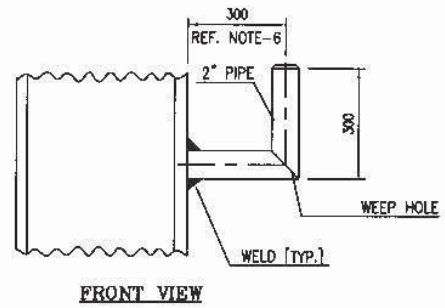
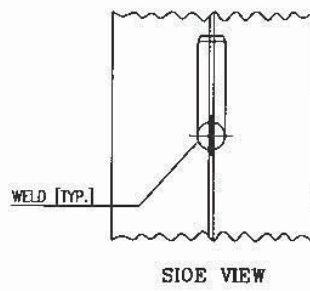
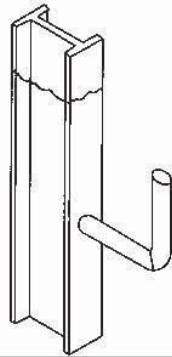


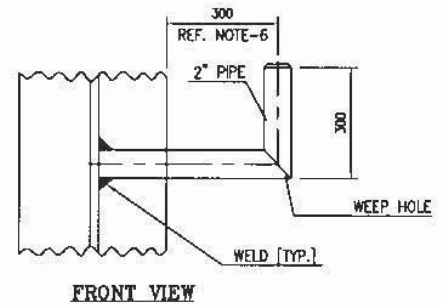
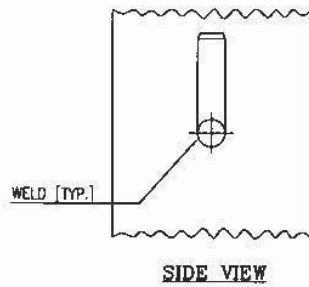
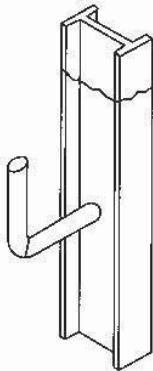
TYPE 15

STEEL COLOUMN MOUNTING [FLANGE FACE]



TYPE 16

STEEL COLOUMN MOUNTING [WEB FACE]

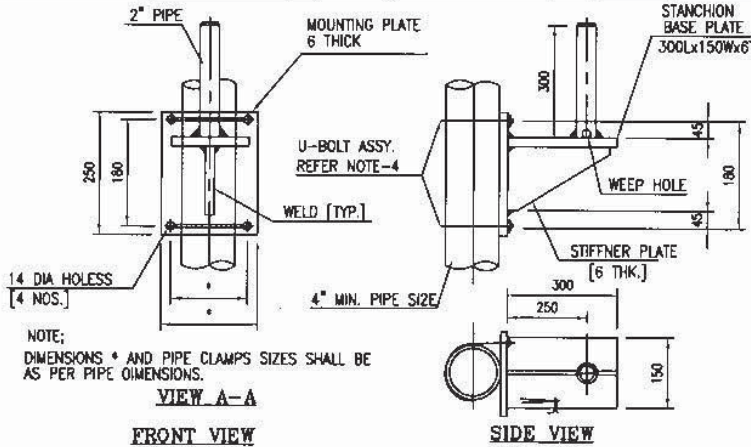


TYPE 17

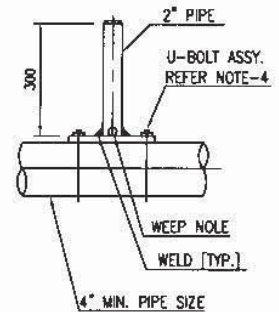
PIPE BRACKET MOUNTING

TYPE 17-1


[VERTICAL PIPE]



TYPE 17-2 [HORIZONTAL PIPE]

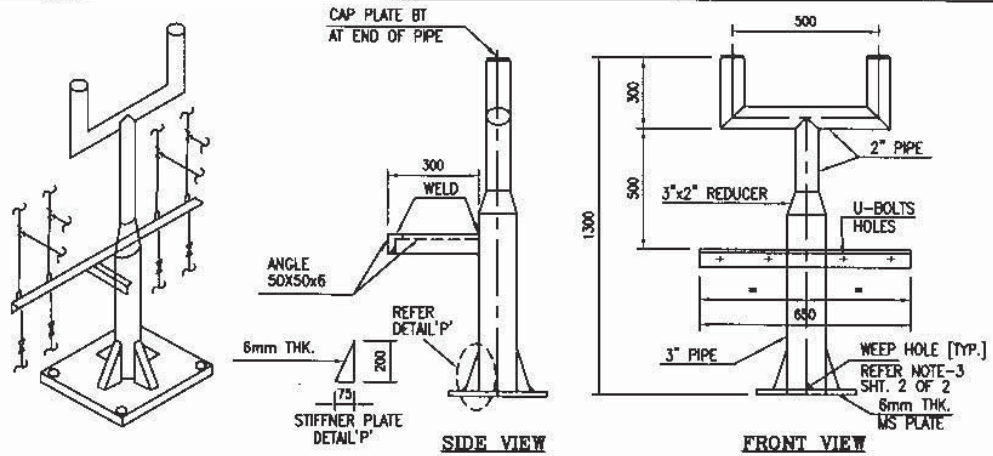


- NOTES:-
1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
 2. PIPE MATERIAL SHALL BE IS:239 HEAVY GRADE AS A MINIMUM.
 3. 6mm OIA WEEP HDLE SHALL BE PROVIDED AT LDW POINT.
 4. U-BDLT ASSMBLY SHALL BE DF MIN. M12 SIZE WITH NUT AND SPRNG WASHERS.
 5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH.
 6. ADD 50mm WHERE-EVER ARE INSULATION IS PROVIDED.
 7. BOLT SHALL BE TURNED FROM MS ROUNDS CONFIRMING TO IS : 432 GRADE 1.
 8. NUTS AND WASHERS SHALL CNFRM TO IS : 1363 AND IS : 313B.

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.
SECTION: INSTRUMENTATION							
DSGN	R.K.S		CHKD	P.S			
DRWN	SUNL						
APPROVED	D.G.M						
STEEL COLOUMN MOUNTING						 मेकॉन लिमिटेड MECON LIMITED	
						SCALE : N.T.S.	(SH. 3 OF 3) REV
						DRG.NO MEC/05/E5/SD/IS/010 A	D

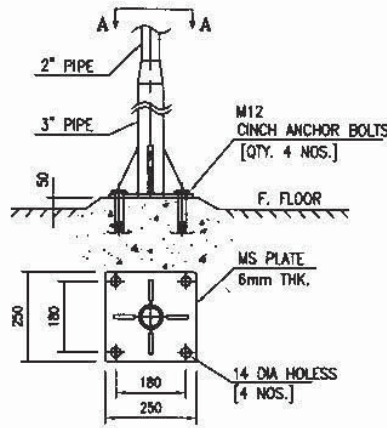
TYTE 21

TWO INSTRUMENT SUPPORT - GENERAL ARRANGEMENT

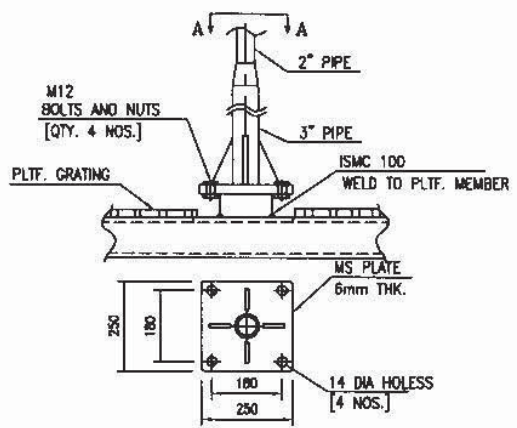


TYTE 21-1

TYTE 21-2



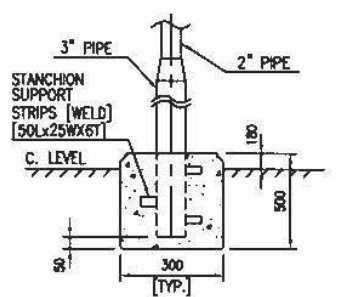
VIEW A-A
PAVED AREA MOUNTING



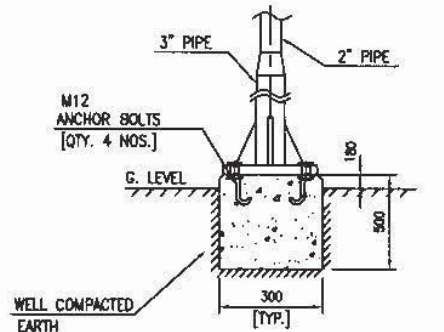
VIEW A-A
PLATFORM MOUNTING

TYTE 21-3


TYTE 21-4



UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

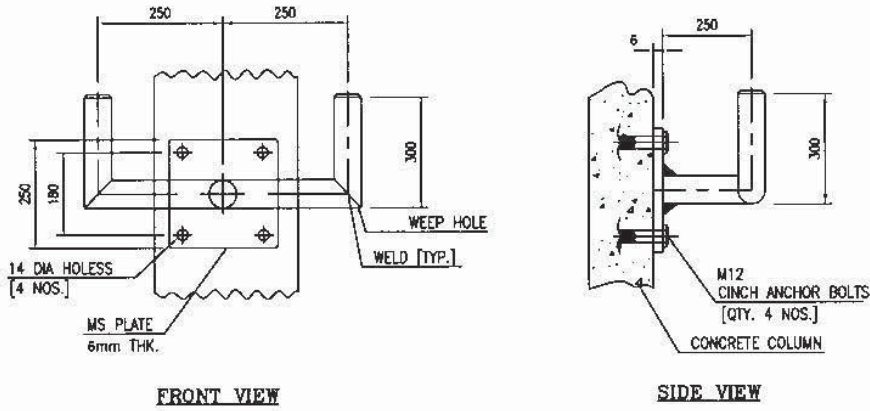


UNPAVED AREA MOUNTING
(WITH SEPERATE CONC. BLOCK)

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.
SECTION: INSTRUMENTATION							 <p>मेकॉन लिमिटेड MECON LIMITED</p>
DSGN	R.K.S		CHKD	P.S.	<p>SCALE : N.T.S. (SH. 1 OF 3) REV</p> <p>DRG.NO : MEC/05/E5/SD/IS/D1D B D</p>		
DRWN	SUNL						
APPROVED				D.G.M.			

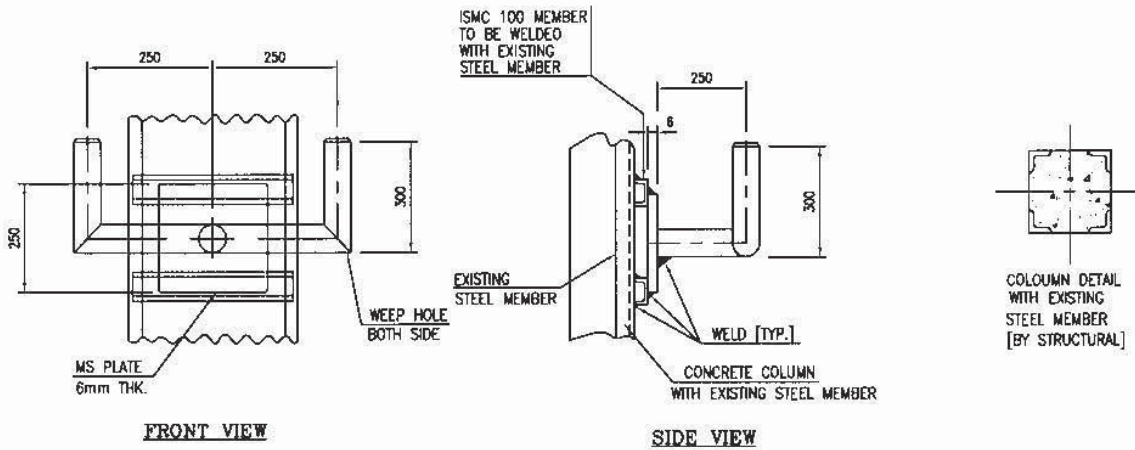
TYTE 22

CONCRETE COLOUMN MOUNTING



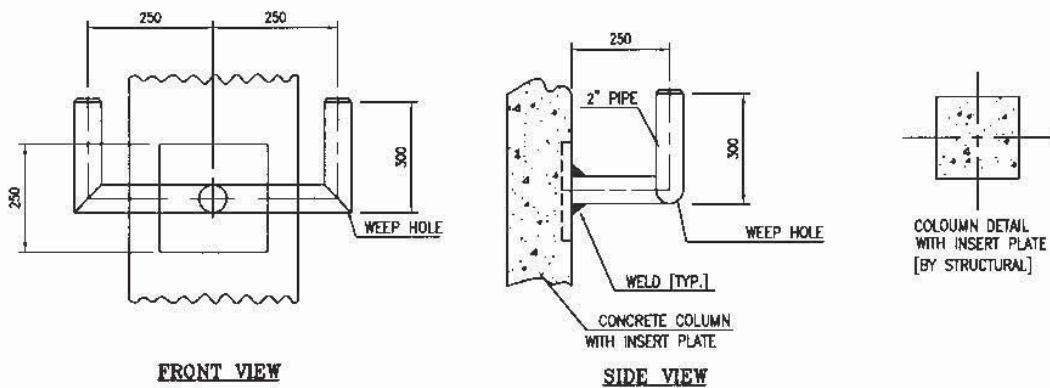
TYTE 23


CONCRETE COLOUMN [WITH ANGLE INSERT] MOUNTING



TYTE 24

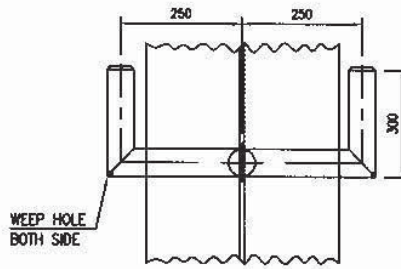
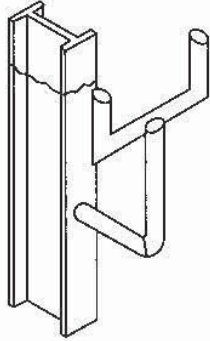
CONCRETE [WITH INSERT PLATE] MOUNTING



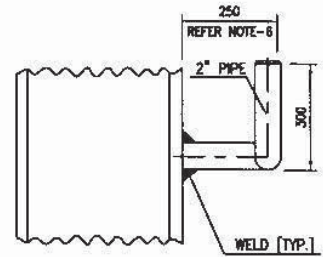
REV NO	DATE	ZONE	DESCRIPTIONS REVISIONS	BY	APPRD	REFERENCES	DRG. NO.
SECTION: INSTRUMENTATION							
DSGN	R.K.S		CHKD	P.S.	CONCRETE COLOUMN MOUNTING		
DRWN	SUNIL						
APPROVED			D.C.M.				
							मेकॉन लिमिटेड MECON LIMITED
						SCALE : N.T.S.	(SH. 2 OF 3) REV
						ORG.NO: MEC/05/E5/SD/IS/010 B	0

TYPE 25

STEEL COLOUMN MOUNTING [FLANFE FACE]



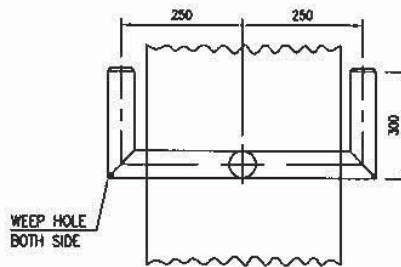
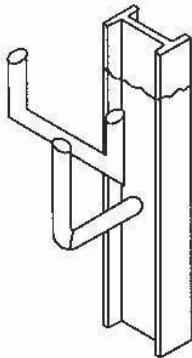
FRONT VIEW



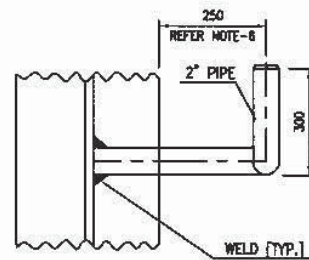
SIDE VIEW

TYPE 26

STEEL COLOUMN MOUNTING [WEB FACE]




FRONT VIEW

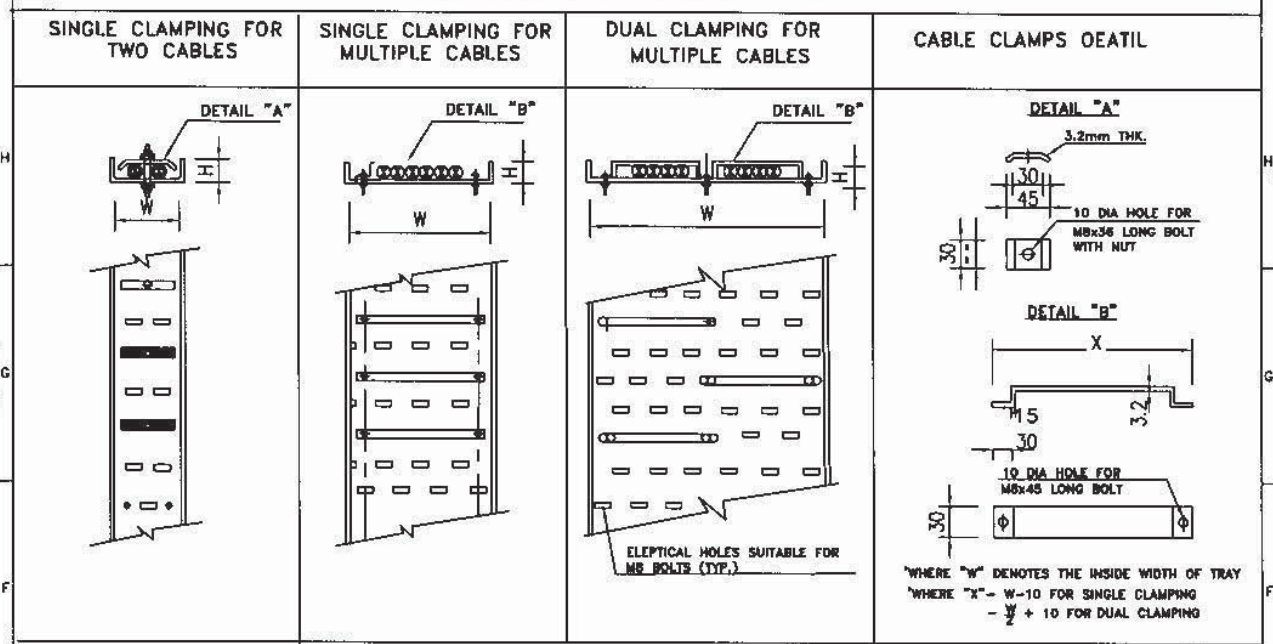


SIDE VIEW

- NOTES:-
1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
 2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
 3. 6mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
 4. U-BOLT ASSEMBLY SHALL BE OF MIN. M12 SIZE WITH NUT AND SPRING WASHERS.
 5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH.
 6. ADD 50mm WHERE-EVER ARE INSULATION IS PROVIDED.
 7. BOLT SHALL BE TURNED FROM MS ROUNDS CONFIRMING TO IS : 432 GRADE 1.
 8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.

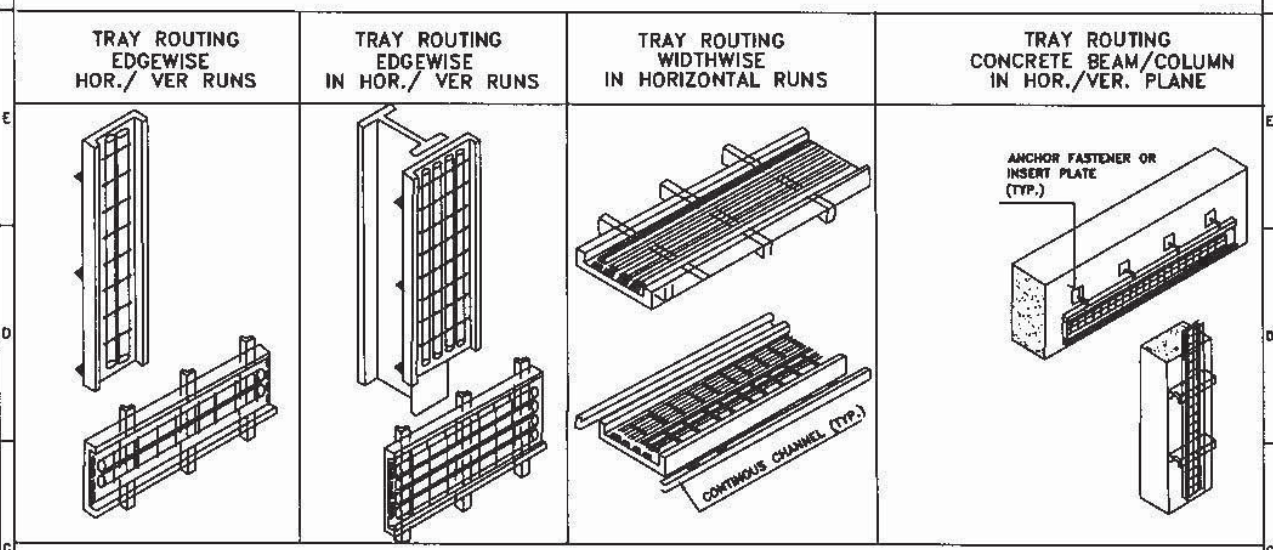
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SECTION: INSTRUMENTATION							
DSGN	R.K.S		CHKD	P.S.			
DRWN	SUNIL						
APPROVED			D.G.M.				
STEEL COLOUMN MOUNTING						 मेकॉन लिमिटेड MECON LIMITED	
						SCALE : N.T.S.	(SH. 3 OF 3) REV
						DRG.NO: MEC/05/E5/SD/IS/010 B	

CABLE CLAMPING ON PERFORATED TRAYS



WHERE "W" DENOTES THE INSIDE WIDTH OF TRAY
 WHERE "X" - W-10 FOR SINGLE CLAMPING
 - $\frac{W}{2}$ + 10 FOR DUAL CLAMPING

PERFORATED TRAY-SUPPORTING DETAILS



NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. PERFORATED TRAY SHALL BE SUPPORTED AT EVERY 1000mm (TYP.) INTERVAL FOR HORIZONTAL AS WELL AS VERTICAL RUNS USING MINIMUM ANGLE SIZE AS 40x40x5 DR CONTINUOUS CHANNEL SUPPORT MC50.
3. CLAMPING OF CABLES ON PERFORATED TRAYS SHALL BE AT EVERY 500 mm DN VERTICAL RUNS AND EVERY 1000mm DN HORIZONTAL RUNS.
4. PERFORATED TRAYS SHALL BE SUPPLIED WITH CLAMPS, BOLTS/NUTS AND WASHER OF GALVANISED MILD STEEL.
5. GALVANISING SHALL BE AS PER 47SB(66um/480g/m²)
6. THE PERFORATED TRAY THICKNESS SHALL BE 2mm.

CAPACITY OF PERFORATED TRAYS

TRAY WIDTH (W)	FLANGE HEIGHT (H)	NO. OF CABLES		
		1 PAIR / 1 TRIAD	6 PAIR / 6 TRIAD	12 PAIR / 6 TRIAD
60	20	2	1	1
100	30	4	2	1
150	30	8	4	3
200	30	10	8	4
300	30	15	8	6

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRO	
REVISIONS						REFERENCES
SECTION: INSTRUMENTATION						DRG. NO.
DSGN	NAME	DATE	CHKD	DATE	मेकॉन लिमिटेड MECON LIMITED	
ORWN	R.K.S		P.S			
APPROVED	SUNIL					
PERFORATED TRAY SUPPORTS & CABLES CLAMPING DETAILS						SCALE : N.T.S.
D.G.M						(SH. 1 OF 1) REV
DRG.NO MEC/D5/E5/SD/CB-LY/D12						0

ANNEXURE – V

**LIST OF VENDORS FOR BOUGHT-
OUT ITEMS**

INSTRUMENTATION

I-A) PRESSURE REGULATOR AND SLAM SHUT VALVE

- 1) M/s Pietro Fiorentini S.P.A. (Italy)
- 2) M/s Emerson Process Management (Singapore)
- 3) M/s RMG-Regel Messtechnik (Germany)
- 4) M/s Nirmal Industrial Controls (India)
- 5) M/s Gorter Controls (Netherlands)
- 6) M/s Dresser

I-B) CONTROL VALVE

- 1) M/s Forbes Marshall (Pune)
- 2) M/s ABB Ltd. (Nashik)
- 3) M/s Fisher Xomox (New Delhi)
- 4) M/s Fouress Engg. (New Delhi)
- 5) M/s Instrumentation Ltd. (Palghat)
- 6) M/s MIL Controls Ltd. (Noida)
- 7) M/s Samson Control (Thane)
- 8) M/s Dresser

II) PID CONTROLLER

- 1) M/s ABB
- 2) M/s EUROTHERN
- 4) M/s TATA HONEYWELL
- 5) M/s MASIBUS

III-A) ULTRASONIC FLOW METER

- 1) M/s Emerson Process
- 2) M/s Instromet International, Belgium
- 3) M/s FMC Measurement Solution , UK
- 4) RMG Messtechnik GMBH

- 5) M/s SICK MAHAIK

III-B) TURBINE METER

- 1) M/s Instromet (Belgium)
- 2) M/s RMG (Germany)
- 3) M/s Elster (Germany)
- 4) M/s Fluid Components (USA)
- 5) M/s Barton Instruments (UK)
- 6) M/s Bopp & Reuther (Germany)
- 7) M/s Daniel Industries (USA)
- 8) M/s Hoffer Flow (USA)
- 9) M/s Rockwin Flow Meters
- 10) M/s Vemmtec, Germany

IV) PANEL MOUNTED FLOW COMPUTERS

- 1) M/s Barton Instruments System Ltd. (UK)
- 2) M/s Daniel Measurement and Controls
- 3) M/s Instromet International, Belgium
- 4) M/s RMG Messtechnik GmbH (Germany)
- 5) M/s Omni Flow Computers Inc. (USA)

V) GAS CHROMATOGRAPH

- 1) ABB Ltd , India
- 2) Daniel Measurement & Control Asia Pacific, India
- 3) Instromet Internationa, NV
- 4) RMG Regal+Messtechnik GmbH

VI) L.E. L DETECTION SYSTEM

- 1) Crowcon Detection Instruments Ltd
- 2) Detection Instruments (I) Pvt Ltd
- 3) Detector Electronics Corporation
- 4) MSA – Mines safety appliances.

- 5) Oldham France S.A.
- 6) Honeywell

VII) CONTROL AND SIGNAL CABLES

- 1) M/s ASSOCIATED CABLES
- 2) M/s ASSOCIATED FLEXIBLES
- 3) M/s DELTON Cables Ltd, India
- 4) M/s BROOK
- 5) M/s KEI Industries Ltd INDIA
- 6) M/s Suyog Electricals Ltd, India
- 7) M/s Thermo Cables Ltd
- 8) M/s Udey Pyrocables Pvt Ltd, India
- 9) M/s T C Communication Ltd.

VIII) ZENER BARRIERS/ISOLATORS

- 1) M/s MTL
- 2) M/s P & F

IX) RTDs

- 1) M/s General Instruments Ltd., Mumbai
- 2) M/s Nagman Sensors (Pvt.) Ltd.
- 3) M/s Pyro Electric, Goa

X) PRESSURE, TEMPERATURE & DIFF PRESSURE TRANSMITTER

- 1) M/s Fisher Rosemount (Emerson)
- 2) M/s Yokogawa
- 3) M/s Fuji
- 4) M/s Honeywell

XI) PRESSURE GAUGES, TEMPERATURES GAUGES & DIFFERENTIAL PRESSURE GAUGE

- 1) M/s AN Instruments Pvt. Ltd., New Delhi
- 2) M/s General Instruments Ltd., Mumbai
- 3) M/s WIKA

XII)A SS TUBE

- 1) Sandvik, Sweden
- 2) Choksy Tube Co Ltd.
- 3) Heavy Metals & Tubes Ltd.
- 4) Nuclear Fuel Complex, India
- 5) Scorodite
- 6) Ratnamani Metal & Tubes Ltd

7) Jindal Saw

XII)B SS TUBE FITTINGS

- 1) M/s Swagelok (USA)
- 2) M/s Parker (USA)
- 3) M/s Excelsior
- 4) M/s Reliance
- 5) M/s Multimetal
- 6) M/s Comfit
- 7) M/s Aura Inc
- 8) M/s Arya Crafts
- 9) M/s Swastic

XII)C SS VALVES & MANIFOLDS

- 1) M/s Swagelok (USA)
- 2) M/s Parker (USA)
- 3) M/s Excelsior
- 4) M/s Comfit
- 5) M/s Aura Inc
- 6) M/s Arya Crafts
- 7) M/s Swastic

XIII) JUNCTION BOXES AND CABLES GLANDS

- 1) M/s EX-PROTECTA
- 2) M/s FLAMEPROOF CONTROL GEARS
- 3) M/s BALIGA
- 4) M/s FLEXPLO ELECTRICALS

XIV) PUSH BUTTONS/LAMPS:

- 1) L&T
- 2) SIEMENS

XV) MCB'S:

- 1) HAVELL'S
- 2) INDO ASIAN
- 3) MDS

XVI) RELAYS:

- 1) OEN
- 2) JYOTI

XVII) POWER SUPPLY UNIT:

- 1) ELNOVA
- 2) APLAB

XVIII) CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES

- 1) M/s Keltron Controls Ltd., Kerala
- 2) M/s RITTAL
- 3) M/s Pyrotech
- 4) M/s Positronics Pvt. Ltd.
- 5) M/s ABB Instruments Ltd., New Delhi
- 6) M/s Emerson Process Management (I) Pvt. Ltd.
- 7) M/s Rockwell Automation (I) Ltd., Ghaziabad
- 8) M/s Siemens Ltd.
- 9) M/s Tata Honeywell Ltd.

XIX) PRINTERS

1. Compaq
2. Dell
3. IBM
4. HP
5. EPSON

XX) ACTUATOR

1. Rotork
2. Schuck
3. Biffi
4. Ledeen

MECHANICAL

i) PIPE CARBON STEEL TO INDIAN STANDARDS

1. A.S.T. PIPES PVT. LTD. (AST GROUP)
2. ADVANCE STEEL TUBE LTD.
3. APL APOLLO TUBES LTD. (ER. BIHAR TUBES LTD.)
4. ASIAN MILLS PVT. LTD.
5. ASRANI TUBES LIMITED
6. DADU PIPES (P) LTD.
7. ESSAR STEEL LIMITED(ER HAZIRA PIPES MILL)
8. GAURANG PRODUCTS PVT LTD. (AST GROUP)
9. GOODLUCK STEEL TUBES LTD.
10. HI-TECH PIPES LIMITED
11. INDUS TUBE LIMITED
12. JINDAL INDUSTRIES LTD
13. JINDAL PIPES LTD.
14. JINDAL SAW LTD (KOSI WORKS)
15. JOTINDRA STEEL & TUBE LTD
16. LALIT PIPES AND PIPES LTD.
17. MAHARASHTRA SEAMLESS LTD.
18. MAN INDUSTRIES (INDIA) LTD. – PITHAMPUR
19. MAN INDUSTRIES (INDIA) LTD. ANJAR
20. MUKAT TANKS & VESSELS LTD.
21. NEZONE TUBES LIMITED

22. NORTH EASTERN TUBES LIMITED
23. PRATIBHA INDUSTRIES LIMITED
24. PRATIBHA PIPES & STRUCTURAL LTD.
25. PSL LTD (CHENNAI)
26. PSL LTD (V1, V2 & NC)
27. RAMA STEEL TUBES LTD.
28. RATNAMANI METALS AND TUBES LTD.
29. RAVINDRA TUBES LIMITED
30. SAMSHI PIPE INDUSTRIES LIMITED
31. SURYA ROSHNI LTD.
32. SWASTIK PIPES LTD.
33. UTKARSH TUBES & PIPES LTD. (FORMLY BMW)
34. WELSPUN CORP. LIMITED (DAHEJ)
35. ZENITH BIRLA (INDIA) LIMITED

ii) PIPE & TUBULARS TO A.P.I. STANDARDS

1. ARCELORMITTAL TUBULAR PRODUCTS ROMAN SA, ROMANIA
2. BHEL (TRICHY), INDIA
3. DALMINE SPA (ENQUIRY TO TENARIS), UAE
4. EEWKOREA CO. LTD (GERMANY), KOREA
5. EEW KOREA CO. LTD. (KOREA), KOREA
6. EISENBAU KRAMER GMBH, GERMANY
7. HYUNDAI RB CO. LTD. SOUTH KOREA
8. ILVA LAMIERE E TUBI SRL (ENQ TO ILVA SPA, ITALY)
9. INOX TECH. SPA, ITALY
10. ISMT LTD. AHMEDNDR, INDIA
11. ISMT LTD. BARAMATI, INDIA
12. JINDAL PIPES LTD., INDIA
13. JINDAL SAW LTD. (KOSI WORKS), INDIA
14. JINDAL SAW LTD. (NASHIK WORKS), INDIA
15. LALIT PIPES AND PIPES LTD. INDIA
16. MAHARASHTRA SEAMLESS LTD., INDIA
17. MAN INDUSTRIES (I) LTD. (PITHAMPUR), INDIA
18. MUKAT TANKS & VESSELS LTD., INDIA
19. PRATIBHA INDUSTRIES LIMITED, INDIA
20. RATNAMANI METALS AND TUBES LTD., INDIA
21. SIDERCA S.A.I.C (ENQUIRY TOTENARIS), UAE
22. SUMITOMO METAL IND. LTD., INDIA
23. SURYA ROSHNI LTD., INDIA
24. SWASTIK PIPES LTD, INDIA
25. TATA STEEL UK LIMITED (FORMERLY C702)
26. TUBOS DE ACERO DE MEXICO SA (ENQ. TENARIS), UAE
27. TUBOS REUNIDOS SA SPAIN
28. UMRAN STEEL PIPE INC (TURKEY), TURKEY
29. VALCOVNY TRUB CHOMUTOV, CZECH REPUBLIC
30. VALLOUREC AND MANNESMANN TUBES, FRANCE
31. WELSPUN CORP LIMITED (DAHEJ), INDIA

iii) PIPE/TUBE CS (SEAMLESS) TO ASTM STDS

1. ARCELORMITTAL TUBULAR PRODUCTS ROMAN SA, ROMANIA
2. BHEL (TRICHY), INDIA
3. CHANGSHU SEAMLESS STEEL TUBE CO. LTD., CHINA
4. DALMINE SPA (ENQUIRY TO TENARIS), UAE
5. HEAVY METALS & TUBES LIMITED (MEHSANA), INDIA
6. ISMT LTD. AHMEDNDR, INDIA
7. ISMT LTD. BARAMATI INDIA
8. JFE STEEL CORPORATION, UAE
9. JINDAL SDAW LTD (NASHIK WORKS) INDIA
10. KLT AUTOMOTIVE AND TUBULAR PRODUCTS LTD., INDIA

11. MAHALAXMI SEAMLESS LIMITED, INDIA
12. MAHARASHTRA SEAMLESS LTD, INDIA
13. PRODUCTS TUBULARES S.A.U, SPAIN
14. RATNADEEP METAL TUBES LTD., INDIA
15. STAINNEEST TUBES PVT LTD., INDIA
16. SUMITOMO METAL IND. LTD., INDIA
17. TUBOS REUNIDOS SA SPAIN
18. VALCOVNY TRUB CHOMUTOV, CZECH REPUBLIC
19. VALLOUREC ANDMANNESMANN TUBES FRANCE
20. YANGZHOU CHENGDE STEEL PIPE CO. LTD DUBAI (UAE)

iv) **PIPE CARBON STEEL (WELDED) TO ASTM STDS**

1. EEW KOREA CO. LTD. (GERMANY), KOREA
2. EEW KOREA CO. LTD. (KOREA), KOREA
3. EISENBAU KRAMER GMBH, GERMANY
4. HYUNDAI RB CO. LTD., SOUTH KOREA
5. INOX TECH. SPA, ITALY
6. JINDAL SAW LTD (KOSI WORKS), INDIA
7. LALIT PIPES AND PIPES LTD., INDIA
8. MAN INDUSTRIES (I) LTD.(PITHAMPUR), INDIA
9. MAN INDUSTRIES (INDIA) LTD. ANJAR, INDIA
10. MUKAT TANKS & VESSELS LTD., INDIA
11. RATNAMANI METALS AND TUBES LTD., INDIA
12. SUMITOMO METAL INDIA LTD., INDIA
13. TATA STEEL UK LIMITED

v) **Valve**

a) **Globe Valves**

- 1) M/s Weir BDV Valves (Aunit of Weir India Pvt. Ltd.)
- 2) M/s Datre Corpn (Calcutta)
- 3) M/s KSB Pumps Ltd., Coimbatore, India
- 4) M/s L&T Audco
- 5) M/s Neco Schuber & Salzer Ltd. (New Delhi)
- 6) M/s Niton Valve India Pvt. Ltd., India
- 7) M/s Ornate Valves (Mumbai)
- 8) M/s Panchavati Valves & Flages (P) Ltd., India
- 9) AV Valves Ltd., India
- 10) BHEL (Trichy), India
- 11) Econo Valves Pvt Ltd, India
- 12) Fouress Engg (I) Ltd (Aurangabad), India
- 13) Leader Valves Ltd, India
- 14) Oswal Industries Ltd, India
- 15) Petrochemical Engineering Enterprises, India (Fouress Group)
- 16) Sakhi Engineers Pvt Ltd., India
- 17) Shalimar Valves Pvt Ltd., India
- 18) Steel Strong Valves India Pvt Ltd, India
- 19) Petro Valves Pvt. Limited, Ahmedabad
- 20) Fluid Line Valves Co. (P) Ltd., India
- 21) MICON Engineers (Hubli) (P) Ltd., India

b) **Check Valves**

1. M/s Advance Valves Pvt. Ltd., Noida
2. M/s Aksons & Mechanical Enterprises, Mumbai
3. M/s Larsen & Toubro Limited (M/s Audco India Limited, Chennai)
4. M/s AV Valves Ltd., India

5. M/s Weir BDK Valves (A unit of Weir India Pvt. Ltd.)
6. M/s BHEL, Trichy
7. M/s Datre Coroportion Limited, Calcutta
8. M/s Leader Valves Ltd., Jalandhar
9. M/s Neco schubert & Salzer Ltd., New Delhi
10. M/s Niton Valves Industries (P) Ltd., Mumbai
11. M/s Precision Engg.Co., Mumbai
12. Econo Valves Pvt Ltd, India
13. Fouress Engg (I) Ltd (Aurangabad)
14. KSB Pumps Ltd (Coimbatore), India
15. NSSL Ltd. (Neco Schubert & SalzerLtd)
16. Oswal Industries Ltd, India
17. Panchvati Valves & Flanges Pvt Ltd, India
18. Petrochemical Engineering Enterprises, India (Fouress Group)
19. Sakhi Engineers Pvt Ltd
20. Shalimar Valves Pvt Ltd
21. Steel Strong Valves India Pvt Ltd, India
- 22) Fluid Line Valves Co. (P) Ltd., India
22. MICON Engineers (Hubli) (P) Ltd., India

c) **Plug Valves**

- 1) M/s Breda Energia Sesto Industria Spa, Italy
- 2) M/s Fisher Sanmar Ltd., Chennai
- 3) M/s Larsen & Toubro Ltd., (Audco) New Delhi
- 4) M/s Nordstrom Valves, USA
- 5) M/s Serck Audco Valves, UK
- 6) M/s Sumitomo Corporation India Pvt. Ltd., New Delhi
- 7) M/s Z Corporation, Korea
- 8) M/s Hawa Valves (India) Pvt. Ltd., Mumbai
- 9) M/s Steel Strong Valves India Pvt. Ltd., Navi Mumbai
- 10) M/s Econo Valves Pvt. Ltd., India (WSSL Ltd. Group Co.)
- 11) M/s Flow-Serve PTE (Mfr. SERCK), India
- 12) M/s Galli Cassina SPA, Italy

d) **Ball Valves**

1. M/s Hawa Valves (India) Pvt. Ltd, Navi Mumbai
2. M/s Larsen & Toubro (Audco), India
3. M/s Oswal Industries Ltd., India
4. M/s Virgo Engineers Ltd., Delhi
5. M/s Boteli Valve Group Co. Ltd., China
6. M/s Cameron Italy s.r.l., Italy
7. M/s Dafram S.P.A., Italy
8. M/s Fangyuan Valve Group Co. Ltd., China
9. M/s Franz Schuck GmbH, Germany
10. Kita Mura Valve Manufacturing Co.Ltd., India
11. Petrol Valve S.R. Italy
12. Piplviessie S.P.A. Italy
13. Tormene Gas Technology S.P.A. Valvetalia Group, Italy
14. Valbeot S.R.L. Italy
15. KMC Corporation, South Korea
16. MSA a.s. Czeek Republic
17. OMS Aleri, Italy
18. PCC Valves s.r.l. Italy
19. Perar s.p.a. (Engineering. To TRP srl), Italy
20. Italy s.r.l., Italy
21. MIR Valves, Malaysia

vi) Split Tee

- 1) M/s Ipsco, Canda
- 2) M/s TD Willamsons, USA

vii) Flanges

1. M/s Aditya Forge Ltd., Vadodara
2. M/s Amforge Industries Ltd., Mumbai
3. M/s CD Engineering Co., Ghaziabad
4. M/s Echjay Forgings Pvt. Ltd. (Bombay), Mumbai
5. M/s Echjay Industries Ltd., Rajkot
6. M/s Forge & Forge Pvt. Ltd., Rajkot
7. M/s Golden Iron & Steel Works, New Delhi
8. M/s JK Forgings, New Delhi
9. M/s Metal Forgings Pvt. Ltd., Mumbai
10. M/s Perfect Marketings Pvt. Ltd., New Delhi
11. M/s Sky Forge, Faridabad
12. M/s S&G, Faridabad
13. Chaudhry Hammer Works Ltd, India
14. JAV Forgings (P) Ltd, India
15. Kunj Forgings Pvt Ltd, India
16. MS Fittings Mfg. Co. Pvt. Ltd.
17. R.N. Gupta & Co. Ltd, India
18. R.P. Engineering Pvt Ltd, India
19. Sanghvi Forgings & Engineering Ltd
20. Shri Ganesh Forgings Ltd., India
21. Uma Shankar Khandelwal & Co., India
22. Sawan Engineers, Baroda
23. Stewarts & Lloyds of India Ltd., Kolkata
24. Engineering Services Enterprises
25. Abasi Engineersing Works, India
26. Anandmayee Forgings Pvt Ltd, India
27. CD Industries., India
28. Fivebros Forgings Vot Ltd., India
29. Good Luck Engineering Co., India
30. Korea Flange, South Korea
31. Lal Metal Forge Ltd, India
32. Melesi Officine
33. Amlrojje Melesi & C. srl. Italy
34. Nicola Galperti & Figlio S.P.A India
35. Paramount Forge, India
36. Pradeep Metal Limited, India
37. Punjab Steel Works (the), India
38. R.D.Forge, India
39. Shah Industrial & Comml. Corporation, India
40. Ulma Forja S. Coop.
41. Vivial Forge Pvt. Ltd., Vadodara

viii) Fittings

1. M/s Commercial Supplying Agency, Mumbai
2. M/s Dee Development Engineers Ltd.
3. M/s Eby Industries, Mumbai
4. M/s Flash Forge Pvt. Ltd., Vishakhapatnam
5. M/s Gujarat Infra Pipes Pvt. Ltd., Vadodara
6. M/s M.S. Fittings Mfg. Co. Pvt. Ltd., Kolkata
7. M/s Stewarts & Lloyds of India Ltd., Kolkata
8. M/s Teekay Tubes Pvt. Ltd., Mumbai

9. M/s Pipe Fit, Baroda
10. M/s Sky Forge, Faridabad
11. M/s S&G, Faridabad
12. M/s Sawan Engineers, Baroda
13. Eby Fasteners, India
14. R.N. Gupta & Co. Ltd, India
15. Exten Engg Pvt Ltd
16. Sivananda Pipe & Fittings Ltd
17. Chero Piping SPA, Italy
18. CSA Fittings, India
19. EBY Fasteners, India
20. Fittnox SRL, Italy
21. Keonsae High Pressure Co. Ltd., South Korea
22. Munro & Miller Fittings Ltd., U.K.
23. TK Corporation, South Korea
24. Tube Turn (India) Pvt Ltd., India
25. Topaz Piping Industries, India
26. Technoforge SPA, Italy
27. P.K. Tubes & Fittings Pvt. Ltd., India
28. Vivial Forge Pvt. Ltd., Vadodara

ix) Gaskets

1. IGP Engineers (P) Ltd., Madras
2. Madras Industrial Products, Madras
3. Dikson & Company, Bombay
4. Banco Products (P) Ltd., Vadodara
5. Goodrich Gaskets Pvt Ltd
6. Starflex Sealing India Pvt Ltd, India
7. Teekay Meta Flex Pvt Ltd
8. UNIKLINGER Ltd
9. HEM Engg. Corp.
10. Unique Industrial Packing Pvt. Ltd.

x) Fasteners

1. Nireka Engg. Co. (P) Ltd., Calcutta
2. Precision Taps & Dies, Bombay
3. AEP Company, Vithal Udyoug Nagar
4. Fix Fit Fasteners, Calcutta
5. Precision Engg. Industries, Baroda
6. Echjay Forgings Pvt. Ltd., Bombay
7. Capital Industries, Bombay
8. Boltmaster India Pvt Ltd, India
9. Deepak Fasteners Limited, India
10. Fasteners & Allied Products Pvt Ltd, India
11. Hardwin Fasteners Pvt Ltd, India
12. J.J. Industries, India
13. Multi Fasteners Pvt Ltd, India
14. Nexo Industries, India
15. Pacific Forging & Fasteners Pvt Ltd, India
16. Pioneer Nuts & Bolts Pvt Ltd, India
17. Precision Auto Engineers, India
18. President Engineering Works, India
19. Sandeep Engineering Works, India
20. Syndicate Engineering Industries, India
21. BEA SRL, Italy
22. Korea Parts & Fasteners (KPF), South Korea
23. Kundan Industries Ltd., India

24. Mega Engineering Pvt. Ltd., India
25. OME Metallurgica ERBESE S.R.L, Italy
26. Pankaj International, India
27. Udehra Fasters Ltd., India

xi) Welding Electrodes

1. For Mainline – Lincon make
2. For Terminal –For root pass - Lincon Make
For other passes – Lincon, D&H or equivalent make

PROCESS

I) CARTRIDGE FILTER

- 1) M/s Grand Prix Fab (Pvt.) Ltd. (New Delhi)
- 2) M/s Multitex Filtration Engineers Ltd. (New Delhi)
- 3) M/s Perry Equipment Corp. (USA)
- 4) M/s Siirtec NIGI SPA (Italy)
- 5) M/s Axsia Howmar Ltd. (UK)
- 6) M/s Faudi Filters Systems GmbH (Germany)
- 7) M/s Filtan Filter Anlagenbau GmbH (Germany)
- 8) M/s Plenty Filters (UK)
- 9) M/s Forain S.r.l. (Italy)
- 10) M/s Ravi Techno Systems (Mumbai)
- 11) M/s Gujarat Otofilt (Ahmedabad)
- 12) M/s Nirmal Industrial Controls (India)
- 13) M/s Flash Point
- 14) M/s Fil Sep Equipments Pvt. Ltd.

II) PRESSURE SAFETY VALVES

- 1) M/s Keystone Valves (India) Pvt. Ltd. (Baroda)
- 2) M/s Sebim Sarasin Valves India (P) Ltd
- 3) M/s Tyco Sanmar Ltd. (New Delhi)
- 4) M/s Parcol SPA, Italy
- 5) M/s Tai Milano SPA, Italy
- 6) M/s Emerson Process, Singapore
- 7) M/s Instrumentation Ltd., Palghat

III) CARTRIDGE ELEMENT MAKE

- 1) PECO
- 2) PALL
- 3) FILTERITE
- 4) VELCON
- 5) FACET
- 6) BURGESS MANNING

For porous metal cartridge

- 1) FUJI
- 2) PALL
- 3) PORAL
- 4) MOTT

IV) QUICK OPENING CLOSURE MAKE

- 1) Peerless
- 2) Grinell
- 3) Peco,
- 4) Siirtec
- 5) Huber Yale
- 6) G.D. Engineering

Note-1

For procuring bought out items from vendors other than those listed above / for items not having vendor list, the same may be acceptable subject to the following :-

- a) The vendor/ supplier of bought out item(s) is a regular and reputed manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing/ supply range.
- b) The vendor/ supplier should not be in the Holiday list of CLIENT/MECON/OTHER PSU.
- c) Should have supplied at least 50% of required quantity or minimum 1 number whichever is higher of maximum size and rating of item(s) as required for intended services.

Successful bidder shall submit documentary evidences i.e. PO copies, Inspection Certificate etc. for the above at the time of drawing approval. Bidder may fulfill the above requirement using multiple PO in last seven years reckoned from bid due date. In case of ARC contracts, 50% qty. shall be determined based on quantity derived from FOA skid quantities specified in ARC FOA. Since Qtys are very large therefore Vendor can opt for Multiple makes in order to meet delivery schedule.

For MECHANICAL Items - category (v) VALVES, for makes of following Items , i.e., (b) CHECK VALVES , (c) PLUG VALVES and (d) BALLVALVES, valve manufacturer's valid API 6D certificate shall be submitted, even if his name appears in the above vendor list. Manufacturers of BALL / PLUG / CHECK valves, whose API 6D license is not found in active status during drawing approvals will not be accepted.

Note-2

The details of vendors indicated in this list are based on the information available with MECON; Contractor shall verify capabilities of each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each party and also to expedite the material in time.

For MECHANICAL Items - category (v) VALVES, for makes of following Items , i.e., (b)

CHECK VALVES , (c) PLUG VALVES and (d) BALLVALVES, valve manufacturer's valid API 6D certificate shall be submitted, even if his name appears in the above vendor list. Manufacturers of BALL / PLUG / CHECK valves, whose API 6D license is not found in active status during drawing approvals will not be accepted.

ANNEXURE - VI

QAPs



MECON Limited
(A Govt. of India Enterprise)

**QUALITY ASSURANCE PLAN
FOR
FLANGES**

PROJECT:

ITEM : FLANGES

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/A

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**QUALITY ASSURANCE PLAN
FOR
FLANGES**



MECON Limited
(A Govt. of India Enterprise)

**QUALITY ASSURANCE PLAN
FOR
FLANGES**

PROJECT:

ITEM : FLANGES

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/A

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APPLICABLE CODES AND SPECIFICATIONS : MEC/TS/05/21/025, R-0 and MEC/TS/05/21/026, R-0 WITH AMENDMENTS									SCOPE OF INSPECTION		
S. NO.	STAGE	CHARACTERISTICS	CATEGORY	METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD	Vendor/ Sub Vendor	TPI	MECON
1.	Review of PO / Drg.	Review of PO Doc. / Drg.	Critical	Scrutiny / Verification	Each doc. of P.O.	Appl. Spec. / STD	-	-	P	R	R
2.	Raw Material	1. Manufacturing process of steel 2. Visual 3. Dimensional 4. Chemical Composition	Critical	Verification with M.T.C. Spectro Analysis	Each Heat Each Heat	Appl. Material Specification / STD	As per tender document / Material Specification / STD	Material Test Certificate and MI Register	P	R	R
3.	Forgins	1. Reduction Ratio 2. Temperature During Forging 3. Forging Dimensions	Critical	Measurement Optical Pyrometer Measurement	Minimum 1 per size	Standard Manufacturing Procedure	Std. Procedure As per Std. AMSE B16.5	Forging process record / internal Register	P	R	R
4.	Heat Treatment (as applicable)	Heat Treatment Cycle	Major	Verification of Heat Treatment Cycle	Each Heat / HT Lot	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	T.P.M. Sheet, Heat Treatment Graph	P	W	R
5.	Mechanical Testing (as applicable)	1. Tensile Test (TS, YS, RA%, EL%) 2. Hardness 3. Charpy V-Notch Test	Major	Tensile Testing IMPACT Testing	One / HT / Lot / Group	As per Tender Doc. / Material Specification / STD	Std. Procedure As per Tender Doc. / Material Specification / MECON Std	Mechanical Test Report & T.C.	P	W	R



MECON Limited
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**QUALITY ASSURANCE PLAN
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FLANGES**

PROJECT:

ITEM : FLANGES

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/A

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APPLICABLE CODES AND SPECIFICATIONS : MEC/TS/05/21/025, R-0 and MEC/TS/05/21/026, R-0 WITH AMENDMENTS									SCOPE OF INSPECTION		
S. NO.	STAGE	CHARACTERISTICS	CATEGORY	METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD	Vendor/ Sub Vendor	TPI	MECON
6	NDT	1. DP 2. UT 3. MPI	Major	DP Testing Ultrasonic Flaw Detector MPI Testing	100%	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Mechanical Test Report & T.C.	P	W	R
7.	Final Inspection	Visual & Dimensions	Major	Visual / Measurement	100%	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Dimension Report Format	P	W	R
8.	Making, Colour Coding, Rust Prevension & Packing	Making, Colour Coding, Rust Prevension & Packing	Major	Visual	100%	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Packing List	P	W	R
10.	Certification & Release Notes	Inspection Release Note as per EN 10204 Type 3.2	Major	Verification of PO Spec. & QAP	100%	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Release Note	R	IR	R
11.	Shipping	Verification of surface coating / type of packing	Major	-	-	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Shipping documents	P	R	R



MECON Limited
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**QUALITY ASSURANCE PLAN
FOR
FLANGES**

PROJECT:

ITEM : FLANGES

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/A

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APPLICABLE CODES AND SPECIFICATIONS : MEC/TS/05/21/025, R-0 and MEC/TS/05/21/026, R-0 WITH AMENDMENTS									SCOPE OF INSPECTION		
S. NO.	STAGE	CHARACTERISTICS	CATEGORY	METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD	Vendor/ Sub Vendor	TPI	MECON
Note :											
1. MAKE : As per Approved Make List in Tender Document or Approved PTR as per Tender conditions .											
2. All items shall be provided with EN 10204 Type 3.2 certificate.											
3. All inspection related documents shall be reviewed (Sign & Stamp) by the contractor.											
Legends : H – Hold (Offer for Witness & obtain clearance), W – Witness, R – Review, A – Approval, I – Information, IR – Issue Release Note, C – Certify, X – Submit, PO – Purchase Order, PR – Purchase Requisition, SR – Stress Relieving, MPI – Magnetic Particle Inspection, DI-Dye Penetrant Test , UT – Ultrasonic examination, TS – Technical Specification, WPS – Welding Procedure Specification, PQR – Procedure Qualification Record, WQT – Welder Qualification Test.											
All the NDT / Leak Testing / Heat Treatment / Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used. In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable. The document describes generally the requirements pertaining to all types of Flanges. Requirements specific to the item are only applicable.											



MECON Limited
(A Govt. of India Enterprise)

**QUALITY ASSURANCE PLAN
FOR
FITTINGS**

PROJECT:

ITEM : PIPE FITTINGS

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/B

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**QUALITY ASSURANCE PLAN
FOR
FITTINGS**



MECON Limited
(A Govt. of India Enterprise)

**QUALITY ASSURANCE PLAN
FOR
FITTINGS**

PROJECT:

ITEM : PIPE FITTINGS

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/B

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APPLICABLE CODES AND SPECIFICATIONS : MEC/TS/05/21/025, R-0 and MEC/TS/05/21/026, R-0 WITH AMENDMENTS									SCOPE OF INSPECTION		
S. NO.	STAGE	COMPONENT	CHARACTERISTICS	METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD	Vendor/ Sub Vendor	TPI	MECON
1.	Material	FITTINGS	Fully killed steel	MTC	100%	PO & Std. Spec.	PO QAP & Std. Spec.	MTC	P	R	R
2.	Inspection	FITTINGS									
i)	Visual Inspection	FITTINGS	Visual Imp.	Visual Internal & External Surface	100%			Inspection Report	P	W	R
ii)	NDT	FITTINGS	Soundness of Tee & Butt Welds	UT, RT & MPI	100%	PO & Std. Spec.	PO QAP & Std. Spec.	Inspection Report	P	W & Evaluation of RT Films	R
iii)	NDT	FITTINGS	Forgings	WET MPI	100%	PO & Std. Spec.	To comply with MSS-SP-53	Inspection Report	P	W	R
iv)	NDT	FITTINGS	End Laminations	UT for Distance of 25 mm on ends.	100%	PO & Std. Spec.	Any lamination than 6.35 mm not accepted	Inspection Report	P	W	R
v)	Testing Destructive	FITTINGS	Properties of Mech. / Chemical & Impact Test	Chemical by Spectro and other test as per ASTM A - 370	As per Heat / Lot	PO & Spec.	MSS-SP-75	IMP Lab Report	P	W	R



MECON Limited
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**QUALITY ASSURANCE PLAN
FOR
FITTINGS**

PROJECT:

ITEM : PIPE FITTINGS

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/B

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APPLICABLE CODES AND SPECIFICATIONS : MEC/TS/05/21/025, R-0 and MEC/TS/05/21/026, R-0 WITH AMENDMENTS									SCOPE OF INSPECTION		
S. NO.	STAGE	COMPONENT	CHARACTERISTICS	METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD	Vendor/ Sub Vendor	TPI	MECON
3.	Final Inspection	FITTINGS	Dimensional	-	As per lot	PO & Spec.	PO & Spec.	Inspection Report	P	W	R
4.	Marking	FITTINGS	Identification manufacturer's Name, nominal diameter end thickness malts & Tag No.	By painting	100%	PO & Spec.	-	-	P	W	R
5.	Certification & Release Notes	FITTINGS	Inspection Release Note as per EN 10204 Type 3.2	Verification of PO Spec. & QAP	100%	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Release Note	R	IR	R
6.	Shipping	FITTINGS	Verification of surface coating / type of packing	-	-	As per Tender Doc. / Material Specification / STD	As per Tender Doc. / Material Specification / MECON Std	Shipping documents	P	R	R



MECON Limited
(A Govt. of India Enterprise)

**QUALITY ASSURANCE PLAN
FOR
FITTINGS**

PROJECT:

ITEM : PIPE FITTINGS

QAP NO.: MEC/WINO/05/21/M/001/S026/QAP/B

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APPLICABLE CODES AND SPECIFICATIONS : MEC/TS/05/21/025, R-0 and MEC/TS/05/21/026, R-0 WITH AMENDMENTS									SCOPE OF INSPECTION		
S. NO.	STAGE	COMPONENT	CHARACTERISTICS	METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	RECORD	Vendor/ Sub Vendor	TPI	MECON
<p>Note :</p> <ol style="list-style-type: none">All items shall be provided with EN 10204 Type 3.2 certificate.All inspection related documents shall be reviewed (Sign & Stamp) by the contractor. <p>Legends : H – Hold (Offer for Witness & obtain clearance), W – Witness, R – Review, A – Approval, I – Information, IR – Issue Release Note, C – Certify, X – Submit, PO – Purchase Order, PR – Purchase Requisition, N-Normalizing, N&T – Normalizing & Tempering, SA – Solution annealing, N & SR – Normalizing & Stress relieving.</p> <p>All the NDT / Leak Testing / Heat Treatment / Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used. In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable. The document describes generally the requirements pertaining to all types of Fittings. Requirements specific to the item are only applicable.</p>											

	CONTRACTOR		QUALITY ASSURANCE PLAN FOR STRUCTURAL AND MECHANICAL EQUIPMENT	PROJECT :	
	ORDER NO. & DATE			PACKAGE NO.:05/51/WINO/GAIL/002	
	SUB-CONTRACTOR			PACKAGE NAME : Ball Valve, Plug Valve, Check Valve,Globe Valve	
	ORDER NO. & DATE				

<p>INSTRUCTIONS FOR FILLING UP :</p> <ol style="list-style-type: none"> QAP shall be submitted for each of the equipment separately with break up 1. of assembly/sub-assembly & part/component or for group of equipment 2. having same specification. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description 5. for extent of inspection & tests may be added as applicable for the plant 6. and equipment Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging 9. to different facilities are grouped together. Weight in kilograms must be indicated under Column-5 for each item. Estimated weights may be indicated wherever actual weights are not available. 	<p>CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS :</p> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%;"><i>Code</i></td> <td style="width:35%;"><i>Description</i></td> <td style="width:15%;"><i>Code</i></td> <td style="width:35%;"><i>Description</i></td> </tr> <tr> <td></td> <td>Visual</td> <td>18.</td> <td>Amplitude Test</td> </tr> <tr> <td></td> <td>Dimensional</td> <td>19.</td> <td>Sponge Test</td> </tr> <tr> <td>3.</td> <td>Fitment & Alignment</td> <td>20.</td> <td>Dust/ Water Ingress Test</td> </tr> <tr> <td>4.</td> <td>Physical Test (Sample)</td> <td>21.</td> <td>Friction Factor Test</td> </tr> <tr> <td></td> <td>Chemical Test (Sample)</td> <td>22.</td> <td>Adhesion Test</td> </tr> <tr> <td></td> <td>Ultrasonic Test</td> <td>23.</td> <td>Performance Test/Characteristic Curve</td> </tr> <tr> <td>7.</td> <td>Magnetic Particle Test (MPI)</td> <td>24.</td> <td>No Load/ Free Running Test</td> </tr> <tr> <td>8.</td> <td>Radiography Test</td> <td>25.</td> <td>Load/ Overload Test</td> </tr> <tr> <td></td> <td>Dye Penetration Test</td> <td>26.</td> <td>Measurement of Speeds</td> </tr> <tr> <td>10.</td> <td>Metallographic Exam.</td> <td>27.</td> <td>Accoustical Test</td> </tr> <tr> <td>11.</td> <td>Welder's Qualification & Weld Procedure Test</td> <td>28.</td> <td>Geometrical Accuracy</td> </tr> <tr> <td>12.</td> <td>Approval of Test and Repair Procedure</td> <td>29.</td> <td>Repeatability and Positioning Accuracy</td> </tr> <tr> <td>13.</td> <td>Heat Treatment</td> <td>30.</td> <td>Proving Test</td> </tr> <tr> <td>14.</td> <td>Pressure Test</td> <td>31.</td> <td>Surface Preparation</td> </tr> <tr> <td>15.</td> <td>Leakage Test</td> <td>32.</td> <td>Manufacturer's Test Certificates bought-out items</td> </tr> <tr> <td>16.</td> <td>Balancing for</td> <td>33.</td> <td>IBR/ Other Statutory agencies compliance certificate</td> </tr> <tr> <td>17.</td> <td>Vibration Test</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>34.</td> <td>Internal Inspection Report by Contractor</td> </tr> <tr> <td></td> <td></td> <td>35.</td> <td>Hardness Test</td> </tr> <tr> <td></td> <td></td> <td>36.</td> <td>Spark Test for Lining</td> </tr> <tr> <td></td> <td></td> <td>37.</td> <td>Calibration</td> </tr> <tr> <td></td> <td></td> <td>38.</td> <td>Safety Device Test</td> </tr> <tr> <td></td> <td></td> <td>39.</td> <td>Ease of Maintenance</td> </tr> <tr> <td></td> <td></td> <td>40.</td> <td>Fire Test (Type Test)</td> </tr> <tr> <td></td> <td></td> <td>41.</td> <td>Charpy V-Notch Test</td> </tr> <tr> <td></td> <td></td> <td>42.</td> <td>Operational Torque Test</td> </tr> <tr> <td></td> <td></td> <td>43.</td> <td>ENP (Electroless Nickel Plating) Execution</td> </tr> <tr> <td></td> <td></td> <td>44.</td> <td>Painting</td> </tr> <tr> <td></td> <td></td> <td>45.</td> <td>Anti-Static Test</td> </tr> <tr> <td></td> <td></td> <td>46.</td> <td>Hydrostatic Double Block & Bleed Test</td> </tr> <tr> <td></td> <td></td> <td>47.</td> <td>Functional Test</td> </tr> <tr> <td></td> <td></td> <td>48.</td> <td>Pneumatic Double Block & Bleed Test</td> </tr> <tr> <td></td> <td></td> <td>49.</td> <td>Cyclic Test</td> </tr> <tr> <td></td> <td></td> <td>50.</td> <td>STRIP TEST</td> </tr> </table> <p>Code DOCUMENTS:</p> <ol style="list-style-type: none"> D1. Approved GA drawings D2. Information and other reference drg/ stamped drgs released for mfg. D3. Relevant catalogues D4. Bill of matl./Item no./ Identification D5. Matchmarks details D6. Line/ Layout diagram D7. Approved erection procedures D8. Unpriced sub P.O. with specification and amend-ments, if any D9. Calibration Certificate of all measuring instruments and gauges D10. X-Ray Reports 	<i>Code</i>	<i>Description</i>	<i>Code</i>	<i>Description</i>		Visual	18.	Amplitude Test		Dimensional	19.	Sponge Test	3.	Fitment & Alignment	20.	Dust/ Water Ingress Test	4.	Physical Test (Sample)	21.	Friction Factor Test		Chemical Test (Sample)	22.	Adhesion Test		Ultrasonic Test	23.	Performance Test/Characteristic Curve	7.	Magnetic Particle Test (MPI)	24.	No Load/ Free Running Test	8.	Radiography Test	25.	Load/ Overload Test		Dye Penetration Test	26.	Measurement of Speeds	10.	Metallographic Exam.	27.	Accoustical Test	11.	Welder's Qualification & Weld Procedure Test	28.	Geometrical Accuracy	12.	Approval of Test and Repair Procedure	29.	Repeatability and Positioning Accuracy	13.	Heat Treatment	30.	Proving Test	14.	Pressure Test	31.	Surface Preparation	15.	Leakage Test	32.	Manufacturer's Test Certificates bought-out items	16.	Balancing for	33.	IBR/ Other Statutory agencies compliance certificate	17.	Vibration Test					34.	Internal Inspection Report by Contractor			35.	Hardness Test			36.	Spark Test for Lining			37.	Calibration			38.	Safety Device Test			39.	Ease of Maintenance			40.	Fire Test (Type Test)			41.	Charpy V-Notch Test			42.	Operational Torque Test			43.	ENP (Electroless Nickel Plating) Execution			44.	Painting			45.	Anti-Static Test			46.	Hydrostatic Double Block & Bleed Test			47.	Functional Test			48.	Pneumatic Double Block & Bleed Test			49.	Cyclic Test			50.	STRIP TEST
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<p>ABBREVIATIONS USED :</p> <p>SV : SUB VENDOR MFR : MANUFACTURER TPI : DESIGNATED THIRD PARTY INSPECTION AGENCY H : HOLD R : REVIEW W : WITNESS</p>	<p>KEY TO SYMBOLS :</p> <p>* : TO BE FILLED BY VENDOR ** : TEST TO BE PERFORMED, IF APPLICABLE</p>																																																																																																																																												

Sl. No.	Description (with equipment heading, place of use and brief specifications)	EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	REMARKS/ SAMPLING PLAN		
		Identification No. (MR/SOR Item No.)	Quantity No./M	Unit Weight (Kg)	Manufacturer's Name and Address	Expected Schedule of Final Inspn.	Raw Material and In-Process Stage Inspection				Final Inspection/ Test by								
							MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	14	15	16		
1.0	Ball Valve, Plug Valve, Check Valve, Globe Valve		Refer (MR/SOR)	*	*	*	As per attached sheet 2 to 10												

QAP NO. MEC/WINO/05/28/M/001/QAP-002	REV 0
SHEET 1 OF 10	

For CONTRACTOR <div style="border: 1px solid black; width: 60px; height: 60px; margin: 0 auto;"></div>	For SUB-CONTRACTOR (Valve Manufacturer) <div style="border: 1px solid black; width: 60px; height: 60px; margin: 0 auto;"></div>	
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EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipment name, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1	2	3	4	5	8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
1.01	Body	Material As per MR/SOR/ Alternate Material accepted by MECON			1,2	1,2	-	-	-	-	-	-	1. 1 2. Report	1DD1 2. MECON's TS & DS 3. Relevant Material Standard 4. Manufacturer's Specification	P	R	R	R	
					4	4	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's TS & D.S.	P	W	R	R	
					5	5	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					6**	6**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-IV 2. MECON's T.S. & DS	P	W	R	R	Forgings, welds, wrought weld ends
					7**	7**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-II 2. MECON's T.S. & DS	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel surfaces (MPI/ DP)
					8**	8**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-I 2. MECON's T.S.& DS	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast
					9**	9**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-III 2. MECON's T.S.& DS	P	W	R	R	Bevel Surfaces (by MPI/ DP)
					13	13	-	-	-	-	-	-	Report/ Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S.& DS	P	R	R	R	
					35	35	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					41	41	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipmenting, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1	2	3	4	5	8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
1.02	Closure/ Body Adapter/ Tail Piece / Bonnet	Material Manufacturer to indicate (to be approved by ECON) M			1,2	-	-	-	-	-	-	-	1. 1 2. Report	1DD1 2. MECON's TS & DS 3. Relevant Material Standard 4. Manufacturer's Specification	P	R	R	R	
					4	4	-	-	-	-	-	-	Material est Certificates	1. Relevant Material Standard 2. MECON's D.S.& TS	P	W	R	R	
					5	5	-	-	-	-	-	-	Material est Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					6**	6**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-IV 2. MECON's T.S. & DS	P	W	R	R	Forgings, welds, wrought weld ends
					7**	7**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-II 2. MECON's T.S. & DS	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel surfaces (MPI/ DP)
					8**	8**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-I 2. MECON's T.S.& DS	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast
					9**	9**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-III 2. MECON's T.S. & D.S.	P	W	R	R	Bevel Surfaces (by MPI/ DP)
					13	13	-	-	-	-	-	-	Report/ aterial est Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	R	R	R	
					35	35	-	-	-	-	-	-	Material est Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
41	41	-	-	-	-	-	-	Material est Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R						

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS	
Sl. No.	Description (with equipmenting, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON		
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON								
1	2	3	4	5	8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D		
1.03	Top Cover/Disc / Hinge Pin (For Check Valves)	Material Manufacturer to indicate (to be approved by ECON) M			1,2	-	-	-	-	-	-	-	1. 1 2. Report	1DD1 2. MECON's TS & DS 3. Relevant Material Standard 4. Manufacturer's Specification	P	R	R	R		
					4	4	-	-	-	-	-	-	Material est Certificates	T	1. Relevant Material Standard 2. MECON's D.S. & T.S.	P	W	R	R	
					5	5	-	-	-	-	-	-	Material est Certificates	T	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					6 **	6 **	-	-	-	-	-	-	Test Report		1. ASME B16.34, Annex-E 2. MECON's T.S. & D.S.	P	W	R	R	Forgings, welds, wrought weld ends
					7 **	7 **	-	-	-	-	-	-	Test Report		1. ASME B16.34, Annex-C 2. MECON's T.S. & D.S.	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel surfaces (MPI/ DP)
					8 **	8 **	-	-	-	-	-	-	Test Report		1. ASME B16.34 Annex-B 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast
					13	13	-	-	-	-	-	-	Report/ aterial est Certificates	est	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	R	R	R	
					35	35	-	-	-	-	-	-	Material est Certificates	T	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					41	41	-	-	-	-	-	-	Material est Certificates	T	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipmenting, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1	2	3	4	5	8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
1.04	Trunnion (for Trunnion Mounted Valves)	Material Manufacturer to indicate (to be approved by ECON) M			1,2	1,2	-	-	-	-	-	-	1. 1 2. Report	15	P	R	R	R	
					4	4	-	-	-	-	-	-	Material est Certificates	T	P	W	R	R	
					5	5	-	-	-	-	-	-	Material est Certificates	T	P	W	R	R	
					13	13	-	-	-	-	-	-	Report/ aterial est Certificates	T	P	R	R	R	
					43 **	43 **	-	-	-	-	-	-	1. Test Report 2. Material Test Certificates for composition, hardness, thickness & integrity	T	P	H	R	R	
1.05	Ball /Disc / Plug / Obturator	Material As per MR/ Alternate Material accepted by MECON			1,2	1,2	-	-	-	-	-	-	1. 1 2. Report	15	P	R	R	R	
					4	4	-	-	-	-	-	-	Material Test Certificates	T	P	W	R	R	
					5	5	-	-	-	-	-	-	Material est Certificates	T	P	W	R	R	
					6**	6**	-	-	-	-	-	-	Test Report	T	P	W	R	R	Forgings, welds, wrought weld ends
					7**	7**	-	-	-	-	-	-	Test Report	T	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipment, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1					8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
					8**	8**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-I 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast valves
					9**	9**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-III 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Bevel Surfaces (by MPI/ DP)
					13	13	-	-	-	-	-	-	Report/ Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	R	R	R	
					35	35	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					41	41	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					43	43	-	-	-	-	-	-	1. Test Report 2. Material Test Certificates for composition, hardness, thickness & integrity	1. MECON's T.S. 2. MECON's D.S. 3. ASTM B733 Std. 4. Manufacturer's Specification	P	W	R	R	
1.06	Stem	Material As per MR/ Alternate Material accepted by MECON			1,2	1,2	-	-	-	-	-	-	1. 1 2. Report	1. DD1 2. MECON's TS & DS 3. Relevant Material Standard 4. Manufacturer's Specification	P	R	R	R	
					4	4	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's D.S. & T.S.	P	W	R	R	
					5	5	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					6**	6**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-IV 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Forgings, welds, wrought weld ends

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipment, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1	2	3	4	5	8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
					7**	7**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-II 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel
					8**	8**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-I 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast
					9**	9**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-III 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Bevel Surfaces (by MPI/ DP)
					13	13	-	-	-	-	-	-	Report/ Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S.& DS	P	R	R	R	
					35	35	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					41	41	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					43	43	-	-	-	-	-	-	1. Test Report 2. Material Test Certificates for composition, hardness, thickness & integrity	1. MECON's T.S. 2. MECON's D.S. 3. ASTM B733 Std. 4. Manufacturer's Specification	P	W	R	R	
1.07	Metal Seats / Retainer Ring (If provided)	Material As per MR/ Alternate Material accepted by MECON			1,2	1,2	-	-	-	-	-	-	1. 1 2. Report	1DD1 2. MECON's TS & DS 3. Relevant Material Standard 4. Manufacturer's Specification	P	R	R	R	
					4	4	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's D.S. & T.S.	P	W	R	R	
					5	5	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipment name, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1	2	3	4	5	8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
					6**	6**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-IV 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Forgings, welds, wrought weld ends
					7**	7**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-II 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel surfaces (MPI/ DP)
					8**	8**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-I 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast
					9**	9**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-III 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Bevel Surfaces (by MPI/ DP)
					13	13	-	-	-	-	-	-	Report/ Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. & D.S.	P	R	R	R	
					35	35	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					41	41	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
					43	43	-	-	-	-	-	-	1. Test Report 2. Material Test Certificates for composition, hardness, thickness & integrity	1. MECON's T.S. 2. MECON's D.S. 3. ASTM B733 Std. 4. Manufacturer's Specification	P	W	R	R	
1.08	Bolting Material (Stud Bolts)	Material As per MR/ Alternate Material accepted by MECON			1,2	1,2	-	-	-	-	-	-	1. 1 2. Report	1DD1 2. MECON's T.S. & D.S. 3. Relevant Material Standard 4. Manufacturer's Specification	P	R	R	R	Alongwith thickness measurement for ENP Coating.
					4	4	-	-	-	-	-	-	Material Test Certificates	1. Relevant Material Standard 2. MECON's D.S. & T.S.	P	W	R	R	

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipmenting, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1					8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
					5	5	-	-	-	-	-	-	Material est Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	H	R	R	
					6**	6**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-IV 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Forgings, welds, wrought weld ends
					7**	7**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-II 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	Wet MPI for 100% of internal surfaces of all castings & forgings & bevel surfaces (MPI/ DP)
					8**	8**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-I 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	All castings as per clause 5.1.4 b) of T.S., all welds, weld ends of all cast valves
					9**	9**	-	-	-	-	-	-	Test Report	1. ASME B16.34, Appendix-III 2. MECON's T.S.	P	W	R	R	Bevel Surfaces (by MPI/ DP)
					13	13	-	-	-	-	-	-	Report/ Material est Certificates	1. Relevant Material Standard 2. MECON's T.S. & D.S.	P	R	R	R	
					41	41	-	-	-	-	-	-	Material est Certificates	1. Relevant Material Standard 2. MECON's T.S. 3. MECON's D.S.	P	W	R	R	
1.09	Assembled Valves				-	-	-	-	1,2	1,2	-	-	Report	1. D1 2. MECON's T.S.	P	W	R	R	
					-	-	-	-	3	3	-	-	Report		P	W	R	R	
					-	-	-	-	14	14	-	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	
					-	-	-	-	15	15	-	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	
					-	-	-	-	40	40	-	-	1. Report 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	R	R	R	

EQUIPMENT DETAILS					INSPECTION AND TESTS								Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ MECON TS / API /Normsand DOCUMENTS:	Inspection Codes & Sampling Plan				REMARKS
Sl. No.	Description (with equipment name, place of use and specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Raw Material and In-Process stage inspection				Final Inspection/ Test by						MFR/SV	TPIA	CONTR	MECON	
					MFR/SV	TPIA	CONTR	MECON	MFR/SV	TPIA	CONTR	MECON							
1					8	9	10	11	12	13	14	15	14	15	16A	16B	16C	16D	
							-	-	42 **	42 **	-	-	1. Report 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	If Applicable
					-	-	-	-	37	37	-	-	Certificates		-	R	R	R	
					-	-	-	-	44	44	-	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	
					-	-	-	-	45 *	45* *	*	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	If Applicable
					-	-	-	-	46 *	46* *	*	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	If Applicable
					-	-	-	-	47	47	-	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	Refer note fN 3 Table 2 of TS no. MEC/ TS / 05 / E5 / 002A
					-	-	-	-	48 *	48* *	*	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	If Applicable
					-	-	-	-	49 *	49* *	*	-	1. Report R 2. Test Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	If Applicable
					-	-	-	-	50	50	-	-	1. Final Report R 2. Final Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	W	R	R	One valve per size per rating
1.10	Complete documentation check and compilation				-	-	-	-	-	-	-	-	1. Final Report R 2. Final Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	P	P	/H/RR	R	
1.11	Issue I.C. / I.R.N and give Dispatch clearance				-	-	-	-	-	-	-	-	1. Final Report R 2. Final Certificates	1. D1 2. MECON's T.S. 3. MECON's D.S. 4. Applicable Standard	R	P	R	R	
1.12	Actuator Tests (If Applicable)				As per Actuator Quality Assurance Plan (to be submitted by vendor for approval)														

1) MAKE : As per Approved Make List in Tender Document or Approved PTR as per Tender conditions .


- 2) VENDOR shall establish approved WPS-PQR-WPQ for the weldings duly witnessed by TPIA (Applicable for fully welded body valves OR valves with welded pup pieces and size 2" and above only).
- 3) Vendor shall do RT for Body adapter to PUP piece welding and RT report shall be reviewed by MECON & TPIA (Applicable for valves with welded pup pieces and size 2" and above only)
- 4) Vendor shall do UT/RT for Bodt to Body adapter welding witnessed by TPIA (Applicable for fully welded body valves only)

For CONTRACTOR

For SUB-CONTRACTOR
(Valve Manufacturer)

QAP NO.: MEC/WINO/05/28/M/001/QAP-002

REV
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	CONTRACTOR		QUALITY ASSURANCE PLAN FOR STRUCTURAL AND MECHANICAL EQUIPMENT	PROJECT :	
	ORDER NO. & DATE			PACKAGE NO. :	
	SUB-CONTRACTOR			PACKAGE NAME : ASSORTED PIPES	
	ORDER NO. & DATE			MR NO. :	TS No.: MEC/TS/05/62/59A

INSTRUCTIONS FOR FILLING UP :

- QAP shall be submitted for each of the equipment separately with break up of assembly/sub-assembly & part/component or for group of equipment having same specification.
- Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment
- Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
- Weight in kilograms must be indicated under Column-5 for each item. Estimated weights may be indicated wherever actual weights are not available.



CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS :


<table border="0" style="width:100%;"> <tr> <td style="width:33%;"><i>Code Description</i></td> <td style="width:33%;"><i>Code Description</i></td> <td style="width:33%;"><i>Code Description</i></td> </tr> <tr> <td>1. Visual</td> <td>18. Amplitude Test</td> <td>34. Internal Inspection Report by Contractor</td> </tr> <tr> <td>2. Dimensional</td> <td>19. Sponge Test</td> <td>35. Hardness Test</td> </tr> <tr> <td>3. Fitment & Alignment</td> <td>20. Dust/ Water Ingress Test</td> <td>36. Spark Test for Lining</td> </tr> <tr> <td>4. Physical Test (Sample)</td> <td>21. Friction Factor Test</td> <td>37. Calibration</td> </tr> <tr> <td>5. Chemical Test (Sample)</td> <td>22. Adhesion Test</td> <td>38. Safety Device Test</td> </tr> <tr> <td>6. Ultrasonic Test</td> <td>23. Performance Test/Characteristic Curve</td> <td>39. Ease of Maintenance</td> </tr> <tr> <td>7. Magnetic Particle Test (MPI)</td> <td>24. No Load/ Free Running Test</td> <td>40. Fire Test (Type Test)</td> </tr> <tr> <td>8. Radiography Test</td> <td>25. Load/ Overload Test</td> <td>41. Charpy V-Notch Test</td> </tr> <tr> <td>9. Dye Penetration Test</td> <td>26. Measurement of Speeds</td> <td>42. Operational Torque Test</td> </tr> <tr> <td>10. Metallographic Exam.</td> <td>27. Acoustical Test</td> <td>43. ENP (Electroless Nickel Plating) Execution</td> </tr> <tr> <td>11. Welder's Qualification & Weld Procedure Test</td> <td>28. Geometrical Accuracy</td> <td>44. Painting</td> </tr> <tr> <td>12. Approval of Test and Repair Procedure</td> <td>29. Repeatability and Positioning Accuracy</td> <td>45. Anti-Static Test</td> </tr> <tr> <td>13. Heat Treatment</td> <td>30. Proving Test</td> <td>46. Hydrostatic Double Block & Bleed Test</td> </tr> <tr> <td>14. Pressure Test</td> <td>31. Surface Preparation</td> <td>47. Functional Test</td> </tr> <tr> <td>15. Leakage Test</td> <td>32. Manufacturer's Test Certificates for bought-out items</td> <td>48. Pneumatic Double Block & Bleed Test</td> </tr> <tr> <td>16. Balancing</td> <td>33. IBR/ Other Statutory agencies compliance certificate</td> <td>49. Proof Test (Type Test)</td> </tr> <tr> <td>17. Vibration Test</td> <td></td> <td>50. Dielectric Test</td> </tr> </table>	<i>Code Description</i>	<i>Code Description</i>	<i>Code Description</i>	1. Visual	18. Amplitude Test	34. Internal Inspection Report by Contractor	2. Dimensional	19. Sponge Test	35. Hardness Test	3. Fitment & Alignment	20. Dust/ Water Ingress Test	36. Spark Test for Lining	4. Physical Test (Sample)	21. Friction Factor Test	37. Calibration	5. Chemical Test (Sample)	22. Adhesion Test	38. Safety Device Test	6. Ultrasonic Test	23. Performance Test/Characteristic Curve	39. Ease of Maintenance	7. Magnetic Particle Test (MPI)	24. No Load/ Free Running Test	40. Fire Test (Type Test)	8. Radiography Test	25. Load/ Overload Test	41. Charpy V-Notch Test	9. Dye Penetration Test	26. Measurement of Speeds	42. Operational Torque Test	10. Metallographic Exam.	27. Acoustical Test	43. ENP (Electroless Nickel Plating) Execution	11. Welder's Qualification & Weld Procedure Test	28. Geometrical Accuracy	44. Painting	12. Approval of Test and Repair Procedure	29. Repeatability and Positioning Accuracy	45. Anti-Static Test	13. Heat Treatment	30. Proving Test	46. Hydrostatic Double Block & Bleed Test	14. Pressure Test	31. Surface Preparation	47. Functional Test	15. Leakage Test	32. Manufacturer's Test Certificates for bought-out items	48. Pneumatic Double Block & Bleed Test	16. Balancing	33. IBR/ Other Statutory agencies compliance certificate	49. Proof Test (Type Test)	17. Vibration Test		50. Dielectric Test	<p><i>Code DOCUMENTS:</i></p> <p>D1. Approved GA drawings D2. Information and other reference drg/ stamped drgs released for mfg. D3. Relevant catalogues D4. Bill of matl./Item no./ Identification D5. Matchmarks details D6. Line/ Layout diagram D7. Approved erection procedures D8. Unpriced sub P.O. with specification and amendments, if any D9. Calibration Certificate of all measuring instruments and gauges D10. X-Ray Reports</p>
<i>Code Description</i>	<i>Code Description</i>	<i>Code Description</i>																																																					
1. Visual	18. Amplitude Test	34. Internal Inspection Report by Contractor																																																					
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17. Vibration Test		50. Dielectric Test																																																					

ABBREVIATIONS USED :
CONTR : CONTRACTOR
MFR : MANUFACTURER
H : HOLD
R : REVIEW
W : WITNESS

KEY TO SYMBOLS :
* : MFR/ CONTRACTOR - AS APPLICABLE
** : TEST TO BE PERFORMED, IF APPLICABLE

Sl. No.	Description (with equipment heading, place of use and brief specifications)	EQUIPMENT DETAILS					INSPECTION AND TESTS						Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ ASTM/ Norms and Documents	REMARKS/ SAMPLING PLAN
		Identification No. (MR Item No.)	Quantity No./M	Unit Weight (Kg)	Manufacturer's Name and Address	Expected Schedule of Final Inspn.	Raw Material and In-Process Stage Inspection			Final Inspection/ Test by					
							MFR	CONTR	TPI	MFR	CONTR & TPI	MECON			
1		3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.0	Assorted Pipes		As per SOR / P& ID		As per Approved Make List in Tender Document or Approved PTR as per Tender conditions		1,2,4,5,41		-	1,2,14,35,41	1,2,14,35,41	1,2,14,35,41	1,2,4,5,32,34,D9	CONSULTANT's T.S. & Relevant Standards mentioned therein	100%

For CONTRACTOR (Stamp & Signature)		SUB-CONTRACTOR (Stamp & Signature)		QAP NO. SHEET 1 OF 1	REV 0
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	CONTRACTOR	QUALITY ASSURANCE PLAN FOR STRUCTURAL AND MECHANICAL EQUIPMENT	PROJECT :
	ORDER NO. & DATE		BID DOCUMENT NO. :
	SUB-CONTRACTOR		ITEM NAME : PRESSURE SAFETY VALVE
	ORDER NO. & DATE		SPEC. NO.: MEC/TS/05/62/056, REV-01

INSTRUCTIONS FOR FILLING UP :

1. QAP shall be submitted for each of the equipment separately with break up of assembly/sub-assembly & part/component or for group of equipment having same specification.
2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment
3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
4. Weight in kilograms must be indicated under Column-5 for each item. Estimated weights may be indicated wherever actual weights are not available.

CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS :

Code	Description	Code	Description	Code	Description
1.	Visual	18.	Amplitude Test	34.	Internal Inspection Report by Contractor
2.	Dimensional	19.	Sponge Test	35.	Hardness Test
3.	Fitment & Alignment	20.	Dust/ Water Ingress Test	36.	Spark Test for Lining
4.	Physical Test (Sample)	21.	Friction Factor Test	37.	Calibration
5.	Chemical Test (Sample)	22.	Adhesion Test	38.	Safety Device Test
6.	Ultrasonic Test	23.	Performance Test/Characteristic Curve	39.	Ease of Maintenance
7.	Magnetic Particle Test (MPI)	24.	No Load/ Free Running Test	40.	Fire Test (Type Test)
8.	Radiography Test	25.	Load/ Overload Test	41.	Charpy V-Notch Test
9.	Dye Penetration Test	26.	Measurement of Speeds	42.	Operational Torque Test
10.	Metallographic Exam.	27.	Acoustical Test	43.	ENP (Electroless Nickel Plating) Execution
11.	Welder's Qualification & Weld Procedure Test	28.	Geometrical Accuracy	44.	Painting
12.	Approval of Test and Repair Procedure	29.	Repeatability and Positioning Accuracy	45.	Anti-Static Test
13.	Heat Treatment	30.	Proving Test	46.	Hydrostatic Double Block & Bleed Test
14.	Pressure Test	31.	Surface Preparation	47.	Functional Test
15.	Leakage Test	32.	Manufacturer's Test Certificates for bought-out items	48.	Pneumatic Double Block & Bleed Test
16.	Balancing	33.	IBR/ Other Statutory agencies compliance certificate		
17.	Vibration Test				

- Code DOCUMENTS:**
- D1. Approved GA drawings
 - D2. Information and other drgs released for mfg. reference drg/ stamped
 - D3. Relevant catalogues
 - D4. Bill of matl./Item no./ Identification
 - D5. Matchmarks details
 - D6. Line/ Layout diagram
 - D7. Approved erection procedures
 - D8. Unpriced sub P.O. with specification and amendments, if any
 - D9. Calibration Certificate of all measuring instruments and gauges
 - D10. X-Ray Reports


ABBREVIATIONS USED :
 CONTR : CONTRACTOR * : MFR/ CONTRACTOR - AS APPLICABLE
 MFR : MANUFACTURER ** : TEST TO BE PERFORMED, IF APPLICABLE
 H : HOLD
 R : REVIEW
 W : WITNESS
 P : PERFORM

KEY TO SYMBOLS :

EQUIPMENT DETAILS							INSPECTION AND TESTS						Test Certificates & Documents to be submitted to MECON	Acceptance Criteria Standards/ IS/ BS/ ASME/ Norms and Documents	REMARKS/ SAMPLING PLAN					
Sl. No.	Description (with equipment heading, place of use and brief specifications)	Identification No.	Quantity No./M	Unit Weight (Kg)	Manufacturer's Name and Address	Expected Schedule of Final Inspn.	Raw Material and In-Process Stage Inspection			Final Inspection/ Test by										
							MFR	TPI	MECON	MFR	TPI	MECON								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16					
	PRESSURE SAFETY VALVE (PSV)	-	-	-			1,2,3	P	1,2,4	W	-	1,2,3	P	1,2,3	W	1,2,3	R	1,2,3,4,5,8,14,15	D1,D3,D8,D10	47
							4,5	P	5,41	W	-	14,15	P	14,15	W	14,47	R	31,32,34,41,44,47	ASME SEC-VIII, DIV-1	100%
							8,41	P	8	R		31,32	P	44,47	W				MECON TS	
												44,47	P	31,32	R				APPROVED DS	


For MECON (Stamp & Signature)	For CONTRACTOR/ SUB-CONTRACTOR (Stamp & Signature)		QAP NO.	REV 0
			SHEET 1 OF 1	

* To be field by party as per index above & approved by MECON

	CONTRACTOR	QUALITY ASSURANCE PLAN FOR STRUCTURAL AND MECHANICAL EQUIPMENT					PROJECT :																																																																																																																																																						
	ORDER NO. & DATE						BID DOCUMENT NO. :																																																																																																																																																						
	SUB-CONTRACTOR						ITEM NAME : CARTRIDGE FILTER																																																																																																																																																						
	ORDER NO. & DATE						SPEC. NO.: MEC/TS/05/62/017, REV-01																																																																																																																																																						
INSTRUCTIONS FOR FILLING UP : 1. QAP shall be submitted for each of the equipment separately with break up of assembly/sub-assembly & part/component or for group of equipment having same specification. 2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment 3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together. 4. Weight in kilograms must be indicated under Column-5 for each item. Estimated weights may be indicated wherever actual weights are not available.							CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS : <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%;"><i>Code</i></td> <td style="width:35%;"><i>Description</i></td> <td style="width:15%;"><i>Code</i></td> <td style="width:35%;"><i>Description</i></td> <td style="width:15%;"><i>Code</i></td> <td style="width:35%;"><i>Description</i></td> <td style="width:15%;"><i>Code</i></td> <td style="width:35%;"><i>DOCUMENTS:</i></td> </tr> <tr> <td>1.</td> <td>Visual</td> <td>18.</td> <td>Amplitude Test</td> <td>34.</td> <td>Internal Inspection Report by Contractor</td> <td>D1.</td> <td>Approved GA drawings</td> </tr> <tr> <td>2.</td> <td>Dimensional</td> <td>19.</td> <td>Sponge Test</td> <td>35.</td> <td>Hardness Test</td> <td>D2.</td> <td>Information and other reference drg/ stamped</td> </tr> <tr> <td>3.</td> <td>Fitment & Alignment</td> <td>20.</td> <td>Dust/ Water Ingress Test</td> <td>36.</td> <td>Spark Test for Lining Calibration</td> <td>D3.</td> <td>Relevant catalogues</td> </tr> <tr> <td>4.</td> <td>Physical Test (Sample)</td> <td>21.</td> <td>Friction Factor Test</td> <td>37.</td> <td>Safety Device Test</td> <td>D4.</td> <td>Bill of matl./Item no./ Identification</td> </tr> <tr> <td>5.</td> <td>Chemical Test (Sample)</td> <td>22.</td> <td>Adhesion Test</td> <td>38.</td> <td>Ease of Maintenance</td> <td>D5.</td> <td>Matchmarks details</td> </tr> <tr> <td>6.</td> <td>Ultrasonic Test</td> <td>23.</td> <td>Performance Test/Characteristic Curve</td> <td>39.</td> <td>Fire Test (Type Test)</td> <td>D6.</td> <td>Line/ Layout diagram</td> </tr> <tr> <td>7.</td> <td>Magnetic Particle Test (MPI)</td> <td>24.</td> <td>No Load/ Free Running Test</td> <td>40.</td> <td>Charpy V-Notch Test</td> <td>D7.</td> <td>Approved erection procedures</td> </tr> <tr> <td>8.</td> <td>Radiography Test</td> <td>25.</td> <td>Load/ Overload Test</td> <td>41.</td> <td>Operational Torque Test</td> <td>D8.</td> <td>Unpriced sub P.O. with specification and amendments, if any</td> </tr> <tr> <td>9.</td> <td>Dye Penetration Test</td> <td>26.</td> <td>Measurement of Speeds</td> <td>42.</td> <td>ENP (Electroless Nickel Plating) Execution</td> <td>D9.</td> <td>Calibration Certificate of all measuring instruments and gauges</td> </tr> <tr> <td>10.</td> <td>Metallographic Exam.</td> <td>27.</td> <td>Accoustical Test</td> <td>43.</td> <td>Painting</td> <td>D10.</td> <td>X-Ray Reports</td> </tr> <tr> <td>11.</td> <td>Welder's Qualification & Weld Procedure Test</td> <td>28.</td> <td>Geometrical Accuracy</td> <td>44.</td> <td>Anti-Static Test</td> <td></td> <td></td> </tr> <tr> <td>12.</td> <td>Approval of Test and Rep: Procedure</td> <td>29.</td> <td>Repeatability and Positioning Accuracy</td> <td>45.</td> <td>Proving Test</td> <td></td> <td></td> </tr> <tr> <td>13.</td> <td>Heat Treatment</td> <td>30.</td> <td>Proving Test</td> <td>46.</td> <td>Hydrostatic Double Block & Bleed Test</td> <td></td> <td></td> </tr> <tr> <td>14.</td> <td>Pressure Test</td> <td>31.</td> <td>Surface Preparation</td> <td>47.</td> <td>Functional Test</td> <td></td> <td></td> </tr> <tr> <td>15.</td> <td>Leakage Test</td> <td>32.</td> <td>Manufacturer's Test Certificates for bought-out items</td> <td>48.</td> <td>Pneumatic Double Block & Bleed Test</td> <td></td> <td></td> </tr> <tr> <td>16.</td> <td>Balancing</td> <td>33.</td> <td>IBR/ Other Statutory agencies compliance certificate</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>17.</td> <td>Vibration Test</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>							<i>Code</i>	<i>Description</i>	<i>Code</i>	<i>Description</i>	<i>Code</i>	<i>Description</i>	<i>Code</i>	<i>DOCUMENTS:</i>	1.	Visual	18.	Amplitude Test	34.	Internal Inspection Report by Contractor	D1.	Approved GA drawings	2.	Dimensional	19.	Sponge Test	35.	Hardness Test	D2.	Information and other reference drg/ stamped	3.	Fitment & Alignment	20.	Dust/ Water Ingress Test	36.	Spark Test for Lining Calibration	D3.	Relevant catalogues	4.	Physical Test (Sample)	21.	Friction Factor Test	37.	Safety Device Test	D4.	Bill of matl./Item no./ Identification	5.	Chemical Test (Sample)	22.	Adhesion Test	38.	Ease of Maintenance	D5.	Matchmarks details	6.	Ultrasonic Test	23.	Performance Test/Characteristic Curve	39.	Fire Test (Type Test)	D6.	Line/ Layout diagram	7.	Magnetic Particle Test (MPI)	24.	No Load/ Free Running Test	40.	Charpy V-Notch Test	D7.	Approved erection procedures	8.	Radiography Test	25.	Load/ Overload Test	41.	Operational Torque Test	D8.	Unpriced sub P.O. with specification and amendments, if any	9.	Dye Penetration Test	26.	Measurement of Speeds	42.	ENP (Electroless Nickel Plating) Execution	D9.	Calibration Certificate of all measuring instruments and gauges	10.	Metallographic Exam.	27.	Accoustical Test	43.	Painting	D10.	X-Ray Reports	11.	Welder's Qualification & Weld Procedure Test	28.	Geometrical Accuracy	44.	Anti-Static Test			12.	Approval of Test and Rep: Procedure	29.	Repeatability and Positioning Accuracy	45.	Proving Test			13.	Heat Treatment	30.	Proving Test	46.	Hydrostatic Double Block & Bleed Test			14.	Pressure Test	31.	Surface Preparation	47.	Functional Test			15.	Leakage Test	32.	Manufacturer's Test Certificates for bought-out items	48.	Pneumatic Double Block & Bleed Test			16.	Balancing	33.	IBR/ Other Statutory agencies compliance certificate					17.	Vibration Test						
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ABBREVIATIONS USED : KEY TO SYMBOLS : CONTR : CONTRACTOR * : MFR/ CONTRACTOR - AS APPLICABLE MFR : MANUFACTURER ** : TEST TO BE PERFORMED, IF APPLICABLE H : HOLD R : REVIEW W : WITNESS P : PERFORM																																																																																																																																																													
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1	CARTRIDGE FILTER	-	-	-			1,2,3,4	P	1,2,3,4	W	-	1,2,3	P	1,2,3	W	1,2,3	R	1,2,3,4,5,6,8,9,11,12	D1,D2 &	Butt welding to be radiographed 100%																																																																																																																																									
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For MECON (Stamp & Signature)							For CONTRACTOR/ SUB-CONTRACTOR (Stamp & Signature)							QAP NO. SHEET 1 OF 1		REV 0																																																																																																																																													

* To be field by party as per index above & approved by MECON



	CONTRACTOR		QUALITY ASSURANCE PLAN FOR INSTRUMENTATION EQUIPMENT	CLIENT	
	ORDER NO. & DATE			PACKAGE NO.	030
	SUB-CONTRACTOR			PACKAGE NAME	METERING SKID
	ORDER NO. & DATE				

INSTRUCTIONS FOR FILLING UP :

- QAP shall be submitted for each of the equipment separately with break up of assembly/sub-assembly & part/component or for group of equipment having same specification.
- Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment
- Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
- Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.

ABBREVIATIONS USED :

CONTR : CONTRACTOR

MFR : MANUFACTURER

CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS:

Code	Description	Code	Description	Code	Description	DOCUMENTS:
1.	Marking, Tagging, Unique Srl. No., Finish	12.	Routine test as per relevant IS other standard	23.	Electrical/Conduit Entry Connection check	D1. Approved GA drawings
2.	Dimensions	12(a).	Accessories check	24.	Operational & functional check	D2. Approved single line/ schematic diagram
3.	Fitment & Alignment	13.	Type test as per relevant IS/ other standard	25.	Hydro Test	D3. Approved data sheet / Doc.
4.	Physical Test	14.	Impulse Test	26.	Flame Proof Test	
5.	Chemical Test	15.	Hysteresis	27.	Threading	D4. Approved bill of materials
6.	Ultrasonic Test	16.	Accuracy	28.	Process Connection Check	D5. Unpriced P.O. copy
7.	Magnetic Particle Test (MPT)	17.	Enclosure Protection Test	29.	Indicator Operation Check	D6. Calibration Certificate of all measuring instruments
8.	Radiography Test	18.	Calibration	30.	Communication with Field Communicator	
9.	Surface Defect (DPT)	19.	Noise & Vibration	31.	IR at amb. & at 500V DC	
10.	Measurement of IR Value	20.	IP/Hazardous area/COC/ Test/Calibr./Type Test Cert.	32.	N ₂ Test	
a)	Before HV Test	21.	Over range protection	33.	Response Time test	
b)	After HV Test	22.	Repeatability	41.	Charpy V-Notch Test	
11.	High Voltage test/Dielectric test	23(a).	Impact Test	45.	Fire Test (Type Test)	
11(a).	Paint Test	35.	Hardness Test			
34.	Heat Treatment	44.	Pressure Test			
43.	ENP (Electroless Nickel Plating)	46.	Anti-Static Test			
		11(b).	Pneumatic Test for Internal seal & external tightness and functional test (as per EN 334 for PCV & 14382 for SDV)			
		11(c).	Pressure retaining parts	11(d).	Plug/seat leakage test	
		11(f).	Functional Test	11(e).	Packing leakage test	
		11(i).	Actuator stroking Time	11(g).	Leak Test	
		11(j).	Acceptance Tests as per relevant IS/ other standard	11(h).	Running Test	

EQUIPMENT DETAILS							INSPECTION AND TESTS										Test Certificates & documents to be submitted to MECON	Acceptance Criteria Standards /IS/ BS/ASM E/ Norms and Documents	REMARKS/ SAMPLING PLAN		
Sl. No	Description Of item	Identification No.	Quantity		Manufacturer's Name and Address	Expected schedule of Final Inspection	Raw Material and inprocess stage inspection					Final Inspection/Test by									
			No/M	T			MFR	TPI	CLIENT / MECON	MFR	TPI	CLIENT / MECON									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16						
01	PCV / SDV / FCV	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	1,2,4,5,6,7,8,9,34,35,41,43	P	1,2,4,5,6,7,8,9,34,35,41,43	W	1,2,4,5,6,7,8,9,34,35,41,43	R	1,2,3,4,44,45,11(f),18,11(a),46,25,11(b),20	P	1,2,3,4,44,45,11(f),18,11(a),46,25,11(b),20	W	1,2,3,4,44,45,11(f),18,11(a),46,25,11(b),20	R	1,2,3,4,5,6,7,8,9,34,35,41,43,44,45,11(f),18,11(a),46,25,11(b),20,D6	D3 & Tech. Spec., EN 334 / 14382 / IEC 60534-4	100% Witness
02	Pressure gauges / Temperature gauges / Diff. Pressure gauges	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	1,2,15,16,18,21,22,20	P	1,2,15,16,18,21,22,20	W	1,2,15,16,18,21,22,20	R	1,2,5,15,16,18,20,21,22,D6	D3 & Tech. Spec., EN 837-1	100% Witness
03	Pressure Transmitter / Diff. Pressure Transmitter / Temperature Transmitter	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	1,2,12(a),23,28,16,18,22,29,30,20	P	1,2,12(a),23,28,16,18,22,29,30,20	W	1,2,12(a),23,28,16,18,22,29,30,20	R	1,2,5,12(a),23,28,16,18,22,29,30,20,D6	D3 & Tech. Spec.	100% Witness

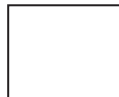
04	Resistance Temp. Detector with Thermowell	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	-	1,2,3,4,5,6,7,8,9,25,16,31,32,18,3,20,27,44,11(a),11(g),2,3,34,35,41	P	1,2,3,4,5,6,7,8,9,25,16,31,32,18,3,20,27,44,11(a),11(g),23,34,35,41	W	1,2,3,4,5,6,7,8,9,25,16,31,32,18,3,20,27,44,11(a),11(g),23,34,35,41	R	1,2,3,4,5,6,7,8,9,25,16,31,32,18,3,20,27,44,11(a),11(g),23,34,35,41,D6	D3 & Tech. Spec.	100% Witness
05	Flow Computers	Refer P&ID, Tech. Spec. and Data Shts.	* No.	-	-	-	-	-	-	-	-	-	-	1,2,3,24,18,20	P	1,2,3,24,18,20	W	1,2,3,24,18,20	R	1,2,3,24,20,18,D6	D3 & Tech. Spec., AGA-3,5,7,8,9	100% Witness
06	Ultrasonic / Turbine Flowmeter	Refer P&ID, Tech. Spec. and Data Shts.	* No.	-	-	-	-	1,2,4,5,6,7,8,9,34,35,41	P	1,2,4,5,6,7,8,9,34,35,41	W	1,2,4,5,6,7,8,9,34,35,41	R	1,2,3,44,45,11(f),18,11(a),46,25,11(g),20,23	P	1,2,3,44,45,11(f),18,11(a),46,25,11(g),20,23	W	1,2,3,44,45,11(f),18,11(a),46,25,11(g),20,23	R	1,2,3,4,5,6,7,8,9,34,35,41,44,45,11(f),18,11(a),46,25,11(g),20,23,D6	D3 & Tech. Spec., AGA 7/9	100% Witness
07	LEL Detection System	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	-	1,2,3,18,20,24,23	P	1,2,3,18,20,24,23	W	1,2,3,18,20,24,23	R	1,2,3,18,20,24,23,D6	D3 & Tech. Spec.	100% Witness
08	Barrier, SDC, SS tube, fittings, Manifolds, GSM Modem, Laptop, Printer, Gas Chromatograph, Junction Boxes, Cable Glands	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	-	1,2,3,4,12,13,20,24,27,26,23,17,11(a),10,11	P	1,2,3,4,12,13,20,24,27,26,23,17,11(a),10,11	W	1,2,3,4,12,13,20,24,27,26,23,17,11(a),10,11	R	1,2,3,4,12,13,20,24,27,26,23,17,11(a),10,11,D6	D3 & Tech. Spec.	100% Review
09	Control Panel	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	-	1,2,3,4,10,11,11(a),12,13,17,24,20	P	1,2,3,4,10,11,11(a),12,13,17,24,20	W	1,2,3,4,10,11,11(a),12,13,17,24,20	R	1,2,3,4,10,11,11(a),12,13,17,24,20,D6	D3 & Tech. Spec.	100% Witness
10	Cables	Refer P&ID, Tech. Spec. and Data Shts.	* Nos.	-	-	-	-	-	-	-	-	-	-	1,2,3,4,5,10,11,12,13,20,11(j)	P	1,2,3,4,5,10,11,12,13,20,11(j)	W	1,2,3,4,5,10,11,12,13,20,11(j)	R	1,2,11(j), 12,13, D3,D6	D3 & Tech. Spec., rel. IS / other std.	100% Witness

Note :- This is Typical QAP. Bidder to prepare the QAP considering the tests / stds. (as applicable) & submit for review/approval. Review/Witness category & stage category will be finalized during approval. However, EN 10204 3.2 certification shall be provided for all the items.

*Qty as per MR /PO and P& Id requirement.

P : Perform, W : Witness, R : Review

For MECON (Stamp & Signature)



for CONTRACTOR SUB-CONTRACTOR
(Stamp & Signature)



QAP No.: MEC/05/E5/QAP - 030

R0

ANNEXURE - VII

FAT PROCEDURE/ FAT MANUAL

FAT PROCEDURE / FAT MANUAL
For
METERING SKIDS

(Doc. No. : MEC / /05 / E5/ M/ FAT-030A)

**(This is typical procedure and to be filled by the Bidder for Factory Acceptance
Test at Bidder's works for the items as applicable)**

1	11.07.2019				
Revision	Date	Description	Prepared by	Checked by	Approved by


MECON LIMITED DELHI	FAT PROCEDURE / FAT MANUAL FOR METERING SKIDS		
INSTRUMENTATION SECTION	Doc. No: MEC/05/E5/FAT- 030A		
	Rev. 1	Page 2 of 24	

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Scope
Reference Documents
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Test Certificates
Action List

2. VISUAL INSPECTION

Skid Review
Test Certificates

3. FACTORY ACCEPTANCE TEST


Hydrostatic Test
Pneumatic Leak Test
Function Test for PG,TG,DPG
Functional test of SSV, PCV and FCV, CRV/PSV
Functional Test of flow computer
Transmitter Test Procedure
Flow Meter (USM/TFM)
Control Panel
Gas Chromatograph
LEL system
Metering Supervisory System
Solar Panel

4. SPARES

5. PAINTING

6. DOCUMENTS REVIEW

7. ANNEXURES

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1. PREFACE

Introduction:

This document defines procedure for Factory acceptance Test (FAT) to be carried out for Metering Skid(s). The purpose of carrying out FAT is to check functionality of the entire natural Gas Pressure regulation Skid with respect to agreed technical documents.

NOTE: All the tests, inspection, checking, data-configuration etc shall be conducted as per FAT procedure by the vendor and the same shall be submitted to Mecon for review. The records / test reports/ calibration reports/ certificates, configuration sheet for flow computers and other relevant document should be prepared / obtained by the vendor and sent to Mecon for review.

Scope.

The FAT will confirm the compliance of Metering Skid with the project specifications. The purpose of FAT is to check the performance of each component as well as entire skid. Upon completion of the test described in the following procedures, the system will be considered to be ready to be dispatched to the site. All the physical & functional tests are described in the remaining sections. When each functional test has been completed, the TPIA will indicate acceptance of the tests by signing the test certificates.

All the equipments / instruments/ items shall be installed (as far as possible) for demonstration during FAT. In case some of the items can not be erected/ installed during FAT, list of such item along with the reason for not installing the same shall be provided before start of FAT. FAT shall not be conducted before our approval of such list. In case difference in calculated values (calculated by different Instruments) is observed for any parameter, the list of such parameters along with values and suitable reason for such deviation to be submitted to us in advance for our review. In case deviation is observed in the parameter-values displayed by various components, the same shall be recorded and may result in to rejection of FAT.


All connectivity/ its simulation mentioned elsewhere in tender shall be established and demonstrated during FAT. Non-compliance to any of these shall result in rejection of Metering skid

Reference Documents: Refer List of documents (Doc. No. MEC/05/E5/SKID/DCI/3.2) available in tender document.

Orientation of Witnesses:

All representatives shall be briefed on details/ description/ operating principles of the Metering Skid for this project before commencing the FAT.

Test Certificates:

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Upon completion of the tests mentioned in this document, Test Certificates should be filled with the results and signed / stamped by all the parties.

Action List:

Any discrepancies noted during the functional tests shall be defined, recorded and summarized in the Action List Form. Once proper action has been taken on those points, this Action List shall be signed / stamped by Customer/ TPIA duly filled with the results.

2. VISUAL INSPECTION OF SKID.

2.1 Skid Review:

The Skid will be inspected for installation of all the components as per approved P & ID and approved G.A. Drawing. Dimensional Checking shall be done as per approved G.A. Drawing. Skid will also be inspected for correctness of installed Equipments/ instruments and approachability for maintenance. The Skid will be inspected for proper support with neoprene sheet / rubber pads / clamps for the major equipments/ Instruments and pipes / tubes.

2.2 Test Certificate for Visual Inspection:

Upon completion of the visual inspection described in this section, the test certificate for Visual Inspection of skid should be dully filled and signed by both parties.

3. FACTORY ACCEPTANCE TEST:

3.1 Hydrostatic Test : Refer separate QAP for Piping.


3.2 Pneumatic Test : Refer separate QAP for Piping.

3.3 Functional test of PG, TG & DPG

Check the readings of Local Pressure Gauge, Temperature Gauge & Differential Pressure Gauge when pressurized.

3.4 Functional test of SSV, PCV and FCV, CRV/PSV

1. Set point of PCV– set the required pressure of PCV as per approved data sheet/approved P&ID by Pilot adjusting screw.
2. Set point of SSV - Increase the PCV pressure to cross the set point of SSV. The SSV should trip at set pressure value as per approved data sheet/ approved P&ID. Record the Over Pressure Shut off value, CRV/ PSV set point during test.
3. SSV's Limit switch feed back (contact) signal to be checked in FC, Metering supervisory system, indicating lamp in panel & RTU/ SCADA TB.
4. Flow control valves position (0-100%) (command & feedback) shall be checked in FC & Metering supervisory system by simulation of analogue signal (4-20 mA signal).
5. Test report/ record for Set pressure of PCV/ SSV shall be reviewed during FAT.

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3.5 Functionality Test of Flow Computer


1. Configuration check, parameter settings/ checking etc shall be carried out as per approved Data Sheet/ FDS.
2. Volumetric flow rate, Mass flow rate by simulation of Flow meter signal using Function Generator/ any other equipment. Flow, Energy and Mass Totalizers, shall be also be checked.
3. Line Temperature and pressure, Diff. Pressure etc. shall be checked by inputting respective analog signals.
4. Interface data of flow computer with RTU – Measurement by Laptop.
5. Visual checking of instrumentation cable connection including cable gland, cable tag nos., JB mounting installation, cable dressing etc. as per drawing, wiring diagram.
6. Facility of entry of Atmospheric pressure and temperature by operator to be verified.
7. Various Units of measurement (Pressure, flow rate, heating value, energy etc.) shall be checked as per approved documents.
8. Functioning of PID loop (AO) for FCV shall be done by simulation.
9. Simulation of Flow Computer output to SCADA by GSM Modem.
10. GC data input to Flow computer from SCADA via GSM modem.
11. Proper entry of the flow meter error curve, K factors etc.
12. Checking of Audit Trail facility in the flow computer and its printing.
13. Modbus address details to be verified.
14. Availability and functioning of USB ports with connecting cables for communication of various devices/Instruments/ Equipments (like GC, flowmeter, RTU/ SCADA, Metering supervisory system, Printers, Laptop etc) with flow computers.(Functioning of standalone Software for flow calculation verification to be checked.)
15. Check functioning of Solar Panel.(If applicable)
16. Check functioning of Batteries for Solar Panel. (If applicable)
17. Check installation accessories of solar panel with batteries. Charger for batteries to be kept in separate JB. Battery JBs shall be equipped with breathing valves.
18. Check HOV status in FC (If applicable)
19. Serial Communication from field mounted flow computer to be provided in JB & to be checked.

3.6 Transmitter Test Procedure (Pressure, Differential Pressure, Temperature):

Provide power supply to the transmitter and check the local indication, in FC, RTU/SCADA TB & Metering supervisory system & output during the pneumatic test. Calibration report (from approved Lab) and Hart functionality to be checked

3.7 Flow Meter :

The Flow meter has been manufactured by ----- and is calibrated at ----- using Natural Gas as per approved data sheet. The calibration Certificates shall be submitted for review during FAT. Insulation of metering system and Environmental enclosure for custody metering equipments shall be checked visually during FAT. Functioning of SOS calculation software as per AGA 8. being supplied shall be checked. Also provision of alarming in case of variance in SOS calculation as per meter and as per AGA 8 to be checked. AGA 7, AGA 8 & AGA 9 verification to be done.

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3.8 Control Panel(if applicable):

1. Check the complete functional test as per loop diagram / Data sheet.
2. Hot stand by functionality of Power supply in control panel to be checked.
3. Visual Check: Wiring diagram and marking
4. Operation of Fan, Light and other items.
5. Check the painting quality, cable identification mark, tags, cable dressing,
6. Door alignment, locks and overall dimensions to be checked.
7. IS ground and panel ground shall be independent and to be checked.
8. Check the availability of spare items & space.


3.9 Gas Chromatograph (if applicable):

1. GC controller/ display unit and interface unit Installation in control panel shall be checked as per approved data Sheet/ FDS.
2. Parameter settings/ software loading checking, default values etc shall be carried out for GC controller/ remote configurator as per approved data Sheet/ FDS.
3. Probes, Tools for insertion/ removal in pipe shall be also be checked.
4. Field Analyser unit with stand shall be also be checked as per Data sheet.
5. Calibration Gas cylinders, carrier gas cylinders, self acting pressure regulator for Cylinders (calibration gas/ carrier gas) shall be checked.
6. Report for composition of calibration gas shall comply to the specifications.
7. Shed for Analyser, Cable for remote configurator/ controller etc shall also be checked.
8. Communication between GC and Laptop shall also be checked and GC data simulation to be checked.
9. Simulation of GC data input to Flow computer, Metering supervisory system and RTU/ SCADA via GSM modem.
10. Availability and functionality checking of communication with flow computers, Laptop, Metering supervisory system, RTU/ SCADA, Printer
11. GC Calibration shall be performed and chromatogram for 3 consecutive runs shall be recorded as base for future. Also heating value as displayed by GC and as calculated by FC shall be checked for exact matching and shall comply to GPA 2145 / 2172.
12. Modbus address details to be verified.

3.10 LEL Detection system (if applicable):

1. Installation and Simulation of LEL monitor/ controller to be checked.
2. Installation & functioning of LEL Detectors to be checked.
3. LEL calibration gas cylinder, Regulator, portable LEL detectors etc. to be verified.
4. Verification of calibration report for Calibration mixture, CCOE certification for cylinders etc to be done.
5. Signals in Metering Supervisory system & RTU to be verified.
6. Modbus address details to be verified.

3.11 Metering Supervisory system (if applicable):

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1. Availability and installation (in panel) of all hardware like CPU, Monitor, Printers, cables and accessories shall be done.
2. Installation/ operation of all software shall be checked.
3. Serial interface between various Instruments/ equipments (like GC, Flow computers, RTU/SCADA, LEL, printers etc) shall be simulated/ checked.
4. Simulation of communication with RTU/ SCADA shall be done.
5. Checking of Graphics and trends (as per P&ID) for ease of operation and record keeping shall be checked.
6. Simulation of all analog/ digital signals from/ to field (like PT/ DPT/ TT/ flowmeter/ FCV/ SSV status etc) shall be done.
7. Modbus address details to be verified.

3.12 Solar Panel (if applicable):

1. For each stream, check the functional test as per reference Document.
2. No. of Batteries as per Battery sizing Calculation to be checked
3. Output Voltage of each streams shall be recorded.
4. Visual Check: Support for Solar Panel, Battery enclosure/ mounting, Cable, identification

4.0 Spares:

List to be prepared as per P.O. terms/ tender documents for all the mandatory spares, commissioning spares, cables, and materials required for erection. All the spares shall be verified by TPIA during FAT test. All spares shall be identified with proper tags. Foundation bolt and mating flanges shall be checked during FAT.

5.0 Painting: Refer separate QAP for Piping.


6.0 Documents Review:

After completion of all tests, Documents like material test certificates, Radiography test, Hydro-test, calibration/ test reports etc. for Ball valves/ Plug valves/ CRV/ NRV/ PSV/ FCV/ Filters, pipes, fittings, Tee/ elbow/ weld joints, shall be reviewed to check the compliance with the tender specifications and QAP for the equipments / instruments. All the documents shall be signed & stamped by TPI & bidder.

7.0 Annexure to FAT Manual:

Apart from FAT procedure, FAT Manual shall have Annexure which shall include the following:


- a) List of all the loose items with details to be provided by vendor (like Mandatory Spares, commissioning spares, Consumables, Parts of metering skids, Parts of GC analyzer and shed, Parts of Control panel, mating flanges, Gaskets, materials required for installation of skid, Hand held communicators, portable LEL detector, Calibration gas, Printers with its accessories, laptop with its accessories, Connecting and power cable for laptop/ Printers/ peripherals, Earthing strips, Cable Trays, cable glands, plugs, blind flanges, lugs, ferrules, earthing Cables, Mounting Accessories, any other hardware required for establishing various connectivity mentioned elsewhere, Software etc.) to be enclosed as Annexure in the

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FAT Manual for our review/ approval. The items mentioned in the list (Annexure) shall be demonstrated during FAT.

- b) List of all the reports (like calibration reports for various Instruments, test reports for all the equipments, CCOE certificates etc.), with details like Report no., date, description etc shall also be prepared as Annexure of FAT manual. The same shall also be reviewed during FAT

Any discrepancy observed during FAT shall be recorded/ noted in the Action list. Issue of Inspection Release note/ Dispatch clearance shall be subject to compliance of all the FAT Check-list points/ Action list & submission of TPI release note for the complete skid.

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FAT CHECKLIST

VISUAL INSEPCION

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----


Sr. No	POINT INSPECTED	RESULTS FOUND OK
1	Skid checked as per P & ID and GA Drawing	YES / NO
2.	Process parameter in Name Plate	YES / NO
3	Lifting hook	YES / NO
4	Copper jumper for all flanges	YES / NO
5	Earthing Connection at base frame	YES / NO
6	Insulation for Metering system	YES / NO
7	Instrumentation cable connection, cable dressing, cable tray covers and JB mounting installation etc. as per wiring diagram.	YES / NO
8	Identification Tags for cable and all Instruments	YES / NO
9	Painting colour of pipe line	YES / NO
10	Spares as per P.O. requirement	YES / NO
11	Foundation bolt and Matting flanges	YES / NO
12.	Support for all the equipments/ Instruments, Pipe, tubes, Trays	YES / NO
13.	Adequacy of O&M Platform and approachability	YES / NO
14.	Canopy to all transmitters	YES / NO
15.	Operating handles on all valves	YES / NO

Company Representative

TPIA

Client /Mecon Representative

Date:

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FAT CHECKLIST

HYDROTEST OF SKID

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Refer Separate QAP for Piping

Test Pressure : _____ Kg/cm² (g)

Test Media :

Duration :

POINT INSPECTED

RESULT FOUND OK

a) Leak test at flange joints and other connections


YES / NO

Company Representative

TPIA

Client /Mecon Representative

Date:

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FAT CHECKLIST

PNEUMATIC TEST OF SKID

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Refer Separate QAP for Piping

Test Pressure :

Test Media :

Duration :

POINT INSPECTED

Leak test at flange joints and other connections

RESULT FOUND OK


YES / NO

Company Representative

TPIA

Client /Mecon Representative

Date:

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FAT CHECKLIST

DIMENSIONAL INSPECTION

Project : -----
Client : -----
P.O. No : ----- **Dtd.** -----


Sr. No	Parameters Requirement	Result Found
1.	Base Frame Dimension As per Foundation drawing	YES / NO
2.	Height of inlet pipe from base in mm _____	YES / NO
3.	Height of Outlet pipe from base in mm _____	YES / NO
4.	Upstream flow straightener Length in mm _____	YES / NO
5.	Down stream flow straightener Length in mm _____	YES / NO
6.	Location of Thermowell as per AGA 7 / 9	YES / NO
7.	Cable and trays from Metering system to control room ____ meters	YES / NO
8.	Painting thickness of pipe line as per Specifications	YES / NO
9.	Dimension of Control Panel as per Approved Drawing	YES / NO

Company Representative

TPIA

Client /Mecon Representative

Date:

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FAT CHECKLIST

PG, TG & DPG

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----


SR. No.	ITEM	CHECKED		REMARKS
1.	Pressure Gauge (Tag No. : ____)	O Accepted	O Rejected	
2.	Temperature Gauge (Tag No. : ____)	O Accepted	O Rejected	
3.	Differential Pressure Gauge (Tag No. : ____)	O Accepted	O Rejected	

Company Representative

TPIA

Client/Mecon Representative

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FAT CHECK LIST

PRESSURE REGULATION SYSTEM

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----


SR. No.	ITEM	CHECKED		REMARKS
1.	Set Point of PCV (Tag No. : ____) - ____	O Accepted	O Rejected	
2.	Set Point of SSV (Tag No. : ____) - ____	O Accepted	O Rejected	Status – LOCAL, FC/HMI, RTU
3.	Set Point of CRV/PSV (Tag No. : ____) - ____	O Accepted	O Rejected	

Company Representative

TPIA

Client /Mecon Representative

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FAT CHECK LIST

FIELD TRANSMITTERS

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----


SR. No.	ITEM DESCRIPTION	INDICATION CHECKED (LOCAL, FC/HMI, RTU)		REMARKS
1.	Pressure Transmitter (Tag No. : ____)	O Accepted	O Rejected	
2.	Temp. Transmitter (Tag No. : ____)	O Accepted	O Rejected	
3.	Diff Pressure Transmitter (Tag No. : ____)	O Accepted	O Rejected	
4.	Functioning of HART communication of transmitters	O Accepted	O Rejected	

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Client /Mecon Representative

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FAT CHECK LIST

FLOW COMPUTER

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Tag No.: _____


Inspection / Simulation done for	CHECKED/ OBSERVED		REMARKS
Volumetric Flow rate (SCMH)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Totaliser (SCM)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Mass Flow rate (kg/ hr)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Energy Flow rate (Kcal/ hr)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Pipe Line Temperature °C	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Pipe Line Pressure Kg/Cm2g / Bar(g)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Atmospheric pressure entry at site condition	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Base Pressure/ Base Temperature entry	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Configuration check, parameter settings	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
PID controller Analog O/P check	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Functioning of PID loop for FCV by simulation	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Interface data of flow computer with RTU – Measurement by Laptop	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Various Units of measurement (Flow rate, heating value, energy)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Flow computer o/p to SCADA	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
GC data input to Flow computer from SCADA	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
K factors for meter error curves	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Audit trail printout (to be attached)	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Software for flow calculation verification	<input type="radio"/> Accepted	<input type="radio"/> Rejected	

Company Representative

TPIA

Client /Mecon Representative

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FAT CHECK LIST

FLOW CONTROL VALVES

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Tag No.: _____


INSPECTION		CHECKED (LOCAL, FC/HMI, RTU)		REMARKS
Current	Open Position			
4 mA	100 %	O Accepted	O Rejected	
8 mA	75 %	O Accepted	O Rejected	
12 mA	50 %	O Accepted	O Rejected	
16 mA	25 %	O Accepted	O Rejected	
20 mA	0 %	O Accepted	O Rejected	

Company Representative

TPIA

Client /Mecon Representative

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FAT CHECKLIST

CONTROL PANEL

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Type of Skid :

<u>POINT INSPECTED</u>	<u>OBSERVATION/ RESULT FOUND</u>
1) Wiring connection as per wiring diagram	Yes / NO
2) Functional Check as per data sheet	Yes/ NO
3) Hot stand by functionality of Power supply, Modem	Yes/ NO
4) Door alignment	Yes/ NO
5) Dimensions / Drawings	Yes/ NO
6) Painting	Yes/ NO
7) Identification mark/ Tagging (Cable, Instruments)	Yes/ NO
8) Cable Dressing, Plugging of spare holes	Yes/ NO
9) Fan, Tube Light	Yes/ NO
10) Adequacy of Installed spares for future use	Yes/ NO


Remarks (if any):

Company Representative

TPIA

Client /Mecon Representative

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FAT CHECK LIST

FLOW METER

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Tag No.: _____


Inspection / Simulation done for	CHECKED/ OBSERVED		REMARKS
Make/ Model for Flow meter	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Probes installation	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Installation of flowmeter in skid	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Communication with respective Flow computers	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Wet Calibration report	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Software for SOS calculation as per AGA 8	<input type="radio"/> Accepted	<input type="radio"/> Rejected	
Communication ports and its functionality	<input type="radio"/> Accepted	<input type="radio"/> Rejected	

Company Representative

TPIA

Client /Mecon Representative

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FAT CHECK LIST
GAS CHROMATOGRAPH

Project : -----

Client : -----


P.O. No : ----- **Dtd.** -----

Inspection / Simulation done for	CHECKED/ OBSERVED	REMARKS
MAKE/ Model of GC	O Accepted O Rejected	
GC controller/ remote configurator Installation in control panel	O Accepted O Rejected	
Parameter settings/ configuration/ application software loading, default values etc for GC controller/ remote configurator	O Accepted O Rejected	
Probes, Tools for insertion/ removal	O Accepted O Rejected	
Calibration Gas cylinders, carrier gas cylinders, self acting pressure regulator for Cylinders (calibration gas/ carrier gas) with stand, mounting arrangement	O Accepted O Rejected	
Field Analyser with Stand	O Accepted O Rejected	
Composition of calibration gases	O Accepted O Rejected	
Shed for Analyser, Cable for remote configurator/ controller, communication with various devices, instruments, equipments etc	O Accepted O Rejected	
Communication between GC and Laptop and GC data simulation	O Accepted O Rejected	
Simulation of GC data input to Flow computer, Metering supervisory system and RTU/ SCADA and via GSM modem	O Accepted O Rejected	
Functionality/ simulation of communication ports for communication with flow computers, Laptop, Metering supervisory system, RTU/ SCADA, Printers,	O Accepted O Rejected	
Interface of GC with RTU/ SCADA, Flow computers, LAPTOP, Printer, Metering supervisory system etc	O Accepted O Rejected	
Calibration methods, Various Units of measurement (heating value/ energy)	O Accepted O Rejected	
Communication with RTU/ SCADA	O Accepted O Rejected	
GC data input to Flow computer through SCADA	O Accepted O Rejected	
Calibration run for GC	O Accepted O Rejected	
Chromatogram for 3 consecutive runs	O Accepted O Rejected	

Company Representative
Date:

TPIA

Client /Mecon Representative

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FAT CHECK LIST

METERING SUPERVISORY SYSTEM

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----


Inspection / Simulation done for	CHECKED/ OBSERVED	REMARKS
MAKE/ Model of PC, Printer and other peripherals	O Accepted O Rejected	
Installation of PC, Printer and other peripherals in control panel	O Accepted O Rejected	
Application software loaded in system and license	O Accepted O Rejected	
Development of Graphics, Alarm summary etc as per P&ID	O Accepted O Rejected	
Simulation of Field signals (analog and digital)	O Accepted O Rejected	
Functionality/ simulation of communication for communication with flow computers, Laptop, Metering supervisory system, RTU/ SCADA, Printers, GC etc.	O Accepted O Rejected	
Licensed copy of HMI software	O Accepted O Rejected	

Company Representative

TPIA

Client /Mecon Representative

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FAT CHECKLIST

SOLAR PANEL

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

POINT INSPECTED

OBSERVATION/ RESULT FOUND

- | | |
|---|-----------------|
| 1) Functional check of Solar panel in stream No._____ | Yes / NO |
| 2) Output Voltage _____ VDC in stream No._____ | Yes/ NO |
| 3) No. of _____(Ah) Batteries per stream _____ | Yes/ NO |
| 4) Identification mark/ tagging | Yes/ NO |
| 5) Adequacy of the Solar panel system mounting arrangement, fittings, requires cable and other hardware | Yes/ NO |


Remarks (if any):

Company Representative

TPIA

Client /Mecon Representative

Date:

MECON LIMITED DELHI	FAT PROCEDURE / FAT MANUAL FOR METERING SKIDS		
INSTRUMENTATION SECTION	Doc. No: MEC/05/E5/FAT- 030A		
	Rev. 1	Page 23 of 24	

FAT CHECKLIST

ACTION LIST

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

Type of Skid :


Sr. No.	Description	Action By
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

Company Representative

TPIA

Client /Mecon Representative

Date:

MECON LIMITED DELHI	FAT PROCEDURE / FAT MANUAL FOR METERING SKIDS		
INSTRUMENTATION SECTION	Doc. No: MEC/05/E5/FAT- 030A		
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FAT CHECK LIST
REVIEW OF DOCUMENTS

Project : -----

Client : -----

P.O. No : ----- **Dtd.** -----

SR. No.	DOCUMENTS REVIEWED	CHECKED	REMARKS
1.	Radiography Test for all items of skid (as per List prepared by vendor and attached as Annexure)	O Accepted O Rejected	
2.	Dye Penetration Test for all items of skid (as per List prepared by vendor and attached as Annexure)	O Accepted O Rejected	
3.	Test Certificate (for Filtration system, Slam Shut valves, Pressure Regulator (PCV), PSV, CRV, FCV, NRV, Flow profiler, Flow meter, Isolation Ball Valves, Plug valves, Flow computer, PT, DPT, TG, PG, DPG, Thermo-well, RTD, TT, LEL detection system, GC, metering supervisory system, Control panel, JBs, Pipe spools etc.), CCOE/ATEX certificates, Type approvals	O Accepted O Rejected	
3.	Hydro test for all items of skid (as per List prepared by vendor and attached as Annexure)	O Accepted O Rejected	
4.	Material test Report for all items of skid (as per List prepared by vendor and attached as Annexure)	O Accepted O Rejected	
5.	Certification as per 3.2 for all Pressure Equipments (as per List prepared by vendor and attached as Annexure)	O Accepted O Rejected	
6.,	Calibration Report for PG, TG, DPG, PT, DPT, TT, PSV, CRV, Flow Computer, GC, flowmeter, LEL sensors, LEL detection system, Calibration Gas (for FC & LEL) AND Test report for SSV, PCV.	O Accepted O Rejected	
7.	Welding Procedure Specification, Welder qualification.	O Accepted O Rejected	
8.	Configuration Sheet for Flow computers, GC	O Accepted O Rejected	
9.	Compliance Certification for Painting of skid including all items (Filtration system, PRS, Valves, PSVs, CRVs etc) and control panel	O Accepted O Rejected	
10.	Material Correlation Chart & Welding Joints Correlation Chart	O Accepted O Rejected	

Company Representative

TPIA

Client /Mecon Representative

Date:

ANNEXURE - VIII

STANDARD SPECIFICATIONS

Standard Specifications


- | | | |
|-----|---|-------------------------|
| 1. | Technical specification of Cartridge Filter | MEC/TS/05/62/017, Rev-1 |
| 2. | Specification of Assorted Pipe | MEC/TS/05/62/59A, Rev-0 |
| 3. | Technical Specification of Pressure Safety Valve | MEC/TS/05/62/056, Rev-1 |
| 4. | Specification for Seamless Fittings & Flanges up to 400 mm (16") NB | MEC/TS/05/21/025, Rev-0 |
| 5. | Specification for Gaskets, Nuts and Bolts | MEC/S/05/21/19, Rev-0 |
| 6. | Specification for Piping, Fabrication and Erection | MEC/S/05/21/06, Rev-0 |
| 7. | Specification for Vents, Drains and Wells, Pressure tapping | MEC/S/05/21/15, Rev-0 |
| 8. | Specification for Flushing and Testing | MEC/S/05/21/11, Rev-0 |
| 9. | Technical Specification for Ball Valve | MEC/TS/05/21/002, Rev-1 |
| 10. | Technical Specification for Plug Valve | MEC/TS/05/62/003, Rev-2 |
| 11. | Technical Specification for Check Valve | MEC/TS/05/62/004, Rev-2 |
| 12. | Specification For Shop & Field Painting | MEC/S/05/21/07, Rev-0 |
| 13. | Specification for Installation of Instruments | MEC/S/05/26/01, Rev-0 |
| 14. | Specification for Instrument Tubing | MEC/S/05/26/02, Rev-0 |
| 15. | Specification for Inlet, Outlet Sections and Flow Straightner | MEC/S/05/26/03, Rev-0 |
| 16. | Specification for Instrument Tube Fittings | MEC/S/05/26/04, Rev-0 |
| 17. | Specification for Instrument Valves and Manifolds | MEC/S/05/26/05, Rev-0 |
| 18. | Specification for Junction Boxes and Cable Glands | MEC/S/05/26/06, Rev-0 |
| 19. | Specification for Signal Cable | MEC/S/05/26/07, Rev-0 |
| 20. | General Technical Specification for Instrumentation | MEC/S/05/26/08, Rev-0 |
| 21. | Specification for Cabling | MEC/S/05/E5/21, Rev-0 |
| 22. | Specification for Earthing | MEC/S/05/26/23 A, Rev-0 |

TECHNICAL SPECIFICATION
FOR
CARTRIDGE FILTER & ACCESSORIES
(Dry Gas Filters)

SPECIFICATION NO. : MEC/TS/05/62/017, Rev-2




MECON LIMITED
DELHI - 110 092

MECON LIMITED REGD. OFF RANCHI	PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION CARTRIDGE FILTER	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/017		REV-2	Page 1 of 10

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REVISION	PREPARED BY	CHECKED BY	APPROVED BY

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1.0 **GENERAL**

1.1 This specification outlines the minimum requirements under which the manufacturer shall design, manufacture, test and supply Cartridge Filter for separating solid contaminants from the gas stream.

2.0 **SCOPE OF SUPPLY**


2.1 The vendor's scope of supply shall be Cartridge Filter alongwith accessories complete in all respects as per data sheet enclosed. The detailed scope of work is as follows :

The filters shall comprise of the following :

- Filter vessel alongwith necessary filtering cartridge.
- Necessary nozzles, companion flanges, blind flanges (with nuts, bolts, gaskets etc.) on the filter vessel as specified in the data sheets.
- Cartridge supporting arrangement inside the vessel.
- Quick opening closure for maintenance and filter element replacement.
- Instruments, viz. PSV as per Instrumentation inputs.
- Necessary supports for filter vessel.
- Cleats for platforms and ladders.
- Foundation bolts & base plate for embedding/ grouting into civil foundation.
- Documents clause 10, 11 & elsewhere in spec.
- Spare parts for two years normal operation.

3.0 **SCOPE OF SERVICES**

- Engineering, design and manufacturing.

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- Procurement of raw materials etc. from sub-vendors.
- Preparation and submission of documentation for design approval by purchaser/consultant.
- Inspection and testing as per T.S.
- Surface preparation, protective coating and painting as per T.S.
- Packaging for transportation to site and supply.

4.0 **DESIGN**

4.1 Following codes & standards (latest edition) shall be followed for design, manufacture, testing etc. of the equipment.


ASME Sec-VIII Div-1	:	Boiler and Pressure Vessel Code
ASME Sec-IX	:	Welding and Brazing Qualifications
ASME Sec-II & ASTM	:	Material Specifications
ANSI B16.5	:	Pipe Flanges & Pipe Fittings
ANSI B16.1	:	Forged Steel Fittings Socket Welded & Threaded
ASME B16.47	:	Large Diameter Steel Flanges
ANSI B36.10	:	Welding & Seamless Wrought Steel Pipe.

4.2 For purpose of material selection national code of the country of origin shall also be acceptable provided the vendor specifically establishes, to the satisfaction of the purchaser, the equivalence or superiority of the proposed material with respect to those specified.

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5.0 **TECHNICAL REQUIREMENTS**

- 5.1 The cartridge shall be from approved make.
- 5.2 Filter elements must withstand a pressure of 1.0 kg/cm²(g) without breaking or failure.
- 5.3 At least 300mm space from bottom tangent line to be provided.
- 5.4 Filtering efficiency shall be as per enclosed data sheet.
- 5.5 Particle size shall be as indicated in the data sheets.
- 5.6 The end closure to be high pressure quick release type interlock to open only when vessel is completely depressurised.
- 5.7 Filter element should be suitable for specified mole% of CO₂.
- 5.8 Core of filter element shall be of SS material.
- 5.9 A davit/ hinged arrangement shall be provided for the closure for convenient handling. The closure shall have perfect sealing arrangement to prevent leakage.
- 5.10 The equipment shall be of the type as mentioned in the data sheets and shall meet the duty requirements and performance parameters as mentioned therein.
- 5.11 Vendor shall submit calculations for sizing of the equipment together with all supporting documents/ catalogues/ nomographs etc. with the bid. The type, model and number of cartridge shall be selected based on allowable pressure drop and supplier's recommendation. The total internal cross sectional area of mounted cartridge shall not be less than inlet nozzle area for inlet size upto 150 NB. The calculation for the selected number of cartridge shall be furnished, alongwith the bid.

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5.12 Suitable baffle plates shall be provided in the vessels for proper fluid flow distribution. Vessel diameter shall be minimum twice the diameter of inlet nozzle. All internal nuts and bolts shall be of stainless steel irrespective of material of construction of vessel.

5.13 All nozzles/ pipes on the vessel shall be of seamless construction. All nozzle less than or equal to 50 NB size shall be provided with 2 Nos., 6mm thick stiffeners at 90 degree to each other. All nozzles above 80 NB size, shall be provided with reinforcement pads.

5.14 All flanges shall be WNRF except DPT connection which is to be socket welded.

5.15 Dimensions of flanges including shell flanges, blind head cover flanges, nozzle flanges and blind flanges shall be as per ANSI B16.5. Larger flanges shall be as per ANSI B16.47.

5.16 Pressure parts joined by butt welds shall be with full penetration welds. Where both sides welding is not accessible, root run by tungsten inert gas process or backing strip, shall be used to ensure full penetration. Backing strip if used, shall be removed after welding.


5.17 Vessels shall be post weld heat treated, whenever it is required due to service requirement or due to code requirements. Vessels shall be post weld heat treated as a complete unit and no welding shall be permitted after the post weld heat treatment is completed.

5.18 For vessels in stainless steel construction, lower allowable stress values shall be considered as per ASME Code for their design.

5.19 Filter vessel shall be provided with lifting and earthing lugs. Fire proofing and insulation supports shall be provided if indicated in data sheet.

6.0 **INSPECTION AND TESTING**

6.1 Equipment shall be subjected to stage wise expediting, inspection and testing at vendor's/ sub-vendor's works by purchaser/ its authorised inspection agency. Vendor shall submit Quality Assurance (QA) procedures before commencement of fabrication. Approved QA procedures shall form the basis for equipment inspection.

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6.2 Testing at vendor's works shall include but not limited to the following:

- Non destructive tests such as radiography, dye penetration tests.
- Hydrostatic test at 150% of design pressure for the vessel.
- Any other tests as per data sheets/ standards/ codes.

6.3 Any or all the tests, at purchaser's option, shall be witnessed by purchaser/ its authorised inspection agency. However, such inspection shall be regarded as check-up and in no way absolve the vendor of this responsibility.

6.4 Extent of radiography shall be 100%.

7.0 **PROTECTION AND PAINTING**

7.1 All exposed carbon steel parts to be painted shall be thoroughly cleaned from inside and outside to remove scale, rust, dirt and other foreign materials by wire brushing and sand blasting as applicable. Minimum acceptable standard in case of power tool cleaning shall be St. 3 and incase of blast cleaning shall be Sa 2½ as per Swedish Standard SIS 0055900.


7.2 Non-ferrous materials, austenitic stainless steels, plastic or plastic coated materials, insulated surfaces of equipment and pre-painted items shall not be painted.

7.3 Stainless steel surfaces both inside and outside shall be pickled and passivated.


7.4 Machined and bearing surfaces shall be protected with varnish or thick coat of grease.

7.5 Depending on the environment, following primer and finish coats shall be applied.

	<u>Environment</u>	<u>Description</u>
i)	Normal Industrial	Surface Preparation : Sa 2½
		Primer : 2 coats of Redoxide zinc chromate each 25 microns (min.) thick.

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		Finish Coat	:	2 coats of synthetic enamel, each 25 microns (min.) thick.
ii)	Corrosive Industrial	Surface Preparation	:	Sa 2½
		Primer	:	2 coats of Epoxy zinc chromate each 35 microns (min.) thick.
		Finish Coat	:	2 coats of Epoxy high build paint each 100 microns (min.) thick.
iii)	Coastal and Marine	Surface Preparation	:	Sa 2½
		Primer	:	2 coats of high build Chlorinated Rubber zinc phosphate, each 50 microns (min.) thick.
		Finish	:	2 coats of chlorinated rubber paint, each 35 microns (min.) thick.
iv)	All Environment (temp. 80-400°C)	Surface Preparation	:	Sa 2½
		Finish	:	2 coats of heat resistant aluminium paint suitable for specified temp. each 20 μ thick. (All values refer to dry film thickness).
7.6	The colour of finish coat shall be intimated to vendor after placement of order.			
8.0	<u>PACKAGING AND IDENTIFICATION</u>			
8.1	All packaging shall be done in such a manner as to reduce the volume. The equipment shall be dismantled into major components suitable for shipment and shall be properly packed to provide adequate protection during shipment. All assemblies shall be properly match marked for site erection.			

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8.2 Attachments, spares parts of the equipment and small items shall be packed separately in wooden-cases. Each item shall be appropriately tagged with identification of main equipment, its denomination and reference number of the respective assembly drawing.

8.3 Detailed packing list in water-proof envelope shall be inserted in the package together with equipment.

8.4 Each equipment shall have an identification plate giving salient equipment data, make, year of manufacture, equipment number, name of manufacturer etc.

9.0 **SPARE PARTS**

9.1 Vendor shall submit his recommended list of spare parts for two years with recommended quantities and operation of the equipment. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment will be facilitated.

9.2 Recommended spares and their quantities should take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, parts and availability of vendor's service facilities around proposed location of equipment.

9.3 Vendor shall also submit a list of recommended commissioning spares with quantities.


10.0 **INFORMATIONS/ DOCUMENTS/ DRAWINGS TO BE SUBMITTED WITH THE OFFER**

Contractor shall submit with the offer four copies each of the following:

10.1 Manufacturer's complete descriptive and illustrative catalogue/ literature.

10.2 The completion schedule activity wise.


10.3 In case of failure to submit the documents listed above, the offer may be rejected.

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11.0 **INFORMATION/ DOCUMENTS/ DRAWINGS TO BE SUBMITTED BY SUCCESSFUL VENDOR**

Successful vendor shall submit six copies unless noted otherwise, each of the following :

- 11.1 Inspection & test reports for all mandatory tests as per the applicable code. Test reports for any supplementary tests, in nicely bound volumes.
- 11.2 Material test certificates (physical) property, chemical composition, make, heat treatment report etc.) as applicable for items in nicely bound volumes.
- 11.3 Statutory test certificates, as applicable.
- 11.4 Filled in QAP for Owner's/ Consultants approval. These QAP's shall be submitted in four copies.
- 11.5 WPS & PQR, as required.
- 11.6 Within two(2) weeks of placement of order, the detailed fabrication drawings alongwith mechanical design calculations for Owner's/ Consultants approval. These drawings shall be submitted in four copies.
- 11.7 Detailed completion schedule activity wise, within one week of placement of order.
- 11.8 Weekly & fortnightly progress reports for all activities including procurement.
- 11.9 Purchase orders of bought out items soon after placement of order.
- 11.10 Manufacturer's drawings for bought out items, in 4 copies, for Owner's/ Consultant approval within 4 weeks.
- 11.11 Manufacturer related information for design of civil foundation & other matching items within 6 weeks of LOI.

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11.12 All approved drawings/ documents as well as inspection and test reports for Owner's/ Consultants reference/ record in nicely category wise bound volumes separately.

Note: All drawings, instructions, catalogues, etc. shall be in English language and all dimensions shall be metric units.

12.0 **ORDER OF PRECEDENCE**

The following order of precedence shall govern in interpretation of various requirements and data :

- Data Sheets
- This Specification
- Codes & Standards
- Vendors Standards


PROCESS & PIPING DESIGN SECTION
MECON LIMITED
DELHI 110 092



मेकॉन

TECHNICAL SPECIFICATION
FOR
ASSORTED PIPES


SPECIFICATION NO. : MEC/TS/05/62/59A, R-0

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR ASSORTED PIPES	 मेकॉन
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Prepared By :	Checked By :	Approved By :
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MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR ASSORTED PIPES	 मेकॉन
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/59A		REV-0	PAGE 2 OF 9

1.0 **GENERAL**

1.1 All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydrotest and other testing and marking requirements shall conform to the latest codes and standards specified in the Material Requisition (MR). Deviation(s), if any, shall be clearly highlighted in the offer.

1.2 **Testing**

1.2.1 Test reports shall be supplied for all mandatory tests as per the applicable material specifications. Test reports shall also be furnished for any supplementary tests as specified in the MR & Clauses 1.10 & 1.11.

1.2.2 Material test certificates (physical property, chemical composition & treatment report) shall also be furnished for the pipes supplied.

1.3 **Manufacturing Processes**


1.3.1 Steel made by Acid Bessemer Process shall not be acceptable.

1.3.2 All longitudinally welded pipes other than IS:3589 should employ automatic welding.

1.4 Pipe shall be supplied in single or double random length of 4 to 7 and 7 to 14 meters, respectively.

1.5 a) Seamless and E.R.W. pipes shall not have any circumferential seam joint in a random length. However, in case of E.FS.W. pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted. This weld shall be at least 2.5 m from either end. The longitudinal seams of the two portions shall be staggered by 90°. Single random length in such cases shall be 5 to 7m.

b) Unless otherwise mentioned in the respective material code, E.FS.W. pipes < 36" shall not have more than one longitudinal seam joint and E.FS.W. pipes ≥ 36" shall not have more than two longitudinal seam joints.

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- 1.6 Pipe with screwed ends shall have NPT external taper pipe threads conforming to ASME/ ANSI B1.20.1 upto 1.5" NB & IS:554 for 2" to 6" NB.
- 1.7 Pipe with bevelled ends shall be in accordance with ASME B16.25. Weld contours shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22mm	Figure 2 Type A
	> 22mm	Figure 3 Type A
Alloy Steel Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	>10 mm & Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A


- 1.8 Gavanished pipes shall be coated with zinc by hot dip process conforming to IS:4736/ ASTM A 153.
- 1.9 All austenitic stainless steel pipes shall be supplied in solution annealed condition.
- 1.10 **I.G.C. Test for Stainless Steels**
- 1.10.1 For all austenitic stainless steel pipes, intergranular corrosion test shall have to be conducted as per following:

ASTM A262 practice " B " with acceptance criteria of "60 mils/ year (max.)"

OR

ASTM 262 practice " E" with acceptance criteria of " No cracks as observed from 20X magnification" & "Microscopic structure to be observed from 250X magnification".

- 1.10.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg.SS 309, 310, 316, 316H etc.), ASTM A262 practice "C" with acceptance criteria of "15 mils/ year (max.)" shall have to be conducted.
- 1.10.3 For the IGC test as described in 1.10.1 & 1.10.2, two sets of samples shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and the other corresponding to the highest pipe

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thickness. When testing in is conducted as per Practice "E", photograph of microscopic structure shall be submitted for record.

- 1.11 All welded pipes indicated as 'CRYO' & 'LT' in MR shall be impact tested per requirement and acceptance criteria of ASME B31.3. The impact test temperature shall be -196°C & -45°C for stainless steel and carbon steel, respectively, unless specifically mentioned otherwise in MR.
- 1.12 Pipes under 'NACE' category shall meet the requirements given in MR-01-75.
- 1.13 Specified heat treatment for carbon steel & alloy steel and solution annealing for stainless steel pipes shall be carried out after weld repairs. Number of weld repairs at the same spot shall be restricted to maximum two by approved repair procedure.
- 1.14 For black or galvanised pipes to IS:1239, the minimum percentage of elongation shall be 20%.

2.0 **IBR PIPES**


2.1 **IBR Documentation**

- 2.1.1 Pipes under purview of IBR shall be accompanied with IBR certificate original in Form IIIA, duly approved and countersigned by IBR authority/ local authority empowered by the Central Boiler Board of India. Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.
- 2.1.2 For materials $1\frac{1}{4}\text{Cr}-\frac{1}{2}\text{Mo}$ (ASTM A335 Gr. P11/ A691 Gr. $1\frac{1}{4}\text{Cr}$) & $2\frac{1}{4}\text{Cr}-1\text{Mo}$ (ASTM A335 Gr.P22/ A691 Gr. $2\frac{1}{4}\text{Cr}$.), from III-A approved by IBR shall include the tabulation of E_t , S_c & S_r values for the entire temperature range given below. E_t , S_c & S_r values shall be such that throughout the temperature range

$$\begin{aligned} E_t / 1.5 & \geq \\ S_r / 1.5 & \geq S_a \\ S_c & \geq \end{aligned}$$

where,

- S_A : Allowable stress at the working metal temperature.
 E_t : Yield point (0.2% proof stress at the working metal temperature).

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- S_c : The average stress to produce elongation of 1% (creep) in 1,00,000 hrs at the working metal temperature.
- S_r : The average stress to produce rupture in 1,00,000 hrs. at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

S_A (psi)	Temperature (°F)											
	500	600	650	700	750	800	850	900	950	1000	1050	1100
A335 Gr. P11	17200	16700	16200	15600	15200	15000	14500	12800	9300	6300	4200	2800
A 691 Gr. 1½ Cr	18900	18300	18000	17600	17300	16800	16300	15000	9900	6300	4200	2800
A335 Gr. P2/ A691 Gr. 2 ¼ Cr	17900	17900	17900	17900	17900	17800	14500	12800	10800	7800	5100	3200

Note: S_A values given above are as per ASME B31.3-1999. Values shall be as per the latest edition prevailing.

2.2 For carbon steel pipes under IBR, the chemical composition shall conform to the following;

- Carbon (max.) : 0.25%
- Others (S, P, Mn) : As prescribed in IBR regulation.

The chemical composition as indicated in this clause is not applicable for pipes other than IBR services.

3.0 **HYDROSTATIC TEST**


Refer Annexure – I.

4.0 **MARKING AND DESPATCH**


4.1 All pipes shall be marked in accordance with the applicable codes, standards and specifications. In addition, the purchase order number, the item code & special conditions like "IBR", "CRYO", "NACE", etc., shall also be marked.

4.2 Pipes under "IBR", "CRYO", & "NACE" shall be painted in red stripes, light purple brown stripes & canary yellow stripes, respectively, longitudinally throughout the length for easy identification.

4.3 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating.

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- 4.4 Pipes shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.
- 4.5 Pipes shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.
- 4.6 Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.
- 4.7 Both ends of the pipe shall be protected with the following material:
- | | | |
|--------------|---|-------------------------------|
| Plain end | : | Plastic cap |
| Bevel end | : | Wood, Metal or Plastic cover |
| Threaded end | : | Metal or Plastic threaded cap |
- 4.8 End protectors to be used on bevelled ends shall be securely and tightly attached with belt or wire.
- 4.9 Steel end protectors to be used on galvanised pipes shall be galvanised.

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ANNEXURE-I

3.0 **HYDROSTATIC TEST**

3.1 All pipes shall be hydrostatically tested.

3.2 The mill test pressure shall be as follows:

3.2.1 **Seamless, E.R.W. & Spiral Welded**

a) Carbon Steel

Material Standard	Test Pressure Standard
ASTM A 106 Gr. B	ASTM A 530
API 5L Gr. B, Seamless	API 5L
API 5L, E.R.W.	API 5L
API 5L, Spiral	API 5L
ASTM A333 Gr.3 & 6, Seamless	ASTM A 530
ASTM A 333 Gr. 3 & 6, E.R.W.	ASTM A 530

b) Seamless Alloy Steel


Material Standard	Test Pressure Standard
ASTM A335 GR.P1, P12, P11, P22, P5, P9	ASTM A 530
ASTM A268 TP 405, TP410	ASTM A530

c) Seamless Stainless Steel

Material Standard	Test Pressure Standard
ASTM A312 Gr.TP304, 304L, 304H, 316, 316L, 316H, 321, 347	ASTM A 530

d) Seamless Nickel Alloy

Material Standard	Test Pressure Standard
ASTM B161 UNS No.2200	ASTM B161
ASTM B165 UNS No.4400	ASTM B165
ASTM B167 UNS No.6600	ASTM B167
ASTM B407 UNS No.8800	ASTM B407

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e) Welded Nickel Alloy

Material Standard	Test Pressure Standard
ASTM B725 UNS No.2200, 4400	ASTM B725
ASTM B517 UNS No.6600	ASTM B517
ASTM B514 UNS No.8800	ASTM B514

3.2.2

Electric Fusion Welded

a) Carbon Steel & Alloy Steel E.FS.W. (16" & above)

Material Standard	Test Pressure Standard
API 5L Gr.B ASTM A 671 Gr.CC65, 70 (Cl.32) ASTM A 672 Gr.C60, 65, 70 (Cl.12,22) ASTM A 671 Gr.CF60, 65, 66, 70 (Cl.32) ASTM A 691 Gr. ½ Cr, 1Cr, 1 ¼Cr, 2 ¼Cr, 5Cr, 9Cr (Cl.42)	P=2ST/ D S=90% of SMYS (except for API 5L Gr.B) S=85% of SMYS for API 5L Gr.B T=Nominal Wall Thickness D=O.D. of Pipe


b) Stainless Steel E.FS.W. (2" to 6")

The hydrostatic test pressure in kg/ cm² for the following materials shall be as given below:

Material Gr.1: ASTM A312 TP304/ 304H/ 316/ 316H/ 321/ 347 welded

Material Gr.2: ASTM A312 TP 304L/ 316L welded

Size	Pipe Schedule: S10		Pipe Schedule : S40		Pipe Schedule : S80	
	Material Gr.1	Material Gr.2	Material Gr.1	Material Gr.2	Material Gr.1	Material Gr.2
2"	100	80	155	130	230	190
3"	80	60	155	130	230	190
4"	80	50	155	130	230	190
6"	65	35	90	75	155	130

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c) Stainless Steel E.FS.W. (8" and above).

Material Standard	Test Pressure Standard
ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 1, 3 & 4)	P = 2ST/D S = 85% of SMYS T = Nominal Wall Thickness D = O.D. of Pipe
ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 2 & 5)	P = 2ST/D S = 72% of SMYS T = Nominal Wall Thickness D = O.D. of Pipe

3.2.3

Carbon Steel Pipes to IS Standards


Material Standard	Test Pressure Standard
IS :1239	IS :1239
IS :3589	IS :3589

PROCESS & PIPING DESIGN SECTION
MECON LIMITED
DELHI – 110 092



TECHNICAL SPECIFICATION
FOR
PRESSURE SAFETY VALVES

SPECIFICATION NO. : MEC/TS/05/62/056, Rev-1


MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PRESSURE SAFETY VALVES	
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Revision No.	Date	Revised by	Checked by	Approved by
1		K.P. Singh	A.K. Johri	Niraj Gupta


PREPARED BY : K.P. SINGH	CHECKED BY : A.K. JOHRI	APPROVED BY : NIRAJ GUPTA
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TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/056		REV-1	Page 2 of 9

1.0	<u>GENERAL</u>
1.1	Scope
1.1.1	This specification together with the attached data sheets covers the requirements for the design, materials, nameplate marking, testing and shipping of pressure safety valves.
1.1.2	The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry :
	ASME B 1.20.1 : Pipe threads
	ASME B 16.5 : Pipe flanges and flanged fittings
	ASME B 16.20 : Ring joint gaskets and grooves for steel pipe flanges
	ASME Sec.VIII : Boiler & pressure vessels codes for unfired pressure vessel
	API RP 520 (Part-I & II) : Sizing, selection and installation of pressure relieving devices in refineries
	API RP 521 : Guide for pressure relieving and depressurising systems
	API 526 : Flanged steel safety-relief valves
	API 527 : Commercial seat tightness of refineries relief valve with metal to metal seats
	DIN 50049 : Document on material testing
	IBR : Indian boiler regulations
1.1.3	In the event of any conflict between this specification, data sheets, related standards, codes etc, the Vendor should refer the matter to the Purchaser for clarifications and only after obtaining the same, should proceed with the manufacture of the items in question.
1.1.4	Purchaser's data sheets indicate the selected valve's relieving area, materials for the body, bonnet, disc, nozzle, spring, indicative inlet/outlet connection sizes, bellows etc. However, this does not relieve the Vendor of the responsibility for proper selection with respect to the following :

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a) b)	Sizing calculations and selection of valve with proper relieving area to meet the operating conditions indicated. Selection of materials for all parts of the valve suitable for the fluid and its conditions indicated.
1.1.5	All process-wetted parts, metallic and non-metallic, shall be suitable for the fluids and service specified by the Purchaser. The service gas composition shall be as given in Annexure-I.
1.2	Bids
1.2.1	Vendor's quotation shall include a detailed specification sheet for each pressure safety valve which shall provide all the details regarding type, construction materials, relieving area, relieving capacity, orifice letter designation, overpressure, blowdown, operating pressure, etc., and any other valve accessories.
1.2.2	All the units of measurement for various items in the Vendor's specification sheets shall be to the same standards as those in Purchaser's data sheets.
1.2.3	All the material specifications for various parts in the Vendor's specification sheets shall be to the same standards as those in Purchaser's data sheets.
1.2.4	Deleted.
1.2.5	Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of pressure safety valve covered in the bid.
1.2.6	Vendor's quotation, catalogues, drawings, operating and maintenance manual, etc., shall be in English.
1.2.7	Vendor's quotation shall include detailed sizing calculation for each pressure safety valve. Published data for certified discharge coefficient and certified flow capacities and actual discharge area shall be furnished. Data used by Vendor without the above mentioned supported documentation shall, on prima-facie basis, be rejected.
1.2.8	All valves shall have been type tested for capacity as per ASME. A copy of the certificate shall be provided.
1.2.9	Vendor shall also quote separately for the following : a) Two years recommended operational spares for each pressure relief valve and its accessories. List of such spares without price shall be indicated along with technical bid and separately with price. b) Any specific tools needed for maintenance work.

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1.2.10 Vendor's quotation shall include general arrangement and sectional drawings showing all features and major parts with reference numbers and material specification.

IMPORTANT

The drawings to be submitted alongwith the bid shall be in total compliance with the requirement of technical specification and data sheets of the valves with no exception & deviation.

1.2.11 Vendor's quotation shall include Quality Assurance Plan (QAP) enclosed with this tender duly signed, stamped & accepted.

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues required from the Vendor are indicated by the Purchaser in this specification. The required number or reproducibles and prints should be dispatched to the address mentioned, adhering to the time limits indicated.


1.3.2 Within two weeks of placement of order, Vendor shall submit six copies of certified drawings and specification sheets for each pressure safety valve for Purchaser's final approval. These documents shall specially include the following :

- a) Flange face to face dimension.
- b) Height of the complete valve assembly.
- c) Weight of the complete valve assembly.
- d) Cold bench set pressure for the valve to be tested at atmospheric temperature and back pressure.
- e) The cold test medium to be used for bench test in case it is different from air.
- f) Horizontal reaction force at center line of valve outlet.
- g) Relieving capacity of the valve under the same operating conditions.
- h) Over pressure and blowdown/ reclosing pressure for each valve.

1.3.3 Vendor shall provide test certificates for all the tests indicated in clause 5.0 of this specification. In addition Vendor shall provide the Manufacturer's certificate of conformity to Purchaser's specifications as per clause 2.2 of Din 50049.

1.3.4 Within 30 days from the approval date, Manufacturer shall submit to Purchaser one reproducible and six copies of the approved drawings, documents and specifications as listed in clause 1.3.2 above.

1.3.5 Prior to shipment, Manufacturer shall submit one reproducible and six copies of the following:

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- a) Test certificates for all the tests indicated in clause 5.0 of this specification.
- b) Manual for installation, erection, maintenance and operation instructions, including a list of recommended spares for the valves.

2.0 **VALVE SIZING**

2.1 Sizing shall be carried out using the formulae mentioned in the following standards, whenever the sizing code mentioned in the Purchaser's data sheets refers to them:

Sizing Code	Standard
API	API RP 520 Part-I
ASME	ASME boiler and pressure vessel code section VIII titled - Unfired pressure vessels
IBR	Indian Boiler Regulations Paragraph – 293

2.2 Discharge co-efficient of Vendor's pressure safety valves shall be minimum 0.975 as per API – 520. However, for valves covered under IBR, regulations of IBR shall govern.

2.3 For flanged pressure safety valves, the orifice letter designation and the corresponding relieving area indicated in the Purchaser's data sheet shall be as per API 526. For a valve of given inlet and outlet sizes and letter designation, relieving area of the valves offered by Vendor shall meet those in API-526, as a minimum.

2.4 The discharge capacity of selected pressure safety valves shall be calculated based on certified ASME capacity curves or by using ASME certified discharge coefficient and actual orifice area. Higher valve size shall be selected in case pressure relief valve discharge capacity is less than the required flow rate.


2.5 The definitions of various terminologies used in Purchaser's data sheets are as per paragraph 3.1 of API RP 520 Part-I.

3.0 **VALVE CONSTRUCTION**


3.1 **Body**

3.1.1 Unless otherwise mentioned end connection details shall be as below :-


- a) Threaded end connections shall be to NPT as per ASME B 1.20.1.
- b) Flanged end connections shall be as per ASME B 16.5.

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	<p>c) Flanged face finish shall be serrated concentric to paragraphs 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ASME B 16.5. The face finish as specified in data sheets, shall have serrations as follows.</p> <p style="padding-left: 40px;"> Serrated : 250 to 500 microinches AARH 125 AARH : 125 to 200 microinches AARH 63 AARH : 32 to 63 microinches AARH </p> <p>3.1.2 For flanged valves, inlet and outlet sizes & ratings and center to flange face dimensions shall be in accordance with API-526. Dimensional tolerances shall be as mentioned therein.</p> <p>3.1.3 Body drain with a plug shall be provided as a standard feature on every pressure safety valve.</p> <p>3.2 Trim</p> <p>3.2.1 The term `trim' covers all the parts of the valves exposed to and in contact with the process fluid except for the body and bonnet assembly.</p> <p>3.2.2 Valves shall in general be of the full nozzle full lift type, unless otherwise specified.</p> <p>3.2.3 Wherever stelling of disc and nozzle has been specified, it stands for stelling of the seat joint and the entire disc contour, unless otherwise mentioned.</p> <p>3.2.4 Resilient seat/ seal or `O' rings wherever used shall be suitable for pressure and temperature conditions specified.</p> <p>3.3 Bonnet and Spring</p> <p>3.3.1 All valves shall be provided with a cap over the adjusting bolt.</p> <p>3.3.2 Lifting lever shall be provided whenever the fluid to be relieved is steam or air.</p> <p>3.3.3 Valve spring design shall permit an adjustment $\pm 5\%$ of the set pressure as a minimum.</p> <p>3.3.4 Carbon Steel spring shall be cadmium/ nickel plated.</p> <p>3.3.5 The allowable tolerances in set pressures are as below :</p> <p style="padding-left: 40px;"> $\pm 0.14 \text{ kg/cm}^2(\text{g})$ for set pressures upto and including $5 \text{ kg/cm}^2(\text{g})$; $\pm 3\%$ for set pressure above $5 \text{ kg/cm}^2(\text{g})$. </p> <p>3.3.6 Bonnet shall be of the enclosed type in general. Open type of bonnet may be used only for non-toxic fluids.</p>
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3.4	Pilot
3.4.1	Wherever pilot operated valves are specified, pilot shall be non-flowing type and shall be designed fail safe.
3.4.2	All accessories like back flow preventer, pilot filter etc. required for proper operation of pilot operated valves as per indicated service conditions shall be included.
3.4.3	Wherever the body is part of flow path, body material shall be same as trim material, as a minimum.
4.0	<u>NAMEPLATE</u>
4.1	Each pressure safety valve shall have a S.S. nameplate attached firmly to it at a visible place, furnishing the following information:
	<ul style="list-style-type: none"> a) Tag number as per Purchaser's data sheets. b) Manufacturer's serial no. or model no. c) Manufacturer's name/ trade mark. d) Nominal flanged size in inches and rating in lbs. for both inlet and outlet. e) Orifice letter designation. f) Valve set pressure. g) Cold bench test set pressure.
	Unit of the above pressures shall be marked in the same units as those followed in Purchaser's data sheets.
5.0	<u>INSPECTION & TESTING</u>
5.1	Unless otherwise specified, Purchaser reserves the right to test and inspect all the items at the Vendor's works.
5.1.1	Purchaser's Inspector shall perform inspection and witness test on all valves as indicated in the Quality Assurance Plan (QAP) attached with this specification.
5.2	Vendor shall submit the following test certificates and test reports for Purchaser's review:
	<ul style="list-style-type: none"> a) Material test certificate from the foundry (MIL certificate) for each valve body and bonnet castings, nozzle, disc etc. b) Certificate of radiography / x-ray for valve castings. 100% radiography shall be carried out for all valve castings with body rating of 600# and above. A minimum of two shots shall be taken for all curved portion of the body and bonnet.

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	<ul style="list-style-type: none"> c) Hydrostatic test reports for all valve bodies and functional test reports for all valves as per clause 5.3 and 5.4 of this specification. d) IBR certificate in Form III item 11 and shall be furnished for all safety valves in steam service in addition to Form III C. Form III C shall also be furnished for pressure relief valves in distribution network.
5.3	Hydrostatic Test
5.3.1	Each pressure safety valve body and nozzle shall undergo hydrostatic test as per outlet flange and inlet flange ANSI rating, respectively. However all the safety valves castings covered under IBR shall be tested as per IBR regulations. There shall not be any visible leakage during this test.
5.4	Functional Tests
5.4.1	Assembled valves shall be subjected to functional tests as below :
	<ul style="list-style-type: none"> a) Cold bench set pressure test <p>Pressure relief valve shall be tested for opening at specified set pressure and also for seat tightness.</p> b) Seat Leakage test as per API <p>Whenever the specified set pressure is less than or equal to 70 kg/cm²g, the valve shall meet the seat tightness requirements specified in API RP-527. The maximum permissible leakage rates for conventional and balanced bellow valves against various sizes shall be as specified therein. Whenever the specified set pressure exceeds 70 kg/cm²g, the Vendor shall submit the leakage rates of valves for approval by the Purchaser.</p> <p>Where bubble tightness has been specified, there shall be no leakage or bubbles of air at the specified percentage of set pressure.</p> c) Valve lift test
5.5	Witness Inspection
	All pressure safety valves shall be offered for pre-despatch inspection for following as a minimum : <ul style="list-style-type: none"> a) Physical dimensional checks and workmanship b) Hydrostatic test as per clause 5.3 of this specification. c) Functional test on representative samples. d) Review of all certificate and test reports as indicated in clause 5.2 of this specification.

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In the event of tests being not witnessed by Purchaser, the tests shall anyway be completed by the Vendor and documents for same submitted for scrutiny.

6.0 **SHIPPING**

6.1 Valves shall be supplied as a whole, complete with all the accessories like cap, lifting lever, test gag, etc.

6.2 All threaded and flanged opening shall be suitably protected to prevent entry of foreign material.

7.0 **GUARANTEE**

7.1 Manufacturer shall guarantee that the materials and machining of valves and fittings comply with the requirements in this specification and in the Purchase Order.

7.2 Manufacturer is bound to replace or repair all valve parts which should result defective due to inadequate engineering or to the quality of materials and machining.

7.3 If valve defect or malfunctioning cannot be eliminated, Manufacturer shall replace the valve without delay,

7.4 Any defect occurring during the period of Guarantee shall be attended to by making all necessary modifications and repair of defective parts free of charge to the Purchaser as per the relevant clause of the bid document.

7.5 All expenses shall be to Manufacturer's account.

8.0 **REJECTION**

8.1 Vendor shall make his offer in detail with respect to every item of the Purchaser's specifications. Any offer not conforming to this shall be summarily rejected.

Rev. : 0


Edition : 1

**SPECIFICATION
FOR
SEAMLESS FITTINGS & FLANGES
[SIZE UPTO DN 400 mm (16") NB]**

SPECIFICATION NO.: MEC/TS/05/21/025




**(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092**

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SEAMLESS FITTINGS & FLANGES [SIZE UPTO DN 400 mm (16") NB]	DOCUMENT NO. MEC/TS/05/21/025	Page 1 of 1
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8.0	PAINTING, MARKING AND SHIPMENT
9.0	DOCUMENTATION

PREPARED BY: (Shalini Singh)	CHECKED BY: (Sunil Kumar)	APPROVED BY: (A.K. Johri)	ISSUE DATE : Dec. 2008
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SEAMLESS FITTINGS & FLANGES [SIZE UPTO DN 400 mm (16") NB]	DOCUMENT NO. MEC/TS/05/21/025	Page 1 of 5
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1.0 SCOPE


This specification covers the minimum requirements for the design, manufacture and supply of following carbon steel flanges and fittings of size upto DN 400 mm (16") to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG) :

- Flanges such as welding neck flanges, blind flanges, spectacle blinds, spacers and blinds etc.
- Seamless fittings such as tees, elbows, reducers, caps, outlets etc.

2.0 REFERENCE DOCUMENTS

2.1 Reference has been made in this specification to the latest edition (edition enforce at the time of issue of enquiry) of the following Codes, Standards and Specifications :

- | | | |
|---------------|---|---|
| ASME B31.4 | - | Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids |
| ASME B31.8 | - | Gas Transmission and Distribution Piping Systems |
| ASME B16.5 | - | Pipe Flanges and Flanged Fittings |
| ASME B16.9 | - | Factory Made Wrought Steel Butt Welding Fittings |
| ASME B 16.11 | - | Forged Steel Fittings, Socket Welding and Threaded |
| ASME B 16.48 | - | Steel Line Blanks |
| ASME Sec VIII | - | Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels |
| ASME Sec IX | - | Boiler and Pressure Vessel Code - Welding and Brazing Qualifications |
| ASTM A 370 | - | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |
| MSS-SP-25 | - | Standard Marking System for Valves, Fittings, Flanges and Unions |

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	OIL & GAS SBU, DELHI		
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MSS-SP-97 - Forged Carbon Steel Branch Outlet Fittings - Socket Welding, Threaded and Butt welding Ends.

2.2 In case of conflict between the requirements of this specification and the requirements of above referred Codes and Standards, the requirements of this specification shall govern.

3.0 **MANUFACTURER'S QUALIFICATION**

Manufacturer who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provisions of ASME B16.9 / MSS-SP-75 as applicable.

4.0 **MATERIAL**

4.1 The Carbon Steel used in the manufacture of flanges and fittings shall be fully killed. Material for flanges and fittings shall comply with the material standard indicated in the Purchase Requisition. In addition, the material shall also meet the requirements specified hereinafter.

4.2 Each heat of steel used for the manufacture of flanges and fittings shall have Carbon Equivalent (CE) not greater than 0.45 calculated from check analysis in accordance with the following formula:


$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Carbon contents on check analysis shall not exceed 0.22%.

4.3 For flanges and fittings specified to be used for Gas service or LPG service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at 0°C in accordance with the impact test provisions of ASTM A 370 for flanges and fittings.

The average absorbed impact energy values of three full-sized specimens shall be 27 joules. The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 Joules.

When Low Temperature Carbon Steel (LTCS) materials are specified for flanges and fittings in Purchase Requisition, the Charpy V-notch test requirements of applicable material standard shall be complied with.

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4.4 For flanges and fittings specified to be used for Gas service or LPG service, Hardness test shall be carried out in accordance with ASTM A 370. Hardness testing shall cover at least 10% per item, per size, per heat, per manufacturing method. A full thickness cross section shall be taken for this purpose and the maximum hardness shall not exceed 248 HV₁₀.

4.5 In case of RTJ (Ring Type Joint) flanges, the groove hardness shall be minimum 140 BHN. Ring Joint flanges shall have octagonal section of Ring Joint.

5.0 DESIGN AND MANUFACTURE

5.1 Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B16.5.

5.2 Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48.

5.3 Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conform to ASME B16.9 for sizes DN 50 mm (2") to DN 400 mm (16") (both sizes included) and ASME B 16.11 for sizes below ON 50 mm (2").

5.4 Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with MSS-SP-97.


5.5 Type, face and face finish of flanges shall be as specified in Purchase Requisition.

5.6 Flanges and fittings manufactured from bar stock are not acceptable.

5.7 All butt weld ends shall be bevelled as per ASME B 16.5 / ASME B 16.9 / MSS-SP-97 as applicable.

5.8 Repair by welding on flanges and fittings is not permitted.

5.9 Stub-in or pipe to pipe connection shall not be used in the manufacture of tees. Tees shall be manufactured by forging or extrusion methods. The longitudinal weld seam shall be kept at 90° from the extrusion. Fittings shall not have any circumferential joint .

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6.0 INSPECTION AND TESTS

6.1 The Manufacturer shall perform all inspections and tests as per the requirement of this specification and the relevant codes, prior to shipment at his works. Such inspections and tests shall be, not but limited to the following :

- a) All flanges and fittings shall be visually inspected. The internal and external surfaces of the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.
- b) Dimensional checks shall be carried out on finished products as per ASME B16.5 for flanges, ASME B16.48 for spacers and blinds and ASME B16.9 / MSS-SP-97 as applicable for fittings and as per this specification.
- c) Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.
- d) All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger than 6.35 mm shall not be acceptable.


6.2 Purchaser's Inspector reserves the right to perform stage wise inspection and witness tests, as indicated in clause 6.1 of this specification at Manufacturer's Works prior to shipment. Manufacturer shall give reasonable notice' of time and shall provide, without charge, reasonable access and facilities required for inspection, to the Purchaser's Inspector.

Inspection and tests performed / witnessed by Purchaser's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

7.0 TEST CERTIFICATES

Manufacturer shall furnish the following certificates:

- a) Test certificates relevant to the chemical analysis and mechanical properties of the materials used for manufacture of flanges and fittings as per relevant standards and this specification.
- b) Test Reports on non destructive testing.
- c) Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100 % of

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the specified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

8.0 PAINTING, MARKING AND SHIPMENT

- 8.1 After all inspection and tests required have been carried out; all external surfaces shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with standard mill coating for protection against corrosion during transit and storage. The coating shall be easily removable in the field.
- 8.2 Ends of all fittings and weld neck flanges shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for fittings and flanges. Flange face shall be suitably protected to avoid any damage during transit.
- 8.3 All flanges and fittings shall be marked as per applicable dimension / manufacturing standard.

9.0 DOCUMENTATION

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document / Material Requisition.

- 9.1 At the time of bidding, Manufacturer shall submit the following documents:
- Reference list of previous supplies of similar fittings of similar specification.
 - Clausewise list of deviations from this specification, if any.
 - Brief description of the manufacturing and quality control facilities at Manufacturer's works.
 - Manufacturer's qualification requirement as per clause 3.0 of this specification.
 - Quality Assurance Plan (QAP) enclosed with this tender duly signed, stamped and accepted.
- 9.2 Prior to shipment, the Manufacturer shall submit test certificates as listed in clause 7.0 of this specification.
- 9.3 All documents shall be in English Language only.

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SPECIFICATION FOR GASKETS, BOLTS & NUTS

SPECIFICATION NO.: MEC/S/05/21/19




**(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092**

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1.0	GASKETS
2.0	NUTS AND BOLTS

PREPARED BY: (Shalini Singh)	CHECKED BY: (Sunil Kumar)	APPROVED BY: (A.K. Johri)	ISSUE DATE : Jan. 2009
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AMENDMENT STATUS


Sl. No.	Clause / Paragraph / Annexure / Exhibit / Drawing Amended	Page No.	Revision	Date	By (Name)	Verified (Name)

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TECHNICAL NOTES FOR GASKETS

- 1.0 All gaskets shall conform to the codes/standards and specifications given in the requisition. Vendor shall strictly comply with MR / PR stipulations and no deviations shall be permitted.
- 2.0 Process of manufacture, dimensions and tolerances not specified in requisition shall be in accordance with the requirements of the manufacturer's standards.
- 3.0 Test reports shall be supplied for all mandatory tests for gaskets as per the standards specified in the requisition.
- 4.0 Chemical composition and hardness of RTJ gaskets shall also be furnished in the form of test reports on samples.
- 5.0 For Spiral wound material following shall be furnished:
 - a. Manufacturer's test certificate for filler material and spiral material as per the relevant material specifications.
 - b. Manufacturer's test certificate for raw materials and tests for compressibility / sealability & recovery as per the relevant material specifications.
- 6.0 Full face gaskets shall have bolt holes punched out.
- 7.0 Filler material for spiral wound gaskets shall not have any colour or dye.
- 8.0 All spiral wound gaskets shall be supplied with Outer ring. Material of the outer ring shall be CS unless other wise specified in the MR.
- 9.0 For spiral wound gaskets, material of Inner Compression ring shall be same as Spiral Strip material. In addition to the requirements as per code and as specified in the MR, inner rings shall be provided for the following:
 - a. Sizes 26" and above.
 - b. Class 900 and above.
- 10.0 Hardness of metallic RTJ gaskets shall not exceed the values specified below unless otherwise specified in MR :

Ring Gasket Material	Maximum Hardness (BHN)
Soft Iron	90
Carbon steel	120
5 Cr. ½ Mo	130
Type 304, 316, 321, 347	140
Type 304L, 316L	120


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- 11.0 Face finish of metallic RTJ gaskets shall be 32 to 63 AARH.
- 12.0 Gaskets of different types and sizes shall be placed in separate shipping containers and each container clearly marked with the size, rating, material specification and item code.
- 13.0 All items shall be inspected and approved by MECON Inspector or any other agency authorized by MECON.
- 14.0 Any additional requirements specified in the requisition, shall be fully complied with.
- 15.0 Non-metallic ring gaskets as per ASME B16.21 shall match flanges to ASME B16.5 upto 24" (except 22" size) and to ASME B16.47B above 24" unless specified otherwise. For 22" size, the matching flange standard shall be MSS-SP44 unless specified otherwise.
- 16.0 Spiral wound gasket as per ASME B16.20 shall match flanges to ASME B16.5 upto 24" (except 22" size) and to ASME B16.47B above 24" unless specifically mentioned otherwise. For 22" size, the matching flange standard shall be MSS-SP44 unless specified otherwise.
- 17.0 The following abbreviations have been used in the Material Requisition for Spiral Wound Gaskets :
- (I) : Inner Ring
(O) : Outer Ring
CAF : Compressed Asbestos Fibre
GRAFIL : Grafoil Filler

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TECHNICAL NOTES FOR BOLTS & NUTS

- 1.0 The process of manufacture, heat treatment, chemical & mechanical requirements and marking for all stud bolts, m/c bolts, jack screws & nuts shall be in accordance with the codes / standards and specification given in the requisition. The applicable identification symbol in accordance with the material specification shall be stamped on each bolt and nut. Vendor shall strictly comply with MR / PR stipulations and no deviations shall be permitted.
- 2.0 Test reports shall be supplied for all mandatory tests as per the relevant material specifications.
- 3.0 Material test certificate shall also be furnished. (Heat Analysis, Product Analysis and Mechanical Requirement)
- 4.0 Stress Rupture Test as detailed in ASTM A453 shall be carried out for all ASTM A453 bolting material irrespective of the temperature.
- 5.0 All bolting shall be as per ANSI B 18.2.1 for studs. M/c bolts and jackscrews and ANSI BI8.2.2 for nuts.
- 6.0 Threads shall be unified (UNC for 1" dia and BUN for > 1" dia) as per ANSI B.1.1 with class 2A fit for studs, M/c bolts and jackscrews and class 2B fit for nuts.
- 7.0 Stud bolts shall be threaded full length with two heavy hexagonal nuts. Length tolerance shall be in accordance with the requirement as per ANSI B 16.5.
- 8.0 The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process and stamped as per respective material specification.
- 9.0 Heads of jackscrews and m/c bolts shall be heavy hexagonal type. Jackscrew end shall be rounded.
- 10.0 Each size of studs & m/c bolts with nuts and jackscrews shall be supplied in separate containers marked with size and material specifications. 'CRYO' shall be marked additionally in case 'CRYO' is specified in the requisition.
- 11.0 All items shall be inspected and approved (stagewise) by MECON inspector or any other agency authorized by MECON.
- 12.0 The heat treatment for stud bolts & nuts shall be as per code unless mentioned otherwise.
- 13.0 All austenitic stainless steel bolts, nuts, screws shall be supplied in solution annealed condition unless specified otherwise in the material specification.
- 14.0 Any additional requirements specified in the requisition shall be fully complied with.

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- 15.0 Stud bolts, nuts & jackscrews shall be impact tested wherever specified in the material specification and also where the material specification is indicated as "CRYO". For" S.S. nuts and bolts minimum impact energy absorption shall be 27 Joules and test temperature shall be -196°C unless mentioned otherwise. For other materials impact energy and test shall be as per respective code.
- 16.0 Bolts / nuts of material of construction B7M / 2HM shall be 100% Hardness tested as per supplementary requirement S3 of ASTM A 193.
- 17.0 When specified as galvanized, the studs, m/c bolts and nuts shall be 'hot dip zinc coated' in accordance with requirements of 'class C' of 'ASTM A 153'. As an alternative, electro-galvanizing as per IS 1573, 'Service Grade Number 2' is also acceptable.
- 18.0 All Stud Bolts of Bolt diameter size 1" and above shall be provided with three nuts irrespective of whatever has been specified elsewhere in the MR.

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SPECIFICATION FOR PIPING FABRICATION AND ERECTION

SPECIFICATION NO.: MEC/S/05/21/06



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MECON LIMITED
DELHI 110 092**

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ANNEXURE-1 - WELDING SPECIFICATION


- EXHIBIT-A - ELECTRODE QUALIFICATIONS TEST RECORD
- EXHIBIT-B - STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION
- EXHIBIT-C - STANDARD PROCEDURE SPECIFICATION NO.
- EXHIBIT-D - COUPON TEST RECORD
- EXHIBIT-E - WELDER'S IDENTIFICATION CARD
- EXHIBIT-F - RADIOGRAPHIC PROCEDURE FOR PIPE WELDING
- EXHIBIT-G - WELDING SPECIFICATION CHART

ANNEXURE-2 - DESTRUCTIVE TESTING OF WELDED JOINT - BUTT WELDS

ANNEXURE-3 - ULTRASONIC INSPECTION

ANNEXURE-4 - RADIOGRAPHY

PREPARED BY: (Shalini Singh)	CHECKED BY: (Sunil Kumar)	APPROVED BY: (A.K. Johri)	ISSUE DATE : Dec. 2008
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1.0 GENERAL

This specification covers general requirements of fabrication and erection of aboveground and trench piping systems at site. The specification covers the scope of work of contractor, basis of work to be carried out by contractor and standards, specifications and normal practice to be followed during fabrication and erection by the contractor.


2.0 SCOPE

Generally the scope of work of contractor shall include the following :

- 2.1 Transportation of required piping materials, pipe support and all other necessary piping materials from Owner's storage point or contractor's storage point (in case of contractor's scope of supply) to work site / shop including raising store requisitions for issue of materials in the prescribed format & maintaining an account of the materials received from Owner's stores.
 - 2.1.1 Piping materials include the following but not limited to the same.
 - a. Pipes (All sizes and schedule)
 - b. Flanges (All sizes, types & Pressure ratings).
 - c. Fittings (All sizes, types and schedule)
 - d. Valves (All sizes, types and Ratings)
 - e. Gaskets (All sizes, types & Ratings)
 - f. Bolts, Nuts or M/C Bolts (All types)
 - g. Expansion Joint / Bellows (All types)
 - h. Specialty items like online filters, ejectors, sample coolers, steam traps, strainers, air traps etc.
 - i. Online instruments like control valve, orifice flange, rotameter, safety valves etc.
 - 2.2 Shop & field fabrication and erection of piping in accordance with documents listed under Cl. 3.0 i.e. 'BASIS OF WORK' including erection of all piping materials enumerated above.
 - 2.3 Fabrication and erection of pipe supports like shoe, saddle, guide, stops, anchors, clips, cradles, hangers, turn buckles, supporting fixtures, bracket cantilevers, struts, teeposts including erection of spring supports and sway braces.
 - 2.4 Fabrication
 - 2.4.1 Fabrication of piping specials like special radius bends, reducers, mitres etc.

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- 2.4.2 Fabrication of plain and threaded nipples from pipes as required during erection.
- 2.4.3 Fabrication of swage nipples as and when required.
- 2.4.4 Fabrication of odd angle elbow like 60°, 30° or any other angle from 90/45° elbows as and when required.
- 2.4.5 Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.
- 2.4.6 Fabrication of stub-in connection with or without reinforcement.
- 2.4.7 Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven / different thickness wherever required.
- 2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.
- 2.6 Preparation of Isometrics, bill of materials, supporting details of all NON-IBR lines upto 2-1/2" within the unit battery limit and get subsequent approval from Engineer-in-Charge as and when called for.
- 2.7 Obtaining approval for drawings prepared by contractor from statutory authority, if required.
- 2.8 Spun concrete lining of the inside of pipes 3" NB & above including fittings and flanges as required in accordance with specification.
- 2.9 Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.
- 2.10 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.
- 2.11 Performing PMI using alloy analysers as per 'Standard Specification for Positive Material Identification at Construction Sites, 6-82-0002'.
- 2.12 Casting of concrete pedestals and fabrication & erection of small structures for pipe supports including supply of necessary materials.
- 2.13 Providing insert plates from concrete structures and repair of platform gratings around pipe openings.
- 2.14 Making material reconciliation statement and return of Owner's supply left over materials to Owner's storage.
- 2.15 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems (Specification No. MEC/S/05/21/11).

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3.0 BASIS FOR WORK

3.1 The complete piping work shall be carried out in accordance with the following

3.1.1 "Approved for Construction" drawings and sketches issued by MECON to the Contractor - Plans and/or Isometrics.

3.1.2 "Approved for Construction" drawings and sketches issued by Turn-key bidders to the Contractor - Plans and/or Isometrics.

3.1.3 Approved Process licensor's standards and specifications.

3.1.4 Drawings, sketches and documents prepared by contractor duly approved by Engineer-in-Charge' (such as isometrics and offsite piping etc.)


3.1.5 Approved construction job procedures prepared by Contractor as stipulated in 2.16

3.1.6 MECON specifications/documents as below :

- a. Process and Instrument Diagram.
- b. Piping Materials Specification
- c. Piping support standards.
- d. Line list / Number
- e. Piping support index.
- f. Standard specification of NDT Requirement of Piping
- g. Welding specification charts for piping classes.
- h. Standard specification for Pressure Testing of Erected Piping System.
- i. Welding specification for fabrication of piping
- j. Any other MECON or OTHER specifications attached with Piping Material Specification or special condition of contract.
- k. Procedure for storage, preservation and positive identification of materials Contractors works / stores.

3.1.7 Following codes, standards and regulations

- a. ASME B 31.3 : Process Piping
- b. ASME Sec. VIII : Code for unfired pressure vessel.
- c. IBR Regulations

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- d. IS:823 : Code for procedure for Manual Metal Are Welding of Mild Steel (for structural steel).
- e. NACE Std. : Code for Sour Services material requirements MR.

Note : All codes referred shall be latest edition.

3.2 Deviations

Where a deviation from the "Basis of Work" and approved job procedure described above is required or where the basis of work does not cover a particular situation, the matter shall be brought to the notice of Engineer - in - Charge and the work carried out only after obtaining written approval from him in each case.


4.0 FABRICATION

4.1 Piping Material

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the "Piping Material Specification" for the "Pipe Class" specified for that system. To ensure the above requirement, all piping material supplied by the Owner / Contractor shall have proper identification marks as per relevant standards / MECON's specifications / Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated / erected. Material traceability is to be maintained for AS., S.S., NACE, LTCS, material for Hydrogen service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to colour coding for all piping materials to avoid mix-up.

4.2 Fabrication

- 4.2.1 All fabrication shall be carried out in accordance with piping general arrangement drawings, (prepared by CONTRACTOR and approved by COMPANY) including this specification and codes as specified in section 2.0.
- 4.2.2 CONTRACTOR shall be responsible for working to the exact dimensions as per the approved drawings. Dimensional tolerances to be adopted during implementation of fabrication work shall be as per attached sketch "TOLERANCES FOR FABRICATION".
- 4.2.3 Flange bolt holes shall generally straddle the established centre lines unless other orientation is required and as called out in approved drawings.
- 4.2.4 Threading shall be NPT to ANSI B 1.20.1. Threading shall preferably be done after bending, forging or heat treatment operation. However if it is not possible, precaution shall be taken to protect threading against deformation. Thread shall be clean cut with no burrs or stripping. Dies shall be new, sharp and properly designed for piping material. Ends shall be reamed to remove burrs.

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- 4.2.5 All threaded joints shall be aligned properly. The pipe entering unions shall be true to centrelines so as to avoid forcing of union coupling during make up. Damaged threads shall be cut from the end of run and the pipe shall be rethreaded.
- 4.2.6 Immediately before testing the piping, all threads of pipe and fittings shall be thoroughly cleared of cuttings, fuel oil or other foreign matter. The male threads shall be sealed with thread sealant and the piping made up sufficiently for the thread to seize. Sealant shall be teflon tape.
- 4.2.7 Seal welding of threaded connections when specified shall include the first block valve, cover all threads. The joint shall be cleaned of all cutting oil and other foreign material and made up dry to full thread engagement. Instrument threaded connections which are frequently subjected to testing and maintenance shall not be seal welded.
- 4.2.8 All threaded connections shall be protected from rusting by applying greases or oil when in operating condition.
- 4.2.9 When socket weld fittings or valves are used, pipe shall be spaced approximately 1/16" to avoid bottoming which could result in excessive weld stress.
- 4.2.10 Where the ends of the piping components being welded have an internal surface misalignment exceeding 1.6mm, the wall of the component extending internally shall be trimmed by machining so that the adjoining internal surface will approximately flush.

For the purpose of common understanding the construction job procedure, to be submitted by the contractor, shall include proposal for

- Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.
- Positive material identification, handling, storage & preservation.

4.3 Dimensional Tolerances

Dimensional tolerances for piping fabrication shall be as per MECON Standard Specification. The Contractor shall be responsible for working to the dimensions shown on the drawings. However, the Contractor shall bear in mind that there may be variations between the dimensions shown in the drawing and those actually existing at site due to minor variations in the location of equipments, inserts, structures etc. To take care of these variations "Field Welds" shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawing may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld, shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Contractor to provide adequate number of field welds. In any case no extra claims will be entertained from the Contractor on this account. Wherever errors / omissions occur in drawings and Bills of Materials it shall be the Contractor's responsibility to notify the Engineer-in-Charge prior to fabrication or erection.

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4.4 IBR Piping

- 4.4.1 Contractor shall be supplied generally with all drawings for steam piping falling under the purview of Indian Boiler Regulations duly approved by Boiler Inspectorate. The Contractor shall carry out the fabrications, erection and testing of this piping as per requirements of Indian Boiler Regulations and to the entire satisfaction of the local Boiler Inspector. The Contractor shall also get the approval of IBR inspector for all fabrication and testing done by him at his own cost. All certificates of approval shall be in proper IBR forms.
- 4.4.2 Approval of boiler inspector on the drawings prepared by the contractor shall be obtained by the contractor at his own cost.

4.5 Pipe Joints

The piping class of each line specifies the type of pipe joints to be adopted. In general, joining of lines 2" and above in process and utility piping shall be accomplished by butt welds. Joining of lines 1-1/2" and below shall be by socket welding / butt welding / threaded joints as specified in "Piping Material Specifications". However, in piping 1-1/2" and below where socket welding/ threaded joints are specified butt - welds may be used with the approval of Engineer-in-Charge for pipe to pipe joining in long runs of piping. This is only applicable for non-galvanized piping without lining.

Flange joints shall be used at connections to Vessels, Equipment's, Valves and where required for ease of erection and maintenance as indicated in drawings.

4.6 Butt Welded and Socket Welded Piping


End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heat, post-heating and heat treatment shall be as described in the welding specification and NDT specification.

4.7 Screwed Piping

In general, Galvanized piping shall have threads as per IS:554 or ANSI B 2.1 NPT as required to match threads on fittings, valves etc. All other piping shall have threads as per ANSI B 2.1, tapered unless specified otherwise.

Threads shall be clean cut, without any burrs or stripping and the ends shall be reamed. Threading of pipes shall be done preferably after bending, forging or heat treating operations. If this is not possible, threads shall be gauge checked and chased after welding heat treatment etc.

During assembly of threaded joints, all threads of pipes and fittings shall be thoroughly cleaned of cuttings, dirt, oil or any other foreign matter. The male threads shall be coated with thread sealant and the joint tightened sufficiently for the threads to seize and give a leakproof joint.

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Threaded joints to be seal-welded shall be cleaned of all foreign matter, including sealant and made up to full thread engagement before seal welding.

4.8 Flange Connections

All flange facings shall be true and perpendicular to the axis of pipe to which they are attached. Flanged bolt holes shall straddle the normal centerlines unless different orientation is shown in the drawing.

Wherever a spectacle blind is to be provided, drilling and tapping for the jack screws in the flange, shall be done before welding it to the pipe.

4.9 Branch Connections

Branch connections shall be as indicated in the piping material specifications. For end preparation, alignment, spacing, fit-up and welding of branch connections refer welding specifications. Templates shall be used wherever required to ensure accurate cutting and proper fit-up.

For all branch connections accomplished either by pipe to pipe connections or by using forged tees the rates quoted for piping shall be inclusive of this work.

Reinforcement pads shall be provided wherever indicated in drawings/ specifications etc.

4.10 Bending


Bending shall be as per ASME B31.3 except that corrugated or creased bends shall not be used.

Cold bends for lines 1-1/2" and below, with a bend radius of 5 times the nominal diameter shall be used as required in place of elbows wherever allowed by piping specifications. Bending of pipes 2" and above may be required in some cases like that for headers around heaters, reactors etc.

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any cross-section, shall not exceed 8% and 3% of the nominal outside diameter, for internal and external pressure respectively.

4.11 Forging and forming

Forging and forming of small bore fittings, like reducing nipples for piping 1-1/2" and below, shall be as per ASME B 31.3.

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4.12 Mitre Bends and Fabricated Reducers

The specific application of welded mitre bends and fabrication reducers shall be governed by the Piping Material Specifications. Generally all 90 deg. mitres shall be 4-piece 3-weld type and 45 deg. mitres shall be 3-piece 2-weld type as per MECON Standard unless otherwise specified. Reducers shall be fabricated as per directions of Engineer-in-Charge. The radiographic requirements shall be as per Material Specifications for process and utility systems and NDT Specification for steam piping under IBR, radiographic requirements of IBR shall be complied with.

4.13 Cutting and Trimming of Standard Fittings & Pipes

Components like pipes, elbows, couplings, half-couplings etc. shall be cut / trimmed / edge prepared wherever required to meet fabrication and erection requirements, as per drawings and instructions of Engineer-in-Charge. Nipples as required shall be prepared from straight length piping.

4.14 Galvanised Piping

Galvanised carbon steel piping shall be completely cold worked, so as not to damage galvanised surfaces. This piping involves only threaded joints and additional external threading on pipes may be required to be done as per requirement.

4.15 Jacketed Piping

The Jacketing shall be done in accordance with MECON Specification or Licensors specification as suggested in material specification or special condition of contract.


Pre-assembly of jacketed elements to the maximum extent possible shall be accomplished at shop by Contractor. Position of jumpover and nozzles on the jacket pipes, fittings etc. shall be marked according to pipe disposition and those shall be prefabricated to avoid damaging of inner pipe and obstruction of jacket space. However, valves, flow glasses, in line instruments or even fittings shall be supplied as jacketed.

4.16 Shop Fabrication / Prefabrication

The purpose of shop fabrication or pre-fabrication is to minimise work during erection to the extent possible. Piping spool, after fabrication, shall be stacked with proper identification marks, so as facilitate their withdrawal at any time during erection. During this period all flange (gasket contact faces) and threads shall be adequately fabricated by coating with a removable rust preventive. Care shall also be taken to avoid any physical damage to flange faces and threads.

4.17 Miscellaneous

4.17.1 Contractor shall fabricate miscellaneous elements like flash pot, seal pot, sample cooler, supporting elements like turn buckles, extension of spindles and interlocking arrangement of valves, operating platforms as required by Engineer-in-Charge.

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4.17.2 Spun Concrete Lining

The work of inside spun concrete lining of pipes and specials of diameter 3" and above shall be done as per material specifications and special condition contract.

4.17.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications attached and the actual Piping Material Specification.

5.0 ERECTION

5.1 Cleaning of Piping before Erection

Before erection all pre-fabricated spool pieces, pipes, fittings etc. shall be cleaned inside and outside by suitable means. The cleaning process shall include removal of all foreign matter such as scale, sand, weld spatter chips etc. by wire brushes, cleaning tools etc. and blowing with compressed air/or flushing out with water. Special cleaning requirements for some services, if any shall be as specified in the piping material specification or isometric or line list. S.S jacketed piping requiring pickling shall be pickled to remove oxidation and discolouring due to welding.

5.2 Piping Routing


No deviations from the piping route indicated in drawings shall be permitted without the consent of Engineer- in-Charge.

Pipe to pipe, pipe to structure / equipments distances / clearances as shown in the drawings shall be strictly followed as these clearances may be required for the free expansion of piping / equipment. No deviations from these clearances shall be permissible without the approval of Engineer-in-Charge.

In case of fouling of a line with other piping, structure, equipment etc. the matter shall be brought to the notice of Engineer-in-Charge and corrective action shall be taken as per his instructions.

5.3 Cold Pull

Wherever cold pull is specified, the Contractor shall maintain the necessary gap, as indicated in the drawing. Confirmation in writing shall be obtained by the Contractor from the Engineer-in-Charge, certifying that the gap between the pipes is as indicated in the drawing, before drawing the cold pull. Stress relieving shall be performed before removing the gadgets for cold pulling.

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5.4 Slopes

Slopes specified for various lines in the drawings / P&ID shall be maintained by the Contractor. Corrective action shall be taken by the Contractor in consultation with Engineer-in-Charge wherever the Contractor is not able to maintain the specified slope.

5.5 Expansion Joints / Bellows

Installation of Expansion Joints/Bellows shall be as follows:

- All Expansion joints / Bellows shall be installed in accordance with the specification and installation drawings, supplied to the Contractor.
- Upon receipt, the Contractor shall remove the Expansion Joints/ Bellows from the case(s) and check for any damage occurred during transit.
- The Contractor shall bring to the notice of the Engineer-in-Charge any damage done to the bellows / corrugations, hinges, tie-rods, flanges / weld ends etc.
- Each Expansion Joint / Bellow shall be blown free of dust / foreign matter with compressed air or cleaned with a piece of cloth.
- For handling and installation of Expansion Joints, great care shall be taken while aligning. An Expansion Joints shall never be slinged from bellows corrugations / external shrouds, tie / rods, angles.
- An Expansion Joints / Bellow shall preferably be slinged from the end pipes / flanges or on the middle pipe.
- All Expansion Joints shall be delivered to the Contractor at "Installation length", maintained by means of shipping rods, angles welded to the flanges or weld ends or by wooden or metallic stops.
- Expansion Joints stop blocks shall be carefully removed after hydrostatic testing. Angles welded to the flanges or weld ends shall be trimmed by saw as per manufacturer's instructions and the flanges or weld ends shall be ground smooth.
- The pipe ends in which the Expansion Joint is to be installed shall be perfectly aligned or shall have specified lateral deflection as noted on the relevant drawings.
- The pipe ends / flanges shall be spaced at a distance specified in the drawings.
- The Expansion Joint shall be placed between the mating pipe ends / flanges and shall be tack welded/bolted. The mating pipes shall again be checked for correct alignment.
- Butt-welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flanges shall be bolted.

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- After the Expansion Joint is installed the Contractor shall ensure that the mating pipes and Expansion Joints are in correct alignment and that the pipes are well supported and guided.
- The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.
- Precautions
 - For carrying out welding, earthing lead shall not be attached with the Expansion Joint.
 - The Expansion bellow shall be protected from arc weld spot and welding spatter.
 - Hydrostatic Testing of the system having Expansion Joint shall be performed with shipping lugs in position. These lugs shall be removed after testing and certification is over.

5.6 Flange Connections

While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled together, without inducing any stresses in the pipes and the equipment nozzles. Extra care shall be taken for flange connections to pumps, turbines, compressors, cold boxes, air coolers etc. The flange connections to these equipments shall be checked for misalignment, excessive gap etc. after the final alignment of the equipment is over. The joint shall be made up after obtaining approval of Engineer-in-Charge.


Temporary protective covers shall be retained on all flange connections of pumps, turbines, compressors and other similar equipments, until the piping is finally connected, so as to avoid any foreign material from entering these equipments.

The assembly of a flange joint shall be done in such a way that the gasket between these flange faces is uniformly compressed. To achieve this the bolts shall be tightened in a proper sequence. All bolts shall extend completely through their nuts but not more than 1/4".

Steel to C.I. flange joints shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate pattern and lateral alignment.

5.7 Vents and Drains

High point vents and low point drains shall be provided as per the instructions of Engineer-in-Charge, even if these are not shown in the drawings. The details of vents and drains shall be as per piping material specifications / job standards.

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5.8 Valves

Valves shall be installed with spindle / actuator orientation / position as shown in the layout drawings. In case of any difficulty in doing this or if the spindle orientation / position is not shown in the drawings, the Engineer-in-Charge shall be consulted and work done as per his instructions. Care shall be exercised to ensure that globe valves, check valves, and other uni-directional valves are installed with the "Flow direction arrow "on the valve body pointing in the correct direction. If the direction of the arrow is not marked on such valves, this shall be done in the presence of Engineer-in-Charge before installation.

Fabrication of stem extensions, locking arrangements and interlocking arrangements of valves (if called for), shall be carried out as per drawings / instructions of Engineer-in-Charge.

5.9 Instruments

Installation of in-line instruments such as restriction orifices, control valves, safety valves, relief valves, rotameters, orifice flange assembly, venturimeters, flowmeters etc. shall form a part of piping erection work.

Fabrication and erection of piping upto first block valve / nozzle / flange for installation of offline Instruments for measurement of level, pressure, temperature, flow etc. shall also form part of piping construction work. The limits of piping and instrumentation work will be shown in drawings / standards / specifications. Orientations / locations of take-offs for temperature, pressure, flow, level connections etc. shown in drawings shall be maintained.

Flushing and testing of piping systems which include instruments mentioned above and the precautions to be taken are covered in flushing, testing and inspection of piping. Care shall be exercised and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

5.10 Line Mounted Equipments / Items


Installation of line mounted items like filters, strainers, steam traps, air traps, desuperheaters, ejectors, samples coolers, mixers, flame arrestors, sight glasses etc. including their supporting arrangements shall form part of piping erection work.

5.11 Bolts and Nuts

The Contractor shall apply molycoat grease mixed with graphite powder (unless otherwise specified in piping classes) all bolts and nuts during storage, after erection and wherever flange connections are broken and made-up for any purpose whatsoever. The grease and graphite powder shall be supplied by the Contractor within the rates for piping work.

5.12 Pipe Supports

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design pipe supports will be shown in drawing for lines 2" NB. However, any extra supports desired by Engineer-in-Charge

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shall also be installed.

No pipe shoe / cradle shall be offset unless specifically shown in the drawings.

Hanger rods shall be installed inclined in a direction opposite to the direction in which the pipe move during expansion.

Preset pins of all spring supports shall be removed only after hydrostatic testing and insulation is over. Springs shall be checked for the range of movement and adjusted if necessary to obtain the correct positioning in cold condition. These shall be subsequently adjusted to hot setting in operating condition. The following points shall be checked after installation, with the Engineer-in-Charge and necessary confirmation in writing obtained certifying that :

- All restraints have been installed correctly.
- Clearances have been maintained as per support drawings.
- Insulation does not restrict thermal expansion.
- All temporary tack welds provided during erection have been fully removed.
- All welded supports have been fully welded.

6.0 **WELDING**

Welding of pipelines shall be done as per applicable codes and **Annexure-1**

7.0 **ERECTION**

7.1 **Pre-fabrication and Field Assembly**


Extent of pre-fabrication shall be purely at the discretion of CONTRACTOR keeping in view the following :-

7.1.1 Field joint shall be decided by CONTRACTOR keeping in view the transportation of pre-fabricated pieces to site.

7.1.2 There can be some variations in the dimensions and level appearing in the arrangement drawings and those actually occurring at site due to minor variations in the location of equipments, structures, cut out etc. Adequate field joints shall be provided, permitting assembly and erection of pipe work without major modification.

7.2 **Supporting**

Location and design of pipe supports shown in approved drawings and support drawings shall be strictly followed.

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7.2.1 Supports shall be installed in such a way that they do not contribute to over stressing of a line.

7.2.2 Fabrication and erection of additional supporting elements and structural fixtures which in COMPANY's view are required for proper supporting of the system, shall be carried out by CONTRACTOR at no extra cost.

7.2.3 All temporary supports, elements required for alignment, erection and assembly shall be removed after completion of work.

7.3 **Equipment hook-up**

7.3.1 Prior to hook-up, the alignment and trueness of flange faces shall be checked to ensure that no undue stresses shall be induced in the system while hooking up.

8.0 **INSPECTION**

8.1

8.2 CONTRACTOR shall provide all facilities/ assistance to COMPANY for proper execution of their inspection without any extra charge.


8.3 All piping work shall be subjected to inspection by COMPANY at any time during fabrication. CONTRACTOR shall furnish to COMPANY detailed work programme sufficiently in advance, in order to enable COMPANY to arrange for inspection.

9.0 **PROTECTIVE COATING**

9.1 All above ground piping system shall be applied with protective coating in accordance with specification for shop & field painting.

9.2 All under ground portion of piping system shall be coated with three layer P.E. coating. CONTRACTOR shall prepared procedure for epoxy painting of burried pipeline for approval of COMPANY. Procedure shall include surface preparation, brand and type of coating to be adopted. Coating of pipes shall not commence without approval of coating procedure. Total dry film thickness to be achieved shall not be less than 300 microns. Compatible primer and finish coat as recommended by coating manufacturer shall only be applied. Coating integrity shall be checked by "Holiday detector" over full length of coated pipe work. Coating to be supplied by CONTRACTOR shall be suitable for design temperature.

9.3 Once the coating has been accepted by COMPANY, backfilling operation can be started. In order to protect coated pipe from damage, the excavated trench shall be examined for stone, rock and any other hard substance detrimental to coating. All such substances shall be removed before lowering the pipe in the trench. COMPANY may ask for a 100mm padding of clear sand under and above pipeline in rocky or otherwise hard soil area. No additional payment on account of padding shall however be admissible.

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10.0 **FLUSHING**

Completed piping systems shall be flushed by CONTRACTOR with fresh water, to clean the pipe of all dirt, debris, and foreign material. CONTRACTOR shall prepare a procedure for flushing of the system for approval of COMPANY. Flushing shall not be commenced without approval of flushing procedure.

10.1 CONTRACTOR shall perform all activities like dismantling and reinstalling of all strainers, in line instruments etc. before and after completion of flushing.

10.2 Flushing shall be considered as complete only after inspection and approval by COMPANY.

10.3 Disposal of muck and flushing media shall be arranged by CONTRACTOR as directed by COMPANY, in such a manner that it does not spoil the adjacent installation. CONTRACTOR shall obtain COMPANY approval regarding the place and method to be adopted for disposal of debris.

10.4 Record of flushing giving following details shall be submitted by CONTRACTOR to COMPANY for its approval and records :

- a) Date of flushing
- b) Identification of line : flushed-line number

11.0 **HYDROSTATIC TESTING**


11.1 Completed piping system as approved by COMPANY shall be hydrostatically tested in the presence of COMPANY. The general requirements of hydrostatic testing shall be in accordance with codes specified in section 2.0.

11.2 CONTRACTOR shall prepare hydrostatic test procedure based on specified codes. The hydrostatic test shall commence only after approval of procedure by COMPANY.


11.3 Piping system shall be hydrostatically tested to a pressure corresponding to 1.4 times the design pressure.

11.4 Fresh water shall be used as test media. CONTRACTOR shall locate the source of water supply and arrange for transportation of water to test site. CONTRACTOR shall arrange at his own cost the water analysis and confirm that water is suitable for testing. In case any corrosion inhibitor is to added, the same shall be done after approval of COMPANY.

11.5 Lines repaired subsequent to hydrostatic test shall be retested using the same procedure as originally adopted. However COMPANY may waive such retest in case of minor repairs by taking precautionary measures to ensure sound construction.

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- 11.6 All equipment and instruments used for hydrostatic test shall be approved by COMPANY before start of tests.
- 11.7 Pressure gauges shall be installed on line to measure test pressures. In case of longer lines two or more pressure gauges shall be installed as directed by COMPANY. One gauge shall be installed at the discharge of the pressurising pump. Pressure gauge used for hydrostatic testing shall be calibrated with dead weight tester in the presence of Engineer-in-charge. Range of pressure gauge shall generally be 1.5 times the test pressure.
- 11.8 Orifice plates and restriction orifices shall not be installed until hydrostatic testing is completed. Temporary gaskets shall be used during testing.
- 11.9 First block valve of pressure instruments shall be half open & plugged at the time of hydrostatic testing. Temperature connections shall be blanked off during testing.
- 11.10 All equipments, in line instruments, relief valves shall be disconnected from piping system by means of blinds during testing. Control valves shall be replaced by spool pieces during testing.
- 11.11 High point vents and low point drain required for testing in addition to those marked in the drawings shall be provided by CONTRACTOR at his own cost.
- 11.12 All welded and screwed joints shall be kept clean for detecting leaks during testing.
- 11.13 Test pressure shall be maintained long enough to facilitate complete inspection of the system. Minimum duration of test shall be 6 hours unless other wise specified. Pressurising equipment shall be isolated immediately after test pressure is attained.
- 11.14 After successful completion of hydrostatic testing, the piping system shall be dewatered. All lines shall be completely dried using compressed air. CONTRACTOR shall make his own arrangement for supply of compressed air. Drying of lines shall be considered complete on approval by COMPANY.
- 11.15 **Test Records**
- The records in duplicate shall be prepared and submitted by CONTRACTOR as below :
- Date of test
 - Identification of pipe tested - line number
 - Test pressure
 - Test results
 - Signature of CONTRACTOR
 - Approval signature by COMPANY.

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ANNEXURE-1

WELDING SPECIFICATION

1.0 **GENERAL**

This specification shall be followed for the fabrication of all types of welded joints of carbon steel above ground natural gas service piping systems.

The welded pipe joints shall include the following :

- a) All line pipe joints of the longitudinal and circumferential butt welded.
- b) Attachments of castings, forgings, flanges.
- c) Welded manifold headers and other sub-assemblies
- d) Welded branch connections with or without reinforcing pads.
- e) Joints in welded/ fabrication piping components.
- f) The attachments of smaller connections for vents drain drips and other instrument tappings.

Any approval granted by the Engineer-in-charge or owner's inspectors shall not relieve the contractor of his responsibilities & guarantees.


1.1 **Applicable Codes & Standards**

All welding work, equipments for welding, heat treatment, other auxiliary functions and the welding personnel shall be as per the requirements of the latest editions of the following approved standards and procedures :-

- i) Code for gas transmission and distribution piping systems. ANSI B31.8.
- ii) Code for petroleum refinery piping, ANSI B31.3.

In addition, the following codes/ specifications referred to in the relevant code of fabrication shall be followed for the welding/ brazing qualifications, consumable qualifications and non destructive test procedures.

- i) Standard for welding of pipelines and related facilities API-1104.
- ii) Material Specifications - Welding rods, electrodes and filler materials - ASME Sec. - IIC.
- iii) Code for non destructive examination ASME Sec-V.
- iv) Qualification standard for welding and brazing procedure and welders, brazers, welding and brazing operators - ASME Sec-I

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In the event of any difference due to the additional requirements mentioned in this specification, over and above those obligation as per codes, this specification shall be binding.

1.2 Base Material

- a) In general carbon steel is used in this plant. The details of material specifications are given in the welding Specification Chart.
- b) The contractor shall provide the Manufacturer's test certificates for every heat of the materials supplied by him.

1.3A Filler Materials

- a) The Contractor shall provide all the necessary welding electrodes, filler materials, etc. required for the execution of the work.
- b) The welding electrodes/ filler wires supplied by the Contractor shall conform to the class specified in the welding specification chart. The materials shall be of the make approved by the Engineer-in-charge.
- c) The electrode shall be suitable for the welding process recommended and base metal used. Unless otherwise specified physical properties of the welds produced by a electrode recommended for the welding of a particular base metal shall not be lower than the minimum values specified for the base metal and shall correspond to the physical properties of the class of electrode adopted. The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and shall be the sole prerogative of the Engineer-in-charge.
- d) Tungsten electrodes used shall conform to ASME Sec. II C SFA 5.12 specification. Thoriated Tungsten electrodes shall not be permitted due to possible radiation hazard. Instead, ceriated Tungsten Electrodes (EWCe-2 or equivalent) shall be used for GTA Welding.
- e) Electrode qualification test records should be submitted as per the **Exhibit-A** (attached) in respect of the electrodes tested by the contractor, for obtaining the approval of the Engineer-in-charge.
- f) The Contractor shall submit batch test certificate from the electrode Manufacturers giving details of physical and chemical tests carried out by them, for each batch of electrodes to be used.
- g) All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding ovens at temperature recommended by the electrode Manufacture. Out-of-the oven time of electrodes before they are consumed shall not exceed the limits recommended by the electrodes manufacturer. The electrodes shall be handled with care to avoid any damage to flux covering.

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- h) All low hydrogen type of electrodes shall be rebaked at 350°C for 1 hour minimum and stored in ovens kept at 80-100°C before use. Recommendations of the electrode Manufacturer shall be followed if available.
- i) The electrodes, filler wires and flux used shall be free from rust, oil, greases, earth and other foreign matter which can affect the quality of welding.

1.3B SHIELDING & PURGING GAS

- a) Argon gas used in GTA welding for shielding purposes shall be 99.995% pure. The purity of the gas shall be certified by the manufacturer. The rate of flow for shielding purposes shall be established through procedure qualification tests. Normally this rate may be 12-20 CFH.
- b) Argon gas with a purity level of 99.995% shall be used for purging.
- c) When GTAW process alone or a combination of GTA Wand SMAW processes is recommended for the production of a particular joint, the purging shall be maintained during the root pass and for the first filling pass to minimize oxidation on the inner side of the pipe, unless otherwise specified in Welding Specification Chart.
- d) Initial purging shall be maintained for sufficient period of time so that at least 4-5 times the volume between the dams is displaced, in order to completely remove the entrapped air. In no case should the initial purging period be less than 10 minutes. High gas pressure should be avoided.
- e) After initial purging, the flow of the backing gas should be reduced to a point where only a slight positive pressure prevails. For systems, which have a small volume (up to 1/2 cubic foot) to be purged, a gas flow rate of 6-CFH is usually adequate. Systems of larger volume may require higher flow rates and these should be established during procedure qualification tests.
- f) Gas backing (purging) is not required for socket type of welded joints.
- g) Dams, used for conserving inert gas during purging, shall be removed after completion of the welding, and shall be accounted for. Wherever, removal of dams is not possible after welding, use of water-soluble dams should be made.

1.4 Welding Consumables

The Contractor shall provide at this own expense all the welding consumables necessary for the execution of the job such as electrodes filler wires, oxygen, acetylene, etc. and these should bear the approval of the COMPANYY.

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1.5 **Equipment & Accessories**

- 1.5.1 The Contractor should have the arrangement of sufficient number of welding and cutting equipments, auxiliaries and accessories of sufficient capacities so as to meet the target schedule.
- 1.5.2 All the equipment for performing the heat treatment, including transformers, thermocouples, flow meters, automatic temperature recorders with suitable calibration arrangement etc. shall be provided by the Contractor, at his own expense and these should bear the approval of the COMPANY.
- 1.5.3 Contractor shall make necessary arrangements at his own expense for providing the radiographic equipment, radiographic films, and all the equipment/ materials required for carrying out the dye penetrant/ magnetic particle test for satisfactory and timely completion of the job.
- 1.5.4 Redoing of any work necessitated by faulty equipments or operation used by the Contractor, will be done at his own expense.

1.6 **Welding Processes**

- 1.6.1 Welding of various materials under this specification shall be carried out using Shielded Metal Arc Welding (SMAW) Process with the approval of the Engineer-in-charge.
- 1.6.2 The welding processes to be employed are given in the welding specification chart. Any deviation desired by the Contractor shall be obtained through the express consent of the Engineer-in-charge.
- 1.6.3 Automatic and semi-automatic welding processes shall be employed only with the express approval of the Engineer-in-charge. The welding procedure adopted and consumables used shall be specifically approved.
- 1.6.4 A combination of different welding processes or a could be employed for a particular joint only after duly qualifying the welding procedure as per the requirements of code of fabrication to be adopted and obtaining the approval of the Engineer-in-charge.


1.7 **End Preparation**

1.7.1 **End Preparation**

The edges to be welded shall be prepared to meet the joint design requirements by gas cutting, machining or grinding method. After gas cutting, oxides shall be removed by chipping or grinding.

1.7.2 **Cleaning**

- a) The ends to be welded shall be properly cleaned to remove paint, oil, greases, rust, oxides, sand, earth and other foreign matter. The ends shall be

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completely dry before the welding commences.

- b) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling. Wire brushes used for cleaning stainless steel joints shall have stainless steel wires and the grinding wheels used for grinding stainless steel shall be of a suitable type. Separate grinding wheels and wire brushes should be used for carbon steels and stainless steels.

1.8 Alignment and Spacing

- a) Prior to alignment, the contractor shall inspect the pipe ends inside and outside for damage, dents, laminations etc. Pipe for welding shall be set up correctly spaced. Temporary attachment of any kind shall not be welded. Every effort shall be made to reduce misalignment by the use of clamp and rotation of pipes to the best fit. For pipes of same nominal wall thickness, the off set should not exceed 1.6mm. Any branch connections sleeve shall be at least 150mm from any other weld. The welds for fitting shall be so located that top of the weld shall not come within 50mm of any other weld. The use of internal line up clamps is mandatory for diameters 10" and above. However, in case where it is impossible to use internal line up clamp, external line up clamp may be used.
- b) Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints.

1.9 Weather Conditions


1.9.1 The parts being welded and the welding personnel should be protected from rain and strong winds. In the absence of such a protection no welding shall be carried out.

1.9.2 During field welding using GTAW process, particular care shall be exercised to prevent any air current affecting the welding process.

1.10 Welding

1.10.1 Root Pass

- a) Root pass shall be made with electrodes/ filler wires recommended in the welding specification chart. The preferable size of the electrode is 2.5mm diameter (12 SWG) but in no case greater than 3.25mm (10 SWG).
- b) Uphill welding shall be adopted for welding pipes weld fixed with its axis horizontal. Downward technique of welding shall not be used for welding of pipes in horizontal position, unless specifically permitted by Engineer-in-charge for a particular case.

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- c) The root pass of but joints should be executed properly so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall not exceed .4mm wherever not specified by the applicable code.
- d) Any deviations desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer-in-charge.
- e) Welding shall be continuous & uninterrupted during a pass.
- f) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiselling.
- g) While the welding is in progress care should be taken to avoid any kind of movement of components, to prevent occurrence of weld cracks.
- h) Fillet welds shall be made by shielded metal arc/ GTAW welding process irrespective of the thickness and class of piping.
- i) Peening shall not be used unless specified in the welding specification chart.

1.10.2 **Joint Completion**

- a) Joint shall be completed using the class of filler wires/ electrodes, recommended in the welding specification chart. Size of the electrode shall not exceed 4 mm in diameter for stainless steels and alloy steels used for low temperature applications.
- b) Two weld beads shall not be started at the same point in different layers.
- b) Butt joints shall be completed with a cover layer that would effect good cover at the joint edge and a gradual notch free surface.
- d) Each weld joints should have a workman like finish.
- e) Weld identification mark shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on the thin wall pipe. Suitable paint shall be used on thin wall pipes for identification.
- f) No painting shall be done until the weld joint has been hydrostatically tested.

1.10.3 **Dissimilar Welds**

Where welds are to be produced between carbon steels and alloy steels, preheat and post weld heat treatment requirements shall be those specified for corresponding alloy steels and filler wire / electrodes shall correspond to ER 70 S-G or AWS E-7016/7018 type. For welds between two dissimilar Cr-Mo low alloy steels, preheat and post weld

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heat treatments shall be those specified for higher alloy steel and electrodes used shall correspond to those specified for steel of lower alloy content. For carbon steel or alloy steel to stainless welds, use of filler wire / electrodes E/ER-309/E-310/E NiCr Fe-3 shall be made. The welding procedure, electrodes / filler wires to be used shall be approved by the Engineer-in-Charge.

1.11 **Heat Treatment**

1.11.1 **Preheating**


- a) Preheating requirements for the various materials shall be as per the welding specification chart attached. No welding shall be carried out without preheating the joint to 10°C (50°F) when the ambient temperature is below 10 degree.
- b) Preheating shall be performed using resistance or induction heating methods. Preheating by gas burners, utilising any acetylene or oxy-propane gas mixtures, with neutral flame may also be carried out when permitted by the Engineer-in-charge.
- c) Preheating shall extend uniformly to atleast three times the thickness of the joint, but not less than 50mm, on both sides of the weld.
- d) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature indicating crayons or other temperature indicating devices shall be provided by the contractor to check the temperature.
- e) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature recorders shall be provided by the Contractor to record the temperature.

1.11.2 **Post Heating**

In case of alloy steel materials such as Cr-Mo steels, if the post weld heat treatment is not performed immediately after welding, the weld joint and adjacent portion of pipe, at least 50 mm on either side of weld, shall be uniformly heated to 300°C. This temperature shall be maintained for half an hour minimum, and then wrapped with mineral wool before allowing it to cool to room temperature. If the Post Heating temperature specified in the Welding Specification Charts exceeds 300°C, the same shall be followed. Similarly, if the welding specification chart specifies post-heat time, the same shall be applicable. Post weld heat treatment as specified in the Welding Specification Chart shall be carried out later on.


1.11.3 **Postweld Heat Treatment**

- a) Post weld heat treatment, wherever required for joints between pipes, pipes and fittings, pipe body and supports shall be carried out as per the relevant specifications, applicable standards and the instructions of the Engineer-in-charge. In this regard procedure qualification to be done before carrying out

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PWHT in production welds.

- b) The heat treatment of welded joints shall be carried out as per the requirements laid down in ANSI B31.8 and welding specification chart.
- c) The contractor shall submit for the approval of the Engineer-in-charge, the details of the post weld heat treatment procedure, as per **Exhibit 'B'** attached, that the propose to adopt for each of the materials/ assembly/ part involved, well before carrying out actual heat treatment.
- d) Post weld heat treatment shall be done by using an electric resistance or induction heating equipment as decided by the Engineer-in-charge.
- e) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat treated. Care shall be taken to ensure that width of treated band over which specified post weld heat treatment is carried out, the temperature attained is atleast as that specified in the relevant applicable standards/ codes.
- f) Throughout the cycle of heat treatment, the portion outside the heated band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose temperature at the exposed surface of the pipes should not be allowed to exceed 400°C.
- g) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples should be attached to the pipe directly at the equally spaced location along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 1 upto 6" dia, 2 upto 10" dia and 3 upto 12" and above. However the Engineer-in-charge can increase the required minimum number of thermocouples to be attached if found necessary.
- h) Automatic temperature recorders which have been duly calibrated should be employed. The calibration chart of each recorder should be submitted to the Engineer-in-charge prior to starting the heat treatment operation and his approval should be obtained.
- i) Immediately on completion of the heat treatment, the post weld heat treatment charts/ records alongwith the hardness test results on the weld joints (whenever required as per the welding specification chart), shall be submitted to Engineer-in-charge for his approval.
- j) Each joint shall bear an identification number which shall be maintained in the piping sketch to be prepared by the contractor. The joint identification number should appear on the corresponding post weld heat treatment charts. The same identification numbers shall also be followed for identification for corresponding radiographic films. The chart containing the identification

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numbers and piping sketch shall be submitted to the Engineer-in-charge in suitable folders.

- k) The hardness of the heat affected zone as well as of the weld metal, after heat treatment, shall be measured using suitable hardness tester and shall not exceed the maximum hardness specified in the welding specification chart. The weld joint shall be subjected to re-heat treatment when hardness measured exceeds the specified limit, at the contractor's own expenses.
- l) The contractor shall arrange for the hardness testing and shall maintain the records of all joints tested. These records shall be checked by the plant Owner's inspector.

1.12 **Cleaning of the Weld Joints**

All weld joints shall be free from adherent weld spatter, slag, dirt or foreign matter. This can be achieved by brushing.


1.13 **Inspection & Testing**

1.13.1 **General**

- a) The owner's inspector shall have free access to all concerned areas, where the actual work is being performed. The contractor shall also offer the Owner's inspector all means and facilities necessary for carrying out inspection.
- b) The owner is entitled to depute his own inspector to the shop or field where pre-fabrication and erection of pipelines are being done with (but not limited to) the following objectives :-
 - i. To check the conformance to relevant standards and suitability of various welding equipments and the welding performance.
 - ii. To supervise the welding procedure qualification.
 - iii. To supervise the welder performance qualifications.
- c) Contractor shall intimate sufficiently in advance the commencement of qualification tests welding works and acceptance tests, to enable the plant owner's inspector to be present to supervise them.

1.13.2 **Welding Procedure Qualifications**

- a) Welding Procedure Qualification shall be carried out in accordance with the relevant requirements of API 1104/ ASME Sec-IX or other applicable codes and other job requirements by the contractor at his expense. The contractor shall submit the welding procedure specifications in format as per **Exhibit-C** (attached) immediately after the receipt of the order.

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- b) COMPANY's inspector will review, check and approve the welding procedure submitted and shall release the procedure for procedure qualification tests. The procedure qualification test shall be carried out by the Contractor under field conditions at this own expense. A complete set of test results in format as per **Exhibit-D** (attached) shall be submitted to the COMPANY's inspector for approval immediately after completing the procedure qualification test and atleast 2 weeks before the commencement of actual work. Standard tests as specified in the code shall be carried out in all cases. In addition to these tests, other tests like radiography, macro/ micro examination, hardness testers, dye penetrant examination, Charpy V-notch etc. shall be carried out on specimens. It shall be the responsibility of the contractor to carry out all the tests required to the satisfaction of the COMPANY's Inspector. The destructive testing of welded joints shall be as per **Annexure-2** and ASME Sec-IX.

1.13.3 Welder's Qualification

- a) Welders shall be qualified in accordance with the API 1104/ ASME IX and other applicable codes by the contractor at his expense. The butt weld test pieces of the qualification test shall meet the radiographic tests requirements as mentioned in this specification. The COMPANY's inspector shall witness the test and certify the qualification of each welder separately. Only those welders who have been approved by the COMPANY's inspector shall be employed for welding. Contractor shall submit the welder qualification test reports in the standard format and obtain express approval, before commencement of the work. No welder shall be permitted to work without the possession of the identify card. It shall be the responsibility of contractor to carry out Qualification tests of welders.
- b) The welders shall always have in their possession the identification card as shown in **Exhibit-E** and shall produce it on demand by the COMPANY's Inspector. It shall be the responsibility, of the Contractor to issue the identify cards after it has been duly certified by the COMPANY. If a welder is found to perform a type of welding for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the Contractor.

1.13.4 Visual Inspection

Inspection of all welds shall be carried out by COMPANY as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage, cracks, under cuts, dimensions of the weld, surface porosity and other surface defects. Under-cutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/ code.

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1.13.5 Non-destructive Examination

The non destructive examination shall mainly consist of examination using x-ray radiography as detailed in **Annexure-4**.

Radiographic examination of one hundred percent (100%) girth welds will be required by the COMPANY. Welds shall meet the standards of acceptability as set forth in API 1104 and as per the requirements laid in subsequent paragraphs.

The CONTRACTOR shall make all the arrangements for the radiographic examination of work covered by this specification at his expense.

The COMPANY will review all the radiographs of welds and inform the CONTRACTOR regarding unacceptable welds. The decision of the COMPANY shall be final and binding in this regard.


All requirements mentioned in the specification shall be arranged and executed by the CONTRACTOR through his own resources. In addition, for pipes with wall thickness 9.5mm and above, ultrasonic inspection is required in the following cases as per **Annexure-3** of this specification.

- a) On the first 100 welded joints corresponding to each automatic (GTAW/ GMAW) welding procedure used.
- b) When 20mm or more are cut from the pipe end as supplied, the ends shall be ultrasonically inspected for an additional length of 20mm to ensure no lamination exist.
- c) When welds are repaired.
- d) When in the opinion of COMPANY, ultrasonic inspection is required to confirm or clarify defects indicated by radiography.
- e) When automatic procedure is used at least 10cm on each weld shall be ultrasonically inspected at COMPANY's discretion.

In addition, ultrasonic inspection may be required for certain critical weldings of the pipeline (i.e. tie-ins, welding of valves, flanges) randomly selected at COMPANY's discretion. All fillet and groove welds other than that radiographed shall be subjected to dye penetrant/ MP inspection. The non destructive test system used for inspecting welds must be approved by the COMPANY.

Weld quality is judged on the basis of the acceptability criteria mentioned below :

Any weld which as a result of radiographic and / or ultrasonic examination in the opinion of COMPANY **exhibits** imperfections greater than the limits stated in API-1104 latest edition or as superseded in this article shall be considered defective and shall so be marked with an identification paint marker.


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In addition to the API-1104 requirements, the welds containing cracks including crater cracks regardless of size of location are unacceptable.

- i. Any amount of inadequate penetration of the root bead as defined by API-1104 is unacceptable.
- ii. Any amount of incomplete fusion between the root and bevel as defined by API-1104 is unacceptable.
- iii. Unrepaired burn through areas are unacceptable.

Contractor shall appoint agency for carrying out the radiography works at site from the list of agency (ies) enclosed in the bid document.

- The Radiographic Examination procedures to be adopted shall be submitted by the contractor as per **Exhibit-F** and shall be got approved from the Owner's Inspector prior to employment. A person qualified to ASNT Level-II or ASNT Level-III in Radiographic testing shall prepare the procedure. The Radiography Procedure shall be established to demonstrate that the required sensitivity can be consistently achieved under the most unfavorable parameters (e.g. source to film distance, geometric unsharpness, thickness etc.). The radiographic technique and procedure adopted shall conform of the requirements mentioned in Article 2 as well as Article 22 of ASME Sec.V. The IQI sensitivity obtained shall be equal to or better than the requirements mentioned in Article 2 of ASME Sec.V. Source side penetrometer shall be used in establishing radiographic procedure / technique. The acceptance criteria shall be as per the relevant codes of Fabrication and over riding requirements if mentioned else where in the technical specifications of the contract. The Contractor shall be responsible for carrying out Radiography; rectification of defects and re-radiography of welds repaired/rectified at his cost.
- The extent of Radiography shall be as per specifications to be supplied to the Contractor. For welds between dissimilar materials, the extent of Radiographic Examination shall be the more stringent of the two recommended for the materials being welded. Wherever random Radiography is called for, in a particular piping class, the dissimilar materials weld joints shall essentially be included.
- Type of Radiation source and film to be used shall be as per **Exhibit-H** for carrying out radiographic examination. However if specifications (as given else where in the contract) for some critical material require usage of X-Radiation, then Radiography shall be done using X-Rays only.
- The Contractor shall fulfill all the statutory and owner's safety requirements while handling X-ray and Gamma-ray equipments.


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- In case of random radiography, the joints for Radiography shall be selected by the Owner's Inspector and the Radiography shall be performed in his presence, if he instructs the contractor to do so. The contractor shall furnish all the radiographs, to the Owner's Inspector immediately after processing along with evaluation by a person qualified to ASNT Level-II in Radiographic testing, inline with Article 2 of ASME Sec.V. The certificate of ASNT / ISNT Level II qualification of the NDT personnel shall be submitted to owner's inspector for his approval prior to start of job.
- The Contractor shall provide the Owner's Inspector, all the necessary facilities at site such as a dark room with controlled temperature, illuminator (viewer) suitable for varying densities, a duly calibrated electronic densitometer with batteries, magnifying glass, tracing papers, ruler, marking pencils etc. to enable him to review the radiographs.
- Where random radiography is specified, the first weld of each welder shall be completely radiographed. In the case of pipe of size 6" and below, the first two welds shall be completely radiographed.
- For each weld performed by a welder found unacceptable, two additional checks shall be carried out on welds performed by the same welder. This operation is iterative and the of two additional welds for each weld deemed unsatisfactory shall be continued till such time that two consecutive welds of satisfactory quality are found for every defective weld.
- The Contractor shall carry out these additional radiographic testing at his own expense. To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period to time, the Contractor shall promptly arrange for Radiographic Examination so that there is no accumulation of defective joints.
- Contractor shall quote rates for X-ray as well as Gamma Ray for joints indicated to be radiographed by X-ray in Table of **Exhibit-H**.

1.13.6

Check shots

- (a) Owner / Engineer- in- charge or his representative shall select 5% of the total joints radiographed on a day for check shots. Contractor shall carry out check shots as directed.
- (b) Weld profiles of check shots shall be compared with weld profile observed in the earlier Radiographs. In the event of anyone variation in the check shots and earlier Radiographs, contractor shall re-shoot the entire lot of joints radiographed by particular Radiography agency on the particular date. All the re-shot films shall be compared with the originally submitted films.

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1.13.7 **Magnetic Particle & Liquid Penetrant Examination**

- a) Whenever such tests are specified, the tests shall be carried out on joints chosen by the Owner's inspector, as per ASME Section V article 6 and 7 respectively. The tests are to be performed by a person possessing a valid ASNT / ISNT Level-II qualification in the method being used.
- b) For austenitic stainless steels and other nonmagnetic materials, liquid (dye) penetrant test shall be carried out. For carrying out this test, the materials shall be brought within a temperature limit of 15° to 50°C.

1.13.8 **Hardness Test**


Hardness requirements for welds shall be as per the Welding Specification Chart / Non Destructive Examination Specification attached elsewhere in the contract. Hardness testing shall be carried out by Vickers Hardness Tester during welding procedure qualification and shall be cross sectional. For production welds, hardness testing shall be carried out by portable digital hardness testers. Poldi hardness tester shall not be permitted. Contractor shall produce documentary evidence/calibration certificate to the Owner's Inspector and obtain approval of the hardness testing equipment.

1.13.9 **Proof Tests**

Hydrostatic and pneumatic tests shall be performed as per the requirements laid down in the respective flushing & testing specification/ applicable codes to demonstrate the soundness of the welds. The tests shall be conducted only after fulfilling the requirements of visual examination, radiography etc. and after the entire work has been certified by the Owner's inspector, as fit for subjecting to such test.

1.14 **Repairs of Welds**

- a) Defects ascertained, through the inspection methods, which are beyond acceptable limits shall be removed from the joint completely by the process of chipping and grinding.
- b) When an entire joint is judged unacceptable, the welding shall be completely cut and the edges be suitably prepared as per required alignment tolerances. The welded joint shall again be examined following standard practices.
- c) No repair shall be carried out without prior permission of the Owner's inspector.
- d) Where random radiography is specified, the test welds of each welder shall be completely radiographed. In the case of pipes of sizes 6" and below, the first two welds shall be completely radiographed.
- e) For each weld found unacceptable due to a welder's fault, two additional checks should be carried out on welds performed by the same welder. This operation is interactive and the procedure of radiographing two additional

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welds for each weld deemed unsatisfactory shall be continued till such time that the two consecutive welds of satisfactory quality are found for every defective weld.

The contractor shall carry out these additional radiographic testing.

To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period of time, the Contractor shall promptly arrange for radiographic examination so that there is no accumulation of defective joints.

1.15 **Limitations on Repairs**

Only one attempt at repair of any region is permitted. Repairs are limited to a maximum 30% of the weld length. For internal or external repairs which open the weld root, only 20% of the weld length may be repaired. Repairs opening the root must only be carried out in the presence of COMPANY. The minimum length of a repaired area shall be 100mm as measured over the recapped length. Welds containing cracks shall be cut out and rebevelled to make a joint, COMPANY shall authorise all repairs.

1.16 **Weld Rejected by Accumulation of Defects**

Where a weld is rejected by the accumulation of defect clause, as defined by API-1104 and this specification, repairs within these limitations are permitted. Defects in the filling and capping passes shall be repaired preferentially.

1.17 **DOCUMENTS TO BE SUBMITTED BY CONTRACTOR (4 COPIES EACH)**

- a) Electrode and Welding Consumable Qualification Records as per **Exhibit-A**, for the Welding Consumables tested and approved for the work.
- b) Batch Test Certificates, for the Electrodes used, obtained from the Electrode Manufacturers.
- c) Proposed Heat Treatment Procedure as per **Exhibit-B**.
- d) Heat Treatment Charts.
- e) Weld joint hardness test results.
- f) Welding Procedure Specifications as per **Exhibit-C** immediately after receipt of the order.
- g) Welding Procedure Qualification records as per **Exhibit-D**.
- h) Welder Performance Qualification records as per **Exhibit-E** immediately after conducting Welder Qualification Tests.
- i) Radiography Procedure as per **Exhibit-F** and other NDT procedures.
- j) Radiographic test Report along with Radiographs and other NDT reports.
- k) Piping Sketch (Isometric) giving all the details regarding the pipe specifications, welded joints, joints radiographed magnetic particle, tested, ultrasonic tested, penetrant tested, joints heat treated, WPS used, welders identification number, etc.


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EXHIBIT-A

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ELECTRODE QUALIFICATIONS TEST RECORD

A : Tested at (Site Name) Date :
Test Period :

Manufacturer's Name :
Brand Name :
Batch Number & size Tested :
Classification & Code :
Intended for Welding in positions :
In combination with (if any) :
Code of Reference (used for testing) :
Special requirements (if any) :

B : **All - Weld Tensile Test**

Base Material used :
Pre-heat temperature :
Postweld Heat Treatment Details :
Visual Examination :
Radiographic Examination Results :

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Tensile Test Results :

Sl. No.	Identification Number	U.T.S.	Yield Point	Elongation	Remarks

C : Impact Test Results

Test Temperature : Notch in :

Type of Specimens (Impd, Charpy) : Size of Specimens :


Specimen No.	Impact Value	Average
1.		
2.		
3.		
4.		
5.		

D : Chemical Analysis Result

Electrode size used :

Batch No.

%C	%S	%P	%Si	%Mn	%Cr	%Ni	%Mo

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E : Fillet Weld Test Results

Welding Positions :

Base Materials :

Size of electrode used :

Visual Inspection Results : 1)
2)
3)

Micro Test Results

Fracture Test Results :

Remarks :

F : Other Test Results

i) Transverse Tensile Test :

In Combination with :

Base Material used :


Position of Welding :

Preheat Temperature :

Postweld Heat Treatment :

Radiography :

Identification No.	U.T.S.	Fracture in	Remarks

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2. **Guide Bend Test**

Position	ID No.	Root, Face or Side Bend	Remarks
	1		
	2		
	3		
	4		
	5		

3. **Any other tests**

Conclusions

Approved By :


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STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Name of the Heat - Treatment :

Name of the Project :Specification
Reference No.

1. General Details

Name of the Equipment :

Name of the Assembly/ Part :

Assembly/ Part Drawing No. :

Material :

2. Furnace Details

Type of Heating : Gas/ Oil/ Elec. Res./ Induction (Tick Mark)

Capacity (size) :

Maximum Temp. (°C)

Method of temp. measurement :

Atmosphere Control :

3. Heat Treatment Cycle Details

Charging Temp. °C :


Rate of Heating, °C/Hr :

Soaking Temp., °C :

Soaking Time, Hrs. :

Rate of Cooling, °C/Hr :

Mode of Cooling :

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4. Other Details, if any :
5. The following documents are to be furnished :
along with these specification :
 - i) Material Test Certificates
 - ii) Assembly/ Part Details



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STANDARD PROCEDURE SPECIFICATION NO.

for Welding of Pipe and Fittings

- Process & type (Details of special machines).
- Material (Pipes to which the procedure applied, grade of steel, type of pipe, Reference Specification).
- Diameter and wall thickness (Series of dia and thickness to which procedure is applicable)
- Joint Design
- Filler Metal and Number of Beads
- Electrical or Flame Characteristics
- Position
- Direction of Weldings (Uphill, Downhill, Mixed)
- Number of Welders
- Time Lapse between passes
- Type of Line-up Clamp
- Removal of Line-up Clamp (Minimum percentage of welding carried out before removal of clamps)
- Cleaning
- Preheat, Stress Relief
- Shielding Flux
- Speed of Travel
- Sketches and Tabulations (to be attached)
- Wire Speed (rate of wire speed and variation range)
- Minimum No. of passes which must be completed before discontinuing weld.

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- Minimum No. of welders required for the first pass and second pass :

Tested : Welder

Approved : Welding Supt.

Accepted : Chief Engineer

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Remarks on Bend Tests

1.
2.
3.
4.

Remarks on Nick Tests

1.
2.
3.
4.

Other Tests

(Use back for additional remarks)


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EXHIBIT-E

WELDER'S IDENTIFICATION CARD

Name :
Identification :
Date of Testing :
Valid Unit :
Approval of Welding :
Welding Position :
Material :
Diameter :
Wall Thickness :
Type of Welding Consumable :

Approved By :

Employer's Signature
with Seal


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EXHIBIT-F


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RADIOGRAPHIC PROCEDURE FOR PIPE WELDING

1. Location
2. Date of Testing
3. Name of Supervised Contractor
4. Material
5. Dia. & Thickness
6. Type of Weld Joint
7. Radiation Source (X-ray, gamma ray)
8. Type of equipment (external/ internal)
9. Intensifying screens and material
10. Filter type and placement mask, diaphragm lead screen etc. adjacent to radiation sources or specimen.
11. Geometric relationship (source local spot size, max and min source strength, object to film distance, radiation angle with respect to weld and film).
12. Limit of film coverage
13. Film type and make
14. Exposure Time
15. Processing (time temperature for development stop bath or rinse, fixation, washing, drying etc.)
16. Density
17. Sensitivity
18. Type of penetrameter

Approval of the COMPANYY

Signature of CONTRACTOR
with seal

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WELDING SPECIFICATION CHART

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Class :

Material Specification :

Pipes : API 5L Gr. X 60, API 5L Gr. B API 5L Gr. X 42
Fittings : A 105, A234 Gr. WPB. MSS-SP-75, Gr. WPHY42, MSS-S
Flanges : A 105, MSS-SP-44 Gr. F42, MSS-SP as Gr. WPH 60
Other : _____ 44 Gr. F6C

Base Metal of NCL :

Welding Processes : Groove Joints : Butt

Root Pass SMAW Filler Pass SMAW Root Pass SMAW Filler Pass SMAW Filler Joints/ Socket Joints : SMAW

Welding Materials : Groove Joints : Butt

Root Pass E6010G/ E7010G Filler Pass F7010G/ E8010G/ E8818G
Root Pass E7010/ E7018G/ E8018G Filler Pass F7016/ E7018G/ E80118G

Filler Joints/ Socket Joints : E7016/ E7018/ E7018G/ E8018G

Backing Page _____ Consumable :

Gases : Purging _____ Sheilding


Gas Composition : Purging _____ Sheilding

Preheating : 10 min for all welds, 100°C Post heating

Post weld heat treatment :

Holding temp. : 595-650 C Holding Time : 1 Hr. per inch thk
Rate of heating : 200 C/hr max. Min holding time : 1 hr.
Method of cooling : Controlled Rate of cooling : 200°C/hr max.

Mechanical property requirements :


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Charpy `V' notch impact test valve :

Normal : 22 J
 Average : 27 J
 At temperature : 0 °C
 Hardness : 300 HV10 (for weld & HAZ)

Code of fabrication : ANSI B31.8; API 1104 and welding specifications.

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TECHNICAL NOTES


1. Welding, heat treatment and non destructive testing shall be carried out in accordance with the requirement of ANSI B31.8/ API-1104 and additional requirement specified in the specification. In case of conflict between code and specification more stringent conditions shall be applicable.
2. No welding shall be carried out without preheating the joint to 10°C (50 °F) when the ambient temperature is below 10°C (50 °F).
3. Preheat shall be applied while welding the following material as detailed below :

API 5L Gr. B	:	Thickness upto and inclusive of 12mm	100 °F min.
A 105	:		
MSS-SP-44 Gr. F60	:	Thickness beyond	200 °F
A 234 Gr. WPB	:	12 mm	
MSS-SP-75-WPHY60			

4. For fillet welds complete welding may be carried out using the electrodes recommended for filler passes.
5. All weldments & HAZ shall meet the hardness requirements of 300 HV10 during procedure qualification. If the hardness exceeds 300 HV10 the joints shall be heat treated at temp. 1100-1250 °F for one hour. The heating and cooling rates shall be decided during procedure qualification subject to a maximum of 200 °C/Hr. Hardness testing shall be carried out by Vickers hardness tester during welding procedure qualification test only. No hardness test is required for production welds.
6. The electrodes used shall meet the following additional requirement :

<u>Specification</u>	<u>UTS (Min.) (As welded)</u>	<u>Impact (As welded)</u>
E7018-G	52.7 kg/mm ²	20 ft. lb. at 0°C
E7018-I	52.7 kg/mm ²	-
E6010	-	-
E6018	-	20 ft. lb. at 0°C

7. All the weldments & HAZ shall meet the impact test requirement of 20 ft. lb at 0°C.

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ANNEXURE-2

1.0 **DESTRUCTIVE TESTING OF WELDED JOINT - BUTT WELDS**

1.1 **Preparation**

Having passed the visual and the non destructive inspection, the test weld shall be subjected to mechanical test.

After satisfactory completion of all visual and non destructive testing the procedure test weld shall be set aside for a period not less than 24 hours. No further work on the test weld and no cutting of test specimens from the weld be performed till a period of at least 24 hours has expired.


Weld specimens, for pipe diameter greater than or equal to 12.3/4" shall be taken from the positions indicated in Fig. 1 of this specification from areas as free from defects as possible. For this reason it is necessary to take the previous non destructive tests into account. The minimum no. of tests to be carried out is given in Table-I of this specification.

The test shall be carried out at laboratories approved by COMPANY. The specimens shall be prepared in accordance with the figure given in the paragraphs which refer to the individual test.

Table-I

TYPE AND NUMBER OF TEST SPECIMENS FOR PROCEDURE QUALIFICATION TEST

Pipe Size, Out-side diameter Inches	Number of Specimens									
	Tensile API	Tensile ISO	Nick Break	Root Bend	Face Bend	Side Bend	Macro	Hard- ness	Impa ct	Total
Wall Thickness > 1/2 inch (12.7mm) and under										
Under 2 3/8	0	0	2	2	0	0	0	0	0	4
2 3/8 to 4 1/2 incl.	0	0	2	2	0	0	0	0	0	4
Over 4 1/2 less than 12 3/4	2	0	2	2	2	0	2	2	12	24
12 3/4 and over	2	2	4	4	4	0	2	2	24	44
Wall Thickness > 1/2 inch (12.7mm)										
4 1/2 and smaller	0	2	0	0	0	2	0	0	0	4
Over 4 1/2 less than 12 3/4	2	0	2	2	2	0	2	2	12	24
12 3/4 and over	2	2	4	0	0	8	2	2	24	44

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1.2 Tensile Strength

Specimens for pipe diameter over 12 3/4" shall be taken from the position indicated in Fig. 1 of this specification. Two API type specimen shall be taken for pipe diameter greater than or equal to 12 3/4".

1.3 Nick-Break Test

1.3.1 Preparation

Specimens for nick-break test with notches thus worked can break in the base metal, instead of in the fusion zone; therefore an alternative test piece may be used after authorisation by the COMPANY with a notch cut in the reinforcement of outside weld bead to a maximum depth of 1.5mm measured from the surface of the weld bead.

1.4 Macroscopic Inspection

1.4.1 Preparation

Specimens shall be taken from the positions indicated in Fig. 1 of this specification and shall be prepared in accordance with ASTM E2 and E3.

The width of the macrosection has to be at least three times the width of the weld. The section is to be prepared by grinding or polishing and etching to clearly reveal the weld metal and heat effected zone.

1.4.2 Method

Specimens shall be carefully examined under the microscope with a magnification of at least 25 times. The COMPANY may ask for a macrograph with 5 times magnification for documentation purposes.


1.4.3 Requirements

Under macroscopic examination, the welded joints shall show good penetration and fusion, without any defect exceeding the limits stated in the evaluation criteria of the nick break test.

1.5 Hardness Test

1.5.1 Preparation

The prepared macrosection is to be used for hardness testing using the Vickers method with 100 N (10 kg) load. Indentations are to be made along traverses each approximately 1mm below the surface at both side of the weld.

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In the weld metal a minimum of 6 indentations equally spaced along the traverses are to be made. The HAZ indentations are to be made along the traverses for approximately 0.5mm each into unaffected material, and starting as close to the fusion line as possible.

One indentation at each side of the weld along each traverse has to be made on parent metal. Reference is made to fig. 3 of this specification. The indentation are to be made in the adjacent region as well as on the opposite side of the macrosection along the specified traverses.

1.5.2 Method

The test shall be carried out in accordance with Recommendation ISO R81, Vickers hardness, using laboratory type machine controlled as per-recommendation of ISO R 146 and using a diamond pyramid penetrator set at 2.37 rad. (136) with a load of 100 N (10 kg).

1.5.3 Requirements

Hardness value shall not exceed 300 H VI0 . In case of a single reading slightly (+10 HV) higher than the specified limit, further indentations should be made to check if the high value was an isolated case.

All the hardness values obtained from the heat effected zone shall not exceed 100 HV with respect to the average hardness of the values obtained for the base metal.


If these additional tests mentioned above give a hardness within the specification limit, the slightly higher value may be accepted.

1.6 Charpy-V-notch Impact Test

1.6.1 Specimens shall be taken from the position indicated in Fig. 1 of this specification. The test specimens will be prepared in accordance with ISO R 148. Charpy V-notch specimens shall have dimensions as given in Fig. 3 of the specification.

Three test specimens shall be taken from each sample and they shall be cut and worked so that their length is transversal and perpendicular to the weld bead with the notch position as shown in Fig. 4 of this specification. The notch shall be perpendicular to the roller surface. The test specimens width shall depend upon the pipe wall nominal thickness as following :

Nominal wall thickness in mm	Test Specimens width in mm
> 12	12
> 9.5 and ≤ 12	7.5

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 ≥ 7 and ≤ 9.5

5

 < 7

2.5

1.6.2 Test Method

The test shall be carried out as indicated in ISO R 148 "Beam Impact Test V-notch.

Test pieces shall be immersed in a thermostatic bath and maintained at the test temperature for at least 15 minutes. They shall then be placed in the testing machine and broken within 5 seconds of their removal from the batch.

1.6.3 Requirements

The impact energy shall be greater or equal to :-

Test Specimens in mm	Average of Three specimens Joule (min) (Note-2)	Minimum Single Value Joules (Note 1)
10	27	22
7.5	21.5	17.5
5	18.5	15.0
2.5	10.0	8.0

Note:

1) Only one value is permitted to be lower than average upto the value specified.


1.7 Bend Test Requirements

The bend test specimens shall be made and tested as per the requirements of API-1104 sixteenth edition - May, 1983 except that the dimensions of Jig for guided bend test fig. 5 para 2.6 API-1104 shall be modified as follows :

Radius of the plunger	°A'	= 2 t
Radius of the die	°B'	= 3 t + 1.6mm
Width of the die	°C'	= 50.8

The acceptance criteria shall however be as per para 2.643 and 2.653 of API-1104 sixteenth edition - May, 1983.

Note t = Thickness of Specimen (nominal)

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ANNEXURE-3

1.0 **ULTRASONIC INSPECTION**

In addition to the radiographic inspection ultrasonic inspection is required as per conditions mentioned in **Annexure-1** of this specification.

This section concerns manual ultrasonic inspection. However ultrasonic inspection by automatic equipment may be used if approved by the COMPANY.

1.1 **Equipment and Operators**

The CONTRACTOR who carries out the ultrasonic inspection shall have sufficient qualified personnel, equipment and instrument at his disposal to be able to effect the tests without hindering or delaying the pipeline assembly operations.

- Calibrate the equipment;
- Perform an operational test under production conditions;
- Interpret the screen picture;
- Evaluate the size and location of reflectors
- Interpret the type of defects detected.

The COMPANY has the option of checking the ability of personnel employed for ultrasonic testing by means of qualification tests.

The CONTRACTOR appointed to carry out UT inspection shall supply the instruments necessary for their execution on site.


1.2 **Specification for Ultrasonic Testing Procedure**

Qualification

Before work begins the CONTRACTOR shall present a specification describing the proposed U.T. procedure qualification.

This specification shall be state, as an indication only but not limited to the following information :

- Type of U.T. equipment used
- Type and dimensions of transducers
- Frequency range
- Details for calibration
- Coupling medium
- Inspection technique
- Record details
- Reference to the welding procedure where it is intended to adopt the specification.
- Temperature range of the joints to be inspected.

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1.3 **Qualification of Ultrasonic Inspection Procedure**

The ultrasonic inspection procedure shall be approved by the COMPANY. Before inspection begins, the COMPANY may require the qualification test of the ultrasonic inspection procedure. This specification test consists in testing (under normal operating conditions) some CONTRACTOR welds made according to the same production procedure, when there are typical defects the test intends to detect.

1.4 **Test Procedure**

Circumferential weld shall be inspected from both sides using angled. Probes.

The surface with which the probe comes into contact shall be free of metal spatter, dirt, iron oxide and scales of any type: therefore it shall be necessary to clean a strip at least 50mm wide on both sides of the weld with steel - wire brushes and anyhow the cleaned strip must be atleast wide enough to allow full skip examination.

If during the test, echoes of doubtful origin appear, it shall be necessary to inspect a convenient area on the pipe surface, close to the weld, with a straight beam transducer in order to check whether any manufacturing defects are present which could have interfered with the ultrasonic beam.

By way of an example, the equipment shall include but not be limited to the following :


- Ultrasonic equipment and coupling medium
- Sample sections for calibration of instruments.
- Equipment for cleaning of surface to be examined.
- Rulers calibrated in centimeters for exact location of the position of defects.

The characteristics of the above-listed instruments and equipment shall guarantee:

- a) that the required standards of the inspection procedure, as previously established and approved by the COMPANY, are satisfied.
- b) continuous operation

All the instruments and equipment shall be approved by the COMPANY before being used. The COMPANY has the authority to reject any item which is considered unsuitable. The decision of the COMPANY is final. The CONTRACTOR appointed to carry out ultrasonic inspection shall also ensure the operational efficiency and maintenance of the instruments and equipment, and shall immediately substitute any item rejected by the COMPANY.

All the instrument and equipment necessary for carrying out ultrasonic inspection on site shall satisfy the requirements laid down by the public board of institutions which regulate "safety at work".

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1.5 **Ultrasonic Instruments**

The ultrasonic instruments :

- Shall be each pulse type, able to generate, receive and display, on the screen a cathode ray tube (CRT) pulse, at frequencies between 1 and 6 mhz. The useful part of the CRT screen shall be at least 70mm wide and at least 50mm high.
- Shall have various amplification, with steps of 1 or 2 dB over a range of a least 60 dB.
- The regulation control shall be accurate to within 1 dB and this accuracy shall be certified by the instrument manufacturer.
- May be powered by a battery or an electric generator. In the first case, the autonomy of operation (endurance) of the instrument shall be sufficient to carry on working without frequent interruptions, and the instrument shall be equipped with an automatic switch which switches it off when the battery runs down, in the second case, there must be a voltage stabilising device with a tolerance of 2 volts.

1.6 **Probes**

The probes used shall have dimensions, frequencies, and a refraction angle suited to the type of steel, the diameter the thickness of the pipeline and to the joint design.

1.7 **Reference Sample Pieces**


The efficiency of the equipment used, the effective refraction angle of the probe, and the beam output points, shall be checked using a V₁ and V₂ sample block, IIW type or the calibration block ASTM E-428.

For the calibration of runs and the regulation of detection sensitivity during the test, a calibration piece be used. This piece shall be taken from the production material, and will be at least 150mm long (measured in the direction of the axis), and at least 50mm wide (measured in the direction of the circumference), (see Fig. 4 of this specification).

In the middle of the inside and the outside surface of the calibration piece a groove shall be made. The groove will have a rectangular cross-section, a flat bottom and the following dimensions :-

- Depth : 1 +/- 0.1mm
- Breadth (measured parallel to the 150mm side) : 1 +/- 0.1mm
- Length (measured parallel to the 50mm side) not less than 30mm.

In addition, the calibration piece shall have a hole, 2mm in diameter, passing through its thickness and positioned so that during calibration the echoes returning from the two grooves do not interfere with those returning from the hole.

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1.6 Calibration

For a precise check of the sound paths necessary for a full inspection of the weld joint, the probe shall be moved (half skip and full skip distance) until internal and external notches on the test piece are detected (see Fig. 5 of this specification).

The relevant defect limits the path lengths on the time base. The calibration of reference sensitivity is obtained by utilising the through drilled test hole in the thickness of the reference block to draw the distance amplitude correction curve relevant to the test probe.

Calibration shall be carried out according to the following procedure : place its internal vertex until the maximum height of echo is displayed on the screen; this echo is adjusted to 80% of full screen height by means of the sensitivity adjuster set in dB. Without varying the amplification, the probe placed at full skip distance from the hole is moved to detect the external vertex the hole until the maximum height of echo is obtained. The straight line connecting the peaks of the two echoes obtained by the above procedure, represents the 100% reference level, while the one connecting the two points at half height of the same echoes represents "50% reference level".

The two straight lines shall be marked on the screen with a pen. Calibration shall be repeated each time tests are re-started at intervals not longer than 30 minutes during normal operations; each time the conditions fixed in advance are altered. This calibration is applicable provided that the crystal of the probe is 8 x 9mm size. Should this size of the crystal be different, the value of the sensitivity obtained from the calibration by a crystal of a different size shall be brought to the value of sensitivity obtained from the calibration by a 8 x 9mm crystal. The sensitivities of the two different size probes shall be compared through the echoes obtained on the notch of the test piece with the probe position at half skip of the distance.

1.9 Regulation of Amplification during Production Testing


The amplification during production testing shall be obtained by adding 2-6 dB (according to the surface condition of the pipe and its cleanliness) to the reference amplification.

1.10 Qualification of Ultrasonic Testing Operators

Before the inspection begins or during the same inspection, the COMPANY may require a qualification test for the ultrasonic equipment operators.

1.11 Evaluation of Indications given by Ultrasonic Tests

Each time that echoes from the weld bead appear during production testing, the instrument amplification shall be altered to coincide with the reference amplifications and the probe shall be moved until maximum respond is obtained paying attention all the time to the probetube coupling.


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If, under these conditions, the height of the defer echo is equal to or greater than that of the reference echo, the defect shall be evaluated. If the defect has also been detected by the radiographic and or visual examination, the dimensions shall be judged according to the type of examination which detects the greater defects. Returns which are less than 50% of the reference echo, will not be considered. If returns are above 50% but lower than 100% of the reference echo, and if the operator has good reasons to suspect that the returns are caused by unfavorably oriented cracks, he shall inform the COMPANY. Moreover, when there is a defect to be repaired such defect shall be removed for a length corresponding to the one where no more return echo is given.

1.12 **Other Equipment**

The use of rules calibrated in centimeters, attached if possible to the probe, for the precise location of the position of welding defects, it recommended. Defect location is effected by measuring the projection distance between the probe output and the reflecting surface.

The operators carrying out the tests shall have besides the probing instrument, tools for cleaning the pipe surface (files, brushes, etc.) as well as the coupling liquid or paste appropriate for the temperature of the section to be examined.

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ANNEXURE-4

RADIOGRAPHY

1.0 **SCOPE**

This annexure covers the radiographic inspection of all types of welded joints of the main pipeline. The welded joints shall include the following :

- i) Full girth welds on the mainline construction including double jointing of pipe, if adopted.
- ii) Welds for installation of block valves, insulating joints and other appurtenances and tie-ins.
- iii) Welds at scraper launching and receiving barrels
- iv) Terminal Piping.

2.0 **APPLICABLE STANDARDS**

This specification shall apply in conjunction with the following (all latest edition) :


- i) API 1104, Standard for welding pipelines and related facilities.
- ii) ANSI B31.8, code for Gas Transmission and Distribution Piping Systems.
- iii) ANSI B31.4, Code for Liquid Petroleum Transportation Piping System.
- iv) ASTM E94, Recommended practice for Radiographic Testing.
- v) ASTM, E 142, Standard Method for Controlling Quality of Radiographic Testing.
- vi) The American Society for non-destructive Testing. Recommended Practice No. SNT-TC-1A Supplement-A.

3.0 **PROCEDURE**

3.1 The radiographic examination procedure to be adopted shall be submitted by the CONTRACTOR as per **Exhibit-F**.


3.2 The procedure of radiographic examination shall be qualified to the entire satisfaction of COMPANY prior to use. It shall include but not be limited to the following requirements.

- i) Lead foil intensifying screens, at the rear of the film shall be used in all exposures.

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- ii) Type 2 and 3 films as per ASTM E-94 shall be used.
- iii) A densitometer shall be used to determine film density. The transmitted film density shall be 2.0 and 3.5 through out the weld. The unexposed base density of the film shall not exceed 0.30.
- iv) Radiographic identification system and documentation for radiographic interpretation reports and their recording system.

- 3.3 The CONTRACTOR shall qualify each procedure in the presence of the COMPANY prior to use.
- 3.4 The procedure of radiographic examination shall produce radiographs of sufficient density, clarity and contrast so that defects in the weld or in the pipe adjacent to the weld, and the outline and holes of the penetrometer are clearly discernible.
- 3.5 All the girth welds of mainline shall be subjected to 100% radiographic examination. The CONTRACTOR shall furnish all the radiographs to the COMPANY, immediately after processing them, together with the corresponding interpretation reports on approved format. The details of the radiographs alongwith the joint identification number shall be duly entered in a register and signed by the CONTRACTOR and submitted to the COMPANY for approval.
- 3.6 When the radiation source and the film are both on the outside of the weld and located diametrically opposite each other, the maximum acceptable length of film for each exposure shall not exceed the values given in Table 4 of API 1104. The minimum film overlap, in such cases, shall be 40mm. The ellipse exposure technique may be used on nominal pipe sizes of 2 inch and smaller provided that the source to film distance used is a minimum of 12 inches.
- 3.7 Three copies of each acceptable radiographic procedure (as outlined in Specification no. MEC/S/05/62/02) and three copies of radiographic qualification records, shall be supplied to COMPANY. One set of the qualifying radiographs on the job shall be kept by the CONTRACTOR's authorised representative to be used as a standard for the quality of production radiographs during the job. The other two sets shall be retained by COMPANY for its permanent record.
- 3.8 Three copies of the exposure charts relating to material thickness, kilo voltage, source to film distance and exposure time shall also be made available to aCOMPANY by the CONTRACTOR.
- 3.9 The CONTRACTOR shall, on a daily basis, record for each radiograph (1) radiography number (2) approximate chainage of weld location, (3) whether or not the welds meet the specified acceptance standards and (4) the nature and approximate location of unacceptable defects observed. It must be possible to relate to a particular butt weld and welder on piping drawing and pipeline alignment drawing.

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3.10 Each day's production of processed radiographs shall be properly packaged separately, identified by at least the (1) date, (2) radiographic unit, (3) job locations, (4) starting and ending progress survey stations and (5) shall include original and three copies of the daily radiographic record. The package shall be submitted to the COMPANY daily when possible, but in no event later than noon of the following day.

3.11 The CONTRACTOR shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the COMPANY to examine the radiographs.

3.12 The CONTRACTOR, if found necessary, may modify the procedure of radiographic examination suiting the local conditions prevailing. This shall, however, be subject to the approval of the COMPANY.

3.13 COMPANY shall have free access to all the CONTRACTOR's work facilities in the field.

3.14 Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his responsibilities and guarantees.

4.0 **RADIATION SOURCE**

4.1 Radiographic examination shall be carried out using x-radiations. Radiographic examination by Gamma rays may be allowed, at the discretion of the COMPANY, in case of inaccessible joints.

4.2 Whenever possible, pipeline welds will be inspected by placing the radiation source inside the pipe, on the pipeline axis, with a radiation of 6.28 rad. (360°).


If it is impossible to place the radiation source inside the pipe, the weld will be inspected with the source on the outside. An overlap of at least 40mm at the ends of each film shall be required to ensure that the first and last location increment numbers are common to successive films and to establish that no part of a weld has been omitted.

5.0 **LEVEL OF QUALITY**

The quality level of radiographic sensitivity required for radiographic inspection shall be at least equivalent to the values in Figure-6.

6.0 **PENETRAMETERS**

6.1 The image quality indicator (abbreviation : IQI) shall be used for the qualification of the welding procedure and during normal line production. Radiographic sensitivity shall be measured with the wire image quality indicator (Penetrameter). The penetrameter shall be selected according to DIN 54109 or ISO 1027. For radiographs made with the source on the outside, a penetrameter shall be placed on each side of the film with the smaller wire of the penetrameter turned towards the end of the film itself. When a complete weld is radiographed in a single exposure using a source inside the piping,

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four penetrameters approximately equally spaced around the circumference shall be used. During the procedure qualification, IQI shall be placed both on the source side and on the film side. The sensitivity obtained with IQI on the source side shall not be less than the values shown in Fig. 6 of this specification.

The sensitivity limit may be considered to have been reached when the outline of the IQI, its identification number and the wire of the required diameter show up clearly on the radiographs.

The COMPANY may authorise use of types of IQI other than those planned, provided that they conform with recognised standards and only if the CONTRACTOR is able to demonstrate that the minimum sensitivity level required is obtained. For this demonstration, a test shall be carried out comparing the IQI specified and the CONTRACTOR's to show up the identification number and other details of the proposed IQI, which must be visible in the test radiograph.

7.0 **FILM IDENTIFICATION MARKERS**

All films shall be clearly identified by lead numbers, letters, and/ or markers. The image of the markers shall appear on the films, without interfering with the interpretation. These markers positions shall also be marked on the part to be radiographed and shall be maintained during radiography.

8.0 **PROTECTION AND CARE OF FILM**

8.1 All unexposed films shall protected and stored properly as per the requirements of API 1104 standard and ASTM E 94.

8.2 The exposed and unexposed film shall be protected from heat, light, dust and moisture. Sufficient shielding shall be supplied to prevent exposure of film to damaging radiation prior to and following the use of the film for radiographic exposure.


9.0 **RE-RADIOGRAPHY**

9.1 The weld joints shall be re-radiographed in case of unsatisfactory quality of the radiographs, at the expense of the CONTRACTOR.

9.2 All the repaired weld joints shall be re-radiographed at no extra cost to the COMPANY in the same manner as that followed for the original welds. In addition, the repaired weld area shall be identified with the original identification number plus the letter 'R' to indicate the repair.

9.3 When evaluating repair film, radiographers shall compare each section (exposure) of the weld with the original film to assure repair was correctly marked and original defect removed.

9.4 The COMPANY will review prior to any repair of welds, all the radiographs of welds which contain, according to the CONTRACTOR's interpretation, unacceptable defects.

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The final disposition of all unacceptable welds shall be decided by the COMPANY.

10.0 **QUALIFICATION OF RADIOGRAPHERS**

10.1 Pipeline radiographers shall be qualified in according with the requirement of API 1104 and to the full satisfaction of COMPANY.

10.2 Certification of all the radiographers, qualified as per 10.1 above, shall be furnished by the CONTRACTOR to the COMPANY before a radiographer will be permitted to perform production radiography. The certificate record shall include :

- i) Background and experience record
- ii) Training course record
- iii) Technical examination record
- iv) Doctor's report on radiographer's Oaecuer 0-1 acquity eye test.
- v) Date of qualification.

10.3 The radiographers shall be required to qualify with each radiographic procedure they use, prior to performing the work assigned to him in accordance with the specification.

11.0 **PRESERVATION OF RADIOGRAPHS**

11.1 The radiographs shall be processed to allow storage of films without any discoloration for at least three years. All the radiographers shall be presented in suitable folders for preservation alongwith necessary documentation.

11.2 All radiographs shall become property of the COMPANY.

12.0 **EQUIPMENT AND ACCESSORIES**


12.1 CONTRACTOR shall make necessary arrangement at his own expense, for providing the radiographic equipment, radiographic films and the accessories for carrying out the radiographic examination for satisfactory and timely completion of the job.

12.2 For carrying out the mainline radiographic examination the CONTRACTOR shall be equipped with suitable mobile/ stationary type with rooms. These shall have all the required facilities for film processing. Film viewer used shall be equipped with the film illuminator that has a light source of sufficient intensity and can be suitably controlled to allow viewing film densities upto 4.0 without damaging the film.

13.0 **RADIATION PROTECTION**

13.1 CONTRACTOR shall be responsible for the protection and personal monitoring of every man with or near radiation sources.

13.2 The protection and monitoring shall comply with local regulations.

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13.3 In view of visual hazards in the handling of radioactive source of material, CONTRACTOR shall be solely responsible for complying with all rules and regulations set forth by Atomic Energy Commission or any other Government agencies of India in this regard and COMPANY shall not be responsible and shall be kept indemnified by the CONTRACTOR for default(s) of whatever nature by the Contractor. Safety equipment as considered adequate by the COMPANY for all necessary personnel shall be made available for use and maintained for immediate and proper use by the CONTRACTOR.

14.0 **DISPLAY OF SAFETY INSTRUCTIONS**

14.1 The safety provisions shall be brought to the notice of all concerned by display on a notice board at prominent place at the work spot. The person responsible for the "safety" shall be named by the CONTRACTOR.

15.0 **ENFORCEMENT FOR SAFETY REGULATIONS**

15.1 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangement made by the CONTRACTOR shall be open to inspection by COMPANY or its representatives.

16.0 **FIRST AID INDUSTRIAL INJURIES**

16.1 CONTRACTOR shall maintain first aid facilities for its employees and those of its sub-contractors.

16.2 CONTRACTOR shall make outside arrangements for ambulance service and for treatment of industrial injuries. Names of those providing these services shall be furnished to COMPANY prior to start of work and their telephone no. shall be posted prominently in CONTRACTOR's field office.

16.3 All critical industrial injuries shall be reported promptly to the COMPANY and a copy of CONTRACTOR's report covering each personal injury requiring the attention of physician shall be furnished to the COMPANY.

17.0 **NO EXEMPTION**

17.1 Notwithstanding the above there is nothing in these clauses to exempt the CONTRACTOR from the operation of any other act or rules in force.