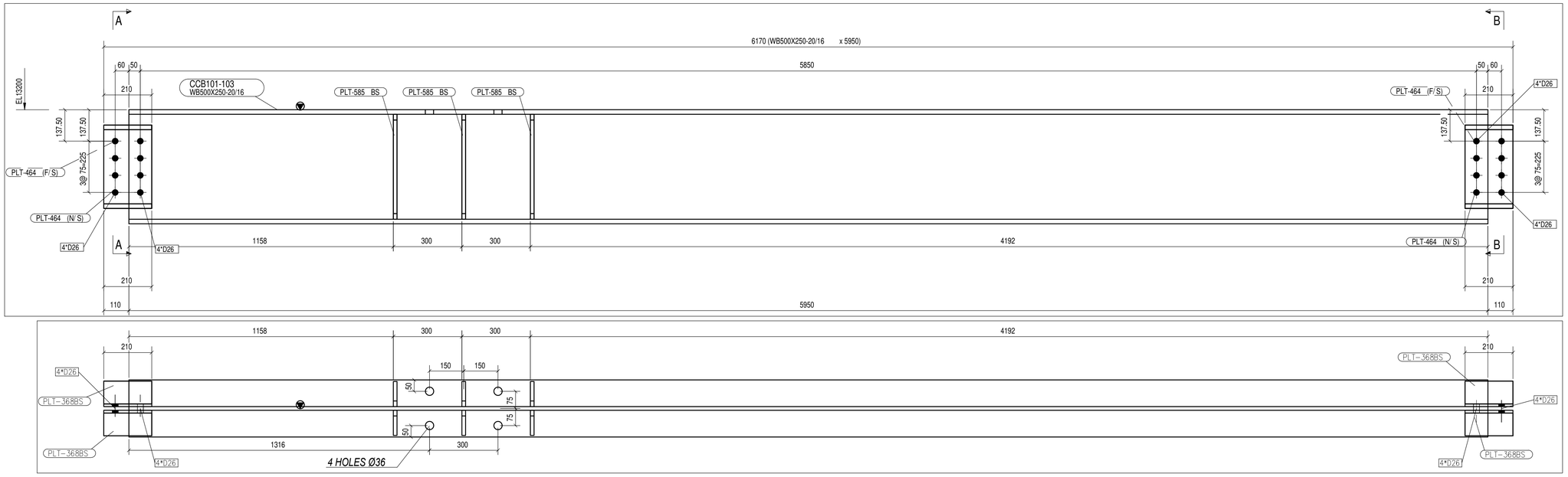
TITLE: **FB314-160**

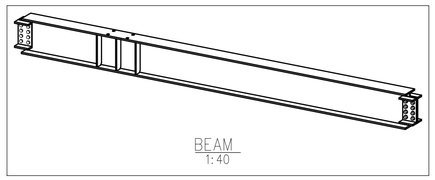
DRAWING NO : **1-36-314-27825**

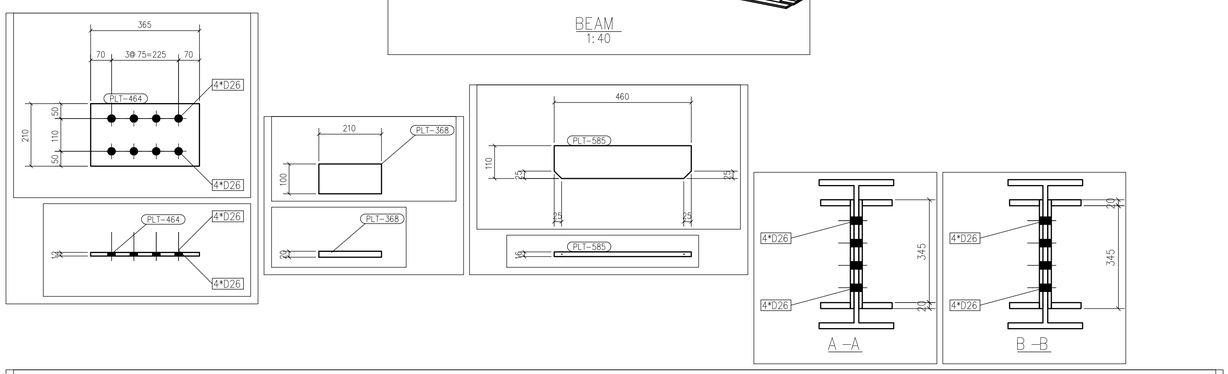
REV **01**

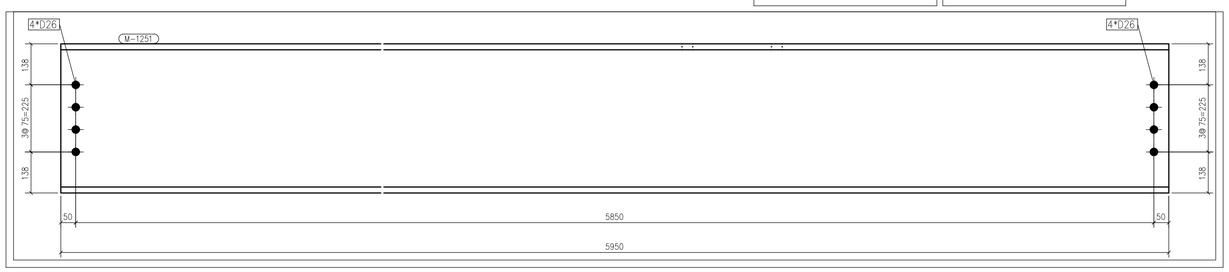
DRAWING NO: 1-39-102-32272

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299









1 NUMBER REQUIRED AS DRAWN, MARKED CCB101-103

NOTES: –

FOR ASSEMBLY, REFER PRINCIPAL DRAWING MENTIONED IN GMS
THIS DRAWING IS READ ALONG WITH DRG NO : 0-39-101-10633,
0-39-101-10634,0-39-102-10635,1-39-101-32269.

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO	MATERIAL CODE	A/C/P	UNIT	UNIT WEIGHT	GS	ZONE
					VAR NO	MATERIAL SPECN		DI	QUANTITY		
	8	PLATE-16 110.0x460.0		PLT-585		15-011-217 IS2062 E250BR		No	6.277 6		
	7	PLATE-12 210.0x365.0		PLT-464		15-211-003 IS2062 E250BR		No	7.220 4		
	6	PLATE-20 100.0x210.0		PLT-368		15-011-218 IS2062 E250BR		No	3.297 8		
	5	PLATE-16 460x5950		M-1251xWEB		15-011-217 IS2062 E250BR		No	343.767 1		
	4	PLATE-20 250X5950		M-1251xTFL		15-011-218 IS2062 E250BR		No	233.537 1		
	3	PLATE-20 250X5950		M-1251xBFL		15-011-218 IS2062 E250BR		No	233.537 1		
	2	NUT HEX Gr.C M24				4130400024		No	0.110 4		
	1	BOLT HEX Gr.C M24x80.0				4122124080		No	0.384 4		

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

	NAME	SIGNATURE	DATE
DRN	SSR/KS.PANDIAN		23.10.2018
CHD	A.GANESAN		24.10.2018
APPD	M.SHANMUGAM		25.10.2018

355-052

DEPT: ST
CODE: 122
ALL DIMENSIONS ARE IN MM
PROJECTION
SCALE: NTS
WEIGHT (Kg): 905.127
REF TO ASSY / OLD DWG

TITLE: CCB101-103

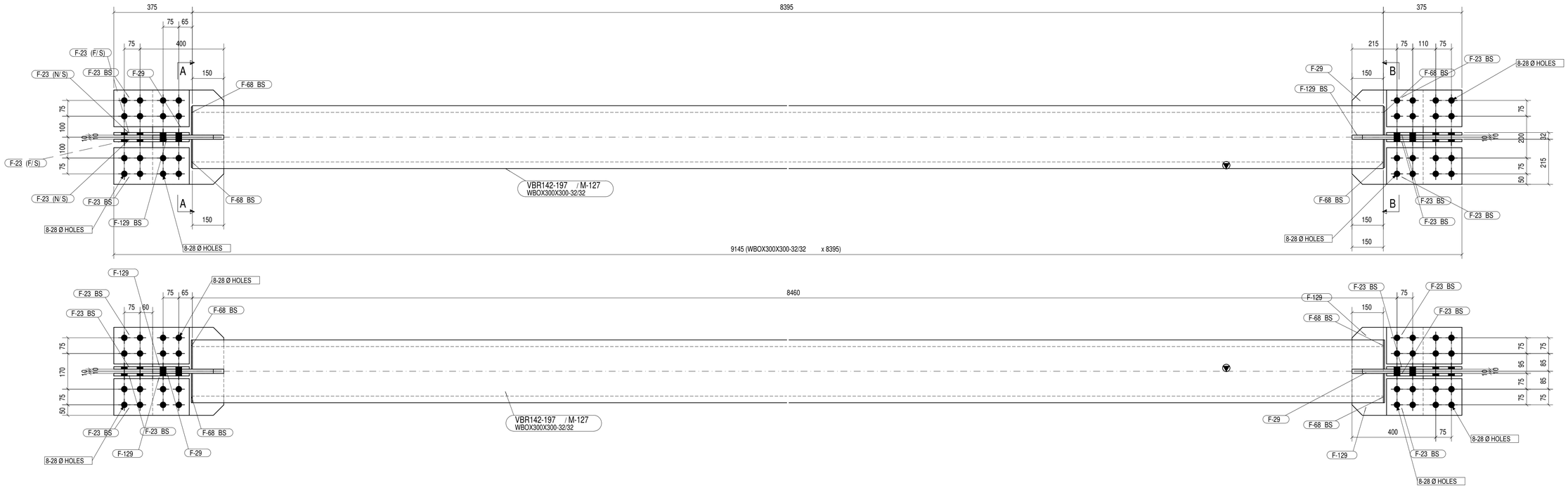
DRAWING NO : 1-39-102-32272

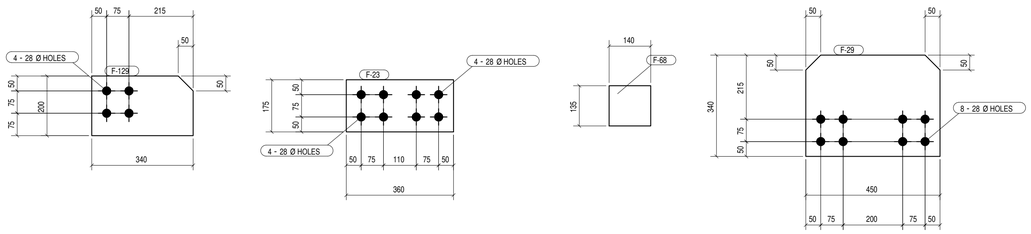
REV: 01

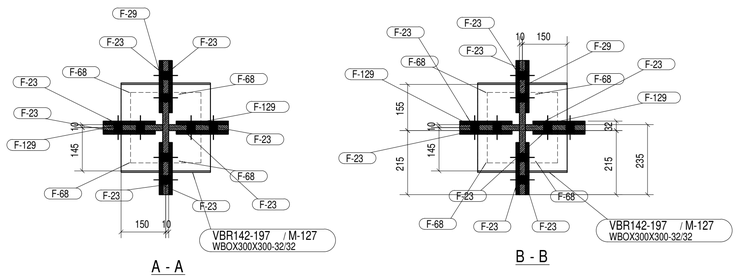
REV	DATE	ALTERED : SSR/K.S.PANDIAN
01	14.11.2018	CHD & APPD : A.GANESAN
ZONE		DIMENSIONS ADDED

DRAWING NO: 1-39-142-32190

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299







NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER		MATERIAL CODE		UNIT	UNIT WEIGHT		GS	ZONE
					VAR NO	MATERIAL SPECN	ACP	DI	QUANTITY			
	7	PLATE-32 236X8395		M-127xWEB		15-211-006 IS2062 E250BR		No No	497.689 2			
	6	PLATE-32 300X8395		M-127xFL		15-211-006 IS2062 E250BR		No No	632.655 1			
	5	PLATE-32 300X8395		M-127xFL		15-211-006 IS2062 E250BR		No No	632.655 1			
	4	PLATE-20 200.0x340.0		F-129		15-011-218 IS2062 E250BR		No No	10.480 4			
	3	PLATE-5 135.0x140.0		F-68		15-011-213 IS2062 E250BR		No No	0.742 8			
	2	PLATE-20 340.0x450.0		F-29		15-011-218 IS2062 E250BR		No No	23.628 2			
	1	PLATE-12 175.0x360.0		F-23		15-211-003 IS2062 E250BR		No No	5.935 16			

2 No's. REQUIRED AS DRAWN MARKED. VBR142-197

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014
355-052

	NAME	SIGNATURE	DATE
DRN	S.SETHUPATHI		28.10.2018
CHD	P.SUBATHRADEVI		28.10.2018
APPD	V.SARAVANAKUMAR		28.10.2018

DEPT: ST
CODE: 122
ALL DIMENSIONS ARE IN MM
PROJECTION
SCALE: NTS
WEIGHT (Kg): 2444.723
REF TO ASSY / OLD DWG

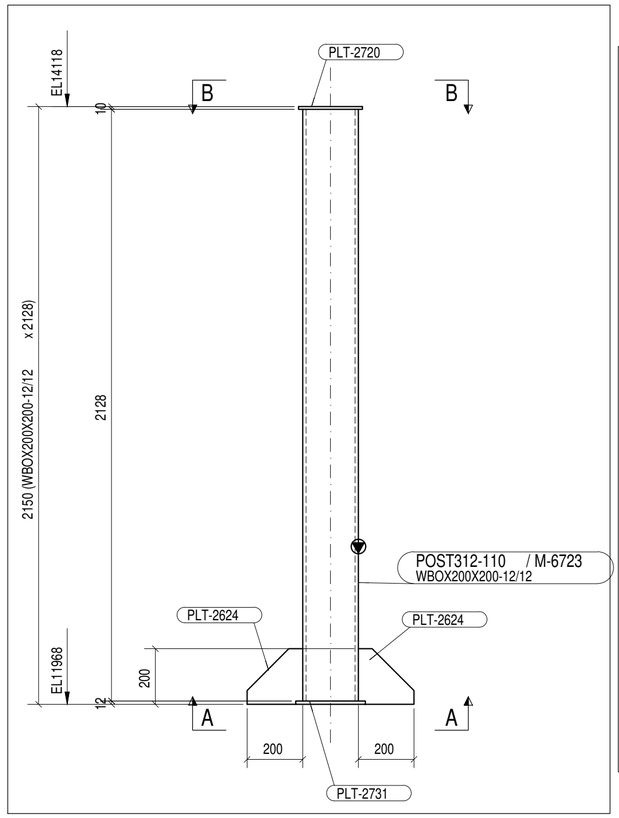
TITLE: VBR142-197

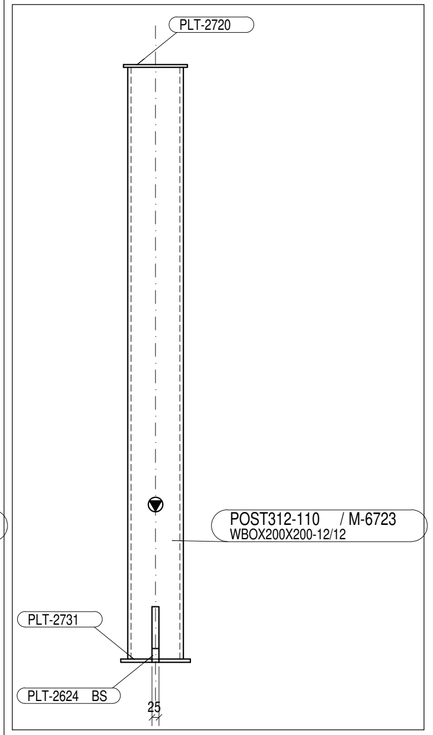
DRAWING NO : 1-39-142-32190

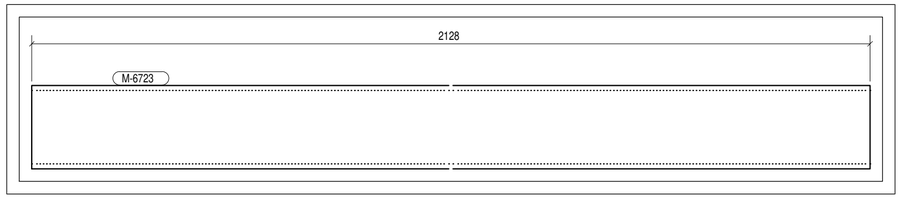
REV

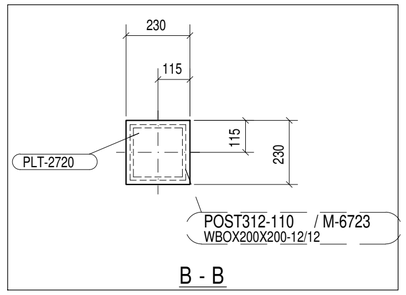
DRAWING NO: 2-36-312-A2951

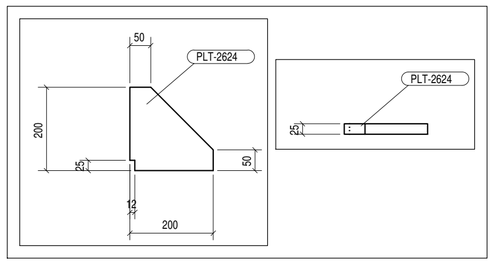
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299

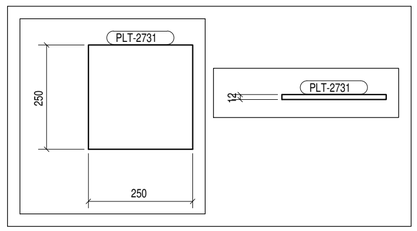


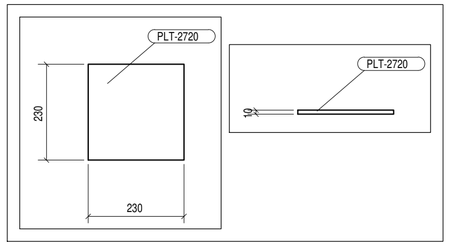


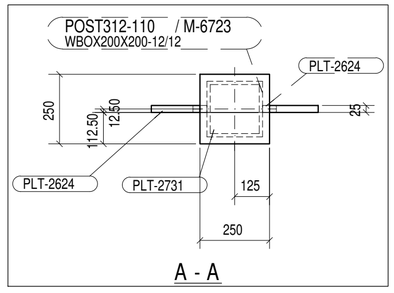












10 No's. REQUIRED AS DRAWN MARKED. POST312-110

NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/OP	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	6	PLATE-12 250.0x250.0		PLT-2731		15-011-132 IS2062E250A(Fe410W)		No	5.887 1		
	5	PLATE-10 230.0x230.0		PLT-2720		15-211-098 IS2062E250A(Fe410W)		No	4.153 1		
	4	PLATE-25 200.0x200.0		PLT-2624		15-011-081 IS2062E250B(Fe410W)		No	5.583 2		
	3	PLATE-12 176X2128		M-6723xWEB		15-011-132 IS2062E250A(Fe410W)		No	35.281 2		
	2	PLATE-12 200X2128		M-6723xFL		15-011-132 IS2062E250A(Fe410W)		No	40.092 1		
	1	PLATE-12 200X2128		M-6723xFL		15-011-132 IS2062E250A(Fe410W)		No	40.092 1		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014
355-052

	NAME	SIGNATURE	DATE
DRN	R.KARTHIKEYAN		19.06.2018
CHD	M.PADMANABAN		20.06.2018
APPD	V.SARAVANAKUMAR		20.06.2018

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
ST			NTS	171.951	
CODE 122					

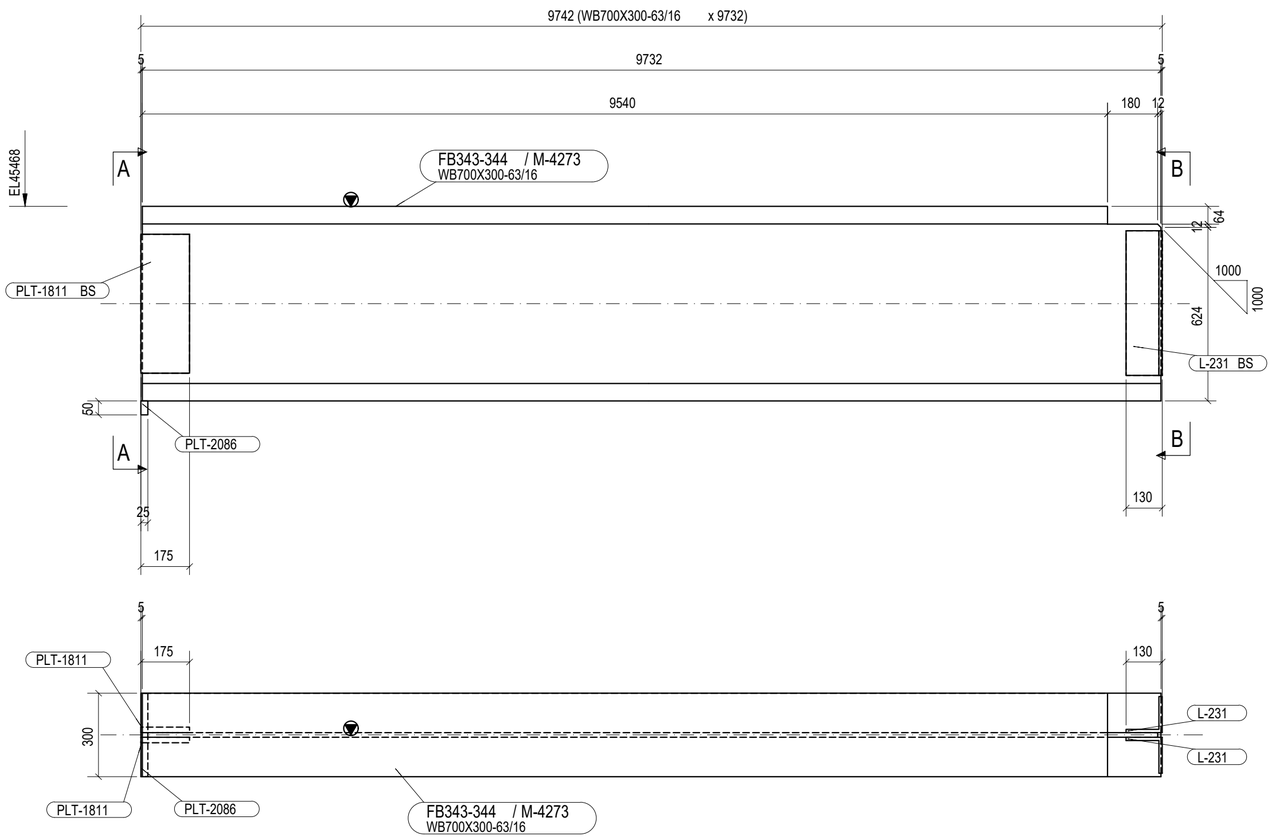
TITLE: POST312-110

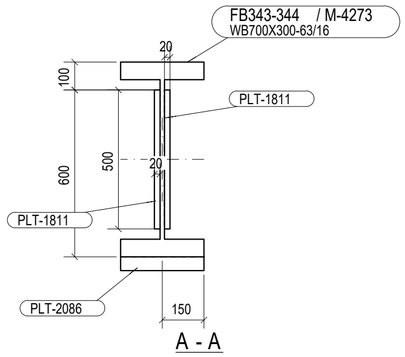
DRAWING NO : 2-36-312-A2951

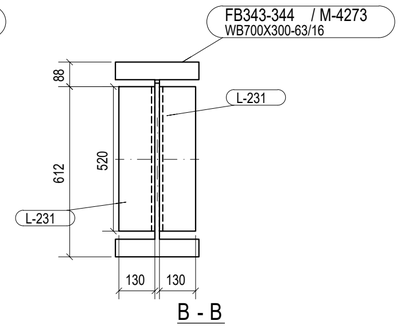
REV

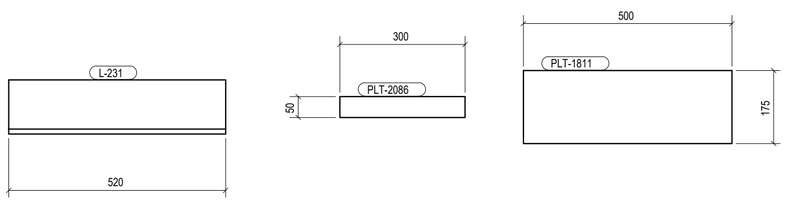
DRAWING NO: 2-36-343-B5647

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299









NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/C/P	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	6	PLATE-25 50.0x300.0		PLT-2086		15-011-081 IS2062E250B(Fe410W)		No 	2.944 1		
	5	PLATE-20 175.0x500.0		PLT-1811		15-011-150 IS2062E250A(Fe410W)		No 	13.737 2		
	4	PLATE-16 574x9732		M-4273xWEB		15-011-026 IS2062E250A(Fe410W)		No 	701.622 1		
	3	ISA130X130X12 520		L-231		15-013-171 IS2062E250A(Fe410W)		No 	12.220 2		
	2	PLATE-63 300X9540		M-4273xTFL		15-011-125 IS2062E250B(Fe410W)		No 	1415.402 1		
	1	PLATE-63 300X9732		M-4273xBFL		15-011-125 IS2062E250B(Fe410W)		No 	1443.888 1		

1 No. REQUIRED AS DRAWN MARKED. FB343-344

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014
355-052

	NAME	SIGNATURE	DATE
DRN	K.PRAKASH		25.02.2019
CHD	V.MENAGA		26.02.2019
APPD	S.YUVARAJ		27.02.2019

DEPT: ST
CODE: 122
ALL DIMENSIONS ARE IN MM
PROJECTION
SCALE: NTS
WEIGHT (Kg): 3615.737
REF TO ASSY / OLD DWG

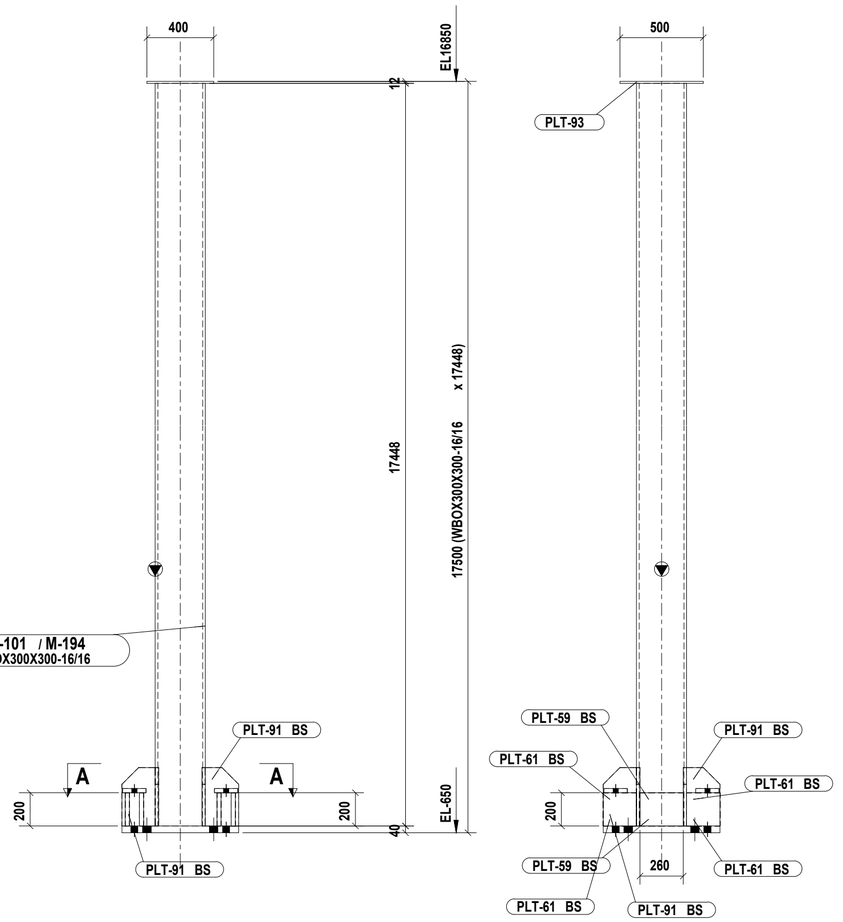
TITLE: FB343-344

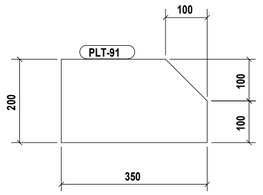
DRAWING NO : 2-36-343-B5647

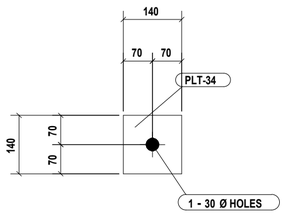
REV

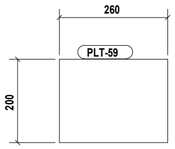
DRAWING NO: **2-39-101-30474**

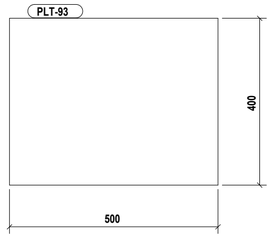
FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299

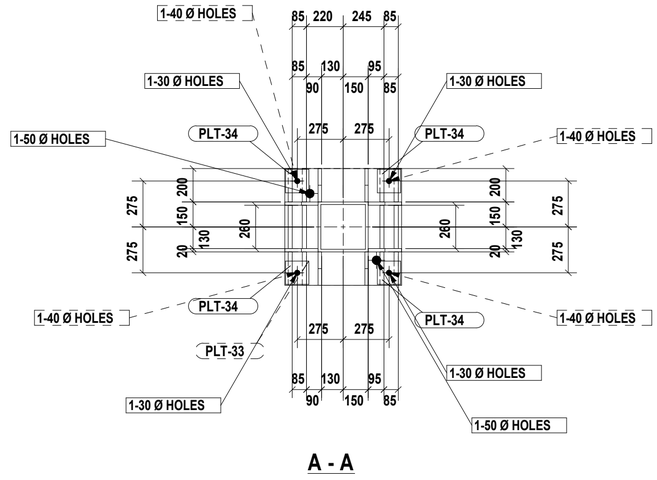




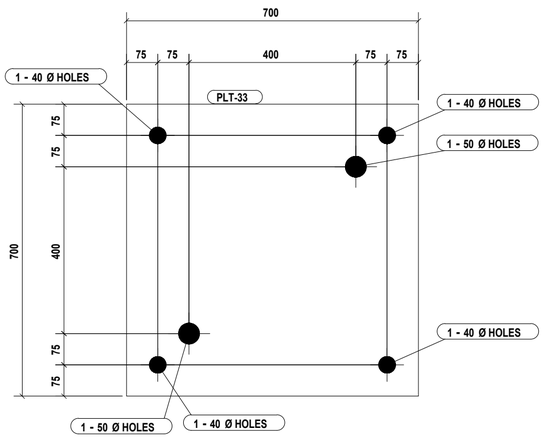


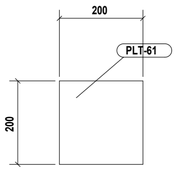






A - A





NOTES:-

FOR ASSEMBLY DRAWING REFER PRINCIPAL DRAWING MENTIONED IN GMS

VARIANT NUMBER	ITEM NUMBER	DESCRIPTION	STD	DRAWING NUMBER	ITEM NO / VAR NO	MATERIAL CODE / MATERIAL SPECN	A/C/P	UNIT / DI	UNIT WEIGHT / QUANTITY	GS	ZONE
	9	PLATE-12 400.0x500.0		PLT-93		15-011-132 IS2062E250A(Fe410W)		No 	18.840 1		
	8	PLATE-20 200.0x350.0		PLT-91		15-011-150 IS2062E250A(Fe410W)		No 	10.205 8		
	7	PLATE-25 200.0x200.0		PLT-61		15-011-081 IS2062E250B(Fe410W)		No 	7.850 8		
	6	PLATE-25 200.0x260.0		PLT-59		15-011-081 IS2062E250B(Fe410W)		No 	10.205 4		
	5	PLATE-25 140.0x140.0		PLT-34		15-011-081 IS2062E250B(Fe410W)		No 	3.846 4		
	4	PLATE-40 700.0x700.0		PLT-33		15-011-184 IS2062E250B(Fe410W)		No 	153.860 1		
	3	PLATE-16 268X17448		M-194xWEB		15-011-026 IS2062E250A(Fe410W)		No 	587.314 2		
	2	PLATE-16 300X17448		M-194xFL		15-011-026 IS2062E250A(Fe410W)		No 	657.441 1		
	1	PLATE-16 300X17448		M-194xFL		15-011-026 IS2062E250A(Fe410W)		No 	657.441 1		

TYPE OF PRODUCT
OR NAME OF
CUSTOMER/PROJECT

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-052

	NAME	SIGNATURE	DATE
DRN	INDHUMATHI B		03.04.2017
CHD	SUBATHRADEVI P		03.04.2017
APPD	SOMASUNDARAM J		03.04.2017

DEPT	CODE	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
ST	122			NTS	2862.855	

TITLE: **L1L-101**

DRAWING NO : **2-39-101-30474**

REV

1 No. REQUIRED AS DRAWN MARKED. L1L-101

PAINTING SCHEME DOCUMENT: SIP: PP: 22

PREPARED BY :	
K.Srinivasan Engr./Plant Lab	*N.Ramasamy, Sr.Mgr./QC/OLI*
REVIEWED BY	**SIGNATURE**
PLANT LAB *(Dr. V.RajaSekharan, Sr.Mgr./Plant Lab)*	
PRODUCT ENGINEERING *(M.Arunachalam, AGM/PE(FB))*	
QUALITY CONTROL *(M.V.Selvan, AGM/QC)*	
QUALITY ASSURANCE *(U.ReviSankaran, AGM/ QA & BE)*	03/03/16

Revision No.	Date	Approved by	Signature
06	03/03/2016	*GM/QUALITY*	
06	03/03/2016	*GM/WRI & LABS*	

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RECORD OF REVISIONS

Rev. No.	Date	Details of revision	Remarks
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 PGMAs deleted. Painting schemes modified in Sl.No. 2.4 & 3.5.	Feedback from QA and task performers. & Galvanization of floor grills based on ED's approval note BHE: QC: 2008 Dt. 03.01.2008
06	03.03.16	All SIP:PP documents are merged into one. Document revised based on the decision taken at PQC (Ref QQC: 8:2016 dt.29.01.2016) to have an improved painting scheme for Boiler Structural PGMA and other improvements.	As per feedback from QC, QA & task Performers.

1.0 SCOPE

1.1 This procedure covers the requirements of Surface preparation, application of primer, intermediate and finish paints, personnel qualification, testing, inspection for manufactured and subcontracted components of boilers and Valves based on various 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 those 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.

1.4 Good preservation /transportation enhance the life of painted products. Suitable lasing method (use of rubber, nylon rope/belt) shall be used while transporting and avoid metal slings to tie up the product with load carrier.

2.0 GENERAL

2.1 This procedure specifies the painting requirements to
a) provide adequate surface protection of components under prescribed storage conditions at shop / 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 & REFERENCE ANNEXURES

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 Standard painting scheme for normal environment / coastal (or) refinery environment/ export projects can be referred in Part – I / II / III available with this document.

3.3 Annexure-I shall be referred for notes on painting scheme furnished in this document. Necessary instructions given for protective coating of various boiler components.

3.4 Total PGMA list of boiler components required to be painted is grouped under Annexure II.

3.5 Inspection and testing plan on surface preparation and painting is given under Annexure III. Description given for various grade of surface cleanliness and inspection techniques.

3.6 Procedure for painter qualification given under Annexure IV. Painter qualification certificate for BHEL painters and BHEL vendor painters provided separately under annexure – IVA & IVB.

3.7 The Paints envisaged as per this document are indicated in this document under the annexure V-"Painting Scheme-Details for procurement & application purposes".

3.8 Good Painting Practices, which will be of assistance to task performers, have been detailed in Annexure-VI.

All the annexures as stated above are indexed with page number for ready reference.

INDEX

PART-I

Standard Painting Scheme for Normal Environment

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
1.1	1AC	Drum/ Collecting and separator vessels (Except Internals) Drum/ Collecting & separator vessels suspension	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 / DFT= 20µ per coat	Inter-national Orange Shade No: 592 of IS 5	70
1.2	5	(Drum/ collecting & separator vessels) Internals &Other Machined Components, DD items (threaded/ machined surfaces)	SSPC-SP1 or SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04	1 / DFT=25µ per coat	--	--	--	--	--	25
1.3	1AE	Drum - Transport Structures Temporary structures to be removed after erection at site	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 / DFT= 20µ per coat	Yellow Shade No: 356 of IS 5	70
2.1	5B	Foundation Materials and Pin:, & Columns below " 0 " level of PG 35,36, 38 & 39	- -		- -	- -	- -	Rust Preventive Fluid to PR: CHEM: 09 – 04	2 / DFT= 20µ per coat	--	40

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-I contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats / DFT	Paint	No. of coats/ DFT	Shade	
2.2	31D	Buck Stays and Structural Items: Buck stays, Boiler Supporting Structures, Duct supports, bunker structures (exposed to atmosphere) etc.	Blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy based Zinc phosphate Primer to IS 13238 (latest)	1 / DFT= 30µ per coat	Epoxy Based MIO pigmented intermediate coat (latest)	1 / DFT= 75µ per coat	Epoxy based Polyamide cured finish paint to IS14209 (latest) + Aliphatic acrylic Polyurethane paint to IS 13213 (latest)	1 / DFT= 30µ per coat 1 / DFT= 30µ per coat	Smoke Grey Shade No: 692 of IS 5	165
2.3	1A	Hangers	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µ per coat	Smoke Grey Shade No: 692 of IS 5	70
2.4	6	Floor grills, Guard plate** Step treads	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 Ladders & Stairs	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2/ DFT= 20µ per coat	Black	70
3.1	9	Components >95 deg.C but <400deg.C Un-insulated components other than coming in Gas Path,	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 microns)	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 µ per coat)	Aluminium	40
	10	Components >400 deg.C & <600deg.C Un-insulated components other than coming in Gas Path	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 microns)	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 µ per coat)	Aluminium	40

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-I contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats / DFT	Paint	No. of coats/ DFT	Shade	
3.2	3	Components > 95° C Insulated	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30µ per coat	-	- -	- -	- -	Red Oxide	60
3.3	2	Heat Exchanger Coils: (SH, RH & Economizer Coils)	SSPC – SP2 or SSPC – SP3 Hand tool / Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	1/ DFT= 35µ per coat	--	--	--	--	Red Oxide	35
3.4	3	Components coming in Gas Path other than coils	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30µ per coat	- -	- -	- -	- -	Red Oxide	60
3.5	8A	Uninsulated Fuel pipes, Duct for Tube Mill	SSPC-SP3/ Power Tool Cleaning	General purpose Aluminium paint to IS 2339	2 / DFT= 20µ per coat	--	--	--	--	Aluminum	40
4	15	Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14 of ANNEXURE V)	Abrasive blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1 DFT= 40µ / coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min) t	1 / DFT= 30µ per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1A	Miscellaneous and Casing Sheets, Steam Blowing Piping, Duct Plates and Expansion Joints, Coal Handling, (Temp: <95 deg.C)	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2/ DFT= 20µm per coat	Smoke Grey Shade No: 692 of IS 5	70

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-I contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate coat		Finish coat			Total DFT µ (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
5.2	3	Erection Materials and Commissioning Components:	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µ / coat	- -	- -	- -	- -	Red Oxide	60
6.1	10 / 9	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, Control valves (spring loaded bypass, economizer CV etc)	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.I / II	2 / DFT= 20µ per coat	--	--	--	--	--	40
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq.ft.	--	--	--	--	--	--	--
6.3	1AS	Soot Blower components	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 / DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 / DFT= 20µ per coat.	Verdigris Green Shade No. 280 of IS**5**	100
6.4	36	On Shore OFE Components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer	2 / DFT= 50µ per coat	--	--	Chlorinated Rubber Based Finish Paint	2 / DFT= 30µ per coat	French Blue Shade No: 166 of IS 5	160
6.5	35B	Off Shore Components	SSPC-SP3/ Power Tool Cleaning	Epoxy based Free Mastic G-316 Primer	1 / DFT= 100µ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT=30µ 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= 20µ per coat	--	--	--	--	--	40

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

Painting Scheme for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5

PART II

Standard Painting Scheme for Costal/Refinery Environment

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
1.1	1AC	Drum/ Collecting and separator vessels (Except Internals) Drum/ Collecting & separator vessels suspension	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µ per coat	Inter-national Orange Shade No: 592 of IS 5	70
1.2	5	(Drum/ collecting & separator vessels) Internals & Other Machined Components, DD items (threaded/ machined surfaces)	SSPC-SP1 or SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04	1 / DFT=25 µ per coat	--	--	--	--	--	25
1..3	1AE	Drum - Transport Structures Temporary structures to be removed after erection at site	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µ per coat	Yellow Shade No: 356 of IS 5	70
2.1	5B	Foundation Materials and Pin:, & Columns below " 0 " level of PG 35,36, 38 & 39	- -	- -	- -	- -	- -	Rust preventive	2 DFT =20 microns	- -	40
2.2	31D	Buck Stays and Structural Items: Buck stays, Boiler Supporting Structures, Duct supports, bunker structures (exposed to atmosphere) etc.	Blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy based Zinc phosphat e Primer to IS 13238 (latest)	1 / DFT= 30µ per coat	Epoxy Based MIO/ TiO2 pigmented intermedia te coat (latest)	1 / DFT = 75µ per coat	Epoxy based Polyamide cured finish paint to IS14209 (latest) + Aliphatic acrylic Polyurethane paint to IS 13213 (latest)	1 / DFT= 30µ per coat 1 / DFT= 30µ per coat	Smoke Grey Shade No: 692 of IS 5	165

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-II contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of Coats/ DFT	Shade	
2.3	1BA	Hangers:	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50µ per coat	1	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µ per coat	2	Smoke Grey Shade No: 692 of IS 5	90
2.4	6	Floor grills, Guard plate** Step treads	Floor Grills: Hot dip Galvanizing to a coating weight of 610 g 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	1BB	Hand Rails & Posts Ladders & Stairs	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50µ per coat	1	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µ per coat	2	Black	90
3.1	9	Components >95 deg.C but <400deg.C Un-insulated components other than coming in Gas Path,	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 microns)	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-II	1 (DFT =20 µ per coat)	Aluminium	40
	10	Components >400 deg.C & <600deg.C Un-insulated components other than coming in Gas Path	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 microns)	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =20 µ per coat)	Aluminium	40
3.2	3	Components >95° C **Insulated**	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µ per coat	---	- -	- -	- -	Red Oxide	60
3.3	2	Heat Exchanger Coils: (SH, RH & Economiser Coils)	SSPC – SP2 or SSPC – SP3 Hand tool / Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	1 DFT= 35µ per coat	--	--	--	--	Red Oxide	35
3.4	3	Components coming in Gas Path other than Coils	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µ per coat	- -	- -	- -	- -	Red Oxide	60

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-II contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of Coats / DFT	Paint	No. of Coats	Paint	No. of Coats/ DFT	Shade	
3.5	8A	Uninsulated Fuel Pipes Duct for Tube Mill:	SSPC-SP3/ Power Tool Cleaning	General purpose Aluminium paint to IS 2339	2 DFT= 20µ per coat	--	--	--	--	Aluminum	40
4	15	Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14 of ANNEXURE V)	Abrasive blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1 DFT=40 µm / coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1 DFT=30µ per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1A	Miscellaneous and Casing Sheets: Steam Blowing Piping: Duct Plates and Expansion Joints: Coal Handling (Temp: <95 deg.C)	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm 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:	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µm / coat	- -	- -	- -	- -	Red Oxide	60
6.1	10/ 9	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. Control valves (spring loaded bypass, economizer CV etc)	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.I/II	2	--	--	--	--	Aluminum	40
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq. ft	--	--	--	--	--	--	--
6.3	1AS1	Soot Blower components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer	1 DFT= 50µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µ per coat	Verdigris Green Shade No. 280 of IS**5**	90

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-II contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of Coats / DFT	Paint	No. of Coats	Paint	No. of Coats/ DFT	Shade	
6.4	36	On Shore OFE Components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50µ per coat	2	--	--	Chlorinated Rubber Based Finish Paint DFT= 30µ per coat	2	French Blue Shade No: 166 of IS 5	160
6.5	35B	Off Shore Components	SSPC-SP3/ Power Tool Cleaning	Epoxy based Free Mastic G-316 Primer	1 / DFT= 100µ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT=30 µ 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= 20µm per coat	--	--	--	--	--	40

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

Painting Scheme for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5

PART III

Standard Painting Scheme for EXPORT CONTRACTS

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	Total DFT µm (min)
1.1	18	Drum/ Collecting and separator vessels (Except Internals) Drum/ Collecting & separator vessels suspension	Blast cleaning to Sa 2 ½ (Near white metal) with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 70µ per coat	--	--	Epoxy Polyamide cured Finish Paint to IS 14209	1/ DFT= 35µ per coat	Smoke Grey Shade No: 692 of IS 5	105
1.2	4S	(Drum/ collecting & separator vessels) Internals RETAINERS Other Machined Components: DD items (threaded/ machined surfaces)	Blast cleaning to Sa 2 ½ (Near white metal) with surface profile 35- 50 microns	Sea worthy Rust Preventive Fluid to PR: CHEM: 09 – 06	2/ DFT=25µ per coat	--	--	--	--	--	50
1.3	1AE	Drum - Transport Structures Temporary structures to be removed after erection at site	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30µ per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µ per coat	2	Yellow Shade No: 356 of IS 5	70
2.1	4S	Foundation Materials and Pin:, & Columns below " 0 " level of PG 35,36, 38 & 39	Blast cleaning to Sa 2 ½ (Near white metal) with surface profile 35- 50 microns	Sea worthy Rust Preventive Fluid to PR: CHEM: 09 – 06	2/ DFT=25µ per coat	--	--	--	--	--	50
- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'											

PART-III contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
2.2	19C/ 19RC	Buck Stays and Structural Items: Buck stays, Boiler Supporting Structures, Duct supports, bunker structures (exposed to atmosphere) etc.	Blast cleaning to Sa 2 ½ (Near white metal) with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 75µ per coat	Epoxy Based MIO pigmented intermediate coat	1 / DFT= 75µ per coat	#Epoxy based finish paint + Aliphatic acrylic Polyurethane paint to IS 13213 (latest)	2 / DFT= 35µ per coat 1 / DFT= 30µ per coat	Smoke Grey Shade No: 692 of IS 5 or Grey White RAL 9002	250
2.4	6	Floor grills, Guard plate	Floor Grills: Hot dip Galvanizing to a coating weight of 610 g per m^2 (minimum) and to a coating thickness of 85.0 microns (minimum). ** Guard plates & Stringer channels will be painted as given in Sl. No. 2.2.								
2.5	6	Hand Rails & Posts Ladders and Stairs	Hot dip Galvanizing to a coating weight of 610 g per m^2 (minimum) and to a coating thickness of 85.0 microns (minimum). Hood ladders will be painted as given in Sl. No. 2.2								
3.1	10A	Un-insulated Components >95° C but <400° C (Other than components coming in Gas Path) Control valves (spring loaded bypass, economizer CV etc)	Blast cleaning to SSPC-SP10 with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 65µ per coat	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-2	2/ DFT= 20µ per coat	Aluminium	105
	10C	Un-insulated Components >400° C but <600° C (Other than components coming in Gas Path)	Blast cleaning to SSPC-SP10 with surface profile 35- 50 microns	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20µ per coat	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20µ per coat	Aluminium	80
3.2	1JS	Components >95° C **Insulated**	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µ per coat	2 Shall be done at shop	- -	- -	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µ per coat	2 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	100

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

PART-III contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3.3	2A	Heat Exchanger Coils: (SH, RH & Economiser Coils)	SSPC – SP6## or SSPC – SP3 Commercial Blast cleaning/ Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	2/ DFT=35µ per coat	--	--	--	--	--	70
			## - Commercial blast cleaning is to be adopted for components which cannot be containerized during voyage								
3.4	1GS	Components coming in Gas Path other than Coils	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2/ DFT=30µ per coat	- -	- -	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µm per coat	1 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	80
3.5	10A	Uninsulated Fuel Pipes	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Inorganic Ethyl Zinc Silicate Primer to IS 14946	1/ DFT= 65µ per coat	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-2	2/ DFT= 20µ per coat	Aluminium	105
4.0	15	Constant Load and Variable Load Hangers (CLH / VLH) (See NOTE 14 of ANNEXURE V)	Abrasive blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1/ DFT=40 microns per coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1/ DFT=30.0 microns per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1JS	Miscellaneous and Casing Sheets Fuel Firing: Steam Blowing Piping: Duct Plates and Expansion Joints: Coal Handling:	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2 Shall be done at shop	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µm per coat	2 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	100
- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'											

PART-III contd…..

Sl. No.	Scheme No.	PGMA** / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
5.2	1GS	Erection Materials and Commissioning Components:	Blast cleaning to SSPC-SP10/ Sa2 ½ (near white metal) with surface profile 35- 50 microns	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2/ Shall be done at shop	- -	- -	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µ per coat	1 Shall be done at shop	Smoke Grey Shade No: 692 of IS 5	80
6.1	10C	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.	Blast cleaning to SSPC-SP10 with surface profile 35- 50 microns	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20µm per coat	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-I	2/ DFT= 20µm per coat	Aluminium	80
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq. ft	--	--	--	--	--	--	--
6.3	15	Soot blower components	Blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1/ DFT=40 microns per coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1/ DFT=30. microns per coat	Phirozi Blue Shade No. 176 of IS5	70
6.4	36	On Shore OFE Components	SSPC-SP10/ Blast cleaning to Sa 2 ½ with surface profile 35 microns	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50µµ per coat	2	--	--	Chlorinated Rubber Based Finish Paint DFT= 30µµ per coat	2	French Blue Shade No: 166 of IS 5	160
6.5	35B	Off Shore Components	SSPC-SP10/ Blast cleaning to Sa 2 ½ with surface profile 35 microns	Epoxy based Free Mastic G-316 Primer	1 / DFT= 100µ per coat	--	--	Aliphatic acrylic Poly-urethane paint To IS13213 %VS=40 (min)	1 DFT= 30µ 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= 20µm per coat	--	--	--	--	--	40

- For PGMA details, refer corresponding Sl.No. in Annexure-II- ' **PG-MA Grouping'

Painting Scheme for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5

ANNEXURE I

NOTES FOR PAINTING SCHEME PART I, II & III:

1. This painting scheme covers a comprehensive list of PGMAs being used in 125 to 800 MW and Industrial Boilers under Fossil Boilers working in normal environment, in an effort to standardize the painting scheme. Therefore, the entire list of PGMAs will not be applicable for any specific project and only those PGMAs 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 and inside surfaces of fabricated structure shall be painted with red oxide primer paint during fit up stage.

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 Splice/cover plate/gusset plate, and metal contact area usually bolted at site to enhance the load transfer by friction grip 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. PGMAs 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 on any damaged painting area. This repair is not applicable to inorganic ethyl zinc silicate painted component.

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. Inside surface of fabricated items such as box type columns need to be painted with 2 coat of red oxide primer before fabrication of the component.

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 PGMAs are covered. Requirements for Missing / new PGMA s will be included under the relevant section, following the appropriate paint logic.

10. Ground shade/color 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 dia <25mm 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 Sl no: 5.1 of SIP:PP:22-A/B/C. For all commissioning components-erection materials (xx-993) two coats of Red oxide Zinc Phosphate Primer shall be applied to meet the temporary protection till erection, after power tool cleaning.

12. Touch-up painting of damaged areas shall be carried out as per clause applicable painting scheme.

13. Structural members having welded connections at site, relevant area can be painted with primer paint. Instead of Weldable primer.

14. DUs coming under Constant Load Hangers (CLH)/ Variable Load Hangers (VLH) shall be painted as per the system - PS 15 indicated in Sl. No. 4 of the table. However, for DUs other than CLH/VLH, the painting shall be as per Painting Scheme PS 1A indicated in Sl. 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/m^3. For tubes typically 4 – 5 tablets per end are to be put. For C & I items the dosage of self-indicating Silica Gel (colorless) shall be 250 gm/ m^3. (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. For chequered plates having thickness <=5mm, surface preparation can be power tool cleaning to St3 and painting shall be in line with Sl. No. 5.1 of corresponding category.

17. Structures: Metal to metal contact area usually bolted connections (namely, Splice/cover plate, rest plate etc.,) designed to enhance the load transfer by friction grip bolt shall be applied with rust preventive fluid after blasting.

18. Handrails covered under Sl. No. 2.2 of annexures-II/III/IV need to be painted in line with painting scheme for handrails (i.e. Sl .No. 2.5). Similarly step treads of structurals (sl.no.2.2) shall be galvanized in line with PS6.

19. This painting scheme is the final document and it overwrites any other document indicating painting/ coating schemes. The component not covered in approved painting scheme, this is the governing document to decide the type of paint application.

20. All threaded components of spring assemblies and turnbuckles shall be galvanized and achromatized to 15 microns minimum thickness.

ANNEXURE- II

PG-MA Grouping

Sl. No.	PGMA / Description
1.1	Collector and separator vessels/ Drum & Drum suspension (Except Internals), supports **04** – 114, 116, 118, 124, 126, 128, 142, 144,146,147, 148, 210 212, 214, 270 , 321,323,547
1.2	(Collector and separator vessel/ Drum) Internals: **04** – 114, 134, 136, 138, 210, 347; Retainers: **30**-310,410,510,520; **32**-010,310,410,510,520,610,710; **33**-310; **37**-010; Other Machined Components: **43** – 101, 102, 103, 104, 105, 106, 107; Dd items: **07-**302, 309,331,361,362,393; **12-**314,317,324,327,328,344,348,354,393;**17-**304,306,319; **19-**306,307; **21-602,605; 24-**352,803,813,818,827,842; **41-710; 42-710; 43-710; 45-710; 47-710; 65-710; 67-710**
1.3	Drum Transport Structures **04** - 194, 196, **35** - 391, 810 & Temporary structures to be removed after erection at site
2.1	Foundation Materials and Pin: **28**-700; **35** - 010, 011, 012, 013, 020, 030, 190, 700, 701; **36**-700,701; **38** – 010; **39** - 010, 011, 012, 020, 030, 040, 700; **48** – 019,913 & Columns below " 0 " level of PG 35,36, 38 & 39
2.2	Buck Stays and Structural Items: Buck stays: **08** – 001, 003, 006, 007, 101, 104, 107, 111, 380, 382, 400, 500, 501, 503, 700, 900, 901, 904, 907, 910 Boiler Supporting Structures: **35** – 100, 110, 111, 112, 120, 121, 122, 130, 131, 132, 133, 134, 135, 136, 140, 141, 142, 143, 144, 145,146,150, 151, 152, 153,154,155,156, 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, 371, 372, 380, 381, 382, 383,384,385,386,387, 390,392, 410, 420, 430, 440, 441, 442, 443,444 to 447, 451, 452, 453,454 to 457, 461, 462, 463, 471, 472, 473, 481, 482, 483, 500, 510, 511, 512, 513, 514,515 to 558 520, 521,522, 523, 524,525 to 528, 530, 531, 532, 533, 534 to 538, 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; **36** – 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, 336 to 338, 340, 341, 342, 343, 344, 345, 346, 347, 348, 350, 351, 352, 353, 354, 355, 356, 360, 361, 362, 363, 364, 365, 366, 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; **38** – 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: **39** - 100, 101, 102, 110, 120, 121, 130, 140, 141, 142, 143, 150, 160, 200, 210, 299, 300, 301, 303, 304, 305, 306, 311, 312, 323, 390, 391, 392, 393, 901; Duct Supports **48** – 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, 395, 415, 425, 435, 445, 455, 465, 475, 485, 495, 665, 805, 815, 825, 845, 855, 865, 875, 885, 995 Piping Centre: **80**-800 to 882, 920 to 933, 940. Bunker structures: **34-** 100 to 104,111,112,151,152,200,201,205,206,251,255,256,301 to 303,351 to 353,390, 401 to 403,406 to 408, 451 to 453, 456 to 458, 501 to 503, 506 to 508, 551 to 553, 556 to 558, 610, 650, 911, 951. Columns, bracing, bunker shell & hopper, platforms, monorails etc. **68-** 101,102 to 104, 111 to 114,150,160, 180, 190, 201 to 203, 206 to 208, 211 to 213, 216 to 218,251,253,256, 261,263, 266,281,286,287,291, 296, 297, 301,306,311,316,351,356,361,366, 381.383,386,391,396,401,411,610, 620,630,640; **66 -** 101,102, 151,152;
2.3	Hangers: **36** - 740, 741, 742, 743, 744.
2.4	Floor grills, Guard plate** **35** – 811,812; **36** - 010, 810, 811, 812, 813, 814, 815, 816, 840; **38** - 810, 811; **39** – 810, 811, 840, 841
2.5	Hand Rails & Posts **34**-810,820,850; **35** - 850, 851; **36** – 820,850, 851, 852, 853; **38** – 820,850, 851; **39** – 820,850, 851; Ladders & Stairs **35** – 820, 821, 822, 823; **36** – 820, 821, 822, 823; **38** – 820, 821; **39** – 820, 830, 831; **48** – 466
3.1	Components >95 C Un-insulated other than components coming in Gas Path **09** - 001, 002, 003; **21** - 800, 850, 875, 997; **24** – 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, 642,660, 665, 680, 685, 690, 807, 820, 860, 865, 867, 880, 885; **28** – 200, 220; **42** – 200, 318, 328, 348, 358; **48** – 380, 915. Valves/ Temp up to 400 deg.C: **42** - 300; **24** - 883; Seal boxes (temp >400 & <600 deg.C): **09**-004, 005; For export projects: (>95^{0}C but <400^{0}C) **24**-120,185,190,195,220,373,395,420,490,495,520,590,820,860,885; **42**-300,318,328,348,358; (>400^{0}C but <600^{0}C) **09**-001,002,003; **21**-800,850,875,997; **24**-160;
3.2	Components >95 C **Insulated** **05** - 137, 139, 147, 153, 154, 155, 158, 159, 175, 188, 195, 220, 227, 229, 231, 236, 241, 246, 251, 265, 281, 283, 296, 327, 330, 340, 341, 350, 493, 879, 900; **07** - 101, 102, 104, 106, 107, 108, 109, 110, 125, 200, 201, 202, 203, 204, 211,

	212, 214, 215, 216, 217, 218, 221, 222, 223, 225, 226, 229, 231, 232; **10** – 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, 285, 291, 295, 315, 687; **12**-178,179, 181,850,852,900; **15** – 136, 138, 147, 174, 177, 178, 192, 193, 236, 238, 274, 278, 279, 292, 293, 999; **17** – 138, 177, 407, 776, 807, 900, 903; **18** – 001, 002, 003, 010, 020; **19** – 701, 702, 753, 903; **21** – 600,602,603,604; **24** – 100, 115, 175, 200, 215, 275, 295, 300, 315, 375, 475, 500, 568, 600, 603, 620, 624,627,628, 675,811,824,828,836,837,855,860,865,867; **42** - 020, 021, 025, 030, 031, 032, 033, 036, 037, 038, 128, 150, 153, 158, 159,200; **48** –018,035,135,202, 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.
3.3	Heat exchanger coils: (SH, RH & Economizer coils): **11–** 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, 374,377,378,395,406, 416,467,469,474, 487,491,494,585,587,591, 606,608,616,618,682,683,684,685,686,687, 688,694,716, 717,718,767, 768,769,787,791,882,883,884,885,887,916,917,918,967,968, 969,986,987,988,991,994,999**; 12-** 135,136,170,174,178,184,187,335, 368,395, 403,405, 495,506,514,515, 517, 524,528,535,544,548, 551,554,568,619,800,803,805,850,851,852,900,901,903,906,914,917,924,927, 928,944,948,954,968, 988,999; **16-** 077,079,132,201,202, 203,235,236,237,238,256,270,275,277,278,279,281,377,379; **19-** 001,104,105,114,124,184,802,803,804,814,824,884,886,887,914,924,984, 987;
3.4	Components coming in Gas Path other than Coils **06** - 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, 401,430, 431,437,447,451,455,466, 467, 500, 501,530, 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, 734,735, 737, 740, 741, 743, 744, 745,747, 749, 750, 751, 752,753, 755, 759,789, 790, 830, 840, 850, 851, 857, 895, 896, 897; **07**-315,316,318,883,993; **10** – 182, 183, 184, 185,687; **12**-883; **16** – 988, 999; **17**-174,175,474,476,504,506,519,910,903; **18**-002; **19** – 091,092,703, 704, 708, 753,763,783,793, 802,850, 851, 852,853,900, 988, 999; **20**-988,998; **21**-987,988; **24**-822,823,987,988,989,993; **30** – 010, 103, 104, 105, 211, 212, 215, 216, 217, 218, 219, 220, 223, 227, 228, 233, 235, 993; **31** – 010, 101, 102, 103, 104, 105, 108, 301, 993; **32** – 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; **35**-993; **37**-010,810; **38**-993; **39**-993; **41**-988; **42** – 129,858,988; **48**-664,993; **67**-200; **95**-988; **96**-193; **97**-282,590; **99**-099,501,502;
3.5	Uninsulated Fuel Pipes **47** – 229, 265, 266. 267, 268, 269, 306, 307, 308, 309; Duct for Tube Mill: **48** – 802, 804, 812, 814, 817, 822, 824, 832, 834, 842, 844, 852, 854, 857, 862, 864, 867, 872, 874, 882, 884;
4	Constant Load and Variable Load Hangers (CLH / VLH) **(See NOTE 14)** **07** - 400, 401, 402, 403, 404, 405, 410, 420, 431; **10** – 200; **17** – 904, 906, 919, 929; **19** – 506,507,901, 904, 905, 906, 907; **24** - 346, 351,353,817,819; **48**-206;
5.1	Miscellaneous and Casing Sheets: **07**-409,431,460,461,462,500, 501, 502, 503, 531, 560, 561, 600, 601, 997, 999; **12**-906,907; **19** – 101, 102; **21** - 601, 604,606,987; **24** - 101, 125, 130, 135, 140, 201, 225, 230, 235, 240, 301, 325, 335, 340, 350, 351,352,354,370, 374, 400, 401, 425, 430, 435, 440, 470, 471, 473, 501, 525, 535, 540, 570, 601, 604,625, 626,635, 640, 641,800, 801, 804,805,806,808,809,810,815, 821,825,826,835,840,841,950,987 989, 996, 998;30-233,234, **35** - 994, 995; **36** – 396,611,613, 903, 999; **37** - 010, 110, 210, 310, 410, 510, 610; **39** - 302, 924; Fuel Firing: **41** – 100, 110, 200, 310, 320, 330, 340, 350, 390, 410, 420, 430, 450, 460, 470, 500, 997; Steam Blowing Piping: **42** – 001,002, 003, 005, 010; **42** – 040, 045, 046, 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; **43** –000, 001, 002, 003, 004, 005, 006, 007, 008, 104,105,200,997, 999; **45** – 050, 120, 160, 161, 180, 181, 200, 220, 221, 260, 261, 321, 325, 326, 401, 801, 803, 804, 805, 858; **47** – 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, 223224, 225, 241, 242, 243, 244, 245, 246, 247, 248, 249, 261, 262, 263, 264, 301, 303, 647, 648, 649, 650, 746, 858, 953, 959, 963; Duct Plates and Expansion Joints: **48** – 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, 141, 142, 144, 152, 154, 162, 172, 182, 184, 192, 194, 911; Coal Handling: **65** – 051, 060, 070, 260, 402, 403, 460, 724, 736, 738, 786; **67** – 204, 251, 256, 261, 266, 271, 272, 276, 277, 283, 286, 400, 801, 802, 803, 804, 999; **99** – 201, 299 Others: **95**-088,089,091,092,485,495: **96**-186,187,189; **97**-099,585,591,592; **99**-100,300,600;

5.2	Erection Materials and Commissioning Components: **04** - 988, **05**-993, **06**-993, **07** – 988, 993, **12**-993, **24** – 993, **28** – 993, **35** – 993, **36** – 993, **37** – 993, **38** – 993, **39** – 993, **48** – 988, 993, **65** – 988, **97**-585,**99** – 045, 099, 501, 502;
6.1	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
6.2	Forged valves
6.3	Soot Blower components **20**-001,003,004,021,051,054,201,204,301,304,331,511,794,801,821,831,962,972
6.4	On Shore OFE Components
6.5	Off Shore Components
6.6	Hand Wheels

*Consolidated list of above PGMAs are categorized tentatively. Modification/ inclusion can be made periodically with approval.

ANNEXURE III

INSPECTION & TESTING PLAN FOR SURFACE PREPARATION, PAINTING

SL NO	COMPONENT/ OPERATION	CHARACTERISTICS	Cl	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOC/ ACCEPTANCE NORM	TYPE OF RECORD	AGENCY			REMARKS
								M	C		
1.0	Surface preparation for Plates /Rolled sections /Components										
1.1	Raw material	Rust, pitting	B	Visual	100%	Note 1	R	P	V	-	
1.2	Blasting media	Type & quality of abrasives	B	Random sample test	Abrasive quality for each lot	Note 1a	R	P	V		
1.2.1	Blasting /Power tool cleaning	Surface roughness /cleanliness	A	Visual Measurement	100% 10 spots/ Sq.meter	Surface profile as per approved painting scheme, Note 2	R	P	W	-	
		Profile defects	B	Visual	100%	Note 3	R	P	W		
1.2.2	Substrate Dust contamination (for blasting)	Adhesive tape test	B	Measurement	Two spots/ component	Note 4	R	P	W	-	Randomly selected 10 X magnifier, Transparent adhesive tape 25mm width
1.2.3	Substrate Chemical contamination (for blasting)	Surface Contamination test	B	Measurement	One Test/ abrasive lot used	SSPC-SP12 Chloride < **15** µg/cm² (PPM), Sulphate < **20** PPM	R	P	W	-	Any suitable method to identify salt contamination
1.2.4	Substrate-Coating conditions	Flash rusting Steel temp. Environmental Condition	A	Visual Measurement	100% One spot /Lot	Note 5	R	P	V	-	

SL NO	COMPONENT/ OPERATION	CHARACTERISTICS	Cl	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOC/ ACCEPTANCE NORM	TYPE OF RECORD	AGENCY M	AGENCY C	AGENCY	REMARKS
2.0	In process PAINTING										
2.1	Paint	Physical & Chemical	A	Review of documents	100%	In voice/data sheet	TC	P	V	-	Physical verification of Shade, batch no, date of manufacture. Supplier Approval status
2.2	Mixing (Two pack system)	Mixing ratio & durations	B	Documents	100%	Painting data sheet Note 6	R	P	V		Electrical/pneumatic Agitator
2.2.1	Filtering	Free from foreign particle	B	Documents	100%	use sieves 80-100 microns	R	P	V		Nylon mesh or muslin cloth.
2.2.2	Paint testing	Physical & Chemical properties	C	Lab test	Random $	Supplier TC/data sheet/ IS specifications	R	P	W		$ - sample collected at each vendor at regular intervals as advised by BHEL shall be sent to BHEL/NABL accredited lab.
2.2.3	Painting	Personnel qualification- i. Painter ii.Inspection personal	C C	Review of documents Review of documents	100% 100%	In line with this SIP- Annexure-III Certification by reputed Institution or by an Expert. (NACE/SSPC LEVEL II)	R R	V V	V V		
2.3	Airless /air spray	Spray process Pot life	B	Documents	100%	Supplier manual Tip selections , Note 7	R R	V P	V V		

SL NO	COMPONENT/ OPERATION	CHARACTERISTICS	Cl	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOC/ ACCEPTANCE NORM	TYPE OF RECORD	AGENCY M	AGENCY C	AGENCY	REMARKS
2.4	Coating thickness & coating intervals	Wet film , Dry film thickness	B	Measurement	100%	SSPC-PA 2 Note 8	R	P	V		
		Intervals	B	Documents	100%	Painting data sheet/ specification	R	P	V		Min:24 Hrs or as per paint specification/data sheet
3.0	FINAL TESTING										
3.1	Peel off test Cross cut /X-cut	Adhesive strength between substrate & primer and subsequent over coats	A	Test on each coat : Primer, intermediate and final coat	3 spots	ASTM D3359-7 Note 9	R	P	W		4X magnifier lens, 25 mm width pressure sensitive tape (P99),Cutting edges with template
3.2	Final inspection	Dry film thickness Finish, shade and Paint defect	A A	Document Visual	15 spots / Sq. M 100%	Approved Painting scheme, SSPC-PA 2 Note 8	R R	P P	W W		**Use of shade card**

NOTE-1: Rust grade

As per ISO 8501-1, rust and pitting are graded into four categories as A, B, C & D. Rust and pitting shall be removed by competent process prior to application of primer. Pitted area shall be cleaned by blasting /power tool cleaning/grinding provided thickness shall be met to the design requirement. Plates/Components identified under heavy pitted category C or D, acceptance/rejection reserved to QC/ BHEL.

NOTE - 1a: Blasting media

Blasting media shall be copper slag, iron slag, steel shots/grits &aluminum oxide. The abrasive used for blasting process shall be within chemical contaminations chloride < 15 ppm and sulphate < 20 ppm. Mixing ratio of shots/grits (generally 3:1) shall meet the surface roughness 35-50 microns after blasting. Blasting media shall be suitably sieved to get the required particle size 0.5 to1.0 mm. (Steel shots ASTM G40/G80)

NOTE 2: Blast cleaning

a) Air quality must be checked before start of blasting process by blotter test.

b) Surface finish: The blasted surface shall meet the SSPC-SP10 (SA 2.5) finish near white metal. Surface roughness shall be checked in 10 spots/ Sq.m. Digital/ Analog instrument duly calibrated shall be used to measure the surface roughness. Power tool cleaned surface shall be met to SSPC -SP3. Blasting/ power tool cleaned surface shall be met as per ISO 8501-1 requirement.

c) Surface roughness: Average value shall be 35-50 microns for blast cleaned surface.

d) Blasting: Shall not be done during rainy / mist seasons where Relative Humidity is more than 80%.

e) Optimum blasting pressure and nozzle size (straight bore or venture type) to get required surface roughness (90-100 psi for mineral abrasives and 120-125 psi for metallic abrasives, standing distance 12-18 inches and standing angle 80-90 deg. for full blasting, Sweep blast 45-60 deg. with respect to the substrate).

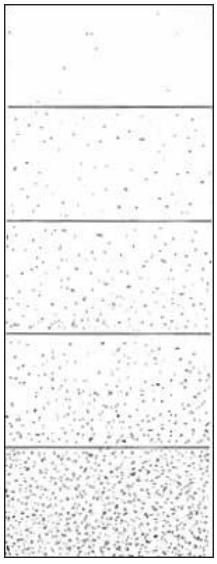
NOTE 3: Profile defects

a) Surface shall be visually checked and free from defects such as rust, dust, grease , oil, sharp corner/edges, rolling imperfection / overlap, vein, undulations, mill scales, improper weld beads/shapes/undercuts, weld slag, spatters etc.

b) Sharp corner/edges shall be ground off to radius 1.5 to 2 mm and blunted. Other profile defects if any shall be ground/chipped out / repaired by suitable means

NOTE 4: Dust

A transparent adhesive tape test shall be conducted on substrate to ensure cleanliness of the substrate and the same shall meet class 1 requirement



NOTE 5: Coating Conditions

a. Abrasive media used for blasting shall be free from moisture and other contaminations.
b. Flash rusting if any, shall be removed by sweep blasting
c. Primer paint shall be applied immediately or within 4 hours in the case of blast cleaning and within 8 hours in the case of power tool cleaning.
d. Painting shall not be done during rainy / mist seasons when Relative Humidity is > 80%.
e. Painting shall be commenced, when the metal surface temperature is > 3 ºC above the dew point temperature.
f. Painting shall not be done, when the steel surface temperature is > 45 ºC
g. A suitable instrument duly calibrated is required to check the dew point temperature and steel surface temperature.

NOTE 6: Mixing

a) Paint mixing ratio for two packs painting system shall be done as per painting data sheet provided by the paint manufacturer. Individual component shall be mixed thoroughly and then mix the both component as per data sheet ratio (by volume or by weight).Blend by boxing is prohibited for inorganic zinc rich primer (ie react with moisture). Off ratio (partial ratio) blends won't cure properly.
b) Mixing of thinner is not required for airless spray, however mixing of thinner < 5% is permitted. If required add thinner after mixing of paints and mix it with homogenously.
c) Paint mixing shall be done at least for not less than 20 minutes or as per Paint Data Sheet with electrical/pneumatic operated tool to achieve mixing chemically matured.
d) Mixed paint particles shall be filtered with sieves of 80-100 microns to avoid clogging of nozzle tip. Once components are blended, pot life begins and use the mixed paint immediately as

specified pot life period indicated in the data sheet.

e) Zinc rich powers dispersed slowly in to binder and agitate slowly while mixing process.

f) Primer, intermediate and final coat, shall be the same supplier, if any change, compatibility certificate shall be obtained from the paint supplier.

NOTE 7: Spray Process

a) Painting shall be done at controlled environment only and free from dust & paint soot.

b) When volume solids of paint is more than 50%, airless spray shall be selected for painting application.

c) Select proper nozzle tip size and pressure to achieve uniform DFT and less wastage.

d) Painting shall be done within pot life period specified in the paint product data sheet, to avoid premature paint failure.

e) Avoid arcing, tilting, maintain constant distance (12-18 inch), tip selection and tip pressure according to paint, triggering at appropriate locations and banding while painting.

f) While painting of inorganic zinc silicate, RH shall be above 65%, if painted below RH 65% water curing is required.

g) Top coat over and above epoxy intermediate coat shall be done within a month and proper roughness shall be created before top coat.

NOTE 8 : Coating Thickness

a) Wet film thickness (WFT) shall be measured immediately after paint applications using Comb gauge / eccentric wheel.

b) WFT can be calculated as: WFT= (100 x DFT)/ VS where, DFT is the dry film thickness and VS = % of volume solid of supplied paint from data sheet.

c) Dry film thickness shall be measured after hard dry condition of each coat.

d) Dry spray /dust particles embedded after previous coat shall be cleaned / removed with fine emery paper prior to application of subsequent
Coat. Coating thickness shall not be less than the requirement as specified in the painting scheme at any case tolerance on total DFT as specified in the applicable painting scheme shall be within – 0 / +20 microns or + 10% of total DFT, whichever is higher.

e) Coating thickness shall not be less than the requirement as specified in the painting scheme at any case. Tolerance shall be within - 0/ +20 microns as specified in the applicable painting scheme.

f) Painted surface shall be free from paint defects namely crack, sagging, dry spray, orange peel, etc.,.

g) Finish and shade as per paint data sheet. A painted panel shall be made available at works to check/compare the painted surface.

NOTE 9: Peel off Test

a) Paint peel off test shall be done after 48 hours of painting operation, on single/ multi coated painted surface of the component for each coat.

b) When total DFT is less than 125 microns- Cross cut method shall be followed.

c) DFT up to 50 microns 1 mm spacing with 6 cuts minimum to the length of 20 mm .

d) DFT more than 50 microns and less than 125 microns 2 mm spacing with 6 cuts minimum to the length of 20 mm

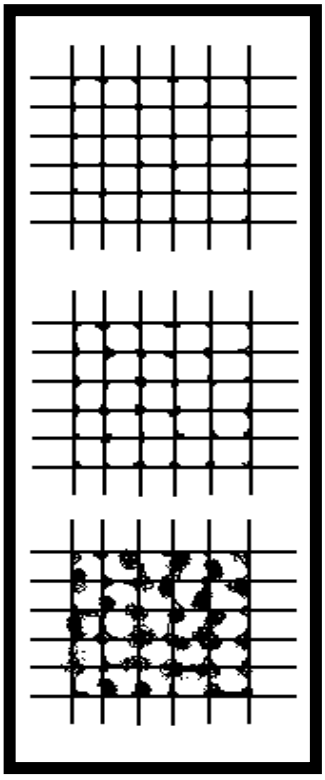
e) When total DFT is more than 125 microns- X cut method shall be followed .The smaller angle

of cut shall be between 30 to 45 degrees cut to length of 40 mm.

f) For all tests, ensure that coating film has been penetrated and minimum three locations shall be tested.

The adhesion test shall be conducted when the substrate temperature is below 35 °C for alkyd base paints.

Acceptable norm for Cross cut method:



< 5% Peel- Acceptable-(5A)

5-10% % Peel – Acceptable (4A)

>10% Peel - Not Acceptable (3A)

Acceptable norms for X cut method:

5A -No peeling - Acceptable.

4A- Trace peeling along incisions or at their intersection –Acceptable.

3A- Jagged removal along incision up to 1.6 mm on either side- Not acceptable.

PAINTING INSPECTION FORMATS

VENDOR CODE	I ST VENDOR : FABRICATION/ 2 ND VENDOR BLASTING SURFACE PREPARATION (POWER TOOL/BLASTING REPORT			
PAINTING SCHEME		REPORT NO& date		
PROJECT		PO.NO.		
WO.NO.				
PRODUCT DESCRIPTION				
SURFACE PREPARATION (REF STANDARD ISO 8501)				
Sieve size used and size of abrasive				
BLASTING MEDIUM USED		RAW MATERIAL RUST GRADE A B C D		

DU .NO	QTY	TEMPERATURE			RH	DATE	START TIME	END TIME REMARKS
		DRY BULB	WET BULB	DEW POINT				

MOISTURE CONTENT TEST FOR IF COMPRESSED AIR USED (BLOTTING PAPER CHECK)	OK / NOT OK
SURFACE PROFILE GAUGE READING(IN MICRONS) DATE & TIME SURFACE FINESH TO SA 2.5 (SSPC SP 10)/ SURFACE CLEANLINESS FOR POWER TOOL CLEANING	
SURFACE SALT CONTAMINATION TEST(IF ANY) FOR BLASTED SURFACE	REPORT OK / NOT OK
DUST FREE CHECK TEST FOR BLASTED SURFACE	TAPE REPORT
DUST FREE CHECK RESULT LEVEL FOR BLASTED SURFACE	1 2 3 4 5
Visual inspection(pitting, weld spatter/slag, rolling defects ,etc.,	
FIRM QC	TPI /BHEL QC

VENDOR CODE	1'ST VENDOR;FABRICATION, 2'ND VENDOR: PAINTING		
	PAINT REPORT		
PAINTING SCHEME		REPORT NO & date	
PROJECT		PO.NO.	
WO.NO.			
PRODUCT			

PRIMER COAT PAINT

PAINT SPECIFICATION/STD IS No:…… /SHADE	
PAINT MANUFACTURER	
SUPPLIER/TRADER NAME	
MANUFACTURING DATE / BATCH NO. / TC No	
MIXING RATIO / TWO PART SYSTEM IF ANY	
NUMBER OF COAT	
DURATION OF MIXING (use of stirrer) DATE / TIME :	

DU NO	QTY	TEMPERATURE				RH	DATE	START TIME	END TIME	REMARKS
		DRY BULB	WET BULB	METAL SURFACE	DEW POINT					

WET FLIM THICKNESS (in microns)			
SPRAY GUN USED			
HARD DRY TIME (REQURIED)			
DFT REQUIRED			
DFT ACTUAL MEASURED (SSPC PA 2)			
Visual inspection(pitting,weld spatter/slag,rolling defects ,etc.,) / paint defect			
PEAL OFF TEST(AST M- D3359)	CROSS CUT TEST DFT UP TO 50 MICRONS PITCH 1mm , cut Length 20mm	REPORT	OK / NOT OK
	CROSS CUT TEST DFT BETWEEN 50 TO 125 MICRONS PITCH 2mm, cut length 20 mm	REPORT	OK / NOT OK
	X CUT TEST ABOVE 125 MIC(included angle 30 to45 deg, cut length 40mm)	REPORT	OK / NOT OK

FIRM QC	TPI /BHEL QC

VENDOR CODE	1ST VENDOR;FABRICATION 2ND VENDOR: PAINTING
	PAINT REPORT

PAINTING SCHEME	-	REPORT NO& Date	
PROJECT		PO.NO.	
WO.NO.			
PRODUCT			

INTERMEDIATE/FINAL COAT	
PAINT SPECIFICATION/ SHADE	
PAINT MANUFACTURER	
SUPPLIER/TRADER NAME	
MANUFACTURING DATE / BATCH NO. / TC No./DC	
MIXING RATIO / TWO PART SYSTEM IF ANY	
NUMBER OF COAT	
DURATION OF MIXING (use of stirrer) DATE / TIME :	

DU NO	QTY	TEMPERATURE				RH	DATE	START TIME	END TIME	REMARKS
		DRY BULB	WET BULB	METAL SURFACE	DEW POINT					

WET FLIM THICKNESS (in microns)	
SPRAY GUN/NOZZLE NO USED	
HARD DRY TIME (REQURIED)	
DFT REQUIRED	
DFT ACTUAL MEASURED (Not less than specified in painting scheme)	
Visual /paint defect (if any)	

Peel of test (ASTM-D3359)	CROSS CUT TEST DFT BETWEEN 50 TO 125 MICRONS PITCH 2mm, cut length 20 mm	REPORT	OK / NOT OK
	X CUT TESTABOVE 125 MIC(cut included angle 30 to45 deg, cut length 40mm)	REPORT	OK / NOT OK

FIRM QC	TPI/BHEL QC

Annexure IV

PROCEDURE FOR QUALIFICATION OF PAINTERS

1.0 SCOPE:

This standard describes, in general, the procedure and criteria to be followed for qualifying an operator / painter for carrying painting work at BHEL shop or at vendor works.

.

2.0 OBJECTIVE:

To evolve criteria and procedure for qualification of operators / painters.

3.0 PROCEDURE:

Following procedure shall be adopted for certification of operator/painter qualification for carrying out painting process.

3.1 Shop shall initiate the format 'Record of personnel deployed for painting work' as shown **3.1**in ANNEXURE III A & III B. This annexure is subsequently forwarded to concern certifying department of the unit. For out sourced product, the vendor shall initiate /arrange for painter certification program.

3.2 Concern certifying department/ reputed agency/expert having NACE/SSPC (Level II) shall assess and certify the suitability of an operator/painter to conduct a painting process. In case, a new operator/painter is inducted shall have experience in the painting field minimum 2 years and qualification not less than VII std, then he shall be assessed by certifying department/reputed agency/expert. In case, an operator/painter does not carry out painting work for more than two years, then he shall be re-qualified and issued a certificate in line with Annexure.

3.3 An operator/painter engaged in carrying special process like painting, shall be re-qualified once in 3 years.

3.4 Following criteria have been identified and evaluated for each operator/painter. Each criterion has been allocated 10 marks.

3.4.1 Mainly, there are three type of painting processes which are being followed for carrying out painting. These are,

- Brush application,
- Air spray painting,
- Airless spray painting / air assisted airless spray

The operator/painter is expected to know the basics of the above painting processes, technical details of process equipment and their salient features, awareness about Do's and Don'ts in painting work.

3.4.2Understanding of the documents/specification

The operator/painter should have the knowledge about surface cleaning and acceptance norms, paint systems, mixing ratio and pot life of two pack systems, drying and curing behavior, use of proper thinner, control of viscosity and its importance, overcoating interval, precautions to be observed during their use, etc.

3.4.3 Awareness about handling of materials/jobs

The operator/painter is expected to have knowledge about handling of paint components like base, hardener and thinner, handling and upkeep of painting equipment, cleaning of brush, gun and other parts of equipment. He is also expected to know how to handle the cleaned and painted jobs.

3.4.4 Performance evaluation based on job/samples

The operator/painter shall be asked to prepare the test panel/job which shall be evaluated for following parameters:

- Uniformity of coating + 10% DFT required.
- Visual defects like, brush marks, wrinkles, pinholes, etc.
- Surface finish, gloss,
- Presence of dry spots, overflow marks

The operator/painter shall first clean the test panels thoroughly followed by a coat of primer/finishing paint etc., using the requisite painting process, i.e., brush / air spray/airless spray etc. After evaluation of test panels and based on result, the marks shall be allotted. After evaluation of test panels and based on result, the marks shall be allotted.

3.4.5Knowledge about safety and hygiene

Each operator/painter is expected to know about the safety of self and surroundings, use of safety appliances, effect of solvent vapors on health etc. He is supposed to know personal hygiene as well as upkeep of painting equipment and painting area.

3.4.6Class room training

A class room training by the supplier/expert (manufacturer like Nerolac, Berger etc.) of the paint which the respective units are procuring, must be arranged for the painters to have knowledge about the paints, enamels, coatings etc. and their applications. The class room training must be arranged in local languages for understanding of the painters

4.0 CERTIFICATION FOR QUALIFICATION

Each operator/painter is evaluated for above criteria and marks are being allotted for each criterion. The operator/painter must obtain a minimum marks 5 for each criteria and qualifying marks shall be 25 out of 50. The painter should pass in the field/practical test, even performed well in the written examination. The certification shall be specified in the area of type of application process as a painter is qualified (example: airless / pressure pot/air spray etc.)

5.0 ISSUE OF CERTIFICATE

The operator/painter who qualifies the test shall be issued a certificate in standard format shown below, which shall be kept in the concerned and certifying department/vendor works for record. The format can be modified to suit the requirement at vendor works but prior approval of plant lab. This certificate shall be signed by initiating section in charge and certifying department /reputed agency/expert

6.0 VALIDITY

The validity of the certification is for 3 years from the date of issue. The operator/painter is required to appear for re-test to extend the validity.

Annexure IV-A

(FOR BHEL PAINTER QUALIFICATION)

374-109	**BHARAT HEAVY ELECTRICALS LIMITED** **Tiruchirappalli - 620 014**

QUALITY/PLANTLABORATORY

Photo

PAINTERS'S QUALIFICATION CERTIFICATE

1. Name :
2. Father's name :
3. Date of birth/ Age :
4. Basic Qualification :
5. Experience in the painting field :

Name of Expert trainer :
Designation :

Date of start of training	Training subject	Faculty	Duration (Hrs.)	Certificate issued Yes/no	Remarks
	1.Painting process and Equipment		2		Issued on
	2.Painting Document/ Data sheet/Batch TC		1		
	3.Knowlege of paint component and mixing		1		Validity up to:
	4.Painting performance Evaluation on sample		2		
	5. Safety and hygiene		1		

Marks obtained: (each section carry 10 marks)

1) Knowledge of painting process and equipment : ----------
2) Understanding of documents / specification : ----------
3) Handling of components : ----------
4) Performance evaluation based on jobs/samples : ----------
5) Knowledge of safety and hygiene : ----------

Qualifying marks are 25/50

Qualified for : Airless spray & air spray
Painting System : Alkyd/ Epoxy/zinc silicate and heat Resistant based paints

Signature of Section I/C Initiating the Certificate

Signature of Plant laboratory

Signature of Certifying expert

Annexure IV-B

(FOR BHELVENDORS PAINTER QUALIFICATION)

RECORD OF TRAINING & QUALIFICATION FOR PERSONNEL TO BE DEPLOYED FOR PAINTING PROCESS

Photo

VENDOR NAME AND ADRESS

1. Name :
2. Father's name :
3. Date of birth/ Age :
4. Basic Qualification :
5. Experience in the painting field :

Name of Expert trainer :
Designation :

Date of start of training	Training subject	Faculty	Duration (Hrs.)	Certificate issued Yes/no	Remarks
	1.Painting process and Equipment		2		Issued on
	2.Painting Document/ Data sheet/Batch TC		1		
	3.Knowlege of paint component and mixing		1		Validity up to:
	4.Painting performance Evaluation on sample		2		
	5. Safety and hygiene		1		

Marks obtained: (each section carry 10 marks)

1) Knowledge of painting process and equipment : ----------
2) Understanding of documents / specification : ----------
3) Handling of components : ----------
4) Performance evaluation based on jobs/samples : ----------
5) Knowledge of safety and hygiene : ----------

Qualifying marks are 25/50

Qualified for : Airless spray & air spray
Painting System : Alkyd/ Epoxy/zinc silicate and heat Resistant based paints

Signature of Initiating Official

Signature of Certifying expert

Annexure V

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 Smoke Grey	166 692	Brush / Spray	12
11	--	Epoxy based Free mastic G-316 Primer-	10	2	100	100	Grey/ blue	---	Airless Spray	24
12	120011130000	General Purpose Aluminium Paint to IS 2339	10	Dual	20	20	Aluminium	---	Brush / 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.

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.
13	120016121800	Heat Resistant Aluminium paint to IS 13183 Grade II	10	1	-	-	Aluminium	--	Brush / Spray	24
14	130070840000	Sea worthy Rust preventive fluid to PR: CHE: 09 – 06	10	1	--	--	Amber	--	Brush / Spray	12
15	120012311700 / 120012311800	Epoxy based polyamide cured finish paint to IS14209	10	2	40	35	Smoke grey/ Grey white	692/ RAL 9002	Spray	24
16	120015111700	Inorganic ethyl zinc silicate to IS 14946	8	2	60	65	Grey	--	Airless Spray only	16
17	120012211700	Poly amide cured Epoxy based Tio2/MIO pigmented intermediate coat	8	2	50	75	Grey/ Brown	--	Spray	24
18	120012111700	Epoxy based zinc phosphate primer to IS13238	10	2	40	35	Grey	--	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.

ANNEXURE-VI

GOOD PAINTING PRACTICES (DOs and DON'Ts IN PAINTING)

1.0 DO'S:

01 Remember, painting is an important value adding activity. Give it all your care.
02 Store paints in covered places. Avoid direct exposure to sunlight on paints.
03 Ensure the validity of the shelf life of the paint before use.
04 Roll the paint drum several times to ensure through mixing of the paint before use.
05 Use proper tools to open lid of the drum.
06 Mix the paints thoroughly to ensure homogeneity.
07 Apply strip coat on edges, corners and weld beads.
08 Follow instructions on the paint can or literature whenever a new scheme / source of paint is used.
09 Draw only the required quantity of the paint for the job and immediately recap the can.
10 Ensure proper ratio of mixing in case of two-pack system, as per norms.
11 Use only the specified thinner prescribed by the supplier or standard.
12 Ensure good quality of compressed air (free from moisture and oil) prior to spray painting.
13 Use only clean/new brushes of definite size for painting.
14 Clean the bristles well in the thinner before they are used for painting.
15 Painting shall be done in a well-ventilated area/identified area.
16 Ensure proper surface preparation as per the painting scheme.
17 Ensure that the blasted surface be painted within 4 hours after blasting.
18 Ensure that the surface to be painted is free from oil, grease, stray arcs, dents etc.
19 Adhere to the number of coats shade, dry film thickness and inter-coat curing time interval as specified. Clarify with lab, if needed.
20 Use lint free cloth/clean wiping rags for cleaning the surfaces prior to painting.
21 Maintain the right distance between the surface and spray gun (6 inches to 8 inches).
22 Ensure that mixed paints will be used before the expiry of its pot life in case of two-pack systems.
23 Ensure that the items to be painted/painted are inspected and cleared by the inspection personnel concerned.
24 Preserve the balance thinned paints in a separate closed container for future use, if they don't have any restricted pot life.
25 Clean the brush before and immediately after painting. Keep them clean during interruptions too.

1.10 DON'TS:

01 Do not use the paint, which has crossed its expiry date.
02 Do not draw more paint than necessary from the stores.
03 Do not make holes in the drum to draw the paint.
04 Do not keep the paint drum open for a long time.
05 Do not inter-change the thinners for the same generic paint between suppliers.
06 Do not use kerosene as thinner.
07 Do not smoke while painting.
08 Do not leave the brush without cleaning after painting.
09 Do not paint close to a welding area.
10 Do not paint when there is rain or sandstorm or when the relative humidity is about 90%.
11 Do not paint when the metal is chill (temp < (dew point+3deg.C)) or very hot (>48 deg.C).
12 Do not paint when the surface is not cleaned/prepared for painting requirements.
13 Do not paint the finish coat if the primer coat is not satisfactory.
14 Do not leave the balance paint open after painting.
15. Do not use VCI pellets for stainless steel components and its composite assemblies.

2.0 CLEANING OF PAINTED & RUST PREVENTIVE COATED SURFACES

Wherever required, paints and rust preventive protection can be removed either by using the following commercial solvents or by flame cleaning/ blasting.

For Rust preventive	Acetone, Methyl Ethyl Ketone or Tri-Chloro Ethylene
For all paints	Alkaline paint strippers or Solvent based paint strippers

3.0 SURFACE PREPARATION

- Surfaces of components shall be thoroughly cleaned before the application of primer paint and shall be free from grease, oil, dust, rust, weld slag, spatters etc.
- Abrasive blast cleaning to SSPC-SP6 (Sa2) grade shall be done to prepare the surfaces of hot worked pipes prior to application of primer.
- A comparative chart indicating the surface preparation standard equivalents is given below for ready reference.

DESCRIPTION	SSPC Scheme	Swedish Standard SIS - 05 - 5900
Solvent cleaning	SSPC-SP1	-
Hand tool cleaning	SSPC-SP2	St2
Power tool cleaning	SSPC-SP3	St3
Flame cleaning	SSPC-SP4	Fl
Blast cleaning to white metal	SSPC-SP5	Sa3
Commercial blast cleaning	SSPC-SP6	Sa2
Brush off blast cleaning	SSPC-SP7	Sa1
Pickling	SSPC-SP8	-
Blast Cleaning to near white metal	SSPC-SP10	Sa2½

4.0 APPLICATION OF PAINT

1. Primer paint shall be applied immediately or within 4 hours in the case of shot blast cleaning and within 8 hours for mechanical cleaning.
2. Wherever tubes / pipes are not either shot blasted or heat treated during manufacture, the rust preventive coating provided by the tube / pipe mill shall be treated as base for primer coating for subsequent painting of alkyd base paints like one coat of red-oxide zinc Phosphate (when called for). When special paint is specified in the painting scheme, the existing Rust preventive fluid is to be removed by blast cleaning. However, the rusted areas are to be cleaned free of oil, grease, rust etc. thoroughly using emery paper/ wire brush and making the rust preventive coated surfaces coarse.
3. Ready mixed paints shall be used as supplied by the supplier **without any addition of thinner unless otherwise specified.** Two pack systems are to be used as per supplier's instructions.
4. Wherever Second coat or Finish coat is to be applied in succession, 24 hours minimum drying time shall be provided between each coat for single pack paints. For two-pack system refer paint supplier's catalogue.
5. No painting is required in case of Stainless Steel, Aluminum and Galvanized components, unless otherwise specified in contracts.
6. For all machined components, rust preventive fluids shall be applied.

7. All weld edge preparations for site welding shall be applied with one coat of Weldable primer. For small components having weld ends on both sides, full surface can be painted with Weldable primer.
8. Part processed items meant for shop assembly shall be painted at sub-contractors works with primer / special paints (when called for in the painting scheme) based on the scope of the indent/Purchase Order. Further paint touchup / Coating shall be given appropriately during assembly.
9. 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 and not with respect to PGMA. All running meter items for spares one coat of Red Oxide primer and two coats of Synthetic Enamel Paint to IS 2932 (Latest) shall be applied.
10. Assemblies consisting of machined components and special equipments shall not be shot blasted wherever it may affect the system. In such cases power tool cleaning may be adopted for the localized areas only.

********** End of Document**********

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPALLI 620 014
QUALITY ASSURANCE

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

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

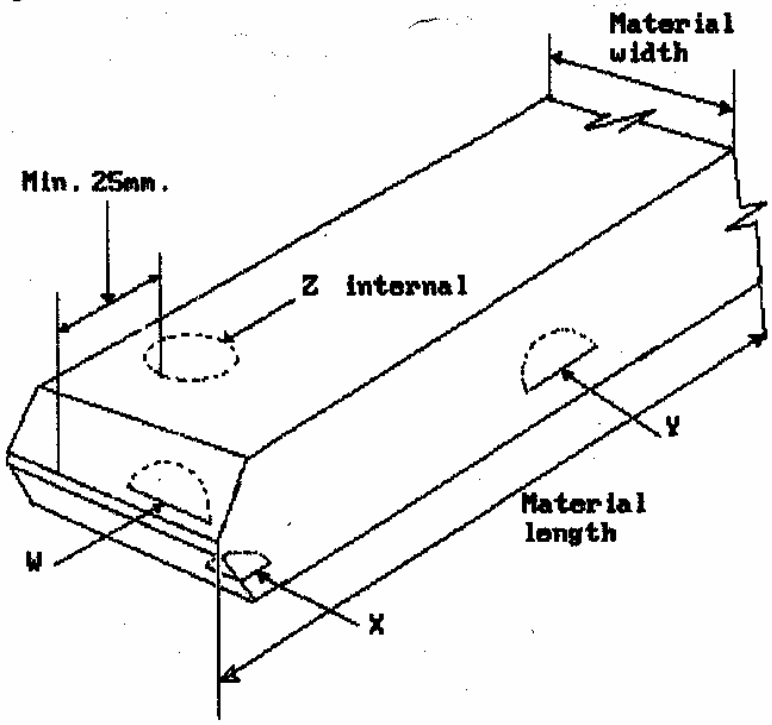
3.1 Acceptability and repair of mill induced laminar discontinuities in cut surfaces

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**

Nature of defects	Acc. norms	Disposition
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.
Weld contour		
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
TIRUCHIRAPPALLI - 620 014
QUALITY ASSURANCE DEPARTMENT

AMENDMENT TO QUALITY WORK INSTRUCTIONS (QWI)

QWI NO: QCP002 REV.: 04 Dt. 08.12.2011

AMENDMENT SL NO: A1 DATE: 13.06.13

DESCRIPTION:

Clause No	The existing points	Amended as…	Basis for amendment
4.6	4.6 Post weld heat treatment Note-1: All fabricated components of P4 materials with any member above 16mm thickness, the entire assembly shall be Post weld heat treated. However when the size of fillet weld is less than 12mm PWHT is not required for non load carrying members..	4.6 Post weld heat treatment In respect of the fabricated components of P4 Materials , PWHT requirement of entire assembly is detailed in the tabulated columns.	CE M&P and collobarator practice.

Plate thick	Load carrying members (PWHT)		Non-Load carrying members (PWHT)	
	Fillet size >12mm	Fillet size =<12mm	Fillet size >12mm	Fillet size =<12mm
>16mm	YES	YES	YES	NO
16mm & below	NO	NO	NO	NO

NOTE	The above-mentioned changes will be incorporated in the relevant QWI during the next revision of the document.

Prepared by: A.Francis	Approved by: Bikramoditya Roy
Dt: 13-06-2013	Dt: 13-06-2013

BHARAT HEAVY ELECTRICAL LIMITED

TIRUCHIRAPALLI

QUALITY CONTROL PROCEDURE
For
Non Pressure parts **QCP:002/04**

Prepared by A.Francis Quality assurance	

Reviewed by	SIGNATURE
Engineering (Shri.V.Sridharan)	
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Quality control (Shri.Amitroy)	
Quality Assurance (Shri.Bikramodityaroy)	

Revision No	Date	Approved	Signature
00	01-04-1993	--SM/QA	--Sd--
01	01.01.1995	SM/QA	--Sd--
02	24.04.2004	SDGM/QA	--Sd--
03	10.06.2010	SM/QA	--Sd--
04	08.12.2011	DGM/QA	

ECORD 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		Editorial correction made for better clarity. Scope of machining added in this document.
03		Shaded clauses & Type of joints for base plates incorporated. Pwht temperature for P4 matl.revised.
04		**P91&92 Bar process requirements added (Shaded clauses)**

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):

P No. Group	Specifications
P1 - Group 1 - SA 515 Gr 60.	Carbon steel IS 2062/**E250A & E250B**, IS 1239, IS 1161, A 36,
P1 - Group 2 -	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.
P5A – Gr 1(LAS),	SA 387 Gr 22 Cl.1 &Cl.2, SA 182 Gr F 22
P5B-Gr.1 (AS)	SA387 Gr5 Cl.1 & SA387 Gr9 CL.2
P15E Gr1	SA182F91, F92 , SA387 Gr.91,GR.92, SA335 P91, P92 SA213T91, T92, SA234WP91, WP92&SA336F91, F92
P6 -	SA 240-410,429
P8 - Stainless steel	SA 240 - 304 ,309,310, 316, 321, 347 & 253MA

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 grinding the notches smoothly for 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 either by groove weld/fillet weld sufficient to hold the parts in place instructions given in the respective SQPs/ Drawings/DCN (Incl. Production Notes)

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>12.5mm and for P5 materials t>10mm.

4.1.8 Shearing /Flame/gas cutting is prohibited on Gr 91 and Grade 92 materials.

4.1.9 Use only bandsaw for cutting of Gr91&92 materials. However for plates use plasma/waterjet/bandsaw only

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

Carbon steel	t <= 50mm…….Nil
Carbon steel	t > 50mm……100 ° C.min.
Alloy steel (P4)	t < =25mm…….Nil
Alloy steel (P4)	t > 25mm……..150 ° C
Alloy steel (P5A,B Gr.1)	All ……150 ° C
Stainless steel	…….Not applicable……..

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

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

4.1.11.1 For materials other than P5, P15E Gr 1(Grade 91) and Grade 92 this heat treatment may be clubbed with the final heat treatment of the product.

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

4.1.13 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 Before forming , proper cutting plan (Drawing dimensions with process allowances) shall be prepared and cleared by the concerned agency. Forming shall be done using proper tooling free from damages. Method of forming and work centre shall be identified in OPS / relevant QWI refered in PO.

4.2.2 Built up (Forming) operations for Beams and columns shall be done done by suitable Fixtures,Machines ,WPS & other accessaries required for forming. All the Forming operations of sheets / plates shall be done by rolling / pressing. For shell formed components 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 /Built up 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: **<u>Forming of U-ROD(Gr 91 &92)</u>**

4.2.6.1 Identify, mark and cut the rod using bandsaw to a length of equivalent to the arc length indicated in the drawing with two arm length(upto butt joint) +20mm .

4.2.6.2 Mark the centre of the rod with a heat resistant chalk to be visible after heating. For temperature and other details refer the SQP:NP:15(Latest)

4.2.6.3 Remove the “U”rod and air cool to room temperature .

4.2.6.4 Visually inspect the bend surface and check dimensions and ensure no surface imperfections.

4.2.6.5 Normalizing and tempering of "U"Rods to be done within 72 hours after pressing/bending operation.(Ref.SQP:NP:15(latest)

4.2.6 .6 Shot blast the "U"Rod to remove scaling and check the dimension. Conduct LPI/Wet MPI and ensure no surface indications.

4.2.6.7 Mark and cut the limbs of "U" rods such that the straight portion shall be as per drawing from the tangent point.

4.2.6.8 Edge prepare the "U"rod s for butt joint preparation as shown in the drawing by machining No gouging and grinding is allowed.

4.2.6.9 For Detailed operation of cold and hot forming of Gr 91 &Gr 92 materials refer SQP:NP:15(latest)

4.2.7 Threading of "U"Rods

4.2.7.1 Mark and cut the rods equivalent to the straight portions as shown in the drawings.

4.2.7.2 Threading to be done on one end of the rod to thread size as mentioned in the drawing/SQP: NP15(latest).

4.2.7.3 Edge prepare the other end of the rods by machining for butt welding as shown in the drawing.

4.2.8 Tolerances for formed components when not specified in drg. /SQP:NP15(latest).Shall be as follows

a) St.Length / Dia, Width & Height : + 1 mm/M, 5 mm Max
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 : + 2º
g) Ovality : 1%
h) E.P Angle : + 5º / - 2.5º
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 (E 7018) shall be used in the following cases:-

a. All Strength welds in ceiling girders, flange/web butt welds and 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 BSEN 10025 E250A & B, 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 250-300 deg.C for 2 hours and the electrodes shall be held at 120 deg.C until they are used.Electrodes shall not be re-baked more than once and use of elctrodes in wet condtion is prohibited.

4.3.1.5 All rutile electrodes (EXX 13) shall be dried at 120 deg. C for 1 hour min. and held at 120 deg.C till use.

4.3.1.6 Fluxes for SAW shall be dried at 250 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 º - 150 º C until use.

4.3.1.8 The type of welds employed in the structural fabrications (Girders,Columns,Beams & Base plates etc) are identified in the annexure –A along with sketch for better clarity and under standing. For further details the fabricator can ref the engg.drg. no.3-35-110-00995/00

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. However for P15E Gr.1.(F91 & F92) prepare a fixture for fit-up of butt joint of 'U' rod with Straight rods.

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	+ 10º - 5º	+ 10º - 5º

*(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.

4.3.2.5 The types of weld joints indicated in the fabrication of structural components are identified with symbols in ANNEXUR -A & B .For further details refer the Engg standard drawing no.3-35-110-00995(Latest)

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 chalks or thermocouples prior to start of welding as well as during welding for a width of 't' (maximum) or (100)75 mm whichever is less.

4.3.3.4 Where interpass temperature control is required during welding, the temperature must be ensured using thermal chalks / thermocouples with recorder . 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 after welding, the preheating shall be continued 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 (including away centre fabrication) , for requirements of procedure and personnel qualification SIP:NP: 07 (Latest) 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. However for P15E Gr.1.(F91 & F92) Only back grinding to be done after interstage PWHT.

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.For furher details ref.SQP:NP:20

4.3.7.2 While cutting long web plates suitable camber may be provided /required to compensate for the distorion 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.

4.3.15 Pre heating of Gr 91 &Gr 92 shall be 220 Deg.C .For other process parameters refer the applicable WPS.

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 º C and shall be ensured using thermal chalks / thermocouples.

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

4.5.3.1 For Austenitice stainless steels the maximum temperature shall not exceed 430 º 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 315º 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 º 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 º C during heating period (above 315 º 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	625 +/- 25 º C	a) For all butt welds in plate welded girders when t > 50mm.
	T= 39-62	100 º C		
	t> 63	150 º C		

P4 Gr 1&2	All	150	665 +/- 15 ° C	a)All butt welds in tension member b)All fabricated components when t>16mm(Note1)
P5A Gr 1& P5BGr2	All	150 ° C (Note2)	705+/- 25 ° C	All welds (Note 3)
P15E Gr1	All	220 ° C	760+/- 10 ° C	After welding, cool to below 95 ° C before PWHT. PWHT to be done within 72hrs after completion of welding .(Post heat as perWPS)
P8	300 type 400type	120 ° C 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:

a. 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".
b. 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, P1 (A,B) + P4, P1C + P4, P1 + P3 P4 + P5A, P15E Gr1	Up to 25 mm	125
	26 - 50 mm	200
	51 - 80 mm	250
	81 - 150mm	375

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 - 670º C.

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

4.6.7.3 For PWHT of P15E Gr 1 (Grade 91) & Grade 92 materials, soaking time shall be 1 hour per/inch with minimum soaking of 1 hour . The hardness of the weld metal or heat affected zone after PWHT shall be within 181 BHN to 303 BHN.

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	70º C / hour
Above 75 mm	55 ° C/hour
For S.S Matl	200 ° C / hour min (Forced air cooling)
GR 91 &92	Furnace cooling upto 350 ° C

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 400º 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.

a. All Butt welds of Carbon steel for thickness t > 32mm
b. All butt welds of alloy steels for thickness t >12.0mm for P5 and T > 16mm for P4.
c. All butt welds in monorails.
d. SS butt welds of T > 16mm unless otherwise specified.

5.3.1 All radiographic films shall possess Firm code , RT agency, Cust. No, Part No, RT reference Number. and weld location reference number. The job shall be numbered with Radiograph number.

5.4 MPI / LPI BEFORE PWHT

a. All flame cut edges of Carbon steel for t >= 38 mm and alloy steels for t > 12mm.
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 hardwares (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.

.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 ± 0.5º
b. Other characteristics ± 1º

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 weldeable 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 relavant details by paint, bordered and covered by one coat of transparent varnish

Project Name :
Work order number , DU NO. Weight & Sub-contractor Name/Code:
Co mponent / Assly. Designation :

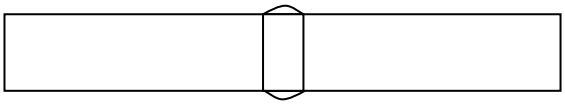
8.5 Tension flanges in girders are to be identified by hard punching indicating `TENSION FLANGE'

8.6 Apply grease on the threaded portion of "U"Rod and protect the threaded portion from damage with suitable plastic end caps.

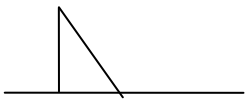
8.7 For subcontracted items the firm code shall be punched and bordered with white paint.

ANNEXURE - A

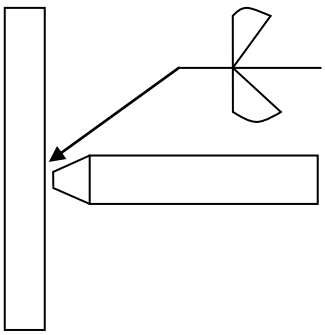
SQUARE BUTT WLED



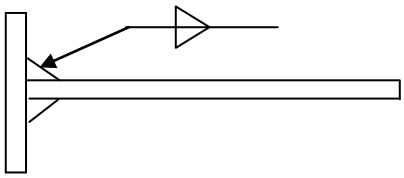
BEVEL WELD



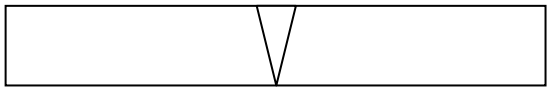
K WELD



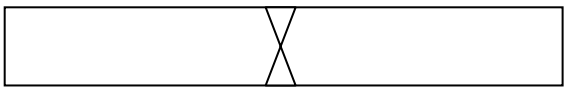
FILLET WLED



SINGLE V JOINT

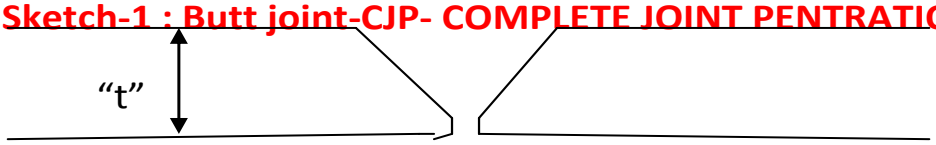


DOUBLE V JOINT



ANNEXURE-B

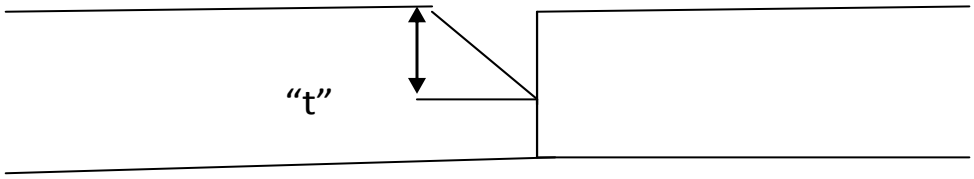
Sketch-1 : Butt joint-CJP- COMPLETE JOINT PENTRATION



Where "t" is base metal thickness . If "t" is > 50mm PWHT to be done.

If "t" is > 32mm RT to be done.

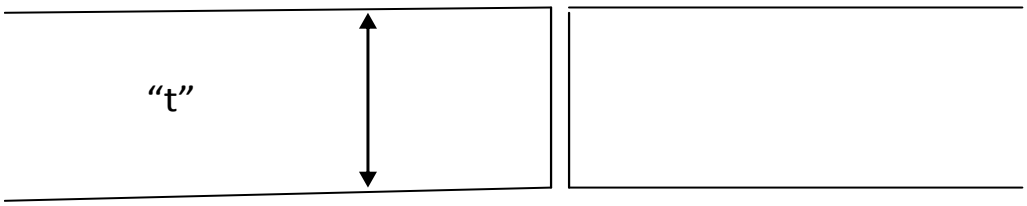
Sketch: 2 GROOVE Butt joint-PJP- PARTIAL JOINT PENTRATION



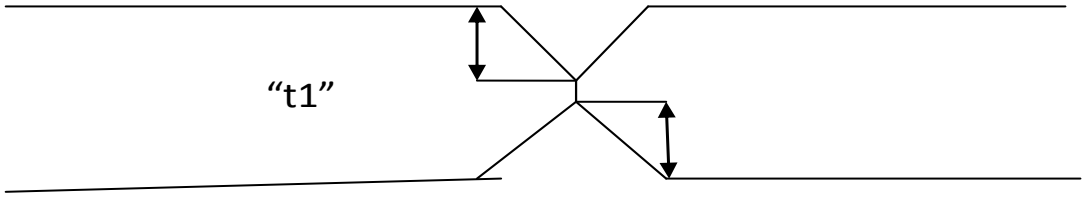
Where "t" is weld metal thickness. If weld depth is >50mm PWHT to be done

RT: is not applicable.

Sketch:3 - SQUARE BUTT JOINT PWHT & RT is not applicable in this case

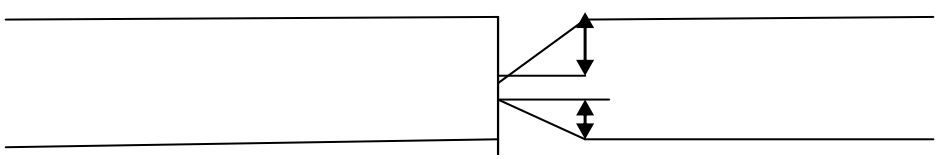


Sketch:4 - DOUBLE "V" GROOVE BUTT JOINT –PARTIAL PENTRATION JOINT



Where " t" is equal to t1+t2 . If "t" is > 50mm PWHT to be done. RT is not applicable

Sketch:5 – "K" **GROOVE WELD BUTT JOINT –PJP-PARTIAL PENTRATION JOINT**



BHARAT HEAVY ELECTRICALS LIMITED, TIRUCHIRAPPALI 620 014

QUALITY ASSURANCE DEPARTMENT

STANDARD QUALITY PLAN FOR **SQP: NP: 27/03**

BOLTED STRUCTURES

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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	----------

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≥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.

BHEL Tiruchirappalli	QUALITY ASSURANCE	STANDARD QUALITY PLAN for Bolted Structures Columns (Box, Plus & I type), Beams, Bracings & Ceiling Girders	QP NO. : SQP:NP: 027 REV.: 03 DATE : 08/06/15 PAGE : Page **1** of 9

SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	Class	TYPE OF CHECK	Quantum		REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD		Agency			REMARKS
					M	C			D	M	C	N	
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	
2.0	**Qualification**												
2.1	Welding Control	Procedure Qualification	A	Review of documents	100%	100%	AWSD 1.1/SIP:NP:07	WPS/PQR	√	P	W		
2.2		Personnel Qualification	A	Review of documents	100%	100%	AWSD1.1/SIP:NP:07	WPQ	√	P	W		
2.3	NDE Personnel	Personnel Qualification	B	Review of documents	100%	100%	SNT-TC-1A, or Equiv.	Certificates	√	P	V		
3.0	**In process :**	**Refer QCP :002 for process control**											
3.1	**Cutting Edge preparation , Fit up**												
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≥ 38mm # 20≤ t <38 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 ≥ 20 mm.
4.0	**Welding**												
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/SIP:NP:06		√	P	V		

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					M	C			D	M	C	N	
5.0	**NDE on Butt Welds**												
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. t≥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.
6.0	**NDE on Fillet Welds**												
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		
7.0	**Production Test Coupons (if specified in Contract Quality Plan)**												
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	**End Plates/ Splice Joint Plates for bolted Connections**												
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	**Final Inspection**												
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,stenciling,punching &dispatch clearance	B	Verification	100%	100%	All documents identified as ‘R’ in the D column			P	V		

SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	Class	TYPE OF CHECK	Quantum		REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD		Agency			REMARKS
					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	100^0C
E450 BR, BSEN10025 /S460M&S355J2	>25	150^0C
SA299 Gr A	all thickness	150^0C

Note-3

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

Material	Wall Thickness (mm)	Preheating Temperature (^{0}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

SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	Class	TYPE OF CHECK	Quantum		REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD		Agency			REMARKS
					M	C			D	M	C	N	

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

Material	Wall Thickness (mm)	Post heating Temperature (^{0}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

SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	Class	TYPE OF CHECK	Quantum		REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD		Agency			REMARKS
					M	C			D	M	C	N	

Note:6 **Tolerance**

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

Sl.No.	Structural Parts / Parameters	Tolerance in mm		
1	**Section Depth / width** upto and including 1.0 metre	+3 / -2 (± 1 at the joints)		
2	**Section Depth/Width** over 1.0 metre	+3 / -2 (± 2 at the joints)		
3	**Web Shift**	± 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	**Camber**			
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	**Sweep**			
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	**Twist**	± a/3000 = ± 0.33mm/m, where 'a' is depth of member		
9	**Combined warpage**	W /100 or 3 mm whichever is greater where 'W' is the width of flange other than joint area		
10	**Drilled Holes for Bolts**			
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		

SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	Class	TYPE OF CHECK	Quantum		REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD		Agency			REMARKS
					M	C			D	M	C	N	

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

Sl.No.	Structural Parts / Parameters	Tolerance in mm
1	**Length**	
a	For members where ends are free	± 1mm / m subject to 5mm max.
b	For members connecting between two structural members	+0 / -3
2	**Deviation in straightness**	
a	**Sweep**	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	**Camber**	5mm max.
3	**Twist**	± 1mm / metre or 6mm whichever is greater, where 'h' is depth of member
4	**Drilled Holes for Bolts**	
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.