

Rev. : 0


Edition : 1

**SPECIFICATION
FOR
VENTS, DRAINS AND WELLS**

SPECIFICATION NO.: MEC/S/05/21/15



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

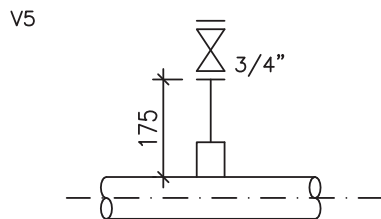
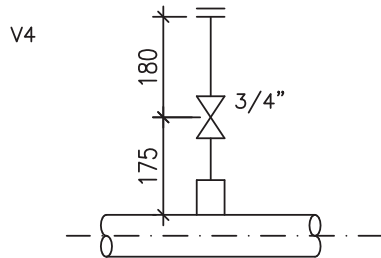
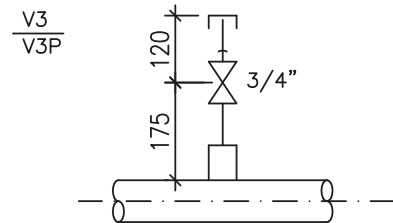
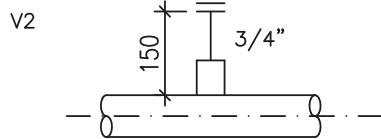
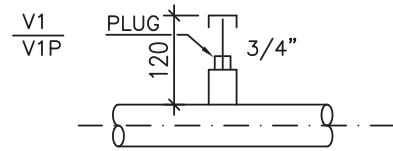
MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	VENTS, DRAINS AND WELLS	DOCUMENT NO. MEC/S/05/21/15	Page 1 of 1
			REVISION : 0
			EDITION : 1

CONTENTS

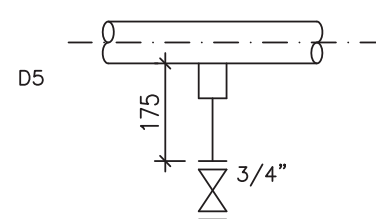
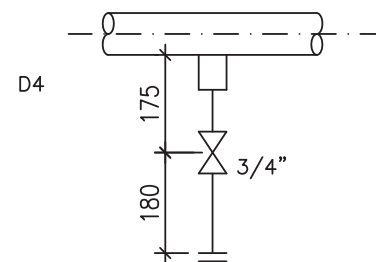
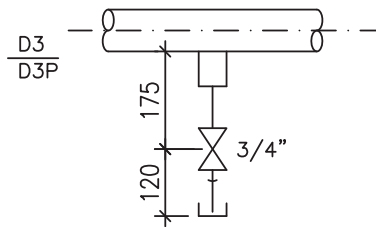
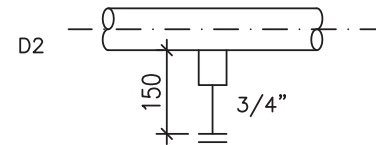
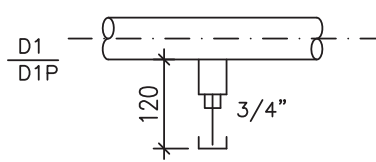
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1.	Vent & Drain for Line 2" & above	MEC/SD/05/21/15/01
2.	Wells Installation 1½ Dia Taps	MEC/SD/05/21/15/02 (Sheet 1 of 2)
3.	Wells Installation 1½ Dia Taps	MEC/SD/05/21/15/02 (Sheet 2 of 2)
4.	Vent & Drain for lines 1½" & below	MEC/SD/05/21/15/03
5.	Pressure Tapping	MEC/SD/05/21/15/05

PREPARED BY: (Binita Brahma)	CHECKED BY: (Sunil Kumar)	APPROVED BY: (A.K. Johri)	ISSUE DATE : Feb. 2009
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TYPE VENT

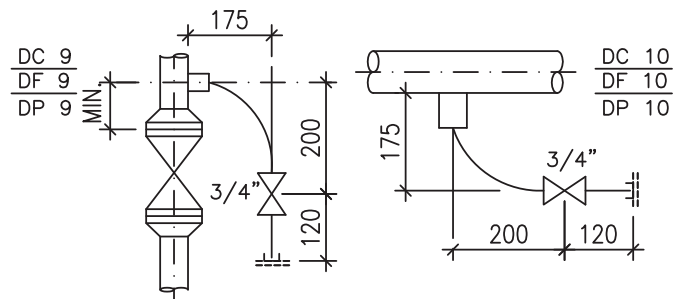


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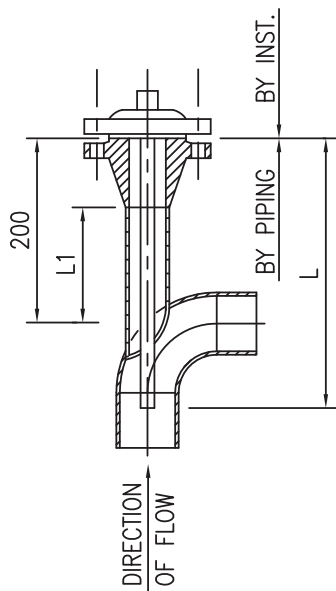


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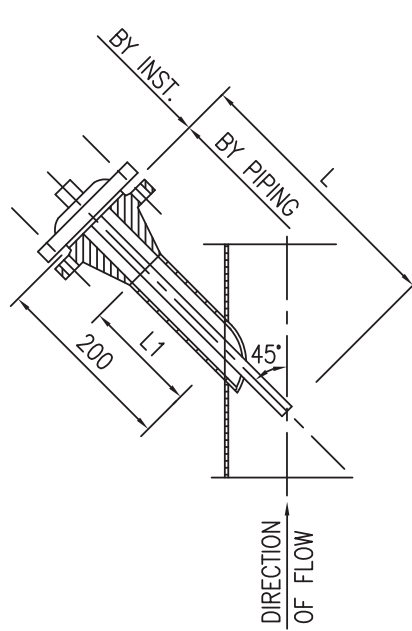
1. DIMENSIONS ARE VALID FOR 75mm (MAX.) THICKNESS INSULATION FOR HIGHER INSULATION THICKNES INCASE DIMENSIONS AS REQUIRED.
2. VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE WITH HALF COUPLING OR STUB IN WITH CAP OR FLANGE, BLIND FLANGE, AS PER PIPING SPECIFICATIONS.
3. VENTS/DRAINS CAN BE PROVIDED ON FLAT SIDE OF ECCENTRIC REDUCERS ON SIZES 4" & ABOVE.
4. LEGEND V=VENT, D=DRAIN, C=CAP, F=FLANGE, P=PLUG
5. PLUGGED END OF VALVE OR FITTING SHALL BE THREADED.



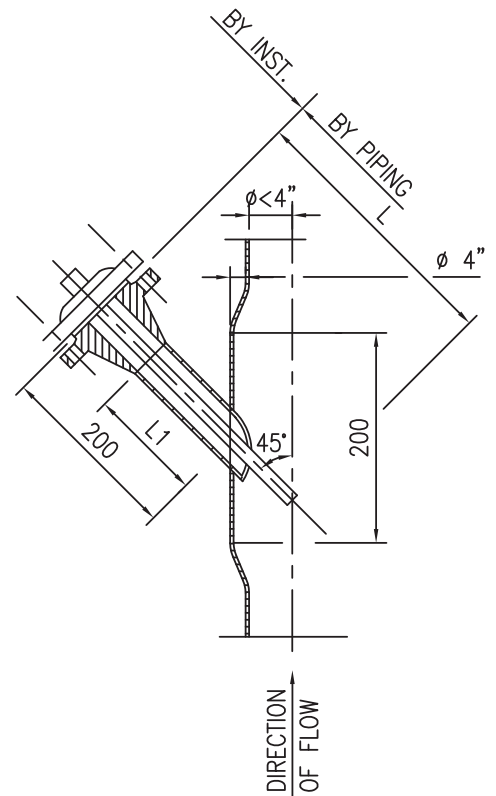
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DSGN							
DRWN							
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SCALE : N.T.S.						393 of 626	
DRG.NO MEC/SD/05/21/15/01						REV 0	



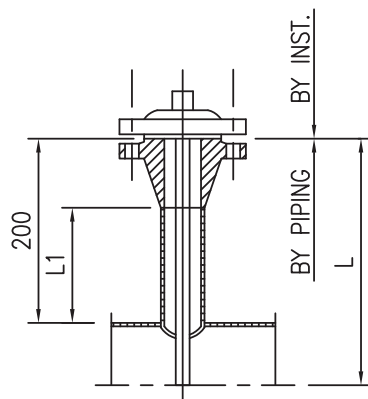
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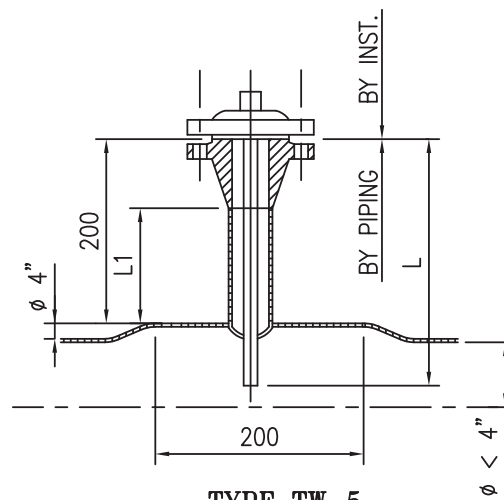
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TYPE TW-4



TYPE TW-3



TYPE TW-5

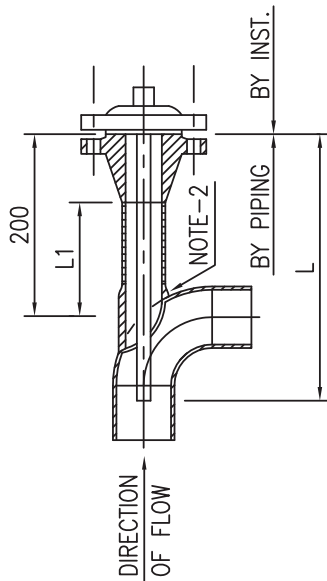
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4"	200
6"	300
8"	300
10"	300
12"	300
14"	300
16"	400
18"	400
20" & LARGER	500
VESSELS	AS REQUIRED

1. ELBOW MIN. 4" ϕ OR LARGER
2. VERTICAL LINE 4" ϕ OR LARGER
3. HORIZONTAL LINE 4" ϕ OR LARGER
4. VERTICAL LINE DIA LESS THAN 4"
5. HORIZONTAL LINE DIA LESS THAN 4"

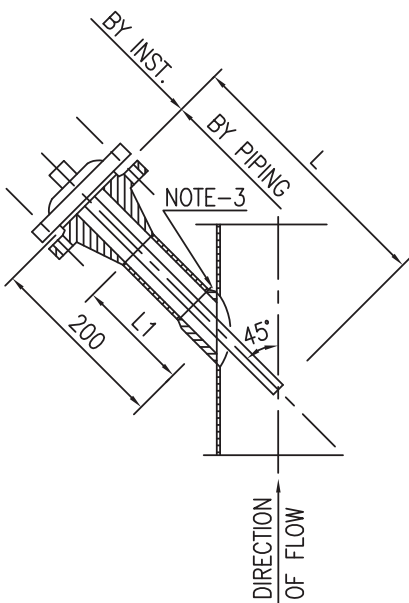
NOTES:

1. BOLTS, NUTS AND GASCKETS BY PIPING.
2. MIN. CLEARANCE FOR REMOVAL L+550
3. L1 DIMENSIONS ARE CALCULATED FOR WN, RF FLG. ONLY.
4. IN CASE ANY DEVIATION IS REQUIRED FOR INSTALLATION TAPS FROM THIS STD. INST. DEPTT. TO BE CONSULTED.

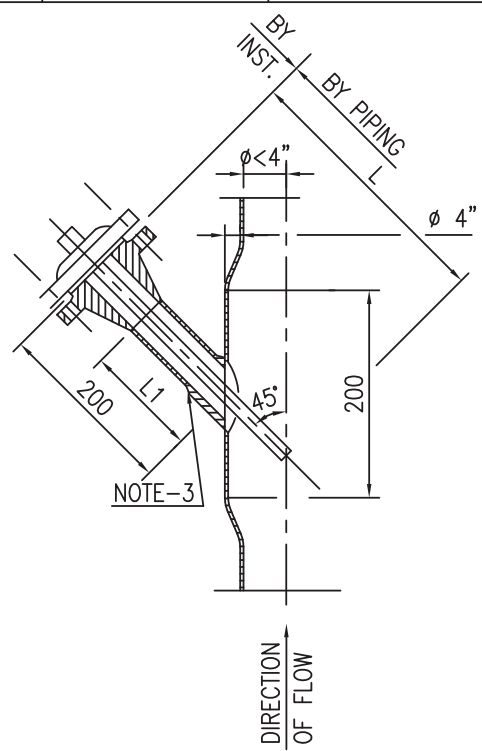
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SECTION: P&PD		WELLS INSTALLATION 1 1/2" DIA TAPS				MECON LIMITED SCALE : N.T.S. 394 of 626																															
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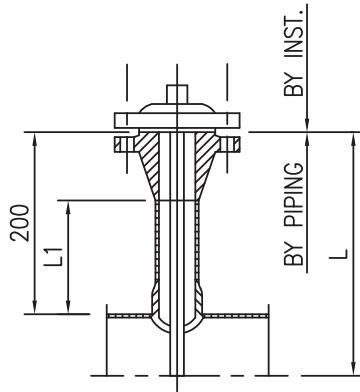
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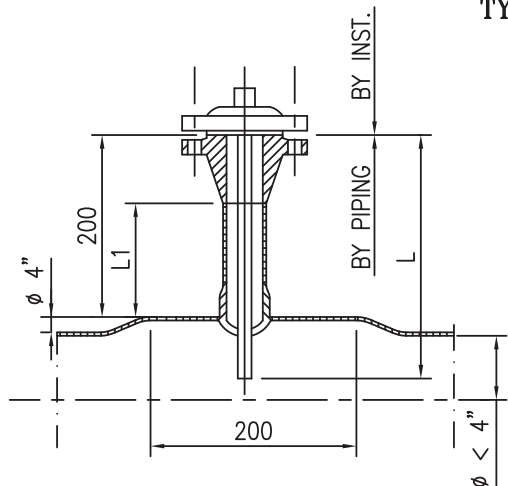
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TYPE TW-9



TYPE TW-8



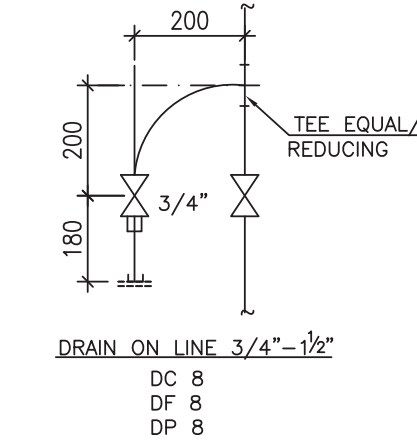
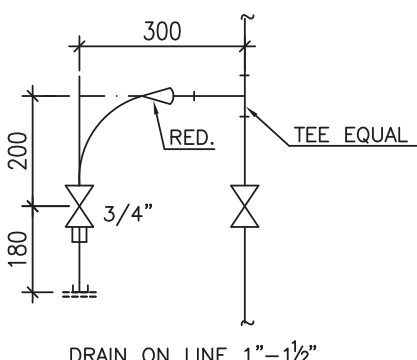
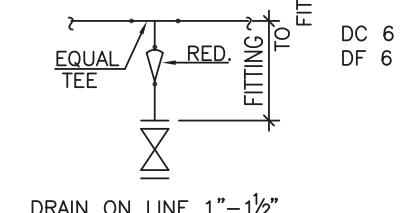
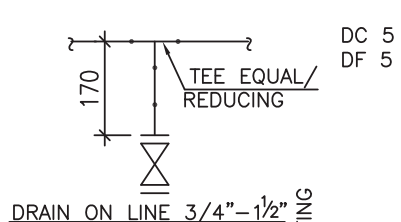
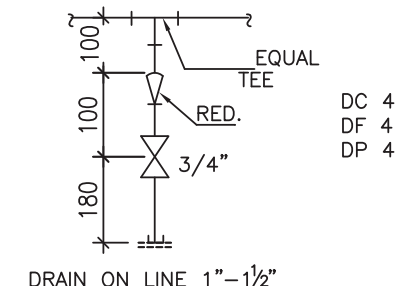
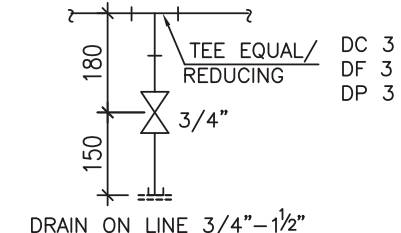
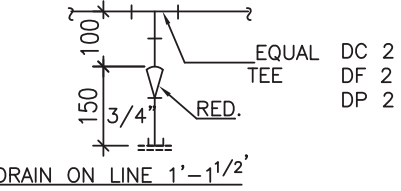
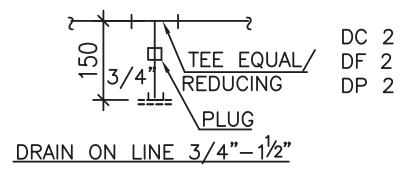
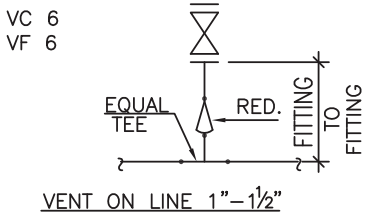
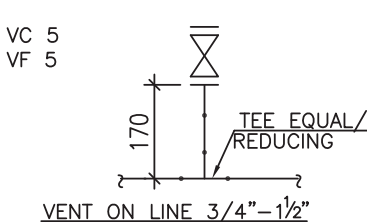
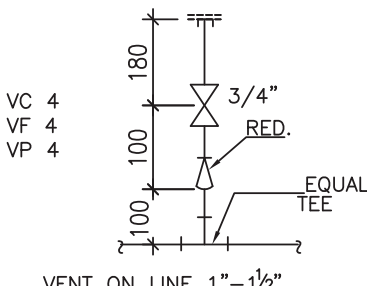
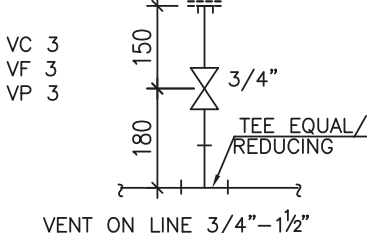
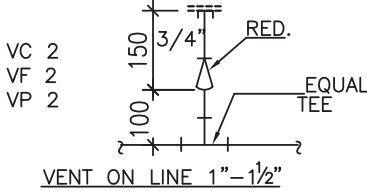
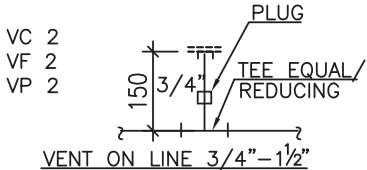
TYPE TW-10

LINE DIA	L 1.5" FLANGED WELD
4"	200
6"	300
8"	300
10"	300
12"	300
14"	300
16"	400
18"	400
20" & LARGER	500
VESSELS	AS REQUIRED

- 6. ELBOW MIN. 4" ϕ OR LARGER
- 7. VERTICAL LINE 4" ϕ OR LARGER
- 8. HORIZONTAL LINE 4" ϕ OR LARGER
- 9. VERTICAL LINE DIA LESS THAN 4"
- 10. HORIZONTAL LINE DIA LESS THAN 4"

- NOTES:
- 1. BOLTS, NUTS AND GASCKETS BY PIPING.
 - 2. MIN. CLEARANCE FOR REMOVAL L+350.
 - 3. COUPLING TO BE SPECIAL LENGTH.

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.		
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NAME	DATE	CHKD				DATE	SCALE : N.T.S.	395 of 626	REV
DSGN							DRG.NO MEC/SD/05/21/15/02 (SH. 2 OF 2)		0
DRWN									
APPROVED									

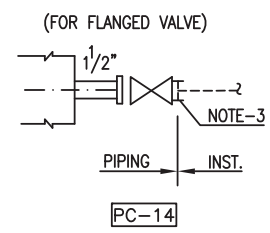
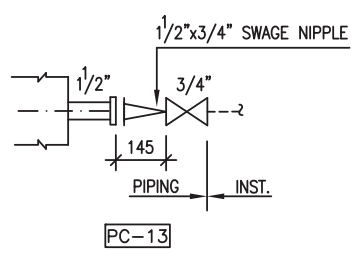
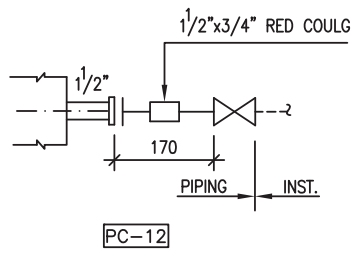
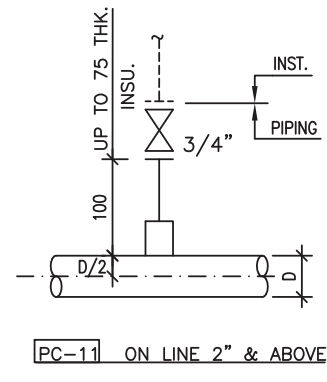
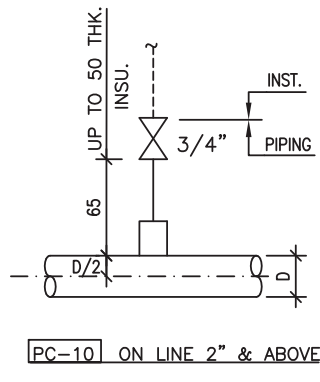
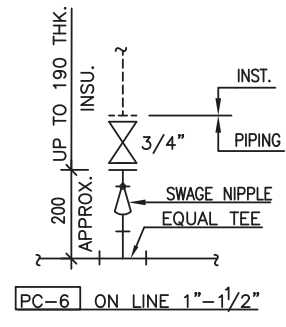
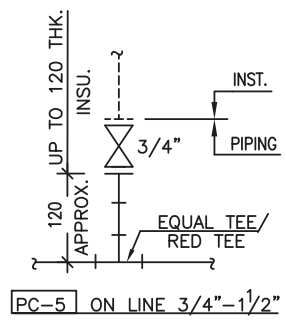
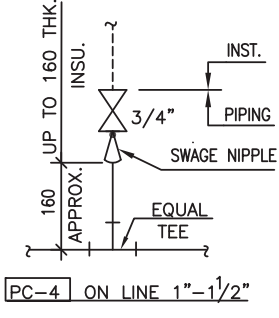
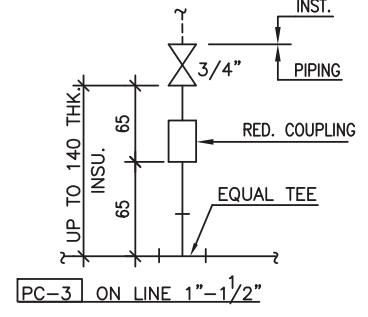
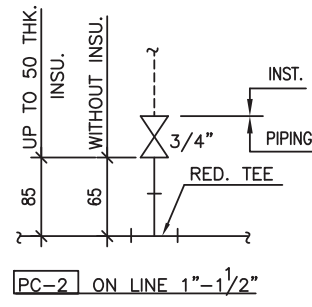
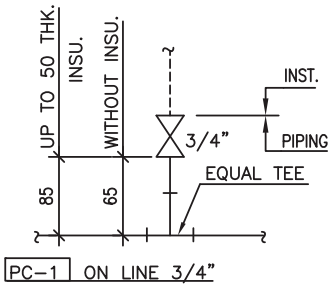


NOTES:-

1. DIMENSIONS ARE VALID FOR 50mm (MAX.) THICKNESS INSULATION. FOR HIGHER INSULATION THICKNES INCASE DIMENSIONS AS REQUIRED.
2. VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE
3. LEGEND V=VENT, D=DRAIN, C=CAP, F=FLANGE, R=REDUCER, COUPLING OR SWAGE, P=PLUG
4. PLUGGED END OF VALVE OR FITTING SHALL BE THREADED.

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.
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SECTION: P&PD				<h2 style="margin: 0;">VENT & DRAIN</h2> <h3 style="margin: 0;">ON LINES 1 1/2" & BELOW</h3>				MECON LIMITED			
NAME	DATE	CHKD	DATE					SCALE : N.T.S. 396 of 626			
DSGN								DRG.NO MEC/SD/05/21/15/03			
DRWN								REV 0			
APPROVED											



PC-15 WITH 2" VALVE

ON VESSELS/ COLUMNS

NOTES:-

1. THE INDICATED DIMENSIONS ARE IN MINIMUM WHICH ALSO COVER INSULATION TO THE EXTENT SHOWN ABOVE. IN HIGHER THICKNESS OF INSULATION THAN INDICATED, THE DIFFERENCE SHALL BE ADDED IN THE DIMENSIONS SHOWN ABOVE ACCORDINGLY.
2. PRESSURE TAPPING SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE WITH TEE, HALF COUPLING OR STUB-IN, AS PER PIPING SPECIFICATION.
3. IN CASE OF FLGD. VALVES BOLTING & GASKET ON BOTH SIDES OF VALVE SHALL BE IN PIPING SCOPE.
4. IN CASE OF TAPPINGS PROVIDED OTHER THAN INDICATED IN THIS STD FOR LAYOUT REASONS DETAILED DIMENSIONS WILL BE CALLED OUT.

REV NO	DATE	ZONE	DESCRIPTIONS	BY	APPRD	REFERENCES	DRG. NO.		
REVISIONS									
SECTION: P&PD									
NAME	DATE	CHKD	DATE	PRESSURE TAPPING				MECON LIMITED	
DSGN									
DRWN									
APPROVED						SCALE : N.T.S.	397 of 626	REV 0	
						DRG.NO MEC/	SD/05/21/15/05		

Rev. : 0


Edition : 1

**SPECIFICATION
FOR
FLUSHING AND TESTING OF
PIPING SYSTEMS**

SPECIFICATION NO.: MEC/S/05/21/11




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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 1 of 1
			REVISION : 0
			EDITION : 1

CONTENTS


<u>SL. NO.</u>	<u>DESCRIPTION</u>
1.0	SCOPE
2.0	REFERENCES
3.0	INSPECTION
4.0	FLUSHING
5.0	TESTING
5.1	EXTENT OF TESTING
5.2	GENERAL REQUIREMENT/TEST PREPARATION FOR TESTING
5.3	TESTING MEDIA, TEST PRESSURE AND TEST PRESSURE GAUGES.
5.4	TESTING PROCEDURE
5.5	COMPLETION OF TESTING
5.6	TEST RECORDS

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	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 1 of 1
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS

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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 1 of 8
			REVISION : 0
			EDITION : 1

1.0 SCOPE

This specification covers the general requirements for Inspection, flushing and testing of piping systems. However testing of steam lines falling under IBR shall also be governed by Indian Boiler Regulations.

Flushing and testing of all piping system shall be witnessed by the Consultant Representative / Engineer-in- Charge.

2.0 REFERENCE

ASME B31.3-2004 : Process Piping

IBR : Indian Boiler Regulations

3.0 INSPECTION

During various stage and after completion fabrication and erection, the piping system shall be inspected by the Consultant Representative / Engineer- in - Charge to ensure that :

- Proper piping material has been used.
- Piping has been erected as per drawings and the instruction of the engineer- in charge.
- All supports have been installed correctly.
- Test preparations mentioned in this specification have been carried out.


4.0 FLUSHING

Flushing of all lines shall be done before pressure testing.

Flushing shall be done by 'fresh potable water' or 'dry compressed air, wherever water flushing is not desirable' to clean the pipe of all dirt, debris or loose foreign materials.

Required pressure of water, flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing the line, system will be pressurised by compressed air at the required pressure which shall be 50 psi maximum. The pressure shall then be released by quick opening of a valve, already in the line for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.

In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermowells which may interfere with flushing shall not be included in the flushing circuit.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 2 of 8
			REVISION : 0
			EDITION : 1

From all permanent strainers the screens/meshes shall be removed before flushing. Screens/meshes shall be re- installed after flushing but before testing.

During flushing temporary strainers shall be retained. These shall be removed, cleaned and reinstalled after flushing, but, before testing.

In case an equipment such as column, vessel, exchanger etc. forms part of a piping circuit during flushing, this shall be done with the approval of Engineer- in - Charge. However equipment thus included in the circuit, shall be completely cleaned and dried with compressed air, after flushing is completed.

During flushing discharged water/air shall be drained at the place directed the Engineer- in - Charge. If necessary, proper temporary drainage shall be provided by the contractor.

Care shall be taken during flushing so as not to damage/spoil work of other agencies. Precautions shall also be taken to prevent entry of water/foreign matter into equipment, electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.

The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following.

Dropping of valves, specials, distance pieces, online instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the contractor and approved by the Engineer-in-Charge. These flanges shall be provided with temporary gaskets at the time of flushing.


After flushing is completed and approved, the valve, distance pieces, piping specials etc. shall be re-installed by the contractor with permanent gaskets. However, flanges of equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

Records in triplicate shall be prepared and submitted by the Contractor for each piping system for the flushing done in the proforma provided / approved by EIC.

5.0

TESTING

Pressure testing, in general shall be as per clause 345 of ASME B31.3, unless otherwise specified, herein. Lines carrying highly hazardous / poisonous fluids must have a sensitive leak test. For IBR lines, 'IBR Regulations' shall also be followed.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 3 of 8
			REVISION : 0
			EDITION : 1

5.1 Extent of testing

With the exclusion of instrumentation. piping system fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding of fabrication.

To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Engineer-in-charge, if the test pressure specified is equal to or less than that for the vessels and other equipments.

Pumps, compressors and other votary equipments shall not be subjected to field test pressures.

Lines which are directly open to atmosphere such as vents, drains, safety valves, discharge need not be tested, but all joints shall be visually inspected wherever necessary such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockage. However, such lines if provided with block valve shall be pressure tested upto the first block valve.

Seats of all vales shall not be subjected to a pressure in excess of the maximum cold welding pressure of the valve. Test pressure applied to vales shall not be grater than the manufacturer is recommendation nor less than that required by the applicable code. Where desirable set pressure is less than test pressure, test shall be made through an open valve.


Instruments in the system to be tested, shall be excluded from the test by isolation or removal, unless approved otherwise by the Engineer-in-charge. Restrictions which interfere with filling, venting and drawing such as orifice plates etc. shall not be installed unless testing is complete.

Control valves shall not be included in the test system. Where by-passes are provided test shall be performed through the by-pass end/or necessary spool shall be used in place of the control valve.

Pressure gauges which are part of the finished system, but cannot withstand test pressure shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility tests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valves or blinds.

5.2 General Requirement/Test preparation for Testing

Test shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer-in- charge.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 4 of 8
			REVISION : 0
			EDITION : 1

No pressure test shall be carried out against close valve unless approved by the Engineer-in-charge.

The Engineer-in-charge shall be notified in advance by the contractor, of the testing sequence and programme, to enable him to be present for witnessing the test. The contractor shall be fully responsible for making arrangements with the local boiler inspector to witness the tests for steam lines falling under IBR. IBR certificates for these tests shall be obtained in the relevant IBR forms and furnished to the Engineer-in-charge. Before testing, all piping shall be cleaned by flushing to make it free from dist loose scale, debris and other loose foreign materials.

All piping systems to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.

Wherever in the line any void is existing due to any reasons, for absence of control valve, safety valve, check valves etc. it shall be filled with temporary spools.

All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressuring the lines, each weld joint shall be cleaned by wire brush to free it from rest and any other foreign matter.


Where a system is to be isolated of a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.

Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spool have been received or disconnected prior to hydrostatic testing, shall be blinded – off by using standard blind flanges of same rating as the piping system being tested.

Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portion of the system. For longer lines and vertical lines, two or more pressure gauges shall be installed at locations selected by the Engineer-in-charge. For lines containing check valves any of the following alternatives shall be adopted for pressure testing. Wherever possible pressurise up-stream side of valve.

Replace the valve by a temporary spool and re-install the valve after testing.

Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. All these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently. For check valves in lines 1-1/2" and below, flapper or seat shall be

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 5 of 8
			REVISION : 0
			EDITION : 1

removed during testing (if possible). After completion of testing the flopper/ seat shall be refitted.

Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by Engineer-in-charge.

Piping which is spring or counter – weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.

When testing any piping system, air or steam of approximately 2 kg/cm² (g) may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of purging the gas to make repairs. However, this method may not be used for this purpose, if the steam temperature is more than the design temp. of the line.

For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously packed, before it is jacketed. The outer jacket shall be tested separately as a system for piping with discontinuous jacketing, the core pipe and the jacket shall be tested as separate system.


5.3 Testing Modes, Test pressure and Test Pressure Gauges

5.3.1 Testing Modes

In general all pressure test shall be hydrostatic using iron free water, which is clean and free of silt. Maximum chlorine content in water for hydrostatic testing for MS piping shall be 15-20 ppm. Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Engineer-in-charge.

If operating fluid in the line is much lighter than testing fluid, the additional weight of testing fluid may render piping supports (as designed) inadequate. This will call for additional temporary supports. The typical examples are flare and vapor lines. It is preferable that hydrostatic testing is avoided in such systems and instead pneumatic testing may be specified.

Where air/water tests are undesirable substitute fluid such as gas, oil, methanol etc. shall be used as the testing medium, with due consideration to the hazards involved. These test fluids shall be specified in the line list given to the contractor.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 6 of 8
			REVISION : 0
			EDITION : 1

5.3.2 Test Pressure

The hydrostatic/pneumatic test pressure shall be as indicated in the line list or as per the instruction of Engineer-in-charge.

The selection of the piping system for one individual test shall be based on the following :-

Test pressure required as per line list.

Maximum allowable pressure for the material of construction of piping depending upon the above requirements and based on construction progress, maximum length of piping shall be included in each test.

5.3.3 Test Pressure Gauge

All gauge used for field testing shall have suitable range so that the test pressure of the various system falls in 35% to 65% of gauge scale range. Pressure gage shall be minimum of 150 mm. Size of Bourdon shall not be less than 75% of nominal diameter of dial range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programmes, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge having an incorrect zero reading or error of more than $\pm 2\%$ of full scale range shall be discarded. The Engineer-in-charge shall check the accuracy of master pressure gauge used for calibration.


5.4 Testing Pressure

5.4.1 Hydrostatic Test

All vents and other connections used as vents shall be kept open while filling the line with test fluid for complete removal of air. For pressurising and depressurising the system, temporary isolating valves shall be provided if valves, vents, drains do not exist in the system.

Pressure shall be applied only after the system/line is ready and approved by the Engineer-in-charge.

Pressure shall be applied by means of a suitable test pump or other pressure source which shall be isolated from the system as the desired test pressure is reached and stabilised in the system.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 7 of 8
			REVISION : 0
			EDITION : 1

A pressure gauge shall be provided at the pump discharge for guiding the system to the required pressure.

The pump shall be attended constantly during the test by an authorised person. The pump shall be isolated from the system wherever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit through inspection of all joints for leakage or signs of failure. Any joint found leaking during a pressure test, shall be re-tested to the specified pressure after repair. Test period shall be maintained for a minimum of four hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges. These gauges are to be checked by the standard test gauge before each pressure test.

Care shall be taken to avoid increase in the pressure due to atmospheric variation during the test.

5.4.2 Air Test

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver after cooler & oil separator.

Piping to be tested by air shall have joints covered with a soap and water solution so that the joints can be examined for leaks.


All other activities shall be same as per hydrotesting procedure (specified above).

5.5 Completion of Testing

After the hydrostatic test has been completed, pressure shall be released in a manner and at a rate so as not to endanger personnel or damage equipments.

All vents and drains shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining lines/systems shall be dried by air.

After testing is completed the test blinds shall be removed and equipment/piping isolated during testing shall be connected using the specified gaskets, bolts and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the contractor for complete loop/circuit including equipments (except rotary equipments).


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	FLUSHING AND TESTING OF PIPING SYSTEMS	DOCUMENT NO. MEC/S/05/21/11	Page 8 of 8
			REVISION : 0
			EDITION : 1

Pressure tests shall be considered complete only after approved by the Engineer-in-charge. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system/line shall be done by the contractor at his cost.

5.6

Test Records

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the proforma provided / approved by the Engineer-in-charge.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO.	Page 1 of 20
		MEC/TS/05/21/002	REVISION : 1
			EDITION : 1


STANDARD TECHNICAL SPECIFICATION FOR BALL VALVES

SPECIFICATION NO.: MEC/TS/05/21/002




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

PREPARED BY:	CHECKED BY:	APPROVED BY:	ISSUE DATE :

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 2 of 20
			REVISION : 1
			EDITION : 1


AMENDMENT STATUS

Sl. No.	Clause / Paragraph / Annexure / Exhibit / Drawing Amended	Page No.	Rev.	Date	By		Verified	
					Name	Sig.	Name	Sig.
1.	Cl. No. 4.6	4	1	April 09	Gurdeep Singh		K.K. De	
2.	Overall Revision	All	1	July 20	K.P. Singh		A.K. Tyagi	

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 3 of 20
			REVISION : 1
			EDITION : 1


Abbreviations :

ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing and Materials
API	:	American Petroleum Institute
BHN	:	Brinell hardness number
DN	:	Nominal Size
HAZ	:	Heat Affected Zone
LC	:	Lock Close (valve locked in full close position)
LO	:	Lock Open (valve locked in full open position)
MSS-SP	:	Manufacturers Standardization Society – Standard Practice
NDT	:	Non Destructive Testing
NPS	:	Nominal Pipe Size
RTJ	:	Ring Type Joint
SSPC	:	Steel Structures Painting Council

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 4 of 20
			REVISION : 1
			EDITION : 1

C O N T E N T S

Sl.No.	Description
1.0	SCOPE
2.0	REFERENCE DOCUMENTS
3.0	MATERIALS
4.0	DESIGN AND CONSTRUCTION
5.0	INSPECTION AND TESTS
6.0	EXTENT OF INSPECTION & TESTING
7.0	TEST CERTIFICATES
8.0	PAINTING, MARKING AND SHIPMENT
9.0	SPARES AND ACCESSORIES
10.0	DOCUMENTATION
11.0	GUARANTEE
FIGURE-1	VENT, DRAIN & SEALANT INJECTION DETAILS

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 5 of 20
			REVISION : 1
			EDITION : 1

1.0 **SCOPE**

This specification covers the minimum requirements for design, manufacture, testing and supply of carbon steel ball valves of size DN 50 mm (2") and above and ANSI pressure rating class 150 to 900 to be used in on-shore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase, including Liquefied Petroleum Gas (LPG).


This specification does not cover ball valves for sour hydrocarbon (liquid / gas) service as defined in NACE standard MR-01-75.

2.0 **REFERENCE DOCUMENTS**

2.1 All valves shall be manufactured and supplied in accordance with the latest edition of American Petroleum Institute (API) Specification 6D / ISO 14313, with additions and modifications as indicated in the following sections of this specification.

2.2 Reference has also been made in this specification to the latest edition of the following Codes, Standards and Specifications:

ASME B 16.5	:	Pipe flanges and flanged fittings
ASME B 16.10	:	Face-to-face and end-to-end dimensions of valves
ASME B 16.25	:	Butt welding ends
ASME B 16.34	:	Valves – flanged, threaded and welding ends
ASME B16.47	:	Large diameter steel flanges
ASME B 31.3	:	Process piping
ASME B 31.4	:	Pipeline transportation systems for liquid hydrocarbons and other liquids
ASME B 31.8	:	Gas transmission and distribution piping systems
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
ASTM B 733	:	Autocatalytic nickel phosphorous coating on metals
API 6FA	:	Fire test for valves

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 6 of 20
			REVISION : 1
			EDITION : 1

- API 607 : Fire test for soft-seated quarter-turn valves
- API 1104 : Welding of pipelines and related facilities
- BS EN ISO 10497 : Testing of valves – Fire type-testing requirements
- MSS-SP-6 : Standard finishes for contact faces of pipe flanges and connecting-end flanges of valves and fittings
- MSS-SP-44 : Steel pipeline flanges
- SSPC-VIS-1 : Steel structures painting council-visual standard

2.3 **In case of conflict** between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred in clause 2.2 above, the requirements of this specification shall govern. Order of precedence shall be as follows :

- Valve Data Sheets
- Material Requisition
- This Specification
- API 6D Specification
- Other Referred Codes & Standards
- Manufacturer's Standard

3.0 **MATERIALS**


3.1 Material for major components of the valves shall be as indicated in Valve Data Sheet. Other components shall be as per Manufacturer's standard (suitable for the service conditions indicated in Data Sheet) and shall be subject to approval by Purchaser. In addition, the material shall also meet the requirements specified hereinafter.

3.2 Carbon steel used for the manufacture of valves shall be fully killed.

3.3 The Carbon Equivalent (CE) of valve end connections which are subject to further field welding by Purchaser, shall not exceed 0.43% (as calculated by the following formula) on check analysis for each heat of steel used:

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

3.4 For Valves specified to be used for Gas service or LPG service, Charpy V-notch test, on each heat of base material shall be conducted as per API 6D Clause 8.5, for all pressure containing parts such as body, end flanges and welding ends as well as bolting material for pressure containing parts. Unless stated otherwise, the Charpy V-notch test shall be conducted at 0 °C. Test procedure shall conform to ASTM A370. The average absorbed energy value of three full sized specimens shall be 27 J. The

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 7 of 20
			REVISION : 1
			EDITION : 1

minimum impact energy value for any one specimen of the three specimens analysed as above, shall not be less than 22 J.

When Low Temperature Carbon Steel (LTCS) materials are specified in Valve Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

3.5 For all such valves where carbon steel is used as ball material, the ball shall have 75 micrometer (0.003 inch) thick Electroless Nickel Plating (ENP) as per ASTM B733 with following classification : SC2, Type II, Class 2. The hardness of plating shall be minimum 50 RC.

3.6 For valves specified to be used for Gas service or LPG service, hardness test shall be carried out as per ASTM A370 for each method of manufacture and each heat of steel used in the manufacture of valves. A full thickness cross-section shall be taken for this purpose and the maximum hardness of the materials of valve components shall not exceed 248 HV₁₀.

3.7 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 elsewhere in the Material Requisition. In addition, Manufacturer shall confirm that all wetted parts are suitable for treated water / seawater environment, which may be used during field testing.

3.8 Non-metallic parts of the valves (including O-rings, soft seal etc.) intended for hydrocarbon gas service at pressures of PN 100 (600 #) and above shall be resistant to explosive decompression.


4.0 **DESIGN AND CONSTRUCTION**

4.1 Valve design shall meet the requirements of API 6D and other referred codes and shall be suitable for the service conditions indicated in Valve Data Sheet. The ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, may be used to design the valve body. Allowable stress requirements shall comply with the provisions of ASME B31.3. In addition, corrosion allowance indicated in Valve Data Sheet shall be considered in valve design. However, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The Manufacturer shall have a valid license to use API 6D monogram for manufacture of ball valves.

4.2 For above ground valves, valve body design shall be either fully welded or bolted type, as indicated in Valve Data Sheet. Valve body joints with threads are not permitted.

For buried valves, valve body design shall be fully welded type only. Valve body joints with bolts or threads are not permitted.

4.3 Ball shall be of single piece, solid type construction.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO.	Page 8 of 20
		MEC/TS/05/21/002	REVISION : 1
			EDITION : 1

4.4 Valves shall be Full Opening (FO) or Reduced Opening (RO) as indicated in Valve Data Sheet. FO valves shall be suitable for the passage of all types of pipeline scraper and inspection pigs on regular basis without causing damage to either the valve component or the pig. The FO valve shall provide an unobstructed profile for pigging operations in either direction. FO valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded.


The opening size of RO valves shall be corresponding to that of a FO valve of smaller nominal diameter as indicated in table below. For sizes of a particular rating not covered in API 6D, the opening sizes of the RO valve shall be as per Manufacturer's standard.

Nominal Valve Size	Nominal Valve Size for Reduced Opening	Nominal Valve Size	Nominal Valve Size for Reduced Opening
DN mm (NPS inches)	DN mm (NPS inches)	DN mm (NPS inches)	DN mm (NPS inches)
50 (2)	50 (2)	600 (24)	500 (20)
80 (3)	50 (2)	650 (26)	550 (22)
100 (4)	80 (3)	700 (28)	600 (24)
150 (6)	100 (4)	750 (30)	600 (24)
200 (8)	150 (6)	800 (32)	650 (26)
250 (10)	200 (8)	850 (34)	700 (28)
300 (12)	250 (10)	900 (36)	750 (30)
350 (14)	250 (10)	950 (38)	800 (32)
400 (16)	300 (12)	1000 (40)	850 (34)
450 (18)	350 (14)	1050 (42)	900 (36)
500 (20)	400 (16)	1200 (48)	1050 (42)
550 (22)	450 (18)		


4.5 Ball mounting shall be trunnion / pivot type or as indicated in Valve Data Sheet. Ball mounting, either trunnion or floating, unless otherwise specified, shall be as follows.

Sl. No.	ANSI Pressure Rating	Nominal Valve Size (NPS inches)	
		Floating Ball	Trunnion Mounted
1.	150#	≤ 8"	> 8"
2.	300#	≤ 4"	> 4"
3.	600#	Nil	≥ 2"

Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 9 of 20
			REVISION : 1
			EDITION : 1

- 4.6 Valve seats shall have metal to metal contact. O-rings or other seals, if used for drip tight sealing, shall be encased in a suitable groove in such a manner that it can not be removed from seat ring and there is no extrusion during opening or closing operation of valve at maximum differential pressure corresponding to valve class rating. The seat rings shall be so designed as to ensure sealing at low as well as high differential pressures.
- 4.7 Valves shall have double block and bleed feature to facilitate complete flushing, draining and venting of the valve body cavity.
- 4.8 For valves to be used in liquid service, the body cavity over-pressure shall be prevented by self relieving seat rings / assemblies. A pressure relief hole in the ball is not permitted. Self relieving seat rings shall relieve at a body cavity differential pressure not exceeding 50% of the valve class rating pressure.
- 4.9 Valves shall be designed to withstand a sustained internal vacuum of at least 1 (one) milli-bar in both open and closed positions.
- 4.10 FO valves of nominal size DN 200 mm (8") & above and RO valves of nominal size DN 250 mm (10") & above shall have provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connections shall be provided with a needle valve, a grease fitting and non-return valve. Valve design shall have a provision to replace the sealant injection fitting under full line pressure. Location and arrangement of sealant points shall be as per Figure-1.
- 4.11 Valves shall be provided with vent and drain connections. Location and arrangement of vents and drains shall be as per Figure-1. Body vent and drain shall be provided with valves (ball or plug type). Number and size shall be as per Figure-1.
- 4.12 Valve design shall ensure repair of stem seals / packing under full line pressure.
- 4.13 a) Valve ends shall be either flanged or butt welded or one end flanged and one end butt welded as indicated in Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast / forged with the body of valve. Face-to-face/ end-to-end dimensions shall conform to API 6D. Face-to-face and end-to-end dimensions for valve sizes not specified in API 6D shall be in accordance with ASME B 16.10. Face-to-face and end-to-end dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Purchaser.
- b) Flanged ends shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24 inches) excluding DN 550 mm (22 inches) and as per MSS-SP-44 / ASME B 16.47 series A for valve sizes DN 550 mm (22 inches) & for DN 650 mm (26 inches) and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. Smooth finish when specified shall be 125 to 200 microinches AARH. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 10 of 20
			REVISION : 1
			EDITION : 1

c) Butt weld end preparation shall be as per ASME B16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in Valve Data Sheet. Valves shall be without transition pups, unless otherwise specified in Valve Data sheet. In case significant difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8, as applicable.

4.14 Design of weld end valves shall be such that during field welding operations, the soft seals or plastic components of the valve (where ever used) are not liable to be damaged. The Manufacturer shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.

4.15 Valves shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions.

4.16 FO valves of nominal size \geq DN 200 mm (8") and RO valves of nominal size \geq DN 250 mm (10") shall be equipped with support foot and lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs. Height of support foot shall be kept a minimum. The location and size of support foot / lifting lugs shall ensure unrestrictive operation of vent / drain valves.

4.17 Valve design shall be such as to avoid bimetallic corrosion between carbon steel and high alloy steel components. Suitable insulation shall be provided as required.

4.18 Valves shall be of fire resistant design as per API 607/BS EN ISO 10497/API 6FA, as indicated in Valve Data Sheet.


4.19 Valves shall be provided with anti-static devices to ensure electrical continuity between stem / ball and valve body.

4.20 Valves shall be suitable for either buried or above ground installation as indicated in Valve Data Sheet.

4.21 When stem extension requirement is indicated in Valve Data Sheet, the valves shall have the following provisions :

a) Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator / power actuator as applicable).

b) Vent and drain connections and sealant injection lines shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. Pipe used shall be API 5L Gr. B / ASTM A 106 Gr. B, with Sch. 80. Fittings shall be ASTM A 105 / ASTM 234 Gr. WPB, Socket Welded, ANSI class 6000.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 11 of 20
			REVISION : 1
			EDITION : 1


- c) Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving a positive drive under all conditions with no possibility of free movement between valve body, stem extension or its operator.
- d) Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.

4.22 **Operating Devices**

- a) Valves shall have a power actuator or manual operator as indicated in Valve Data Sheet. In case of manual operator, valve sizes \leq DN 100 mm (4 inches) shall be wrench operated and valve sizes \geq DN 150 mm (6 inches) shall be gear operated. Each wrench – operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b) The power actuator shall be in accordance with the Purchaser specification issued for the purpose and as indicated in Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator torque output shall be 1.25 times the break torque required to operate the ball valve under the maximum differential pressure corresponding to the valve class rating.
- c) For manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall conform to API 6D requirements and be such that under maximum differential pressure, the total force required to operate the valve does not exceed 350 N. Manufacturer shall also indicate the number of turns of hand wheel (in case of gear operators) required for operating the valve from full open to full close position.
- d) Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e) Gear operators, when provided, shall have a self locking provision and shall be fully encased, in water proof/ splash proof/ dust proof/ weather proof enclosure and shall be filled with suitable grease.
- f) Operating devices shall be designed for easy operation of the valve under maximum differential pressure corresponding to the valve rating.

4.23 All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall include impact test and hardness test and shall meet the requirements of clauses 3.4 and 3.6 of this specification, respectively.

4.24 All welds shall be stress relieved in accordance with ASME Section VIII.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 12 of 20
			REVISION : 1
			EDITION : 1

4.25 Repair by welding is not permitted for fabricated and forged body valves. However, repair by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test and shall meet the requirements of clauses 3.4 & 3.6 of this specification, respectively.

4.26 The tolerance on internal diameter and out of roundness at the ends for welded end valves shall be as per applicable connected pipe specification as indicated in Valve Data Sheet.

4.27 When indicated in Material Requisition, valves shall have locking device to lock the valve either in full open (LO) or full close (LC) positions. Locking devices shall be permanently attached to the valve operator and shall not interfere with operation of the valve.

4.28 Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME Section VIII, Division I. In case of power actuated valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at valve stem.

5.0 **INSPECTION AND TESTS**

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


5.1.1 All valves shall be visually inspected. The internal and external surfaces of the valves shall be free from any strikes, gouges and other detrimental defects. The surfaces shall be thoroughly cleaned and free from dirt, rust and scales.

5.1.2 Dimensional check on all valves shall be carried out as per the Purchaser approved drawings.

5.1.3 Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.

5.1.4 Non-destructive examination of individual valve material and components consisting of, but not limited to castings, forgings, plate and assembly welds shall be carried out by the Manufacturer.

- a) Body castings of all valves shall be radiographically examined on 100% of the surface of critical areas as per ASME B16.34. Procedure and acceptance criteria shall be as per ASME B16.34. The extent of radiography shall be as follows:

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 13 of 20
			REVISION : 1
			EDITION : 1

ANSI Pressure Rating	Valve Size	Extent of Radiography
150 #	All sizes	Nil
300 #	≤ DN 400mm (16") ≥ DN 450mm (18")	Nil 100%
≥ 600 #	All sizes	100%

All castings shall be wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall comply with ASME B.16.34.

- b) All valves, with body fabricated from plates or made by forgings, shall be ultrasonically examined in accordance with the procedure and acceptance standard of Annexure E of ASME B16.34.

All forgings shall be wet magnetic particle inspected 100% of the internal surfaces. Method and acceptance shall comply with ASME B 16.34

- c) Bodies and bonnets made by welded assembly of segments of castings, forgings, plates or combinations thereof shall be examined, as applicable, by methods of clause 5.1.4 a) for cast components or clause 5.1.4 b) for forged components and plates.

5.1.5 Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ASME B 31.4 or ASME B31.8, as applicable, and API 1104.


5.1.6 Welds, which in Purchaser's opinion cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Section VIII, Division 1, Appendix 12 and Appendix 6, respectively.

5.1.7 a) All finished wrought weld ends subject to welding in field shall be 100% ultrasonically tested for lamination type defects for a distance of 50mm from the end. Laminations shall not be acceptable.

- b) Weld ends of all cast valves subject to welding in field shall be 100% radiographically examined and acceptance criteria shall be as per ASME B16.34.

- c) After final machining, all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm are rejected, as are defects between 6.35 mm and 1.59mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.

5.1.8 All valves shall be tested in compliance with the requirements of API 6D. During pressure testing, valves shall not have sealant lines and other cavities filled with sealant, grease or other foreign material. The drain, vent and sealant lines shall be

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 14 of 20
			REVISION : 1
			EDITION : 1

either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes. No leakage is permissible during hydrostatic testing. The body cavity self-relieving feature meeting the requirements of clause 4.8 of this specification shall also be checked.

5.1.9 A supplementary air seat test as per API 6D (Annex B, Clause B.3.3, Type II) shall be carried out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

5.1.10 Manufacturer who intends bidding, must submit at bid stage, certificate and report for successful fire type-tests for valves in accordance with API-607/ BS EN ISO 10497 / API 6FA, as applicable in Valve Data Sheet.

Failure to comply with this requirement shall be a cause of rejection of the Bidder's offer.

5.1.11 Valves shall be subjected to Operational Torque Test as per API 6D (Annex B, Clause B.6) under hydraulic pressure equal to maximum differential pressure corresponding to the valve pressure class rating.

For manual operator of all valves, it shall be established that the force required to operate the valve does not exceed the requirements stated in clause 4.22(c) of this specification.


5.1.12 Power actuated valves shall be tested after assembly of the valve and actuator at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure shall be performed on the valve actuator assembly. The time for Full Open to Full close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing times are within the limits stated in Actuator Data Sheet issued for the purpose.

Hand operator provided on the actuator shall also be checked after above testing, for satisfactory manual over-ride performance.

These tests shall be conducted on minimum one valve out of a lot of five (5) valves of the same size, rating and the actuator model / type. In case the tests do not meet the requirements, retesting / rejection of the lot shall be decided by Purchaser's Inspector.

5.1.13 Subsequent to successful testing as specified in clause 5.1.11 and 5.1.12 above, one (1) valve out of the total ordered quantity shall be randomly selected by the Purchaser's Representative for cyclic testing as mentioned below :

- a) The valve shall be subjected to at least 100 Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating.
- b) Subsequent to the above, the valve shall be subjected to hydrostatic test and supplementary air seat test in accordance with clause 5.1.8 and 5.1.9.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 15 of 20
			REVISION : 1
			EDITION : 1

In case this valve fails to pass these tests, the valve shall be rejected and two more valves shall be selected randomly and subjected to testing as indicated above. If both valves pass these tests, all valves manufactured for the order (except the valve that failed) shall be deemed acceptable. If either of the two valves fails to pass these tests, all valves shall be rejected or each valve shall be tested at the option of Manufacturer.

Previously carried out test of similar nature shall be considered acceptable if the same has been carried out by Manufacturer in last two years. Valves of two sizes below and two sizes above the size of valve previously tested, and rating similar or one rating lower of valve tested previously, shall be qualified.

5.1.14 Checks shall be carried out to demonstrate that the dissimilar metal used in the valves are successfully insulated as per the requirement of clause 4.17 of this specification.

5.1.15 When indicated in Valve Data Sheet, valves shall be subjected to anti-static testing as per supplementary test requirement of API 6D (Annex B, Clause B.5).

5.2 Purchaser reserves the right to perform stage-wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Purchaser's Inspector.

Purchaser reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.


In no case shall any action of Purchaser or his Inspector relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

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

6.0 **EXTENT OF INSPECTION & TESTING**

6.1 Purchaser's Inspector shall perform inspection and witness tests on all valves or as indicated in the Quality Assurance Plan (QAP) attached with this specification.

6.2 The hydrostatic testing and cyclic opening and closing of the valves with the operator shall be witnessed by Purchaser's Inspector.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 16 of 20
			REVISION : 1
			EDITION : 1

7.0 **TEST CERTIFICATES**

7.1 Manufacturer shall submit the following certificates:

- a) Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for valve construction as per the relevant standards.
- b) Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- c) Test reports on radiograph and ultrasonic inspection.
- d) Test report on operation of valves conforming to clause 5.1.11, 5.1.12 and 5.1.13 of this specification.
- e) All other test reports and certificates as required by API 6D and this specification.

The certificates shall be valid only when signed by Purchaser's Inspector. Only those valves which have been certified by Purchaser's Inspector shall be despatched from Manufacturer's works.

8.0 **PAINTING, MARKING & SHIPMENT**


8.1 Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SP-6 in accordance with "Steel Structures Painting Council – Visual Standard SSPC-VIS-1". For valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of the buried portion of valves shall be painted with three coats of suitable coal tar epoxy resin with a minimum dry film thickness of 300 microns.

8.2 Manufacturer shall indicate the type of corrosion resistant paint used, in the drawings submitted for approval.

8.3 All valves shall be marked as per API 6D. The units of marking shall be metric except Nominal Diameter which shall be in inches. Marking shall be done by die-stamping on the bonnet or on the housing. However, for buried valves, the marking shall be done on the above ground portion of the stem housing only.

8.4 Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors, for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.

8.5 All sealant lines and other cavities of the valve shall be filled with sealant before shipment.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 17 of 20
			REVISION : 1
			EDITION : 1

8.6 Packaging and shipping instructions shall be as per API 6D.

8.7 On packages, following shall be marked legibly with suitable marking ink :

- a) Order Number
- b) Manufacturer's Name
- c) Valve Size and Rating
- d) Tag Number
- e) Serial Number

9.0 **SPARES & ACCESSORIES**

9.1 Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.


9.2 Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

9.3 Manufacturer shall quote for spares & accessories as per Material Requisition.

10.0 **DOCUMENTATION**

10.1 At the time of bidding, Manufacturer shall submit the following documents:

- a) General arrangement / assembly drawings showing all features and relative positions and sizes of vents, drains, gear operator / actuator, painting, coating and other external parts together with overall dimensions as well as weights of valve & actuator.
- b) Sectional drawing showing major parts with reference numbers and material specification. In particular, a blow-up drawing of ball-seat assembly shall be furnished complying the requirement of clause 4.6 of this specification.
- c) Reference list of similar ball valves manufactured and supplied in last five years indicating all relevant details including project, year, client, location, size, rating, service, etc.
- d) Torque curves for the power actuated valves along with the break torque and maximum allowable stem torque. In addition, sizing criteria and torque calculations shall also be submitted for power actuated valves.
- e) Descriptive technical catalogues of the Manufacturer.
- f) Copy of valid API 6D certificate.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 18 of 20
			REVISION : 1
			EDITION : 1


- g) Details of support foot, including dimensions and distance from valve centre line to bottom of support foot.
- h) Quality Assurance Plan enclosed with this tender duly signed, stamped and accepted.
- i) List of recommended spares required during start-up and commissioning.
- j) List of recommended spares required for 2 years of normal operation and maintenance.
- k) Other documents / drawings / data as per Material Requisition.

10.2 Within two weeks of placement of order, the Manufacturer shall submit six copies of, but not limited to, the following drawings, documents and specifications for Purchaser's final approval :

- a) Detailed sectional arrangement drawings showing all parts with reference numbers and material specifications as referred to in clause 10.1 above.
- b) Assembly drawings with overall dimensions and features. Drawing shall also indicate the number of turns of hand wheel (in case of gear operators) required for operating the valve from full open to full close position and the painting scheme. Complete dimensional details of support foot (where applicable) shall be indicated in these drawings as referred to in clause 10.1 above.
- c) Welding, heat treatment and testing procedures.
- d) Procedure for cyclic testing.
- e) Details of corrosion resistant paint to be applied on the valves.
- f) Design calculation for pressure containing parts.
- g) Other documents / drawings / data as per Material Requisition.

Manufacture of valves shall commence only after approval of the documents indicated in clause 10.2a) to 10.2c) above. Once approval has been given by Purchaser, any changes in design, material and method of manufacture shall be notified to Purchaser whose approval in writing of all changes shall be obtained before the valve is manufactured.

10.3 Within 2 weeks from the approval date, Manufacturer shall submit to Purchaser six copies of the approved drawings, documents and specifications as listed in clause 10.2 above.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 19 of 20
			REVISION : 1
			EDITION : 1

10.4 Prior to shipment, Manufacturer shall submit six hard copies and six soft copies (on CD-ROMs) of the following:

- a) Test certificates as per clause 7.0 of this specification.
- b) Manual for installation, erection, maintenance and operation instructions, including a list of recommended spares for the valves.
- c) Other documents / drawings / data as per Material Requisition.

10.5 All documents shall be in English language.

10.6 **The above documents & data requirements shall also be supplemented by all requirements of clause 2.0 of the Material Requisition.**

11.0 **GUARANTEE**


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

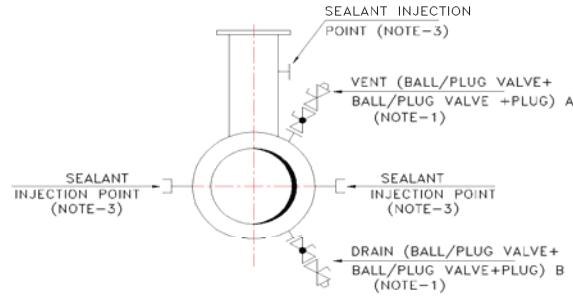
11.2 Manufacturer is bound to replace or repair all valve parts which should result defective due to inadequate engineering or to the quality of materials and machining.

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

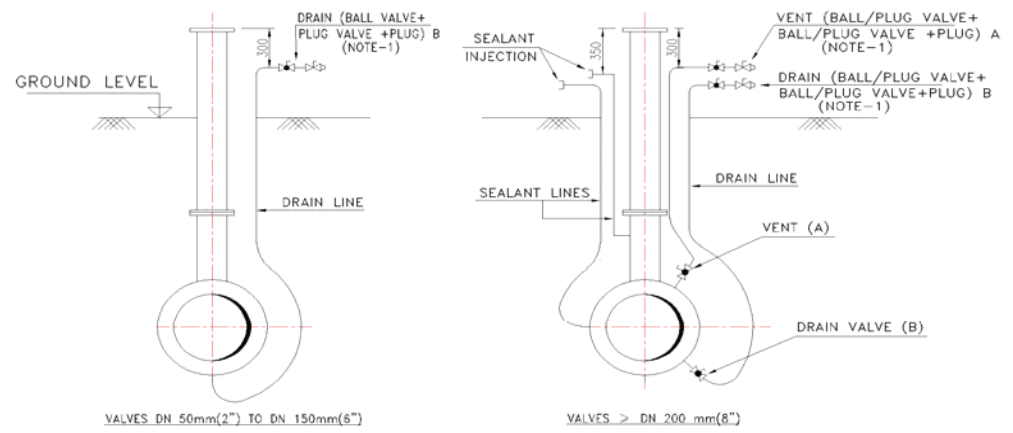
11.4 Any defect occurring during the period of Guarantee shall be attended to by making all necessary modifications and repair of defective parts free of charge to the Purchaser as per the relevant clause of the bid document.

11.5 All expenses shall be to Manufacturer's account.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	BALL VALVE	DOCUMENT NO. MEC/TS/05/21/002	Page 20 of 20
			REVISION : 1
			EDITION : 1






ABOVE GROUND INSTALLATION



UNDERGROUND INSTALLATION

SIZES OF VENT & DRAIN CONNECTIONS		
NOM. VALVE SIZE	A, DN(mm)	B, DN(mm)
50 TO 150	-	15
200 TO 600	15	25
750 & ABOVE	15	50 (REFER NOTE-2)

LEGEND:
 BALL VALVE
 PLUG VALVE
 PLUG

- NOTES:**
1. ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
 2. VALVES OF SIZE 50mm SHALL BE MANUFACTURED AS PER API-6D.
 3. SEALANT INJECTION POINTS SHALL BE PROVIDED FOR FULL OPENING VALVES OF NOMINAL VALVE SIZE 200mm (8") & ABOVE AND REDUCED OPENING VALVES OF NOMINAL VALVE SIZE, DN 250mm (10") AND ABOVE ONLY.
 3. IN BURIED SECTION, ALL VENT & DRAIN CONNECTION SHALL BE OF WELDED CONSTRUCTION.

FIGURE-1

VENT, DRAIN & SEALANT INJECTION DETAILS

ADDITIONAL NOTES FOR SUPPLY OF VALVES



OIL & GAS SBU, DELHI

Page 1 of 5

Following notes, in addition to respective Technical Specification shall be taken care while purchasing valves.

- 1.0 Compliance with Specification:** The Main Contractor & their Vendors shall be completely responsible for the design, materials, manufacture & fabrication, testing, inspection, preparation for shipment and transport of the above equipment strictly in accordance with all the relevant document enclosed in tender. Minimum all pressure containing and pressure controlling parts of Valves shall be provided with EN 10204-3.2 certificates.
- 2.0 Scope of Work:** Scope of work includes the equipment with all internals and accessories shown on the datasheets, specifications and all unmentioned parts necessary for a satisfactory operation and testing, except those which are indicated to be out of the vendor's supply.
- 3.0 Inspection:** Main Contractor shall appoint the TPIA for inspection purpose in a manner described hereunder-

"The Successful Contractor shall propose minimum four (4) nos. of TPIA's from the below listed TPIA's within four (4) weeks from date of FOA. GAIL/MECON shall approve any one TPIA out of the four (4) nos. proposed TPIA's. The Successful Contractor shall appoint the same approved TPIA for inspection purpose."

- a) Lloyd Register of Industrial Services
- b) Technische Ulierwachungs Verein(TUV)
- c) Det Norske Veritas (DNV)
- d) AB-Vincotte
- e) Bureau Veritas
- f) SGS
- g) American Bureau Services
- h) Velosi Certification Services
- i) Certification Engineers International Limited(CEIL)

Apart from inspection by TPIA & Main Contractor, inspection may also be performed by MECON / GAIL's delegate any time during fabrication and testing of valves.

- 4.0** a) For all valves to be used in gaseous hydrocarbon service, impact & hardness test values shall be as per respective technical specification.

ADDITIONAL NOTES FOR SUPPLY OF VALVES



OIL & GAS SBU, DELHI

Page 2 of 5

b) Valve Vendor shall establish the equivalence/superiority of any material proposed (With justification of material properties and availability) other than that specified in Datasheet. Vendor shall also indicate the ASTM equivalent of his proposed material as well as of all the AISI designated materials specified in datasheets.

5.0 Valve Vendors to note that for minimum inspection and testing requirement of the valves shall be governed by attached QAP. However, Valve vendor shall submit their own QAP for approval covering the requirement specified in attached QAP.

6.0 In the event of Conflict/inconsistency among the documents attached/ referred, the following order of precedence generally shall govern in interpretation of various requirements / data.

- P&ID
- Additional Notes to Valves
- Datasheets
- Technical Specification
- Codes and Standards
- Vendor's Standards

However, Owner/Consultant reserves the right to consider most stringent requirement among the document attached / referred.

7.0 DOCUMENTS & DATA REQUIREMENTS

7.1 The table hereunder specifies the quantities and the nature of the documents to be submitted by the Package Contractor to Purchaser.

7.1.1 The documents required at the inquiry stage and to be included in the bid are listed under column A.- **Not applicable**

7.1.2 The documents required after award of the Contract and subject to the written approval of the Purchaser are listed under column B.

7.1.3 The final and certified documents are listed under column C.

7.2 All document shall bear the Purchaser's Project reference, the Package no. and the identification number.

ADDITIONAL NOTES FOR SUPPLY OF VALVES



OIL & GAS SBU, DELHI

Page 3 of 5

- 7.3 The drawings/documents shall be reviewed, checked, approved and duly signed/stamped by successful Bidder/supplier before submission. Revision number shall be changed during submission of the revised successful Bidder's/supplier's documents and all revisions shall be highlighted by clouds. Whenever the successful Bidder/supplier require any sub-supplier drawings to be reviewed by MECON, the same shall be submitted by the supplier after duly reviewed, approved and stamped by the successful Bidder/supplier. Direct submission of the sub-supplier's drawings without contractor's approval shall not be entertained.
- 7.4 Bidder/supplier shall submit hard copies of all documents/ drawings to MECON, as listed in columns B & C of note no 7.6 of Additional notes for supply of valves and also in all technical specifications. The date of receipt of these documents/ drawings at MECON shall be deemed as the date of submission. If any documents/ drawings require re-submission due to any error/ deficiency noticed during review/ approval stage, in that event the additional time required by the bidder/supplier to get the revised document/ drawing reviewed/approved by MECON shall be solely to bidder's/supplier's account and in no case the bidder/ supplier shall be entitled for any time or cost benefit.
- 7.5 Review/Approval of the successful Bidder/supplier drawings by MECON would be only to review the compatibility with basic designs and concepts and in no way absolve the successful Bidder/supplier of his responsibility/contractual obligation to comply with tender requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the successful Bidder/supplier without any extra cost or time, whether or not comments on the same were received from MECON during the drawing review stage.
- 7.6 THE DOCUMENTS ARE FULLY PART OF THE SUPPLY WHICH SHALL BE COMPLETE ONLY IF AND WHEN THE DOCUMENTS COMPLYING FULLY WITH THE TENDER REQUIREMENTS ARE RECEIVED BY THE PURCHASER.**

Item	Documents & Data	A(N.A.)	B		C	
		No. of Copies	No. of Copies	Required Date (from FOI/FOA)	No. of Copies	Required Date (before Despatch)
1.	Completed Data Sheets	3	6	10 Weeks	6	2 Weeks (with final technical file)
2.	Fabrication, test and delivery schedule (per item)	-	6	10 Weeks + monthly	6	2 Weeks
3.	Fire Safe certificate as per API 6FA & API 607 as applicable	3	6	10 Weeks	-	-

ADDITIONAL NOTES FOR SUPPLY OF VALVES



OIL & GAS SBU, DELHI

Page 4 of 5

Item	Documents & Data	A(N.A.)	B		C	
		No. of Copies	No. of Copies	Required Date (from FOI/FOA)	No. of Copies	Required Date (before Despatch)
4.	Progress Report	-	6	10 Weeks + monthly	6	2 Weeks
5.	Catalogues / References	3	3	10 Weeks	3	With final technical file
6.	GA drawings + Sectional drawings + Material specification. (all above per valve)	3	6	10 Weeks	6	With final technical file
7.	Design calculations for pressure containing parts	-	6	10 Weeks	6	2 Weeks (with final technical file)
8.	Welding details for the pups (If required).	-	6	10 Weeks	6	2 Weeks (with final technical file)
9.	Bill of materials (on drawings)	-	6	10 Weeks	6	2 Weeks (with final technical file)
10.	Welding procedure specification and records WPS / PQR	-	6	10 Weeks	6	2 Weeks (with final technical file)
11.	QA / QC program	3	6	10 Weeks	6	2 Weeks (with final technical file)
12.	Inspection and Test Procedures alongwith Quality Assurance Plan	3	6	10 Weeks	6	2 Weeks (with final technical file)
13.	Test Reports	-	-	-	6	2 Weeks (with final technical file)
14.	NDE / NDT Reports	-	-	-	6	2 Weeks (with final technical file)
15.	Heat Treatment Reports	-	-	-	6	2 Weeks (with final technical file)
16.	Hydrotest and air test report	-	-	-	6	2 Weeks (with final technical file)

ADDITIONAL NOTES FOR SUPPLY OF VALVES



OIL & GAS SBU, DELHI

Page 5 of 5

Item	Documents & Data	A(N.A.)	B		C	
		No. of Copies	No. of Copies	Required Date (from FOI/FOA)	No. of Copies	Required Date (before Despatch)
17.	Maintenance and operating manuals	-	-	-	6	2 Weeks (with final technical file)
18.	Installation instructions & Site inspection procedure	-	-	-	6	2 Weeks (with final technical file)
19.	Material certificate as per EN 10204 - 3.2	-	-	-	6	2 Weeks (with final technical file)
20.	Painting system description & procedure	3	6	10 weeks	6	2 Weeks (with final technical file)
21.	CENELEC / Statutory certificates for electrical instruments in hazardous locations (if applicable).	-	6	10 weeks	6	2 Weeks (with final technical file)
22.	Final technical file, preliminary copy for approval (in soft & hardcopy)	-	3	10 weeks before shipping	-	-
23.	Final technical file (in soft & hardcopy)	-	-	-	6	Before shipping

NOTES

- 1) In case of e-bids, only single copy of documents / drawings / data under column A need be uploaded- **Not Applicable**
- 2) Durations in column B (required date) are weeks after FOI or as indicated in Table.

Durations in column C (required date) are weeks after document approval or as indicated in Table.

Due date of each document may be proposed.
- 3) Final technical file shall be supplied in hard copy as indicated and in electronic format (.pdf Acrobat files) on six (6) CD-ROMs.


PROCESS & PIPING DESIGN SECTION
MECON LIMITED



DELHI - 110 092

TECHNICAL SPECIFICATION
FOR
PLUG VALVES
(NB \geq 2")


SPECIFICATION NO.: MEC/TS/05/62/003, Rev-2

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 1 of 13

CONTENTS

<u>Sl.No.</u>	<u>Description</u>	<u>Page No.</u>
1.0	SCOPE	2
2.0	REFERENCE DOCUMENTS	2
3.0	MATERIALS & TEST PROCEDURES	3
4.0	DESIGN & CONSTRUCTION	4
5.0	INSPECTION & TESTS	7
6.0	EXTENT OF INSPECTION & TESTING	9
7.0	TEST CERTIFICATES	9
8.0	PAINTING, MARKING & SHIPMENT	10
9.0	SPARES & ACCESSORIES	10
10.0	DOCUMENTATION	11
11.0	GUARANTEE	12

PREPARED BY : Gurdeep Singh Date	CHECKED BY : A.K. Sarkar Date	APPROVED BY : A.K. Johri Date
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MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 2 of 13

1.0 **SCOPE**


This specification covers the minimum requirements for design, manufacture and supply of carbon steel plug valves of size DN 50mm (2") and above and ANSI Class 150# thru 900# for use in onshore pipeline systems handling non sour hydrocarbons in liquid phase or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 **REFERENCE DOCUMENTS**

2.1 All valves shall be manufactured and supplied in accordance with the Twenty Second Edition, January, 2002, or the latest edition of American Petroleum Institute (API) Specification 6D, twenty first edition, 1994 including supplement 1 & 2 thereof with additions and modifications as indicated in the following sections of this specification.

2.2 Reference has also been made in this specification to the latest edition of the following Codes, Standards and Specifications :

ASME B 16.5	:	Pipe flanges and flanged fittings
ASME B 16.25	:	Buttwelding ends
ASME B 16.34	:	Valves – Flanged, threaded and welding end
ASME B16.47	:	Large diameter steel flanges
ASME B 31.3	:	Chemical & process plant piping system
ASME B 31.4	:	Liquid transportation systems for hydrocarbons and other liquids
ASME B 31.8	:	Gas transmission and distribution piping systems
ASME Sec.VIII	:	Boiler and pressure vessel code
ASTM A 370	:	Standard test methods and definitions for mechanical testing of steel products
ASTM B 733	:	Autocatalytic nickel phosphorous coating on metals
API 6FA	:	Fire test for valves
API 1104	:	Welding of pipelines and related facilities
BS:6755 (Part-II)	:	Testing of valves – Specification for fire type - testing requirements
MSS-SP-6	:	Standard finishes for contact faces of pipe flanges and connecting-end flanges of valves and fittings

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 3 of 13

MSS-SP-44 : Steel pipeline flanges

SSPC-VIS-1 : Steel structures painting council-visual standard

2.3 **In case of conflict** between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred in clause 2.2 above, the requirements of this specification shall govern. Order of precedence shall be as follows :

- Data Sheets
- This Specification
- API 6D Specification
- Other Referred Codes & Standards
- Manufacturer's Standard

3.0 **MATERIALS & TEST PROCEDURES**

3.1 Material for major components of the valves shall be as indicated in Valve Data Sheet. Other components shall be as per Manufacturer's standard which will be subject to approval by Purchaser.

3.2 Carbon steel used for the manufacture of valves shall be fully killed.

3.3 Chemical composition (check analysis) of valve end connection which are subject to further welding by Purchaser shall meet the following requirements for each heat of steel used:


- | | | | |
|----|------------|---|----------------|
| a) | Carbon | : | 0.22% (max.) |
| b) | Manganese | : | 1.70 % (max.) |
| c) | Silicon | : | 0.55 % (max.) |
| d) | Phosphorus | : | 0.030 % (max.) |
| e) | Sulphur | : | 0.030 % (max.) |

Total percentage of Vanadium, Niobium and Titanium shall not exceed 0.20. Residual elements shall not exceed the following limits :

- | | | | |
|----|------------|---|---------|
| a) | Nitrogen | : | 0.019 % |
| b) | Nickel | : | 0.30 % |
| c) | Copper | : | 0.20 % |
| d) | Aluminum | : | 0.070 % |
| e) | Chromium | : | 0.15 % |
| f) | Molybdenum | : | 0.05 % |

Carbon equivalent (CE) as calculated by the following shall not exceed 0.45%.

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

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 4 of 13

3.4 For valves specified for Gas Service or high vapour pressure liquid service, Charpy V-Notch test on each heat of base material shall be conducted as per API 6D, for all pressure containing parts such as body, end flanges and welding ends as well as the bolting material for pressure containing parts. Unless specified otherwise in Valve Data Sheets, the Charpy impact test shall be conducted at 0°C. The Charpy impact test specimen shall be taken in the direction of principal grain flow and notched perpendicular to the original surface of plate or forging.

Unless specified otherwise in Valve Data Sheets, the minimum average absorbed energy per set of three specimens shall be 27 J with an individual minimum per specimen of 22 J.

3.5 For valves specified for Gas Service or high vapour pressure liquid service, the hardness of base material of body and principal parts of the valve such as plug, stem, etc., shall not exceed 22 RC.

3.6 Plug for valve size DN 200mm (8") and above or as specified in Valve Data Sheets shall have Electroless Nickel Plating (ENP) or equivalent. The hardness of plating shall be minimum 50 RC. Manufacturer shall ensure that the adhesive strength of plating is sufficient so as to prevent peeling of plating during operation of the valve.


3.7 All process-wetted parts, metallic and non-metallic, shall be suitable for the fluids and service specified by the Purchaser. The service gas composition when applicable shall be as given in Annexure-I.

4.0 **DESIGN & CONSTRUCTION**


4.1 The Manufacturer shall have a valid license to use API 6D monogram for manufacture of Plug Valves.

4.2 Valve pattern shall be short, regular or venturi as specified in the following table:


Class	Size Range, NB mm (inch)	Pattern
150	50-100 (2-4)	Short
	150-300 (6-12)	Regular
	350 (14) & above	Venturi
300	50-100 (2-4)	Short
	150-250 (6-10)	Regular
	300 (12) & above	Venturi
600	50-250 (2-10)	Regular
	300 (12) & above	Venturi
900	50-250 (2-10)	Regular
	300 (12) & above	Venturi

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 5 of 13

4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 4.11 4.12 4.13	<p>Valve shall have an inherent feature using line pressure to ensure that the line pressure cannot cause taper locking of the plug/ plug movement into taper i.e. valves shall be of pressure balanced design.</p> <p>Cover shall be bolted to the body and screwed connections are not acceptable.</p> <p>Soft seats to achieve a seal between plug and body are not permitted.</p> <p>All valves shall have provisions for secondary sealant injection under full line pressure for seat and stem seals. Sealant injection points shall be provided with a ball type check valve or needle valve to replace the sealant injection fitting under full line pressure.</p> <p>Valves shall have vent and drain connections as per API 6D.</p> <p>When specified in the Valve Data Sheet, valves shall be designed to withstand a sustained internal vacuum of at least one milli-bar in both open and closed position.</p> <p>Valve design shall ensure repair of gland packing under full line pressure.</p> <p>a) Valve ends shall be either flanged or butt welded or one end flanged and one end butt welded as indicated in Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast/forged with the body of valve. Face-to-face/ end-to-end dimensions shall conform to API 6D.</p> <p>b) Flanged end shall have dimensions as per ASME B16.5 for valve sizes upto DN 600mm (24 inches) excluding DN 550mm (22 inches) and as per MSS-SP-44 for valve sizes DN 550mm (22 inches) & for DN 650mm (26 inches) and above. Flange face shall be either raised face or ring joint type as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. Smooth finish when specified shall be 125 to 200 AARH. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.</p> <p>c) Butt weld end preparation shall be as per ASME B16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in Valve Data Sheet. Valves shall be without transition pups. In case significant difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8, as applicable.</p> <p>Valves shall be provided with position indicator and stops at the fully open and fully closed positions.</p> <p>Valves of size DN 200mm (8") and above shall be equipped with lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs.</p> <p>Valves shall have locking devices to be locked either in full open or full close position when indicated in the Valve Data Sheets. Locking devices shall be permanently attached to the valve operator and shall not interfere with operation of the valve.</p>
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MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 6 of 13

- 4.14 Valves shall be of fire safe design as per BS:6755 (Part-II)/ API 6FA, if indicated in Valve Data Sheet.
- 4.15 Valves shall be suitable for either buried or above ground installation as indicated in the Valve Data Sheet.
- 4.16 Valves with stem extension, when indicated in Valve Data Sheet shall have following provisions :
- a) Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in the Valve Data Sheet. The length indicated corresponds to the distance between the centreline of the valve opening and the top of the mounting flange for valve operating device (gear operator/ power actuator as applicable).
 - b) Vent and drain connections shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. Pipe used shall be API 5L Gr. B/ ASTM A106 Gr. B, with Sch. 160. Fittings shall be ASTM A105/ ASTM A 234 Gr. WPB, Socket Welded, ANSI class 6000.
 - c) Sealant injection lines shall be extended and terminated adjacent to the valve operator in manner as indicated in (b) above.
 - d) Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving a positive drive under all conditions with no possibility of free movements between valve body stem extension or its operator.
 - e) Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.
- 4.17 **Operating Devices**
- a) Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. Manual operated valves of size \leq DN 100mm (4") shall be wrench operated and valves of sizes \geq DN 150mm (6") shall be gear operated. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and damaged parts can be replaced without the bonnet being removed.
 - b) The power actuator shall be in accordance with the specification issued for the purpose and as indicated in the valve and actuator data sheet. Operating time shall be as indicated in valve data sheet. Valve operating time shall correspond to full close to full open / full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator torque shall be atleast 1.25 times the maximum torque required to operate the valve under maximum differential pressure corresponding to the valve class rating.
 - c) Operating device shall be designed for easy operation of valve under maximum differential pressure corresponding to the valve rating.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 7 of 13

- d) For manual operation of all valves, the diameter of the hand wheel or the length of operating lever shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350 N. Manufacturer shall also indicate the number of turns of hand wheel (in case of gear operator), required to operate the valve from full open to full close position.
- e) Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- f) Gear operators, if specified, shall have a self locking provision and shall be fully encased in waterproof/ dustproof/ weatherproof/ splashproof enclosure and shall be filled with suitable grease.

4.18 Repair by welding is not permitted for fabricated and forged body valves. However repair by welding as per ASME B16.34 is permitted for cast body valves. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 and 3.6 of this specification and shall meet the requirements as specified therein.

4.19 The tolerance on internal diameter and out of roundness at the ends for welded ends valves shall be as per connected pipe specification as indicated in the Valve Data Sheet.

4.20 Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME section VIII, Division-1.

For Power Actuated Valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at the valves stem.

5.0 **INSPECTION & TESTS**


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

5.1.1 All valves shall be visually inspected.

5.1.2 Dimensional check shall be carried out as per the Purchaser approved drawings.

5.1.3 Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.

5.1.4 a) Non-destructive examination of individual valve material and component consisting of but not limited to castings, forgings, plates and assembly welds shall be carried out by the Manufacturer.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 8 of 13

b) Valves castings shall be radiographically examined at the cover and body portion, seat location, flanged body ends and circumference of ends to be field welded. Procedure and acceptance criteria shall be as per ASME B16.34. The extent of radiography shall be as follows :

ANSI Class 150-	All Sizes	-	Nil
ANSI Class 300-	≤ DN 400mm (16")	-	Nil
	≥ DN 450mm (18")	-	100%
ANSI Class 600- and above	All Sizes	-	100%

All castings shall be wet magnetic particle inspected 100 % of the internal surfaces. Method and acceptance shall comply with ASME B16.34.

c) Valve forgings shall be examined by ultrasonic method. Inspection procedure and acceptance criteria shall be as per Annexure E of ASME B16.34.

5.1.5 Areas which, in Purchaser's Inspector's opinion, cannot be inspected by radiographic methods shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec-VIII, Division I, Appendix 12 and Appendix 6 respectively.

5.1.6


a) Weld ends of all cast valves shall be 100% radiographically examined and acceptance criteria shall be as per ASME B16.34.

b) After final machining all bevel surfaces shall be inspected by dye penetrant, or wet magnetic particle methods. Any defects longer than 6.35mm shall be rejected and also defects between 6.35mm and 1.59mm that are separated by a distance less than 50 times their greatest length. Weld repair of bevel surface is not permitted. Rejectable defects must be removed.

c) All finished wrought weld ends subject to welding in the field shall be 100% ultrasonically tested for lamination type defects for a distance of 50mm from the end. Laminations shall not be acceptable.

5.1.7 All valves shall be tested in compliance with the requirements of API 6D. Hydrostatic shell testing shall ensure that the whole of the shell is subjected to the test pressure. If necessary, the empty shell shall be pressure tested prior to assembly of the plug. The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. No leakage is permissible during hydrostatic testing.

5.1.8 A supplementary air seat test as per API 6D shall be carried out for all valves. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 9 of 13

5.1.9 Manufacturer who intends bidding must submit at bid stage, certificate and report for successful fire safe tests for all types of valves in accordance with BS:6755 (Part-II)/ API 6FA, as applicable in Valve Data Sheet.

Failure to comply with the requirement shall be a cause of rejection of the offer.

5.1.10 Valve shall be subjected to Operational Torque Test as per supplementary test requirement of API 6D under hydraulic pressure equal to the maximum differential pressure corresponding to the valve rating. The maximum handwheel force shall not exceed 350 N.

5.1.11 Power actuated valves shall be tested after assembly at the valve Manufacturer's works. Actuator shall be capable to allow minimum five consecutive "opening" and "closing" cycles. To achieve this, the Manufacturer shall provide "closing" and "opening" operations. This test shall be conducted on one valve out of a lot of five valves of the same size, rating and actuator type. In case the test result dose not meet the requirements, retesting/ rejection of the lot shall be as decided by Purchaser's Inspector.

The actuator shall be adjusted to ensure that opening and closing time is within the limits stated in Actuator Data Sheet issued for the purpose.

The hand operator installed on the actuator shall also be checked after the cyclic testing, for satisfactory manual over-ride performance.

5.2 Purchaser reserves the right to perform stagewise inspection and witness tests as indicated in para 5.1 at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to Purchaser's Inspector.

Purchaser reserves the right to request additional testing at any time to confirm or further investigate a suspected fault. If the suspected fault is confirmed, the cost incurred shall be to Manufacturer's account.


In no case shall any action of Purchaser or his representative relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.

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

6.0 **EXTENT OF INSPECTION & TESTING**

6.1 Purchaser's Inspector shall perform inspection and witness test on all valves as indicated in the Quality Assurance Plan (QAP) attached with this specification.

6.2 The hydrostatic testing and cyclic opening and closing of the valves with the operator shall be witnessed by Purchaser's Inspector.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 10 of 13

7.0 **TEST CERTIFICATES**

7.1 Manufacturer shall submit the following certificates :

- a) Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for valve construction as per the relevant standards.
- b) Test certificates on hydrostatic and pneumatic test complete with records of timing and pressure of each test.
- c) Test reports conforming to clause 5.1.9 of this specification, if applicable.
- d) Test reports on radiographic and ultrasonic inspection.
- e) Test reports on operation of valves conforming to clause 5.1.10 and 5.1.11 of this specification.
- f) All other test reports and certificates as required by API 6D and this specification.

The certificates shall be valid only when signed by Purchaser's Inspector. Only those valves which have been certified by Purchaser's Inspector shall be dispatched from Manufacturer's works.


8.0 **PAINTING, MARKING & SHIPMENT**

8.1 Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SP 6 in accordance with "Steel Structures Painting Council - Visual Standard - SSPC-VIS-1". For the valves to be installed underground, when indicated in Valve Data Sheet, external surfaces of the buried portion of valves shall be painted with three coats of suitable coal tar epoxy resin with a minimum dry film thickness of 300 microns.

8.2 Manufacturer shall indicate the type of corrosion resistant paint used, in the drawings submitted for approval.

8.3 All valves shall be marked as per API 6D. The units of marking shall be metric except Nominal Diameter which shall be in inches. Marking shall be done by die-stamping on the bonnet or on the housing. However for buried valves the marking shall be done on the above ground portion of the stem housing only.

8.4 Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors, for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic bevel protectors.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 11 of 13

8.5 All sealant lines and other cavities of the valves shall be filled with sealant before shipment.

8.6 Packaging and shipping instructions shall be as per API 6D.

8.7 Packages shall be marked legibly, with suitable marking ink, the following.

- a) Order Number
- b) Manufacturer's Name
- c) Valve Size and Rating
- d) Tag Number
- e) Serial Number

9.0 **SPARES & ACCESSORIES**


9.1 Manufacturer shall recommend and quote separately the spares for valves required for commissioning and two years of normal operation. List of such spares without price shall be indicated alongwith technical bid and separately with price.

9.2 Manufacturer shall recommend and quote unit price separately for the accessories (like wrench, sealant injector, etc.), sealant and special tools required for maintenance of valves.

10.0 **DOCUMENTATION**

10.1 At the time of bidding, the bidder shall submit the following documents :

- a) General arrangement/ assembly drawings showing all features and relative positions & sizes of vents, drains, gear box & other external parts together with overall dimensions.
- b) Sectional drawing showing major parts with reference numbers and material specification.
- c) Reference list of similar plug valves manufactured and supplied in last five years, indicating all relevant details including project, year, client, location, size rating, service, etc.
- d) Torque curves for the power actuated valves alongwith break torque and maximum allowable stem torque. In addition, sizing criteria and torque calculations shall also be submitted for power actuated valves.
- e) Descriptive technical catalogues of the Manufacturer.
- f) Copy of valid API 6D certificate, wherever applicable.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 12 of 13

- g) Details of support foot, including dimensions and distance from valve centre line to bottom of support foot.
- h) Quality Assurance Plan enclosed with this tender duly signed, stamped and accepted.

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.

10.2 Within two weeks of placement of order, the manufacturer shall submit six copies of, but not limited to, the following drawings, documents and specifications for approval :

- a) Design drawings and relevant calculations for pressure containing parts and other principle parts.
- b) Detailed sectional arrangement drawing showing all parts with reference numbers and materials specification.
- c) Assembly drawings with overall dimensions & clearances required and showing all features. Drawing shall also indicate the numbers of turns of handwheel (in case of gear operator) required for operating the valve from full open to full close position and the painting scheme.
- d) Welding, heat treatment, testing and quality control procedures.
- e) Details of corrosion resistant paint to be applied on the valves.
- f) Design calculation for pressure containing parts.


Manufacture of valves shall commence only after approval of the above documents. Once approval has been given by Purchaser, any change in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing for all changes shall be obtained before the valves are manufactured.

10.3 Within 30 days from the approval date, Manufacturer shall submit one reproducible and six copies of the approved drawings, documents and specification as listed in clause 10.2 of this specification.

10.4 Prior to shipment, Manufacturer shall submit one reproducible and six copies of following :-

- a) Test certificates as listed in clause 7.0 of this specification.
- b) Manual for installation, erection instructions, maintenance and operation instructions, including a list of recommended spares for the valves.

10.5 All documents shall be in English Language.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR PLUG VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/003		REV-2	Page 13 of 13

11.0

GUARANTEE

11.1

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

11.2

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.

11.3

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

11.4

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.

11.5


All expenses shall be to Manufacturer's account.

PROCESS & PIPING DESIGN SECTION
MECON LIMITED
DELHI – 110 092



TECHNICAL SPECIFICATION
FOR
CHECK VALVES

SPECIFICATION NO. : MEC/TS/05/62/004, Rev-2

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 1 of 8


CONTENTS

Sl.No.	Description	Page No.
1.0	SCOPE	2
2.0	REFERENCE DOCUMENTS	2
3.0	MATERIALS	2
4.0	DESIGN AND CONSTRUCTION	3
5.0	INSPECTION AND TESTS	4
6.0	TEST CERTIFICATES	5
7.0	PAINTING, MARKING AND SHIPMENT	6
8.0	SPARES AND ACCESSORIES	6
9.0	DOCUMENTATION	6
10.0	GUARANTEE	7

PREPARED BY

CHECKED BY

APPROVED BY

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 2 of 8

1.0 **SCOPE**

This specification covers the minimum requirements for design, manufacture and supply of carbon steel check valves of size DN 50mm (2") and above and ANSI class 150, 300 and 600 , for use in onshore pipeline systems handling non-sour hydrocarbons in liquid phase or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 **REFERENCE DOCUMENTS**

2.1 All valves shall be manufactured and supplied in accordance with the latest edition of American Petroleum Institute (API) Specification 6D or 594 or British Standard BS:1868, with additions and modifications as indicated in the following sections of this specification.

For Contractual purpose, the edition in force at the time of floating of the enquiry shall be termed as "latest edition".

3.0 **MATERIALS**

3.1 Material for major components of the valves shall be as indicated in Valve Data Sheet. Other components shall be as per Manufacturer's standards which will be subject to approval by Purchaser.


3.2 Carbon steel used for the manufacture of valves shall be fully killed.

3.3 The Carbon Equivalent (CE) of valve end connections which are subject to further field welding by Purchaser, shall not exceed 0.45% (as calculated by the following formula) on check analysis for each heat of steel used :

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

3.4 Charpy V-Notch test on each heat of base material shall be conducted as per API 6D, clause 7.5, for all pressure containing parts such as body, end flanges and welding ends as well as bolting material for pressure containing parts. Unless specified otherwise, the Charpy impact test shall be conducted at 0°C. The Charpy impact test specimen shall be taken in the direction of principal grain flow and notched perpendicular to the original surface of plate or forging.

The minimum average absorbed energy per set of three specimens shall be 27 J with an individual minimum per specimen of 22 J. No specimen shall exhibit less than 80 percent shear area.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 3 of 8

3.5 All process – wetted parts, metallic and non-metallic, shall be suitable for the fluids and service specified by the Purchaser.

4.0 **DESIGN AND CONSTRUCTION**

4.1 Following types of check valves, meeting the requirements of applicable standards (refer clause 2.1 of this specification) are acceptable :

- a) Swing check valve
- b) Dual plate check valve
- c) Axial flow (Nozzle) check valve

Valve design shall be suitable for the service conditions indicated in Valve Data Sheet. Corrosion allowance indicated in Valve Data Sheet shall be considered in valve design.

4.2 In case of swing check valves, the disc hinge shall be mounted on the valve body and shall not be attached to the valve body cover. Valve body cover joint shall be of bolted design. Screwed covers shall not be used.


4.3 Valves shall be provided with non-renewable integral type seats as indicated in Valve Data Sheet. Non-renewable seats shall be of a design which does not require renewal over the design life of the valve.

4.4 Valves shall be provided with drain connection as per the Manufacturer's standard. Drain tapping shall be provided in a position suitable to completely drain the valve with valve in horizontal position.


4.5 Valve ends shall be either flanged or butt welded or one end flanged and one end butt welded as indicated in Valve Data Sheet. Flanged end shall have dimensions as per ASME B16.5 for sizes upto DN 400mm (16"). Flanges of the flanged end cast body valves shall be integrally cast with the body of the valve.

4.6 Butt weld end preparation shall be as per ANSI B16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of valve neck end and connecting pipe, the bevel end of valve shall be prepared as per ANSI B31.8 or ANSI B31.4, as applicable.

4.7 Valves of size DN 200mm (8") and above shall be equipped with lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 4 of 8

4.8	An arrow indicating the direction of flow shall be embossed or cast on the body of all valves.																				
4.9	All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The welding and repair welding procedure qualification shall include impact test and shall meet the requirements of clause 3.4 of this specification.																				
4.10	Repair by welding is permitted for cast body valves subject to written approval by Purchaser and shall be carried out as per ANSI B16.34. Repair shall be carried out before any heat treatment of casting is done.																				
5.0	<u>INSPECTION AND TESTS</u>																				
5.1	The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment at his works. Such inspection and tests shall be, but not limited to, the following :																				
5.1.1	All valves shall be visually inspected.																				
5.1.2	Dimensional check on all valves shall be carried out as per the Purchaser approved drawings.																				
5.1.3	Chemical compositions and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.																				
5.1.4	<p>a) Where applicable, the body castings of valves shall be radiographically examined on 100% of the surface of critical areas as per ANSI B16.34. Procedure and acceptance criteria shall be as per ANSI B16.34.</p> <p>b) Where applicable, valve body made by forging and plate components shall be ultrasonically examined in accordance with procedure and acceptance standard of Annexure E of ANSI B16.34.</p> <p>c) The extent of radiography/ ultrasonic examination shall be as follows :</p> <table border="0" style="margin-left: 40px;"> <tr> <td>ANSI class 150</td> <td>-</td> <td>All sizes</td> <td>-</td> <td>Nil</td> </tr> <tr> <td>ANSI class 300</td> <td>-</td> <td>≤ DN 400mm (16")</td> <td>-</td> <td>Nil</td> </tr> <tr> <td></td> <td></td> <td>≥ DN 450mm (18")</td> <td>-</td> <td>100%</td> </tr> <tr> <td>ANSI class 600</td> <td>-</td> <td>All sizes</td> <td>-</td> <td>100%</td> </tr> </table>	ANSI class 150	-	All sizes	-	Nil	ANSI class 300	-	≤ DN 400mm (16")	-	Nil			≥ DN 450mm (18")	-	100%	ANSI class 600	-	All sizes	-	100%
ANSI class 150	-	All sizes	-	Nil																	
ANSI class 300	-	≤ DN 400mm (16")	-	Nil																	
		≥ DN 450mm (18")	-	100%																	
ANSI class 600	-	All sizes	-	100%																	

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 5 of 8

5.1.5 All valves shall be tested in compliance with the requirements of applicable standard (refer clause 2.0).

5.2 Purchaser reserves the right to perform stage-wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Purchaser's Inspector.

Purchaser reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

In no case shall any action of Purchaser or its Inspector relieve the Manufacturer of his responsibility for material, design, quality or operation of valves.


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

6.0 **TEST CERTIFICATES**

Manufacturer shall submit the following certificates :

- a) Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b) Hydrostatic test certificates complete with records of timing and pressure of each test.
- c) Test reports of radiograph and ultrasonic inspection, as applicable.
- d) All other test reports and certificates as required by applicable standard and this specification.

The certificates shall be valid only when signed by Purchaser's Inspector. Only those valves which have been certified by Purchaser's Inspector shall be despatched from Manufacturer's works.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 6 of 8

7.0 **PAINTING, MARKING AND SHIPMENT**

7.1 Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SP-6 in accordance with "Steel Structures Painting Council – Visual Standard SSPC-VIS-1".

7.2 All valves shall be marked as per applicable standard. The units of marking shall be metric except nominal diameter which shall be in inches.

7.3 Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves.

7.4 Packaging and shipping instructions shall be as per applicable standard.

7.5 On packages, the following shall be marked legibly with suitable marking ink:

- a) Order Number
- b) Manufacturer's Name
- c) Valve Size and Rating
- d) Tag Number


8.0 **SPARES AND ACCESSORIES**

8.1 Manufacturer shall recommend and quote separately the spares for valves required for commissioning and two years of normal operation.


9.0 **DOCUMENTATION**

9.1 At the time of bidding, Manufacturer shall submit the following documents :

- a) General arrangement drawings showing all features together with overall dimensions and actual valve bore size.
- b) Sectional drawing showing major parts with reference numbers and material specification.

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 7 of 8

	<ul style="list-style-type: none"> c) Details of corrosion resistant paint proposed to be applied. d) Reference list of similar supplies of check valves, including project, year, client, location, size, rating, services, etc. shall be furnished by the Manufacturer for the last three years. (The valves shall be proven for service indicated in Valve Data Sheet).
9.2	<p>Within three weeks of placement of order, the Manufacturer shall submit four copies of, but not limited to, the following drawings, documents and specifications for Purchaser’s approval.</p> <ul style="list-style-type: none"> a) Detailed sectional drawings showing all parts with reference numbers and material specification. b) Assembly drawings indicating overall dimensions, features and painting scheme. <p>Once the approval has been given by Purchaser, any changes in design, material and method of manufacture shall be notified to Purchaser whose approval in writing of all changes shall be obtained before the valve is manufactured.</p>
9.3	<p>Within 30 days from the approval date, Manufacturer shall submit to Purchaser one reproducible and six copies of all approved drawings, documents and specifications as listed in clause 9.2 above.</p>
9.4	<p>Prior to shipment, Manufacturer shall submit to Purchaser one reproducible and six copies of the following :</p> <ul style="list-style-type: none"> a) Test certificates as listed in clause 6.0 of this specification. b) Manual for installation, erection, maintenance and operation instructions, including a list of recommended spares for the valves.
9.5	<p>All documents shall be in English language.</p>
10.0	<p><u>GUARANTEE</u></p>
10.1	<p>Manufacturer shall guarantee that the materials and machining of valves and fittings comply with the requirements in this specification and in the Purchase Order.</p>

MECON LIMITED Delhi	PROCESS & PIPING DESIGN SECTION	TECHNICAL SPECIFICATION FOR CHECK VALVES	
TECHNICAL SPECIFICATION NO. : MEC/TS/05/62/004		REV-2	Page 8 of 8

10.2	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.
10.3	If valve defect or malfunctioning cannot be eliminated, Manufacturer shall replace the valve without delay,
10.4	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.
10.5	All expenses shall be to Manufacturer's account.

TECHNICAL NOTES FOR GATE & GLOBE VALVES

(A) **TECHNICAL NOTES FOR GATE & GLOBE VALVES**

1.0 **General**

1.1 Valves shall be designed, manufactured, tested, inspected, marked and supplied as per the specifications, applicable design standards & codes and manufacturing standards (latest editions) as specified.

1.2 Material test certificates (Physical property, Chemical composition & Heat treatment report) of the pressure containing parts shall be furnished for the valves supplied. Material test certificates of other parts shall also be furnished for verification during inspection.

1.3 For heavy valves, provision for lifting shall be made by way of lugs, eyebolts, or similar standard devices.

1.4 Unless otherwise stated, all flanged valves shall have end flanges integral with valve body. Weld on flanges are not acceptable. Flange finish shall be serrated finish 250 AARH (250 AARH to 500 AARH) or 125 AARH (125 AARH to 250 AARH) or 63 MRH (32 AARH to 63 AARH) as per valve specification sheet.

1.5 For all weld end valves, with bevel end as per ANSI B 16.25, the bevel contour shall be as follows:

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

1.6 If an overlay weld-deposit is used for the body seat ring, seating surface, the seat ring base material shall be at least equal to the corrosion resistance of the materials of the shell.

1.7 For valve body/ bonnet, forging is acceptable where castings are specified but not vice versa.

1.8 Material of construction of yoke shall be as a minimum equivalent to body/ bonnet material.

1.9 Stem shall be forged or machined from a forged bar. Castings are not permitted except integral stem.

1.10 Stellite/ hard facing by deposition shall have minimum 1.6mm thickness. Renewable seat rings shall be seal welded.

1.11 Face to face dimension of flanged valves shall conform to ANSI B 16.10 to the extent covered. For valves not covered in the ANSI specification, Contractor shall furnish certified dimensional drawings.

- 1.12 Flange dimensions of steel, alloy steel and stainless steel flanged valves shall conform to ANSI B 16.5 for sizes up to 24" and API 605 for size 26" and above.
- 1.13 Flange dimensions for cast iron flanged valves shall conform to ANSI B 16.1 for size up to 24" class 125 and API 605 with flat face for sizes greater than 24".
- 1.14 Unless otherwise mentioned, various valves should conform to following standards / codes.
- | | | |
|--|---|-------------------|
| SW gate valves (1 1/2" and below) | : | API 602 |
| SW Globe/Check valves (1 1/2" and below) | : | BS 5352 |
| Flanged gate valves | : | API 600 |
| Flanged Globe valves | : | BS 1873 |
| Flanged check valves | : | BS 1868 |
| Diaphragm valves | : | BS 5156 |
| Butterfly valves | : | BS5155/AWWVA C504 |
- 1.15 Wherever stellite is specified, it means facing of seat and disc are welded by Cr-Co-W alloy. Stellite facing shall maintain minimum hardness of 375 BHN at high temperature.
- 1.16 All weld end valves shall have bevel ends as per ANSI B 16.25.
- 1.17 If an overlay weld deposit is used for the body seat ring or seating surface, the seat ring base material shall be at least equal to corrosion resistance of the material of the shell.
- 1.18 By Pass
- Unless otherwise noted, by-pass requirement for gate valves shall be under -

150 Class	:	on sizes 26" and above
300 Class	:	on sizes 16" and above
600 Class	:	on sizes 6" and above
900 Class	:	on sizes 4" and above
1500 Class	:	on sizes 4' and above
2500 Class	:	on sizes 3" and above
 - By-pass valve shall be a globe valve.
 - Contractor shall supply the by-pass valve duly tested and fitted to the main valve. By-pass attachment to the main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP / MP test.
- 1.19 Spiral wound bonnet gasket is to be provided with inner / outer ring except when encapsulated gaskets type body bonnet joints are employed. Outer ring may be avoided in case of non-circular spiral wound gasket used in 150#

valve provided the outermost layer of spiral touches the bolts ascertaining the centering.

1.20 Pressure Test

- Valves covered under API codes shall be tested as per API 598 unless otherwise specified in the applicable valve code.
- Valves covered under BS code shall be tested as per BS 6755 unless otherwise specified in the applicable valve codes.

1.21 For all austenitic stainless valves, inter-granular corrosion test shall have to be conducted as per following: -

- ASTM A 262 Practice 'E' with acceptance criteria of "60 mils / year (max.)".
- OR
- ASTM A 262 practice 'E' with acceptance criteria of "No cracks as observed from 20X magnification U & Microscopic structure to be observed from 250X magnification".

1.22 When specifically asked for high temperature application of some grades of austenitic stainless steel (like SS 309, 310, 316, 316H etc.) ASTM A 262 practice 'C' with acceptance criteria "15 MILS/YEAR" shall have to be conducted. When testing is conducted as per practice 'E' photograph of microscopic structure shall be submitted for record.

1.23 For the IGC test as described in 1.16.1 & 1.16.2 two sets of samples shall be drawn from each solution treatment lot, one set corresponding to highest carbon content and other set corresponding to the highest rating/ thickness.

2.0 **OPERATION**

2.1 Valves shall be supplied with gear operations based on the following requirements:

Valve Types	Class	Size Requiring Gear Operation
Gate & Diaphragm Valves	150	14" and larger
	300	14" and larger
	600	12" and larger
	900	6" and larger
	1500	3" and larger
	2500	3" and larger
Globe Valves	900	6" and larger
	1500	3" and larger
	2500	3" and larger
Butterfly Valves	150	10" and larger
	300	6" and larger

2.2 Gear operator shall be as under with position indicators for open / close positions, with limit stops.

For Gate / Globe / Diaphragm Valves	Totally enclosed bevel gear in grease case with grease nipples/ plug
For Butterfly Valves	Totally enclosed helical worm gear or combination of helical worm and spur gear in grease case with grease nipples/ plugs.

2.3 Gear operators shall be so designed to operate effectively with the differential pressure across the closed valve equal to the cold non-shock pressure rating.

2.4 Butterfly valves even with wrench or lever operators shall have "open" and "closed" position indicators with limit stops.

2.5 Hand wheel diameter shall not exceed 750 mm and effort to operate shall not exceed 35 kg at hand wheel periphery. In case these limits cannot be satisfied for any valve, a gear operation shall be provided.

3.0 **INSPECTION AND TESTING**

3.1 All valves and valves operators shall be subject to stage wise and final inspection by third party inspection agency (at Contractor's cost). However, Company reserves the right to depute its authorized / representative in addition to third party inspection agency. Minimum 15 days notice shall be given to Company for all shop inspection and testing.

3.2 All the mandatory shop tests and inspection required by the respective data sheet and applicable standards & codes etc. shall be carried out.

3.3 The extent of inspection by shall be as under. However the exact extent with hold points shall be decided during review of the inspection plan to be submitted to Company as part of the post-order documentation.

3.4 Valves under NACE should follow the requirements of MR-01-75

FORGED VALVES

- Visual and dimensional inspection
- Review of material test certificates
- Any mandatory or supplementary test
- Hydrostatic test of all valves
- Strip check on 1% of total ordered quantity of valves at random to verify compliance with specification requirements.

CAST STEEL VALVES

- Visual and dimensional inspection
- Review of material test certificates

- Review of radiographs / radiographic reports and reports of any other NDT tests, wherever applicable as per data sheets
- Any mandatory or supplementary tests
- Hydrostatic test 100% for body
- Strip check on 1% of total ordered quantity of valves at random to verify compliance with specification requirements.

3.5 For motor /actuator operated valves, functional / operational checks as per the requirements of the specifications shall be made on each valve.

4.0 **RADIOGRAPHY OF CAST VALVES**

4.1 When specifically not mentioned in individual data sheets, valves castings shall undergo radiographic examination as specified hereunder:

MATERIAL	RATING	SIZE RANGE	RADIOGRAPHY
All	150#	24" and below	Nil
	150#	26" and above	100%
	300#	16" and below	Nil
	300#	18" and above	100%
	600# and above	All sizes	100%

4.2 Radiography procedure areas of casting to be radiographed shall be as per ANSI B 16.34 and acceptance criteria shall be as per ANSI B 16.34 Annexure -B. However for areas of casting to be radiographed for types of valve not covered in ANSI B 16.34, Contractor shall enclose details of areas to be radiographed in line with ANSI B 16.34.

5.0 **IBR VALVES**

5.1 All valves described as "IBR Valves" shall be in accordance with the latest IBR (Indian Boiler Regulations) as well as the other requirements specified in the specification.

5.2 For BW / SW end carbon steel valves under "IBR", the chemical composition shall conform to the following:

Carbon (Max.) : 0.25%
 Others (S, B, Mn) : As per IBR

Above composition is not applicable for non-IBR valves.

5.3 For all "IBR Valves", test certificate in form III-C shall be furnished duly signed by IBR inspection authority or an IBR approved representative.

5.4 All valves shall be painted red.

6.0 **MARKING**

6.1 Valves markings, symbols, abbreviations, etc. shall be in accordance with

MSS-SP-25 or the standard referred to in the specifications as applicable Manufacturer's name, valve size and rating, material designation, nominal size, direction of flow (if any) etc. shall be integral on the body.

6.2 Each valve shall have a corrosion resistant tag giving size and valve tag/code no. securely attached on the valve body.

6.3 Paint or ink used for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which may result in corrosive attack on heating.

6.4 Carbon steel valves shall be painted with two coats of red oxide zinc chromate primer.

6.5 All alloy steel high temp valves shall be painted with heat resistant silicone paint suitable for intended temperature.

7.0 **DESPATCH**

7.1 Valves shall be dry, clean and free from moisture, dirt and loose foreign material of any kind.

7.2 Valves shall be protected from rust, corrosion and any mechanical damage during transportation, shipment, and storage.

7.3 Rust preventative applied on machined surfaces to be welded shall be easily removable with a petroleum solvent or shall not be harmful to welding.

7.4 Each end of valves shall be protected as follows:

Flange Face	:	Wood, plastic or metal cover
Beveled End	:	Wood, plastic or metal cover
SW / Screwed End	:	Plastics cap

7.5 End protectors to be used on flange faces shall be attached by at least three bolts or wires through bolt holes and shall not be smaller than the outside diameter of the flange. Plastic caps for SW / Screwed and valves shall be press fit type.

7.6 End protectors to be used on beveled ends shall be securely attached.

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SPECIFICATION FOR SHOP & FIELD PAINTING

SPECIFICATION NO.: MEC/S/05/21/07




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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 1 of 1
			REVISION : 0
			EDITION : 1

CONTENTS


<u>SL. NO.</u>	<u>DESCRIPTION</u>
1.0	GENERAL
2.0	SCOPE
3.0	CODES & STANDARDS
4.0	EQUIPMENT
5.0	SURFACE PREPARATION
6.0	PAINT MATERIALS
7.0	PAINTING SYSTEMS
7.1	PRE-ERECTION/ PRE-FABRICATION AND SHOP PRIMING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, STEEL STRUCTURES, PIPING AND EQUIPMENT ETC.
7.2	REPAIR OF PRE-ERECTION/ FABRICATION AND SHOP PRIMING AFTER ERECTION/ WELDING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, ITEMS IN ALL ENVIRONMENTS.
8.0	FIELD PAINT SYSTEM FOR NORMAL CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL)
9.0	FIELD PAINT SYSTEM FOR CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL AND LOW ALLOY STEEL)
10.0	FIELD PAINT SYSTEM FOR HIGHLY CORROSIVE AREA (FOR CARBON STEEL, LOW ALLOY STEEL) EXTERNAL SURFACE OF UNINSULATED COLUMNS, VESSELS, HEAT EXCHANGERS, BLOERS, PIPING, PUMPS, TOWERS, COMPRESSORS, FLARE LINES, STRUCTURAL STEEL ETC.
11.0	FIELD PAINT SYSTEM FOR CARBON STEEL STORAGE TANKS (EXTERNAL) FOR ALL ENVIRONMENTS
12.0	FIELD PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANK (INTERNAL)
13.0	COATING SYSTEM FOR EXTRNAL SIDE OF UNDERGROUND CARBON STEEL, PLANT PIPING AND TANKS.
14.0	PAINTING UNDER INSULATION FOR (HOT, COLD & SAFETY) CARBON STEEL LOW TEMPERATURE CARBON STEEL & STAINLESS STEEL PIPING AND EQUIPMENT IN ALL ENVIRONMENT
15.0	INTERNAL PROTECTION OF CARBON STEEL WATER BOXES AND TUBE SHEETS OF COOLERS/ CONDENSERS.
16.0	FIELD PAINTING SYSTEM FOR GI TOWERS/ NON-FERROUS TUBE SHEET
17.0	STORAGE
18.0	COLOURS CODE FOR PIPING
19.0	IDENTIFICATION OF VESSELS, PIPING ETC.
20.0	PAINTING FOR CIVIL DEFENCE REQUIREMENTS
21.0	INSPECTION AND TESTING
22.0	GUARANTEE
23.0	QUALIFICATION CRITERIA O PAINTING CONTRACTOR.
24.0	PROCEDURE FOR APPROVAL OF NEW PAINT MANUFACTURERS.
	ANNEXURE-I- LIST OF RECOMMENDED MANUFACTURES
	ANNEXURE-II- LIST OF RECOMMENDED MANUFACTURE'S PRODUCTS.

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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 1 of 1
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS

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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 1 of 54
			REVISION : 0
			EDITION : 1

1.0 **GENERAL**

1.1 These technical specifications shall be applicable for the work covered by the contract, and without prejudice to the various codes of practice, standard specifications etc. it is understood that contractor shall complete the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-in-charge.

1.2 Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done it shall be deemed that the same shall be supplied or carried out by the contractor.

Any deviation from this standard without within deviation permit from appropriate authority will result in rejection to job.

2.0 **SCOPE**


Scope of work covered in the specification shall include, but not limited to the following.

2.1 This specification defines the requirements for surface preparation, selection and application of paint on external surfaces of equipment, vessels, machinery, piping, ducts, steels structures, external & internal protection of storage tanks for all services RCC Chimney & MS Chimney with or without refractory lining and flare lines etc.

2.2 **Extent of Works**

2.2.1 The following surface and materials shall require shop, pre-erection and field painting.

- a. All uninsulated C. S. & A.S. equipment like columns, vessels, drums, storage tanks, heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All uninsulated carbon and low alloy piping fitting and valves (including painting of identification marks), furnace, ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 2 of 54
			REVISION : 0
			EDITION : 1

- e. RCC/ MS chimneys with or without refractory lining & Flare lines.
- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and non-ferrous piping.
- g. Identification lettering/ numbering on all painted surface of equipment/ piping insulated aluminium clad, galvanised, SS and non-ferrous piping.
- h. Marking/ identification signs on painted surfaces of equipment/ piping for hazardous service.
- i. Supply of all primers, paints and all other materials required for painting other than owner's supply.
- j. Over insulation surface of equipments and pipes wherever required.
- k. Painting under insulation for carbon steel and stainless steel as specified.
- l. Repair work of damaged/ preerection/ fabrication shop primer and weld joints at field.


2.2.2 The following surface and materials shall not be painted unless otherwise specified:

- a. Uninsulated austentic stainless steel.
- b. Plastic and/ or plastic coated materials.
- c. Non ferrous materials like aluminium, galvanised "piping", "gratings" and "handrails" etc. except G. I. Towers.

2.3 Documents

2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for executions of work.

- a. Bill of quantities for piping, equipment, machinery and structure etc.
- b. Piping line list.
- c. Painting specifications including special civil defence requirement.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 3 of 54
			REVISION : 0
			EDITION : 1

2.4 Unless otherwise instructed final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after mechanical completion and testing on system are completed as well as, after completion of steam purging wherever required.

2.5 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to MECON for deviation permit.

3.0 CODES & STANDARDS

3.1 Without prejudice to the provision of clause 1.1 above and the detailed specifications of the contract, the following codes and standards shall be followed for the work covered by this contract.

IS:5 : Colour coding

IS-101 : Methods of test for ready mixed paint and enamels.

IS-2379:1990 : Indian standard for pipe line Identification –Colour code.

ASTM Vol. 6.01 and 6.03 : American standard test methods for Paints and coatings.


ANSI A 13.1-1981 : Scheme for Identification of piping systems : American National Standard Institution.

3.2 Surface Preparation Standards:

Following standards shall be followed for surface preparations:

3.2.1 Swedish Standard : SIS-05 5900-1967/ ISO-8501-1-1998 (Surface preparation standards for painting steel surfaces).

This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-in-Charge.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 4 of 54
			REVISION : 0
			EDITION : 1

3.2.2 Steel structure painting Council, U.S.A (surface preparations specifications (SSPC-SP).

3.2.3 British standard (surface finish or Blast-cleaned for painting) BS:4232

3.2.4 National Associations of Corrosion Engineers, U.S.A. (NACE)

3.2.5 Various International Standards equivalent to swedish Standard for surface preparation are given in Table-I.

3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of any one of the above standards and codes at site.

3.4 The paint manufacturer's instructions shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

- a. Instructions for storage to avoid exposure as well as extremes of temperature.
- b. Surface preparations prior to painting.
- c. Mixing and thinning.
- d. Application of paints and the recommended limit on time intervals between coats.


4.0 EQUIPMENT

4.1 All tools, brushes, rollers, spray guns, abrasive materials hand/ power tools for leaning and all equipments, scaffolding materials, shot/ wet abrassive blasting, water blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity.

Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer-in-Charge may allow the hand mixing of small quantities at his discretion.

5.0 SURFACE PREPARATION, SHOP COAT, COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 5 of 54
			REVISION : 0
			EDITION : 1

5.1.1 In order to achieve the maximum durability, one or more of following methods of surface preparation shall be followed, depending on condition of steel surface and as instructed by Engineer-in-Charge. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system:

- a. Manual or hand tools cleaning.
- b. Mechanical or power tool cleaning.
- c. Blast cleaning.

5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. The minimum acceptable standard in case of manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be Sa 2½ or equivalent as per Swedish Standard SIS-055900-1967/ ISO-8501-1-1988. Where highly corrosive condition exists, then blast cleaning shall be Sa3 as per Swedish Standard.


Remove all other contaminants, oil, grease etc. by use of an aromatic solvent prior to surface cleaning.

5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceeding 85%.

5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavourable weather conditions, the Engineer-in-Charge shall have the liberty to control the time period, at his sole discretion and / or to insist on recleaning, as may be required, before primer application is taken up. In general, during unfavourable weather conditions, blasting and painting shall be avoided as far as practicable.

5.1.5 The external surface of R.C.C. chimney to be painted be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by rubbing with soft wire brush if necessary, acid etching with 10-15% HCL solution about 15 minutes shall be carried out and surface must be thoroughly washed with water to remove acid & loose particles then dry completely before application of paint.

5.2 Procedure of Surface Preparation.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 6 of 54
			REVISION : 0
			EDITION : 1

5.2.1 Blast Cleaning

5.2.1.1 Air Blast Cleaning

The surface shall be blast cleaned using one of the abrasives: AL₂O₂ particles chilled casts iron or malleable iron and steel at pressure of 7kg. Cm² at appropriate distance and angle depending on nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size not greater than 0.055" maximum in case of steel and malleable iron and 0.04" maximum in case of chilled iron. Compressed air shall be free form moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the material for liners. Nozzles orifice may vary from 3/16" to 3/4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic lusture. Primer or first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal which is to be cleaned, surface profile shall be uniform to provide good key to the paint adhesion (i.e.35to 50μ). If possible vacuum collector shall be installed for collecting the abrasive and recycling.


5.2.1.2 Water Blast cleaning

Environmental, health and safety problems associated with abrasive blast cleaning limit the application of air blast cleaning in many installations. In such case water blast cleaning is resorted to.

Water blast cleaning can be applied with or without abrasive and high-pressure water blasting. The water used shall be inhibited with sodium chromate/ phosphate. The blast cleaned surface shall be washed thoroughly with detergents and wiped solvent and dried with compressed Air. For effective cleaning abrasives are used. The most commonly used pressure for high pressure water blast cleaning for maintenance surface preparation is 3000 to 6000 psi at 35-45 liters/ minute water volume and pressure upto 10000 psi and water volume of 45 liters/ minute provide maximum cleaning.

The water blast cleaned surface shall be comparable to SSPC-SP-12/ NACE No. 5. The operation shall be carried out as per SSPC guidelines for water blast cleaning. The indicative values for sand injection is

Air : 300 to 400 Cu.ft/ min.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 7 of 54
			REVISION : 0
			EDITION : 1

Water : 5-10 liter/ min. with corrosion inhibitor
Sand : 200-400 lbs/ hr.
Nozzle : 0.5 to 1" dia

Special equipments for water blast cleaning with abrasives now available shall be used.

5.2.2 Mechanical of Power tool cleaning

Power tool cleaning shall be done mechanical striking tools, chipping hammers, griding wheels or rotating steels wire-brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and/ or washed by water or stream and thoroughly dried with compressed air jet before application of paint.

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the specifications of paint systems.


Hand tool cleaning normally consists of the following:

- a. Hand descaling and/ or hammering
- b. Hand scraping
- c. Hand wire brushing

Rust, mill scale spatters, old coating and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose materials shall be removed from the surface by clean rags and the surface shall be brushed, swept, deducted and blown off with compressed air/ steam to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.


5.3 Non compatible shop coat primer

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc. as shop coat the pant system shall depend on condition of shop coat, if shop coat is in satisfactory condition showing no major defects, the shop

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 8 of 54
			REVISION : 0
			EDITION : 1

coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

- 5.4 Shop coated (coated with primer & finishing coat) equipment should not be repainted unless paint is damaged.
- 5.5 Shop primed equipment and surface will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning and then spot primed before applying one coat of filed primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before applications of selected paints system for particular environment.
- 5.6 For packaged units/ equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.
- 5.7 **Coating Procedure and Application:**
- 5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5° F above dew point when the relative humidity is greater then 85% or when the temperature is below 40° F.
- 5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs. the same day.
- 5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- 5.7.4 Each coat shall be proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can applied without the development of any detrimental film irregularities such as lifting or loose of adhesion of the under coat. Manufacturer instruction shall be followed for intercoat interval.
- 5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life.


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 9 of 54
			REVISION : 0
			EDITION : 1

5.7.6

Air spray application shall be in accordance with the following:

- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
- b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show condensed water or oil.
- c. **Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.**
- d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for change in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by overspray.
- e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.
- f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 10 of 54
			REVISION : 0
			EDITION : 1

- h. Areas inaccessible to the spray gun shall be painted by brush: if not accessible by brush, daubers or sheepking shall be used.
- i. All nameplates, manufacturer's identification tags, machined surface instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating disposition. If these surface are coated, the component shall be cleaned and restored to its original condition.
- j. Edges of structural shapes and irregular coated surface shall be coated first and an extra pass made later.
- k. If spray gun shown choking, immediately dechoking procedure shall be followed.

5.7.7

Airless spray application shall be in accordance with the following procedure: as per steel structure paint manual vol. 1 & vol. 2. By SSPC, U.S.A., Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1,000 to 6,000 psi. Paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This result in more repaid coverage with less overspray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional airspray.


Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in built agitator that keep the paint uniformly mixed during the spraying. The unit shall consists of in built strainer. Usually very small quantities of thinning is required before spray. Incase of High Build epoxy coating (two pack), 30:1 pump ratios and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should no be less than 3/8" ID and not longer than 50ft to obtain optimum results.

In case of gun choking, decoking steps shall be followed immediately.

5.7.8

Brush application of paint shall be in accordance with the following:

- a. Brushes shall be of a style and quality that will enable proper application of paint

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 11 of 54
			REVISION : 0
			EDITION : 1

- b. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- c. Paints shall be applied into all corners.
- d. Any runs or sags shall be brushed out.
- e. There shall be minimum of brush marks left in the applied paint
- f. Surface not accessible to brushes shall be painted by spray, duubers, or sheepkin.

5.7.9 Manual application by sling (where 6 O' clock position of pipe is not approachable)


A canvas strip (alternatively a tinplate strip) about 450mm wide and 1.5m long is held under the pipe by two men. Liquid coating poured on the sling at each side of the pipe. The men holding this sling move it up and down and walk slowly forward while fresh coating is poured on the pipe and they manipulate the sling so that an even coating is obtained all round the bottom. This work shall be done very carefully and by experienced personnel. There shall not be any formation of "Whiskers" and holes in the coating. The coating film shall be inspected by mirror.

5.7.10 For each coat the painter should know the WFT corresponding to the specified DFT and standardise the paint application technique to achieve the desired WFT. This is to be ensured in the qualification trial.

5.8 **Drying of Coated Surface**

5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.

5.8.2 No paint shall be force dried under condition which will cause checking, wrinkling blistering formation of pores, or detrimentally after the condition of the paint.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 12 of 54
			REVISION : 0
			EDITION : 1

No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.

Paint shall be protected from rain, condensation, contamination snow and freezing until dry to the fullest extent practicable.

5.9 **Repair of damaged paint surface.**

5.9.1. Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-creation/ fabrication shall be as given below.

5.9.2. Repair of damaged inorganic zinc silicate primer after erection/ welding:

Quickly remove the primer from damaged area by mechanical scraping and emery paper to expose the white metal. Blasts clean the surfaces possible. Feather the primer over the intact adjacent surface surrounding the damaged area by emery paper.

5.9.3 Repair of damaged pre-erection and shop priming in the design temperature of 90° C to 500° C.

- Surface preparation shall be done as per procedure 5.9.2

- One coat of F-9 shall be applied wherever damaged was observed on pre-erection/ pre-fabrication/ shop primer of inorganic zinc silicate coating (F-9) shall not be applied if damaged area is not more than 5 x 5 cm.

5.10 **PAINT APPLICATION**


5.10.1 Shop priming/ pre-erection priming with F9 of F12 shall be done only on blasted surface.

5.10.2 Shop priming/ pre-erection priming with F-9 or F-12 shall be done only with airless spray.

5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.11 **Assessment of Painting Requirement**

The paint system to be applied for a specific job shall be arrived as sequentially as given below :

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 13 of 54
			REVISION : 0
			EDITION : 1

- Identify the environment from area classification details and chose the appropriate table.
- Identify the design temperature from the technical documents.
- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table 7.2.

5.12

Documentation.

A written quality plan with procedure for qualification trials and for the actual work.

Daily progress report with dedtails of weather condition, particular of application no of coats and type of materials applied, anomolies, progress of work versus programme.


Result of measurement of temperature relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

Particular of surface preparation and paint application during trials and during the work.

Details of non-compliance, rejects and repairs.

Type of testing equipments and calibration.

Code and batch numbers of paint material used.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 14 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

**TABLE-I (for clause 5.0)
SURFACE PREPARATION STANDARDS**

S. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARK
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	BRITISH STANDARD BS-4232: 1967	
1.	MANUAL OR HAND TOOL CLEANING REMOVAL OF LOOSE RUST LOOSE MILL SCALE AND LOOSE PAINT, CHIPPING, SCRAPING, SANDING AND WIRE BRUSHING, SURFACE SHOULD HAVE A FAINT METALLIC SHEEN.	ST.2	SSPC-SP-2	-	-	THIS METHOD IS APPLIED WHEN THE SURFACE IS EXPOSED TO NORMAL ATMOSPHERIC CONDITION WHEN OTHER METHODS CANNOT BE ADOPTED AND ALSO FOR SPOT CLEANING DURING MAINTENANCE PAINTING.
2.	MECHANICAL OR POWER TOOL CLEANING REMOVAL OF LOOSE RUST, LOOSE MILL SCALE AND LOOSE PAINT TO DEGREE SPECIFIED BY POWER TOOL CHIPPING, DESCALING, SANDING, WIRE BRUSHING AND GRINDIN, AFTER REMOVAL OF DUST, SURFACE SHOULD HAVE A PRONOUNCED METALLIC SHEEN.	ST.3	SSPC-SP-3	-	-	-DO-


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000 १९९१
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 15 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1


TABLE-I (for clause 5.0)
SURFACE PREPARATION STANDARDS

S. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARKS
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	BRITISH STANDARD BS-4232: 1967	
3.	BLAST CLEANING (AIR & WATER) THERE ARE FOUR COMMON GRADES OF BLAST CLEANING					
3.1	WHITE METAL BLAST CLEANING TO WHITE METAL CLEANLINESS REMOVAL OF ALL VISIBLE RUST, MILL SCALE PAINT & FOREIGN MATTER 100% CLEANLINESS WITH DESIRED SURFACE PROFILE.	SA-3	SSPC-SP-5	NACE#1	FIRST QUALITY	WHERE EXTREMELY CLEAN SURFACE CAN BE EXPECTED FOR PROLONG LIFE OF PAINT SYSTEMS.
3.2	NEAR WHITE METAL BLAST CLEANING TO NEAR WHITE METAL CLEANLINESS, UNIT AT LEAST 95% OF EACH ELEMENTS OF SURFACE AREA IS FREE OF ALL VISIBLE RESIDUES WITH DESIRED SURFACE PROFILE.	SA 2 ½	SSPC-SP-10	NACE #2	SECOND QUALITY	THE MINIMUM REQUIREMENT FOR CHEMICALLY RESISTANT PAINT SYSTEM SUCH AS EPOXY, VINYL, POLYURETHANE BASED AND INORGANIC ZINC SILICATE PAINTS, ALSO FOR CONVENTIONAL PAINT SYSTEM USED UNDER FAIRLY CORROSIVE CONDITIONS TO OBTAIN DESIRED LIFE OF PAINT SYSTEM.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 16 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

TABLE-I (for clause 5.0)
SURFACE PREPARATION STANDARDS

S. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	
3.3	COMMERCIAL BLAST BLAST CLEANING UNIT AT LEAST TWO—THIRD OF EACH ELEMENT OF SURFACE AREA IS FREE OF ALL VISIBLE RESIDUES WITH DESIRED SURFACE PROFILE.			No. 3	THIRD QUALITY FOR STEEL REQUIRED TO BE PAINTED WITH CONVENTIONAL PAINTS FOR EXPOSURE TO MILDLY CORROSIVE ATMOSPHERE FOR LONGER LIFE OF THE PAINT SYSTEMS.
3.4	BRUSH-OFF BLAST BLAST CLEANING TO WHITE METAL CLEANLINESS, REMOVAL OF ALL VISIBLE RUST, MILL SCALE, PAINT & FOREIGN MATTER, SURFACE PROFILE IS NOT SO IMPORTANT.	SA-1	SSPC-SP-7	No. 4	

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 17 of 54
			REVISION : 0
			EDITION : 1

6.0 PAINT MATERIALS


Paint manufacturers shall furnish all the characteristics of paint material on printed literature, alongwith the test certificate for all the specified characteristics given in this specifications. All the paint materials shall be of first quality and conform to the following general characteristics as per the table 6.1, 6.2 and 6.3.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION	
	OIL & GAS SBU, DELHI	
TITLE SHOP & FIELD PAINTING	DOCUMENT NO.	Page 18 of 54
	MEC/S/05/21/07	REVISION : 0
		EDITION : 1




PAINT MATERIALS
TABLE NO.: 6.1 PRIMERS

S. No.	DESCRIPTION	P-2	P-4	P-6
1.	Technical Name	Chlorinated rubber Zinc Phosphate primer	Etch primer/ wash primer	Epoxy zinc phosphate primer
2.	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with Zic phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zic tetroxy choromate.	Two component polyamide cured epoxy resin medium, pigmented with zinc phosphate.
3.	Volume solids (approx)	40%	7-8%	40%
4.	DFT (Dry dilm thickness) per coat (approx)	40-50µ	8-10µ	40-50µ
5.	Theoretical covering capacity in M2/ coat/ litre (approx)	8-10	8-10	8-10
6.	Weight per litre in kgs/ litre (approx)	1.3	1.2	1.4
7.	Touch dry at 30° C (approx)	30 minutes	2 hrs.	After 30 mins.
8.	Hard dry at 30° C (approx)	Min.: 8 hrs. Max.: no limitation	Min.: 2 hrs. Max.: 24 hrs.	Min.: 8 hrs. Max.: 3-6 months
9.	Over Coating Interval (approx.)	Min : 8 hrs Max : No limitation	Min : 4.6 hrs Max : 24 hrs	Min : 8 hrs Max : 3-6 months
10.	Pot life (approx) at 30° C for two component paints (approx).	Not applicable	Not applicable	8 hrs.
11.	Temperature Resistance	60°C	Not applicable	80°C

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000
	OIL & GAS SBU, DELHI		
TITLE SHOP & FIELD PAINTING	DOCUMENT NO.	Page 19 of 54	
	MEC/S/05/21/07	REVISION : 0	
		EDITION : 1	

PAINT MATERIALS
TABLE NO.: 6.2FINISH PAINT

S. No	DESCRIPTION	F-2	F-3	F-6	F-7
1.	Technical Name	Acrylic polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High build finish paint	High build coaltar epoxy coating.
2.	Type and composition	Two-pack aliphatic isocyanate cured acrylic finish paint	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	Tow- pack polyamide/ ployamine cured epoxy resin medium suitable pigmented.	Tow pack polyamide cured epoxy resin blended with coal/ tar medium, suitably pigmented.
3.	Volume solids (approx)	40%	40%	62%	65%
4.	DFT (Dry film thickness) per coat (approx)	30-40µ	40-50µ	100-125µ	100-125µ
5.	Theoretical covering capacity in M2/ coat/ litre (approx)	10-13	8-10	5-6	5-2-6.5
6.	Weight per litre in kgs/ litre (approx)	1.3	1.2	1.4	1.5
7.	Touch dry at 30° C (approx)	1 hrs.	30 minutes	3 hrs.	4 hrs.
8.	Hard dry at 30° C (approx)	Overnight	8 hrs.	Overnight	48 hrs.
9.	Overcoating interval (approx)	Min.: Overnight (12) hrs. Max.: Unlimited	Min.: Overnight Max.: Unlimited	Min.: Overnight Max.: 5 day	Min.: 24 hrs. Max.: 5 day
10.	Pot life at 30° C for two component paints (approx).	6-8 hrs.	Not applicable	4-6 hrs.	4-6 hrs.
11.	Temperature Resistance	80°C	60°C	80°C	125°C

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 20 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

PAINT MATERIALS
TABLE NO.: 6.3 FINISH PAINTS

S. No	DESCRIPTION	F-8	F-9	F-11	F-12
1.	Technical Name Self priming type surface tolerant high build epoxy coating (Complete rust control coating)	Inorganic Zinc Silicate coating	Heat resistant medium pack aluminum paint suitable upto 250°C dry temperature	Heat resistant silicone aluminum paint suitable upto 500° C temperature	
2.	Type and composition Two-pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating	A two-pack air drying self-curing solvent based inorganic zinc silicate coating.	Heat resistant synthetic medium based two pack aluminum paint suitable upto 250°C	Heat resistant silicone resin based medium with aluminum flakes.	
3.	Volume solids (approx)	60%	25%	20%	
4.	DFT (Dry film thickness) per coat (approx)	100-125µ	65-75µ	20-25µ	
5.	Theoretical covering capacity in M2/ coat/ litre	6.0-7.2	8-9	10-12	8-10
6.	Weight per litre in kgs/ litre (approx)	1.4	2.3	1.2	1.1
7.	Touch dry at 30° C (approx)	3 hrs.	30 min.	3 hrs.	30 min.
8.	Hard dry at 30° C (approx)	24 hrs.	12 hrs.	12 hrs.	24 hrs.
9.	Overcoating interval (approx)	Min.: 10 hrs. Max.: 6 months	Min.: 8 hrs. at 20°C and 50% RH. Max.: Unlimited	Min.: 16 hrs. Max.: Unlimited	Min.: 16 hrs. Max.: Unlimited

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI

TITLE

SHOP & FIELD PAINTING

DOCUMENT NO.

MEC/S/05/21/07

Page 21 of 54

REVISION : 0

EDITION : 1




S. No	DESCRIPTION	F-8	F-9	F-11	F-12
10.	Pot life (approx) at 30° C for two component paints (approx).	90 min.	4-6 hrs.	Not applicable	Not applicable
11.	Temperature resistance	80° C	400° C	250° C	500° C

F-14: Specially for mulated polyamine cured coal tal epoxy suitable for-45°C to 125°C for application under insulation


F-15: Two pack cold cured epoxy phenolic coating suitable for 45°C to 125°C for application under insulation

F-16: Eoxy siloxane anser coat 738

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 22 of 54
			REVISION : 0
			EDITION : 1

PAINT MATERIALS
TABLE NO. 6.4 FINISH PAINTS

Sl. No.	Description	F-14	F-15	F-16	F-17
1.	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating / High build cold applied inorganic copolymer based aluminum coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic / novalac epoxy phenolic coating cured with Polyamine adduct hardner system.
2.	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS / SS piping.	Amercoat 738 from Ameron Products, USA / Berger 938 from Berger Paints Ltd., or Intertherm 751 CSA from Akzo Nobel coating. Note : 6	Two component solvent free type high build epoxy phenolic / novalac epoxy phenolic coating cured with Polyamine adduct hardner system.
3.	Volume Solids (minimum)	70%	65%	60%	98-100%
4.	DFT (Dry Film thickness) per coat (minimum)	125 µm	75 - 100 µm	75 - 100 µm	125- 150 µm
5.	Theoretical covering capacity in M ² / coat / litre (minimum)	5.5	6.5-8.5	6.0-8.0	6.5-8.0
6.	Weight per liter in kgs/litre (max paint) (minimum)	1.5	1.7	1.3	1.7
7.	Touch dry at 30°C (maximum)	4 hrs.	2 hrs.	1 hr.	2 hrs.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 23 of 54
			REVISION : 0
			EDITION : 1

Sl. No.	Description	F-14	F-15	F-16	F-17
8.	Hard dry at 30°C (maximum) Full cure 30°C (for immersion / high temp. service)	24 hrs. 168 hrs.(7 days)	24 hrs. 168 hrs.(7 days)	16 hrs. -	24 hrs. 168 hrs.(7 days)
9.	Over-coating interval	Min. 6 hrs. Max. 5 days	Min. 36 hrs. Max. 21 days	Min. 16 hrs. Max. Not applicable	Min. 16 hrs. Max. 21 days.
10.	Pot life at 30°C for two component paints (minimum)	4 hrs.	1.5 hrs.	1 hr.	1 hr.
11.	Temperature Resistance (min.)	-45°C to 125°C under insulation	-45°C to 125°C under insulation (Note : 5)	Up to 400°C for CS & SS under insulation	-45°C to 150°C for immersion service

Notes:


- Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the loose during the application, minimum specified DFT should be maintained.
- All primers and finish coats should be cold cured and air drying unless otherwise specified.
- All paints shall be applied in accordance with manufacturer's instruction for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured.
- Technical data sheets for all paints shall be supplied at the time of submission of quotations.

6.4 List of recommended manufacturers

The paint shall conform to the specifications given above and the best quality in their products range of the manufacturers listed in Annexure-I.

7.0 PAINT SYSTEM

The paint system should vary with type of environment envisaged in and around the plants. Three types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 24 of 54
			REVISION : 0
			EDITION : 1

Primers & finish coats covered in table nos. 7.0 to 15.0

PRIMERS

- P-2 : Chlorinated Rubber Zinc Phosphate Primer
P-4 : Etch Primer/ Wash Primer
P-6 : Epoxy Zic Phosphate Primer

FINISH COATS/ PAINTS

- F-2 : Acrylic- Polyurethane finish paint
F-3 : Chlorinated Rubber Finish Paint
F-6 : High Build Epoxy finish coating
F-7 : High Build Coal Tar epoxy coating
F-8 : Self-priming surface tolerant high build epoxy coating
F-9 : Inorganic Zinc Silicate Coating.
F-11 : Heat resistant Synthetic medium based Aluminum paint.
F-12 : Heat resistant Silicone Aluminum paint.
F-14 : Specially formulated polyamine-cured coal for Epoxy coating
F-15 : Epoxy phenolic coating
F-16 : Epoxy Siloxane Coating : Amercoat 738
F-17 : Two component solvent free type high built epoxy phenolic / novalac epoxy phenolic coating cured with polyamine.


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000 १९९१
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 25 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

TABLE 7.1: PRE-ERECTION/ PRE-FABRICATION AND SHOP PRIMING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, STEEL STRUCTURE, PIPING AND EQUIPMENT ETC.

S. No.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM	TOTAL DFT IN MICRONS (MIN.)	REMARKS
7.1.1	-90 TO 400	SSPC-SP-10	1 COAT OF F-9	65-75	No overcoating is to be done
7.1.2	401 To 500	SSPC-SP-10	1 COAT OF F-12	40-50	Finish Coat at Site
7.1.3	-40 to 150 for Structures, hand rails and Grating only	SSPC-SP-3	1 COAT OF F-9 OR 2 COATS OF P-7 @ 40µ DFT / COAT	65-75 OF F-9 OR 80 (P-7)	For Damaged Area of more than 5 x 5 Cm2.

TABLE 7.2: REPAIR OF PRE-ERECTION/ PRE- FABRICATION AND SHOP PRIMING AFTER ERECTION/ WELDING FOR CARBON STEEL LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, ITEMS IN ALL ENVIRONMENT.

S. No.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM	TOTAL DFT IN MICRONS (MIN.)	REMARKS
7.2.1	-90 TO 400	SSPC-SP-3 (FOR REPAIR ONLY) SSPC-SP-10	1 COAT OF F-9	65-75	FOR DAMAGED AREA OF MORE THAN 5X5 CM.
7.2.2	401 TO 550	SSPC-SP-3	1 COAT OF F-12	20	FOR DAMAGED AREA OF MORE THAN 5X5 CM.


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000 १९९१
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 26 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

TABLE 8.0: FIELD PAINT SYSTEM FOR NORMAL CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL)

ALL NORMAL CORROSIVE AREAS SUCH AS OFF SITES EXTERNAL SURFACE OF UNINSULATED COLUMNS, VESSELS, HEAT EXCHANGERS, BLOWERS, PIPING, PUMPS, TOWERS, COMPRESSORS, STRUCTURAL STEEL WORKS, RCC CHIMNEY WITH OR WITHOUT REFRACTORY LINE INSIDE CHIMNEY (ALL ENVIRONMENTS), EXCLUDING TANK TOPS, FLARE LINES, D.M. PLANTS, INTERIOR OF TANKS ETC. FLARE LINES FOR NORMAL CORROSIVE ENVIRONMENT ALSO TO NE PAINTED AS PER TABLE 9.0

S. NO.	DESIGN TEMPERATURE IN C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
8.1	-90 TO -15	SSPC-SP-10	REPAIR OF PRIMER OF PRE-FABRICATION 1 COAT OF F-9 @65-75µ DFT/COAT	NONE	65-75	No over coating to be done follow repair procedure only on damaged areas of pre-erection/ pre-fabrication primer/ coating F-9
8.2	-14 TO 60	SSPC-SP-10	REPAIR OF PRIMER OF PRE-FABRICATION 1 COAT OF F-9 @ 65-75µ DFT/COAT + 2 COATS OF P-2 @ 40µ DFT/COAT 2 X 40 = 80	2 COATS OF F-3 @ 40 µ DFT/ COAT 2 X 40 = 80	225	
8.3	61 TO 80	SSPC-SP-10	REPAIR OF PRIMER OF PRE-FABRICATION 1 COAT OF F-9 @ 65-75µ DFT/COAT + 2 COATS OF P-6 @ 40µ DFT/ COAT 2 X 40 = 80	1 COATS OF F-6 @ 100 µ DFT/ COAT	245	

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI



TITLE

SHOP & FIELD PAINTING

DOCUMENT NO.

MEC/S/05/21/07

Page 27 of 54

REVISION : 0

EDITION : 1

S. NO.	DESIGN TEMPERATURE IN C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
8.4	81 TO 250	SSPC-SP-10	REPAIR OF PRIMER 1 COAT OF F-9 @ 65-75μ DFT/COAT	3 COATS OF F-11 @ 20 μ DFT/COAT 3 X 20 = 60	125	
8.5	251 TO 400	SSPC-SP-10	REPAIR OF PRIMER 1 COAT OF F-9 @ 65-75μ DFT/COAT	2 COATS OF F-12 @ 20 μ DFT/COAT 2 X 20 = 40	105	
8.6	401 TO 500	SSPC-SP-10	REPAIR AS PER 7.2.2	2 COATS OF F-12 @ 20 μ DFT/COAT 2 X 20 = 40	80	

NOTE 1 : FOR MS CHIMNEY OR WITHOUT REFRACTORY LINING 8.3, 8.4 AND 8.5 SHALL BE FOLLOVED.

NOTE 2 : FOR EXTERNAL SURFACE OF RCC CHIMNEY: 2 COATS OF F-6 @ 100 μ DFT/ COAT TO OBTAIN 2 X 100=200μ SHALL BE APPLIED AFTER MAKING SURFACE PREPARATION AS PER GUIDELINES IN 1.5

NOTE 3 : WHEREVER REQUIRED S.NO. 8.3 SHALL BE USED FOR 14°C TO 80°C AND S.NO. 8.2 WILL BE DELETED.


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 28 of 54
			REVISION : 0
			EDITION : 1

TABLE 9.0: FIELD PAINT SYSTEM FOR CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL)

FOR ALL CORROSIVE AREAS ABOVE GROUND WHERE H₂S, SO₂ FUMES OR SPILLAGE'S OF ACID/ ALKALI/ SALT ARE LIKELY TO COME IN CONTACT WITH SURFACE SUCH AS EXTERNAL SURFACE OF UNINSULATED COLUMNS, VESSELS, HEAT EXCHANGERS, BLOWERS, PIPING, PUMPS, TOWERS, COMPRESSORS, FLARE LINES, STRUCTURAL STEEL ETC.

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
9.1	-90 TO -15	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75μ DFT/ COAT	NONE	65-75	Repair of pre-erection/ pre fabrication primer shall be done wherever damage is observed.
9.2	-14 TO 80	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75μ DFT/ COAT + 1 COATS OF P-6 @40 μ DFT/ COAT	1 COATS OF F-6 @ 100μ DFT/ COAT + 1 COAT OF F-2 @ 40μ DFT/ COAT	225	Surface preparation is required only for repairing of damaged pre-erection/ fabrication primer
9.3	81 TO 400	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75μ DFT/ COAT	2 COATS OF F-12 @ 20 μ DFT/ COAT 2 X 20 = 40	105	
9.4	401 TO 500	SSPC-SP-10	REPAIR 2S PER 7.2.2	2 COATS OF F-12 @ 20 μ DFT/ COAT	80	


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 29 of 54
			REVISION : 0
			EDITION : 1

TABLE 10.0: FIELD PAINT SYSTEM FOR HIGHLY CORROSIVE (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL) EXTERNAL SURFACES OF UNINSULATED COLUMNS, VESSELS, HEAT EXCHANGERS, BLOWERS, PIPING PUMPS, TOWERS, COMPRESSORS, FLARE LINES, STRUCTURE STEEL ETC.

EXPOSED TO SPILLAGE OR FUMES OF HCL H₂SO₄, SALTY WATER IMPINGEMENT, CHLORIDE ETC.

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
10.1	-90 TO -15	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 65-75µ DFT/ COAT	NONE	65-75	Repair of pre-erection/ fabrication primer shall be followed. No over coating is allowed
10.2	-14 TO 80	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75µ DFT/ COAT + 1 COATS OF P-6 @40 µ DFT/ COAT	2 COATS OF F-6 @ 100µ DFT/ COAT = 2 X 100= 200 + 1 COAT OF F-2 @ 40µ DFT/ COAT	345	Surface preparation is required only for repairing of damaged pre-erection/ fabrication primer.
10.3	81 TO 400	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75µ DFT/ COAT	2 COATS OF F-12 @ 20 µ DFT/ COAT 2 X 20 = 40	105	
10.4	401 TO 500	SSPC-SP-10	REPAIR AS PER 7.2.2	3 COATS OF F-12 @ 20 µ DFT/ COAT 2 X 20 = 40	80	


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 30 of 54
			REVISION : 0
			EDITION : 1

TABLE 11.0 : FIELD PAINT SYSTEM FOR CARBON STEEL STORAGE TANKS (EXTERNAL) FOR ALL ENVIRONMENTS.

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	<u>REMARKS</u>
			FILED PRIMER	FINISH PAINT		
1.1	EXTERNAL SHELL. WIND GIRDERS APPARATUSSES, ROOF TOPS OF ALL GROUND TANK INCLUDING TOP SIDE OF FLOATING ROOF OF OPEN TANK AS WELL AS COVERED FLOATING ROOF AND ASSOCIATED STRUCTURAL WORK ROLLING AND STATIONARY LADDERS, LDO, HSD, ATF KEROSENE, GASOLINE, MOTOR SPIRIT, DM WATER, FIREWATER, RAW WATER, POTABLE WATER, ACIDS, ALKALIS SOLVENTS AND CHEMICALS ETC.					
11.1.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT + 1 COATS OF P-6 @40 µ DFT/ COAT 65 X 40 = 105	1 COATS OF F-6 @ 100µ DFT/ COAT + 2 COATS OF F-2 @ 40µ DFT/ COAT 2 X 40 = 80	285	F-6 should be suitable for occasional water immersion
11.1.2	81 TO 500	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ COAT	2 COATS OF F-12 @ 20 µ DFT/ COAT 2 X 20 = 40	105	
11.2	EXTERNAL SURFACE OF BOTTOM PLATE (SOIL SIDE) FOR ALL STORAGE TANKS.					
11.2	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ COAT	3 COATS OF F - 7 @ 100 µ DFT/ COAT 3 X 100 = 300	365	F7 should be suitable for immersion service of the products given.

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI



TITLE

SHOP & FIELD PAINTING

DOCUMENT NO.

MEC/S/05/21/07

Page 31 of 54

REVISION : 0

EDITION : 1

TABLE 12.0 : FIELD PAINT SYSTEM FOR CARBON STEEL AND ALLOY STORAGE TANK: (INTERNAL)

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FILED PRIMER	FINISH PAINT		
INTERNAL SURFACE OF UNDERSIDE OF FLOATING ROOF, INTERNAL STRUCTURAL OF CONE ROOF, BOTTOM PLATE, ROOF STRUCTURE, STEEL, LADDERS SUPPORTS FOR STORING GRUIDE OIL, LDO AND HSD (EXCLUDING WHITE OIL PRODUCTS)						
12.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT	3 COATS OF F-7 @ 100µ DFT/ COAT 3 X 100 = 300	365	F7 should be suitable for immersion service of the products given.
12.2 BARE SHEEL OF INSIDE FLOATING ROOF TANK AND CONE ROOF TANK FOR PRODUCTS MENTIONED IN 12.1						
12.2.1	-14 TO 80	SSPC-SP-10	PHOSPHATING TREATMENT WITH PHOSPHATING CHEMICALS (2 COATS)	2 COATS OF @10 µ 2 X 10 = 20	20	
12.3 FLOATING CONE ROOF TANKS FOR PETROLEUM PRODUCTS SUCH AS ATF, GASOLINE, NAPHTHA, KEROSENE, MOTOR SPIRIT, OF BOTTOM PLATE, UNDERSIDE OF FLOATING ROOF AND SHELL ABOVE MAXIMUM LIQUID LEVEL AND STRUCTURAL STEEL, LADDERS ETC.						
12.3.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT	3 COATS OF F-6 @ 100µ DFT/ COAT 3 X 100 = 300	365	F-6 should be suitable for immersion service of petroleum produce like ATF, Kerosene, petrol etc.
12.4 BARE SHELL OF INSIDE OF FLOATING CONE ROOF TANKS FOR PRODUCTS MENTIONED IN 12.3						
12.4.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT	NONE	65-75	No over coating is allowed same as per pre-erection primer, if any
12.5 INTERNAL PROTECTION IF FIXED ROOF TYPE STORAGE TANKS FOR POTABLE WATER: INSIDE OF SHELL, UNDER SIDE OF ROOF AND ROOF STRUCTURE INSIDE SURFACE BOTTOM PLATE AND STRURAL STEEL WORKS, LADDERS, WALKWAYS, PLATFORMS ETC.						
12.5.1	-14 TO 80	SSPC-SP-10	2 COAT OF F-6 @ 40µ DFT/ COAT 2 X 40 = 80	2 COATS OF F-6 @ 100µ DFT/ COAT 2 X 100 = 200	280	F-6 shall be suitable for immersion service.
12.6 D. M. (DEMINERALISED WATER) AND HYDROCHLORIC ACID (HCL): INTERNAL SHELL, BOTTOM PLATE AND ALL ACCESSORIES						
12.6.1	-14 TO 80	SSPC-SP-10	EBONITE RUBBER LINING AS PER SMMS SPECIFICATION 6-06-204			
12.7 EG TANKS (INTERNAL SHELL, BOTTOM PLATE ROOF AND ALL ACCESSORIES)						
12.7.1	ALL	SSPC-SP-10	3 COATS VINYL CHLORIDE AMERCOAT 23 @ 75µ / COAT	CO-POLYMER	225	

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI



TITLE

SHOP & FIELD PAINTING

DOCUMENT NO.

MEC/S/05/21/07

Page 32 of 54

REVISION : 0

EDITION : 1

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FILED PRIMER	FINISH PAINT		
12.8	INSIDE PONTOON AND INSIDE OF DOUBLE DECK OF ALL FLOATING ROOFS.					
12.8.1	-14 TO 80	SSPC-SP-3	1 COAT OF F-8 @ 100µ DFT/ COAT	1 COATS OF F-6 @ 100µ DFT/ COAT 1 X 100 = 100	200	
12.9	INTERNAL SURFACE OF AMINE & SOUR WATER STORAGE TANKS					
12.9.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT 2 X 40 = 80	2 COATS OF F-15 @ 75µ DFT/ COAT 2 X 75 = 150	215-225	

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI

SHOP & FIELD PAINTING
DOCUMENT NO.
MEC/S/05/21/07

Page 33 of 54
REVISION : 0
EDITION : 1



TABLE 13.0 : COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND TANKS

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		REMARKS
			PRIMER	FINISH PAINT	
13.1 CARBON STEEL PLANT PIPING (UNDERGROUND)					
13.1.1 YARD COATING					
13.1.1.1	25 TO 60	SSPC-SP-10	1 COAT OF SYNTHETIC DRYING TYPE-B AS PER AWWA-C-203 (1991)	4mm THICK COALTAR COATING WRAPPING AS PER AWWA-C-203 IN 2 LAYER OF EACH 2mm THICKNESS	4mm CTE coating shall confirm to 120/ 5 as per BS: 4164
13.1.2 OVER THE DITCH COATING					
13.1.2.1	25 Tto 60	SSPC-SP-10	1 COAT OF SYNTHETIC DRYING TYPE-B AS PER AWWA-C-203 (1991)	2 LAYERS OF COALTAR BASED TAPE COATING AS PER AWWA-C-203.	4 mm
13.2 CARBON STEEL PLANT PIPING (UNDERGROUND)					
13.2.1	61 TO 400	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT	NONE	65-75
13.3 EXTERNAL SIDE OF UNINSULATED UNDERGROUND STORAGE TANKS:					
13.3.1	40 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT	3 COATS OF F-7 @ 100µ DFT/ COAT 3 X 100 = 300	365
13.3.2	-90 TO -41 81 TO 400° c	SSPC-SP-10	1 COAT OF F-9 @ 65-75µ DFT/ COAT 1 COAT OF AMERCOAT 738 @ 250µ DFT/ COAT	NONE	65-75 250


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 34 of 54
	PAINTING	MEC/S/05/21/07	REVISION : 0
			EDITION : 1

TABLE 14.0 : PAINTING UNDER INSULATION FOR INSULATED (HOT COLD SAFETY CARBON STEEL, LOW ALLOY STEEL, LOW TEMPERATURE CARBON STEEL & STAINLESS STEEL PIPING, STORAGE TANKS EQUIPMENTS IN ALL ENVIRONMENT

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			PRIMER	FINISH PINTS		
14.1	INSULATED CARBON STEEL, LOW ALLOY STEEL AND LTCS PIPING AND EQUIPMENT & TANKS					
14.1.1	-4 TO 125	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER F-9 @ 65-75µ DFT	2 COATS OF F-14 @ 125µ DFT/ COAT 2 X 125 = 250 OR 3 COATS OF F-15= 3 X 80=240	315	For other temperature ranges no painting is required under insulation.
14.1.2	OPERATING TEMPERATURE -45 TO 125° C BUT DESIGN TEMPERATURE 126-400° C	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER F-9 @ 65-75µ DFT	3 COATS OF F-12 @ 20µ DFT/COAT 3 X 20 = 60	105-115	
14.2	INSULATED STAINLESS STEEL INCLUDING ALLOY-20- PIPING					
14.2.1	BELOW 0° C TO ALL MINUS TEMPERATURE	ALUMINUM SHEETING WITH ALUMINUM FOIL AND CHLORIDE FREE MINERAL SEALANT CONTAINING BARIUM CHROMATE SHALL BE APPLIED				If the piping & equipments are already erected then surface shall be prepared by cleaning with emery paper and wash/ flush with chloride free DM water followed by wiping with organic solvent
14.2.2	0 TO 120	SSPC-SP-10 (15-25µ SURFACE PROFILE)	NONE	2 COATS OF F-14 @ 125µ DFT/ COAT 2 X 125 = 250 OR 3 COATS OF F-15= 3 X 80 = 240	250	

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI



TITLE

SHOP & FIELD PAINTING

DOCUMENT NO.

MEC/S/05/21/07

Page 35 of 54

REVISION : 0

EDITION : 1

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			PRIMER	FINISH PINTS		
14.2.3	121 TO 500	SSPC-SP-10	NONE	3 COATS OF F-12 @ 20µ DFT/ COAT 3 X 20 = 60	60	No pre erection primer to be applied
14.2.4	501 TO 1000	SSPC-SP-10	NONE	1 COAT OF AMERCOAT 738 @ 150µ DFT/ COAT	150	Only Amorcoat 738 from Amorcon is available for this temperature range.
14.2.5	CYCLIC SERVICE-196 TO 480 EXCEPTING -45 TO 120	SSPC-SP-10	NONE	1 COAT OF AMERCOAT 738 @ 150µ DFT/ COAT	150	
14.3	NO PAINTING REQUIRED FOR INSULATED MONEL, IN COLOY AND NICKEL LINES					



MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 36 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

TABLE 15.0 : INTERNAL PROTECTION OF CARBON STEEL WATER BOXES AND TUBE SHEETS OF COOLERS/ CONDENSERS WATER BOXES, CHANNELS, PARTITION PLATES, END COVERS AND TUBE SHEETS ETC.

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			PRIMER	FINISH PAINT		
15.1	Upto 65	SSPC-SP-10	1 COATS OF F-6 @ 40µ DFT/ COAT	2 COATS OF F-7 @ 125µ DFT/ COAT 2 x 125 = 250	290	For C. S.
15.2	Upto 65 NON FERROUS AND BRASS TUBE SHEETS	SSPC-SP-10	1 COATS OF P-4 @ 8µ DFT/ COAT 1 COATS OF P-6 @ 40µ DFT/ COAT	2 COATS OF F-7 @ 125µ DFT/ COAT 2 x 125 = 250	300	FOR FERROUS SURFACE NON

TABLE 16.0 FIELD PAINTING SYSTEM FOR GI TOWERS/ NON-FERROUS TUBE SHEET

S. NO.	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FILED PAINT	FINISH PAINT		
16.1	Upto 65	SSPC-SP-10	1 COATS OF P-4 @ 8-10µ DFT/ COAT + 1 COAT OF P-6 @ 4µ DFT/ COAT	2 COATS OF F-2 @ 40µ DFT/ COAT 2 x 40 = 250	130	SHADE AS PER DEFENCE REQUIREMENTS
16.2	Upto 65 NON FERROUS AND BRASS TUBE SHEETS	SSPC-SP-10	1 COATS OF P-4 @ 8µ DFT/ COAT 1 COATS OF P-6 @ 40µ DFT/ COAT	2 COATS OF F-7 @ 125µ DFT/ COAT 2 x 125 = 250	300	

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 37 of 54
			REVISION : 0
			EDITION : 1

17.0 STORAGE


17.1 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-Charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the words " PAINT STORAGE NO NAKED LIGHT-HIGHLY INFLAMMABLE" shall be clearly displayed outside.

18.0 COLOUR CODE FOR PIPING


For identification of pipeline, the colour code as per Table 18.1 shall be used. Paint material for color-coding shall be as specified in this standard in clause- 6.0.

18.1 Colour coding scheme for pipe, equipment, machinery & structure:

SR. NO.	DESCRIPTION	GROUND COLOUR	FIRST COLOUR BAND	SECOND COLOUR BAND
18.1.1	ALL KINDS OF WATER DRINKING WATER DE-MINERALISED WATER COOLING WATER BOILER FEED WATER CONDENSATE QUENCH WATER WASH WATER PROCESS WATER PROCESS WATER FIRE WATER SEA WATER	Sea Gree -do- -do- -do- -do- -do- -do- -do- -do- -do- Fire red Sea Green	French Blue Gulf Red French Blue Gulf Red Light Brown Dark Grey Ganary Yellow Oxide Red Crimson Red White	Signal Red - - - Signal Red - - - - - -
18.1.2	STEAM VERY HIGH PRESSURE STEAM (VHP) HIGH PRESSURE STEAM (SH) MEDIUM PRESSURE STEAM (SH) LOW PRESSURE STEAM (SL) DILUTION STEAM/ PURGE STEAM	Aluminiumto IS2339 -do- -do- -do-	Signal Red French Blue Gulf Red Canary Yellow Grey	- - Canary Yellow

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 38 of 54
			REVISION : 0
			EDITION : 1

SR. NO.	DESCRIPTION	GROUND COLOUR	FIRST COLOUR BAND	SECOND COLOUR BAND
18.1.3	COMPRESSED AIR PLANT AIR INSTRUMENT AIR NITROGEN OXYGEN CO ₂	Sky Blue -do- -do- Canary Yello -do- -do-	Signal Red Silver Grey French Blue Black White Light Grey	- - - - - -
18.1.4	GASES FUEL GAS AND SOUR GAS CHARGE GAS RESIDUE GAS, LPG ACETYLENE SWEET GAS	Canary Yellow -do- -do- -do- -do-	Grey Signal Red Oxide Red Service Brown Grey	Dark Violet French Blue White - -
18.1.5	ACIDS AND CHEMICALS SULFURIC ACID NITRIC ACID HYDROCHLORIC ACID ACETIC ACID CAUSTIC CHLORINE	DARK Violet -do- -do- -do- smoke Grey Canary Yellow	Briliant Green French Blue Signal Red Silver Grey Light Orange Dark Violet	Light Orange -do- -do- -do- - -do-
18.1.6	HYDRO CARBONS NAPTHAS PROPYLENE PROPYLENE C.G. (LIQ) ETHYLENE GLYCOL ETHYLENE DICHLORIDE BENZENE BUTADIENE ETHANE(LIQ) PROPYLENE(LIQ) ETHYLENE(LIQ) TAR AROMATIC GASOLINE METHANOL (LIQ) PYROLYSIS GASOLINE MIXED C4(LIQ) LPG(LIQ) KEROSENE DIESEL OIL (WHITE) DIESEL OIL (BLACK)	Dark Admiralty Grey -do- -do- -do- -do- -do- -do- -do- Dark Admiralty Grey -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- Light Brown -do- -do-	Brilliant Green -do- -do- -do- Gulf Red Canary Yellow Black Light Grey Signal Red Light Grey Signal Grey Brilliant Green White Brilliant Green Signal Green Brilliant Gren -do- -do- - - -	Black Smoke Grey Gulf Red - - - - French Blue Black Black Brilliant Green Canary Yellow Gulf Red Black Light Brown Dark Violet - - -

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 39 of 54
			REVISION : 0
			EDITION : 1

18.2 The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding of a ground colour and colour bands superimposed on it.

18.3 Ground colours as given in Table 18.1 shall be applied throughout the entire length for uninsulated pipes, on the metal cladding & on surfaces covered by Clause 2.2.2, ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

- a. At battery limit points
- b. Intersection points & change of direction points in piping ways.
- c. Other points, such as midway of each piping way, near valves, junction joints of services appliances, walls, on either side of pipe culverts.
- d. For zong stretch/ xard piping at 50M interval.
- e. At start and terminating points.

18.4 **Identification Sign**


18.4.1 Flow direction shall be indicated by an arrow in the location stated in Para a,b,c & d and as directed by Engineer-in-charge.

18.4.2 Colours of arrows shall be black or white and in contrast to the colour on which they are superimposed.

18.4.3 Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer-in-charge.

18.4.4 Size of arrow shall be either of those given in 18.5.

18.5 **Colour Bands**

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 40 of 54
			REVISION : 0
			EDITION : 1

18.5.1 As a rule minimum width of colour band shall conform to the following table:

Nominal Pipe Size	Width : L(mm)
3" NB and below	25mm
Above 3" NB upto 6" NB	50mm
Above 8" NB upto 12" OD	75mm
Above 12" OD	100mm

Note: For insulated pipes, nominal pipe size means the outside diameter of insulation.

Nominal pipe size figures are to be inches.

18.5.2 Colour band(s) shall be arranged in the sequence shown in Table 18.1 and the sequence follows the direction of flow. The relative proportional width of the first colour band to the subsequent bands shall be 4:1, minimum width of any band shall be as per Clause 18.5.1.


18.5.3 Whenever it is required by the Engineer-in-charge to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal strips of black and golden yellow as per IS:2379 shall be painted on the ground colour.

18.6 Wherever it is required by the Engineer-in-charge to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal strips of black and golden yellow as per IS:2379 shall be painted on the ground colour.

19.0 **IDENTIFICATION OF VESSELS, PIPING ETC.**

19.1 Equipment number shall be stencilled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black or white shall be stencilled on all the pipelines of more than one location as directed by Engineer-in-charge, size of letters printed shall be as below :

Column & Vessels	-	150mm(high)
Pump, Compressor and other machinery	-	50mm (high)
Piping	-	40-150mm

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 41 of 54
			REVISION : 0
			EDITION : 1

19.2 **Identification of storage tanks**

The storage tanks shall be marked as detailed in the drawing.

20.0 **PAINTING FOR CIVIL DEFENCE REQUIREMENTS**

20.1 Following items shall be painted for camouflaging if required by the client.

- a. All columns
- b. All tanks in offsites
- c. Large vessels
- d. Spheres

20.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-in-charge.

20.3 **Method of Camouflaging**

20.3.1 Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matt finish).

Dark Green	Light Green	Dark Medium Brown
5:	3:	2

20.3.2 The patches should be asymmetrical and irregular.


20.3.3 The patches should be inclined at 30 degree to 60 degree to the horizontal.

20.3.4 The patches should be continuous where two surfaces meet at an angle.

20.3.5 The patches should not coincide with corners.

20.3.6 Slits and holes shall be painted and dark shades.

20.3.7 Width of patches should be 1 to 2 meters.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 42 of 54
			REVISION : 0
			EDITION : 1

21.0 **INSPECTION AND TESTING**

21.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufacturers as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.


21.2 Engineer-in-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batchwise test of wet paints for physical & chemical analysis. All costs there shall be borne by the contractor.

21.3 The painting work shall be subject to inspection by Engineer-in-Charge at all times. In particular, following stagewise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

- a. Surface preparation
- b. Primer application
- c. Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e. g. Redd oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer-in-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work. Contractor shall be responsible for making good any defects found during final inspection/ guarantee period/ defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to owner, the extra cost should have prior approval of Engineer-in-Charge.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 43 of 54
			REVISION : 0
			EDITION : 1

21.4 Primer Application

After surface preparation the primer should be applied to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer-in-Charge.

21.5 The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer-in-Charge before application of successive coats.


21.6 The contractor shall provide standard thickness measurement instrument with appropriate ranges(s) for measuring.

Dry film thickness of each coat, surface profile guage for checking of surface profile in case of blast cleaning. Holiday directors and pinhole detector and positector whenever required for checking in case of immersion conditions.

21.7 Prior to application of paints on surface of chimneys the thickness of the individual coat shall be checked by application of each coat of same paint on M. S test panel. The thickness of paint on test panel shall be determined by using guage such as 'Elkomere'. This thickness of each coat shall be checked as per provision of this specification. This shall be approved by Engineer-in-Charge before application of paints on surface of chimney.

21.8 At the discretion of Engineer-in-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

21.9 Final inspection shall include measurement of paint dry film thickness. Adhesion Holiday detection check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by Engineer-in-Charge and shall be within + 10% of the dry thickness, specified in the specifications.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 44 of 54
			REVISION : 0
			EDITION : 1

21.10 The contractor shall arrange for spot checking of paint materials for Sp. Gr., flow time (ford cup) and spreading rate.

22.0 **GUARANTEE**

22.1 The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/ to be provided during execution of work.

22.2 The contractor shall produce test report from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right the test wet samples of paint at random, for quality of same as stipulated in clause 11 above. Batch test report of manufacturer's for each batch paint supplied shall be made available by the contractor.


23.0 **QUALIFICATION CRITERIA OF PAINTING CONTRACTOR**

Painting contractor who is awarded any job for MECON, projects under this standard must have necessary equipments, machinery, tool and tackles for surface preparation, paint application and inspection. The contractor must have qualified trained and experienced surface preparation, paint applicator, inspector, and supervisors. The contractor supervisor, inspector surface perpetrator and paint applicator must be conversant with the standards referred in this specification the contractors capacity, capability and competency requirements for the job shall be quantified in the tender document and shall be assessed by an MECON team before awarding any job.

24.0 **PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURER'S**

Following procedure is recommended to be followed for approval of new manufacturers.

24.1 The manufacturer should arrange testing of the inorganic zinc silicate coating materials as per the list of tests given in para 24.5 below from one of the reputed Government laboratories.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 45 of 54
			REVISION : 0
			EDITION : 1


24.2 Samples of coating should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certificate and sealed by a citifying agency.

24.3 All test panels should be prepared by govt. testing agency coloured photographs of test panels should be taken before and after the test should be enclosed alongwith test report.

Sample batch. No. and manufacturer's test certificate should ne enclosed alongwith the report. Test reports contain details of observation and rusting if any, as per the testing code. Suggested government laboratories are:

RRL, Hayderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratory
UDCT, Mumbai
RITES, Calcutta
PDIL


24.4 Manufacturers should intimate the company, details of sample submitted for testing name of Govt. testing agency, date, contact personnel of the Govt. testing agency. At the end of the test the manufacturer should submit the test report to the company for approval. The manufacturer(s) shall be qualified based on the result of these tests and other assessment and the Company's decision in this regard shall be final and binding on the manufacturer.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 46 of 54
			REVISION : 0
			EDITION : 1

24.5 Tests required for evaluation of acceptance of coating materials for offshore application.

Test	ASTM Test Method
Density	D 1475
Dipping properties	D 823
Film Characteristics	
Drying time	D 1640
Flexibility	D 1737/ D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968/ D 1044
DFT/ Coat	AS PER SSPC GUIDELINES
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt Spray for 2000 hrs.	B 117
Accelerated Weathering	D 822
% Zn in DFT	G 53

24.6 Coating system for panel test shall be decided after discussion with MECON.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO. MEC/S/05/21/07	Page 47 of 54
			REVISION : 0
			EDITION : 1

ANNEXURE-I

LIST OF RECOMMENDED MANUFACTURERS


Indian Vendors

- 1.0 Asian Paints(l) Ltd.
- 2.0 Berger Paints Ltd.
- 3.0 Goodlass Nerlolac Paints Ltd.
- 4.0 Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
- 5.0 Shalimar Paints Ltd.
- 6.0 Sigma Coating, Mumabai
- 7.0 CDC Carboline Ltd.
- 8.0 Premier Products Ltd.
- 9.0 Coromandel Paints & Chemicals Ltd.
- 10.0 Anupam Enterprises
- 11.0 Grand Polycoats
- 12.0 Bombay Paints Ltd.
- 13.0 Vanaprabha Esters & Glycer, Mumbai
- 14.0 Sunil Paints and Varnishes Pvt. Ltd.
- 15.0 Courtaulds Coating & Sealants India (Pvt.) Ltd.
- 16.0 Mark-chem Incorporated, Mumbai (for phosphating chemicals only)
- 17.0 VCM Polyurethane Paint (for polyurethane Paint only)

FOREIGN VENDORS FOR OVERSEAS PRODUCTS

- 1.0 Sigma Coating, Singapore
- 2.0 Ameron, USA
- 3.0 Kansai Paint, Japan
- 4.0 Hempel Paint, USA
- 5.0 Valspar Corporation, USA
- 6.0 Courtaulds Coating, UK.

Note: This list subjected to revision based fresh approval which will be intimated to PDD/ Vendor Cell.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000
	OIL & GAS SBU, DELHI		
TITLE SHOP & FIELD PAINTING	DOCUMENT NO.	Page 48 of 54	
	MEC/S/05/21/07	REVISION : 0	
		EDITION : 1	

ANNEXURE-II

LIST OF RECOMMENDED MANUFACTURER'S PRODUCTS

S. No.	MANUFACTURER NAME	P2 CHLORINATED RUBBER Zp PRIMER	P4 ETCH PRIMER/ WASH PRIMER	P6 EPOXY ZINC PH. PRIMER	F9 INORGANIC ZINC SILICATE PRIMER/ COATING
1.	ASIAN PAINTS (I) LTD.	ASIOCHL OR HB. ZN.PH PRIMER RO PC 168	APCONYL WP 636 (PC 335)	APCODUR HB. RO.ZP-PC433	APCOCIL 605
2.	BARGER PAINT LTD.	LINSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPI LUX 610	ZINC ANODE 304
3.	AMERON/ GODDLASS NEROLAC PAINTS LTD.	-	AMERCOAT 187	AMERCOAT 71	DIMET COTE-9
4.	JENSON & NICHOSON PAINTS LTD. AND CHOKUGU JENSON NICHOLSON	JENSOLAC CHLORINATED RUBBER HB ZN.PH. PRIMER	J & N ETCH PRIMER	EPI LAC ZINC PHOSPHATE PRIMER	-
5.	SHALIMAR PAINTS LTD.	CHIOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETC PRIMER	EPI GUARD 4 ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILICATE TL
6.	SIGMA COATING	SIGMA NUCOL UNICOAT 7321	SIGMA COVER PRIMER (7413)	COLTURE CM PRIMER 7412	SIGMASIL MC (7568)
7.	CDC CARBOLINE LTD.	-	-	CARBOLINE 893	CARBOZINC 11
8.	PRIMER PRODUCTS LTD.	-	-	P-15/3A U-16/92	U17/ 92 ETHYL SILICATE INORGANIC ZINC
9.	CORAMANDEL PAINTS CHEMICALS LTD.	COROCLORE CR HB. ZN. PH. PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZH. PH. HIGH BILD PRIMER	-

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI

SHOP & FIELD PAINTING

DOCUMENT NO.
MEC/S/05/21/07


Page 49 of 54

REVISION : 0

EDITION : 1

TITLE

S. No.	MANUFACTURER NAME	P2 CHLORINATED RUBBER Zp PRIMER	P4 ETCH PRIMER/ WASH PRIMER	P6 EPOXY ZINC PH. PRIMER	F9 INORGANIC ZINC SILICATE PRIMER/ COATING
10.	ANUPAM ENTERPRISES	ANUCLOR ZP PRIMER	ANUPRIME 291	ANUPAM ANILICOR A-EZP-500	-
11.	GRAND POLYCOATS	GP CHILORPRIME 601	GP PPRIME 401	-	-
12.	BOMBAY PAINTS LTD. THEMPEL MAKE PAINTS	HEMPA TEX HIGHBUILD 4633	PENTOLITE WASH PRIMER 8520	HEMPEL'S SHOP PRIMER E-1530	GALVASOL 1570
13.	VANAPRABHA ESTERS & GLYCERIDES,	VEGCHLOR HB PRIMER 1143	VEG WASH PRIMER 1181	VEGPOX 1241 Z/P	-
14.	SUNIL PAINTS AND VARNISHED PVT. LTD.	SUNCHLOR HB ZINC PHOSPHATE PRIMER	SUN WASH	SUNPOXY ZINC PHOSPHATE PRIMER	-
15.	COURTAULDS COATING LTD.	-	-	INTERGARD 251	INTERZINC
16.	MARK-CHEM INCORPORATED, (FOR PHOSPHATING CHEMICAL ONLY)	RUST PREVENTIVE LIQUID DRSAIO			
17.	VCM POLYURETHANE PAINTS (FOR POLYURETHANE PAINTS ONLY)				
18.	JOTUN PAINTS			EPOXY CQ	JOTACOTE -2

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 50 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

S. No.	MANUFACTURER NAME	P2 CHLORINATED RUBBER Zp PRIMER	P4 ETCH PRIMER/ WASH PRIMER	P6 EPOXY ZINC PH. PRIMER	F9 INORGANIC ZINC SILICATE PRIMER/ COATING
				SPECIAL ZINC PHOSPHATE PRIMER	
19.	KCC PRODUCTS (KOREA)				EZ 180(N)

LIST OF RECOMMENDED MANUFACTURER'S PRODUCTS (Contd....)

S. No.	MANUFACTURER NAME	F2 ACRYLIC-POLY YURETHANE FINISH PAINT	F3 CHLORINATED RUBBER FINISH PAINT	F6 HIGH BUILD FINISH PAINT	F7 HIGH BUILD COAL TAR EPOXY COATING
1.	ASIAN PAINTS (I) LTD.	APCOTHANE CF76 (PC 1109)	ASIOCHLOR CF 621 (PC 161)	APCODUR HB COATING 9466	APCODUR CF 300
2.	BARGER PAINT LTD.	BARGER THANE ENAMEL (81)	LINOSOL CHLORINATED RUBBER HB COATING	EPI LUX 04 AND 78 HB EPOXY COATING	EPI LUX 555
3.	AMERON/ GODDLASS NEROLAC PAINTS LTD.	AMERCOAT 450GL	AMERCOAT 515	AMER COAT 383 HS	AMERCOAT 78 HB
4.	JENSON & NICHOSON PAINTS	J & N 993 HB POLYURETHANE	JENSON HB CHLORINATED	EPI LAC 981 ENAMEL	EPI LAC SOLVENTLESS COAT

MECON LIMITED
REGD. OFF: RANCHI
834002

STANDARD TECHNICAL SPECIFICATION

OIL & GAS SBU, DELHI

SHOP & FIELD PAINTING

DOCUMENT NO.
MEC/S/05/21/07


Page 51 of 54

REVISION : 0

EDITION : 1




S. No.	MANUFACTURER NAME	F2 ACRYLIC-POLY YURETHANE FINISH PAINT	F3 CHLORINATED RUBBER FINISH PAINT	F6 HIGH BUILD FINISH PAINT	F7 HIGH BUILD COAL TAR EPOXY COATING
	LTD. AND CHOKUGU JENSON NICHOLSON	FINISH PAINT.	RUBBER FINISH PAINT		TAR EPOXY COATING
5.	SHALIMAR PAINTS LTD.	SHALITHANE FINISH	CHLORKOTE FINISH	EPIGARD KL FINISH	BIPIGARD'S BLACK HB COAL TAR EPOXY COATING
6.	SIGMA COATING	SIGMADOUR HS SEMIGLOSS 7530	SIGMA NUCOL FINISH 7308	SIGMA COVER CM 7456	COLTURIET TCN 300
7.	CDC CARBOLINE LTD.	CARBOLINE 132	-	CARBOLINE 191	CARBOMASTIC-14
8.	PRIMER PRODUCTS LTD.	U3/ 92 POLYURETHANE	CR-71 FINISH PAINT	42B/ 4A HIGH BUILD EPOXY	350B/ 3A, COAL TAR EPOXY COATING
9.	CORAMANDEL PAINTS CHEMICALS	-	COROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
10.	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
11.	GRAND POLYCOATS	GP COAT 131, 132 GP BOND 141	GP CHILOROGAURD 631	GP GUARD HP 234	POLYGUARD GE

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		 ISO 9001:2000
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 52 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1


LIST OF RECOMMENDED MANUFACTURER'S PRODUCTS

S. NO.	MANUFACTURER'S NAME	F2	F3	F6	F7
12.	BOMBAY PAINTS LTD./ PAINTS	PENTATHANE FP 4510	HEMPATEX HIBUILD 4633	HEMPADUR HIGH BUILD 5520	HEMPADUR 1510
13.	VANAPRABHA ESTERS & GLYCERIDES,	VEGTHANE FP 3641	VEGCHLOR FP 3140	VEGPOX- 3265 VEGPOX 3562	VEGPOX 4265
14.	SUNIL PAINTS AND VARNISHED PVT. LTD.	SUNTHANE (ALIPHATIC)	SUNCHLOR HB CR COATING	LPOXY HB 'PS 901'	LPOXY BLACK P. S. 551
15.	COURTAULDS COATING LTD.	INTERTHANE	-	INTEGARD EM SERIES	INTERTUF JXA 006/ 007/ 010
16.	MARK-CHEM INCORPORATED, (FOR PHOSPHATE PAINTS ONLY)				
17.	VCM POLYURETHANE PAINTS (FOR POLY EURETHANE PAINTS ONLY)	PIPCOTHANE ALIPHATIC POLYURETHANE FINISH PAINT			
18.	JOTUN PAINTS	HARDTOP AS		PENGUARD	JOTAGUARD 85
19.	KCC PRODUCTS (KOREA)			KOPOX TOPCOAT HB ET 5740	EH 173

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 53 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

LIST OF RECOMMENDED MANUFACTURER'S PRODUCTS

S. NO.	MANUFACTURER'S NAME	F-8 EPOXY MASTIC COATING SURFACE TOLERANT	F-11 HEAT RESISTANCE SYNTHETIC MEDIUM ALUMINIUM PAINT	F-12 HEAT RESISTANCE SILICON AL. PAINT
1.	ASIAN PAINTS (I) LTD.	APCODOR CF 640	ASIAN HR ALUMINIUM PAINT (PC.300)	HR SILICON ALUMINIUM PAINT (PC. 189)
2.	BARGER PAINT LTD.	PROTECTOMASTIC	FERROLOT HR ALUMINIUM PANT	BARGER HEAT RISISTANT SILICON ALUMINIUM PAINT
3.	AMERON/ GODDLASS NEROLAC PAINTS LTD.	AMERLOCK 400		AMERCOAT 878
4.	JENSON & NICHOSON PAINTS LTD. AND CHOKUGU JENSON NICHOLSON	-	FERROTECT SYNTHETIC RUBBER H/R ALUMINIUM PAINT 4000	FERROTECT SILICON HEAT RESISTANCE 1000
5.	SHALIMAR PAINTS LTD.	EPIPLUS 56	HEAT RESISTING LUSTROL ALUMINIUM	LUSTOTHERM HIGH TEMP ALUMINIUM PAINT
6.	SIGMA COATING	SIGMA ETPC ALUMINIUM	HIGH TEMPERATURE RESISTANT EPOXY SUSTEM UP TO 200° C 4062	AROSTA FINISH HR
7.	CDC CARBOLINE LTD.	CARBOMASTIC-15	CARBOLINE 1248	CARBOLINE 4674
8.	PRIMER PRODUCTS LTD.	HB EPOXY MATIC 150B/ 150A		
9.	CORAMANDEL PAINTS CHEMICALS	-	SILVOTOL HR ALUMINIUM PAINT	CPC SILICONE HR ALUMINIUM PAINT
10.	ANUPAM ENTERPRISES	ANUMASTIC-102	-	ANUPAM HEAT GUARD

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD TECHNICAL SPECIFICATION		
	OIL & GAS SBU, DELHI		
TITLE	SHOP & FIELD PAINTING	DOCUMENT NO.	Page 54 of 54
		MEC/S/05/21/07	REVISION : 0
			EDITION : 1

LIST OF RECOMMENDED MANUFACTURER'S PRODUCTS

S. NO.	MANUFACTURER'S NAME	F8	F11	F12
11.	GRAND POLYCOATS	GP PRIME GUARD 235	-	-
12.	BOMBAY PAINTS LTD./ HEMPEL MARINE PAINTS	HEMPADUR 1708	KANGAROO HHR ALUMINIUM 4950	HEMPADUR HIGH BUILD 5520
13.	VANAPRABHA ESTERS & GLYCERIDES,	VEGEPOX MASTIC 2255	VEG HR AL PAINT TO IS211339	VEG HHR AL PAINT TO 600°C
14.	SUNIL PAINTS AND VARNISHED PVT. LTD.	LPOXY HIGHBUILD P.S.901	-	-
15.	COURTAULDS COATING LTD.	INTERPLUX	-	INTERTHERM 50
16.	MARK-CHEM INCORPORATED, (FOR PHOSPHATE PAINTS ONLY)			
17.	VCM POLYURETHANE PAINTS (FOR POLY EURETHANE PAINTS ONLY)	-		
18.	JOTUN PAINTS	JOTUMATIC 87		SOLVELITT HEAT RESISTANT SILICON PAINT
19.	KCC PRODUCTS (KOREA)	EH 4158H		QT 606

Rev. : 0


Edition: 1

SPECIFICATION
FOR
INSTALLATION OF INSTRUMENTS

SPECIFICATION NO.: MEC/S/05/26/01




ELECTRICAL & INSTRUMENTATION
(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 1 of 21
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 2 of 21
			REVISION : 0
			EDITION : 1

C O N T E N T S

- 1) SCOPE
- 2) STANDARDS OF MATERIALS
- 3) INSTALLATION OF INSTRUMENTS
- 4) TESTING
- 5) CALIBRATION OF INSTRUMENTS

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SHIVASTAVA)	ISSUE DATE : 08 Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 3 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1


INSTALLATION, TESTING AND CALIBRATION OF INSTRUMENTATION AND CONTROL SYSTEM

1.0 SCOPE

- 1.1 The purpose of this specification is to define the general requirements for the installation, installation materials, testing and calibration of instruments and control system.
- 1.2 The work shall be carried out in accordance with the codes, standards and recommended practice listed in this specification and in accordance with local 'Statutory regulations'.
- 1.3 For installation of instruments and control system, of the new material where quality is of the prescribed standards and which is in every way fit for its intended purpose shall be used.
- 1.4 Unless otherwise specified all the materials shall be indicated in this specification except where it is not compatible with fluids being handled. In such cases the selection of the material shall be approved by MECON.
- 1.5 Only the best trade practices shall be used. All the work shall be carried out in a neat, workman like manner and to the satisfaction of MECON.

2.0 STANDARDS OF MATERIALS

- 2.1 Instrument process piping / tubing upto and including the first block valve and 'in-line' instrument equipment shall conform to the line class or vessel rating concerned instrument piping or tubing after the first lock valve may use alternate materials consistent with service conditions. In general they shall conform to the following specification as a minimum.
- 2.1.1 Stainless tubes shall be fully annealed and cold drawn seam less as per ASTM A 269 TP316 with size 1/2"OD x 0.65" WT (wall thickness).
- 2.1.2 Monel tubing shall be fully annealed seamless as per ASTM B165 with size 1/2" OD x 0.35"WT.
- 2.1.3 Carbon steel pipe shall be 1/2" seamless and shall be as per ASTM A106 Gr B min of sch 80 & dimensions as per ANSI B36.10.
- 2.1.4 Seamless stainless steel pipes shall be as per ASTM A 312 Gr TP 316L Sch 80S, dimensions as per ANSI B 36.19.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 4 of 21
			REVISION : 0
			EDITION : 1

2.1.5 Instrument air supply piping from the main instrument air header shall be galvanised heavy class pipes to IS 1239.

2.2 Individual pneumatic signal and air supply tubing shall conform to the following specifications:

2.2.1 Stainless tubes shall be used in general and shall be fully annealed and cold drawn seamless as per ASTM A269 TP 316 with 6mmOD x 1mmWT.

2.2.2 Copper tubing where specified shall be seamless 6mmOD x 1.0mmWT soft annealed as per ASTM 868.74a cd No. 122 (DHP) sheathed with PVC 1.0mm thick coloured Black.

2.3 All fittings shall be as a minimum of 100 rating except for tube fittings. The fittings shall have threading as per B2.1 and socket weld connections as per B 16.11. These shall conform to the following specifications in general.

2.3.1 Tube fittings shall be flare type compression fittings double ferrule and pressure seat type.

All tube fittings in impulse lines shall be rated to 5000 PSIG at 38°C.


2.3.2 Carbon steel pipe fittings shall be forged as per ASTM A105 stainless steel pipe fittings shall be as per ASTM –182 Grf 316L

2.4 Valve shall have normally Globe body and shall be fabricated out of Bar-stock and rated to min. of 1500. These shall be screwed bonnet type with 13% GSS trim and plug shall be integral with the stem. Face to face dimensions shall be approx. 80mm. End connections shall be socket weld to ANSI 16.11 and threaded to B2.1

2.5 Multibore tubing shall have a maximum 19 single polyethylene tubes, 6mmOD x 1mm numbered for easy identification. The bundle shall be marked with inner and outer fire resistance PVC sheath. They shall carry a pair of telephone wire 0.6mm diameter flexible.

2.6 Single pair and multi pair extension cables for Thermocouples shall be matched and calibrated in accordance with ISA MC 96.1. Conductor size shall be AWG for single pair and 20 A for Multipair.

The cable shall be armoured, each twisted pair shall be individually shielded with aluminium Mylar tape and a tinned copper drain wire. The wires and the cable shall be colour coded as per ISA recommended practices.


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 5 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1

- 2.7 Instrument Electrical cables shall conform to the following specifications:
- 2.7.1 Instrument electronic signal cables single pair/ Multipair shall have copper conductor, twisted in pair and individually shielded with Aluminium Mylar tape with drain wire. In multipair cables, each pair shall be armoured with inner and cut PVC sheath. Minimum conductor size shall be 1.5 mm².
- 2.7.2 Control Cables for control signal, alarms actuating devices and solenoid valves of the interlock and shutdown valves shall generally be 1.5 mm² copper conductors armoured with inner and cut PVC sheath.
- 2.7.3 All power supply cables shall have copper/Aluminium conductor depending upon the conductor size. The cables shall be armoured with inner and cut PVC sheath. The cables shall be sized adequately. Minimum conductor size shall be 2.5 mm².
- 2.7.4 2-core armoured cable shall be used for illuminator on level gauges.
- 2.7.5 The material and construction of all electrical cables shall conform to IS- 1554 Part I or appropriate equivalent code and standard.

3.0 **INSTALLATION OF INSTRUMENTS**

3.1 Instrument Mounting

- 3.1.1 No instrument shall be installed in such a way that it bends for support on the impulse piping or electrical connection on it.
- 3.1.2 Pressure gauges and temperature indicator shall normally be mounted directly on line. However direct on line mounting shall be avoided where vibrations are likely to be present.
- 3.1.3 Local mounted instruments shall be mounted on brackets, panels or placed on a suitable pedestal. Transmitters shall be mounted on 2" pipe supports where practical. Instruments to be mounted on steel columns, masonry structure etc. These shall not be mounted on heating equipments, pipelines and structures.
- 3.1.4 Blind transmitters shall be mounted at 130mm above graded platform. Local controllers, indicating transmitters and indicating instruments shall be mounted at approximately 1500 mm.
- 3.1.5 All the instruments shall be accessible from grade, ladder or platform etc. Pressures gauges and other local indicating instruments shall be readable from grade or operating level and if used for manual control shall be visible from the related valve.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 6 of 21
			REVISION : 0
			EDITION : 1

All the instruments shall be located such that they don't impede the process operation.

- 3.1.6 Local mounted instruments which are not available in weather proof housing shall be mounted inside a weather proof case.
- 3.1.7 Items such as pilot valves, solenoid valves etc. shall be located local to its point of application or near to the device being actuated by them.
- 3.1.8 For blind transmitters output meters shall be mounted on instrument supports.
- 3.1.9 Filter regulators shall be mounted on the instrument supports below pneumatic transmitter or on the control valve yoke.
- 3.1.10 Instruments or instrument lines shall not be supported on hand rails, in general.
- 3.1.11 The use of process piping to support instrument lines shall be avoided as far as possible.
- 3.1.12 The instrument impulse piping shall be kept as short as possible.
- 3.1.13 Instruments and impulse lines shall be protected against mechanical damage.
- 3.1.14 In case of capillary tube instruments, capillary tube is to be supported and protected against mechanical damage.
- 3.1.15 Orifice meters shall not be installed on the top of orifice fittings. On horizontal lines orifice pressure taps shall be located as follows:
 - a) On top for air and gas service
 - b) Horizontal for liquid and condensable vapour service.


3.2 Instrument Piping & Tubing.

3.2.1 Impulse Piping/tubing


3.2.1.1 The primary instrument block valves for all instruments shall be as per piping specifications.

3.2.1.23-Valve manifold in general shall be integral type. For pressure gauges, 2-valve manifolds shall also be acceptable instead of isolation valve, drain valve and pipe fittings.

3.2.1.3 Differential or static pressure sensing lines shall not exceed 6 mtrs. (20 feet) in general for direct connected or locally mounted instruments.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 7 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1

- 3.2.1.4 All impulse lines shall be run with a slope not less than 1 in 12 except where otherwise specified. Direction of slope is to be downward from the process for liquid service and upward from the process for gas service.
- 3.2.1.5 Tubing shall be joined by compression fittings.
- 3.2.1.6 Piping shall be joined by pipe fittings/flanges as per the piping specifications.
- 3.2.1.7 All instruments pipes and tubes shall run in horizontal and vertical planes only and shall run with minimum number of changes in direction, consistent with good engineering practices and neat appearance.
- 3.2.1.8 Tubing shall be bent with correct size tube bender as far as possible to avoid use of fittings. Hot bending shall be totally avoided.
- Tube cutter shall always be used to cut tubing. The use of short lengths of tubing in long runs shall be avoided in order to avoid the fittings.
- 3.2.1.9 All tubing shall run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together and clamped.
- 3.2.1.10 Tubing shall be arranged so that the unions can be tightened without distorting lines.
- 3.2.1.11 Instrument tubing or piping shall not run on trays intended for cables and shall not share the same transit.
- 3.2.1.12 No pipe or tube shall be left with mechanical strain on them.
- 3.2.1.13 A mechanical ferrule seater shall be used on tubing for 140 kg/cm² (2000 psi) or more.
- 3.2.1.14 Pipe bushings shall not be used.
- 3.2.1.15 Pipe plugs shall be fabricated out of bar stock and shall have hex-head.
- 3.2.2 Air/Signal Tubing
- 3.2.2.1 Signal Transmission tubes shall be laid on perforated trays prefabricated out of min 2.5 mm. thick steel plates. The width of the tray shall be selected as per the number of tubes to be laid.
- 3.2.2.2 Where tubing is run in permanent enclosures, it should be ensured that entry and exit of such enclosures is clean and smooth.
- 3.2.2.3 Tubing run in permanent enclosures shall not have joints, except at special junctions


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 8 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1

boxes provided for this purpose.

- 3.2.2.4 Where permanent enclosures are left with space for instrument tubing to be laid at some later date, a galvanised pull wire of adequate size shall be left in the tray.
- 3.2.2.5 Where the length of transmission tubing exceeds 60 mtrs (200ft) necessity of installing signal booster relays shall be considered.
- 3.2.2.6 In case of `Skidded' equipment or vessels with instrumentation, where off- skid alarms shutdown or control functions are provided the signal tubes shall be terminated on the control bulk head near the skid boundary.
- 3.2.3 All threaded pipe joints shall be joined after applying Teflon tape. It should be applied in a manner to ensure that the tape does not spill over the end of the male fitting. No other pipe joining compound shall be used except on high temperature service where graphite sealing compounds shall be used.
- 3.2.4 All reasonable precautions shall be taken to prevent foreign materials entering pipe lines or tubing before and during erection.
- 3.2.5 Pipes and tubes installed but not connected, shall have the ends clad in approved fashion to prevent the entry of foreign material. For a period upto one week adhesive tape may be used, for longer periods, caps or plugs shall be used.
- 3.2.6 Piping/Tubing supports
- 3.2.6.1 Piping and tubing shall be adequately supported and fixed at a distance not exceeding that in the following table:

Table

Single tubing/Piping	Max. distance between supports
3/8" OD or less	Continuous
1/2" to 3/4" Nom. size	2 meters (6ft.)
3/4" to 1" Nom. size	3 meters (9ft.)
Multitube bundle	3 meters (9ft)

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 9 of 21
			REVISION : 0
			EDITION : 1

3.2.6.2 All field mounted instrument air tubing shall be supported with galvanised steel angles or channels of minimum 1/8" thickness fabricated to present neat appearance.

3.2.6.3 All instruments tubing supports shall be galvanised prior to installation

3.2.6.4 Trays shall be properly supported either from any rigid steel structure or concrete member. In case of non-availability of above, a suitable support shall be fabricated.

3.3 Instrument Air Supply Distribution

3.3.1 Piping material for instrument main and branched air headers upto the isolation valve at each take-off from main or branch header shall conform to piping specification.

3.3.2 The air header size shall be established in accordance with the table below, unless otherwise specified, for a header pressure of 4 to 8.5 kg/cm²

Table – 2

Max number of users	Nominal pipe size
upto 5	1/2"
upto 10	3/4"
upto 25	1"
upto 80	1-1/2"
upto 150	2"
upto 500	3"


3.2.3 All take off for branch lines are to be from the top of the main header with block valves equal in size to the branch line. All low point shall have a 1/2" valve installed as a drain and blow down point.

3.3.4 A minimum size of 1/2" pipe shall be run to the instrument with a 1/2" valve for each user. Tubing from the isolation valve to the instrument shall be 6.0 mm.

3.2.5 Union shall be provided at convenient location in the air header.

3.3.6 Filter regulator shall be provided for individual field mounted consumer and shall be complete with an output gauge.

3.3.7 In case of skid mounted equipments or vessels which incorporate instrumentation requiring pneumatic supply, on skid supply piping shall terminate at the skid boundary location and size of the supply connections shall be noted on the vendor approval drawings.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 10 of 21
			REVISION : 0
			EDITION : 1

3.4 Installation of multitude and Multicore cables.

3.4.1 Multicore/ Multitube cables shall generally be installed on trays or ducts and properly clamped. At bends minimum radius shall be maintained as per cable manufacturer's standards.

3.4.2 All cables shall be rigidly supported on structural steel and masonry. Drilling of steel member should normally be avoided. However, if the drilling of steel must be resorted to, it must be drilled where minimum of weakening of structure will result cables shall be support at every 500 mm. At every vertical drop these shall be clamped at more frequent intervals max of 300 mm.

3.4.3 Directly buried cables shall be laid underground in excavated cable trenches. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced and arranged with a view of heat dissipation and economy of design construction of trenches laying of cables and filling up of trenches shall be as per relevant standard.

3.4.4 Each underground cable shall be provided with identifying tag of load securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground.

Before cables are placed, the trench bottom shall be filled with a layer of sand. The cables shall be covered with 150 mm of sand on the top of the largest dia. cable tube and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall be laid flat and the balance portion of the trench shall be filled with soil, compacted and levelled.


3.4.5 At each road crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables don't slack and get damaged by pipe ends after back filling.

3.4.6 At the entry into concrete blocks loops shall be provided at either end to prevent any damage to cable.

3.4.7 The cable entry to control room shall be suitably filled and sealed after laying of cables so as to achieve a positive sealing against the entry of gas/water.

3.4.8 All wiring, tubing, cables, Junctions boxes and auxiliary equivalent shall be suitably identified as per applicable codes and practices. All piping and tubing shall be tagged with slip-on or clip on wire marker at both ends.

3.4.9 Jointing of cables is generally not permitted. Cables shall be cut after the exact site measurements at the cable drums shall be so selected before cutting the lengths as to avoid any unnecessary wastage.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 11 of 21
			REVISION : 0
			EDITION : 1


- 3.4.10 Low signal cables like alarms, analysers cables, special cables for turbine meter, thermocouple compensating cables etc. shall be layed separated from power supply cables in ducts/trenches/trays.
- 3.4.11 Electric signal lines for electronic transmitters to receive and to final control element shall be continuously shielded with the shield grounded at the same point as the signal circuit generally at the control instrument.
- 3.4.12 Separate junction boxes shall be used for intrinsically sage cables.
- 3.4.13 Different intrinsically safe system e.g., systems having different rounds shall not be run in the same multicore cable, in general.

Recommended minimum separation distance between twisted pair signal leads and AC Power Lines.

AC Power Cable		Minimum Distance to Signal Lead
Voltage (Volts)	Current (Am) in (cm)	
0 to 125	0 to 10	12" (30)
125 to 250	0 to 50	15" (38)
250 to 440	0 to 200	18" (46)
5KV & Up	200 Amp. & Up	24" (61)

Different intrinsically safe circuits e.g., circuits having different voltage levels, of the same intrinsically safe system shall not be run in the same cable unless each conductor insulation is at least 0.25mm or no hazard can result from interconnection.

- 3.4.14 The physical separation of power and signal cables shall be as per API 550 Part I Section VII. Cable in intrinsically safe circuits shall preferably be not run in the same tray where-- on intrinsically safe circuits cables are being run. If these are being run in the same tray, a metallic earthed separately shall be provided.
- 3.4.15 For temperature controllers, single pair thermocouple extension cable or cable for resistance thermometer, shall be layed directly from the element to the transducer in the control room without intermediate terminal blocks.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 12 of 21
			REVISION : 0
			EDITION : 1

3.4.16 In case of skid mounted equipment or equipment which incorporate skid instrumentation like alarms, shutdown or control function shall terminate signals or control junction box near skid boundary for connection of off skid equipment.

3.4.17 No wire shall be terminated or left with mechanical strain within any conductor.

3.4.18 Splices shall be made only at terminals, in instruments or approval equipment/ junction boxes using lugs and screwed connections. No intermediate splices shall be made in cable trays or in conduct. Number of junction boxes in any cable path shall be limited to only one.

3.5 Installation of Zener barriers

3.5.1 Zener barriers shall be installed in the circuit to make the system intrinsically safe provided:

- a) There is no energy storage system in excess to the minimum permitted by the barrier design on the hazardous side of the barrier. The same shall be met by taking intrinsically safe transmitters and selecting the cable electrical parameters like inductance L/R ratio & capacitance in accordance with the maximum parameters given in barrier specifications.
- b) No power source exceeding the voltage rating of Zener barrier shall be connected on safe side of the Zener barrier.
- c) No outside power source including other intrinsically safe circuits shall be connected to the hazardous side of the barrier.


3.5.2 Zener barriers shall be located as close as possible to the field wiring entry point in the control room.

3.5.3 Single barrier are bolted directly to copper bus bar and multiple barriers on the barrier mounting plates. Copper bus or barriers mounting plates shall be isolated from the panel frame.


3.5.4 The signal ground system for intrinsically safe system shall be separate from power ground system and shall be connected to the signal ground reference point. The maximum resistance allocable between the farthest point on intrinsically safe barrier ground bus and signal ground reference point shall be less than 1 ohm.

3.5.5 Field wires shall directly terminate at the barriers and not through intermediate terminals.

3.6 Installation of Analyser / Gas Chromatograph

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 13 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1

- 3.6.1 Installation of all analyser shall be in general, as per APIP 550 Part II.
- 3.6.2 The analyser housing at its installation shall meet all safety requirements as per classifications.
- 3.6.3 Sampled process fluid, if not returned to the process shall be disposed to a safe location. Piping shall be provided so that vapours can be vented to a safe location and liquids shall be drained in a clean and orderly fashion to a safe place. Toxic vapours shall not be vented to atmosphere.
- 3.6.4 Analyser shall be located as near to the sampling point as possible.
- 3.6.5 Analyser equipment must be protected from the following:
- a) Hot equipment
 - b) Severe ambient temperature changes
 - c) Shock
 - d) Mechanical damage
 - e) Vibration
- 3.6.6 If a separate vent for the analyser is used, the location of that vent shall be in area of minimum air Turbulence. If the vents of different analysers are vented into a common vent, a back pressure regulator shall be used.
- 3.6.7 Vent piping shall be designed to prevent condensate from accumulation in low point and obstruct a free vent flow.
- 3.7 Ducts, Trays and Supports
- 3.7.1 Main cable duct shall be of bottom open type with flat/angle --- construction with side sheet and top cover of 3.2 mm thickness.
- 3.7.2 The ducts and trays shall be properly supported at regular intervals. Wherever insert plates are not available, support on concrete structure or ceiling shall be fixed with a minimum of 10 mm expansion bolts Angle supports for ducts shall be fabricated from minimum of 40 mm angle.
- 3.7.3 All supports shall be neatly cut with hacksaw only and not with gas cutting. Free ends of angle supports shall not have sharp ends and shall be properly rounded off.
- 3.7.4 Ducts and supports shall be painted with one coat of Red oxide Zinc chromate primer conforming to IS-2074 after cleaning to remove scale and then painted with 2 coats of final enamel paint as given below:

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 14 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1

- a) Duct - Dark admirately Grey as per IS0632.
- b) Supports - Black.

3.8 Instrument Steam Tracing

- 3.8.1 Steam for Tracking of instruments shall be taken from main steam header take of valve through carbon steel pipes supported at regular intervals.
- 3.8.2 Steam tracing around individual instrument shall be by copper tube of 1/8" diameter.
- 3.8.3 Piping or tubing for steam tracing shall be installed in such a way as to avoid condensate pockets.
- 3.8.4 After steam tracing, the line is connected to drain funnel through steam trap.

3.9 Identification of Lines and Instruments


- 3.9.1 All site mounted instruments, junction boxes, air headers, tubing and wiring terminations shall be labelled or tagged.
- 3.9.2 Instruments shall be furnished with stainless steel name tags containing Tag no., manufacturer's name, and model no. serial number. This tag number shall be approximately 3"x1" size and shall be attached to the instruments with -- gauge stainless steel wire.
- 3.9.3 Unused cable entries in junction boxes and field instruments are to be plugged.

4.0 **TESTING**

4.1 Instrument Impulse piping/Tubing

- 4.1.1 All process impulse lines shall be disconnected both from the instrument and vessel/piping end and flushed with water.
- 4.1.2 After thorough flushing the impulse lines shall be isolated from the instruments and pressurised hydraulically to 1.5 times the maximum working pressure corrected for ambient temperature. They shall then be isolated from the pressure source and the pressure reading on a test pressure gauge shall not fall at a rate exceeding one psig/hour.

In case no isolation valve is provided near the instrument, impulse piping/tubing shall be pressurised along with the instrument to the maximum pressure of scale in case of pressure transmitter and max. Operating pressure in case of differential pressure instrument with equalising valve open

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 15 of 21
			REVISION : 0
			EDITION : 1

4.1.3 In special conditions where hydro- testing is not permissible due to service requirements, testing shall be carried out by using compressed air/nitrogen.

4.1.4 The external displacer type instruments and cage type level switches shall be tested to 1.5 times the operating pressure using air/nitrogen after thorough flushing.

4.2 Instrument Air lines/signal tubing.

4.2.1 Instrument air lines/signal tubing shall not be hydrostatically tested.

4.2.2 Instrument air tubing shall be disconnected upstream of all filter regulators and blown down to remove water, slag and mill scale, from lines at 7.0 kg/cm² G for fifteen minutes.

Air filter shall be taken in line and tubing shall be disconnected at instrument end, and blown for 3 minutes to remove traces of dirt.

4.2.3 Testing of instrument air shall be carried out with instrument air at 7 kg/cm²G upto the upstream of the filter regulator after thorough flushing. All lines shall be checked with soap solution and bubbler unit for possible leak at joints.

4.2.4 All signal tubing shall be checked with 1.5 kg/cm² after proper flushing. After pressuring, source shall be cut off and rate of fall in pressure shall be less than IPSL for each 100 feet of tubing for a test period of 2 minutes as per instrument society of American RP 7.1 'Pneumatic Control Circuit Pressure Test'

4.3 Cables


4.3.1 All wiring shall be checked to ensure that it is correctly connected and properly grounded.

4.3.2 All cables shall be checked for continuity proper connection and insulation testing.

Insulation test shall be carried out on all wiring with a certified magger after disconnecting the cables at both ends.

4.4 All the results of the above mentioned testing shall be recorded and submitted for check.

4.5 All the in line instruments like orifice plates, turbine meters, Rotameters, Target meters, vortex meters, control valves, safety valves etc. shall be removed and spool pieces shall be provided prior to the flushing of the lines.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO.	Page 16 of 21
		MEC/S/05/26/01	REVISION : 0
			EDITION : 1

5.0 CALIBRATION OF INSTRUMENTS

5.1 All instruments shall be calibrated strictly as per manufacturer's instructions prior to the installation. In addition to calibration of instruments, setting of safety devices like process switches, safety valves etc. and simulation testing of all interlock and shutdown system shall be carried out.

5.2 In general, all tests shall simulate, as closely as possible, design process condition by the use of manometers, potentiometers, deadweight testers, test pressure gauges etc. Four point calibration shall refer to the input signal to an instrument equivalent to 0, 25, 50, 75, 100% of instrument range upscale (rising) and 75, 50, 25, 0% of instrument (downscale) (falling).

All instruments unless otherwise noted shall be calibrated in upscale and downscale direction and if necessary, adjusted until their accuracies conform to those limits state by the manufacturer.

Upon completion of these tests, the instruments shall be drained, completely.

5.3 Temperature Instruments

5.3.1 Temperature Gauges Filled type and Bi metallic dial type Thermometers shall be four point bench checked for proper operation and calibration using a temperature bath prior to installation.

5.3.2 Temperature Elements and Temperature Transmitters.

Temperature Elements and Transmitter shall be four point bench calibrated using a temperature bath precision meter or precision gauge prior to installation.

5.4 Pressure Instruments


5.4.1 Pressure Gauges

5.4.1.1 Direct connected bourdon type pressure gauges shall be dead weight tested or tested against a test gauges prior to installation.

5.4.1.2 Receiver type pressure gauges shall be four points calibrated using a precision gauge and precision air regulator.


5.4.1.3 Pressure and Differential Pressure Transmitters.

Pressure and differential pressure transmitters shall be four points calibrated using a hydraulic or dead weight tester or a precision pneumatic calibrator prior to the


MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 17 of 21
			REVISION : 0
			EDITION : 1

installation. A precision output meter or gauge shall be used to monitor the output.

- 5.5.1 Orifice plates shall be checked visually for the name plate and for an upstream sharp edge. Bore dia. shall be checked for compliance with the specification.
- 5.5.2 Differential pressure type of flow instruments shall be four points calibrated using precision pneumatic calibrator or a manometer and precision regulator. A precision output meter or gauge shall be used to monitor the output of the transmitter.
- 5.5.3
- a) Rotameters shall be installed as received. A check shall be made to confirm that shipping stops have been removed and float has been installed.
 - b) Where rotameters have transmitting mechanism, the float shall be raised and lowered mechanically and output shall be checked. Vendor calibration data/ curve shall be checked.
 - c) A check shall be conducted with plumb for a vertical installation.
- 5.5.4 Turbine meters, Annubar, positive displacement meters, vortex meter, ultrasonic flow meter, etc. shall be installed as received.
- 5.5.5 Target meters shall be checked for calibration using calibration weights. Output shall be monitored using precision output meter.
- 5.6 Level Instruments
- 5.6.1 Level Gauge Glasses
- Gauge glasses shall be installed as received installation of illuminators, frost protectors and other accessories shall be checked.
- 5.6.2 Displacer Type, Level Transmitter
- Displacer type level transmitter shall be checked by raising and lowering mechanically the displacement and checking the pilot or transmitter action. Check transmitter with out put gauge or meter for smooth and full output change.
 - A check shall be conducted with plumb for a vertical installation.
- 5.6.3 Differential pressure type level transmitter Differential pressure type level transmitter shall be calibrated with pneumatic calibrator at four points prior to installation. A precision meter or gauge shall be used to monitor the output of the transmitter.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 18 of 21
			REVISION : 0
			EDITION : 1

- 5.6.4 Tank level gauges
- a) Tank level gauges shall be checked by raising and lowering mechanically the displacer and checking the indicator on the gauge board.
 - b) Check for proper liquid seal prior to installation in case of liquid seal tank gauges.
 - c) In case of servo type gauges, the displacer is hoisted from the tank into the calibration chamber.
- 5.7 Control Valves, shutdown valves and self actuated valves
- 5.7.1 All diaphragm and piston operated control valve shall be stroked pneumatically using a pressure regulator and pressure gauge against the spring range specified on the name plate of the valve.
- 5.7.2 Mechanical seating and travel of the valve stem shall be checked against the side indicator and the name plate
- 5.7.3 Valve positioner shall be calibrated with the control valve in accordance with the name plate data and specifications with the help of pneumatic calibrator or gauge with precision regulator. Zero position or fully close position of the valve shall be a live zero i.e., the plug shall be just off the seat at the minimum setting.
- 5.7.4 Volume bottles, where used shall be checked for proper filling. The signal line shall be bled to zero pressure and failure action shall be confirmed.
- 5.7.5 Control valve accessories such as handwheels, boosters, relays etc. shall be checked operationally. Declutch able handwheel shall be operable both with and without an air signal to the diaphragm.
- 5.7.6 Self actuated control valves shall be installed as received, checking inlet and outlet points and name plate data. Regulators with external pressure connections shall be inspected for proper installation.
- 5.7.7 Butterfly shall be checked carefully to see that the vane moves freely into the upstream and down stream piping. Proper vane movement to stroke shall be confirmed.
- 5.7.8 All control valves and regulators shall be removed from the line prior to flushing and during hydro testing.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 19 of 21
			REVISION : 0
			EDITION : 1

5.8 Safety Relief Valves

5.8.1 Safety relief valves shall be installed as received after carefully checking the name plate data. Pilots, if used, shall be checked carefully for installation on the proper safety valve.

5.8.2 Valves, which are installed in such a manner as to permit on line testing, shall be pressure tested after installation to determine proper operation and setting. Compressed air or nitrogen shall be used for testing of safety relief valves.

5.9 Switches

5.9.1 Level Switches shall be actuated mechanically for switch operation but shall not be calibrated for level setting.

5.9.2 Pressure switches shall be calibrated using hydorlic or dead weight tester or precision air regulator and gauge. The setting/trip point shall be checked using a continuity tester.

5.9.3 Temperature switches shall be calibrated using a temperature both prior to installation and set to the required alarm/ trip point using a continuity tester.

5.10 Receiver Instruments

5.10.1 Receiver Indicator/Recorders

5.10.1.1 Pneumatic indicators/ Recorders shall be calibrated using pneumatic calibrator/ precision pressure regulator and gauge.

5.10.1.2 Electronics indicators/ Recorders shall be calibrated using a current generator and a precision meter.


5.10.1.3 Chart drive assembly shall be checked for proper operation.

5.10.2 Controllers

5.10.2.1 Proper balancing of the controller shall be checked as per the manufacturers catalogues.

5.10.2.2 Controllers shall be checked for manual and Auto operation and Transfer. The transfer from manual to Auto and vice versa shall be bumpless and smooth.

5.10.3.1 Manual loader station Output of the manual loader shall be checked with a precision meter.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 20 of 21
			REVISION : 0
			EDITION : 1

5.10.4.1 Multipoint Temperature Recorders

Each point shall be calibrated using a temperature simulator/ decade box for RTD / voltage generator and precision meter for the thermocouples.

5.10.4.2 Point synchronisation shall be checked.

5.10.5 Pneumatic receiver switches shall be calibrated using precision air regulator and gauge. The setting/ alarm/ trip point shall be checked using continuity tester.

5.10.6 Trip Amplifiers Trip amplifiers shall be calibrated using a temperature simulators or voltage generator and precision meter for thermocouple or Resistance box for RTD's. The required setting/ alarm point/ trip point shall be checked using a continuity tester.

5.10.7 Receiver Switch module Receiver switch modules shall be calibrated using a current source and a precision meter. The required setting/ alarm/ trip point shall be checked using a continuity tester.

5.10.8 Alarm and Annunciator system

5.10.8.1 Alarm and annunciator system shall be checked for visual and audio alarm operation using dummy signals. Full alarm sequence of each alarm point shall be checked.

5.10.8.2 Each point shall be checked for proper engraving.

5.10.9 Shutdown System


5.10.9.1 Operation of final actuating elements shall be checked for proper operation using dummy signals.

5.10.9.2 All timers, push buttons and switches shall also be checked for their proper operation.

5.11 Analytical Instruments

5.11.1 Check the full analyser system including sample handling system for leakage.

5.11.2 Check the full sample handling system for its proper operation. Calibrate and check completely all analysers using zero and span samples as per vendor catalogues.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	INSTALLATION OF INSTRUMENTS	DOCUMENT NO. MEC/S/05/26/01	Page 21 of 21
			REVISION : 0
			EDITION : 1

5.12 Flow computer / Volume corrector

5.12.1 Corrected flow values shall be checked for various D.C. inputs and pressure and temperature variations for upscale and downscale ranges.

5.13 The list of test and calibration instruments with traceability certificates shall be submitted to MECON for approval before carrying out the tests / calibration of instruments at site.

5.14 The formats / description of tests / calibration of all instruments shall be submitted to MECON for approval.

5.15 Daily / weekly reports shall be submitted during execution of work at site.

Rev.: 0


Edition: 1

SPECIFICATION
FOR
INSTRUMENT TUBING

SPECIFICATION NO.: MEC/S/05/26/02




ELECTRICAL & INSTRUMENTATION
(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBING	DOCUMENT NO. MEC/S/05/26/02	Page 3 of 6
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBING	DOCUMENT NO. MEC/S/05/26/02	Page 4 of 6
			REVISION : 0
			EDITION : 1

C O N T E N T S

- 1.0 GENERAL
- 2.0 CONSTRUCTION
- 3.0 TESTING
- 4.0 SHIPPING
- 5.0 REJECTION

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SHIVASTAVA)	ISSUE DATE : 08Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBING	DOCUMENT NO.	Page 5 of 6
		MEC/S/05/26/02	REVISION : 0
			EDITION : 1

1.0 **GENERAL**

1.1 Scope

1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of Instrument Tubing which includes the following types:-

- a) SS tubes
- b) Copper tubes

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

- ASTM A 269 - Specification for seamless and welded ferritic stainless steel tubing for general services.
- ASTM B 251 - Specification for general requirements for wrought seamless copper and copper alloy tube.
- ASTM B 251M - Specification for general requirements for wrought seamless copper and copper alloy tube (Metric)
- ASTM B 68 - Specification for seamless copper tube, bright annealed.
- ASTM B 68M - Specification for seamless copper tube, bright annealed. (Metric)

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes, etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.


1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of tube which shall provide the following information:

- a) All the details regarding the type, construction, materials etc. of the items.
- b) Overall the dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, type wise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these deviations.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBING	DOCUMENT NO.	Page 6 of 6
		MEC/S/05/26/02	REVISION : 0
			EDITION : 1

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of tube in the bid.

1.2.5 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manuals etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible and prints shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 Stainless Steel Tubes

2.1.1 SS tubes of the tubes shall be Rockwell RB 70-70. Tubes shall be free from scratches and to be suitable for bending.

2.1.3 Tube wall thickness shall be 0.049" for 1/2" OD and 1mm for 6 mm unless otherwise specified.

2.1.4 Maximum working pressure shall be 153.0 kg/cm² at 38°C for 1/2" OD Tube, unless otherwise specified and 80.0 kg/cm² at 38° for 6mm OD tube.

2.1.5 Tubes shall be supplied in minimum length of 6 metres without brazing in between.

2.1.6 Dimensional tolerances shall be as per ASTM A 269.

2.1.7 The following shall be marked on the tube:


- a) Name of manufacturer
- b) Type and material grade of tube
- c) Tube O.D. and wall thickness

2.2 Copper Tubes

2.2.1 Copper Tubes (PVC Jacket)

2.2.1.1 The tube shall be soft annealed copper with 6mm OD and a wall thickness of 1.0 mm as per ASTM B 68M Copper No.C12200.

2.2.1.2 The tube shall be jacketed with black PVC. The jacket thickness shall be 1.6mm. The PVC jacket shall confirm to ASTM D-1047.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBING	DOCUMENT NO. MEC/S/05/26/02	Page 7 of 6
			REVISION : 0
			EDITION : 1

2.2.1.3 The tube ends shall be plugged prior to transportation.

2.2.1.4 The tube shall be of continuous length without any brazing in between for 100 metres length.

2.2.1.5 Minimum length of single tube shall be 100 metres.

2.2.1.6 The dimensional tolerances shall be as per ASTM B 251M.

2.2.2 Bare Copper Tubes (For Steam Tracing)

2.2.2.1 The tube shall be soft annealed copper with 3/8" OD or 6mm OD with a wall thickness of 1.0 mm as per ASTM B68 copper No.C12200.

2.2.2.2 The tube ends shall be plugged prior to transportation.

2.2.2.3 The tube shall be of continuous length without any brazing in between for 100 metres length.

2.2.2.4 Minimum length of tube shall be 100 metres.

2.2.2.5 The dimensional tolerances shall be as per ASTM B 251.

3.0 TESTING

3.1 The following tests shall be done for SS tubes.

- a) Hardness test
- b) Hydrostatic test at 153.0 kg/cm² at 38° C for 1/2" tube and at 80.0 kg/cm² at 38° C for 6mm tube, unless otherwise specified.

3.2 PVC jacketed copper tubes shall be tested at 7.0kg/cm²g with dry air for leak check.


3.3 Bare copper tubes shall be hydrostatically tested at 80.0 kg/cm²g at 38°C.

3.4 Final test before delivery shall include ball test to ensure clear opening of the tube for copper tubes. The O.D of the ball shall be minimum 1mm for 6mm O.D tube and 2mm for 3/8" tube.

4.0 SHIPPING

4.1 The tubes shall be plugged at both ends to avoid entry of foreign matter. The tubes shall be packed carefully so as to avoid damage during transport.

5.0 REJECTION

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBING	DOCUMENT NO. MEC/S/05/26/02	Page 8 of 6
			REVISION : 0
			EDITION : 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

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SPECIFICATION


FOR

**INLET / OUTLET SECTIONS
AND FLOW STRAIGHTENER**

SPECIFICATION NO.: MEC/S/05/26/03




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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATIO FOR INLET/ OUTLET SECTIONS AND FLOW STRAIGHTENER	DOCUMENT NO. MEC/S/05/26/03	Page 1 of 3
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATIO FOR INLET/ OUTLET SECTIONS AND FLOW STRAIGHTENER	DOCUMENT NO. MEC/S/05/26/03	Page 2 of 3
			REVISION : 0
			EDITION : 1

CONTENTS

- 1.0 FLOW STRAIGHTNER
- 2.0 INLET SECTION/OUTLET SECTION

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SRIVASTAVA)	ISSUE DATE : 08 Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATIO FOR INLET/ OUTLET SECTIONS AND FLOW STRAIGHTNER	DOCUMENT NO. MEC/S/05/26/03	Page 3 of 3
			REVISION : 0
			EDITION : 1

1.0 FLOW STRAIGHTNER

- 1.1 Flow straightener shall be installed in the inlet section upstream of flow meter.
- 1.2 Flow straightener shall consist of a bundle of tubes designed and assembled as per ISO 5167-1980 (E) or AGA Report no.3 or AGA Report no.7.
- 1.3 Tube diameter shall be 0.2 D or less where D is the diameter of Meter inlet section pipe. Tube shall be seamless quality of SS 316 material thickness 1.5 or 1 mm Tube shall be hydrostatically tested for 75kg/cm² pressure and then cut to the required length for assembly.
- 1.4 On both the sides of tube bundle a very thin retaining rings of SS316 shall be provided for avoiding the dislocation of pipes.
- 1.5 The tube bundle shall be kept in position by 6mm threaded bolt. After tightening the bolt shall seal welded.
- 1.6 Tube ends shall be tempered at 45° angle.

2.0 INLET SECTION/OUTLET SECTION

- 2.1 Inlet/Outlet sections of pipe for flow meter shall be of same inside diameter (ID) as turbine meter.
- 2.2 The pipe used should be circular and with no ovality or any other deformation, the inside surface of pipe shall be smooth, welded portion shall be grinded to smooth finish.

Rev.: 0


Edition: 1

SPECIFICATION
FOR
INSTRUMENT TUBE FITTINGS

SPECIFICATION NO.: MEC/S/05/26/04




ELECTRICAL & INSTRUMENTATION
(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBE FITTINGS	DOCUMENT NO. MEC/S/05/26/04	Page 1 of 5
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBE FITTINGS	DOCUMENT NO. MEC/S/05/26/04	Page 2 of 5
			REVISION : 0
			EDITION : 1

C O N T E N T S

- 1.0 GENERAL
- 2.0 CONSTRUCTION
- 3.0 TESTING
- 4.0 SHIPPING
- 5.0 REJECTION

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SHIVASTAVA)	ISSUE DATE : 08 Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBE FITTINGS	DOCUMENT NO. MEC/S/05/26/04	Page 3 of 5
			REVISION : 0
			EDITION : 1

1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of instrument tube fittings which includes the following types:-

- a) SS compression fittings (SS tube)
- b) Brass compression fittings (copper tube)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchase's enquiry:

- ANSI B 2.1 - Pipe Threads
- B16.11 - Forged steel fittings-socket welding and threaded.
- IS:319 - Specification for free cutting brass bars, rods and sections.
- ISA RP 42.1 - Nomenclature for instrument tubing - fittings.

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of tube fittings which shall provide the following information:


- a) All the details regarding the type, construction, materials, etc. of the items.
- b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, typewise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of fitting in the bid.

1.2.5 Vendor's quotation, catalogues, drawings, etc. shall be in English language.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBE FITTINGS	DOCUMENT NO. MEC/S/05/26/04	Page 4 of 5
			REVISION : 0
			EDITION : 1

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manuals etc., required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducibles and points shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 SS Tube fittings:

2.1.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.

2.1.2 Fittings shall be flareless compression type and of three piece construction with ferrule, nut and body suitable for use on SS tubes conforming to ASTM A 269 TP316, hardness not exceeding RB80.

2.1.3 All parts shall be of SS 316.

2.1.4 Hardness of the ferrules shall be in the range of RB 85-90 so as to ensure a minimum hardness difference of 5 to 10 between tube and fittings, for better sealing.

2.1.5 Nuts and ferrules of particular size shall be interchangeable for each type.

2.1.6 Spanner hold shall be metric.

2.1.7 Threaded ends of fittings shall be NPT as per ANSI B 2.1.

2.1.8 Copper Tube Fittings


2.2.1 Nomenclature of all tube fittings shall be as per ISA 42.1.

2.2.2 Fittings shall be of flareless compression type and of three-piece construction consisting of ferrule, nut and body suitable for use on copper tubes conforming to ASTM B 68/B 68M hardness not exceeding RB 50.

2.2.3 All parts shall be manufactured from Brass as per IS 319 barstock and Nickel plated.

2.2.4 For better grip, vendor shall maintain hardness difference between tube & ferrule and indicate the same along with the offer.

2.2.5 Nuts & ferrules of particular size shall be interchangeable for each type.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT TUBE FITTINGS	DOCUMENT NO. MEC/S/05/26/04	Page 5 of 5
			REVISION : 0
			EDITION : 1

2.2.6 Threaded ends of fittings shall be NPT as per ANSI B 2.1.

2.2.7 Spanner hold shall be metric.

2.2.8 Vendor shall ensure that the ferrules and nuts supplied for fittings shall be suitable for sample tube which shall be supplied during manufacture.

3.0 TESTING

3.1 Random samples of SS tube fittings shall be hydrostatically tested as follows:-

For 6 mm fittings at 80.0 kg/cm², 1/2" fittings at 153.0 kg/cm² at 38°C unless otherwise specified.

3.2 Random samples of brass compression fittings shall be hydrostatically tested as follows:-

For 1/4" fittings, at 10 kg./cm², 3/8" at 80.0 Kg/cm² and all at 38°C.

4.0 SHIPPING

4.1 All thread/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION

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
INSTRUMENT VALVES AND MANIFOLDS

SPECIFICATION NO.: MEC/S/05/26/05




ELECTRICAL & INSTRUMENTATION
(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS	DOCUMENT NO. MEC/S/05/26/05	Page 1 of 6
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS	DOCUMENT NO. MEC/S/05/26/05	Page 2 of 6
			REVISION : 0
			EDITION : 1

CONTENTS

- 1.0 GENERAL
- 2.0 CONSTRUCTION
- 3.0 TESTING
- 4.0 SHIPPING
- 5.0 REJECTION

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SRIVASTAVA)	ISSUE DATE : 08 Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS	DOCUMENT NO. MEC/S/05/26/05	Page 3 of 6
			REVISION : 0
			EDITION : 1

1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of Instrument Valves & Manifolds which includes the following types:-

- a) Miniature instrument valves
- b) Instrument valve manifolds
- c) Instrument air valves

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

- ANSI B 2.1 - Pipe threads
- ANSI B 16.11 - Forged steel fittings-socket welding and threaded.

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes etc, the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of Valves & Manifolds which shall provide the following information:


- a) All the details regarding the type, construction, materials etc. of the items.
- b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, typewise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these in the bid.

1.2.5 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawings, Data and Certification

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS	DOCUMENT NO. MEC/S/05/26/05	Page 4 of 6
			REVISION : 0
			EDITION : 1

Detailed drawings, data, catalogues and manual etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible and prints shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 Instrument Valves (Miniature)

- 2.1.1 The instrument valves shall be globe pattern-needle valves forged/ barstock with inside screwed bonnet.
- 2.1.2 Body and trim material shall be 316 SS unless otherwise specified.
- 2.1.3 The valve body rating shall be 3000 lbs unless specified in piping material specification which shall govern in case it is specified.
- 2.1.4 The end connection shall be 1/2" NPTF to ANSI B2.1.
- 2.1.5 The packing material shall be teflon unless otherwise specified.
- 2.1.6 The hand wheel material shall be carbon steel zinc plated.
- 2.1.7 Flow direction shall be marked on the body.
- 2.1.8 The valve dimension shall be as follows:
- a) End to end dimensions 76 mm (approximately).
 - b) Height in fully open condition - 135mm maximum.


2.2 VALVE MANIFOLDS

2.2.1 3-Valve & 5-Valve manifolds:

2.2.1.13 Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54 mm (2-1/8") centre to centre connections and 41.3 mm (1-5/8") bolt to bolt distance. The manifold shall contain two main block valves and an equalizing by-pass valve. The valves shall be needle valves. They shall use self aligning 316SS ball seats.

2.2.1.25 Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line.

2.2.1.3 The manifold shall be suitably for mounting directly on the stanchion (2" pipe)

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS	DOCUMENT NO. MEC/S/05/26/05	Page 5 of 6
			REVISION : 0
			EDITION : 1

2.2.1.4 All bonnets shall have teflon packing unless otherwise specified.

2.2.1.5 The material of construction shall be 316 SS unless otherwise specified.

2.2.1.5 The material of construction shall be 316SS unless otherwise specified.

2.2.1.6 The flanges shall be integral part of the block.

2.2.1.7 The process connection shall be 1/2" NPTF to ANSI B2.1.

2.2.1.8 The manifolds shall be supplied along with mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B ASTM A 194 GR 2H respectively. Rings shall be teflon and other accessories shall be cadmium plated.

2.2.1.9 Vendor shall furnish the material certificate for body.

2.2.2 3 Way 2 Valve Manifold for pressure gauges.

2.2.2.1 The manifold shall be designed for use with pressure gauges.

2.2.2.2 The valve shall be a ball valve.

2.2.2.3 The body shall be either straight or angle as specified in data sheets.

2.2.2.4 The body and trim material shall be 316SS, packing material shall be teflon unless otherwise specified.

2.2.2.5 The inlet connection shall be 3/4" plain end (female) for socket weld as per ANSI B 16.11.

2.2.2.6 The gauge connections shall be with union nut & tail piece threaded 1/2" NPT (F).

2.2.2.7 The drain connection shall 1/2" NPTF.


2.3 Instrument Air Isolation Valves

2.3.1 The valves shall be full bore ball valves.

2.3.2 Body material shall be Nickel or Cadmium plated carbon steel.

2.3.3 Trim material shall be 316SS.

2.3.4 The end connection shall be 1/2" NPTF to ANSI B2.1 unless otherwise specified.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS	DOCUMENT NO. MEC/S/05/26/05	Page 6 of 6
			REVISION : 0
			EDITION : 1

2.3.5 The packing material shall be teflon.

2.3.6 The handle/wrench material shall be cadmium or nickel plated carbon steel.

2.3.7 The valve body rating shall be ANSI 800 lb.

2.3.8 End to end dimensions shall be 70mm (approximately).

3.0 TESTING

3.1 The instrument valves (miniature) shall be hydrostatically tested at 200kg/cm² g at 38°C.

3.2 All manifolds (3 valves, 5 valves and 3 ways, 2 valves) shall be hydrostatically tested at 200 kg/cm² at 38C.

3.3 The instrument air valves shall be hydrostatically tested at 15.0 kg/cm²g at 38°C and at 10.5 kg/cm²g with dry air.

4.0 SHIPPING

4.1 All threads/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION

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
JUNCTION BOXES AND CABLE GLANDS

SPECIFICATION NO.: MEC/S/05/26/06




ELECTRICAL & INSTRUMENTATION
(OIL & GAS SBU)
MECON LIMITED
DELHI 110 092

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 1 of 7
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 2 of 7
			REVISION : 0
			EDITION : 1

CONTENTS

- 1.0 GENERAL
- 2.0 JUNCTION BOXES
- 3.0 CABLE GLANDS & PLUGS, REDUCERS/ ADAPTORS
- 4.0 NAME PLATE
- 5.0 SHIPPING
- 6.0 REJECTION

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SRIVASTAVA)	ISSUE DATE : 08 Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 3 of 7
			REVISION : 0
			EDITION : 1

1.0 General

1.1 Scope

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, nameplate marking, testing and shifting of junction boxes & cable glands which include the following types:

- a) Electrical junction boxes.
- b) Pneumatic junction boxes
- c) Cable glands (whenever specified)

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:

- ANSI B 2.1 : Pipe threads
- IS-5 : Colours for ready mixed paints and enamels
- IS-2147 : Degrees of protection provided by enclosures for Low voltage switchgear and control gear.
- IS-2148 : Flame proof enclosure of electrical apparatus.


1.1.3 In the event of any conflict between specifications, data sheets, related standards, codes etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same should proceed with the manufacture of the items in questions.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of junction box and cable gland which shall provide the following information:

- a) All the details regarding the type, construction, materials, housing, entries, etc.
- b) All dimensions in millimetre.
- c) Sketch for each type of JB with dimensional details showing the terminal and entries arrangement.
- d) Mounting details.
- e) Vendor shall furnish certificate from statutory body for explosion proof enclosure, indicating the gas group and temperature class.

1.2.2 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 (e.g. BS IS, etc.)

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 4 of 7
			REVISION : 0
			EDITION : 1

1.2.3 Vendor shall attach a list of items, tag number wise, summing up all the deviations from the purchaser's data sheets, if there are any. Also vendor shall furnish reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of JB/cable glands and its accessories covered in the bid.

1.2.5 Vendor's quotation, catalogues, drawings, etc. shall be in English language.

1.3 Drawings, Data and Certification

1.3.1 Detailed drawings, data, catalogues required from the vendor are indicated in vendor data requirements sheets. The required number of reproducible and prints shall be despatched to the address mentioned, adhering to the time limits indicated.

1.3.2 After placement of purchaser order, vendor shall submit certified drawings and specifications sheets for each type of JB/cable gland which shall include the following:

- a) Detailed dimensional drawings
- b) Weight of each in grams/Kg.
- c) Certificate from statutory body suitable for installation in specified hazardous area.

2.1 Junction Boxes


2.0 Junction boxes shall be either of the following type as specified in data sheets.

- I. Weather proof junction boxes.
- II. Weather proof & Explosion proof junction boxes.

2.2 The enclosure shall be as per IS-2147 for weather proof junction boxes and for Explosion proof it shall be as per IS-2148 suitable for the area classification specified.

2.3 Number of entries and locations shall be as per data sheets.

2.4 Junction boxes shall be provided with telephone sockets and plugs for connection of hand powered telephone set.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 5 of 7
			REVISION : 0
			EDITION : 1

2.5 Electrical Junction boxes

2.5.1 Material shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy)

2.5.2 Explosion proof junction boxes shall have detachable cover which is fixed to the box by means of cadmium plated triangular head/hexagonal head screws.

2.5.3 Weather proof junction boxes shall have doors which shall be hinged type and these shall be fixed with cadmium plated countersunk screws.

2.5.4 Explosion proof junction boxes shall have a warning engraved/integrally cast on the cover as given below:

"Isolate power supply elsewhere before opening"

2.5.5 Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.

2.5.6 All terminals shall be suitable for accepting minimum 2.5 sq. mm copper conductor, in general. However for power supply distribution boxes, terminal detail shall be as per job specification/Data sheets.

2.5.7 Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines.

- i) 50 to 60 mm between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25mm for each additional 25 terminals.
- ii) 100 to 120mm between terminals for upto 50 terminals and additional 25mm for each additional 25 terminals.
- iii) Bottom/top of terminal shall not be less than 100 mm from bottom/top of the junction box.


2.5.8 Terminals shall be marked as per the various types indicated in data sheets.

2.5.9 Shall be provided with external earthing lugs.

2.6 Pneumatic junction boxes

2.6.1 Pneumatic junction boxes shall be made of 3mm thick hot rolled steel. They shall have necessary neoprene gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.

2.6.2 Single tube entries shall be suitable for 6mm O.D. copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in data sheets.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 6 of 7
			REVISION : 0
			EDITION : 1

2.7 Painting

2.7.1 Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale.

2.7.2 Two coats of lead-free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.

2.7.3 The colour shall be as specified in data sheets.

3.0 Cable glands & plugs, Reducers/Adaptors

3.1 Cable glands shall be supplied by vendor whenever specified.

3.2 Cable glands shall be double compression type for use with armoured cables.

3.3 The cable glands shall be of Nickel plated brass.

3.4 The cable gland shall be weather proof. Whenever specified they shall be explosion proof and certificate from statutory body shall be furnished.

3.5 Cable glands shall be supplied to suit the cable dimensions indicated along with tolerance indicated in data sheets. Various components like rubber ring, metallic ring, metallic cone and the outer/inner nuts etc. shall be capable of adjusting to the above tolerances of cable dimensions.

3.6 Reducers/Adaptors shall be supplied as per details indicated in data sheets. They shall be nickel plated brass. These shall be weather proof in general. These shall also be explosion proof wherever specified and certificate from statutory body for explosion shall be furnished.


3.7 Plugs shall be provided wherever specified. They shall be of Nickel plated brass.

3.8 Plugs shall be certified explosion proof when used with explosion and junction boxes.

4.0 Name Plate

4.1 Each junction box shall have an anodised aluminium name plate permanently fixed to it at a visible place bearing the tag no. & enclosure. The name plate shall also bear the stamp of certifying agency with certificate number.

5.0 Shipping

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS	DOCUMENT NO. MEC/S/05/26/06	Page 7 of 7
			REVISION : 0
			EDITION : 1

5.1 All threaded openings shall be suitably protected to prevent entry of foreign material.

5.2 All threaded components shall be protected with plastic caps to prevent damage of threads.

6.0 Rejection

Vendor shall furnish his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summararily rejected.

ELECTRICAL & INSTRUMENTATION SECTION
MECON LIMITED
DELHI - 110 092




SPECIFICATION

FOR

SIGNAL CABLES


SPECIFICATION NO.: MEC/S/05/26/07

<p align="center">MECON LIMITED Delhi</p>	<p align="center">ELECTRICAL & INSTRUMENTATION SECTION DELHI</p>	<p align="center">SPECIFICATION FOR SIGNAL CABLES</p>	
<p>SPECIFICATION NO. : MEC/S/05/26/07</p>		<p align="center">REV-0</p>	<p>Page 1 of 7</p>

CONTENTS

- 1.0 GENERAL
- 2.0 CONSTRUCTION
- 3.0 ELECTRICAL CHARACTERISTICS
- 4.0 TESTING
- 5.0 SHIPPING
- 6.0 REJECTION

<p>PREPARED BY</p>	<p>CHECKED BY</p>	<p>APPROVED BY</p>
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<p align="center">MECON LIMITED Delhi</p>	<p align="center">ELECTRICAL & INSTRUMENTATION SECTION DELHI</p>	<p align="center">SPECIFICATION FOR SIGNAL CABLES</p>	
<p>SPECIFICATION NO. : MEC/S/05/26/07</p>		<p align="center">REV-0</p>	<p align="right">Page 2 of 7</p>

1.0 GENERAL

1.1 Scope:

This specification together with the job Specifications attached herewith forms the requirements for design, materials, manufacturing, testing and shipping of PVC insulated signal cables.

1.2 Standards:

The cables shall conform to the latest editions of the various standards mentioned in the specification.

In case of any conflict between any standard and this - specification the matter shall be referred to the purchaser before proceeding with the manufacture of the cables.

1.3 Bids:

1.3.1 Vendor's quotation shall include the following as a minimum.

Completed job specs., Pair identification method, type test certificates, technical literatures, various testing methods and cross sectional dimensional drawings. All information/data shall be in English language.


1.3.2 Vendor's quotation shall include a list of deviations if any from purchaser's specifications and shall also indicate the reasons for such deviations for consideration to arrive at mutually agreed deviations. However vendor shall note that no deviation shall be accepted in respect of the permissible limits of resistance capacitance and L/R ratio of cables.

1.3.3 Vendor shall quote unit price per meter for each type of cable.


1.4 Instructions to Bidder:

1.4.1 The quantity indicated against each type of cable in the job specification may vary by $\pm 25\%$ at the time of placement of order. Vendor shall confirm that there shall be no price implication on this account in unit prices type wise.


1.4.2 Drum length for each type of cable shall be 500 to 1000 meters. Vendor shall indicate the maximum drum length possible for each type of cable in his bid. Exact requirements of drum length will be specified after purchase order during detailed engineering and vendor shall confirm that the same shall not affect the price or delivery schedule. The actual produced drum length shall not vary by more than $\pm 5\%$ from the value indicated in the purchase order.

<p align="center">MECON LIMITED Delhi</p>	<p align="center">ELECTRICAL & INSTRUMENTATION SECTION DELHI</p>	<p align="center">SPECIFICATION FOR SIGNAL CABLES</p>	
<p>SPECIFICATION NO. : MEC/S/05/26/07</p>		<p align="center">REV-0</p>	<p align="right">Page 3 of 7</p>

1.4.3	<p>Tolerance over the total ordered length shall be as follows: ± 5% for total length less than 5 km. ± 2% for total length 5 km or more.</p>
1.4.4	<p>Cable dimensions furnished by vendor in his bid shall be firm. Vendor shall comply with all the values during execution.</p>
1.5	<p>All cables shall be suitable for laying in open air, corrosive hydrocarbon plant atmosphere, direct sun and in trenches. The cable shall also be designed for prolonged use in tropical atmosphere.</p>
1.6	<p>On demand vendor shall furnish documents such as invoice and test certificates to prove the quality and composition of the materials used for manufacturing the cable to the satisfaction of client/ consultant or authorized representative during various stages of expediting and inspection.</p>
2.0	<p><u>Construction:</u></p>
2.1	<p>Type 1 (single pair/triad shielded cable)</p>
2.1.1	<p>Each core shall be 1.5 sq. mm made of 7 stranded annealed electrolytic copper conductor. Each strand shall be 0.53 mm dia.</p>
2.1.2	<p>Primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS-5831 Type C. Thickness shall be 0.5 mm minimum.</p>
2.1.3	<p>Each wire shall have twisted cores and No. Of twists shall be not less than 10 per meter. Color of cores insulation shall be black blue in a pair and black, blue and brown in a triad.</p>
2.1.4	<p>Individual pair and triad shall be shielded. Shield shall be Aluminium backed by mylar/polyester tape bonded together with the metallic side down helically applied with either side 25% overlap and 100% coverage. Minimum shielded thickness shall be 0.05mm. Drain wire shall be 0.5 sq.mm multistrand bare tinned annealed copy conductor. The drain wire shall be in continuous contact with Aluminium side of the shield.</p>
2.1.5	<p>Inner and outer jacket shall be made of extruded flame retardant low smoke 90°C PVC to IS 5831-Type ST2. Oxygen index of PVC shall be 30. Temp. Index shall be over 250° C. Inner jacket color shall be black. Outer jacket color shall be black except for cable to be used in intrinsically safe systems it shall be light blue. Rip cord shall be provided.</p>
2.1.6	<p>Armour over inner jacket shall be of galvanised steel wire/flat as per IS-1554 part-I.</p>

<p align="center">MECON LIMITED Delhi</p>	<p align="center">ELECTRICAL & INSTRUMENTATION SECTION DELHI</p>	<p align="center">SPECIFICATION FOR SIGNAL CABLES</p>	
<p>SPECIFICATION NO. : MEC/S/05/26/07</p>		<p align="center">REV-0</p>	<p align="right">Page 4 of 7</p>

<p>2.1.7</p>	<p>A pair or triad identification shall be with numbers at interval of not more than 250 mm as per vendor's standard.</p>
<p>2.1.8</p>	<p>Tolerance in overall diameter of cable shall be within $\pm 2\text{mm}$ over offered value for cables with OD less than 30mm and $\pm 3\text{mm}$ for cables with OD more than 30mm.</p>
<p>2.2</p>	<p>Type-II (Multipair/multitraid cable with individual pair shield and overall shield)</p>
<p>The cable shall be same as single pair shielded cable except conductor size shall be 0.5 sq.mm made of 16 strands of annealed electrolytic copper conductor. Each strand shall be of 0.2mm dia.</p>	
<p>Additional feature shall be as follows:</p>	
<p>2.2.1</p>	<p>Overall shield shall be of Aluminum backed up by mylar/polyester tape helically applied with the metallic side down either side 25% overlap and 100% coverage. Minimum shield thickness shall be 0.075mm Drain wire shall be similar to individual pair drain wire and shall be in continuous contact with the Aluminium side of the overall shield.</p>
<p>2.2.2</p>	<p>Overall twist of all pair/triads shall be as per vendor's standard.</p>
<p>2.2.3</p>	<p>A pair of communication wire shall be provided for multipair/multitriad cables. Each wire shall be 0.5 sq. mm of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.</p>
<p>2.3</p>	<p>Type-III (Multipair/Multitriad cable with only overall shield)</p>
<p>These cables shall be same as type-II cables except that the individual pair/triad shall not have shielding.</p>	
<p>2.4</p>	<p>Type-IV (Multipair/ multitriad cable with individual pair shield and overall shield)</p>
<p>The cable shall be same as Type II except conductor size shall be 1.5 sq.mm made of 7 stranded annealed electrolytic copper conductor. Each strand shall be 0.53 mm dia.</p>	
<p>2.5</p>	<p>Type-V (Multipair/ Multitriad cable with overall shield only)</p>
<p>The cable shall be same as type IV except that the individual pair/triad shall not have the shielding.</p>	

<p align="center">MECON LIMITED Delhi</p>	<p align="center">ELECTRICAL & INSTRUMENTATION SECTION DELHI</p>	<p align="center">SPECIFICATION FOR SIGNAL CABLES</p>	
<p>SPECIFICATION NO. : MEC/S/05/26/07</p>		<p align="center">REV-0</p>	<p align="right">Page 5 of 7</p>

3.0 Electrical Characteristics

3.1 Maximum d.c. resistance of the conductor of the completed cable shall not exceed 12.3 ohms/km at 20° C for cables with 1.5 sq.mm conductor and 39.7 ohms/km at 20°C for cables with 0.5 sq.mm conductor.

3.2 Capacitance

3.2.1 Mutual Capacitance

The mutual capacitance of the pairs or adjacent cores shall not exceed a maximum of 250 pF/Meter at a frequency of 1KHz.

3.2.2 Capacitance between any core or screen.

The capacitance between any core or screen shall not exceed a maximum of 400 pF/Meter at a frequency of 1KHz.

3.3 L/R ratio of adjacent core shall not exceed 40 micro henry/ohm for cables with 1.5 sq. mm conductor & shall not exceed 25 micro henry/ohm for cables with 0.5 sq. mm conductor.

3.4 The drain wire resistance including shield shall not exceed 30 ohms/km. Insulation resistance on drum length @ 20 Deg. C shall be 25 M-Ohm/Km (as per BS 5308 Part-2).

3.5 Electrostatic noise rejection ratio shall be over 76 dB.

3.6 High Voltage Test shall be carried out between conductors & between core & screen @ 1 KV-AC for one minute (as per BS 5308 Part-2).


3.7 Flammability test shall be as per IEC part 3.

4.0 Testing


4.1 Type test: Cable shall be flame retardant to IEC 332 Part III Cat. A. For qualification, certificates from third party or client /consultants authorised representative for this test shall be furnished by vendor for cables similar to those being offered.

4.2 Routine tests: (To be carried out by vendor during various stages of manufacture. Purchaser / purchaser's representative shall review the related documentation).

4.2.1 Insulation and jackets: All tests as per IS-5831 except insulation resistance, voltage and spark test shall be as per BS-5308. Part-II(1986)

MECON LIMITED Delhi	ELECTRICAL & INSTRUMENTATION SECTION DELHI	SPECIFICATION FOR SIGNAL CABLES	
SPECIFICATION NO. : MEC/S/05/26/07		REV-0	Page 6 of 7

4.2.2	Armour test as per IS-3975.
4.2.3	Conductor resistance.
4.2.4	Cable capacitance and L/R ratio.
4.3	<u>Acceptance test</u> (The test shall be carried out in the presence of purchaser or his authorised representative.)
4.3.1	Continuity test
4.3.2	Voltage test as per BS-5308 Part II.
4.3.3	Conductor resistance, Insulation resistance and drain wire resistance.
4.3.4	Cable capacitance and L/R ratio test.
4.3.5	Tests for uniformity of galvanisation of armour as per IS 2633.
4.3.6	Oxygen and temp. index test as per ASTM D 2863 & Flammability test.
4.3.7	Dimensional check for overall diameter and under armour/over armour diameter.
4.3.7	Visual Check of outer sheath marking (Manufacturer's name, voltage grade, type & size of cable, length marking, year of manufacturing, etc.), colour coding, construction as per datasheet / tech. spec. etc.
4.3.8	Overall finish check. In case of any lump purchaser will have the right to cut outer sheath for lump portion and reject the cable.
4.3.9	Check of drum length and overall length tolerances.
	Immediately after completion of electrical tests, the ends of the cable shall be sealed to prevent ingress of moisture with suitable PVC/Rubber caps.
5.0	<u>Shipping</u>
	Cables shall be despatched in wooden drums, securely battened with take off end fully protected against damage. Each drum shall be marked with following:
	<ul style="list-style-type: none"> a. Manufacturer's name. b. Details of the cable. c. Length of the cable contained in the drum in metres. d. Gross wt. e. Direction of rotation of drum for unwinding by means of an arrow. f. Purchase order no.

<p align="center">MECON LIMITED Delhi</p>	<p align="center">ELECTRICAL & INSTRUMENTATION SECTION DELHI</p>	<p align="center">SPECIFICATION FOR SIGNAL CABLES</p>	
<p>SPECIFICATION NO. : MEC/S/05/26/07</p>		<p align="center">REV-0</p>	<p>Page 7 of 7</p>

6.0

Rejection

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

GENERAL SPECIFICATIONS FOR INSTRUMENTATION

SPECIFICATION NO.: MEC/S/05/26/08




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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 1 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 2 of 17
			REVISION : 0
			EDITION : 1

C O N T E N T S

- 1.0 GENERAL
- 2.0 DEFINITIONS
- 3.0 SCOPE OF WORK
- 4.0 DESCRIPTION OF WORK
- 5.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY OWNER
- 6.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY CONTRACTOR
- 7.0 SCRAP AND EXCESS MATERTIAL
- 8.0 SPECIAL INSTRUCTIONS TO CONTRACTOR

PREPARED BY: (R. SANJAY BABU)	CHECKED BY: (RAKESH SHUKLA)	APPROVED BY: (PANKAJ SRIVASTAVA)	ISSUE DATE : 08 Th DEC 08
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MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 3 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

1.0 GENERAL

1.1 INTRODUCTION

1.1.1 This part of the technical specifications covers in general, definitions, standards, scope of works, specifications of work, documentation, scope of supply of materials and scrap and excess materials and different requirements to be adhered to during the course of execution of instrumentation works.

1.1.2 Instrumentation works shall be performed in accordance with this technical specification and various other drawings and schedules supplied during the execution and time to time instructions from Engineer-in-Charge or his authorised representative(s) during the progress of the work.

2.0 DEFINITIONS

2.1 MANIFOLDS

2.1.1 For close coupled instruments "Manifold" shall mean complete piping of instruments from first block valve upto the instruments, if the distance of the Instrument is within 2 feet (0.6m), from the Instrument tapping. If the distance of instrument is more than 2 feet (0.6m) from primary tapping such as orifice, then the installation is to be considered under remote installation.


2.1.2 For remote mounted instrument, "Manifold" shall mean the assembly of nipples, valves and fittings around the instrument to form a block and bleed or by pass manifold or drain manifold as the case may be. These shall be generally according to the hook up drawings enclosed with tender. Wherever the instruments are with 3--way-valve manifold, this definition shall not be applicable as 3-way manifold forms part of instrument.

2.2 FIRST BLOCK VALVE

First block valve shall mean the valve/valves that are mounted directly on equipment, columns, pipe, standpipe etc. and shall be operated to isolate the instrument and connected instrument piping from the above items.

2.3 SUPPORTS

Supports shall mean the MS angles, flats, channels that are generally provided to support the main cable ways, cable ducts, junction boxes, angle trays, perforated trays, instrument piping, signal tubing, instrument air supply lines etc., at specified intervals from the structures, concrete columns etc. to keep all items firmly secured against vibration, warping, bending etc.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 4 of 17
			REVISION : 0
			EDITION : 1

2.4 SCRAP

2.4.1 Salvageable scraps

Salvage scrap shall mean lengths of tubes, pipes, multicables, other cables etc. that can be used one time or other at later date and normally they are recovered from the cut-pieces of tubes, pipes, multicables, cables, etc.

2.4.2 Non Salvageable Scrap

Non salvageable scrap shall mean the lengths of tubes, pipes, multicables, cables, etc. that cannot be used at all one time or other.

2.5 Standards

The instrumentation erection and calibration works shall be carried out generally in accordance with various international and Indian standards in instrumentation listed below but not limited to the following:

2.5.1 API -RP-550 Manual on Practices for instrumentation.

2.5.2 ISA standards and Practices for instrumentation

2.5.3 Instrumentation hook-up standards enclosed.

2.5.4 Instrumentation supports standard enclosed.

2.5.5 Manufacturer's standards and Practices.


3.0 **SCOPE OF WORK**

3.1.0 The Scope of work shall consist of supply of instrument items (as per schedule of quantities/rates and SCC), instruments, their erection, testing, calibration and commissioning and making it ready for commercial operation. The scope covers various jobs listed under the schedule of quantities/rates. However to ensure proper execution and completeness of instrument--work any or all of the following shall also form the part of the scope and shall be covered in the quoted rates.


3.1.1 Fabrication of pipe nipples, including threading whenever required.

3.1.2 Fabrication of seal pot/syphon/drain pot as per standards. Filling of seal pots with filling liquids as per instructions from Engineer-in-charge.

3.1.3 Back/seal welding of screwed fittings as required by standards.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 5 of 17
			REVISION : 0
			EDITION : 1

- 3.1.4 Laying of cable underground including excavation, sand filling, brick laying and back filling.
- 3.1.5 Connection of purging devices for instruments to the systems provide as per drawings.
- 3.1.6 Civil works including the casting of foundation as per requirements for instruments supports where paved surface do not exist.
- 3.1.7 Minor civil works like chipping of pavement and grouting on the pavements the instrument panels/supports/stanchions, and chipping and refilling of the pavement for conduits.
- 3.1.8 Sealing of cables/ tube entries into the control room after laying and testing of all tubes, cables etc.
- 3.1.9 Degreasing of handwheels of control valves, stud bolts, nuts of side and bottom flange of control valves, orifice plates, other primary elements flanges, oxygen service impulse lines, instruments as per manufacturers instructions and other items as required by Engineer- in-charge.
- 3.1.10 Rotation of control valve bonnet wherever required.
- 3.1.11 Reversing the action of control valves either the replacement of springs, accessories or in positioner wherever required.
- 3.1.12 Minor modification/repairs required to be done on the instruments namely, changing the dial, glasses for pressure gauges, temperature gauges and other instruments, replacement of rotameter tubes, level gauge glasses, replacement of damaged signal tubes, threads, couplings etc.
- 3.1.13 Painting of all structural supports for trays, pipes, junction boxes, instruments, etc, as per painting specification.
- 3.1.14 Identification with approved colour of paint the instruments/impulse, lines manifold connected with alarm/trap circuit. Also, punching of tag numbers on items shall be carried out as per instructions of Engineer-in-charge.
- 3.1.15 Coordination with mechanical and other sub-contractors for proper installation of line/ vessels/ equipment mounted instruments like control valves, orifice assemblies, turbine meters, PD meters, level transmitters, level gauges, level switches etc. which involves removal of instruments, disconnection of tubes/cables, reconnection for alignment proper installation etc.
- 3.1.16 Drilling holes on all panels, shut down cabinets, power supply cabinets, control panels pneumatic enclosures etc., for cables/ multitubes/ glands/ groomats.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 6 of 17
			REVISION : 0
			EDITION : 1

- 3.1.17 Grounding of shield of all shielded cables to respective instruments earth bus provided in the control room/local panel/thermocouple head.
- 3.1.18 Laying and termination at both ends between instrument earth buses provided in control room/ local panel to instrument earth pit provided by others.
- 3.1.19 Supply of all types of consumables required for the execution of the job.
- 3.1.20 Submission of monthly material appropriation statements for cables, piping materials fittings, including the quantity issued and expended in standard proforma.
- 3.1.21 Completion of owners drawings/documents, as per the execution of work at site.
- 3.1.22 Preparation and submission of as built drawings as required.
- 3.1.23 Start-up and commissioning.
- 3.1.24 Submission of final material appropriation statements for all the materials issued by the owner.
- 3.1.25 Any other work not mentioned above, but required for the proper execution of the works.
- 3.1.26 Where requested by owner/Engineer-in-charge or his authorised representatives, all or any of the works detailed above and schedule quantities shall also be performed on package units, local panels/cabinets/gauge board installed by owner or by others.
- 3.1.27 Sealing of safety valves/switches with standard lead seals after final setting in the presence of Engineer- in-charge.


4.0 DESCRIPTION OF WORK

4.1.0 INSTRUMENT PIPING

4.1.1 All primary piping shall be installed in the best workman like manner and shall follow installation standards in each case. Where there is no installation standard, the instruction of the Engineer-in-charge shall be followed.

4.1.2.1 Horizontal and vertical lines shall be installed using levels and plumo bobs.

4.1.3 Unless otherwise specified in the drawings pipelines shall have a slope of 8% on the horizontal runs.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 7 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

4.1.4 All welding shall be carried out as per welding procedures and codes with electrodes approved by Engineer-in-charge. Only qualified welders approved by Engineer-in-charge shall carry out welding. Charges for non-destructive testing like radiography, Dye penetration tests, post heat treatment tests and stress relieving shall be carried out on the basis of actual man hours spent towards these works and man-hour charges with cost of all materials, test equipments, etc. shall be used. However, any materials like electrode, equipments, testing charges for various tests, etc., required for the initial qualification of the welder/welders shall be or the scope of the contractor.

4.1.3.1 Pipe shall be bent using pipe benders only and any bending will be totally rejected. Pipes shall be cut using pipe cutting device. Hot cutting will not be allowed.

4.1.6 Piping for steam tracing shall be installed according to the standards and avoiding condensate pockets.

4.1.7 All threaded joints shall be jointed with Teflon tape and no other pipe jointing compound shall be used except on high temperature service where graphited sealing compounds shall be used.

4.1.8 All primary piping shall be properly supported at regular intervals of 1.0 meters. Angle supports shall be fabricated from 40mmx40mmx5mm MS angles as minimum.


4.2.0 PVC COVERED/BARE TUBE (COPPER/SS/ALUMINIUM)

4.2.1 Single copper/SS/Aluminium tubes shall be laid as per standards on trays. Fabricated out of 2.5 mm thick perforated steel plate. The width of the trays shall be selected as per the number of tubes laid. Tubes shall be clamped to the trays at every 300 mm using clamps made of galvanized steel/Aluminium strips. The practice of flattening tubes for clamping purposes shall be avoided. In case of PVC covered tubes, any exposed portion at ends and connection shall be neatly taped to appropriate thickness.

4.2.2 Trays shall be properly supported either from any rigid steel structure or concrete member as detailed under trays and supports below.

4.2.3 All male/female tube connectors shall be installed with Teflon tape only. Identification tag plates/ferrules shall be provided on either side of copper tubing as per tubing/junction box schedules. Ferrules shall be single sleeve type with letters and numbers neatly printed.

4.3.0 INSTALLATION OF MULTITUBES AND MULTICORE CABLES

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 8 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

4.3.1 Multiple cables/ multitubes shall always be installed on ducts/trays and properly clamped. At every vertical drop to junction boxes, they shall be clamped at more frequency intervals (Maximum of 300mm). They shall be connected inside junction boxes strictly according to the number system as mentioned in cable schedule. At bends minimum radius shall be maintained as per manufacturer's standard. The angle tray supports shall be fabricated from 40mmx40mmx5mm angles minimum size.

4.3.2 Identification tags shall be provided on either end of multitubes, multicore cables as per cable/tubing/cable schedules. Engraved tag plates or PVC ferrules shall be used for identification of tubes/cables.

4.3.3 All Multitubes and Multicables shall be cut after the exact site measurements are taken between ends and the cable/tube drums shall be selected before cutting the lengths so as to avoid any wastage.

4.3.4 In the field, the cables shall be laid in perforated trays as per layout drawings. Cables shall also be buried or laid in concrete trenches. Inside control room, these shall be laid in concrete trenches or under false floorings.

4.3.5 In the field, the cables shall be laid in perforated trays as per layout drawings. Cables shall also be buried or laid in concrete trenches. Inside control room, these shall be laid in concrete trenches or under false floorings.

4.4.0 INSTALLATION OF INSTRUMENTS

4.4.1 All instruments shall be generally installed on supports as per installation standards in each case, and shall be accessible.


4.4.2 Receiver gauges shall be mounted on instrument support itself as per tubing hook up standards.

4.4.3 Filter regulators shall be mounted on the instruments support itself below the instruments or on the control yoke.

4.5.0 INSTRUMENT AIR SUPPLY

4.5.1 The main instrument air header in each area is laid by other contractor. Air supply from the main air header take off valve to individual instrument shall be through either galvanized steel pipe or 1/4" OD PVC covered copper tube or SS tubes.

4.5.2 Individual takes off valves shall always be located on top of the main air header. Unions shall be provided at convenient locations. There shall be one isolation valve at each instrument end. The galvanised pipe shall be supported at a minimum interval of 1000 mm with 40mmx40mmx5mm MS angles of 60°

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 9 of 17
			REVISION : 0
			EDITION : 1

connection to be instrument shall be copper/SS tubing as per tubing hookup standards.

4.5.3 Teflon tapes shall be used on all threaded joints.

4.6.0 INSTRUMENT STEAM TRACING

4.6.1 The mainsteam header in each area is laid by the other contractor. From the main steam header take off valve, steam to individual instrument shall be taken through carbon steel pipes supported at regular intervals. Steam tracing around individual instruments shall be to copper tubes. After steam tracing, the line is connected to the drain funnel through individual steam trap/condensate return header/tapper point as the case may be.

4.6.2 Electrical tracing shall be done by others.

4.7.0 PERFORATED TRAYS AND SUPPORTS

4.7.1 The perforated trays / angle trays shall be properly supported at a regular interval of max. 1000mm from insert plates or steel structures. Wherever insert plates are not available supports on concrete structures on ceiling shall be fixed with a minimum 10mm diameter expansion bolts. Angle supports for perforated trays/angle trays shall be fabricated from 40mmx40mmx5mm M.S. angles minimum size.


4.7.2 All supports shall be cut with hacksaw and any work executed by gas cutting for cutting and drilling holes will be totally rejected. Free ends of angle support shall not have sharp edges and shall be properly rounded off.

4.7.3 Perforated trays/angle trays shall be used for branching cables and tubes from main trays. Perforated trays shall be used for branching cables and tubes from main trays. Perforated trays shall be fabricated out of 2.5 mm perforated steel sheet. Width of trays shall be selected according to number of tubes and cables. Trays shall be laid generally as per site conditions with the approval of Engineer-in-charge.

4.8.0 LAYING OF CABLES


4.8.1 All cables shall be laid in accordance with installation drawings and cable schedules. Before laying, cable/multicable on drums shall be meggered and tested to ascertain the transit damages.

4.8.2 All cables routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Sufficient extra length

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 10 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1


of cable shall be kept at the terminal on points.

- 4.8.3 Cables shall have complete uncut lengths from one terminal to the other.
- 4.8.4 All cables shall be identified close to their termination point by cables number as per cable schedules/junction boxes schedules. PVC ferrule/tag plate shall be used and these identification tags shall be securely fastened to the cables.
- 4.8.5 All cores of electrical cables shall be identified by their wire numbers by means of the PVC ferrules. Wire numbers shall be as per schedules. All temporary ends of cables shall be protected against dirt and moisture. For this purpose, ends of all PVC insulation cables shall be taped with an approved PVC or rubber insulating tape. Use of function type or other fabric type is not permitted.
- 4.8.6 The cable shall be bent in a large radius. Cables installed above ground shall be run exposed on walls, ceilings, structures and shall run parallel or at right angles with beams, walls or columns.
- 4.8.7 Cables shall be rigidly supported on structural steel and masonry individually or in groups as required using galvanised clips, multiple cable supports or cable trays. If drilling of steel must be resorted to, approval must be obtained and steel must be drilled where the minimum of weakening of the structure will result. Cable shall be supported at every 500 mm.
- 4.8.8 All special cables and power supply cables will be laid directly to the field instrument without any junction boxes, unless otherwise specified.
- 4.8.9 While laying cable in trenches or burying them care shall be taken to ensure that low signal cables like alarm, analyser cables, special cables, special cables from turbine meters, compensating cable etc. are separated from other power supply cables.
- 4.8.10 Each underground cable (either in concrete trenches or buried) shall be provided with identifying tag of lead securely fastened every 30m of its underground length with atleast one tag at each end before the cable leaves/enters the ground.
- 4.8.11 Directly buried cables shall be laid underground in excavated cable trench wherever specified in layout drawings. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced. Before cables are placed the trench bottom shall be filled with 100 mm layer of sand and leveled. Each layer of cables shall be covered with 150 mm of sand on top and sand shall be lightly pressed. A protective covering of 75 mm thick second-class red bricks shall be placed flat on the final layer of sand and cable. The remaining portion of the trench shall be then back filled with soil compacted and leveled. On complete of every group of cable laying and before sand filling, every cable shall be given insulation test in the presence of Engineer-in-charge. Any cable proved to be defective should be replaced before the next groups of cables are laid. Cable route markers indicating number of cables, depth and direction will be placed

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 11 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

enroute, on crossovers/turnings, etc. to mark the cable route.

- 4.8.12 At each road crossings and other places, where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends after pack filling.
- 4.8.13 At the entry into concrete blocks at road crossings cable loops shall be provided at either end to prevent any damage to cables. Each cable shall have one tag at each end before the cable enters/leaves conduct pipes
- 4.8.14 After laying of all the cables and multitubings, cables, the cable entry to control room shall be suitably filled and sealed so as to achieve a positive seal against the entry of gas/water.
- 4.8.15 All cables and tubes shall be laid in accordance with the layout drawings with sand and precast concrete slabs shall be placed on the trench.
- 4.8.16 On completion of cable laying in concrete trenches, the trenches shall be filled with sand and precast.
- 4.9.0 EARTHING
- 4.9.1 Earthing of junction boxes, local cabinets as per the documents and instruction from Engineer-in-charge.
- 4.10.0 PAINTING
- 4.10.1 This part of the specification is applicable to cable ducts, MS cable ways, angle trays, instrument supports, perforated trays, all structural supports for the above items, etc.
- 4.10.2 The surface to be painted shall be thoroughly cleaned with wire brush, sand paper to remove all scales. After cleaning, the surface is painted with one coat of red oxide zinc chromate primer conforming to IS- 207 and allowed to dry completely.
- 4.10.3 Primer coated surface is painted with one coat of paint to the colour nearest to the final paint and allowed to dry. The colour number shall be specified from IS-5.
- 4.10.4 Final second coating shall be with the paint of desired colours and shall be selected from IS-5.
- 4.10.5 It shall be noted that final second coating of external surfaces not covered by cables, copper tubes etc. shall be applied just before handling over the plant or commissioning of the plant whichever is earlier.
- 4.10.6 The name of manufacturer, colour and quality of all types of primer paint shall be

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 12 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

subject to approval of Engineer-in-charge.

4.11.0 TESTING

4.11.1 Electrical cables for signal power supply alarms, and compensating cables for thermocouples; resistance thermometer cables shall be checked for megger values and continuity before proper termination and ferruling.

4.11.2 Testing shall be carried out after the installation of instrument with primary piping complete in all respects and approved by Engineer-in-charge.

4.11.3 Primary piping shall be tested hydraulically pneumatically to 1.5 times the operating pressure after isolating the instruments. Flushing of piping shall be carried out as per instructions of Engineer-in-charge. Lines shall be blown after hydro-testing. All external displacement /float type level instrument level gauges shall also be tested as per instructions of Engineer- in-charge.

4.11.4 Tubes and air line shall be tested with compressed air to 7 kg/cm² upto the filter regulator. The down steam side of the filter regulator shall be tested for 1.5kg/cm². The lines shall be blown with the instrument air upto the regulator for 15 minutes to remove any traces of oil, dust & moisture. All lines shall be checked with soap solution and bubbler unit for possible leak at joints. After pressurizing, source shall be cut off and rate of fall in pressure shall be less than 1 p.s.i. for each 100 ft. of copper tubing for a test period of 2 minutes as per I.S.A.R.P.7-1 "Pneumatic control circuit pressure test".


4.11.5 All test results shall be recorded in the approved format.

4.12.0 CALIBRATION

4.12.1 All instruments shall be calibrated strictly as per manufacturer's instructions prior to installation. The scope of calibration includes all field and control rooms of all types namely, pneumatic, electronic, electrical etc.

4.12.2 Contractor shall use his own oil free instruments, air compressor for calibration purposes.

4.12.3 The level switches (external cage type) shall be set by filling the cage with water to the desired alarm/trip level, while setting the switches, it shall be ensured that the micro switches do not reset for full rated travel of the float.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 13 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

4.12.4 Control valves and positioners shall be checked for hysteresis and linearity and calibration for rated strokes. Prior to calibration, valves shall be cleaned externally. The stem is then lubricated if required, and stroked few times to extreme positions of plug to ensure that movement is free from friction. The valve shall then be calibrated for rated stroke and linearity also. Subsequently the valves shall be checked for hysteresis to the accuracy of 1% FS with positioners and 5% FS without positioners.

Stroke speed has to be evaluated for all trip/shutdown valves.

4.12.5 All calibrations reading shall be recorded in the enclosed format and submitted to Engineer-in-Charge for approval. Where significant deviations from specifications are obtained, the matter shall be brought to the immediate notice of the Engineer-in- Charge for corrective actions.

4.12.6 Furnished hereunder is a list of recommended calibration and test equipments required as a minimum for calibration work. The contractor shall clearly state in his offers the complete list of calibration and test equipments along with the range, accuracy and quantity, which he proposes to use for this job. Contractor should also ensure that any equipment not listed below but required at the time of calibration shall be made available at his own cost.

4.12.7 All test equipments/kits shall be approved by NPL authorities.

4.12.7.1 Controller test stands Mft. Standard

4.12.7.2 Indicator/recorder test stands -do-

4.12.7.3 Squeeze bulb (Flow calibrator
Range: 0-770, 10,000 mm wg. -

4.12.7.4 Dead weight testers (Budenberg or equivalent)
For ranges upto 350 kg/cm² - +/- 0.1%


4.12.7.5 Gauge comparator for pressure gauges
Rating : upto 350 kg/cm² -

4.12.7.6 Oil bath for temperature calibrations
max. Temp 350°C. Mfr's Std

4.12.8.7 Standard Mercury in glass thermometers
Range : -50 to + 50°C. 0 to 100°C
(NPL certified) 0-250°C, 0-350°C ± 0.25%

4.12.7.8 Standard gauges for Ranges upto 350kg/cm² ±0.25%

4.12.7.9 U-tube differential manometers/inclined

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 14 of 17
			REVISION : 0
			EDITION : 1


	tube manometer Static pr. rating : 7 kg/cm ²	+_ 1mm
4.12.7.10	Single leg manometers Scale: -1500 mm water and 1500 mm hg. Static pr. rating : 7 kg/cm ² .	+_ 1mm
4.12.7.11	Decade resistance box	MFR' std.
4.12.7.12	Millimeters	+0.05Mv
4.12.7.13	Potentiometer (Cable of generating and measuring mV)	-
4.12.7.14	Meggars 500V/1000V	-
4.12.7.15	Air hydro pump/hydraulic pump	-
4.12.7.16	Vacuum pump	-
4.12.7.17	Instrument air compressor with filters and Regulators and deoilers.	-
4.12.7.18	Current generator (instrument checker) 4-20mA dc(YEW make or equivalent)	-

4.13.0 LOOP TEST

4.13.1 Loop test shall be performed after calibration of all instruments and leak test of signal lines. Loop tests are conducted to check the functional performance of all elements comprising the loop, thereby ensuring proper connections and operations.

4.13.2 Before proceeding for loop tests the calibration results of individual elements shall be recorded on the enclosed proforma and shall get it approved by Engineer-in-Charge for correctness of installation, measurements and calibration results.

4.13.3 Loop testing for all control loops shall be generally by simulation of process

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 15 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

conditions and shall fix points namely 0%, 25%, 50%, 75% and 100% of full-scale inputs. Detailed procedure shall be submitted to Engineer-in-charge for approval before proceeding with the loop testing.

In case of shutdown system field/receiver pressure switches are simulated for abnormality by disconnecting the wires at terminal and function of all associated systems are checked.

4.13.5 Performance of individual loops may be accepted for an overall accuracy of $\pm 1.5\%$ where deviations exist, contractor shall recalibrate the instruments, which form part of loop testing wherever required, at no extra cost.

4.13.5.1 After the loop test is complete, the contractor shall connect back any terminations and connections removed for loop test.

4.13.7 A loop shall be considered as handed over only after measurements in that particular loop are complete and certified by Engineer-in-Charge, in addition to loop sheets being duly filled in all respects and approved and accepted by Engineer-in-Charge and client.

4.13.8 In case of loops in which certain instruments of the loops are calibrated by other agency, loop testing shall be performed in coordination with the agency involved. Any defect in the calibration of the instrument in contractor's scope is observed, it shall be rectified to the satisfaction of the Engineer-in-Charge. However, defect in calibration of the instruments in the scope of other agency, same shall be rectified by the agency involved. After the calibration has been rechecked by the other agency/agencies the loop checking would be performed to the satisfaction of Engineer-in-Charge, and this part covers under the scope of the contract.

4.13.9 Final certified loop sheets shall be submitted in 4 copies and one transparency.


5.0.0 DRAWINGS AND DOCUMENTS TO BE SUPPLIED FOR EXECUTION BY OWNER/ENGINEER IN CHARGE

5.1.1 Piping and Instrumentation diagrams.

5.1.2 General layout plan for all units, showing all information like position of field instruments junction boxes indicative routes of cables, main ducts/cable trays.

5.1.3 Cable schedules for alarm, signal, shutdown, power supply and pneumatic cables, earthing guide lines.

5.1.4 Termination details/drawings for connecting at control room end.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO. MEC/S/05/26/08	Page 16 of 17
			REVISION : 0
			EDITION : 1

- 5.1.5 Individual Instrument specifications
- 5.1.6 Bill of materials
- 5.1.7 Installation standards/ Hook-up
- 5.1.8 Manufacturers hand book with instructions for installation and calibration wherever necessary for reference.


6.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY CONTRACTOR

- 6.1.1 The drawings for materials that are included on their supply and erection scope namely local control panel, junction boxes and local cabinets.
- 6.1.2 The detailed engineering drawing wherever such drawing is assigned.
- 6.1.3 Two sets of layout drawings, standards bill of materials cable schedules etc., duly incorporating the changes/modification carried out during the course of execution of works.
- 6.1.4 Final material appropriation statement for all free issue materials indicating shortages of any in the proforma duly approved by Engineer-in-Charge.

7.1.0 SCRAP AND EXCESS MATERIAL

- 7.1.1 Every month, the contractor shall submit an account for all the materials issued by the Owner in the standard proforma prescribed for this purpose by the Engineer- in-Charge.
- 7.1.2 On completion of the work, the contractor shall submit 'Material appropriation' statements for all materials issued by the Owner in the proforma prescribed by the Engineer-in-Charge.
- 7.1.3 The following scrap allowances are permissible.

Length below 0.5 mm	Non-salvageable	Unaccountable
Steel pipes, SS Tubes single pair/ Twocore / Three Core cables.	2%	0.5%

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	SPECIFICATION FOR INSTRUMENTATION	DOCUMENT NO.	Page 17 of 17
		MEC/S/05/26/08	REVISION : 0
			EDITION : 1

length below 20 m	Non-salvageable	Unaccountable
Multitube, Multicables	2%	0.5%

8.0 SPECIAL INSTRUCTIONS TO CONTRACTOR:

- 8.1.4 All excess materials and scrap shall be returned after duly accounting for, to the storage points designated by the Owner. Where materials are to be weighed before return, the contractor shall be responsible for making the necessary section obtained during the course of construction for fabricating temporary supports or other items, without prior permission of the Engineer - in -Charge.
- 8.1.5 If the contractor fails to return the surplus material as aforesaid, the owner will charge the contractor for such unreturned materials at panel rates, which will be deducted from whatever amount is due to the contractor. In case any material issued by the Owner deteriorates during storage by the contractor, new materials will be issued to him at penal rates, but the delay in procuring such materials will be at the contractor's account only.

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**STANDARD SPECIFICATION
FOR
CABLING**

SPECIFICATION NO.: MEC/S/05/E5/021




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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO. MEC/S/05/E5/021	Page 1 of 13
			REVISION : 0
			EDITION : 1

AMENDMENT STATUS


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

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 2 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

C O N T E N T S

- 1.0 SCOPE
- 2.0 STANDARD
- 3.0 CABLE SPECIFICATIONS
- 4.0 MISCELLANEOUS MATERIALS SPECIFICATIONS
- 5.0 CABLE LAYING
- 6.0 TERMINATION
- 7.0 TESTING

PREPARED BY:	CHECKED BY:	APPROVED BY:	ISSUE DATE :
(R. SANJAY BABU)	(RAKESH SHUKLA)	(PANKAJ SRIVASTAVA)	08Th DEC 08

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 3 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

1.0 SCOPE

This is to define the requirements for supply, wherever applicable, the installation, testing and commissioning of the cabling system.

2.0 STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

3.0 CABLE SPECIFICATIONS

3.1 Power Cables


Power cables for use on 415 V systems shall be of 1100 Volts grade, aluminium stranded conductor, PVC insulated, PVC sheathed, armoured and overall PVC sheathed. Power cables for 3.3 KV 6.6 KV and 11 KV system shall be aluminium conductor, XLPL insulated, screened, PVC bedded galvanized steel flat armoured and PVC sheathed cable. All L.T. Cables conform to standard specification and relevant sections of IS: 1554 Part-I and H.T. Cables shall conform to IS: 7098 (Part II). Unarmoured cables will be used wherever specified on the cable schedule.

3.2 Control Cables:

Control cables shall be 1100 Volt Grade, 2.5 mm² copper conductor PVC insulated PVC sheathed, single wire armoured with an overall PVC sheath, as per IS: 1554 Pt. Unarmoured cables shall be used wherever specified on the cable schedule.

3.3 Communication cables:

Communication cables shall comprise 1 pair unarmoured, 2-pair, 5-pair and multipair armoured cables of sizes as specified in the cable schedule. Minimum conductor size shall be 0.5 mm telephone system and 0.71 for plant communication system.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 4 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

4.0 MISCELLANEOUS MATERIALS SPECIFICATIONS

4.1 Connectors:

Cable terminations shall be made with aluminium / tinned copper crimped type solder less lugs of M/s. Dowell's make or approved equivalent for all aluminium conductors and stud type terminals.

4.2 Cable Identification

Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number, equipment no., etc.

4.3 Ferrules

Ferrules shall be of approved type size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected for ease in identification and maintenance.

4.4 Cable Glands:

Cable glands to be supplied shall be nickel-plated Brass double compression type of approved/ reputed make. Glands for classified hazardous areas shall be certified by CMRS.


4.5 Cable Trays:

This shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays as specified elsewhere. Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. For requirements of larger than 750 mm width two trays shall be run side by side. Cable trays shall be suitable for a cable weight of 50 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively.

Cable trays fabricated from standard rolled sections shall use 50x50x6 /ISMC 100 Sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32 x 6 mm flat/ 25x25x6 angle for width upto 500 mm/ more than 500 mm respectively.

Vertical supports for both the above type of trays shall be fabricated out of ISMC 100 and horizontal supports with 75 x 50 x 6 angle iron/ ISMC 75 as approved by Engineer-in-Charge.

If unit rate is not included in schedule of rates, then cable trays if required, shall be fabricated and installed at site as per tone rate for electrical structural supports etc.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 5 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

5.0 CABLE LAYING

5.1 Cable network shall include power, control, lighting and communication cables, which shall be laid in trenches, cable trays or conduits as detailed in the relevant drawings and cable schedules. Erection of cable trays as required shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary without any extra cost.


5.2 High voltage, medium voltage and other control cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cables trays, as applicable.

All communication cables (telephones, P.A.S.) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench with a minimum clearance of 300 mm away from electrical trench as per the direction of Engineer-in-Charge and Communication cables shall cross power cables at right angles.

All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient lengths for the final connection of the cable to the terminal of the equipment. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. The quantity indicated in the cable schedule is only approximate. The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule; shall be prepared by electrician contractor and get that approved by Engineer-in-Charge to minimize/avoid straight through joints required. Contractor shall work out the actual number of straight through joints required.

5.4 Cables as far as possible shall be laid in complete, uncut lengths from one termination to the other.

5.5 Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor. Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45° to the trench wall. In case of larger dia cables, i.e., 50 mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Engineer-in-Charge.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO. MEC/S/05/E5/021	Page 6 of 13
			REVISION : 0
			EDITION : 1

5.6 All cables will be identified close to their termination point by cable numbers as per cable schedule. Cable numbers will be punched on aluminium straps (2 mm thick) securely fastened to the cable and wrapped around it. Alternatively cable tags shall be circular in construction to which cable numbers can be conveniently punched.

Each underground cable shall be provided with identity tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas, cable trenches shall be identified by means of markers as per standard drawing. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M and at cable joint locations.

5.7 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.


5.8 RCC cable trenches shall be with removable covers. Cables shall be laid in 3 or 4 tiers in these trenches as indicated on the sectional drawings. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases, RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. The electrical Contractor at no extra cost shall do removal of concrete covers for purpose of cable laying and reinstating them in their proper positions after the cables are laid.

Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipment is connected.

5.9 Directly buried cables shall be laid underground in excavated cable trenches where specified in layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables correctly spaced and arranged with a view of heat dissipation and economy of design.

Minimum depth of buried cable trench shall be 750 mm for low voltage and 900 mm for H.V. Cables, the depth and the width of the trench shall vary depending upon the number of layers of cables.

Cables shall be laid in trenches at depth as shown in the drawing. Before cables are placed, the trenches bottom shall be filled with a layer of sand. This sand shall be levelled and cables laid over it. These cables shall be covered with 150

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 7 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

mm of sand on top of the largest diameter cable and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall then be laid flat. The remainder of the trench shall then be back-filled with soil, rammed and levelled.

- 5.10 As each row of cables is laid in place and before covering with sand every cable shall be given an insulation test in the presence of Engineer-in-Charge / Owner. Any cable, which proves defective, shall be replaced before the next group of cables is laid.

All wall openings / pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/-lined trench.

Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection upto a minimum of 300 mm above finished ground level.

Cable ends shall be carefully pulled through the conduits, to prevent damage to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.


Following grade of the pipe fill shall be used for sizing the pipe size:

- | | | | |
|----|------------------|---|----------|
| a) | 1 cable in pipe | - | 53% full |
| b) | 2 cables in pipe | - | 31% full |
| c) | 3 or more cables | - | 43% full |
| d) | Multiple cables | - | 40% full |

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/ 'PUTTI' for sealing purpose. Alternatively G.I. Lidsor PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. Pipe and no separate payment shall be allowed.

- 5.11 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.

- 5.12 At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 8 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

5.13 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

5.14 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls or columns.

Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

5.15 Individual cables or small groups which run along structures/walls etc. will be clamped by means of 10 SWG GI saddles on 25x6 mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables and no separate payment shall be made on this account. Alternatively small group of cables can be taken through 100 mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be resorted to, approval must be secured and steel must be drilled where the minimum weakening of the structure will result.


Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300 mm for cables up to 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia.

5.16 All G.I. Pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. GI Pipes with bends shall be buried in soil/concrete in such way that the bends shall be totally concealed. For G.I. Pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. Pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. Plugs after they are laid in final position. The Contractor at no extra cost shall supply G.I. Plugs.

5.17 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddles/Clamps, whereas cable in horizontal run of cable trays shall be tied by means of nylon cords.

5.18 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

6.0 TERMINATION

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 9 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

6.1 All PVC cables up to 1.1 KV grade shall be terminated at the equipments by means of double compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.

All Cable entries shall be through bottom only and top entry terminations are made only after getting approval of Engineer-in-Charge.

6.2 Power cables wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.

6.3 In case of control cables all cables shall be identified at both ends by their terminal numbers by means of PVC ferrules or Self-sticking cable markers. Wire numbers shall be as per schematic/ wiring /inter- connection diagram. Bidders shall have the samples of PVC ferrules/cable markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends.


6.4 Where threaded cable gland is screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type, at no extra cost. All switchgear and control panels shall have undrilled gland plate.

Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables.

6.5 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit hole should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

6.6 Cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connector as manufactured by M/s. Dowell Electro
610 of 626

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO. MEC/S/05/E5/021	Page 10 of 13
			REVISION : 0
			EDITION : 1

works or approved equivalent.

Crimping shall be done by hand crimping hydraulically operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.

6.7 Cable accessories for H.V. Systems

6.7.1 The 11, skilled and experienced jointers duly approved by the Engineer-in-Charge shall do 6.6 and 3.3 KV cables terminations joints. Termination including supplying of jointing kit shall be threaded in Contractor scope unless specified otherwise.


6.7.2 The termination and straight thro' joint kit. For use on high voltage system shall be suitable for the type of cables red by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumables items. An installation instruction shall be included in each sheet.

6.7.3 The termination kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer motor. The terminating kits shall preferably be of the following types:

- a) TAPLEX' of M-seal make using non-linear resistance material fortress grading.
- b) 'PUSH-ON' type of CCI make using factory - moulded silicone rubber insulators.
- c) 'TROPOLINK' type of CCI makes.
- d) Heat-shrinkable sleeve type of M/s. Raychem.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

6.7.4 The straight thro jointing kits shall be suitable for underground-buried installation

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 11 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1


with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

- a) 'TAPLEX' of M-seal make
- b) 'TROPOLINK' type of CCI make
- c) Heat-shrinkable sleeve type of M/s. Raychem.

6.7.5 Makes of kits other than those specified in 6.7.3 and 6.7.4 may be considered provided the Contractor furnishes type test certificates, along with the offer.

6.7.6 Type tests are to be carried out at manufacturer's works to prove the general qualities and design of a given type of termination/jointing system. The type tests shall include the following tests conforming to the latest IEC 502.2, 466 and VDE 0278 specifications. The Contractor along with the offer for the jointing system considered shall submit the type test certificates.

- a) A.C. Voltage withstand dry test for 1 minute
- b) Partial discharge test - Discharge magnitude shall be less than 20 p.c.
- c) Impulse voltage withstand test with 10 impulses of each polarity.
- d) A.C. high voltage test following load cycling test with conductor temperature at 95°C.
- e) Thermal short circuit test of 250°C for 1 second.
- f) DC Voltage withstand test for 30 minutes.
- g) Humidity test.
- h) Dynamic short circuit test.
- i) Salt log test
- j) Impact test

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO. MEC/S/05/E5/021	Page 12 of 13
			REVISION : 0
			EDITION : 1

7.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.

7.2 Where splices or termination are required in circuits rated above 600 volts, measure insulation resistance of each length of cable before splicing and or terminating. Repeat measurement after splices and/or terminations are completed.

7.3 Measure the insulation resistance of directly buried cable circuits before cable trenches are back-filled. Repeat measurement after back- filling.

For cables up to 1.1 KV grade, 1KV Megger and for H.V. Cables 2.5 KV/5 KV, 2.4 KV/4.9 KV Megger shall be used

7.4 D.C. High Voltage Test shall be conducted after installation on the following and test results are recorded.

- a) All 1000volts grade cables in which straight through joints have been made.
- b) All cables above 1100 V grade.

For record purposes test data shall include the measure values of leakage current versus time.


The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer-in- Charge or his authorized representative only.

Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgears, transformers etc. are not subjected to test voltage.

The test voltage shall be as under: -

- i) For cables 3.3 KV grade 5.4 KV DC
- ii) For cables 6.6 KV grade 10.8 KV DC
- iii) For cables 11 KV grade 18 KV DC

7.5 All cables shall be tested as per standard test Performa available with site

MECON LIMITED REGD. OFF: RANCHI 834002	STANDARD SPECIFICATION		
	ELECTRICAL & INSTRUMENTATION OIL & GAS SBU, DELHI		
TITLE	CABLING	DOCUMENT NO.	Page 13 of 13
		MEC/S/05/E5/021	REVISION : 0
			EDITION : 1

engineer.


- 7.6 Cable schedule and layout drawings must be marked for AS BUILT conditions during the installation work and shall be approved by Site Engineer.

SPECIFICATION FOR EARTHING AND LIGHTNING PROTECTION

SPECIFICATION NO. MEC/S/05/26/23A




(ELECTRICAL SECTION)
MECON LIMITED
DELHI 110 092

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION	SPECIFICATION NO.		PAGE 1 OF 10
		MEC/S/05/26/23A		REVISION 1

CONTENTS

- 1.0 SCOPE
- 2.0 STANDARDS
- 3.0 EARTHING CONDUCTOR/ELECTRODE
- 4.0 EARTHING NET WORK
- 5.0 INSTALLATION OF EARTH ELECTRODE
- 6.0 CONNECTION
- 7.0 TESTING
- 8.0 TEST PROFORMA

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION		SPECIFICATION NO.	PAGE 2 OF 10
			MEC/S/05/26/23A	REVISION 1

1.0 **SCOPE:**

The intent of this specification is to define the requirements for the supply, installation, testing, and commissioning of the Earthing System.

2.0 **STANDARDS:**

The work shall be carried out in the best workmanlike manner in conformity with this specification, the relevant specifications/codes of practice of Indian Standard Institution, approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instructions of Engineer-in-Charge shall be binding.

3.0 **CONDUCTOR ELECTRODE:**


The main grid conductor shall be hot dip galvanized G.I. Flat or PVC insulated aluminum conductor/copper conductor. Sizes for main conductors shall be marked on the drawings. Thickness of hot dip galvanizing shall not be less than 75 microns.


4.0 **EARTHING NETWORK:**

4.1 The earthing installation shall be done in accordance with the earthing drawings, specifications and the standard drawings of reference attached with this document. The entire earthing system shall fully comply with the Indian Electricity Act and Rules framed thereunder. The contractor shall carry out any changes desired by the Electrical Inspector or the owner, in order to make the installation conform to the Indian Electricity Rules at no extra cost. The exact location on the equipment shall be determined in field, in consultation with the Engineer-in-Charge or his authorized representative. Any changes in the methods, routing, size of conductors etc. shall be subject to approval of the Owner/Engineer-in-Charge before execution.

Excavation and refilling of earth, necessary for laying underground earth bus loops shall be the responsibility of the contractor.

4.3 The earth loop impedance to any point in the electrical system shall have a value which will ensure satisfactory operation of protective devices.

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION		SPECIFICATION NO.	PAGE 3 OF 10
			MEC/S/05/26/23A	REVISION 1
4.4	The main earth loop shall be laid at a depth of 500 mm below grade level. Wherever cable trenches are available, the earth lead shall be laid in the trenches and shall be firmly cleared to the walls of concrete lined trenches. The earthing strip shall be protected against mechanical damage.			
4.5	In process unit areas, the earthing cable shall be run along cable trays wherever specified in the layout drawings. The earthing cable shall be suitably cleared and electrically bonded to the cable tray at regular intervals.			
4.6	Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and suitably protected by giving two coats of bitumen and covering with Hessian tape. All joints above ground shall be by means of connectors/lugs as far as practicable. Tee connectors shall be used for tapping, earth leads from the main earth loop wherever it is installed above ground. Earthing plates shall be provided for earthing of two or more equipment at a place from earth grid. Where aluminum cable risers are to be connected to the underground GI earth bus, the aluminum cable riser shall be taken to the nearest earth pit and terminated through a bolted joint. If this is not practicable, then a G.I. risers shall be brought above grade and a bolted joint shall be made between this GI riser and the aluminum cable termination. This G.I. Riser shall be protected applying two coats of bituminous paint/bitumen on the exposed portion.			
4.7	Conduits in which cables have been installed, shall be effectively bonded and earthed. Cable arm ours shall be earthed at both ends.			
5.0	<u>EARTH ELECTRODES:</u>			
5.1	Earth pipe electrodes shall be installed as shown in the earthing layout drawings and in accordance with the standard drawings of reference and IS:3043. Their location shall be marked to enable accurate location by permanent markers.			
5.2	All earth electrodes shall preferably be driven to sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. Wherever practicable, the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes.			

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION	SPECIFICATION NO.	PAGE 4 OF 10	
		MEC/S/05/26/23A	REVISION 1	

5.3 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell. If necessary, a number of electrodes shall be connected in parallel to reduce the earth resistance. The distance between two electrodes shall not be less than twice the length of electrode.

5.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.

5.5 The exact location and number of earth electrodes required at each location shall be determined in the field in consultation with the owner/Engineer-in- Charge, depending on the soil strata and resistivity, to meet the ohmic values prescribed in clause 5.3. Earth Electrodes shall be located avoiding interference with road, building foundation, column etc. Individual earth electrode shall be provided for each lightning arrestor and lightning mast. The electrodes shall be so placed that all lightning protective earths may be brought to earth electrode by a short and straight a path as possible to minimize surge impedance.

5.6 The disconnect facility shall be provided for the individual earth pits to check their earth resistance periodically. All the earth electrodes shall be suitably numbered and this should be indicated in as built drawings.


6.0 **CONNECTION:**

6.1 All electrical equipment is to be doubly earthed by connecting two points on equipment to a main earthing ring. The earthing ring will be connected via links to several earth electrodes. The earth grid formed shall be a closed loop as shown in the drawing with earth electrodes connected to the grid with double strip connection. The cable armour will be earthed through the cable glands.

6.2 In hazardous areas all major process equipments shall be connected to the earthing ring by means of anti- loosening connections and all pipelines will be bonded and earthed on entering the battery limit of the process area.

6.3 The following shall be earthed.


1. Transformer neutrals, CT/PT neutrals.
2. Neutral Grounding Resistors.


MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION	SPECIFICATION NO.	PAGE 5 OF 10	
		MEC/S/05/26/23A	REVISION 1	


3. Transformer Housing.
4. Lightning Arrestors.
5. All switchgear and their earth buses, bus duct.
6. Motor Frames.
7. Non-current carrying metallic parts of electrical equipment such as switchgear, switch racks, panel boards, motor control centers, lighting, power and instrument panels, push button stations, cable trays, pipes, conduits, terminal boxes, etc.
8. All fences, gates/enclosures, housing electrical equipment
9. All steel structures, rails etc. including bonding between sections.
10. Shield Wire
11. Structural steel and Columns.
12. Loading racks.
13. Lighting Mast, poles.
14. Lighting rods (Mast).
15. Tanks and vessels containing flammable materials.
16. Rotating parts of the agitators, pumps etc. through spring loaded brushes of suitable grade.
17. Earth continuity conductor shall be provided for flanges.

Conductor size for connection to various equipments shall be as indicated on Earthing Layout Drawings.

6.4 Two distinct conductors directly connected to independent earth electrodes, which in turn, shall be connected to the earth too, shall earth system.


MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTNING PROTECTION		SPECIFICATION NO.	PAGE 6 OF 10
			MEC/S/05/26/23A	REVISION 1
<p>The earth connection shall be properly made. A small flexible aluminum cable loops to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastening bolts when there is a lightning surge, high voltage surge or failure of the bushings.</p>				
6.5	<p>Each Lightning Arrestor shall be connected to a separate electrode located as close as possible to it and within the fenced area for each set of arrestors. The three nos. electrodes for each set of arrestors shall be spaced about 5 meters apart so that they are all within the enclosing fence. Each of these electrodes shall be connected to the main earth grid.</p>			
6.6	<p>The shield wire shall be connected with the main grid solidly and not through supporting steel structures.</p>			
6.7	<p>All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.</p>			
6.8	<p>All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground. In case of G.I. Earth Loop all underground "T" connections shall be of the same size as main loop however in case of PVC insulated aluminum conductor loops underground joints shall be completely avoided. Connections to motors from earth plate or main loop conductor brought above ground shall not be less than following:</p> <ul style="list-style-type: none"> i) No.8 SWG G.I. Wire upto 3.7 KW motors. ii) 3/8" DIA G.I. FINE WIRE ROPE for all motors above 3.7 KW upto 30 KW with tinned copper lug at both ends or 35 mm² PVC insulated stranded aluminum conductor with crimped lug. iii) 5/8" DIA G.I. FINE WIRE ROPE OR 70 mm² PVC insulated aluminum stranded conductor for motors above 30 KW upto 75 KW terminated as described above. iv) For all motors above 75 KW conductor size shall be same as that of loop conductor with equivalent size flexible, if required. <p>Anchor bolts or fixing bolts shall not be used for earthing connection.</p>			

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION		SPECIFICATION NO.	PAGE 7 OF 10
			MEC/S/05/26/23A	REVISION 1
6.9	<p>All hardware used for earthing installations shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment.</p>			
6.10	<p>Lighting fixtures shall be earthed through the extra core provided in the lighting cable for this purpose.</p>			
7.0	<p><u>TESTING:</u> Earthing systems/connections shall be tested as follows:</p>			
7.1	<p>Resistance of individual electrodes shall be measured after disconnecting it from the grid.</p>			
7.2	<p>Earthing resistance of the grid shall be measured after connecting all the electrodes to the grid. The resistance between any point on the metallic earth grid and the general mass of earth shall not exceed 1 ohm.</p>			
7.3	<p>The resistance to earth shall be measured at the following:</p> <ul style="list-style-type: none"> a) At each electrical system earth or system neutral earth. b) At each earth provided for structure lightning protections. c) At one point on each earthing system used to earth electrical equipment enclosures. d) At one point on each earthing system used to earth wiring system enclosures such as metal conduits and cable sheaths or armor. e) At one point on each fence enclosing electrical equipment. <p>Measurement shall be made before connection is made between the ground and the object to be grounded.</p>			

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION	SPECIFICATION NO.		PAGE 8 OF 10
		MEC/S/05/26/23A		REVISION 1

8.0 LIGHTNING PROTECTION

- 8.1 Lightning protection system shall generally comprise lightning finials (air terminals), roof conductors, down conductors, test links, and earth electrodes. the number, types, materials and sizes shall be in accordance with the drawings.
- 8.2 Air terminals shall be mounted on top of buildings or structure as required. All air terminals shall be inter-connected with roof conductors, pipes, hands rails or any other metallic projection above the roofs shall also be bonded to the roof conductors.
- 8.3 Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends.
- 8.4 All provisions regarding connections of conductors for equipment earthing system shall also apply to lightning protection system.
- 8.5 In corrosive atmospheres, plumbing metal for corrosion protection shall cover lightning finials or air terminals.

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION	SPECIFICATION NO.		PAGE 9 OF 10
		MEC/S/05/26/23A		REVISION 1

9.0

TEST PROFORMA

(INSTALLATION TESTING REPORT EARTHING INSTALLATIONS)

1. Earth system data

Type of electrode :

Total number of electrodes :

Main grid size :

Material :

2. General checks Put Tick if O.K.; otherwise give details.

Construction of earth electrodes as per Standard.

Size of earth conductor for various equipment
O.K. as per Standard.

Minimum distance kept between two electrodes.

Cleanliness and tightness of connectors.
Inspect bolted & clamped connectors.


3. TESTS

3.1 Measured earth resistance
of each electrode in ohms

- No. 1
2
3
4
5

3.2 Measurement of earth grid resistance
(with all electrodes connected to grid)

- a) At each electrical system earth or system neutral earth. :
- b) At each point provided for structure lightning protection :
- c) At one point on each earthing systems used to earth electrical equipment enclosure :
- d) At one point on each earthing systems used to earth wiring systems such as metal conduits etc. :
- e) At one point on each fence enclosing electrical equipment. :

MECON LIMITED REGD. OFF: RANCHI (JHARKHAND)		PROCESS & PIPING DESIGN SECTION NEW DELHI	STANDARD SPECIFICATION	
TITLE	EARTHING AND LIGHTING PROTECTION	SPECIFICATION NO.	PAGE 10 OF 10	
			MEC/S/05/26/23A	REVISION 1

4. Remarks:

PROJECT:		UNIT:	
TESTED BY	WITNESSED BY		DATE
CONTRACTOR	MECON	OWNER	