

ऊर्जा दक्ष निम्न वोल्टेज प्रेरण मोटरों के लिए विनिर्देश

SPECIFICATION FOR ENERGY EFFICIENT LOW VOLTAGE INDUCTION MOTORS

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Approved by						

Abbreviations:

AL	:	Aluminium
BIS	:	Bureau of Indian Standards
BS	:	British Standards
CEA	:	Central Electricity Authority
CIMFR	:	Central Institute of Mines and Fuel Research
CPRI	:	Central power research institute
CT	:	Current Transformer
CU	:	Copper
DGMS	:	Directorate General of Mines Safety
DOL	:	Direct On Line
EIL	:	Engineers India Limited
ERTL	:	Electronics Regional test laboratory
EU	:	European Union
FM	:	Factory Mutual
FRP	:	Fiber Reinforced Plastic
IEC	:	International Electro-technical Commission
IEEE	:	Institute of Electrical & Electronics Engineers
IP	:	Ingress Protection
IS	:	Indian Standard
JEC	:	Japanese Electro-technical Committee
KLPL	:	Karandikar laboratories Pvt. Ltd.
LCIE	:	Laboratoire Central des Industries Electriques
NEMA	:	National Electrical Manufacturers Association
PESO	:	Petroleum and Explosive Safety Organisation
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
RPM	:	Revolutions per Minute
UL	:	Underwriter's Laboratories
VFD	:	Variable Frequency Drive
VDE	:	Verband Deutscher Elektrotechniker

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1.0 SCOPE

This specification covers the design, manufacture, testing, packing and supply of energy efficient-High efficiency (IE2/IE3/IE4 as specified in data sheet) three phase medium voltage squirrel cage induction motors.

2.0 CODES AND STANDARDS

2.1 The squirrel cage induction motors and their components shall comply with the latest editions of following standards issued by BIS (Bureau of Indian Standards) unless otherwise specified:

IS - 5	:	Colours for ready mixed paints and enamels.
IS - 1076	:	Preferred numbers.
IS - 1231	:	Dimensions and output series of foot mounted induction motors-frame numbers 56 to 315 L.
IS - 1271	:	Electrical insulation- Thermal evaluation and designation.
IS - 2223	:	Dimensions of flange mounted AC Induction motors.
IS - 2253	:	Designation for types of construction and mounting arrangement of rotating electrical machines.
IS - 2254	:	Dimensions of vertical shaft motors for pumps.
IS - 4029	:	Guide for testing three phase induction motors.
IS - 6362	:	Designation of methods of cooling of rotating electrical machines.
IS - 8223	:	Dimensions and output series for rotating electrical machines.
IS - 8789	:	Values of Performance Characteristics for Three-Phase Squirrel Cage Induction Motors with Degree of Protection IP-2X.
IS - 9283	:	Motors for submersible pump sets.
IS - 12065	:	Permissible limits of noise level for rotating electrical machines.
IS - 12075	:	Mechanical vibration of rotating Electrical Machines with shaft heights 56 mm and higher - measurement, evaluation and limits of vibration severity.
IS - 12615	:	Line Operated Three Phase a.c. Motors (IE CODE) "Efficiency Classes and Performance Specification"
IS - 13529	:	Guide on effects of unbalanced voltages on the performance of three phase cage induction motors.
IS - 13555	:	Guide for selection and application of three phase induction motors for different types of driven equipment.
IS - 14568	:	Dimensions and output series for rotating electrical machines, frame numbers 355 to 1000 and flange numbers 1180 to 2360.
IS / IEC60079-0:	:	Electrical apparatus for explosive gas atmospheres (General requirements)
IS/IEC-60079-1:	:	Explosive Atmospheres-Equipment protection by flame proof enclosures "d".
IS/IEC60079-2 :	:	Explosive protection by pressurized enclosure "p".
IS/IEC60079-7 :	:	Explosive Atmospheres-Equipment protection by increased safety – "e".
IS/ IEC: 60529 :	:	Degree of protection provided by enclosures (IP Code)
IS/IEC-60034/	:	
IS 15999	:	Rotating Electrical machines
IS/IEC 61241:	:	Electrical apparatus for use in the presence of combustible dust
IS/IEC 60072-1:	:	Dimensions and output services for operating electrical machines Part-1 : Frame number 56-400 and flange number 55 to 1080

2.2 In case of imported motors, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian Standards.

- 2.3** The motors shall also conform to the provisions of CEA regulations and other statutory regulations currently in force in the country.
- 2.4** In case Indian Standards are not available, standards issued by IEC/ BS/ VDE/ IEEE/ JEC/NEMA or equivalent agency shall be applicable.
- 2.5** In case of any conflict between requirements specified in various applicable documents, the most stringent one shall prevail. However, owner's decision in this regard shall be final and binding.

3.0 GENERAL REQUIREMENTS

- 3.1** The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.
- 3.2** Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.
- 3.3** Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to ensure the end user for placement of order for spares and services.

4.0 OPERATING CONDITIONS

4.1 Ambient Conditions

Motors shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in refineries, petrochemical, fertilizer and metallurgical plants. Service conditions shall be as specified in the motor data sheet. If not specifically mentioned therein, a design ambient temperature of 40 °C and an altitude not exceeding 1000 meters above mean sea level shall be taken into consideration.

4.2 Frequency and Voltage Variations

Unless otherwise agreed, motors shall be designed for continuous operation at rated output under the following conditions:

- a) The terminal voltage differing from its rated value by not more than $\pm 10\%$ or
- b) The frequency differing from its rated value by not more than $\pm 5\%$ or
- c) Combined variation — The sum of absolute percent variations of (a) and (b) not exceeding 10 percent.

4.3 Starting

- a) Motors shall be designed for direct-on-line starting or other method of starting as specified in datasheet.
- b) Motors shall be designed for re-acceleration under full load after a momentary loss of voltage with the residual voltage being 100% and is in phase opposition to the applied voltage.
- c) Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. In addition, Locked Rotor withstand time under hot conditions at 75% & 100% voltages, shall be minimum 1.4 times the starting time at the corresponding voltage.

- d) Unless otherwise specified, all motors shall be suitable for starting under specified load conditions with 75 % of the rated voltage at the motor terminals.
- e) Motors shall be designed to allow the minimum number of consecutive starts indicated in Table below:

Starts	Min. no. of consecutive starts
No. of consecutive start-ups with initial temp. of the motor at ambient level (cold)	3
No. of consecutive start-ups with initial temp. of the motor at full load operating level (hot).	2

4.4 Direction of Rotation

Motors shall be suitable for either direction of rotation. In case unidirectional fan is provided for motors, direction of rotation for which the motor is designed shall be permanently indicated by means of an arrow. Directional arrow should be manufactured from corrosion resistant material. When a motor is provided with bi-directional fans, a double-headed arrow should be provided.

Normally, clockwise rotation is desired as observed from the driving (coupling) end, when the terminals UVW are connected to a power supply giving a terminal phase sequence in the order UVW. Counter-clockwise rotation of the motor shall be obtained by connecting the power supply to terminals so that the phase sequence corresponds to the reversed alphabetical sequence of the terminal letters. Ample space shall be provided at the terminal box for interchanging any two external leads for obtaining the reverse phase sequence.

5.0 PERFORMANCE

- 5.1 Motors shall be rated for continuous duty (S₁), unless otherwise specified.
- 5.2 Unless specified, the starting current (as % rated current) shall be as per IS 12615, subject to IS tolerance
- 5.3 In particular cases, when the starting current is to be limited, care shall be taken such that the design values of torque meets the load requirement while at the same time complying to clause 4.3 above of this specification. Unless otherwise specified the minimum pull-up torque of motors, at rated voltage & frequency shall be minimum 50% of the rated full load torque.
- 5.4 In particular cases, when the starting with reduced voltage is specified, care shall be taken such that the design values of torque meets the load requirement while at the same time complying to clause 4.3 above of this specification.
- 5.5 Starting torque and minimum torque of the motor shall be compatible with the speed torque curve of the driven equipment under specified starting and operating conditions.
- In case where characteristics of driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of rated value for motors up to 75 kW and shall be 90% of rated value for motors above 75 kW.
- 5.6 The breakdown torque at the rated voltage shall be not less than 175% of the rated load torque with no negative tolerance. Unless otherwise agreed, the breakdown torque shall not exceed 350% of the rated load torque.

In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors, crushers, ball mills) the minimum value of pull out torque at 75% of the rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.

5.7 Motors fed by variable frequency drive shall additionally meet the following requirements

- a) The motor shall be converter grade motor suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control and shall comply to IS 16724, IEC-60034-25 and relevant part of IS/IEC-60079.
- b) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
- c) The motor shall be designed to operate continuously at any speed over the range (1-100%) of rated speed or as specified in data sheet.
- d) Motor shall be provided with thermistor type temperature detector.
- e) The motors shall be provided with Class 'F' insulation with temperature rise limited to Class 'B'.
- f) Motor shall be designed suitable to deliver the torque required for complete speed torque characteristics of the load considering the voltage available at the motor terminals after taking into account supply voltage tolerances, voltage drop within VFD panel and voltage drop within cable as specified in VFD specification.
- g) Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in line voltage, frequency and starting current limitations as specified in data sheet.
- h) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid state power supply.
- i) The motor insulation shall be designed to accept the applied voltage wave form, within the V_{peak} and dv/dt limits as per IEC-61800-2 and 60034-25.
- j) The motor vendor shall also coordinate with driven equipment vendor & VFD vendor and obtain requisite details for motor design.
- k) Induced voltage at the shaft end of the motor at no load shall not exceed 250 mV rms for roller and ball bearings and 400 mV for sleeve bearings. The non driving end bearing shall be insulated from the motor frame to avoid circulating current. The insulated bearing end shield or pedestal shall bear a prominent warning. Insulated bearing (Non-Drive End) shall be provided irrespective of motor frame size.
- l) Motor for hazardous area application shall have valid type test certificate issued by recognized independent test house certifying that motor is suitable for converter duty application. Corresponding statutory approval (e.g. PESO/DGMS etc.) as applicable for the specified location shall also be furnished for the hazardous area motor.
- m) The motors shall be suitable for the current wave forms produced by the power supply including harmonics generated by the drive. The necessary coordination by motor manufacturers with drive manufacturers regarding harmonics generated by VFD shall be taken care and incorporated in motor design suitably.

- n) The motors shall be designed to operate continuously at any speed over the range as per process requirement with minimum range as 10–100% of rated speed or as specified in data sheet. The characteristics shall be based on the application – in terms of constant torque / variable torque as per the driven equipment. Additional cooling fan shall be provided if required to limit the temperature rise to specified limits, alternatively option of applying suitable de-rating may be considered.
- o) The motors shall withstand torque pulsation resulting from harmonics generated by the solid state power supply.
- p) The motors required to be transferred to DOL bypass mode shall be rated for specified variations in line voltage and frequency.

5.8 The minimum values for performance characteristics of these motors shall be as given in the tables 1, 2 & 3 of IS 12615 for IE2/IE3/IE4 motors, subjected to tolerance as per IS/IEC. Motors operated by frequency converters may have higher losses as compared to line (sinusoidal) power supply due to the harmonic voltage content. These motors must be tested on sinusoidal supply and efficiency must meet the declared efficiency class (which should not be lower than IE 2 class).

6.0 CONSTRUCTIONAL DETAILS

6.1 Windings

- 6.1.1** Unless otherwise specified, motors shall be provided with class 'B' insulation as a minimum. In case of motors with class 'F' insulation, the permissible temperature rise above the specified ambient temperature shall be limited to those specified in the applicable Indian standards for class 'B' insulation.
- 6.1.2** The winding shall be tropicalised. The windings shall preferably be vacuum impregnated. Alternately the windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmospheres.
- 6.1.3** Windings shall be adequately braced to prevent any relative movement during operation. In this respect, particular care shall be taken for the stator windings for direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases that lie together. Core laminations must be capable of withstanding burnout for rewind at 350 °C without damage or loosening.
- 6.1.4** In case of motors driving equipment with pulsating loads, special care shall be taken for the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.
- 6.1.5** The windings shall be connected in delta. However, for motors rated 2.2 kW and below, star connection may be accepted. In case of motors with star-delta starting, the motor windings shall be fully insulated for delta connection.
- 6.1.6** The ends of the windings shall be brought out into a terminal box. These shall be terminated by means of terminals mounted on an insulating base made of non-hygroscopic and non-flammable material.
- 6.1.7** All motors shall be provided with six terminals and suitable links to connect them in star or in delta except for motors rated up to and including 2.2 kW which may be accepted with three terminals.

6.2 Terminal Box and Cable Entries

- 6.2.1** Unless otherwise agreed, the terminal box shall be located on the right hand side as viewed from the driving (coupling) end. The terminal box shall have side cable entry from non-driving end. However, as a special case, terminal box located on top may also be accepted, particularly for hazardous area motors, in case manufacturer has only top mounted terminal box design which is duly tested/certified & approved by corresponding agency as mentioned in clause 11.0 below for installation in hazardous area. The terminal box design shall allow rotation in steps of 90 °C to facilitate cable entry from any direction at site.
- 6.2.2** Terminal box cover shall be provided with handles to facilitate easy removal. However, for terminal box covers weighing less than 5 kg., terminal box covers without handles can be accepted.
- 6.2.3** The terminal box shall be provided entries for suitable cable glands corresponding to the size of the specified cable. Crimp type tinned Copper lugs and nickel-plated brass (or aluminum if specifically required), double compression type cable glands shall be supplied along with the motors for the specified cable sizes for power and space heater cables.
- 6.2.4** For flameproof motors, terminal box can be also provided in increased safety 'Exe' execution.
- 6.2.5** The terminals, cable lugs, terminal box, cable entries and cable glands shall be suitable for the minimum cables sizes as specified below for 2 pole, 4 pole or 6 pole motors:

Motor rating up to and including	Size of phase conductor (mm²)
2.2 kW and below	2.5 cu
3.7 kW	6 cu
5.5 kW	10 cu
7.5 kW	16 cu
9.3 kW	16 cu
11.0 kW	16 cu
15.0 kW	50 Al.
18.5 kW	70 Al
22.0 kW	70 Al
30.0 kW	95 Al
37.0 kW	120 Al
45.0 kW	150 Al
55.0 kW	240 Al
75.0 kW	2x95 Al
90.0 kW	2x120 Al
110.0 kW	2x240 Al
125.0 kW/132 kW	2x240 Al
160.0 kW	2x240 Al

NOTE: - Exact cable size for the motor shall be informed during vendor drawing review. Vendor to provide required size of the terminal box.

- 6.2.6** Cable sizes for motors having synchronous speeds 750 RPM and below shall be as agreed between the purchaser and manufacturer.

6.3 Motor Casing and Type of Enclosure

- 6.3.1** The minimum degree of motor enclosures including terminal boxes and bearing housing shall be IP-55 as per IS/IEC.

6.3.2 Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter or canopy. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors (Type Ex d/Ex de).

6.3.3 All internal and external metallic parts, which may come into contact with cooling air, shall be of corrosion resistant material or appropriately treated to resist the corrosive agents, which may be present in the atmosphere. Screws and bolts shall be of rust proof material or protected against corrosion.

6.3.4 Unless otherwise agreed, motors shall have standard frame sizes (min.) for various output ratings as stipulated in IS/IEC.

6.4 Bearing and Lubrication

6.4.1 Motors shall have grease lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum L-10 rating life of 5 years, (40, 000 hours) at rated operating conditions

(The L-10 rating life is the number of hours at constant speed that 90% of a group of identical bearings will complete or exceed before the first evidence of failure).

6.4.2 The bearings shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion. Motors designed to handle external thrust from the driven equipment shall be supplied with a thrust bearing at the non-driving end.

6.4.3 In cases such as pumps for hot liquids where the driven equipment operates at high temperatures, bearings shall be cooled by a shaft-mounted fan. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven equipment by conduction or convection.

6.4.4 Bearings shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust / moisture e.g. labyrinth seal/ oil seal/ V seal. Where grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices, which ensure passage of grease through the bearings.

6.4.5 Pre-lubricated sealed bearings may be considered provided a full guarantee is given for 4 to 5 years of trouble-free service without the necessity of re-lubrication.

6.5 Cooling System

All motors shall be self ventilated, fan cooled. Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motor rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.

For motors operating in hazardous area, the fans shall be of an anti-static non-sparking material.

6.6 Rotor

The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and long service life for the bearings. Die cast aluminum rotors for motors in hazardous areas may be accepted provided the same are type tested and approved by competent authorities.

6.7 Shaft Extension

Motors shall be provided with a single shaft extension with key-way and full key. Motor shaft shall be sized to withstand 10 times the rated design torque.

6.8 Lifting Hooks

All motors weighing more than 30 kg. shall be provided with lifting hooks of adequate capacity.

6.9 Earth Terminals

Two earth terminals located preferably on diametrically opposite sides shall be provided for each motor. Necessary nuts and spring washers shall be provided for earth connection.

7.0 MISCELLANEOUS ACCESSORIES

7.1 Anti-Condensation Heaters

All motors rated 30 kW and above shall be provided with 240 V anti-condensation heaters, sized and located so as to prevent condensation of moisture during shutdown periods.

For motors with heaters installed in hazardous atmospheres (Zone - 1 or Zone - 2), such heaters shall conform to the provisions of applicable Indian Standards and temperature classification specified in the motor data sheet.

The heater leads shall be brought out, preferably, to a separate terminal box which shall be of the same specification and grade of protection as the main terminal box.

A warning label with indelible red inscription shall be provided on the motor to indicate that the heater supply shall be isolated before carrying out any work on the motor.

7.2 Name Plates

In addition to the motor rating plate, a separate number plate for motor tag number shall be fixed in a readily visible position. This number shall be as per the motor data sheets. Nameplates and tag plates shall be of stainless steel material. Name plate shall include details as specified in IS 15999 Part 1 / IEC 60034 Part 1.

8.0 CRITICAL SPEEDS

The first actual critical speed of stiff rotors shall not be lower than 120 % of the synchronous speed. For flexible rotors this shall be between 60 % and 80 % of the synchronous speed; the second actual critical speed shall be above 120 % of the synchronous speed.

9.0 PAINTING

All metal surfaces shall undergo manufacturer's standard cleaning /painting cycle. After preparation of the under surface, the equipment shall be painted with two coats of epoxy based final paint. Color shade of final paint shall be 632 of IS: 5/ RAL-7031. All unpainted steel parts shall be suitably treated to prevent rust formation. If these parts are moving elements, then these shall be greased.

10.0 INSPECTION AND TESTING

- 10.1** During fabrication, the equipment shall be subjected to inspection by EIL / Owner or by an agency authorised by the Owner, if specified / agreed in Inspection Test Plan. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspector. All routine / acceptance tests shall be carried out at manufacturer's works under his care and expense.
- 10.2** Type test certificates from CIMFR or equivalent test house, applicable PESO/ DGMS approval certificates, BIS license and original drawings referred in type test certificates shall be shown to the inspection agency on demand during inspection. The certificates and BIS license must be valid at the time of dispatch.
- 10.3** Test certificates of bought out components shall be shown to the inspection agency on demand during inspection.
- 10.4** Combined testing of LV motors along with their associated VFDs shall be carried out as a unit. During this testing, temperature rise and harmonics levels shall be measured to ensure they are within the permissible limits as per applicable standards. This test may not be required in case same make / type / rating of motor & VFD as a unit has been already tested and copy of test certificate is available which will be furnished for EIL/Owner's reference.
- 10.5** All equipments shall be subjected to various routine / acceptance tests as per Inspection & Test plan no. 6-81-1064.

11.0 CERTIFICATION

A copy of valid BIS license shall be furnished for energy efficient motors as per IS 12615.

All hazardous area equipment shall have hazardous area test certificates and approvals as per following:

For Indigenous manufactured hazardous area equipment:

For all electrical items manufactured in India, the testing shall be carried out & test report issued by Indian test laboratory recognized by the Chief Controller of Explosives shall be furnished. For Ex protection Electric Apparatus having flameproof type protection, a copy of valid BIS license shall be furnished as per IS/IEC 60079-1.

Alternatively, IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report shall be furnished.

For Imported hazardous area equipment:

For all electrical items manufactured outside India, test report issued by Indian test laboratory recognized by the Chief Controller of Explosives shall be furnished. For Ex protection Electric Apparatus having flameproof type protection, a copy of valid BIS license shall be furnished as per IS/IEC 60079-1.

As an alternative option-1 to this, IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report shall be furnished.

As an alternative option-2 to this, EU Type Examination Certificate, which is applicable for manufacturers having manufacturing locations in countries covered under the European Union, valid copy of Production Quality Assessment / Assurance Notification shall be furnished.

All equipment i.e. Indigenous & imported, shall also have valid statutory approvals, as applicable for the specified location and marking as per IS/IEC 60079 and as required by statutory authorities.

For installations in India, PESO approval letter shall be provided.

12.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

अग्निरोधक नियंत्रण स्टेशनों के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLAMEPROOF CONTROL STATIONS

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Abbreviations

BIS	:	Bureau of Indian Standard	NEMA	:	National Electrical Manufacturers Association
CIMFR	:	Central Institute of Mining & Fuel Research	PB	:	Push Button
DFT	:	Dry Film Thickness	PO	:	Purchase Order
ERTL	:	Electronics Regional Test Laboratory	PESO	:	Petroleum Explosive Safety Organization
FM	:	Factory Mutual	PR	:	Purchase Requisition
FLP	:	Flame Proof	PVC	:	Poly Vinyl Chloride
IL	:	Indicating Lamps	QC	:	Quality Control
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification	VDR	:	Vendor Data Requirement
IS	:	Indian Standard	XLPE	:	Cross Linked Poly Ethylene
IEC	:	International Electro technical Commission			
JEC	:	Japanese Electro technical Committee			
MTC	:	Material Test Certificate			

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INSPECTION AND TEST PLAN
FOR
FLAMEPROOF CONTROL STATIONS

STANDARD SPECIFICATION No.

6-81-1006 Rev. 5

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Flameproof Control Stations.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents/Relevant IS/IEC Standards.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures	--	--	--	--	--	--
2.0	Material Inspection						
2.1	Incoming material like castings, glass, meters, PBs, ILs, Fasteners etc	Visual, Dimensional, Chemical, Physical and Operational checks, (as applicable)	100%	MTC / Lab test records	H	H	R
3.0	In process Inspection						
3.1	Machining, Joints, Sealing methods	As per Test Lab Certified Drawings for Hazardous Area Applications	100%	Test Certificates	-	H	-
3.2	Assembly and Wiring Checks	Visual, Dimensional, Bill of Material, Rating of Components, Tightness of wiring terminations, Size, Type (FR/FRLS), continuity, color coding.	100%	Test Certificates	-	H	-

INSPECTION AND TEST PLAN
FOR
FLAMEPROOF CONTROL STATIONS

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.3	Flameproof enclosure without components	Routine Over-Pressure test	100%	Test Certificates	-	H	R
4.0	Final Inspection						
4.1	Flameproof Control Station (Routine tests)	• Visual/Dimensional/BOM Checks • Nameplate and Tag Number checks • Adherence of panels to Hazardous Area Certification conditions including Flame Path, Flame Gap, Thread Check, Thickness of Enclosure, No. of Cable Entries, Rating of mounted components, Maximum number of door/ cover mounted components, Joints, Sealing etc. • Wiring Checks/Electrical/ Functional Checks • High voltage test • IR test before and after High voltage Test • Paint Shade, Thickness and Adhesion check.	100% by Supplier 10% by EIL/TPIA	Test Records / Inspection Witness Record	-	H	H
4.2	Submission of Certificates & Documents	• Test Certificate of testing agency (CIMFR/ KLPL etc) for suitability of model to intended Hazardous area classification as per latest IS/IEC standards. • Certificate of Statutory authority (PESO). • Valid BIS License.	For each Type/Model	Certificates from test agencies	-	H	R

INSPECTION AND TEST PLAN
FOR
FLAMEPROOF CONTROL STATIONS

STANDARD SPECIFICATION No.

6-81-1006 Rev. 5

Page 5 of 5

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	Painting						
5.1	Painting and Packing	- Visual checks for compliance to Painting requirements as per contract. - Suitable protection to prevent entry of foreign material. - Proper packing to prevent any damage during transportation and storage, as per contract.	100%	Packing list / Supplier's Records	-	H	-
6.0	Documentation and IC						
6.1	Documentation and IC	- Review of Internal Test Reports & MTC - IC Issuance	100%	Supplier's Test Records / Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random 10% , R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

- This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
- Acceptance Norms shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents/ Hazardous Area certifications.
- Supplier has to furnish internal test reports before scheduled inspection date.

ऊर्जा दक्ष मध्यम वोल्टेज मोटरों
के लिए निरीक्षण व परीक्षण योजना

**INSPECTION AND TEST PLAN FOR
ENERGY EFFICIENT
MEDIUM VOLTAGE MOTORS**

1	15.03.2024	Revised	MM	GS	RK	MAN
0	12.11.2018	ISSUED FOR IMPLEMENTATION	MM	RS	RKS	RKT
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations

BIS	:	Bureau of Indian Standard	MTC	:	Material Test Certificate
CIMFR	:	Central Institute of Mining & Fuel Research	NEMA	:	National Electrical Manufacturers Association
EIL	:	Engineers India Limited	PO	:	Purchase Order
FM	:	Factory Mutual	PESO	:	Petroleum Explosive Safety Organization
FLP	:	Flame Proof	PR	:	Purchase Requisition
ITP	:	Inspection and Test Plan	QC	:	Quality Control
IP	:	Ingress Protection	TC	:	Test Certificate
IC	:	Inspection Certification	TPI or TPIA	:	Third Party Inspection Agency
IEC	:	International Electro technical Commission	VDR	:	Vendor Data Requirement
JEC	:	Japanese Electro technical Committee	VFD	:	Variable Frequency Drive

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. G Suresh	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. Avdhesh Agrawal
Mr. Mahendra Mittal	Mr. R Muthuramalingam (RPO Representative)	Mrs Arvind NP Singh (Electrical)	Mr Anil Kumar

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing & inspection requirements of three phase medium voltage energy efficient squirrel cage induction motors.

2.0 REFERENCE DOCUMENTS

PO/PR & Standards referred therein /Job specifications / Approved documents/ Relevant IEC/IS.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures	--	--	--	--	--	--
2.0	Material Inspection						
2.1	Raw Material: Body (casting or fabrication), Rotor Shaft, Core Laminations, Copper, Insulation Material, Bearings, Cable Boxes, Cable Glands, etc.	Chemical, Physical Properties, Finish as per Relevant Standard	100%	Material Test Certificates / Test records	H	H	-

**INSPECTION AND TEST PLAN
 FOR ENERGY EFFICIENT
 MEDIUM VOLTAGE MOTORS**

STANDARD SPECIFICATION NO.

6-81-1064 Rev. 1

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	In-process Inspection						
3.1	Motor Assembly	Vacuum Impregnation and Bracing of Winding, Core Assembly, Rotor Bars and End Rings Assembly, Rotor Balancing, Terminal Box Mounting and Clearances in between, Bearing Setting, etc. as per Supplier's Internal Standards	100%	Test Records	-	H	R
4.0	Final Inspection						
4.1	Motor (Routine Tests)	• Visual Check (Nameplate, Terminal Box Location, Terminal Type, Clearances, Size, Entries, Space Adequacy & Gland Size, Direction of Rotation etc.) • Dimensions Check (Including Shaft Height etc., Foundation Hole Dia and Distance, Shaft Dia.) • Cable Glands, Cable Lugs Size and No. of Entries in Terminal Box • Winding Resistance • Space heater resistance & IR check • Accessories (RTD, BTM and Thermistor) Resistance measurement check (as applicable) • No Load Test and Measurement of Voltage, Speed, Current, Power Input • Reduced Voltage Starting and Running • Insulation Resistance before & after High Voltage Test • High Voltage (Per Phase)	100%	Inspection test records	-	H	H See Note 4 & 5

**INSPECTION AND TEST PLAN
FOR ENERGY EFFICIENT
MEDIUM VOLTAGE MOTORS**

STANDARD SPECIFICATION NO.

6-81-1064 Rev. 1

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		- Vibration at No Load - Noise Level at No load					
4.2	Motor (Type Tests)	- Full Load Test and Measurement of Voltage, Current, Power, Slip, Power Factor, Bearing Noise. - Efficiency and Pf at 100%, 75% and 50% Load - Temp Rise Test - Momentary Overload Test - Vibration before and after over speed test - Over Speed - Measurement of Starting Torque, Starting Current, Full Load Torque, Pull Out Torque by JEC/IEC (By Logarithmic Proportion Current Method II	One Motor from each type/rating	Inspection test records	-	H	H See Note 4 & 5
5.0	Painting						
5.1	Painting and Packing	- Visual - Suitable protection to prevent entry of foreign material. - Proper packing with suitable plugs to prevent Ingress of Moisture and any damage during Transportation and Storage.	100%	Packing list / Supplier's Records	-	H	-
6.0	Documentation and IC						
6.1	Documentation and IC	- Review of Internal Test Reports - Test Certificate from Recognized Testing	100%	Supplier's Test Records /	-	H	H

**INSPECTION AND TEST PLAN
FOR ENERGY EFFICIENT
MEDIUM VOLTAGE MOTORS**

STANDARD SPECIFICATION NO.

6-81-1064 Rev. 1

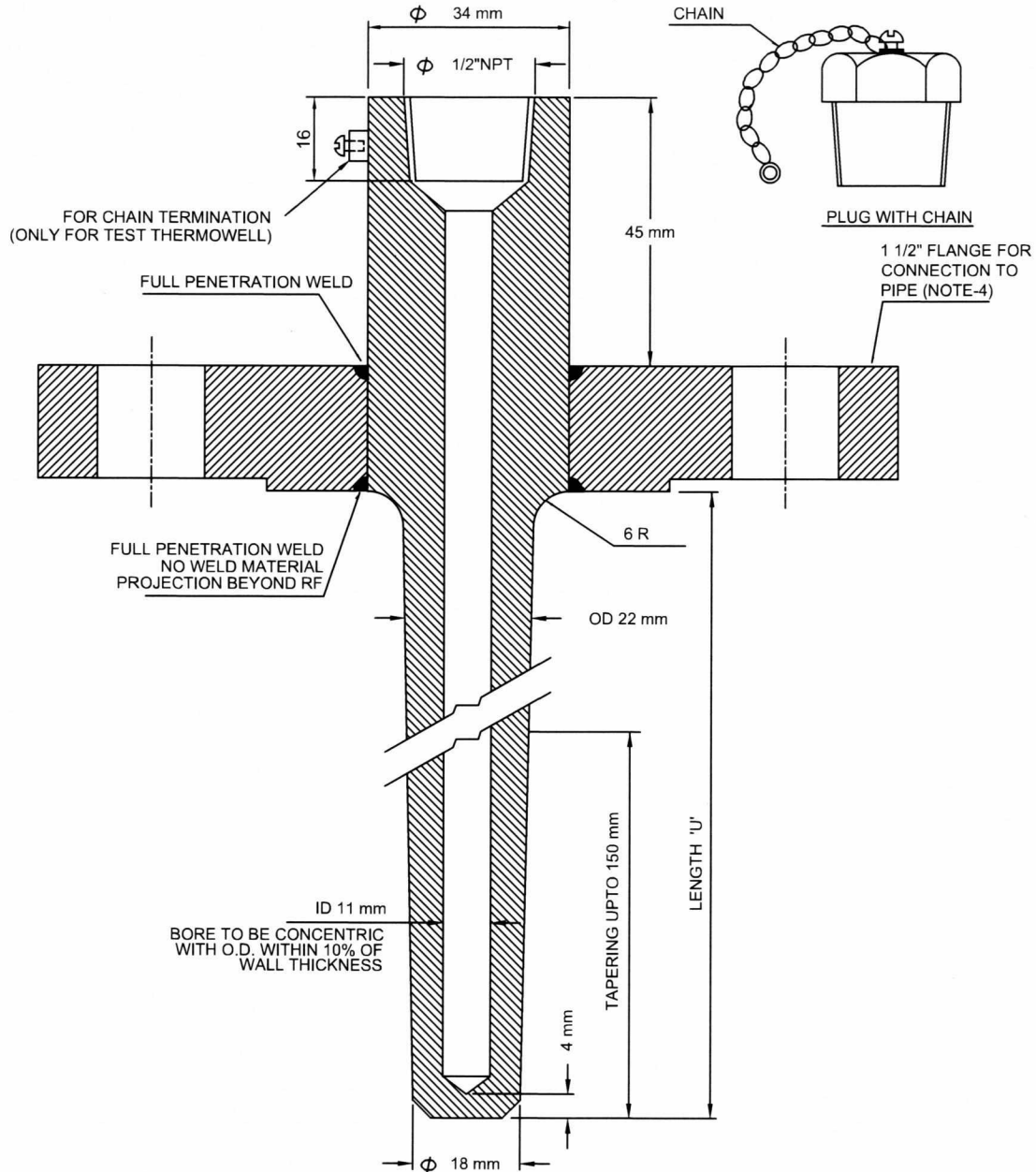
Page 6 of 6

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		Laboratory for Area Classification. • BIS Certificate for FLP Motors and Accessories as applicable. • PESO approved Certificates for Motors and Accessories as applicable. • Degree of Protection of Terminal Box and Body • IC Issuance		Certificates from statutory bodies / Inspection Certificate (IC)			
6.2	Final Document submission	Compilation of Inspection Reports, Drawings, etc. as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

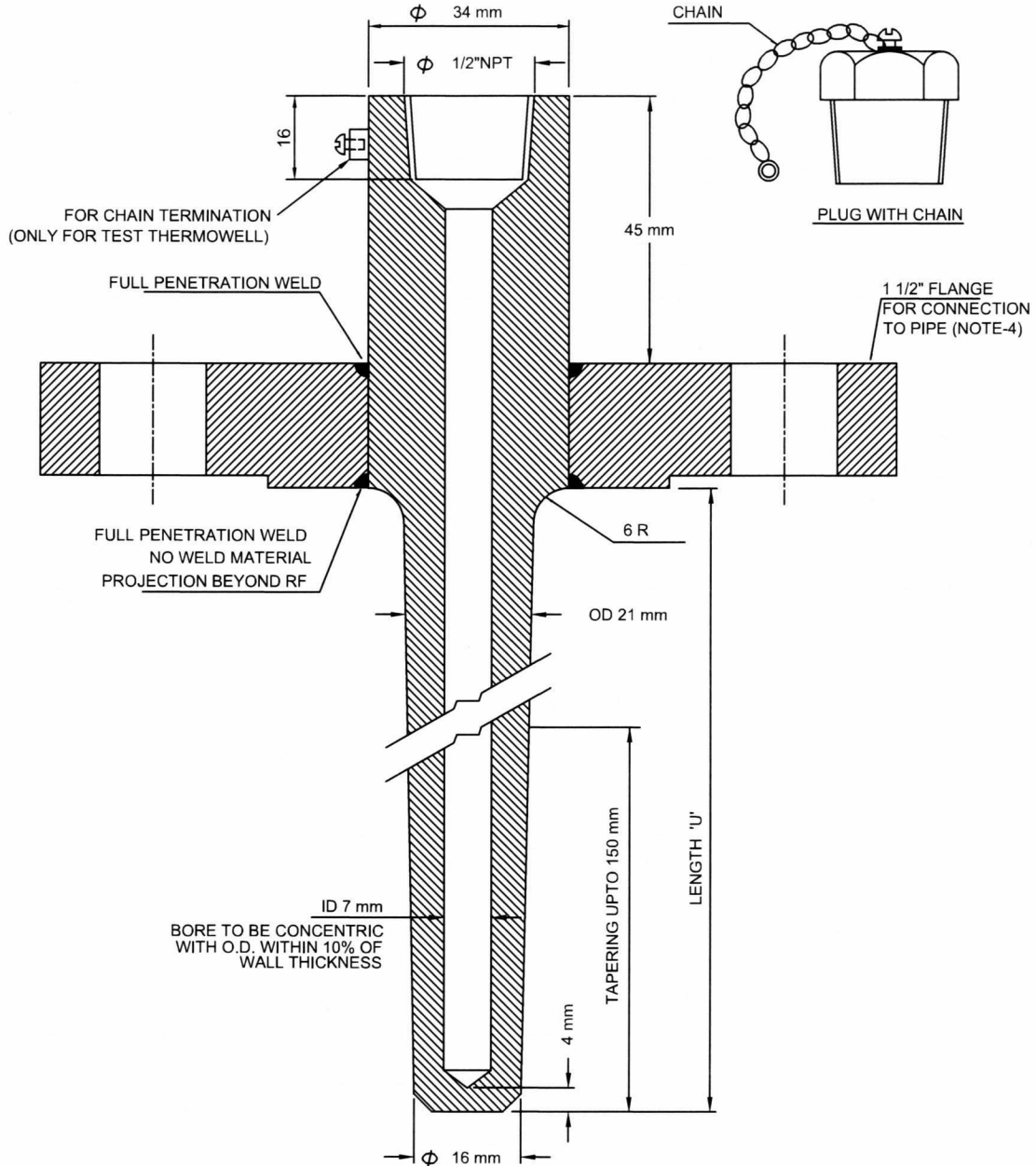
NOTES :-

1. For VFD application motors, separate FAT procedure to be submitted for EIL/ TPIA approval.
2. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable.
3. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred therein/ Job specifications /Approved documents.
4. Motors up to 55 KW would be accepted based on Manufacturer's test certificates. Higher rating will have witness by TPIA appointed by Main Supplier.
5. Motors ordered with integration test (VFD fed motors) requirement as per PR shall be witnessed by EIL/ TPIA (as applicable) and main supplier for integration test (irrespective of rating) at motor manufacturer's works.



- NOTES -**
- THIS STANDARD IS APPLICABLE FOR ;
 - TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
 - THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
 - DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
 - CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
 - FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

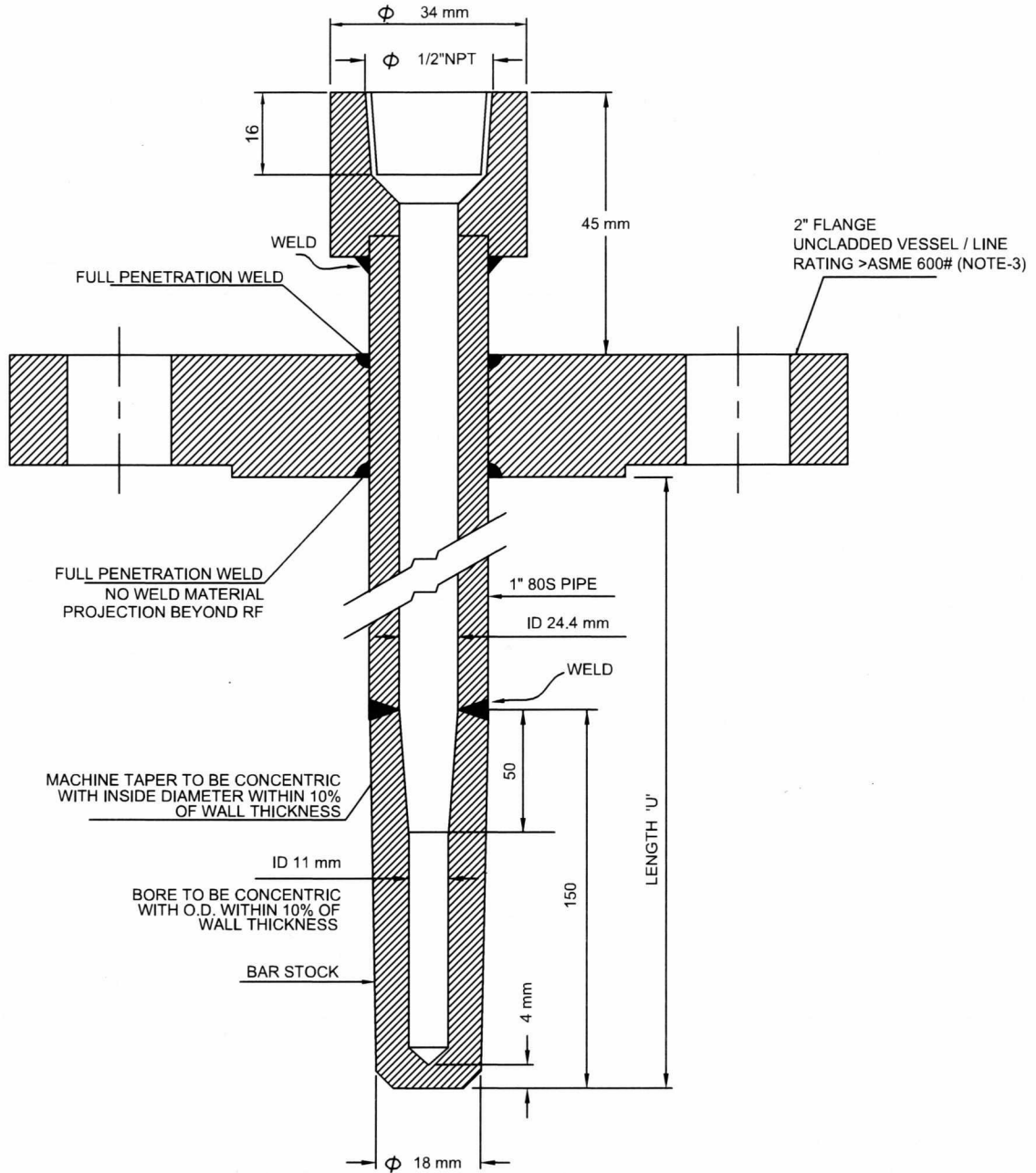


NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
 - a) SINGLE TEMPERATURE ELEMENT.
 - b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

BUILT-UP THERMOWELL

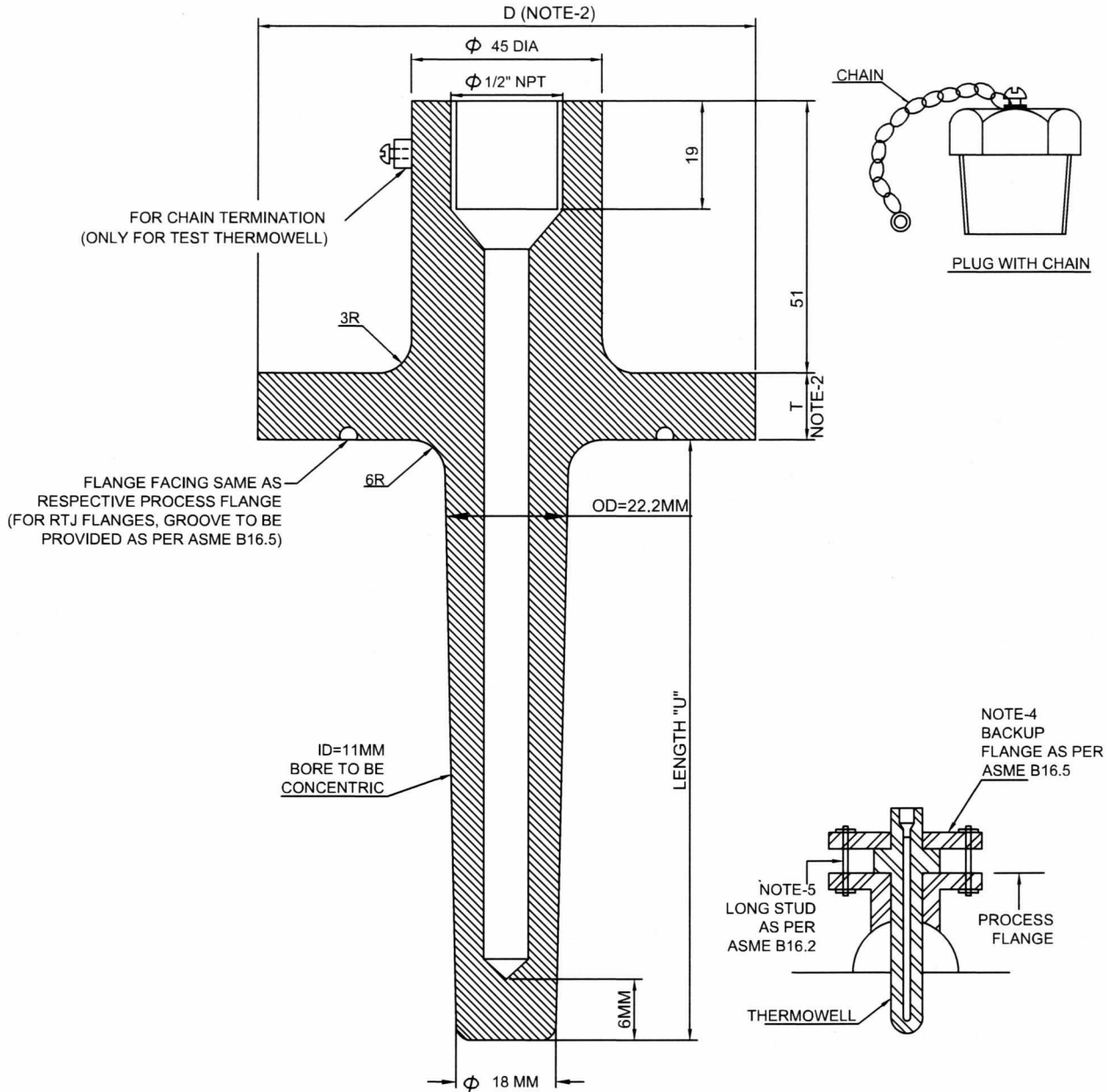


NOTES:-

1. THIS STANDARD IS APPLICABLE FOR ;
 - a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
 - b) THERMOWELL UP TO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. FLANGE SIZE SHALL BE 3" FOR CLADDED EQUIPMENT, FLANGE SIZE SHALL BE 1.5" FOR LINE UP TO ASME CLASS 600#.

5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
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Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

VANSTONE THERMOWELL BARSTOCK TAPERED



NOTES -

1. ALL DIMENSIONS ARE IN "MM". FIGURES IN BRACKETS ARE IN INCHES.
2. THE COLLAR SHOULD BE EQUAL TO RF DIA "R" FOR RF FACING WELD AND COLLAR DIA SHOULD BE DIA "K" AS PER ASME B16.5. THE COLLAR THICKNESS SHOULD BE 15MM FOR RF FACING UP TO 1500# AND 20MM FOR RF UPTO 2500# FLANGE END FOR ALL RATING OF RTJ FLANGE
3. THERMOWELLS SHALL BE HYDROSTATICALLY TESTED INTERNALLY FOR RESPECTIVE PRESSURE RATING.
4. VENDOR SHALL SUPPLY ASME BACK-UP FLANGE WITH A HOLE OF I.D. TO SUIT 45MM O.D. OF THERMOWELL WITH EACH THERMOWELL. THIS BACK UP FLANGE IS TO BE MOUNTED ON THE THERMOWELL ON THE OTHER SIDE OF PROCESS FLANGE. THE BACKUP FLANGE MATERIAL SHALL BE AS PER DATA SHEET.
5. SPECIAL LONG STUDS WITH NUTS TO FIX THE THERMOWELL WITH PROCESS FLANGE AND BACK-UP FLANGES SHALL BE SUPPLIED ALONG WITH EACH TAG.
6. FLANGE SIZE & RATING AS PER DATA SHEET.

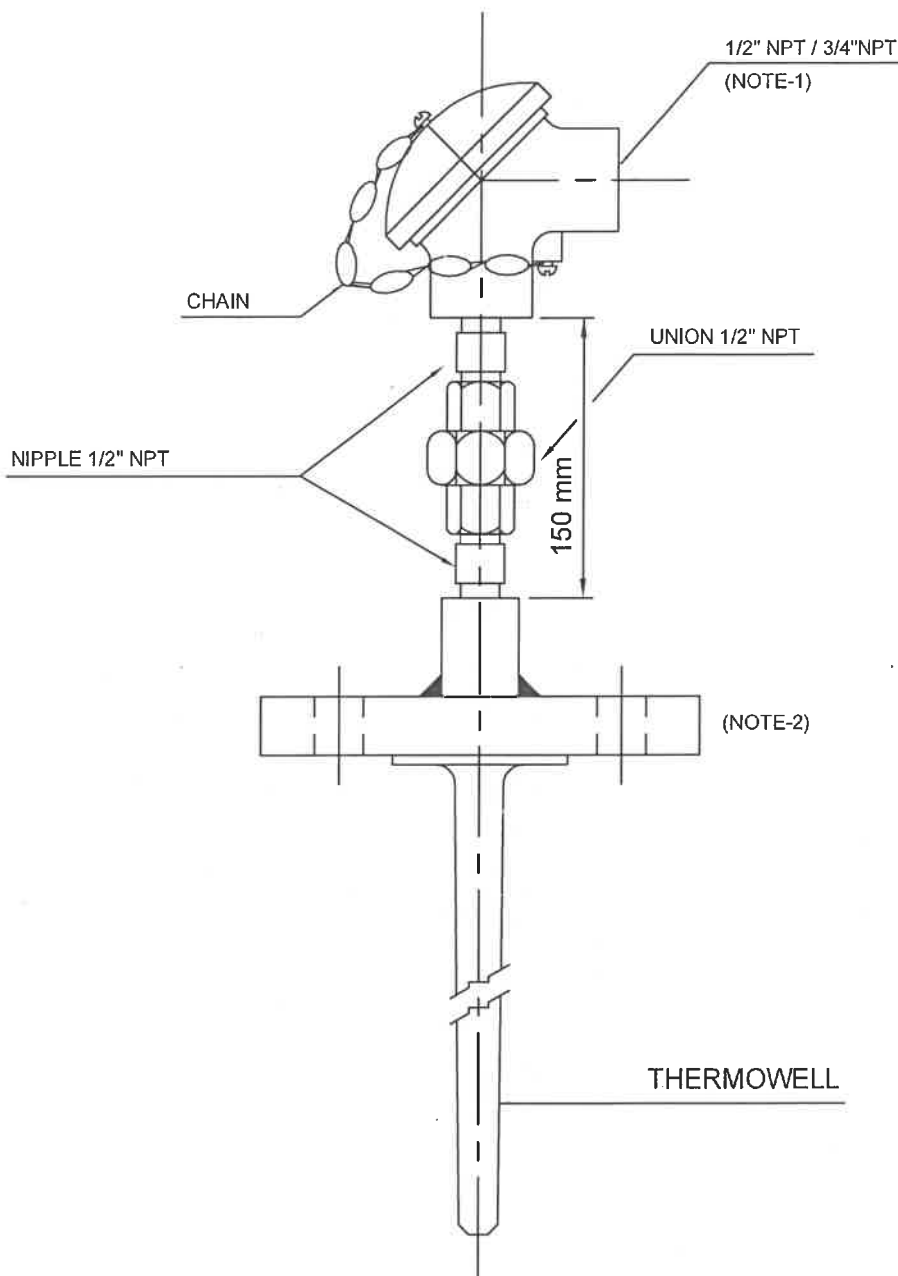
5	14-11-23	ISSUED AS STANDARD	Kushal/RSC	AJS	MN	MN
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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THERMOCOUPLE / RTD ASSEMBLY WITH THERMOWELL

STANDARD No.

7-52-0036 Rev. 6

Page 1 of 1



- NOTE -
1. IN THE CASE OF DUPLEX THERMOCOUPLE/RTD, TWO INDEPENDENT 3/4"(NPT) CABLE ENTRIES SHALL BE PROVIDED.
 2. FLANGE TYPE, SIZE AND RATING SHALL BE AS PER DATA SHEET.

6	21.10.24	Reaffirmed & Reissued As Standard	Sonu	AJS	MN	MN
5	10.10.19	Reaffirmed & Reissued As Standard	Manoj	MN	RG	RN
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ELECTRICAL LOAD DATA

NOTES: -

1. Details of all electrical power consumer loads, which are included in the scope of this MR.

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MOTOR

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Motor Kw	Duty (continuous/in termittent)	No. of poles	Type designation for cooling

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OTHER ELECTRICAL LOADS

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Rated KW	Duty (continuous /intermittent)	Voltage

Project	REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL			Client	NRL
Unit	CDU / VDU	Location	NUMALIGARH	Job No.	C213
				Unit No.	001

PURCHASER'S DATA

A. Site Conditions	
1. Maximum Ambient Temperature	°C
2. Minimum Ambient Temperature	°C
3. Design Ambient Temperature	°C
4. Relative Humidity	%
5. Altitude	mm
6. Environment:	
B. Technical particulars	
1. Motor Tag no.:	
2. Driven Equipment name:	
3. Voltage:	V
4. Phase:	
5. Frequency:	Hz
6. Fault level:	kA
7. Method of starting:	
8. Winding Connection:	
9. No of Terminals:	
10. Cable size:	mm ²
11. Cable type:	
12. Temperature rise:	°C
13. Cooling:	
14. Insulation class:	
15. Temperature rise Limited to insulation class	
16. Hazardous area classification:	
17. Dust classification	
18. Gas group:	
19. Dust Group	
20. Type of explosion protection:	
21. Prestart purging for Ex(n) motor	
22. Type of ingress protection:	
23. Color shade:	
24. Thermisters:	
25. RTD:	
26. BTd:	
27. RTD/BTD monitoring device:	
28. Applicable specification:	
29. Efficiency:	

DRIVEN EQUIPMENT MANUFACTURER's DATA

1. Suggested motor rating:	kW
2. Manufacturer:	
3. BkW at Full load:	kW
4. kW:at end of Curve	kW

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Project	REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL			Client	NRL
Unit	CDU / VDU	Location	NUMALIGARH	Job No.	C213
				Unit No.	001

5.	Speed:	RPM	
6.	Rotation of eqpt. from coupling end:		
7.	Driven equipment:		
8.	Coupling type:		
9.	Torque required starting	mkq	
	Torque required Maximum	mkq	
10.	GD2 of eqpt including flywheel	kqm ²	
	excluding flywheel:	kqm ²	
11.	thrust Up:	kg	
	thrust Down:	kg	
12.	Starting condition:		

MOTOR MANUFACTURER's DATA

1.	Rating:	kW	
2.	Manufacturer:		
3.	No. of poles:		
4.	Frame designation:		
5.	Full load speed:	RPM	
6.	Mounting:		
7.	Full load torque (FLT):	mkq	
8.	Starting torque:	% of FLT	
9.	Break down or pull out torque:	% of FLT	
10.	Full load current (FLC):	A	
11.	Starting current at 100% voltage:	% of FLC	
12.	Rotation viewed from coupling end:		
13.	Starting time at 75% voltage:	sec.	
	100% voltage:	sec.	
14.	Locked rotor withstand time (cold/hot) at,		
	75% voltage	sec.	
	100% voltage:	sec.	
15.	Time (Te) for Increased Safety Motor at 100% Voltag	sec.	
16.	Heating/Cooling Time Const. (min.)	min	
17.	Space heater - voltage & power:		
18.	Efficiency at 75% Load:	%	
	100% Load: voltage:	%	
19.	Power factor at 75%/ Load:		
	100% Load:		
	starting		
20.	Moment of inertia, GD2:	kqm ²	
21.	NDE bearing type & no		
22.	DE bearing type & no.:		
23.	Type of lubrication:		
24.	Weight of motor:	kq	

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Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

Project	REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL			Client	NRL
Unit	CDU / VDU	Location	NUMALIGARH	Job No.	C213
				Unit No.	001
25.	Thermisters, quantity	no.			
	make: type:				
26.	RTD, quantity:	no.			
	make: type:				
27.	BTD, quantity	no.			
	make: type:				
28.	Shaft voltage:	V			
29.	Critical speed, 1st/2nd stage:	RPM			
30.	Canopy:				

Notes

- 1 Recommended list of maintenance spares for two years operation shall include the following as minimum: (a) Bearing DE/NDE one set (b) Terminal box cover with screws (c) Fan (d) Terminal block
- 2 Cable glands to be supplied with motors shall meet all requirements as per IS/IEC-60079.
- 3 GI canopy shall be provided for all outdoor motors.
- 4 For Approved makes of motors refer else where in the MR..
- 5 Starting time calculations shall be based on operating conditions specified on Material Requisition eg. open valve condition/closed valve condition, at no load/full load, as applicable.

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**MANDATORY SPARE LIST
(ELECTRICAL)
FOR
HORIZONTAL CENTRIFUGAL PUMP
(MR NO.: C213-001-PA-MR-5010)**

PROJECT : REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C213

A	03-04-2026	ISSUED WITH MR	GS	HK	HK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Mandatory Spares:

The following mandatory spares for electrical equipment shall be supplied by the vendor as a minimum:

Sl. No.	Part Description	Quantity Required
1.0	MV induction motors 37 kW & above (one set of spares for each rating & type)	
1.1	Bearing Set (DE & NDE)	1 Set
1.2	Terminal studs/ bushing assembly	1 Set each

NOTES:

- Wherever %age is identified, Vendor shall supply next rounded figure.
- The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
- The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
- The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
- Mandatory spares as indicated above do not cover commissioning spares.
- Mandatory spares as indicated above do not cover two year O&M spares.
- Mandatory spares shall be applicable for electrical items of motors / sub-packages as per mandatory spares philosophy specified elsewhere in the bid document.

JOB SPECIFICATION (ELECTRICAL) FOR HORIZONTAL CENTRIFUGAL PUMP (MR NO.: C213-001-PA-MR-5010)

PROJECT : REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C213

A	03-04-2026	ISSUED WITH MR	GS	HK	HK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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1. GENERAL

- 1.1 The specification defines the basic requirements of the electrical works in vendor's scope for the Supply of Horizontal centrifugal Pump at M/s NRL - Numaligarh, Assam as mentioned in scope of work document enclosed elsewhere with this MR. This job specification shall be read in conjunction with EIL standard specifications, data sheets and documents attached with the MR. The designed system shall comply with the requirement of relevant standards and statutory regulations as defined in relevant documents. Codes and standards as prevailing in the country of origin may be followed for equipment purchased abroad provided that the equivalent standards are more stringent than Indian standards and meet the statutory regulations of the approving Indian statutory authorities. In case of any conflict amongst various documents enclosed with MR, the most stringent requirement shall govern and Owner/EIL's decision in this regard shall be binding. The same shall be complied without any time / cost implication to Owner.
- 1.2 The equipment shall conform to this specification, enclosed data sheets and standard specifications.

2. SITE CONDITIONS

The equipment and the installation shall be suitable for continuous operation under the following site conditions:

Maximum Temperature	: 38 °C
Minimum Temperature	: 10 °C
Equipment Design Temperature	: 40 °C
Relative Humidity	: 85% at 40 DEG C
Altitude above MSL	: < 1000m
Environment	: Dusty, Tropical & Corrosive as in Hydrocarbon Industry

3. INPUT POWER SUPPLY

- a.) Motors rated up to 160kW (DOL) : 415V $\pm$ 10%, 50Hz $\pm$ 3%, TP AC
- b.) Auxiliary electric heater : 415V $\pm$ 10%, 50Hz $\pm$ 3%, TP AC
- c.) Anti-condensation heaters (30kW and above) : 240V $\pm$ 10%, 50Hz $\pm$ 3%, SP AC

Note:

- 415V system is solidly grounded.
- 6.6 kV system is resistance earthed/grounded.
- LV - Low Voltage. The voltage which does not normally exceed 250 V.
- MV - Medium Voltage. The voltage which normally exceeds 250 V and does not exceed 650 V.
- HV - High Voltage. The voltage which normally exceeds 650 V but does not exceed 33 kV.

4. ENGINEERING AND JOB SPECIFIC REQUIREMENTS

The enclosure type / area classification requirement for motors and their auxiliaries shall be as listed below:

S. No.	Tag No.	Enclosure Type	Area Classification
1.	WASH WATER PUMP (01-PM-CF-003 A/B)	Ex-n/ Ex-ec ^(#)	Zone-2, IIA/B, Temp. Class T3
2.	RECYCLE WATER PUMPS (01-PM-CF-003 C/D)	Ex-n/ Ex-ec ^(#)	Zone-2, IIA/B, Temp. Class T3

S. No.	Tag No.	Enclosure Type	Area Classification
3.	Other Auxiliary Motors	Ex-n/ Ex-ec ^(#)	Zone-2, IIA/B, Temp. Class T3
4.	Motor Power Junction Box / Local Control Stations	Ex-d	Zone-2, IIA/B, Temp. Class T3

- Ex-ec motors as per IS/IEC-60079-7(2015) shall be acceptable subject to availability of statutory approvals.

- 4.1 Motors of type Ex-n/Ex-ec (without requirement of pre – start ventilation) for Zone-2, Gas group IIC, Temp. Cl. T3. Ex –n motor shall meet the requirements of IS/ IEC 60079-0/15 and Ex-ec motor shall meet the requirement of IS/IEC-60079 Part 0/7.
- 4.2 Flameproof Equipment shall be Ex-d type suitable for Zone-2, Gas group IIC, Temp. Cl. T3. Flameproof (Ex-d) motors shall meet the requirements of IS/IEC/ 60079-0/1.
- 4.3 The Enclosure protection for Electrical Equipment in other classified area shall be suitably selected by vendor. Substation/SRR is safe area, all the electrical equipment located inside the Substation/Satellite Rack Room shall be suitable for safe area.

5. SPECIAL REQUIREMENTS

5.1 MOTORS:

- 5.1.1 Motors shall fulfill the following requirements
 - a.) MV motors (<1100V) shall be as per EIL specification 6-51-0064 and datasheet for MV Motor, C213-001-16-50-DS-5010 (DOL Start).
- 5.1.2 Variation / Clarifications against the standard specification of MV Motor 6-51-0064, shall be as per the MOU agreed with EIL by respective motor manufacturer (if any). No further deviations shall be entertained.
- 5.1.3 All MV motors for hazardous area shall be IE3 type conforming to requirements of EIL specification 6-51-0064 and all operating parameters such as starting current, efficiency for all IE3 and IE4 MV motors shall be in line with latest IS 12615.
- 5.1.4 The rated efficiency and the IE code shall be durably marked on the rating plate, for example “IE3– 95.4 %”.
- 5.1.5 All MV motors shall be provided with spreader box for smooth termination of power cables in the motor.
- 5.1.6 Recommended range for the starting power factor of the DOL start motors shall be in range of 0.2 to 0.3.
- 5.1.7 Space heater shall be provided for motors rated 30 kW and above.
- 5.1.8 Motors shall not have dual winding
- 5.1.9 Vendor to provide adequate size of motor terminal box to accommodate & terminate Owner's cable sizes (refer below table) and avoid additional intermediate JB for motor termination.

Sr. No	Motor rating (in kW) up to and including	Cable Size (mm ²)
1	0.12	1R X 3C X 4 Cu
2	0.18	1R X 3C X 4 Cu
3	0.25	1R X 3C X 4 Cu
4	0.37	1R X 3C X 4 Cu
5	0.55	1R X 3C X 4 Cu
6	0.75	1R X 3C X 4 Cu
7	1.1	1R X 3C X 4 Cu
8	1.5	1R X 3C X 4 Cu
9	2.2	1R X 3C X 4 Cu
10	3.7	1R X 3C X 10 Cu
11	5.5	1R X 3C X 16 Cu
12	7.5	1R X 3C X 16 Cu
13	11	1R X 3C X 50 Al

Sr. No	Motor rating (in kW) up to and including	Cable Size (mm ²)
14	15	1R X 3C X 70 Al
15	18.5	1R X 3C X 70 Al
16	22	1R X 3C X 95 Al
17	30	1R X 3C X 150 Al
18	37	1R X 3C X 240 Al
19	45	2R X 3C X 95 Al
20	55	2R X 3C X 120 Al
21	75	3R X 3C X 120 Al
22	90	3R X 3C X 150 Al
23	110	3R X 3C X 185 Al
24	132	4R X 3C X 240 Al
25	160	4R X 3C X 240 Al

(R: Nos. of cable run, C: Nos. of cable core)

In case it is not feasible to provide motor terminal box suitable to accommodate owner's cables (indicated above), then separate motor junction box shall be provided by vendor to accommodate owner's cable(s) without any time and cost implication to Owner. The Motor junction box shall be Flameproof type (Ex-d) suitable for the specified gas group and temperature classification. FLP JB shall be supplied with FLP cable glands & lugs and shall meet all the requirement of IS/IEC-60079-0/1. Thread shall be Metric type.

The enclosures of the junction boxes shall be of cast light metal alloy. The Junction Box shall be suitable for outdoor location and shall have minimum IP-55 degree of protection. All accessories like nuts, bolts, washers etc. shall be made of stainless-steel SS-304.

- 5.1.10 All opening in the motor terminal boxes shall be supplied with weatherproof (min. IP 55) blanking plugs so that the motor is transported with sealed terminal boxes. The cable entries of all terminal boxes of motors, before dispatch from motor manufacturer works, shall be fitted with suitably sized weatherproof (IP 55 minimum) Metallic Sealing Plugs to prevent water entry/ingress in motor windings through openings meant for cable entry in terminal boxes at construction site till the time motors are erected and cable terminations are carried out. However, same shall be replaced by associated flameproof cable glands and lugs to be also supplied by Contractor along with motors as specified in MR.
- 5.1.11 Vendor to note that, if there is any requirement of emergency electrical power for the auxiliary equipment supplied with the main motor/pump, same shall be highlighted at the bid stage itself.
- 5.1.12 All motors shall have provision for double earthing.
- 5.1.13 External fan cooled/water cooled motors shall not be preferred.
- 5.1.14 Bearings for all motors shall be provided with capability of grease injection from outside. Pre-lubricated sealed bearings shall not be considered.
- 5.1.15 In addition to packing requirements specified in EIL standard specification of motors, Vendor to do plastic wrapping of all electrical equipment for shipping from works to site.
- 5.1.16 Trolley mounted pumps (if applicable) shall be powered from a nearby 5 pin socket supplied by client. Vendor to provide trolley mounted flame proof motors and their flameproof starters suitable for use in Zone-2, Gas group IIC, Temp class T3, with 30 meters of armored copper conductor trailing cable.
- 5.1.17 The trolley mounted pumps shall be complete with integral starters; connection between motor & starter shall be through armored copper conductor cable and shall have motor protections, other hardware & basic control/ indications shall be provided during detailed Engineering state to the successful bidder.
- 5.1.18 The terminal box for the motor shall be one size greater than the standard size associated with the selected motor's frame size.

6. GENERAL REQUIREMENTS

- 6.1 Numbering scheme for various equipment shall be decided during detail engineering and tag number/ service/ other details of all equipment shall be marked accordingly on the tag plate.
- 6.2 All equipment shall be tested and certified by an independent testing authority for use in the specified area. The following statutory approval certificates shall be submitted for all equipment to be installed in hazardous areas.
 - a.) Type Test Certificate from independent testing authorities such as CIMFR / BASEEFA / ATEX / equivalent test house
 - b.) Applicable CCoE/ PESO approval certificates.
 - c.) Valid BIS license for all Ex-d equipment (equipment procured from India)
- 6.3 All equipment shall be subject to routine and acceptance tests as per applicable specifications.
- 6.4 All the instruments, meters, etc., used for testing shall be duly calibrated at NABL laboratory and necessary calibration certificate shall be made available during inspection.
- 6.5 Vendor shall comply to various requirements as per Ministry of Power (GoI) various orders regarding testing of all equipment, components & parts imported for use in the power supply system to check any kind of embedded malware/Trojans/cyber threat and for adherence to Indian Standards.
- 6.6 All external hardware shall be of stainless steel in view of the corrosive atmosphere.
- 6.7 Paint shade for indoor electrical equipment shall be RAL 7032 (if applicable) & for outdoor electrical equipment shall be RAL 7031
- 6.8 Suitability of cable terminal boxes/ chambers for the respective cables sizes / runs as per the final cable schedule shall be ensured by the Vendor. Incoming cable sizes for equipment shall be provided by Owner, as per voltage drop calculations. Terminal box shall be suitable for the cable sizes, to be finalized during detail engineering.
- 6.9 Equipment (LCS, Motor, intermediate junction box etc.) installed in outdoor area shall have GI canopy for additional weather protection
- 6.10 Cable glands shall be of FLP type (minimum IP-55) suitable for use in Zone-2, Gas group IIC, Temp class T3 and shall meet all the requirement of IS/IEC-60079-0/1/15. Cable glands shall be single compression type for indoor equipment and double compression type for outdoor equipment. Glands shall be double compression type Nickel plated brass FLP cable glands. Thread shall be Metric type.
- 6.11 Cable lugs shall be crimping type. All cable lugs shall be long barrel type. Lugs having sector shaped or circular barrel shall be used for making connections for cables having sector shaped or circular geometry of conductor respectively. Lugs shall be as per the following:
 - a.) Aluminum conductor cable termination on Aluminum bus bar/ terminals in switchboards - Aluminum lugs
 - b.) Aluminum conductor cable termination on Copper bus bar/ terminals in switchboards - Bimetallic lugs having Al barrel & tinned Cu palm
 - c.) Copper conductor cable termination on Aluminum bus bar in switchboards - Bimetallic lugs having tinned Cu barrel and Al palm
 - d.) Copper conductor cable termination on copper bus bar/ terminals in switchboards- Tinned copper lugs
- 6.12 Vendor to furnish filled in load data along with nos. of feeders required (of all voltage level, as applicable) as per Doc No. C213-001-16-50-DS-0700 attached with the MR. Vendor to note that, if there is any requirement of emergency electrical power for the auxiliary equipment supplied with the main motor, same shall be highlighted at the bid stage itself.
- 6.13 Weatherproof control stations (minimum IP-55) for all MV/LV motors/aux electric heaters, emergency stop push buttons for motors and emergency push buttons as required for plant operation and safety etc. shall be provided by the vendor. Industrial type Local Control Station shall be with the following facilities:-

LCS for MV Motors

- Local start push button
- Local stop push button
- Local/remote selection switch with locking facility
- Ammeter (range: 0 to 150% of full load current of motor)

LCS for Auxiliary motors

- Local start
- Local stop
- Ammeter (For motors rated above 5.5kW)

- 6.14 Owner shall provide all DOL starter feeders for all auxiliary motors. Any reversible starters/ Brake system required including the mounting in Vendor's Cabinet shall be supplied by the vendor for which MCCB feeders shall be provided by the Owner

7. SPARES

- 7.1 Mandatory Electrical spares as per List of Mandatory Spares attached with the MR are included in vendor's scope of supply.
- 7.2 Commissioning spares for all electrical equipment are included in Vendor's scope of supply and shall be included in the base price. List of the same shall be furnished with the offer.
- 7.3 Vendor shall submit a list with unit prices of recommended maintenance spares for two years of normal operation for all electrical equipment (i.e., Motors, etc.) along with their bid.
- 7.4 Recommended list of maintenance spares for two years operation shall include the following as a minimum for motors. Vendor shall ensure & quote for the same accordingly.
- a.) Bearing for DE/NDE-one set
 - b.) Terminal box cover with screws
 - c.) Fan
 - d.) Terminal block

For other equipment (Heater, etc.) vendor shall quote 2 years recommended O&M spares as per their standard requirements.

8. MAKES OF EQUIPMENT AND COMPONENTS

- 8.1 List of approved vendors for Electrical equipment/components shall be as indicated in the Vendor List-Electrical (Doc. No. C213-001-16-50-VL-5010) attached with the MR
- 8.2 Vendor may procure material from any of the listed vendors. However current validity and range of approval as per EIL enlistment letter, workload, stability and solvency need to be verified by the vendor before placement of order.
- 8.3 For equipment/ components, other than those specified in vendor list, vendor can propose makes of equipment/ components during order execution. The alternate make of equipment/ components will be evaluated post order, based on the satisfactory track record and test certificates to be furnished by the vendor/ Sub vendor. Vendor to take approval from Owner/ EIL before finalization of vendor.
- 8.4 Vendor shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply. Vendor/ sub-vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the products/spares to enable the end user for placement of order for spares and services.

9. LIST OF ATTACHMENTS

Sr. No.	Document Title	Document No.	Rev.
1.	Job Specification - Electrical	C213-001-16-50-SP-5010	A
2.	Mandatory Spares list - Electrical	C213-001-16-50-SL-5010	A
3.	Vendor Data Requirement - Electrical	C213-001-16-50-VR-5010	A
4.	Vendor List – Electrical	C213-001-16-50-VL-5010	A
5.	Data Sheet - MV Induction Motor	C213-001-16-50-DS-5010	A
6.	Electrical Load Data Format	C213-001-16-50-DS-0700	A
7.	Specification for flameproof control stations.	6-51-0006	6
8.	Specification for energy efficient medium voltage induction motors	6-51-0064	3
9.	Inspection and test plan for flameproof control stations	6-81-1006	5
10.	Inspection and test plan for energy efficient medium voltage motors	6-81-1064	1

VENDOR LIST (ELECTRICAL) FOR HORIZONTAL CENTRIFUGAL PUMP (MR NO.: C213-001-PA-MR-5010)

PROJECT : REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C213

A	03/04/2026	ISSUED WITH MR	GS	HK	HK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

PREAMBLE TO VENDOR LIST

1. OWNER/EIL approved vendor list for Electrical items is enclosed in this section. VENDOR shall necessarily procure all the material/equipment forming permanent part of the unit/plant from OWNER/EIL approved vendor only. This shall include sub ordered items/components also. The "Approved Vendors" shall be item specific.
2. VENDOR may procure material from any of OWNER/EIL approved vendors. However current validity of vendor approval & their approved product range and the conditions imposed while according vendor approval as per EIL enlistment letter shall be verified by the VENDOR before placement of order.
 - VENDOR shall also verify the work load, stability and solvency status of the vendor prior to placement of order.
 - Vendors on OWNER/EIL holiday list shall not be considered for ordering, which need to be verified by the VENDOR prior to placement of order. VENDOR shall comply with this requirement without any time or cost implication to Owner.
 - In case any vendor is registered with EIL as an approved vendor subsequent to release of this vendor list, the same may also be considered by the VENDOR with prior intimation to OWNER/EIL and obtain their concurrence prior to placement of order.
 - Wherever job specification calls for requisite proven track record, the same shall be complied and necessary documents to be submitted for EIL/Client/Licensor approval prior to ordering.
3. Compliance to procurement of material from approved vendors is mandatory and shall be fully complied. No deviation to approved vendor list shall generally be acceptable.
4. For items not covered in the above list, the vendor list shall be approved by OWNER/EIL prior to placement of order by VENDOR. VENDOR shall list down the proposed suppliers/vendors for such items and submit the same for OWNER/EIL's review/approval along with necessary documents/credentials. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.
5. VENDOR shall have an independent assessment of capability of all the vendors for timely deliveries of material/equipment. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.
6. At any stage of the project, if it comes to the notice of OWNER/EIL that VENDOR has procured material/equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and/or items not falling in approved product range of vendor(s), then the same shall be rejected forthwith and VENDOR shall be liable to replace such material/plant/machinery within the contract price and without any time/schedule implication.
7. Vendor may procure material from any of owners approved vendors. However current validity & range of approval as per enlistment letter, workload, stability & solvency need to be verified by vendor before placement of order.
8. For all equipment and components listed other than above, vendor shall submit past track record for the proposed sub vendors & obtain written approval from EIL/BPCL before placing order.
9. Make of equipment/component of foreign origin other than listed above shall be subject to EIL/BPCL review during detail engineering based on PTR to be submitted by vendor.

Attachment :

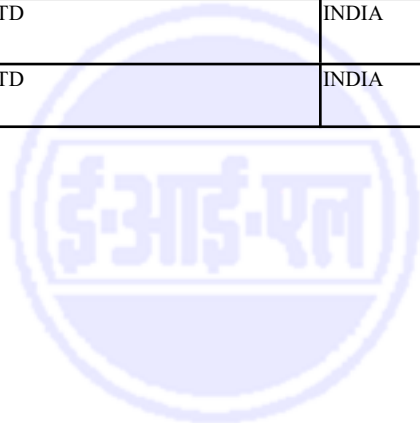
- Suppliers List for REVAMP OF DESALTER SYSTEM OF CDU/VDU AT NRL
(Job : C213) - 6 pages

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13GB		Description : CONTROL STATIONS-FLAME PROOF		
Approved Suppliers				
1	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
2	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
3	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
4	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
5	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
6	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
7	4245	FCG HI-TECH PRIVATE LIMITED	INDIA	
8	3706	PHOENIX MECANO INDIA PVT. LTD.	INDIA	
9	4364	SAI INDUSTRIES	INDIA	
10	G159	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JF		Description : MOTOR-INDUCTION-M.V (FLAME PROOF)		
Approved Suppliers				
1	L065	LAXMI HYDRAULICS PVT LTD	INDIA	
2	A310	ABB INDIA LTD-FARIDABAD	INDIA	
3	M282	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	
4	3940	HEM INDUSTRIES	INDIA	
5	3668	CG POWER & INDUSTRIAL SOLUTIONS LTD.	INDIA	
6	B048	BHARAT BIJLEE LIMITED	INDIA	
On Holiday				
1	3777	KIRLOSKAR ELECTRIC CO LTD	INDIA	Ground-XIII (Negative network or Financial constraints)
2	K005	KIRLOSKAR ELECTRIC CO LTD	INDIA	Ground-XIII (Negative network or Financial constraints)



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JK		Description : MOTORS - IMPORTED		
Approved Suppliers				
1	A717	NIDEC ASI SPA	ITALY	
2	G632	GENERAL ELECTRIC CANADA	CANADA	
3	27420	TMEIC CORPORATION	JAPAN	
4	H510	HITACHI LTD	JAPAN	
5	J511	JEUMONT SA / FRAMATONE ANP	FRANCE	
6	L575	LOHER GMBH	GERMANY	
7	T597	TOSHIBA CORPORATION	JAPAN	
8	L603	LLOYD DYNAMOWERKE GMBH & CO. KG	GERMANY	
9	H641	HD HYUNDAI ELECTRIC CO. LTD.	KOREA, REPUBLIC OF	
10	W598	WEG EQUIPAMENTOS ELETRICOS S.A.	BRAZIL	
11	C730	GE ENERGY POWER CONVERSION FRANCE SAS	FRANCE	
12	C736	CEMP SRL	ITALY	
13	W598A	WEGEURO - INDUSTRIA ELECTRICA S.A.	PORTUGAL	
14	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	
On Holiday				
1	S524	SIEMENS AG	GERMANY	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)
2	F505	FUJI ELECTRIC CO LTD	JAPAN	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CA Description : CABLE GLANDS (HAZARDOUS AREA)				
Approved Suppliers				
1	3890	AKSHAR BRASS INDUSTRIES	INDIA	
2	4364	SAI INDUSTRIES	INDIA	
3	4360	CLEON OPTOBIZ PRIVATE LIMITED	INDIA	
4	4245	FCG HI-TECH PRIVATE LIMITED	INDIA	
5	4187	SIGMA INDUSTRIES	INDIA	
6	S375	STANDARD METAL INDUSTRIES	INDIA	
7	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
8	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
9	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
10	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
11	C195	COMET BRASS PRODUCTS	INDIA	
12	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
13	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
14	4244	METALMECH ENGINEERING	INDIA	
15	27421	CMP PRODUCTS LIMITED	UNITED KINGDOM	
16	3704	METAL CRAFT INDUSTRIES	INDIA	
17	C205	COMET INDUSTRIES	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CF		Description : CONTROL SWITCHES / SELECTOR SWITCHES		
Approved Suppliers				
1	K143	KAYCEE INDUSTRIES LTD.	INDIA	
2	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
3	H142	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
4	R159	RELIABLE ELECTRONIC COMPONENTS PVT LTD	INDIA	
5	S373	SWITRON DEVICES	INDIA	
6	4012	TEKMEC SWITCHGEAR & CONTROLS	INDIA	
7	4312	SIEMENS LIMITED	INDIA	
8	4002	P.P. INDUSTRIES	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MC		Description : METERS		
Approved Suppliers				
1	4233	ELMEASURE INDIA PRIVATE LIMITED	INDIA	
2	S141	SECURE METERS LIMITED	INDIA	
3	N130	NIPPEN ELECTRICAL INSTRUMENTS CO.	INDIA	
4	3901	NEWTEK ELECTRICALS	INDIA	
5	M239	MECO INSTRUMENTS PVT LTD	INDIA	
6	R042	RISHABH INSTRUMENTS LIMITED	INDIA	
7	A028A	AUTOMATIC ELECTRIC LTD.	INDIA	



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VENDOR DATA REQUIREMENTS FOR HORIZONTAL CENTRIFUGAL PUMPS (ELECTRICAL PART)

A	03-APR-2026	ISSUED WITH MR	GS	-HK-	-HK-
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✓" shall be furnished by the bidder.

FLAMEPROOF CONTROL STATIONS

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓		✓	
2.	Dimensional/Assembly Drawings : GA Drawings (For control station and canopy)		✓		✓	
3.	Dimensional/Assembly Drawings : Installation and mounting details			✓	✓	
4.	Wiring Diagram And Terminal Details			✓	✓	
5.	Type Test Certificate from Independent Test Lab			✓	✓	
6.	Statutory approval certificate			✓	✓	
7.	BIS Licence			✓	✓	
8.	List of Maintenance Spares			✓	✓	
9.	List of Special Tools & Tackles			✓	✓	
10.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✓		✓	Refer Note- ¹ *
11.	Test Records				✓	
12.	Data Books/ Manuals : Installation Manual				✓	
13.	Data Books/ Manuals : Operating/ Maintenance Manual				✓	
14.	Data Books/ Manuals : Catalogues/ Brochures				✓	
15.	Equipment storage procedure at site				✓	

MV MOTOR

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✓		✓	
2.	Confirmation of Technical Compliance					
3.	Data Sheets (Duly filled-in)		✓		✓	
4.	Dimensional/Assembly Drawings : GA Drawing For motors < 75kW		✓			
5.	Dimensional/Assembly Drawings : GA Drawing For motors >= 75kW		✓			

**VENDOR DATA REQUIREMENTS
FOR
HORIZONTAL CENTRIFUGAL PUMPS
(ELECTRICAL PART)**

S. N. O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
6.	Dimensional/Assembly Drawings : Installation Plan/Mounting Details			✓	✓	
7.	Dimensional/Assembly Drawings : Terminal Box Arrangement			✓	✓	
8.	Dimensional/Assembly Drawings : Name Plate Drawing			✓	✓	
9.	Performance Curves : Speed Torque Curves			✓	✓	
10.	Performance Curves : Speed-Current/Time Curves			✓	✓	
11.	Performance Curves : Thermal Withstand Curves (Hot & Cold)			✓	✓	
12.	Performance Curves : P.f. & Efficiency Curves			✓	✓	
13.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✓		✓	Refer Note-1*
14.	Test Records				✓	
15.	Type Test Certificates for similar equipment			✓	✓	
16.	List of Commissioning Spares				✓	
17.	List of Maintenance Spares				✓	
18.	List of Mandatory Spares		✓		✓	
19.	List of Special Tools & Tackles				✓	
20.	Data Books/ Manuals : Installation Manual				✓	
21.	Data Books/ Manuals : Operating/ Maintenance Manual				✓	
22.	Data Books/ Manuals : Catalogues/ Brochures				✓	
23.	Equipment storage procedure at site				✓	

Notes :

- "TICK" denotes applicability.
- Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
- All post order documents shall be submitted / approved through EIL eDMS portal.
- Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
- Refer - 6-78-0001: Specification for quality management system from Bidders.
- Refer - 6-78-0002: Specification for documentation requirements from Contractors.
- Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
- All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
- Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
- "@" indicates submission of documents to Inspection Agency.
- Bill of Material shall form part of the respective drawing.

**VENDOR DATA REQUIREMENTS
FOR
HORIZONTAL CENTRIFUGAL PUMPS
(ELECTRICAL PART)**

12. Also refer other department's VDR :-

13. '*' indicates the following:

a. Equipments whose ITP is attached with Contract -ITP for respective equipment shall be followed. Therefore, no ITP is to be furnished for review for those equipments.

b. Equipments whose ITP is not attached with Contract-Manufacturer's ITP shall be submitted by Packager/ Vendor/Contractor to respective Regional Procurement Office (RPO) near to manufacturer's works for approval by EIL Inspection.

14. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to EIL/Owner.

JOB SPECIFICATION AND SCOPE OF WORKSOF
INSTRUMENTATION FOR
WASH WATER PUMP and RECYCLE PUMP
(Tag Nos.01-PA-CF-003A/B & 01-PA-CF-003C/D)
OF DESALTER SYSTEM OF CDU/VDU
M/s NRL

(PUMP SEAL PLANS –11 & 53B)

MR No.: C213-001-PA-MR-5010

A	09.03.2026	ISSUED FOR BIDS	KWB	NA	NK
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

CONTENTS

- 1.0 GENERAL**
- 2.0 SCOPE OF SUPPLY AND WORK**
- 3.0 DESIGN PHILOSOPHY AND TECHNICAL REQUIREMENTS**
- 4.0 COMMISSIONING SPARES**
- 5.0 2 YEAR OPERATION SPARES**
- 6.0 MANDATORY SPARES.**
- 7.0 INSPECTION AND TESTING**
- 8.0 PROVEN TRACK RECORD (PTR)**
- 9.0 VENDOR LIST**

1.0 GENERAL

- 1.1 The purpose of this specification is to define general requirements and philosophy of instrumentation for Mechanical Seal, Sealing and Flushing Plan (as applicable) and other requirement as defined elsewhere in the MR and as per API-610/682 for centrifugal pumps.
- 1.2 This specification along with attached data sheets/ standards and relevant part of this requisition covers the design, engineering, supply and testing of Instrumentation system with all accessories and materials, required for Pump seal Plans, instruments marked as VF/ Vendor Scope in the P&ID and any other instrumentation required as per vendor recommendation.
- 1.3 In the event of any conflict between this specification, data sheets, standard specifications, related standards, codes etc: the following order of priority shall govern:
- Statutory Regulations
 - Job Specifications
 - Standard Specifications
 - Codes & Standards

However, Bidder shall inform EIL/ Owner for any discrepancy for resolution before proceeding. EIL/ Owner decision in this regard shall be final and binding.

2 SCOPE OF SUPPLY AND WORK

- 2.1 Bidder's scope of instrumentation supply and work shall include the following as a minimum.
- Supply of all instruments as per attached pump data sheets, as described elsewhere in this requisition & applicable code API-610/682 for the following pumps including pressure gauge, pressure transmitter, restriction orifice, Temp. gauge etc. as applicable for each pump.
 - Supply of pressure gauge (01-PG-1109 for Pump 003A and 01-PG-1110 for Pump 003B) as loose supply.
 - Design, Engineering and procurement of instruments.
 - Piping and all other erection material including all fittings, mounting accessories, instruments supports (2" yoke type) required for installation/ erection of instruments within package skid (as required), shall be under bidder's scope of supply.
 - Mandatory spares as per mandatory spare philosophy attached elsewhere.
 - Cable glands/plugs shall be duly installed with the instruments.

- g. Submission of filled in data sheets for all instruments and sizing calculations as applicable.

2.2 Bidder shall provide the alarm set values, instrument ranges, type etc during detail engineering for each instrument.

3 DESIGN PHILOSOPHY AND TECHNICAL REQUIREMENTS

3.1 All electronic field transmitters shall be intrinsically safe and shall be certified suitable for Zone-2 Gas Gr. IIA/B, Temp. Class T3 hazardous area classification by statutory body. All the instruments shall also be dust proof. Additionally instruments shall be certified by CCOE/ PESO India, irrespective of the origin of the instrument.

3.2 All instruments shall be weatherproof to IP-65 as per IS/IEC-60529.

3.3 All field instruments/transmitters shall be provided with dual cable entries. Unused entry shall be plugged using suitable metallic plug suitable for specified hazardous area classification.

3.4 Cable gland / entry connection for all instruments shall be in equivalent NPT sizes in place of metric threads. Cable entry size shall be ½" NPTF for single pair cables.

3.5 All cable glands shall be SS double compression type, dual certified Exe/Exd and PESO approval, suitable for armoured cables.

3.6 All the instruments shall be supplied from EIL / purchaser's approved vendors only. Bidder shall furnish proposed sub-vendor list for EIL / purchaser's approval. It shall be approved by EIL / purchaser during detail engineering after order. This shall have no impact on price and delivery schedule. Bidder shall take prior approval of make and specification of all instrument items before placement of order on sub-vendor.

3.7 Pressure rating of thermowell for temperature element / temperature gauge, control valves and on-off valves body and flanges shall be minimum 300 ASME class or as per respective piping specification whichever is higher. Thermowell material shall be SS316.

3.8 Area Classification

3.8.1 All instruments supplied by bidder shall be as per Electrical Area Classification suitable for Zone-2 Gas Gr. IIA/B, Temp. Class T3 hazardous area classification by statutory body.

3.8.2 Bidder shall furnish hazardous area certificate for all instruments located in hazardous area. In addition, instruments located in hazardous area shall be certified by the local statutory authorities for their use in the area of their installation. In general following certification for use in hazardous area shall be as follows:

- For all intrinsically safe / explosion / flameproof equipment / instruments which are manufactured abroad and certified by any statutory authority like BASEEFA, FM, UL, PTB, ATEX, LCIE etc. should also have the approval of PESO(Petroleum Explosives safety organizer) / CCE(Chief Controller of Explosives), Nagpur.

- For all flame proof equipments manufactured locally (indigenously, the testing shall be carried out by any of the approved test house like CIMFR / ERTL etc. The instruments shall in addition bear the valid approval from PESO (Petroleum Explosives safety organizer) / CCE (Chief Controller of Explosives), Nagpur and a valid BIS license.
- For all intrinsically safe equipment manufactured locally (indigenously, the testing shall be carried out by any of the approved test house like CIMFR/ ERTL etc. The equipment shall in addition bear the valid approval from PESO (Petroleum Explosives safety organizer) / CCE (Chief Controller of Explosives), Nagpur.
- Approvals other than above shall neither be offered nor will these be acceptable.

3.9 Installation Standards

- 3.9.1 Remote type installation with piping and tubing at instrument end for pressure upto 600# rating for non-congealing hydrocarbon services as well as utility services except steam shall be followed.
- 3.9.2 Bidder shall develop and submit Installation standards (hook-up) considering the piping material specification for all instruments supplied / installed by the Bidder, for EIL/ Owner's review.
- 3.9.3 Piping material used in installation hook up shall be as per Piping Material specifications. Sch 160 pipe seamless pipe shall be used as a minimum for impulse piping. Tubing (if applicable) used in impulse line shall be minimum SS 316 tube; ½" OD size.
- 3.9.4 Integral type Instrument valve manifold shall be provided. 5 Valves manifold shall be provided for differential pressure instruments. For PG/PT, 2 valves manifold shall be considered.
- 3.9.5 Impulse line isolation valve (after first isolation valve) shall be globe type, however vent & drain valves shall be Gate type.
- 3.9.6 All diaphragm seal installation shall be provided with spacer ring and vent / drain connection with valves and plugs. Spacer ring material for diaphragm seal type instruments shall be same as diaphragm seal material.
- 3.9.7 Painting of installation material, instrument supports and structural supports shall be as per painting specification attached elsewhere in MR.
- 3.9.8 S.S. tag plates shall be provided for all the instruments.
- 3.9.9 All transmitters shall be provided with pre fabricated FRP canopy. Prefabricated FRP canopy shall be used for field electronic instruments; JB's. Canopy to cover the instrument from all sides with a front window & openable shutter for terminal side (for Transmitters) & with a front openable shutter for Junction Boxes.

Typical characteristics of FRP canopy shall be following:

- i) High mechanical strength

- ii) Weather resistant (Resistant to most of the acids, alkalies, vapours & fumes).
- iii) UV resistant
- iv) Anti Static
- v) Special rubber grommets for Cable/ Tube entry.

3.9.10 Bidder shall furnish filled in data sheet for each tag after sizing, range selection, material selection etc. These data sheets shall be reviewed and approved by EIL / purchaser after placement of order. Proper selection of instruments, materials etc. shall be bidder's responsibility. Any necessary change required later for meeting the specification shall be done by the bidder without any price or delivery implications. While filling the instruments data sheets, the following shall be taken care:

- a) All the relevant data shall be filled in. If any point is not applicable then N/A shall be indicated.
 - b) Make and model number of the offered instruments shall be indicated with model decoding details for offered instrument, without model no, data sheet shall not be reviewed.
 - c) Bidder seal with signature shall be provided and pump vendor shall ensure the correctness of the process data.
- Instruments tag numbers /data sheet numbers shall be indicated.

3.10 Instruments Specification

- 3.10.1 All transmitters shall have an integral output meter (LCD type Display output, user configurable in engineering units). Remote mounted meters may be provided if required in addition.
- 3.10.2 Threaded end connections for instruments shall be to NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5. All flanges and flanged valves in pressure rating up to 600# shall have RF flange with smooth surface finish (125 – 250 AARH) as per ASME B46.1. In pressure rating 900# and above, RTJ flange with 63 AARH finish shall be considered.
- 3.10.3 All instruments shall have internal terminal block for cable termination. Internal terminal block for all instruments shall be anti-vibration type, suitable for terminating a minimum of 1.5 mm² size cable conductors. Flying leads are not acceptable.

3.11 Transmitters

- 3.11.1 Transmitter shall be 4-20mA+HART type. Transmitter / electronics / electrical component enclosure shall be copper free aluminium / SS with the manufacturer's standard baked-on epoxy coating. All transmitters shall have dual-compartment housing.
- 3.11.2 Integral LED/LCD output meter shall be provided for all transmitters.

- 3.11.3 Transmitters calibrated accuracy shall be of $\pm 0.065\%$ of span. Calibrated accuracy for diaphragm seal transmitters shall be $\pm 0.25\%$ of span.
- 3.11.4 Transmitters shall have minimum static pressure/overpressure rating of 160 kg/cm²g except for very low-range for which the static pressure will be considered suitably based on the availability.
- 3.11.5 Threaded end connections shall be to NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5.
- a) As a minimum, pressure and differential pressure Transmitter shall meet the following requirement :
- Update rate for Pressure and Differential Pressure and Flow transmitters shall be at least 125msec (8 times per second).
 - Field transmitter with range of 760mmwc or more shall have a response time of 500 milliseconds or better and transmitter with range below 760mmwc, shall have response time 1 second or better.
 - The response time of the transmitter shall be considered as the sum of dead time and 63.2% step response time of the transmitter.
- b) Unless specified otherwise, the over-range/static pressure protection of the transmitters shall be as follows;

Range of Transmitter	Over range/ static pressure	
	Pressure Transmitter (kg/cm ²)	Differential Pressure Transmitter(kg/cm ²)
0 < ® < 250 mm WC	20	20
250 < ® < 1000 mm WC	45	52
1000 < ® < 5000 mm WC	45	70
5000 < ® < 10000 mm WC	45	160
1 < ® < 10 kg/cm ²	52	160
10 < ® < 100 kg/cm ²	160	210
> 100 kg/cm ²	210	210

However if the Over range/ static pressure value specified above is less than the maximum/ design pressure of service conditions, offered instrument shall be suitable for the maximum/ design pressure.

3.12 Pressure Gauges

- a) Pressure gauge dial shall be white, with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment.
- b) Pressure gauges shall be weatherproof with dial size of 150 mm and shall have features like screwed bezels, externally adjustable zero, over range protection

(at least 130% of max. operating pressure) and blowout discs. Shatter proof glass Pressure gauge sensing element shall be of SS 316 and movement of SS 316, as a minimum. Pressure gauges shall have SS304 casing.

- c) Pressure gauges shall have an accuracy of $\pm 1\%$ of URV as a minimum. Differential pressures gauges may have an accuracy of $\pm 2\%$ of URV. And range shall be so selected that gauge normally operates in middle third of the range.
- d) The pressure element shall be Bourdon, diaphragm or bellows depending upon process condition.
- e) Over range protector and pulsation dampener, whenever used, shall be of SS 304, as a minimum. Pulsation dampener shall be used for all pulsating services. It shall be floating pin type, externally mounted and externally adjustable.
- f) Pressure gauges with range as 0-100 kg/Cm²g shall have safety type solid front case.
- g) Pressure gauge shall have 1/2" NPT (M) bottom connection except for diaphragm seal where 2" flanged connection shall be used in general.
- h) Cases shall normally weatherproof to IP-55 as per IEC-60529/IS-2147. Blowout discs shall be provided.
- i) Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible.
- j) Diaphragm seals, filled type or mechanical type shall be furnished for congealing and viscous services where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of the clean out type with flushing connection.
- k) Where vibrations and pressure fluctuations are expected, glycerin filled type shall be used. In case of vibrating service like pump outlets, flexible armored hoses shall be used in place of impulse piping and gauges shall be mounted separate stanchion.

3.13 Pressure Relief Valve / Thermal Relief Valve

- a) Pressure Relief Valve shall meet the limiting relief valve requirements as defined in API RP-520 (part-I & II) and in API-526.
- b) Pressure Relief Valve shall be full nozzle full lift type and Thermal Relief Valve shall be modified nozzle type.

- c) Conventional valves shall be specified for constant back pressure while bellows seal type valves shall be specified for variable back pressure more than 10% of set pressure. Pilot operated pressure relief valves shall be used for special services and where set pressure is closer than 10% of the operating pressure, and back pressure is above 50% of set pressure in general.
- d) Percentage Accumulation shall be 10% for Pressure Relief Valve and 25% for Thermal Relief Valve.
- e) The body material shall, as a minimum, be as per piping specifications. Nozzle and disc material shall be SS316 as a minimum with machined stainless steel guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be at least same as nozzle material.
- f) Spring material shall be selected as per operating conditions. The spring material of pressure relief valves shall be as follows unless other wise necessary because of process conditions;
29°C to 230°C: Cadmium/nickel plated carbon steel.
Above 230°C: Tungsten alloy steel.
Below – 29°C: Stainless steel 316
- g) Pressure Relief Valve shall have flanged connections for sizes 1" and above and where permissible, shall have screwed connection for sizes 3/4" and below. Thermal Relief Valve shall have screwed connection with 0.38 cm² orifice size and inlet outlet shall be of 3/4" NPT (M) X 1" NPT (F) sizes.
- h) Test gag shall be provided for all pressure relief valves.

3.14 Restriction Orifice Plate

- a) Restriction Orifice Plate shall be concentric square edged type.
- b) Each Restriction Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm. with following information punched on it:
 - Tag Number.
 - Nominal pipe size in inches and rating in psi.
 - Material of plate.
 - Bore diameter in mm
 - Upstream side
- c) Restriction Orifice Plate material shall be SS 316 as a minimum or better.
- d) The inlet face of the orifice plate shall be as per ISO-5167. Sizing shall be as per RW miller.

3.15 Temperature Gauges

- a) The temperature gauges shall be bimetallic type and shall be provided with 1½" flanged (min. 300# rating) thermo well with ½" NPT (F) connection for temperature gauges.
- b) Thermo well shall be fabricated out of bar stock.
- c) Temperature gauges shall have accuracy of ± 1 % of URV (Upper Range Value).
- d) Thermo well and flanges of Thermo well shall be minimum of SS-316 or better to suit the service conditions.
- e) Case material for temperature gauges shall be SS 304

3.16 Thermowells

- a) All temperature elements shall be provided with thermowells fabricated out of bar stock of minimum SS 316 material as per EIL Standard 7-52-0035. The base of the thermowells shall be chosen to fit the instrument without air gap for minimizing measurement lag. The type of connection shall be flanged type.
- b) Thermowell flange and well material shall be 316SS or better to suit the service conditions.
- c) The vibration analysis shall be carried out as per latest PTC 19.3 TW 2016 and corrective measures shall be taken as necessary. Proprietary designs shall be selected in case conventional design thermowells do not meet wake frequency criteria as per AME PTC . Length may change by ± 50 mm as per vibration analysis. Immersion length is based on 200 mm length between flange face and outer wall of pipe. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified.

3.17 Temperature elements

- a) Thermocouple elements shall be 18 AWG for simplex & 20 AWG for duplex. In general duplex shall be considered. Two separate cable entries shall be provided with plugs.
- b) Temperature transmitters shall be provided for all temperature elements.
- c) Thermocouple shall be ungrounded type.
- d) Thermocouple assemblies shall be furnished with weatherproof screw type heads as per EIL Standard 7-52-0036.

3.18 Temperature Transmitters

- a) Temperature transmitters shall have a built-in linearising function to produce an output linear to temperature range.
- b) The Temperature transmitters with cold junction compensation for thermocouple shall have an accuracy of 0.25% of URV as a minimum for range above 350 C, 0.5% of URV for temperature range between 350 C to 150 C and 0.75% for calibrated range below 150 C.
- c) Transmitters shall be provided with dual compartment with metallic separation.
- d) Burn out protection must be provided with temperature transmitters. Upscale or downscale protection shall be decided based on its application to ensure fail-safe operation.

- e) All Temperature transmitters shall also have following features:
- Shall be universal type i.e. suitable for accepting both RTD and Thermocouple inputs.
 - Have Dual input capability with automatic transfer to back-up sensor. Accordingly, both the elements of the duplex sensor shall be wired to transmitter with 2 Pair cable.
 - Remote Mounting type. Vendor shall consider approximately 10meter cabling between temperature element and transmitter.

3.19 TAG NUMBERING

- a) Instrumentation symbol shall follow latest edition of ISA standard S 5.1.
- b) All Bidder-supplied instruments shall have Tag No. as per the format indicated below. Numerical no. for all the instruments shall be unique i.e. without any repetition of tag no. for same type of instrument.

Unit No.	Instrument Type	Numerical No.
AA	BBBB	CCDDD

AA= Unit Number, Which shall be "03"

BBBB= Refer ISA S 5.1

CC= Last two digit of P&ID no.

DDD= Instrument serial number (To be allotted during detail engineering.)

4 COMMISSIONING SPARES & SPECIAL TOOL & TACKLES

Bidder shall include Special tools & tackles and Commissioning spares in his scope of supply for instrumentation items, required for erection and commissioning of the pump.

5 2 YEARS OPERATION SPARES

Bidder shall furnish separate list of recommended spares for instruments / system for 2 years operation during detailed engineering.

6 MANDATORY SPARES:

Pressure gauge, Temperature gauge: 15% of the total qty. of each type of same specification of the Enquiry/MR subject to minimum 1 No., whichever is higher.

Pressure transmitter: 15% of the total qty. of each type of same specification of the Enquiry/MR subject to minimum 1 No., whichever is higher.

O" rings (for Transmitter Oval flange/ Valve manifold) : 15% of each type of same specification of the total supplied/ installed items subject to minimum 2 Nos., whichever is higher.

7 INSPECTION AND TESTING

All instruments and system oriented items shall undergo factory testing and inspection by Vendor's authorized representatives, Owner and EIL, unless specified otherwise.

The inspection and testing shall be carried out as per related specifications, international codes and practices/ standards, approved documents and/ or any other document attached elsewhere in this document.

8 PROVEN TRACK RECORD (PTR)

The instrumentation selected for the package shall be rugged in design and must be well proven for use in similar applications. Prototype design or equipment of experimental nature or design undergoing testing etc. shall not be selected and supplied by bidder.

The instruments as being offered / supplied should have been operating satisfactorily in hydrocarbon industry like Refinery, Petrochemical and Gas Processing Plant under similar process conditions for at least 4000 hrs.

9 VENDOR LIST

- 9.1 Vendor List for Instruments Items is attached along with this document. Vendor list provided is for the Make only, and not for any specific Model. All the instruments shall be supplied from approved vendors only. Bidder shall furnish proposed sub-vendor list for EIL/ Owner's approval, which shall be approved by EIL/ Owner during detail engineering after order. This shall have no impact on price and delivery schedule.
- 9.2 Bidder shall take prior approval of make and specification of all instrument items before placement of order on sub-vendor. The offered model for the same must meet the specification and proven track record (PTR) requirement.
- 9.3 For items not appearing in vendor list, Bidder shall furnish proposed sub-vendor list for purchaser's approval.

VENDOR DATA REQUIREMENTS FOR WASH WATER PUMP AND RECYCLE PUMP

A	09-MAR-2026	ISSUED WITH MR	-KWB	-NA-	-NK-
Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by

VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✓" shall be furnished by the bidder.

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Drawing and Document Schedule			✓	✓	
2.	Instrument Sizing calculations			✓	✓	
3.	Filled in Instrument datasheets			✓	✓	
4.	Instrument Installation Drawings			✓	✓	
5.	Bill Of Material for installation items			✓	✓	
6.	Spare part list for 2 years operation	✓				
7.	As Built drawings/documents				✓	
8.	Mandatory Spares List		✓		✓	
9.	Complete catalogues with part list for all vendor supplied instruments, control, etc.			✓	✓	
10.	Installation, operation and maintenance manuals				✓	

Notes :

- "TICK" denotes applicability.
- Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
- All post order documents shall be submitted / approved through EIL eDMS portal.
- Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
- Refer - 6-78-0001: Specification for quality management system from Bidders.
- Refer - 6-78-0002: Specification for documentation requirements from Contractors.
- Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
- All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
- Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
- "@" indicates submission of documents to Inspection Agency.
- Bill of Material shall form part of the respective drawing.
- Sub Vendor list is applicable only for instrumentation item for which approved vendor list is not given.
- Only for critical instruments i.e. flow element(orifice), pressure relief valve along with PR of instruments.
- Along with PR for instruments
- Pipeline
- Heat & Mass Transfer

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15AA		Description : TUBE FITTINGS		
Approved Suppliers				
1	3630	WESMEC ENGINEERING PRIVATE LIMITED	INDIA	
2	C714	CRANE INSTRUMENTATION & SAMPLING PFT CORP.	UNITED STATES	
3	P240	PRECISION ENGINEERING INDUSTRIES	INDIA	
4	27440	FITOK INCORPORATED	CHINA	
5	4167	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
6	27408	SWAGELOK COMPANY	UNITED STATES	
7	E008	EXCELSIOR ENGG. WORKS	INDIA	
8	E104	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	
9	P303	PRIME ENGINEERS	INDIA	
10	3737	HAVI ENGINEERING INDIA PVT LTD	INDIA	
11	3745	MET-LOK VALVES AND FITTINGS	INDIA	
12	F146	FLUID CONTROLS LIMITED	INDIA	
13	H634	HAM-LET (ISRAEL-CANADA) LTD.	ISRAEL	
14	P671	PARKER HANNIFIN CORPORATION	UNITED STATES	
15	S816	SSP FITTINGS CORPORATION	UNITED STATES	
16	T761	TK FUJIKIN CORPORATION	KOREA, REPUBLIC OF	
17	4011	APTEK INSTRUMENTATION PVT LTD	INDIA	
18	4319	VENTIL FLOWERVE PRIVATE LIMITED	INDIA	
19	4342	FLUIDTEQ SYSTEMS	INDIA	
20	4363	HY-TECH ENGINEERS LIMITED	INDIA	
21	4286	SHARP ENGINEERING	INDIA	
22	4120	TUBEFIT ENGINEERS	INDIA	
23	3871	PANAM ENGINEERS LIMITED	INDIA	
24	3931	HP VALVES & FITTINGS INDIA PRIVATE LTD	INDIA	
25	27559	DK-LOK CORPORATION	KOREA, REPUBLIC OF	
26	4057	MET-LOK VALVES AND FITTINGS	INDIA	
27	3937	SHREEMARUTI INSTRUMENTS PVT LIMITED	INDIA	
28	4301	ARCELLOR CONTROLS INDIA	INDIA	
29	4303	TRUEWAY ENGINEERING INDUSTRIES	INDIA	
30	C220	COMFIT & VALVES PVT. LTD.	INDIA	
31	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
32	A345	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	
33	M058	MULTIMETAL INDUSTRIES	INDIA	
34	S146	SEALEXCEL (INDIA) PVT. LTD.	INDIA	
35	S303	SWASTIK ENGINEERING WORKS	INDIA	
36	3694	PRECISION ENGINEERING INDUSTRIES	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CA		Description : THERMO COUPLE EXTENSION CABLES		
Approved Suppliers				
1	3669	KEI INDUSTRIES LIMITED	INDIA	
2	D012	DELTON CABLES LIMITED	INDIA	
3	A034	ASSOCIATED CABLES PVT LTD	INDIA	
4	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
5	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
6	T243	T C COMMUNICATION PVT. LTD.	INDIA	
7	3773	TEMPSENS INSTRUMENTS INDIA LIMITED	INDIA	
8	3765	THERMO CABLES LTD.	INDIA	
9	3796	PARAMOUNT COMMUNICATIONS LTD	INDIA	
10	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	
11	3724	CORDS CABLE INDUSTRIESLTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EC		Description : PRESSURE RELIEF VALVE		
Approved Suppliers				
1	N541	NAKAKITA SEISAKUSHO CO LTD	JAPAN	
2	T181	Anderson Greenwood Crosby Sanmar Limited	INDIA	
3	L569	LESER GMBH & CO. KG	GERMANY	
4	D523	DRESSER INC.	UNITED STATES	
5	F103	LESER INDIA PRIVATE LIMITED	INDIA	
6	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
7	B110	BLISS ANAND PVT LTD	INDIA	
8	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	
9	A710	ANDERSON GREENWOOD CROSBY	UNITED STATES	
10	C700	CURTISS WRIGHT FLOW CONTROL CORPORATION	CANADA	
11	3774	UNI KLINGER LIMITED	INDIA	
12	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15GA		Description : ORIFICE PLATES & FLANGES		
Approved Suppliers				
1	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
2	T516	TM TECNOMATIC SPA	ITALY	
3	3867	DYNAFLUID VALVES AND FLOW CONTROLS P LTD	INDIA	
4	27512	CANALTA CONTROLS LIMITED	CANADA	
5	S286	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	
6	3648	HYDROPNEUMATICS PVT. LTD	INDIA	
7	M313	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	
8	C220	COMFIT & VALVES PVT. LTD.	INDIA	
9	P514	PETROL VALVES SPA	ITALY	
10	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
11	T095	TEMP-TECH	INDIA	
12	3936	ADITYA ENGINEERING WORKS	INDIA	
13	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
14	G016	GURU NANAK ENGG WORKS	INDIA	
15	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
16	M045	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	
17	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
18	P538	PIETRO FIORENTINI SPA	ITALY	
19	27415	CAMERON CANADA CORPORATION	CANADA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15HD		Description : TEMP.ELEMENTS,THERMOWELLS		
Approved Suppliers				
1	P190	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
2	T095	TEMP-TECH	INDIA	
3	T146	TEMPSENS INSTRUMENTS INDIA LIMITED	INDIA	
4	D004	DETRIV INSTRUMENTATION & ELECTRONICS LTD	INDIA	
5	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
6	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
7	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
8	T516	TM TECNOMATIC SPA	ITALY	
9	D677	DAILY THERMETRICS CORPORATION	UNITED STATES	
10	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
11	T514	THERMO ELECTRIC CO. INC.	UNITED STATES	
12	T232	TECHNO INSTRUMENTS	INDIA	
13	A206	ALTOP INDUSTRIES LTD.	INDIA	
14	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
15	3744	TOSHNIWAL INDUSTRIES PVT LTD	INDIA	
16	G622	GAYESCO-WIKA USA, LP	UNITED STATES	
17	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
18	A362	PRECISION MASS PRODUCTS PVT. LTD.065055055053	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15KA		Description : PRESSURE GAUGES		
Approved Suppliers				
1	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
2	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	
3	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
4	H081	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	
5	F114	FORBES MARSHALL (HYD) PVT. LTD	INDIA	
6	3994	ITEC MEASURES PVT. LTD.	INDIA	
7	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
8	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
9	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
10	W064	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	
11	A362	PRECISION MASS PRODUCTS PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15LA		Description : TEMP.GAUGES(BI METALLIC,FILLED SYSTEM)		
Approved Suppliers				
1	H081	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	
2	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
3	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
4	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
5	F114	FORBES MARSHALL (HYD) PVT. LTD	INDIA	
6	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
7	W064	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	
8	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	
9	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
10	3994	ITEC MEASURES PVT. LTD.	INDIA	
11	A362	PRECISION MASS PRODUCTS PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15RD		Description : FIELD INSTRUMENTS (P,DP,F,L,T,TD)		
Approved Suppliers				
1	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
2	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	
3	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
4	H621	HONEYWELL INC.	UNITED STATES	
5	Y006	YOKOGAWA INDIA LIMITED	INDIA	
6	E641	ENDRESS+HAUSER WETZER GMBH+ CO.KG	GERMANY	
7	3615	ENDRESS + HAUSER WETZER INDIA PVT LTD	INDIA	
8	F644	FUJI ELECTRIC SYSTEMS CO. LTD	JAPAN	
9	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
10	4353	ABB INDIA LIMITED	INDIA	
11	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
12	E232	ENDRESS+HAUSER (I) AUTO. INSTR. PVT. LTD	INDIA	

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प्रेसर, डिफरेंशियल प्रेशर और वैक्यूम गेज के लिए

निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR PRESSURE, DIFFERENTIAL PRESSURE AND VACUUM GAUGES

4	20.05.20	Revised and Re-issued	NP	RS	RKS	SKS
3	09.01.14	Revised and Re-issued	MJ	RS	SCG	SC
2	15.07.11	Revised and Re issued	GS	SA	AKC	DM
1	02.01.08	Revised and Re-issued	SA	CRM	MVKK	VC
0	30.04.02	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman

Abbreviations

AS	: Alloy Steel	NDT	: Non Destructive Testing
BIS	: Bureau of Indian Standards	No.	: Number
CEIL	: Certification Engineers International Limited	PMI	: Positive Material Identification
DP/DPT	: Dye Penetrant Testing	PO	: Purchase Order
EPC	: Engineering Procurement Construction	PQR	: Procedure Qualification Record
IC	: Inspection Certification	PR	: Purchase Requisition
IP	: Ingress Protection	QC	: Quality Control
IRN	: Inspection Release Note	SS	: Stainless Steel
ITP	: Inspection and Test Plan	TC	: Test Certificate
Lab.	: Third Party Laboratory	TPI or TPIA	: Third Party Inspection Agency
MTC	: Material Test Certificates	VDR	: Vendor Data Requirement
MOC	: Material of Construction	WPS	: Welding Procedure Specification
Mfr	: Manufacturer	WPQ	: Welders Performance Qualification

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members : Mr. Rajesh Sinha
Mr. R. Muthuramalingam
Mr. Arupjyoti Saikia(Engg.)

Mr. Himangshu Pal
Mr. Avdhesh Agrawal

Mr. Chandrashekhar
Mr. Mahendra Mittal

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements for Pressure, Differential Pressure and Vacuum Gauges

2.0 REFERENCE DOCUMENTS:

PO/PR & Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures						
1.1	WPS/PQR/WPQ	Welding procedure Qualification for Welding	100%	WPS PQR WPQ	--	H	W (New) R (Existing)
2.0	Material Inspection						
2.1	Incoming Material like: Pressure Element, Cases, Flanges, Gauge Savers, Snubber, Syphon, Pipe for extended diaphragm seal type, etc.	Chemical and Mechanical Properties	100%	MTC / Lab. TC / Mfr's TC	H	H	R
3.0	In process Inspection						
3.1	Assembly and calibration of pressure gauge	Calibration, Over pressure, Hysteresis, Accuracy	100%	Test records	--	H	-
4.0	Final Inspection						
4.1	Final Inspection	- Visual Check - DP testing on the weld joints of Pipe & Flanges(For extended Diaphragm seal type) - Dimensional Check - Calibration check on the Gauge. - Over Pressure	100%	Test records	---	H	R

**INSPECTION AND TEST PLAN
FOR
PRESSURE, DIFFERENTIAL PRESSURE
AND VACUUM GAUGES**

STANDARD SPECIFICATION NO.

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		- Vacuum test (if applicable) - Hydro test on Snubbers/Gauges savers (as applicable)					
4.2	Type tests on Assembled Pressure Gauges	- Test for influence of Temperature - Shock test - Endurance test - Weather Proof Construction of housing	One sample per model & range	Type Test Certificates	---	H	R
5.0	Painting	As specified in the PR.	100%	Supplier's record	---	H	---
6.0	Documentation						
6.1	Documentation and IC/IRN	- Reviews of Internal Test Reports - Degree of protection certificate for enclosure - Issuance of IC/IRN	-	Supplier Test Records / Type Test certificate / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports, drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review of Documents, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No. of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :

- This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
- Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
- For EPC jobs, Scope of Inspection shall be under TPJA only, unless specified otherwise.

इलेक्ट्रानिक उपकरणों के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR ELECTRONIC INSTRUMENTS

4	22.05.20	Revised and Reissued	NP	RS	RKS	SKS
3	21.11.13	Revised and Reissued	MJ	RS	SCG	SC
2	22.03.12	Revised and Reissued	MJ	GS	AKC	DM
1	02.01.08	Revised and Re-issued	SA	CRM	MVKK	VC
0	03.03.03	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

INSPECTION AND TEST PLAN FOR ELECTRONIC INSTRUMENTS

STANDARD SPECIFICATION NO.

6-81-2032 Rev. 4

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Abbreviations

AS	: Alloy Steel	Mfr	: Manufacturer
ATEX	: Atmosphère Explosibles	MTC	: Material Test Certificates
BIS	: Bureau of India Standards	MOC	: Material of Construction
BASEEFA	: British Approval Service for Electrical Equipment in Flammable Atmospheres	NAMUR	: Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der Chemischen Industrie
CEIL	: Certification Engineers International Limited	NDT	: Non Destructive Testing
CSA	: Canadian Standards Association	NEMA	: National Electrical Manufacturers Association
DGMS	: Directorate General of Mines Safety	No.	: Number
DP/DPT	: Dye Penetrant Testing	PESO	: Petroleum and Explosives Safety Organisation
EPC	: Engineering Procurement Construction	PMI	: Positive Material Identification
ERTL	: Electronics Regional Test Laboratory	PO	: Purchase Order
FF	: Fieldbus Foundation	PQR	: Procedure Qualification Record
FISCO	: Fieldbus Intrinsically Safe Concept	PR	: Purchase Requisition
FM	: Factory Mutual	PTB	: Physikalisch-Technische Bundesanstalt
FAT	: Factory Acceptance Test	PWHT	: Post Weld Heat Treatment
HART	: Highway Addressable Remote Transducer	QC	: Quality Control
IEC	: International Electrotechnical Commission	RT	: Radiography Test
IP	: Ingress Protection	SIL	: Safety Integrity Level
IRN	: Inspection Release Note	SS	: Stainless Steel
IS	: Intrinsic Safety	TC	: Test Certificate
IT	: Information Technology	TPI or TPIA	: Third Party Inspection Agency
ITP	: Inspection and Test Plan	UL	: Underwriter's Laboratories
Lab.	: Third Party Laboratory	VDR	: Vendor Data Requirement
LCIE	: Laboratoire Central Des Industries Electriques	WPS	: Welding Procedure Specification
LPT	: Liquid Penetrant Testing	WPQ	: Welders Performance Qualification

Inspection Standards Committee**Convenor** : Mr. R.K. Singh**Members** : Mr. Rajesh Sinha

Mr. R. Muthuramalingam

Mr. Arupjyoti Saikia(Engg.)

Mr. Himangshu Pal

Mr. Avdhesh Agrawal

Mr. Chandrashekhar

Mr. Mahendra Mittal

1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements of following types of Electronic Instruments.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures						
1.1	WPS/PQR/WPQ	Welding procedure Qualification for Welding	100%	WPS PQR WPQ	--	H	W (New) R (Existing)
2.0	Material Inspection						
2.1	Incoming Material like : Sensors, Housings, Flanges, Pipe, Spacer Ring, Valve Manifolds etc.	Mechanical/Chemical properties, Heat Treatment as applicable.	100%	MTC/ Mfr's TC	H	H	R
3.0	In process Inspection						
3.1	Welding: For Extended Diaphragm and Remote or Chemical seal Type Instruments.	DP/DPT/LPT on Welds	100%	Supplier's Test Certificates	H	H	R
3.2	Instrument assembly	As per internal setup procedure by the manufacturer.	100%	Supplier's Test Records	-	H	-

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**INSPECTION AND TEST PLAN
FOR
ELECTRONIC INSTRUMENTS**

STANDARD SPECIFICATION NO.

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	Final Inspection						
4.1	Final Inspection on assembled Instruments	• Visual Check • Components and Accessories Verification. • Dimensional verification. • Field bus registration Check Mark • Over-range/ Static Pressure protection check (as applicable) • Vacuum test on Transmitters required for Vacuum service. • Calibration Check of Instruments. • Load Driving Capability(4-20mA and HART Instruments). • Power supply variation check. • Communication, Configuration & Diagnostics check with Hand Held Configurator or Hart/Fieldbus specified –(on representative sample) • Remote Output Meter: Visual & Configuration of Meter Display. • Field Universal Communicator : Visual & Accessories Verification	100%	Supplier's Test Records / Inspection Witness Record	-	H	RW (Note-4)
4.2	For Integral Orifice / Meter run assembly	The requirements shall be as per Engineers India Ltd's Standard ITP ref. 6-81-2004 shall be followed.	--	--	-	-	-

**INSPECTION AND TEST PLAN
FOR
ELECTRONIC INSTRUMENTS**

STANDARD SPECIFICATION NO.

6-81-2032 Rev. 4

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.3	Wireless Network Systems (Including Transmitters, signal repeaters, signal Boosters , gateway etc. and other IT hardware) .	Inspection shall be done with a FAT procedure prepared & submitted by the supplier and approved by concerned authorities.	100%	FAT report	-	H	H
4.4	Submission of certificates / Documents	• <u>For Electrically Hazardous Area :</u> a. Indigenous Items: Certificate from CIMFR/ Karandikar Lab. / ERTL and valid BIS License & corresponding valid PESO Certificate for the requisite Hazardous Area Classification b. Imported items: Certificates from testing agency like LCIE, BASEEFA, FM , UL, PTB, CSA etc. for compliance to ATEX or equivalent recognized standards & corresponding Valid PESO Certificate for the requisite Hazardous Area Classification c. For projects related to mining, approval from DGMS-India required. • Certification for Fieldbus Transmitters for IS/FISCO as per PR • Degree of protection certificate for instrument housing. • Certificate for electromagnetic compatibility and transient protection as per IEC 61000-4 • SIL certification, if applicable • O/P updating frequency and Response time for the transmitter (on 1 unit/model)	sample	Statutory Approval Certificates / Type Test Reports	-	H	R

INSPECTION AND TEST PLAN
FOR
ELECTRONIC INSTRUMENTS

STANDARD SPECIFICATION NO.

6-81-2032 Rev. 4

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		- Compliance to NAMUR NE 43 as applicable - Interoperability certification for the Fieldbus/Profibus Instruments, as applicable					
5.0	Painting						
5.1	Painting	Special cleaning and packing for oxygen and chlorine services	100%	Packing list / Supplier's Records	-	H	-
6.0	Documentation						
6.1	Documentation and IC/IRN	- Review of Internal Test Reports, MTC - Device Description files - Issuance of IC/IRN	100%	Supplier's Test Records / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder / Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Documents Review, RW-Random witness (As specified or 10 % - Samples must include minimum 1No. of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC jobs, Scope of Inspection shall be under TPIA only , unless specified otherwise.
4. Wherever special type Fasteners(such as Long Studs & Nuts) are specified/required for process connection as per PR- Visual check on all fasteners shall be witnessed during Final Inspection.

अवरोधक ओरिफिस प्लेटों के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR RESTRICTION ORIFICE PLATES

4	19.05.20	Revised and Re-issued	NP	RS	RKS	SKS
3	09.01.14	Revised and Re-issued	MJ	RS	SCG	SC
2	15.07.11	Revised and Reissued	GS	SA	AKC	DM
1	09.05.08	Revised and Reissued	RB	SKD	SKP	VC
0	25.11.02	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
						Approved by

Abbreviations

ANSI	: American National Standards Institute	MPT/MT	: Magnetic Particle Testing
AS	: Alloy Steel	MSA	: Multistage assembly/ Multistage Orifice Assembly
BIS	: Bureau of Indian Standards	NACE	: National Association of Corrosion Engineers
CEIL	: Certification Engineers International Limited	NDT	: Non Destructive Testing
CE	: Carbon Equivalent	PO	: Purchase Order
CS	: Carbon Steel	PMI	: Positive Material Identification
DFT	: Dry Film Thickness	PR	: Purchase Requisition
DT	: Destructive Testing	PWHT	: Post weld Heat Treatment
DP/DPT	: Dye Penetrant Testing	PQR	: Procedure Qualification Record
EPC	: Engineering Procurement Construction	QC	: Quality Control
HIC	: Hydrogen Induced Cracking	TC	: Test Certificate
IC	: Inspection Certification	TPI or TPIA	: Third Party Inspection Agency
IGC	: Inter Granular Corrosion	RT	: Radiography Testing
IRN	: Inspection Release Note	RTJ	: Ring Tongue Joint
ITP	: Inspection and Test Plan	SS	: Stainless Steel
Lab.	: Third Party Laboratory	UT	: Ultrasonic Testing
LPT	: Liquid Penetrant Testing	VDR	: Vendor Data Requirement
Mfr	: Manufacturer	WPS	: Welding Procedure Specification
MTC	: Material Test Certificates	WPQ	: Welders Performance Qualification
MOC	: Material of Construction		

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members : Mr. Rajesh Sinha Mr. Himangshu Pal Mr. Chandrashekhar
 Mr. R. Muthuramalingam Mr. Avdhesh Agrawal Mr. Mahendra Mittal
 Mr. Arupjyoti Saikia(Engg.)

1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Restriction Orifice Plates and Multistage Orifice Assemblies.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred therein /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures						
1.1	WPS/PQR/WPQ	Welding procedure Qualification for welding involved in Multistage orifice Assemblies, Meter Runs etc	100%	WPS PQR WPQ	--	H	W (New) R (Existing)
2.0	Material Inspection						
2.1	Incoming Material Plates, Pipes, Flanges, RTJ Plate Holders etc.	- Chemical & Mechanical Properties, - PMI, Heat treatment, - Hardness as applicable	100%	MTC / Lab. TC	H	H/R (Note 1)	R
3.0	In process Inspection						
3.1	Machining of Plates, Welding/Fabrication etc	Visual & Dimensional.	100%	Test Records	-	H	-

**INSPECTION AND TEST PLAN
FOR
RESTRICTION ORIFICE PLATES**

STANDARD SPECIFICATION NO.
6-81-2006 Rev. 4
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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	NDT , PWHT (as specified)	• RT on Weld Joints • DP/DPT/LPT on welds • PWHT of welds,	100%	NDT reports / PWHT chart	-	H	R
4.0	Final Inspection						
4.1	Final Inspection	• Visual Check . • Dimensional verification. • Component Verification • DP/DPT/LPT for all welds of MSA • Hydro test of complete assembly (Post PWHT if specified) before painting.	100%	Test Records	-	H	RW
5.0	Painting						
5.1	Cleaning for special services, Painting of Multistage assemblies	• Special cleaning and packing for oxygen and chlorine services • Pre treatment, primer and final paint, shade, thickness	100%	Test Records		H	---
6.0	Documentation						
6.1	Documentation and IC/IRN	• Review of Internal Test Reports • Issuance of IC/IRN	100%	Supplier's Test Records / IC/IRN	-	H	H

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.2	Final Document submission (if applicable)	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random -10%, R-Review, RW-Random witness, TC, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES:

1. All NACE, Hydrogen service, AS, SS flanges to be inspected by TPIA appointed by the Main Supplier. Carbon Steel(CS) flanges without any special service requirement upto size 24” – 300# ANSI will be accepted on review of Supplier Test Certificates. Supplier test certificate to be reviewed by TPIA.
2. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
3. For EPC jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.
4. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents

तापीय यन्त्रों एवं थर्मोवैल्स के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR TEMPERATURE GAUGES AND THERMO WELLS

4	21.05.20	Revised and Re-issued	NP	RS	RKS	SKS
3	09.01.14	Revised and Re-issued	MJ	RS	SCG	SC
2	15.07.11	Revised and Re-issued	GS	SA	AKC	DM
1	02.01.08	Revised and Re-issued	SA	CRM	MVKK	VC
0	09.12.02	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
						Approved by

Abbreviations

ANSI	: American National Standards Institute	NDT	: Non Destructive Testing
AS	: Alloy Steel	No.	: Number
CEIL	: Certification Engineers International Limited	PMI	: Positive Material Identification
CS	: Carbon Steel	PO	: Purchase Order
DP/DPT	: Dye Penetrant Testing	PQR	: Procedure Qualification Record
EPC	: Engineering Procurement Construction	PR	: Purchase Requisition
IC	: Inspection Certification	PWHT	: Post Weld Heat Treatment
IP	: Ingress Protection	QC	: Quality Control
IRN	: Inspection Release Note	RT	: Radiography Test
ITP	: Inspection and Test Plan	SAMA	: Scientific Apparatus Makers Association
Lab.	: Third Party Laboratory	SS	: Stainless Steel
LPT	: Liquid Penetrant Testing	TC	: Test Certificate
Mfr	: Manufacturer	TPI or TPIA	: Third Party Inspection Agency
MTC	: Material Test Certificates	VDR	: Vendor Data Requirement
MOC	: Material of Construction	WPS	: Welding Procedure Specification
NACE	: National Association of Corrosion Engineers	WPQ	: Welders Performance Qualification

Inspection Standards Committee**Convenor** : Mr. R.K. Singh**Members** : Mr. Rajesh Sinha

Mr. R. Muthuramalingam

Mr. Arupjyoti Saikia(Engg.)

Mr. Himangshu Pal

Mr. Avdhesh Agrawal

Mr. Chandrashekhar

Mr. Mahendra Mittal

1.0 SCOPE:

This Inspection and Test Plan covers the minimum inspection and testing requirements for Temperature Gauges and Thermowells.

2.0 REFERENCE DOCUMENTS:

PO/PR & Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures						
1.1	WPS/PQR/WPQ	Welding procedure Qualification	100%	WPS PQR WPQ	---	H	W (New) R (Existing)
2.0	Material Inspection						
2.1	Incoming Materials like Flanges, Thermowell Bar stock, Bimetal strip, Capillary, Pipe, etc.	Chemical & Mechanical Properties , Heat treatment, Hardness etc. as applicable.	100%	MTC / Lab. TC	H	H (Note 1)	R
3.0	In process Inspection						
3.1	Machining of components & Assembly.	Calibration, Overpressure, Hysteresis, Accuracy	100%	Test records	-	H	-
3.2	NDT / PWHT on Fabricated Thermowells (as applicable)	- RT, DP/DPT/LPT - PWHT	100%	NDT reports / PWHT chart	-	H	R

INSPECTION AND TEST PLAN
FOR
TEMPERATURE GAUGES AND THERMOWELLS

STANDARD SPECIFICATION NO.

6-81-2021 Rev. 4

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIE R	SUPPLIER	EIL/TPIA
4.0	Final Inspection						
4.1	Final Inspection: (Thermowells)	- Visual Check - Dimensional check - Dye Penetration test . - Hydrostatic Pressure withstand test: - External at 1.5 x Pressure as per flange rating (For Barstock / Builtup Type TWs) - Internal Pressure tests at 200kg/cm2 (For Barstock TWs) - Internal Pressure tests for Built-up type Thermowell as per Mfr's recommendation. - Bore Concentricity & wall thickness	100%	Supplier's Test Records / Inspection Witness Record	---	H	RW (Note-5)
4.2	Final Inspection: (Temperature Gauges)	- Visual check - Dimensional check - Check for filling liquid (SAMA class) for filled type temperature gauges. - Calibration checks including accuracy, repeatability, over range, etc.	100%	Test Records	---	H	RW
		- Type test certificate for Hermetic Seal - Case capillary compensation - Dry heat, Liquid immersion tests.	1 sample per model & range	Type Test Certificates	---	H	R
4.3	Assembly	Confirmation of positive contact between Temperature Gauges and Thermowell Tip.	100%	Test Records	---	H	RW
5.0	Painting						

INSPECTION AND TEST PLAN FOR TEMPERATURE GAUGES AND THERMOWELLS

STANDARD SPECIFICATION NO.

6-81-2021 Rev. 4

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.1	Cleaning for special services, Painting	Special cleaning and packing for oxygen and chlorine services	100%	Test Records	---	H	---
6.0	Documentation						
6.1	Documentation and IC/IRN	- Review of Internal Test Reports - Review of Type test reports - Review of Weatherproof Certificates for Gauges - Issuance of IC/IRN	100%	Type Test Reports / Supplier Test Records / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder / Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review of Documents, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No. of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :

- All NACE, Hydrogen service, AS, SS flanges to be inspected by TPIA appointed by the Main Supplier. CS flanges without special service up to size 24" – 300 ANSI will be accepted on review of Supplier Test Certificates.
- This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
- Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
- For EPC jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.
- Dimensional check shall be witnessed for all Thermowells with flange size- rating :12" - 2500# and above

प्रैशर रिलीफ वाल्वों के लिए निरीक्षण व परीक्षण योजना **INSPECTION AND TEST PLAN FOR PRESSURE RELIEF VALVES**

4	21.05.20	Revised and Re-issued	NP	RS	RKS	SKS
3	09.01.14	Revised and Re-issued	MJ	RS	SCG	SC
2	22.03.12	Revised and Re-issued	MJ	GS	AKC	DM
1	02.01.08	Revised and Re-issued	SA	CRM	MVKK	VC
0	09.12.02	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations

API	: American Petroleum Institute	NDT	: Non Destructive Testing
AS	: Alloy Steel	No.	: Number
ASME	: American Society of Mechanical Engineers	PMI	: Positive Material Identification
CBSP	: Cold Bench Test Set Pressure	PO	: Purchase Order
CEIL	: Certification Engineers International Limited	PQR	: Procedure Qualification Record
DP/DPT	: Dye Penetrant Testing	PR	: Purchase Requisition
EPC	: Engineering Procurement Construction	PWHT	: Post Weld Heat Treatment
IC	: Inspection Certification	QC	: Quality Control
IRN	: Inspection Release Note	RT	: Radiography Test
ITP	: Inspection and Test Plan	SS	: Stainless Steel
Lab.	: Third Party Laboratory	TC	: Test Certificate
LPT	: Liquid Penetrant Testing	TPI or TPIA	: Third Party Inspection Agency
Mfr	: Manufacturer	VDR	: Vendor Data Requirement
MTC	: Material Test Certificates	WPS	: Welding Procedure Specification
MOC	: Material of Construction	WPQ	: Welders Performance Qualification

Inspection Standards Committee**Convenor** : Mr. R.K. Singh
Members : Mr. Rajesh Sinha
 Mr. R. Muthuramalingam
 Mr. Arupjyoti Saikia(Engg.)

 Mr. Himangshu Pal
 Mr. Avdhesh Agrawal

 Mr. Chandrashekhar
 Mr. Mahendra Mittal

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Pressure Relief Valves.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures	--	--	--	--	--	--
2.0	Material Inspection						
2.1	Incoming Material Like: Castings for Body/Bonnet/ Cast Nozzle, Forgings for Inlet Nozzle/Disk/Seat Pallet etc.	• Mechanical & Chemical properties • Heat treatment, hardness as applicable	100%	MTC / Lab. TC	H	H	R
2.2	Bought out items: Spring/Bellow/Fasteners, Gaskets/Diaphragm/Pilot etc	• Test requirement as applicable for each Components.	100%	Mfr's TC	H	R	R

**INSPECTION AND TEST PLAN
FOR
PRESSURE RELIEF VALVES**

STANDARD SPECIFICATION NO.

6-81-2026 Rev. 4

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	In process Inspection						
3.1	Machining of components , Assembly & Testing.	• Visual, Dimensions.	100%	Supplier's Test Records	-	H	R
		• Hydrostatic test on Body & Inlet Nozzles before assembling.	100%	Supplier's Test Records	-	H	RW (Note-4)
3.2	NDT , PWHT (As specified)	• RT of Castings as applicable • RT on Cast Nozzle	100%	NDT reports	-	H	R
4.0	Final Inspection						
4.1	Final Inspection	• Visual check . • Dimensional check • Cold Bench Test Set Pressure(CBSP). • Seat Leakage Test • Back Pressure Test & External Joint Leakage Test	100%	Supplier's Test Records and Inspection Witness Record	-	H	RW
4.2	Submission of certificates / Documents	• Capacity Test as per ASME • Blow Down • Valve Lift test • Valve reclosing pressure test	Prototype for each model	Type Test Certificates	-	H	R
5.0	Painting						
5.1	Painting	• Special cleaning and packing for oxygen and chlorine services • Pre treatment, primer and final paint, shade, thickness.	100%	Packing list / Supplier's Records	-	H	-

**INSPECTION AND TEST PLAN
FOR
PRESSURE RELIEF VALVES**

STANDARD SPECIFICATION NO.

6-81-2026 Rev. 4

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.0	Documentation						
6.1	Documentation and IC/IRN	- Review of Internal Test Reports &MTC - Bought out items/accessories TC - Issuance of IC/IRN.	100%	Supplier's Test Records / IC/IRN	-	H	H
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review of Documents, RW-Random witness(Random 10%, minimum 1 No. of type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents .
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.
4. Supplier to carry out this stage Inspection on all items and EIL/TPIA to decide on Witness of this Stage Inspection.

JOB SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING

1	09/11/2023	CLIENT COLOR CODE INCORPORATED AND REISSUED FOR TENDERING	JATIN	SAHIL	SRIDHAR
0	25/10/2021	ISSUED FOR TENDERING	UTTAM	SAHIL	SRIDHAR
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

Abbreviations:

AS	:	Alloy Steel
ASTM	:	American Society for Testing and Materials
AWWA	:	American Water Works Association
CS	:	Carbon Steel
DFT	:	Dry Film Thickness
GI	:	Galvanized Iron
ID	:	Internal Diameter
ISO	:	International Organization for Standardization
LTCS	:	Low temperature Carbon Steel
MS	:	Mild Steel
MR	:	material requisition
NB	:	Nominal Bore
NA	:	Not applicable
OD	:	Outside Diameter
OSHA	:	Occupational Safety and Health Act
RCC	:	Reinforced Cement Concrete
RH	:	Relative humidity
SS	:	Stainless Steel
SOR	:	Schedule of Rate
SSPC	:	Steel Structure Painting Council
WFT	:	Wet Film Thickness

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1.0 GENERAL

1.1 This technical specification shall be applicable for the work covered by the contract and without prejudice to the provisions of various international codes of practice, standard specifications etc. It is understood that the CONTRACTOR shall carry out 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 written deviation permit from appropriate authority will result in rejection of the job.

1.3 This specification covers the requirement for protective coating for new construction.

2.0 SCOPE

2.1 Scope of work covered in the specification shall include, without being limited to, the following:

This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services and chimneys, if any. The items listed in the heading of tables of paint systems are indicative only. However, the CONTRACTOR is fully responsible for carrying out all the necessary painting, coating and lining job on external and internal surfaces as per the tender requirement.

2.2 Extent of work

2.2.1 The following surfaces and materials shall require shop, pre-erection and field painting:

- All un-insulated carbon steel & alloy steel equipment like vessels, columns, storage tanks, exchangers, parts of boilers etc.
- All un-insulated carbon steel and low alloy plant and related piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- All insulated parts of vessels, boilers, chimneys, stacks, piping and steam piping and other insulated items present, if any.
- All items contained in a package unit.
- All structural steel work, pipes, structural steel supports, walkways, handrails, ladders, platforms etc.

- Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.
- Identification of colour bands on all piping, as required, including insulated aluminium clad, galvanized, SS and nonferrous piping.
- Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping.
- Marking / identification signs on painted surfaces of equipment and piping including hazardous service.
- Supply of all primers, paints and all other materials required for painting (other than OWNER supplied materials)
- Application of pre-erection/fabrication and shop primer.
- Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection.
- All CS piping, equipment, storage tanks and internal surfaces of RCC tanks in ETP plant.
- Quality control, testing and inspection during all stages of work (surface preparation, application of coating and testing of furnished coating).

2.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the OWNER, the same shall be painted as per the relevant specifications:

- a. Un-insulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials.
- c. Non-ferrous materials like aluminum, Cu-Ni alloys, galvanized steel.

In general Galvanized steel doesn't require painting. However if painting is required due to OWNERs instructions, contractual or for colour coding requirement then coating system in Table 4.0 shall be followed.

2.3 Unless otherwise instructed, final paint coating (i.e. application of field primer, intermediate and top coats) on pre-erection/ shop primed equipment shall be applied at site, only after all welding, testing on systems are completed as well as after completion of steam purging.

3.0 REFERENCE CODES & STANDARDS

3.1 Without prejudice to the provision of clause 1.1 above and the detailed specifications of the contract, latest editions of the following codes and standards are applicable for the work covered by this contract:

ISO-12944	:	Corrosion protection of steel structures by protective paint system
-----------	---	---

- ASTM-Vol. 6.01&6.03 : American standard test methods for paints and coatings
- IS-101 : Methods of sampling and test for paints, varnishes and related products
- RAL CLASSIC : International standard for colour shade
- IS-2379 : Indian standard for pipe line identification-colour code
- ISO 8501-1/SIS-05 5900 : ISO standard for preparation of steel substrates before application of paints and related products.
- Steel Structures Painting Council, U.S.A. (surface preparation specifications SSPC-SP).
 - National Association of Corrosion Engineers (NACE), U.S.A.

3.2 Surface preparation standards

The latest editions of any of the following standards shall be followed for surface preparation:

- 3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for preparation of steel substrates before application of paints and related products. 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.
- 3.2.2 Steel Structures Painting Council, U.S.A. (surface preparation specifications SSPC-SP).
- 3.2.3 National Association of Corrosion Engineers (NACE), U.S.A.
- 3.2.4 Various international standards equivalent to Swedish standard for surface preparations are given in Table-1.
- 3.3 The CONTRACTOR shall arrange, at his own cost, to keep a set of latest edition of above mentioned standards and codes at site.
- 3.4 The paint manufacturers' instructions shall be followed as far as practicable at all times for the best results. Particular attention shall be paid to the following:
- a. Instructions for storage to avoid exposure as well as extremes of temperature.
 - b. Surface preparation prior to painting shall be followed as per Table-4 to 13 of this standard.
 - c. Mixing and thinning.
 - d. Application, recommended limit on time intervals in between coats & DFT.

4.0 EQUIPMENT

- 4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning, all equipment, scaffolding materials, shot & grit blasting equipment, air compressors etc. required shall be suitable for the work and shall be arranged by the CONTRACTOR in sufficient quantity at the site. The manufacturers test

certificates / data sheets for all the above mentioned items shall be reviewed by Engineer-In-Charge at site before start of the work.

- 4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except in case of specific requirement; the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER / COATING APPLICATION, REPAIR AND DOCUMENTATION

5.1 General

- 5.1.1 Adhesion of the paint film to the 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. In order to achieve the maximum durability, one or more of the following methods of surface preparation shall be followed, depending on condition of surface to be painted and as instructed by the Engineer-In-Charge.

- a. Abrasive blast cleaning
- b. Mechanical or power tool 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. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. The minimum acceptable standard, in case of thermally sprayed metal coatings, in case of mechanical or power tool cleaning shall be St. 3 or equivalent. In case of blast cleaning, it shall be Sa 2-1/2 as per Swedish standard SIS-055900 (latest edition) or SSPC-SP or ISO 8501-01. Blast cleaning shall be Sa 3 as per Swedish standard in case of thermally sprayed metal coatings.

Before surface preparation by blast cleaning, the surface shall be degreased by aromatic solvent to remove all grease, oil etc as per SSPC-SP-1.

- 5.1.3 Irrespective of whether external or internal surface to be coated, blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity >85%. In case of internal coating of storage tanks, dehumidifier shall be used to control humidity level below 60%. Dehumidifier should depress the dew point of air in the enclosed space, sufficient enough so as to maintain it 3°C below the metal substrate temperature during entire period of blasting and coating application. During the interval time between application of primer coat and subsequent intermediate and top coats or between blast cleaning completion and start of application of primer coat, dehumidifier unit should be in continuous operation to ensure that no condensation occurs on the substrate.

Dehumidifier should be able to maintain grain drop (moisture removal) at the rate of 25 grains per pound of air per hour. Dehumidifier should have capacity of at least 2 air changes per hour of the enclosed space. All necessary psychometric data should be collected by the CONTRACTOR for the given site conditions, before

starting operation of dehumidifier, to ensure that desired values of dew point and moisture content in enclosed space is achieved.

Dehumidification to be maintained round the clock for surface preparation and painting till the total coating application is over.

Dehumidifier shall not be stopped under any condition till the entire blasted surface is primed to the satisfaction of the technical representative of the paint manufacturer. In case the dehumidifier breaks down in middle of the job, the same shall be replaced at the risk and cost of the CONTRACTOR.

- 5.1.4 The Engineer in-Charge shall have the right to disallow usage of dehumidifier if the performance is not meeting the specified requirements. Under such circumstances, the CONTRACTOR shall remove the equipment and replace the same with another equipment to provide satisfactory results without any additional cost to the OWNER.
- 5.1.5 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray, if recommended by the paint manufacturer, on dry surface. This should be done immediately and in any case within 4 hours of cleaning of the surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.
- 5.1.6 The external surface of RCC chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush. Acid etching with 10-15% HCl solution for about 15 minutes shall be carried out. The surface must be thoroughly washed with water to remove acid and loose particles and then dried completely before application of paint.

5.2 Procedure for surface preparation

5.2.1 Air blast cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives such as Al_2O_3 particles, chilled cast iron or steel grit, copper slag or nickel slag at a pressure of 7.0 kg/cm^2 and at an appropriate distance & angle depending on nozzle size maintaining constant velocity and pressure. Chilled cast iron or steel shall be in the form of shot or grit of size in the range of G16 – G42 conforming to SSPC AB1 and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak. For all other abrasives, size shall be in the range of G16 – G24. The combination of steel grits and shots shall be normally in the ratio of 3:1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. The compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the material for liners. Nozzle 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 luster. 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. If there is dew on the metal surface, it shall be cleaned. The surface profile shall be uniform to provide good adhesion (i.e. 35 to 50 microns) to the paint. If possible, a vacuum collector shall be installed to collect and recycle the abrasives.

5.2.2 Mechanical or power tool cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of the 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/steam and thoroughly dried with compressed air jet before application of paint.

5.3 Non-compatible shop coat primer

For equipment on which application of total protective coating (primer + intermediate + top coat) is carried out at shop, compatibility of finish coat with primer should be checked with the paint manufacturer. If the shop coat is in satisfactory condition showing no major defect upon arrival at site, the shop coat shall not be removed.

5.4 Shop coated equipment (coated with primer & finishing coat) should not be repainted unless paint is damaged. Repair shall be carried out as per Table-3 of paint systems depending upon the compatibility of paint.

5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer, unless otherwise specified. If shop primer is not compatible with field primer, then shop coated primer should be completely removed before application of selected paint system for a particular environment.

5.6 For package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturers' standard can be followed after review.

5.7 Coating procedure and application

All coatings shall be applied by airless spray except for the following special cases, where application can be carried out by brush subject to suitability of the application of the paint product by brush.

- Spot repair
- Stripe coating on edges
- Small bore parts not suitable for spray application

Irregular surfaces such as sharp edges, welds, small brackets, and interstices may stripe coated to ensure specified DFT is achieved. Paint manufacturer recommendation should be followed before deciding for brush application.

- 5.7.1 Surface shall not be coated in rain, wind or in an environment where injurious airborne elements exist, when the steel surface temperature is less than 5 °F above dew point, when the relative humidity is greater than 85%, when the temperature is below 40°F and when the ambient/substrate temperature is below the paint manufacturers recommended temperature of application and curing. De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20 km per hour.
- 5.7.2 Blast cleaned surface shall be coated with complete application of primer as soon as practicable but in no case later than 4 hours the same day.
- 5.7.3 To the maximum extent practicable, each coat of paint shall be applied as a continuous film with uniform thickness and free of probes. Any spots or areas missed in application shall be re-coated 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 in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for re-coating when an additional coat can be applied without the development of any detrimental film irregularities such as lifting or loss of adhesion of the under coat. Manufacturer's instructions shall be followed for inter coat 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 the complete coverage of the surface. The tinting material shall be compatible with the material underneath and shall not be detrimental to its service life and shall be recommended by the original paint manufacturer.
- 5.7.6 Airless spray application shall be in accordance with the following procedure:
As per steel structure paint manual Vol.1 & Vol.2 by SSPC, USA. Airless spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor, issued to operate a pump to produce pressures of 1000 to 6000 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 results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

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 keeps the paint uniformly mixed during the spraying. The unit shall consist of in-built strainer. Usually, a very small quantity of thinning is required before spray. In case of high build epoxy coating (two packs), 45:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally, fluid hoses should not have ID less than 3/8" and not longer than 50 ft. to obtain optimum results.

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

- 5.7.7 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.
 - b. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces, and rough/ pitted steel. Wide flat brushes are suitable for large flat areas but they shall not have width over 5 inches.
 - c. Paint shall be applied into all corners.
 - d. Any runs or sags shall be brushed out.
 - e. There shall be a minimum of brush marks left in the applied paint.
 - f. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.
- 5.7.8 For each coat, the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.8 Drying of coated surfaces

- 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 this exceeds, the paint material has possibly deteriorated or mixing is faulty.
- 5.8.2 No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- 5.8.3 No drier shall be added to paint on the job unless specifically called for in the manufacturers' specification for the paint.
- 5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dried to the fullest extent practicable.

5.9 Spot repair of damaged primer

- 5.9.1 Where pre-erection/shop primer has been damaged at isolated localized spots during handling and transportation or after erection / welding, its repair shall be done as given below and as per the Table-3 of this specification.
- 5.9.2 Surface preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface, over the intact adjacent surface surrounding the damaged area, by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damage was observed on pre-erection / pre fabrication or shop primer of inorganic zinc silicate coating (F-9). Similarly one coat of F-12 shall be applied wherever damage observed on pre-erection / pre-fabrication/shop primer of silicone aluminium (F-12).

- 5.9.3 If damaged areas are found to be extensive and spread over large areas, then entire pre-erection/pre-fabrication/shop primer shall be removed by blasting to achieve SSPC-SP-10 and entire blasted surface shall be primed again with F-9 or F-12, as applicable, for the intended design temperature. (See note of Table-3).

5.10 Assessment of painting requirement

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

- Identify the environment from area classification details and choose 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 based on compatibility of the above paint system.
- Identify the need of repair of shop primer and execute as per Table-3.

5.11 Documentation / records

- 5.11.1 A written quality plan with procedure for qualification trials and for the actual work including test and inspection plan & procedure for approval before start of work.
- 5.11.2 Daily progress report with details of weather conditions, particular of applications, no. of coats and type of materials applied, anomalies, progress of work versus program.
- 5.11.3 Results of measurement of temperatures, relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
- 5.11.4 Particulars of surface preparation and paint application during trials and during the work.
- 5.11.5 Details of non-compliance, rejects and repairs.
- 5.11.6 Type of testing equipment and calibration.
- 5.11.7 Code and batch numbers of paint materials used.

The coating applicator must maintain a job record consisting of all the information as per 5.11.2 -5.11.7 above as well as the approved procedure of work (5.11.1 above). The job record consisting of information in accordance to 5.11.2 – 5.11.7 shall be entered on daily basis and should be daily signed by Engineer-in-charge.

TABLE-1: SURFACE PREPARATION STANDARDS

Sl. No.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	<u>Manual or hand tool cleaning</u> Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing 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 conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	<u>Mechanical or power tool cleaning</u> Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	St 3	SSPC-SP-3	-	
3	<u>Dry abrasive Blast cleaning</u> There are four common grades of blast cleaning:				
3.1	<u>White metal</u> 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 No.1	Extremely clean surface can be expected to have prolonged life of paint system.
3.2	<u>Near white metal</u> Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.	Sa 2½	SSPC-SP-10	NACE No.2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc

Sl. No.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
					silicate paints. Also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	<u>Commercial Blast</u> Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	Sa 2	SSPC-SP-6	NACE No.3	For steel required to be painted with conventional paints, for exposure to mildly corrosive atmosphere and for longer life of the paint systems.
3.4	<u>Brush-off Blast</u> 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	NACE No.4	-

6.0 PAINT MATERIALS

Typical characteristics and codes of various paint materials used in this specification are as follows.

TABLE-2: PAINT MATERIALS
(Refer to *general notes* at the end of this table)

DESCRIPTION	P-6	P-7	P-4
Technical name	Epoxy Zinc Phosphate Primer	Cold Galvanizing product	Etch Primer/Wash Primer
Type and composition	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack synthetic resin based zinc galvanizing containing min 92% of electrolytic zinc dust of 99.95% purity.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.
Volume solids % Minimum	49	37	9
DFT per coat, μ	40-50	40-50	8-10
Theoretical covering capacity in m^2 /coat/ litre	9.8-12.2	3.4-4.4 m^2 /kg	9.0-11.2
Weight per litre in Kg/litre	1.4 $\pm$ 0.05	2.67 kg at 15 $^{\circ}$ C	1.2 $\pm$ 0.05
Touch dry at 30 $^{\circ}$ C (max.)	30 min.	10 min.	2 hrs.
Hard dry at 30 $^{\circ}$ C (max.), hrs	8	24	24
Over-coating interval, hrs	Min. 8	Min. 4	Min. 4-6
Pot life at 30 C for two component paints, hrs	6 - 8	NA	NA
Adhesion (ASTM D 4541)	>7	NA	NA

Temperature resistance (min) ° C (ASTM D 2485) *Note 8	80 (Method A)	50 (Method A)	NA
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TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-2	F-3	F-6A/B	F-6C
Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build coating	Solvent less epoxy coating
Type and composition	Two-pack aliphatic isocyanate cured acrylic finish paint (free of alkyd/polyester resins).	Single pack plasticized chlorinated rubber based medium with chemical and weather resistant pigments.	F-6A Two-Pack Aromatic polyamine cured epoxy resin medium suitably pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented with MIO.	Two pack, cured with Amine Adduct; catalyzed epoxy resin suitably pigmented
Volume Solids % Minimum.	40	36	57	98
DFT per coat, μ	30-40	30-40	100-125	250-500
Theoretical covering capacity in m^2 /coat/litre	10-13.3	9-12	4.6-5.7	2-3.9
Weight per liter in Kg/litre	1.15 $\pm$ 0.03	1.15 $\pm$ 0.03	1.42 $\pm$ 0.03	1.40 $\pm$ 0.03
Touch dry at 30 °C (max)	30 min.	30 min.	3 hrs	3 hrs
Hard dry at 30 °C (max.), hrs	8	8	16	16
Full cure at 30 °C (for immersion/ high temperature service)	NA	NA	5 days	5 days

Over-coating Interval, hrs	Min.12.	Min. Overnight	Min. Overnight Max. 5 days	Min. 8. Max. 48
Pot life (approx.) at 30 ° C for two component paints, hrs	5-8	NA	3-6	0.5
Adhesion (ASTM D 4541)	>5	>4	>7	>8
Abrasion Resistance (ASTM D4060) For 1000 g load	<300 mg /1000 cycles/CS17 or <100 mg /1000 cycles/CS10	NA	NA	NA
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8	80 (Method A)	60 (Method A)	80 (Method A)	120 (Method A)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-7	F-8	F-9 (primer)	F-11	F-12
Technical name	High build coal tar epoxy coating.	Self priming type surface tolerant high build epoxy coating (complete rust control Coating)	Inorganic zinc silicate Coating	Heat resistant synthetic medium based two pack Aluminium Paint suitable up to 250°C dry temp.	Heat resistant silicone Aluminium Paint suitable up to 540°C dry temp.
Type & composition	Two pack polyamide cured epoxy resin blended with coal tar medium, suitably pigmented	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 with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test as per ASTM D4752.	Heat resistant synthetic medium based two pack Aluminium paint suitable up to 250°C.	Single pack silicone resin based medium with Aluminium flakes.
Volume Solids % Minimum.	62	75	57	35	18
DFT per coat in μ	100-125	100-125	65-75	15-20	15-20
Theoretical covering capacity in M ² /coat/ litre	5-6.2	6-7.5	7.6-8.8	17.5-23.3	9-12
Weight per liter in Kg/litre	1.40±0.03	1.41±0.03	2.3±0.03	0.95±0.03	1.00±0.03
Touch dry at 30°C (maximum), hrs	4	3	0.5	3	0.5
Hard dry at 30°C (maximum), hrs	48	24	12	12	24
Full cure 30°C (for immersion /high temperature service)	5 days	5 days	NA	NA	NA

Over-coating interval, hrs	Min. 24 hrs max.5days	Min. 10	Min. 12 hrs at 20°C & 50% RH	Min. 24	Min. 24
Pot life at 30°C for two component Paints, hrs	4-6	1.5	4-6	NA	NA
Adhesion MPa (ASTM D 4541)	>5	>5	>5	NA	NA
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8	80 (Method A)	80 (Method A)	400 (Method B)	250 (Method A)	540 (Method B)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-14	F-15	F-16	F-17	F-20
Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardener	Inert polymeric matrix coating suitable for under insulation for CS and SS.	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Glass flake reinforced vinyl ester coating.
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	Suitable for high temperature service and under insulation coating for CS, alloy steel and SS	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Two component glass flake filled vinyl ester lining for under immersion services up to 90 deg. C.
Volume Solids % Minimum.	67	67	50	98	98
DFT per coat in microns	100-125	75-100	100-125	300-450	500-600
Theoretical covering capacity in M ² /coat/ litre	5.4-6.7	6.7-8.9	4-5	2.2-3.3	1.6-2
Weight per liter in Kg/litre (mix paint)	1.45±0.03	1.65±0.03	>1.3	1.7	>1.2
Touch dry at 30°C (max) , hrs	4	3	1	2	2
Hard dry at 30°C (max), hrs	24	24	16	24	4

Full cure 30°C (for immersion / high temp service)	168 hrs (7 days)	168 hrs (7 days)	NA	168 hrs (7 days)	96 hrs (4 days)
Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.6 hrs Max. Not applicable	Min. 16 hrs Max.21 days	Min. 4 hrs Max.3 days
Pot life at 30°C, hrs (for two component paints)	4	4-6	1	1	50 min-1 hr
Adhesion, MPa (ASTM D 4541)	>6	>7	NA	>8	>7, Tensile strength >20N/mm2 (ASTM D 638)
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8 & 9	125 (Method A)	150 (Method A)	650 (Method B)	150 (Method A)	90 (Method A)

General notes for TABLE-2:

1. Covering capacity and DFT achieved per coat depends on method of application. Covering capacity specified above is theoretical. For estimation of actual quantity of paints required, include the losses during application. Minimum specified DFT should be maintained in any case.
2. All primers and finish coats should be ambient temperature curing and air drying unless otherwise specified.
3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. Wherever a deviation is noticed from the specification in manufacturer data sheet, more stringent one between the data sheet and the specification shall prevail e.g. if this specification recommends Sa 2 ½ and the manufacturer data sheet requires Sa3, the surface preparation shall be done as per Sa 3. However in another case if this specification requires the surface preparation of Sa 2 ½ and the manufacturer data sheet recommends only Sa 2 as minimum, the surface preparation shall be done as per Sa 2 ½.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. Higher specific gravity of F-9 is also acceptable.
6. Internationally recognized & acceptable testing method shall be used for lab testing wherever testing standards are not mentioned.
7. Touch dry, hard dry, pot life, full cure period, & over coating interval shall be as per manufacturer's data sheets and no testing is required. Slight variation in the values of these parameters along with weight per liter may be permissible with the discretion of engineer-in-charge only.

8. Temperature resistance tests (ASTM D2485) shall be carried out for minimum required temperature resistance indicated.
9. Wherever ASTM D 2485 method B is applicable, test results of the panels subjected to salt spray (ASTM B 117) after muffle furnace exposure shall be submitted for pre-qualification purpose.
10. F-6A shall be suitable for immersion services in line with recommendations in tables-7 to 9.
11. F-6C shall be suitable for immersion services of hydrocarbons and DM water (in line with recommendations in table-9)
12. F-7 shall be suitable for immersion service of hydrocarbons & underground service up to 80 Deg C minimum.
13. F-14 shall be suitable for under insulation service up to 125 deg C.
14. F-15 shall be suitable for high temperature immersion & under insulation services in line with recommendations from table-8 to 13.
15. F-17 shall be suitable for high temperature immersion service and underground services as recommended in table-9 to 10.

7.0 COATING SYSTEMS

The coating system should be selected based on the plant location as given below:

Classification based on plant location:

- a) Plant located in inland area (more than 50 km from coast).
Environment classification – Industrial
 - For offsite areas: Table-5 to be followed.
 - For all process unit areas including DM, CPP and Cooling tower: Table-6 to be followed.
- b) Plant located on sea coast or within 50 km from sea coast.
Environment classification- Industrial marine
 - For offsite areas, process unit areas including DM, CPP, Cooling tower etc.: Table-6 to be followed.
- c) For external surface of above ground tanks, Table-8 to be followed for all locations (inland or coastal)

General notes for clause 7.0:

1. Coating systems (primers, finish paints etc.) based on area classification/environments/applications are tabulated in Table-4 to Table-13
2. Repair of pre-erection/pre-fabrication & shop priming after erection/ welding shall be done as per Table-3.

TABLE-3: REPAIR OF PRE-ERECTION/PRE-FABRICATION OR SHOP PRIMER AFTER ERECTION/WELDING

(For all un-insulated CS, LTCS & low allow steel items in all environments)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating System	Total DFT in Microns (min.)	Remarks
3.1	-45 to 80	SSPC-SP-3	2 coats of F-8 @ 125 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat	290	See Note-1 below and clause 5.9.3
3.2	81 to 400	SSPC-SP-3	1 coat of F-9 @ 65-75 μ DFT/coat + 2 coats of F-12 @ 20 μ DFT/coat	105-115	
3.3	401 to 550	SSPC-SP-3	3 coats of F-12 @ 20 μ DFT/coat	60	

Notes for Table-3:

Note-1: The application and repair of pre-erection/pre-fabrication or shop primer given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread over large area, entire primer shall be removed by blasting to achieve SSPC-SP-10 and surfaces to be primed again with F-9 or F-12 as applicable.

TABLE-4: COATING SYSTEM FOR GI HAND RAILS & GI ITEMS

(Refer clause 2.2.2)

Sl. No.	Design Temp. in °C	Coating System	Total DFT in Microns (min.)	Remarks
4.1	Up to 60	Hot Dip Galvanizing to 80-85 microns (600-610 gm/m ²) as per IS 4759, 2629, 4736, 2633 + 1 coat of P-6 @ 40 μ DFT/coat + 1 coat of F-2 @ 40 microns DFT/coat	80 of finish coat (excluding the thickness of galvanizing)	-

General notes for Table-4:

- No galvanized specimen shall have thickness less than 80 microns.
- Repair of the damaged areas of galvanized coatings due to welding during erection shall be carried out as per recommended practice IS: 11759, using cold galvanizing spray process. Organic paint systems are not acceptable for the repair.
- After repair of damaged galvanized coating by cold galvanization (P-7), the repaired area shall be top coated with paint system as given in table-4 above (i.e. 1 coat of P-6 @ 40 μ DFT/coat + 1 coat of F-2 @ 40 μ DFT/coat).
- Suggested cold galvanizing manufacturers are ZINGA, LOCTITE or Z.R.C.

5. Galvanized gratings don't require painting in general until otherwise specified elsewhere or as per the requirement of the OWNER. Ladders, stairways & hand rails require painting to meet the colour coding requirement of the OWNER. Contractor has to ensure the applicable colour coding prior to application of coating as per this clause.

TABLE-5: COATING SYSTEM FOR NORMAL CORROSIVE AREAS (OFFSITES)

(For all un-insulated above ground CS, LTCS & low allow steel piping, equipment, structures, valves, vessels & columns etc.)

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
5.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	-	None	65-75	No over-coating shall be done on F-9 F-12 shall be ambient temperature curing type
5.2	-16 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	1 coat of P-6 @ 40 μ DFT/coat	1coat of F-6B @ 100 μ DFT/coat+ 1 coat of F-2 @ 40μ DFT/coat	245-255	
5.3	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	-	2 coats of F-11 @ 20μ DFT/coat (2x20=40)	105-115	
5.4	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/coat	-	2 coats of F-12 @ 20μ DFT/coat (2x20=40)	105-115	
5.5	>400	SSPC-SP-10; 1coat of F-12 @ 20μ DFT/coat	-	2 coats of F-12 @20μ DFT/coat (2x20=40)	60	

General notes for Table-5:

- The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The CONTRACTOR is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.
- Flare line within unit or offsite areas shall be coated as per clause 6.3 of Table-6.
- If the application of pre-erection/pre-fabrication/shop primer has already been completed, the same shall not be repeated in the field. In case the damages to the primer coat are severe and are spread over large areas, the Engineer-In-Charge may decide & advise re-blasting and re-application of the primer coat. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table-3.
- In case of paint systems as per sl. nos. 5.4 and 5.5, the colour bands shall be applied over the aluminum paint as per the colour coding requirement for specific service of the piping.

5. All coating system including surface preparation, primer, intermediate and finish coat for piping is recommended to be done at field only until otherwise specified.
6. For equipment, vessels, columns & valves etc scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR and PR etc.

TABLE-6: COATING SYSTEM FOR CORROSIVE AREAS (PROCESS UNITS, COOLING TOWER, DM AND CPP)

(For all un-insulated above ground CS, LTCS & low alloy steel piping, equipment, structures, valves, vessels & columns, furnace stacks etc.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
6.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat	-	-	65-75	a)No over coating on F-9 is allowed b) F-12 shall be ambient temperature curing type
6.2	-16 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat	1 coat of P-6 @ 40 μ DFT/coat	2 coats of F-6B @ 100 μ DFT/coat + 1 coat of F-2 @ 40μ DFT/coat (2x100 + 40= 240)	345-355	
6.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75μ DFT/ coat	-	2 coats of F-12 @ 20μ DFT/coat 2x20=40	105-115	
6.4	>400	SSPC-SP-10; 1coat of F-12 @ 20-25μ DFT/coat	-	2 coats of F-12 @ 20-25μ DFT/coat (2x20=40)	60	This system is suitable up to 540° C

General notes for TABLE-6:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The CONTRACTOR is fully

- responsible for completing painting including prefabrication primer for all the items supplied and fabricated as per tender document and scope of work.
- If the application of pre-erection/pre-fabrication/shop primer has already been completed, the same shall not be repeated in the field. In case the damages to the primer coat are severe and spread over large areas, the Engineer-In-Charge may decide & advise re-blasting and re-application of the primer coat. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table-3.
 - For external surface of RCC Chimney, 2 coats of F-6 B@ 100 μ DFT/coat to obtain a total DFT of 200 μ shall be applied after proper surface preparation as per guidelines in 5.1.6.
 - In case of paint systems as per sl. Nos. 6.3 and 6.4, the colour bands shall be applied over the aluminum paint as per the colour coding requirement for specific service of piping given in clause 9.0.
 - For piping, equipment, vessels, columns & valves etc, scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, and PR etc.

TABLE-7: COATING SYSTEMS FOR EFFLUENT TREATMENT PLANT (ETP)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
7.1	For external surfaces of C.S./M.S. items: screens, walk way bridges, baffles, dual media filters, vertical pumps, piping in treated effluent sump, bio sludge pump, screw pump and pump house, CS tanks, sumps and vessels.					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-6A @100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat (2x100+40 =240)	305-315	-
7.2	For internal surfaces of CS/MS Items: bio-sludge sump, filter feed sump, process sump, sanitary sump, transfer sump, sludge, slop oil tank, scrapping mechanism in clarifier.					
	-14 to 80	SSPS-SP-10	1 coat of F-6A @ 65-100µ DFT/coat.	2 coats of F-6A @100µ DFT/coat (2x100=300)	300	Note-1
7.3	All R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc. in process sump, TPI separator (process and oil), aeration tank and transfer sump etc.					

	-14 to 80	Blast cleaning to SSPC-SP guide lines and acid etching with 10-15% HCl acid followed by thorough water washing.	Epoxy screed lining	3000	Epoxy screed lining shall be applied as per manufacturer and Engineer-In-Charge instructions
7.4	CS dual media filters, chemical dosing tanks – internal surface				
	Up to 60	SSPC-SP-10	1 coat of clear two component solvent free vinyl ester primer @ 100μ DFT/ Coat + 2 coats of F-20 @ 500μ DFT/ Coat	1100	-

TABLE-8: EXTERNAL COATING SYSTEMS FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system (Note-1)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
8.1	All external surfaces of shell, wind girders, appurtenances, roof tops of all above ground tank including top side of external and internal floating roof and associated external structural works.					
8.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75μ DFT/coat + 1coat of P-6 @ 40μ DFT/ coat	2 coats of F-6B @ 100μ DFT /coat + 1 coat of F-2 @ 40μ DFT/ coat	345-355	F-6 should be suitable for occasional water immersion
8.1.2	81 to 150	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat + 1 coat of F-15 intermediate coat @ 80μ DFT/coat	1 coat of F-15 finish coat @80μ DFT/ coat + 1coat of F-2 @ 40μ DFT/ coat	280	-
8.1.3	151 to 400	SSPC-SP-10	1coat of F-9 @ 65-75μ DFT/coat	2 coats of F-12 @20 μ DFT/ coat or 1 coat of F-16 @ 125 μ DFT / coat	105-115 or 190-200	

8.2	External surfaces of bottom plate (in contact with soil) for all storage tanks.					
8.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7@ 100μ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service
8.2.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 400μ DFT/ coat	1 coat of F-17 finish coat @ 400μ DFT/ coat	800-825	-
8.3	For underside of the bottom plate (not in contact with soil) (in case tank is not lifted during PWHT) (Note- 2)					
8.3.1	-29 to 400	SSPC SP-10	1 coat of inert polymeric matrix coating @ 125 μ	1 coat of inert polymeric matrix coating @ 125 μ	250-300	-

Notes for TABLE-8:

- All paint coating application including primer for tanks shall be carried out at field after erection and completion of entire welding.
- For underside of bottom plate :
 - Painting shall be carried out before laying the bottom plate for tanks with non-Post Weld Heat Treatment (PWHT).
 - For tanks with PWHT, painting shall be carried out after PWHT.
 - In case tank is not lifted during PWHT then painting shall be applied before laying the bottom plate, clause no.8.3.1 shall be followed.

TABLE-9: INTERNAL COATING SYSTEMS FOR CARBON STEEL AND LOW ALLOY STORAGE TANKS

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
9.1	All internal surfaces of Crude oil, ATF, turpentine oil, lubricating oil tanks but not limited to: Underside of floating roofs, internal surface of cone roof, inside of bottom plate, internal surfaces of shell for full height, underside of floating roof, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					

9.1.1	-14 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat	240	-
9.2	All internal surfaces of Petroleum products & intermediates like LDO, HSD, gas oil, feeds of FCC-PC, FCC-LCO, VGO-HDT, ISOM, DHDT, reformat, DCU, NHT & gasoline, naphtha, isomerate and kerosene tanks but not limited to: Underside of floating roofs, internal surface of cone roof, inside of bottom plate, internal surfaces of shell for full height, underside of floating roof, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
9.2.1	-14 to 45	SSPC-SP-10	1 coat of F-9 @ 65-75 μ DFT/coat	-	65-75	-
9.2.2	46 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat	240	-
9.3	Potable, Raw & Fire water All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.3.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100 μ DFT/coat	2 Coats of F-6A @ 100μ DFT/ Coat (2x100=200)	300	-
9.4	De-mineralized (DM) water & Condensates etc.: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.4.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100μ DFT/coat	2 coats of F-6C @ 200μ DFT/ coat (2x200=400)	500	Single coat of F-6C @ 400 μ is also acceptable
9.4.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat (80+80=160)	240	-
9.5	Hydrochloric acid (HCl) 10 %: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					

9.5.1	-14 to 60	SSPC-SP-10	1 Coat of clear two component solvent free vinyl ester primer @ 100μ DFT/ Coat	2 Coats of F-20 @ 500μ DFT/ Coat	1100	-
9.6	Aggressive solvents like hexane, hexene, benzene, xylene and toluene etc.: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.6.1	-14 to 65	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	-	65-75	-
9.7	Ethylene glycol tanks: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.7.1	All	SSPC-SP-10	-	3 coats of vinyl chloride co-polymer @ 75μ /Coat; (3x75=225)	225	-
9.8	Inside pontoon and inside of double deck of all floating roofs					
9.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100μ DFT/coat	1 coat of F-8 @ 100μ DFT/coat	200	-
9.8.2	81 to150	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat (80+80=160)	240	-
9.9	Wet slops, amine solutions, sour water , water draw off: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.9.1	-14 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	1 coat of F-15 intermediate coat @ 80μ DFT/coat + 1 coat of F-15 finish coat @ 80μ DFT/ coat (80+80=160)	240	-
9.10	All internal surfaces of Vacuum residue, fuel oil , dry slop, bitumen and other high temperature hydrocarbon liquids but not limited to: Underside of floating roof, internal surface of cone roof, bottom plate, inside of bare shell for full height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel and ladders					
9.10.1	Up to 150	SSPC-SP-10	-	1 coat of F-17 @ 400μ DFT/coat	400	-

9.11	Alkalis up to 50 % concentration: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.11.1	Up to 60°C	SSPC-SP-10	1 coat of F-15 primer @ 80μ DFT/ coat	2 Coats of F-6 A @ 100μ DFT/coat (2x100=200)	280	-

TABLE-10: COATING SYSTEMS FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND VESSELS

Sl. No.	Design Temp. in °C	Surface Preparation & Shop Primer	Coating system		Total DFT in Microns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
10.1	Underground carbon steel plant piping					
10.1.1	25 to 80	-	SSPC-SP-10; 1 coat of synthetic fast drying primer 25 @μ DFT/ coat	1 layer of coal tar tape coating @ 2mm +1 coat of synthetic fast drying primer @25 μ DFT/ coat + 1 layer of coal tar tape coating @ 2mm /layer as per EIL standard No. 6-79-0011 (Latest revision)	4 mm	Primer DFT is not measurable Re-conciliation primer shall be done by coverage of maximum 10 sq. m/litre
10.1.2	81 to 150	-	SSPC-SP-10; 1 coat of F-17 primer @400 μ DFT/ coat	1 coat of F-17 @ 400 DFT/coat	800	Note-2
10.2	External side of underground storage vessels					
10.2.1	-45 to 80	SSPC-SP -10; 1 coat of F-9 @ 65-75μ DFT/ coat	-	3 coats of F-7 @ 100μ DFT/coat	365-375	-
10.2.2	81 to 150	SSPC-SP -10	1 coat of F-17 primer @400 μ DFT/ coat	1 coat of F-17 @400μ DFT/ coat	800	Note-2

Notes for TABLE-10:

- 1 For underground vessels, scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, PR etc.
- 2 This coating system can be used for the lines/equipment/vessels which have operating temperature between ambient and 150 °C (normal operating temperature) with occasional rise in the temperature up to 200 °C (design temperature).

TABLE-11: COATING SYSTEMS FOR UNDER INSULATION (ALL UNIT AREAS & OFFSITES)

(For insulated piping, equipment, storage vessels, tanks, columns etc. of CS, LTCS, Low alloy steel & stainless steels in all environments.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating system		Total DFT Microns (min.)	Remarks
			Primer	Finish paint		
11.1	Carbon steel, LTCS and Low alloy steel Piping, Storage tanks, Vessels, Equipment etc.					
11.1.1	-45 to 125	SSPC-SP-10; 1coat of F-15 @ 75μ DFT/coat	None	2 coats of F-15 @75μ DFT/coat	225	
11.1.2	126 to 450	SSPC-SP-10; 1 coat of F-16 @ 125μ DFT/coat	None	1 coat F-16 @ 125μ DFT/coat	250	
11.2	Stainless Steel, Alloy Steel, Duplex Stainless steel, Super Duplex stainless steel & Alloy-20 Piping, Tanks, Vessels & Equipment etc.					
11.2.1	-45 to 125	SSPC-SP-7; (15-25μ surface profile) 1 coat of F-15 @75 μ DFT/coat	None	2 coats of F-15 @75μ DFT/coat	225	
11.2.2	126 to 550	SSPC-SP-7; (15-25μ surface profile) 1 coat of F-16 @125μ DFT/coat	None	1 coat of F-16 @125μ DFT/coat	250	
11.3	Cyclic service of CS, LTCS, SS, & Alloy Steels (Note-1)					
11.3.1	-45 to 150 (Note-1)	SSPC-SP-10 For CS, LTCS & low Alloy steel. SSPC-SP-7 for SS; (15-25μ surface profile) 1 coat of F-15 @75 μ DFT/coat	None	2 coats of F-15 @75μ DFT/coat	225	Note-2

11.3.2	-29 to 400 (CS) -180 to 400 (SS) -29 to 650 (LAS)	SSPC-SP-10 for CS, LTCS & Alloy steel. SSPC-SP-7 for SS (15-25μ surface profile) 1 coat of F-16 @ 125μ DFT/coat	None	1 coat of F-16 @ 125μ DFT/coat	250	Note-3
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Notes

1. In case of overlapping of cyclic temperature ranges as mentioned in 11.3.1 and 11.3.2 then clause 11.3.1 shall be followed.
2. Alternatively, for this temperature range, 1 coat of F-17 @ 400 μ is also acceptable.
3. The coating system applicable for any other temperature range shall be reviewed if it is encountered.

General notes for TABLE-11:

1. "Cyclic Service" is characterized by rapid or periodical temperature fluctuation or temperature cycles.
2. The blasting abrasives for SS and alloy steels shall be aluminum oxide or garnet only.
3. For insulated vessels & equipment scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, and PR etc.

TABLE-12: COATING SYSTEMS (INTERNAL PROTECTION) FOR CARBON STEEL COMPONENTS OF COOLERS/CONDENSERS WITH FRESH COOLING WATER SERVICE

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Up to 80	SSPC-SP-10	1 coat of F-15 @ 80 μ DFT/coat	2 coats of F-15 @ 80 80 μ DFT/coat	240	-
12.2	81 to 150	SSPC-SP-10	---	2 coats of F-17 @ 400μ/coat	800	-

TABLE-13: COATING SYSTEM (INTERNAL PROTECTION) FOR GALVANIZED OR NON FERROUS OR STAINLESS STEEL/ DUPLEX STAINLESS STEEL COMPONENTS OF COOLERS/ CONDENSERS WITH FRESH COOLING WATER SERVICE

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Up to 80	Sweep Blasting	1 coat of F-15 @ 80μ DFT/coat;	2 coats of F-15 @ 80μ DFT/coat;	240	-
13.2	81 to 150	Sweep Blasting	-	2 coat of F-17@ 400μ/coat	800	-

Note:

Coating systems in Table – 12 & 13 are applicable only as per the requirement specified in the data sheets of the respective exchangers/equipment.

8.0 STORAGE

8.1 All paints and painting materials shall be stored in rooms only which are 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 word “PAINT STORAGE- NO NAKED LIGHT-HIGHLY INFLAMMABLE” shall be clearly displayed outside. Manufacturers’ recommendation shall be followed for storage of paint materials.

9.0 COLOUR CODE

The colour coding shall be as per Annexure 1.

9.1 Identification

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines, ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

9.2 Ground colour

On un-insulated pipes, the entire pipe has to be painted in ground colour. On metal clad insulated lines, minimum 2 m long portion should be painted.

9.3 Colour bands

9.3.1 Location of colour bands:

- At battery limits.
- Intersection points & change of direction points in piping.
- Midway of piping section, near valves, across culverts.
- At 50 m interval on long stretch pipes.
- At starting and termination points.

9.3.2 Minimum width:

NB	Width
3" and below	75 mm
Above 3" to 6"	NB X 25 mm
Above 6" to 12"	NB X 18 mm
Above 12"	NB X 15 mm

For insulated pipes, NB indicates OD of the insulation.

Sequence: Colour bands shall be arranged in sequence as shown above and the sequence follows the direction of flow. The width of the 1st Band to 2nd band is 4:1.

Wherever deemed required by process department or safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of black and golden yellow as per IS : 2379.

9.4 Identification markings on equipment/piping

Equipment tag numbers shall be stenciled/neatly painted using normal 'Arial' lettering style on all equipment and piping (both insulated & un-insulated) after completion of all paint works. Lettering colour shall be either black or white, depending upon the background, so as to obtain good contrast.

Operations group shall specify the location of the marking.

Size of the marking shall be as follows:

Columns, vessels, heaters	:	150 mm
Pumps and other M/c-machinery	:	50 mm
Piping	:	OD / 2 with maximum 100 mm
Storage tanks	:	(as per drawings)

9.5 Colour coding for control valve

- Carbon steel body : Light grey
 - Alloy steel body : Canary yellow
 - Stainless steel body : Natural
- b) The actuator of the control valve shall be painted as:
- | | | |
|--|---|-------|
| Direct action (open on air failure) valves | : | Green |
| Reverse acting (close on air failure) valves | : | Red |

The painting status shall be comprehensively updated every 6 months for compliance.

10.0 IDENTIFICATION OF VESSELS, PIPING ETC.

10.1 Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or un-insulated) after painting. Line number in black or white shall be stenciled on all the piping of more than one location as directed by Engineer-In-Charge. Size of letter printed shall be as below:

Column & vessels	:	150 mm (high)
Pump, compressor & other machinery	:	50 mm (high)
Piping	:	40-150 mm

10.2 Identification of storage tanks

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

11.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

11.1 The following items shall be painted for camouflaging, if required by the client:

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

11.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per clause 11.3 and as per the instructions of Engineer-In-Charge.

11.3 Method of camouflaging

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

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

11.3.2 The patches should be asymmetrical and irregular.

11.3.3 The patches should be inclined at 30° to 60° to the horizontal.

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

11.3.5 The patches should not coincide with the corners.

11.3.6 Slits and holes shall be painted in dark shades.

11.3.7 Width of patches should be 1 to 2 m.

12.0 QUALITY CONTROL, INSPECTION AND TESTING

12.1 All painting materials including primers and thinners brought to site by CONTRACTOR for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturers' test certificates. Paint formulations without certificates are not acceptable (see section 14.0 & 15.0).

12.2 The CONTRACTOR must produce test certificate from pre qualified paint manufacturer for various tests as detailed out in section 15.0 of this document. The Engineer-In-Charge shall have the right to test wet samples of paint at random for verifying quality of paint supplied. CONTRACTOR shall arrange to have such tests, when required by Engineer-in-Charge, performed at his cost at any one of the NABL accredited laboratories.

Samples for the test will be drawn at random in presence Engineer-In-Charge or his representations. Following tests to be carried out if called for by Engineer-in-Charge:

- Specific Gravity
- % solids by weight (% zinc content in case of inorganic or organic zinc primer)
- Drying time (touch dry & full curing)
- Adhesion
- Storage stability (pot life)

Test methods for above tests shall be as per relevant ASTM or ISO Standard.

12.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise 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

Following tests are to be carried out during surface preparation:

- Test for presence of oil/grease and contamination

The steel substrate after degreasing as per SSPC-SP-1 shall be tested as per following procedure to validate absence of oil and grease contamination:

- a) Visual inspection - continue degreasing until all visible signs of contamination are removed.
- b) Conduct a solvent evaporation test by applying several drops or a small splash of residue-free tri-chloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination. Continue degreasing and inspection till test is passed.
 - Tests for surface finish of blasted surface shall be done by visual inspection using SSPC-VIS1. Clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on blasted surface. Checks shall be done on each component at least once per 200 m² of blasted surface and a minimum of 3 checks per shift.
 - Test for presence of soluble salt as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg/m². Checks shall be done on each component at least once per 200 m² of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit, the contaminated surface

shall be cleaned by method as per Annexure-C of IS 12944-4 (water cleaning). After cleaning, surface shall be retested for salt after drying.

Blast Profile Measurement: (In-Process testing during actual production before application coating)

The angular profile depth measurement shall be done by profile tape as per method NACE Standard RP 0287 or ASTM D 4417 method B (Profile depth gauge micrometer). Spot measurement shall be carried out every 15m² of blasted surface. At each spot three measurements shall be taken over an area of 10 cm² and average of measurements to be recorded and reported.

If profile is <65 microns blasting shall continue till greater than 65 microns depth profile is achieved.

Tests for blasting media, blasting air

Blasting Media (For every fresh batch of media and one random test during blasting)

Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.

- a) Inspection for the absence of oil contamination shall be conducted using following procedure :
 - Fill a small clean 200 ml bottle half full of abrasive.
 - Fill the bottle with potable water, cap and shake the bottle.
 - Inspect water for oil film/slick. If present, the blasting media is not to be used.
- b) Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.
- c) Clean blasting equipment, especially pot and hoses, and then replace blasting media and retest.

Test for Blasting Air (Once Daily before start of blasting and once at random during blasting)

The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.

In addition to above, record should include type of shop primer already applied on equipment e.g. zinc silicate or zinc rich epoxy or zinc phosphate. 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 rectifying any defects found during final inspection/guarantee period/defect liability period as defined in general conditions of the 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 coat should have prior approval of Engineer-in-charge.

12.4 Final inspection of finished coating shall consist of the following:

- 1) Coating dry film thickness check:** DFT measurement shall be as per ISO 2808. Type II electromagnetic gauges should be used for ferrous substrates. DFT gauge calibration, number of measurement shall be as per SSPC-DA-2. Measured DFT shall be within + 10% of the dry film thickness, specified in the specifications.
- 2) Adhesion testing:** Adhesion of the primer to the steel substrate and inter-coat adhesion of the subsequent coat(s) after curing for at least a week after application of the topcoat shall be examined by a knife test in accordance with ASTM D6677. For the knife test, if the rating is better than 8, the adhesion is considered acceptable. The adhesion is destructive and tested areas shall be repaired afterward using the spot repair procedure. Alternatively, the applicator may perform the adhesion test on a steel panel coated using the same surface preparation and coating application procedure as the work piece. Adhesion testing shall be carried out for each component at least once per 200 m² of coated surface.
- 3) Holiday detection check:** Holiday testing shall be conducted in accordance with NACE SP0188. For immersion services, 100% of coated area shall be inspected for holidays. For atmospheric exposure, 10% of coated area which must include weld seams, corners and edges to be holiday tested. Voltage at which test is to be carried out will depend upon DFT of coating being tested and shall be as per NACE SP0188. Any holiday is unacceptable and should be marked and repaired immediately.

The CONTRACTOR shall arrange for spot checking of paint materials for specific gravity, glow time (ford cup) and spreading rate.

13.0 GUARANTEE

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.

14.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting CONTRACTOR who is awarded any job for EIL, Projects under this standard must have necessary equipment, machinery, tools and tackles for surface preparation, paint application and inspection. The CONTRACTOR must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The CONTRACTOR supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

15.0 QUALIFICATION/ACCEPTANCE CRITERIA FOR PAINT COATING SYSTEM

15.1 Pre-qualification of paint coating manufacturer and his products

Paint manufacturer meeting the following requirements shall be considered by the CONTRACTOR for supply of the paint products.

- Manufacturer should have been in continuous business of paint coating formulation and manufacturer for at least past 5 years.
- Manufacturer should possess past experience of supplying his products to hydrocarbon, petrochemical, fertilizer. Chemical processing industry or offshore platforms in the past 5 years.
- Coating manufacturer should have supplied at least 10000 litre of an individual product to hydrocarbon, petrochemical, fertilizer. Chemical processing industry or offshore platforms.
- The manufacturer's manufacturing procedure & QA/QC system shall meet ISO 9001 requirements and preferably should possess ISO 14000 certificate.
- The Quality control set up should be manned by qualified paint technologists whose bio data should be sent along with quality control organization chart.

CONTRACTOR shall procure the paint materials from the qualified manufacturer meeting above requirements and after obtaining prequalification testing approval as per requirements mentioned in clause 15.2 below.

15.2 Pre-Qualification Testing procedure:

The paint manufacturer engaged by the mechanical contractor shall carry out the tests in NABL accredited government laboratories like national test house (NTH), as a part of qualification. Paint manufacturer shall provide the paint samples to laboratory for testing of the parameters mentioned in Table-2 (typical characteristics) and Table-15 (tests on coating systems) of this specification. The testing laboratory will confirm the compliance of the paint material with respect to the acceptance criteria mentioned in the respective tables. Contractor shall furnish these test certificates along with all necessary supporting documents/information to EIL site for approval/ acceptance. The paint manufacturer will be qualified and approved by EIL site for supply of paints after review/assessment of the submissions made by the contractor. Test certificates which are more than 3 years old will not be considered. Paint manufacturers are advised to carryout pre-qualification testing accordingly for paints supply to EIL projects.

TABLE-15: PRE-QUALIFICATION TESTING

SYSTEM No.	COATING SYSTEM	REFERENCE CLAUSE (from table-3 to 12)	TOTAL DFT μ (min)
1.	F-9+P6+F6B+F2	6.2	345
2.	F12+F12+F12	6.4	60
3.	F15+F15+F15	9.1.1	240
4.	F16+F16	8.3.1	250
5.	F17	9.10.1	375
6.	F8+F8	9.8.1	200
7.	F20+F20	9.5.1	1100
8.	F6A+F6C+F6C	9.4.1	500
9.	F6A+F6A+F6A	9.3.1	300

S. No.	TEST	FOR SYSTEM NUMBER	DURATION	ACCEPTANCE CRITERIA
1.	<u>Cyclic Test</u> Salt Spray : 72 hrs. Drying in air: 16 hrs. UV-A340 nm weather meter: 80 hrs. One cycle: 168 hrs. (25 cycles at 168 hrs. each cycle) (ASTM D5894)	1	4200 hrs	Shall pass. No chalking, cracking, flaking, blistering or peeling shall be observed.
2.	Chemical Resistance Test (ASTM D543)			
2a.	10% & 40% NaOH	3,5,7 & 9* *H ₂ SO ₄ solution pH = 5.0 to 5.5 for system 9	1000 hrs	Shall pass. No cracking, discoloration, blistering, peeling or softening of film shall be observed.
2b.	5% H ₂ SO ₄		168 hrs	
2c.	Xylene		4 weeks	
2d.	Acetone		4 weeks	
2e.	Ethanol		4 weeks	
2f.	Kerosene		4 weeks	
2g.	Sea water		2000 hrs	
3.	Immersion in DM/DI water @90° (ASTM C868)	3,5 & 7	30 days	No softening, blistering or film damage.
4.	Resistance to DM water using water immersion. (ASTM D870)	8	2000 hrs	Shall pass. No chalking, cracking, flaking, blistering or peeling.
5.	100% Humidity Test (ASTM D2247)	1 to 9 (except system-2)	1440 hrs	Shall pass
6.	Thermal Shock Resistance Test; 5 cycles @ 30 minutes in furnace at 120 ° C and 15 minutes in water after quenching in water for each cycle. (ASTM D2485 method A)	2,3 & 4 (For system-2, testing to be done after heating the panels at 175°C for	-	Shall pass

		2 hrs.)		
7.	Cathodic Disbondment Test (ASTM G8 @60°C)	3&5	-	Shall pass

Each coating product to be qualified shall be identified by the Specific gravity of base and curing agent (ISO 2811). The identification shall be carried out on the batch, which is used for the pre-qualification testing.

15.3 Information to be furnished during delivery of paint materials:

CONTRACTOR along with delivery of paint material has to furnish following information from paint manufacturer to EIL for acceptance/approval of products:

a) Batch test certificates:

Along with paint products delivery to site from the pre-qualified coating manufacturer, CONTRACTOR has to produce test certificate (from paint manufacturer) for each category of product for the following test items. All test results must mention clearly the batch no. and category of product tested. Tests to be conducted for following properties:

- Specific Gravity
- % solids by weight (% zinc content in case of inorganic or organic zinc primer)

b) Product information sheet/ technical data sheet for each category of product.

The contractor shall be fully responsible for the quality of the paints products as per prequalification testing. After the paint materials are supplied to site, the supplier shall organize random sampling and testing in a NABL laboratory as per discretion of the Engineer-in-charge. Failing to meet the specified quality requirements may cause rejection of the paint products.

16.0 METHOD OF SAMPLING & DISPATCH FOR LABORATORY TESTING

(Pre-Qualification tests (sec. 15.2), Batch testing (sec. 15.3) and Inspection testing (sec. 12.0))

- 16.1 Samples of coating materials should be submitted to the laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory.
- 16.2 All test panels should be prepared by testing laboratory. Surface preparation for a system shall be done in accordance with this specification. For individual products testing, minimum shall be Sa 2.5. Colour photographs of test panels should be taken before and after the test and should be enclosed along with test report. Sample batch no. and manufacturer's test certificate should be enclosed along with the report. Test report must contain details of observation and rusting if any, as per the testing code.
- 16.3 Manufacturers should intimate EIL, details of sample submitted for testing, name of testing agency, date, and contact personnel of the testing agency.

ANNEXURE -1

COLOR CODE

Chapter V

COLOUR CODING

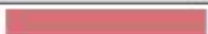
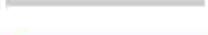
5.1. The following colour coding scheme shall be generally followed:

<i>Sl.No</i>	<i>Service</i>	<i>Ground Colour</i>	<i>1st Colour Band</i>	<i>2nd Colour Band</i>
1	Drinking water	Sea Green	French blue	Signal red
2	DM water	Sea Green	Orange	---
3	Cooling water	Sea Green	French blue	---
4	Boiler Feed Water	Sea Green	Gulf red	---
5	Fire water	Fire Red	--	---
6	Steam condensate	Sea Green	Light brown	---
7	HP Steam	Aluminium	Signal red	---
8	MP Steam	Aluminium	French blue	---
9	LP Steam	Aluminium	Canary yellow	---
10	Plant Air	Sky blue	French blue	---
11	Instrument Air	Sky blue	Gulf red	---
12	Hydrogen	Canary Yellow	Signal red	French blue
13	Nitrogen	Canary Yellow	Black	---
14	Flare Gas	Aluminium	Signal red	---
15	ATF	Aluminium	Black	---
16	SKO	Aluminium	Golden yellow	---
17	HSD	Aluminium	French blue	---
18	Naptha	Aluminium	Dark brown	---
19	Reformer Naptha	Aluminium	Dark brown	French blue
20	VGO	Aluminium	Golden yellow	Signal red
21	Liquid LPG	Aluminium	Signal red	Green
22	Vapour	Aluminium	Signal red	Black
23	Crude Oil	Aluminium	Black	French blue
24	RCO	Aluminium	Black	Brown
25	Fuel Gas / sweet gas	Canary Yellow	Silver grey	
26	Sour gas	Canary Yellow	Grey	Violet
27	Amine	Admiral Grey	Signal red	Lt. brown
28	Acid	Violet	Canary yellow	
29	Other chemicals	White	Violet	Signal red
30	Caustic	White	Violet	
31	Phosphate	Violet	Orange	White

Note : All LPG service PSCs shall be painted Blue.

All drains & Vents shall be painted in Main line colour

COLOUR CODING FOR EQUIPMENT AND STRUCTURES (UN-INSULATED)

Sr.	Service	Recommended Colour	RAL No.	Approx. Appearance
1	Heater Structure	Iron Grey	7011	
2	Heater Casing	Heat-Resistant White Aluminium	9006	
3	Vessels & Columns	Heat-Resistant White Aluminium	9006	
4	Hydrogen Bullets	Antique Pink	3014	
5	LPG Vessels	Oxide Red	3009	
6	Sulphur Dioxide (SO ₂) Vessels	Lemon Yellow	1012	
7	Heat Exchangers	Heat-Resistant White Aluminium	9006	
8	Furnace Oil & Hot Tanks	Jet Black	9005	
9	All other Tanks	Heat-Resistant White Aluminium	9006	
10	Caustic / Amine / Acid Tanks	Golden Yellow	1004	
11	Sour Water	Sky Blue	5015	
12	Outer Surfaces in Boiler House	Heat-Resistant White Aluminium	9006	
13	Compressors & Blowers	Basalt Grey	7012	
14	Pumps	Pigeon Blue	5014	
15	Turbines and Generators	Pebble Grey	7032	
16	All Electrical Equipment including Motors (Indoors & Outdoors)	Light Grey	7035	
17	Hand Railings, support post & Toe guard.	Canary Yellow	1016	
18	Staircase, Ladders & Walkways	Jet Black	9005	
19	Lifting Equipment & Accessories	Clay Brown	8003	
20	General Structure	Smoke grey (BS381C-692)	-----	

Signature Not Verified

Digitally signed by MEHAM SINGH
Date: 2026.04.24 17:56:49 IST
Location: eProcure-EPROC