1.0 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Temperature Gauges & Thermowells along with its accessories.

2.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3.0 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

ANSI/ASME	ASME B 16.5	Steel Pipe Flanges and Flanged Fitting
	ASME B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges
	ASME B1.20.1	Pipe Threads
IEC-529	Degree of Protection by Provided by Enclosures	
SAMA	Scientific Apparatus Maker's Association	
IS-2147`	Degree of Protection provided for Enclosures for Low Voltages Switch gear and control gear.	
IS-7358	Specification for Thermocouples	

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets
b. Job Specifications
c. Standard Specifications
d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4.0 MATERIALS

Materials requirements for Temperature Gauge shall be in accordance with the Data sheets and Company's Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / ISO-15156 latest editions

For all Temperature Gauges, the case & bulb / stem material shall be as a minimum SS316 unless otherwise specified in the Data Sheet. Capillary tubing shall be of SS316 as a minimum with stainless steel flexible armoring and PVC covering over armor.

The casing of the Temperature Gauge shall be as a minimum weather proof to IP-65 & suitable for outdoor installation.

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5.0 DESIGN

5.1 General

The following design requirements cover the general requirements of Temperature Gauge & Thermowells. But for the exact requirement and applications, the relevant job specification and design basis shall be referred and complied.

5.2 Temperature Gauges

Local Temperature Gauges shall be Liquid / vapor / Gas filled type in general and shall be manufactured as per relevant SAMA Class. Bimetallic gauges can also consider if approved by Purchaser. All local Temperature Gauges shall have 150 mm dial size. The bulb size shall be selected to suit the Thermowell.

In vibrating service filled type Temperature Gauges with capillary extension shall only be used. Temperature Gauges shall have accuracy of ±1% URV (Upper Range Value). Bimetallic type dial thermometers shall be avoided where excessive vibrations are encountered, such as compressors. Only filled type with capillary extension shall be used in such cases.

Temperature Gauges shall be of the separate socket type suitable for well installation. Upon assembly of components, the Temperature Gauge element shall firmly contact the bottom of the well. The well shall fit the gauge stem so that maximum transfer rate results. Thermometer stem adjustable gland with union connection and bushing shall be suitable for ½ NPTF connections.

For filled system type Temperature Gauges, the SAMA (Scientific Apparatus Makers Association) classification shall be decoded as below.

SAMA CLASS	FILLING FLUID
I	Liquid
II	Vapor
III	Gas
IV	Mercury

Unless otherwise specified, the Temperature Gauges shall have an over range protection of at least 30% of the specified range.

All other technical details of the Gauges are defined on the Data Sheet

5.3 Name Plate

Each Temperature Gauge Shall have a SS name plate attached firmly to it at a visible place, furnishing the following information:

a. Tag number as per Data Sheet
b. Manufacturer’s name and trade mark

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5.4 Thermowell

Thermowell material shall be as a minimum SS316 unless otherwise specified and shall be machined out of forged bar-stock. Built-up Thermowells can be considered for immersion length greater than 500mm and when special pipe materials are needed for the well. Built-up Thermowells shall be used in low pressure and velocity services like in fired heaters.

Thermowells natural frequency calculations, where specified on the Data Sheet, are required for review. The base of the Thermowells shall be chosen to fit the instrument without air gap for minimizing measuring lag.

Immersion length of Thermowells shall be as follows:

Line Size	Immersion Length
From 4" to 6"	280mm
From 8" Onwards	320mm
Vessels / Columns	400mm

In special applications, not covered above, Vendor shall decide the immersion length based on actual requirements. Immersion length is based on 200 mm length between flange face and inner wall of pipe.

Thermowells shall be capable of withstanding the maximum design temperature and Pressure of the system. Any pipe line less than 4" nominal bore shall be blown to 4" size to install Thermowell.

Unless otherwise specified, the following shall govern:-

a. Threaded end connections shall be to NPT as per ANSI/ASME B 1.20.1. b. Flanged end connections shall be to ANSI/ ASME B 16.5.
b. Where ring type joint flanges have been specified, the groove shall be suitable for octagonal rings as per ANSI/ ASME B 16.20 unless otherwise specified.
c. Flange face finish shall be serrated concentric to paragraphs 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ANSI/ASME 816.5. The face finish as specified in Data Sheets, shall be as follows:-

i. Serrated	250 to 500 AARH
ii. 125 AARH:	125 to 200 AARH
iii. 63 AARH	32 TO 63 AARH

5.5 NAME PLATE DETAILS

The following information shall be punched on the extension of the Thermowell:

a. Tag number as per Purchaser's Data Sheets.
b. Material of the well to the same standards as in Purchaser's Data Sheets.

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c. Thermowell immersion length 'U'.

The following information shall be punched on the Thermowell flange at a visible place:-

a. Nominal flange size in inches and rating in pounds.

b. Flange material to the same standards as per Purchaser's Data Sheets.

6.0 FABRICATION

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Temperature Gauges & Thermowells. Vendor shall submit the required specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein. Painting of Temperature Gauges & Thermowells is in accordance with Company Painting Specifications.

All equipment's shall be coated with anticorrosive paints for a corrosive, near shore environment. Vendor in compliance with the written procedures recommended by the manufacturer shall prepare his own coating procedures including surface preparation and application of coating and curing. Vendor's painting/coating system shall be submitted along with the bid for Buyer's review and approval.

All material shall be new, clean and free from rust, pits and obvious defects.

7.0 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Pressure Transmitter shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

Unless otherwise specified, Purchaser reserves the right to test and inspect all the items at the Vendor's works. Vendor shall submit following test certificates and test reports for Purchaser's review:-

a. Material test certificate (MIL Certificate) for Thermowells and flanges.

b. Certificate of Radiography / X-ray for welded joints. Dye penetration test certificate shall be provided for joints where Radiography / X-ray is not possible.

c. Certificate for concentricity of bore.

d. Hydrostatic test report as Para 7.1 of this specification.

e. Type test report for enclosure class for Temperature Gauges.

f. Calibration report for Temperature Gauges

g. Dimensional Test Report

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7.1 Hydrostatic Test

Each Thermowell made of bar stock or built up type shall be subjected to hydrostatic test for a time period of 20 minutes at the following pressures:-

a. Inside of the well	100 kg/cm2 up to 600# flange rating.
	200 Kg/cm2 above 600# flange rating.
b. Outside of the well	As per flange rating.

During and after the hydrostatic test, the Thermowell shall not show any leaks or rupture.

7.2 Witness Inspection

All Temperature Gauges and Thermowells shall be offered for pre-dispatch inspection for following, as a minimum:-

a. Physical dimensional checks and workmanship.

b. Hydrostatic test on Thermowells at random.

c. Calibration including establishing accuracy and repeatability over the entire range.

d. Review of all certificates and test reports as indicated in Para 7.0 of this Specification.

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

7.3 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Temperature Gauges & Thermowells complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Temperature Gauges & Thermowells.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual inspection

b. Calibration

c. Functional test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

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7.4 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the Temperature Gauges & Thermowells as per the approved test procedure. A comprehensive test procedure in compliance with the Company Specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Pressure Transmitters functions correctly and properly in accordance with the specified requirements.

8.0 MARKING, PACKING AND SHIPMENT

Temperature Gauges & Thermowells Vendor shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9.0 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.

b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Pressure Switch, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

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10.0 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Bill of Materials including Vendor list, details of third party items;

c. Catalogues and Manuals;

d. Quality Assurance Plan;

e. A list of accessory item together with manufacturer's name and part number.

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

f. Specifications, Data Sheets;

g. Bill of materials including Vendor list, details for third party items;

h. Catalogues, Manuals and relevant drawings and documents;

i. Dimensional drawings;

j. Calibration certificates;

k. Material test certificates;

l. Procedures for FAT;

m. Quality Assurance Plan;

n. Any Other documents.

10.3 Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
RTD'S AND THERMOCOUPLES

VCS-SS-IN-5102_02

02	**11.05.2022**	**SV**	**KNC**	**HK**	**GVW**
01	**18.01.2020**	**KS**	**VB**	**KNC**	**AD**
00	**23.05.2018**	**ND**	**UM**	**KP**	**AD**
Rev. No	**Date**	**Prepared By**	**Checked By**	**Approved By**	**Authorized By**

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REVISION RECORD

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00	23.05.2018	Neha Dev	Udit Manichanda	K.Prasanth	Anupam Das	
01	18.01.2020					Format change and document numbering is revised.
		Karan Singh	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
IEC	International Electro technical Commission
IP	Ingress Protection
IS	Indian Standard
NACE	National Association of Corrosion Engineers
SAMA	Scientific Apparatus Makers Association
SS	Stainless Steel
RTD	Resistance Temperature Detector

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1.0 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of RTD'S And Thermocouples RTD'S And Thermocouples along with its accessories.

2.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3.0 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

ANSI/ASME	ASME B 16.5 Steel Pipe Flanges and Flanged Fitting
	ASME B 16.20 Ring Joint Gaskets and Grooves for Steel Pipe Flanges
	ASME B1.20.1 Pipe Threads
IEC-529	Degree of Protection by Provided by Enclosures
IEC-751	Industrial Platinum Resistance Thermometer Sensor
IEC-5842	Thermocouple Tolerances
SAMA	Scientific Apparatus Maker’s Association
IS-2147	Degree of Protection provided for Enclosures for Low Voltages Switch gear and control gear.
IS-2148	Flameproof Enclosures for Electrical Apparatus
IS-7358	Specification for Thermocouples
DIN-43760	Temperature Vs resistance curves for RTD's.
NACE	National association of corrosion Engineers MR-01-75

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

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4.0 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / ISO-15156 latest editions.

5.0 DESIGN

The following design requirements cover the general requirements of RTD & Thermocouples. But for the exact requirements and applications, the relevant, specific Job Specifications and design basis shall be referred and complied. For remote temperature Indication / recording / control / switch etc., Thermocouples or Resistance Temperature Detector (RTD) shall be used depending on the process requirements. Elements shall be spring loaded, mineral insulated and shall have stainless steel sheath.

To avoid the need to provide barrier glands for electrical entries , RTD'S And Thermocouples shall be of a type which provide positive protection against process fluids entering the electrical housing in the event of element failure i.e., by means of a solid barrier and a vent.

5.1 Resistance Temperature Detectors

The RTD assemblies shall be furnished with threaded heads. The heads shall consist of a case, screwed on cover and terminal block. The RTD shall be screwed to the terminal block. A heat resistant and moisture proof gasket shall be fitted between the case & cover. There shall be an extra terminal in the terminal block connected to the head for grounding the shield.

Unless otherwise specified, the assembly shall confirm to the following standards:

a. The heads shall be weather proof to IP-65 as per IEC-529 / IS-2147.

b. In case of flame proof construction, heads shall be flame proof as per IEC-79 / IS-2148 & weather proof to IP-65 as per IEC-529 / IS-2147.

The connecting terminals shall be properly numbered and shall be permanently and legibly identified. The leads shall be copper, up to terminal block. The RTD's shall be of three wires unless otherwise specified. The element shall be of highly refined material of reference grade and shall have been stress relieved.

The wire shall be wound on a ceramic core and immobilized against strain or damage. The winding shall be of bifilar type. The element shall be within a metal sheath, in a manner which provides good thermal transfer and protection against moisture.

RTD (Resistance Temperature Detector) shall be platinum element 3-wire type with 100 ohms resistance at 0°C calibrated as per IEC 751 / DIN 43760, unless otherwise specified. RTD shall be used within a temperature range of -200 to 650°C. Three wire systems shall be adopted in connecting the element. RTD shall be used where accuracies of the order of 0.25% or better and smaller measuring spans are required. Twin element sensors, if used, shall have two separate cable entries.

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5.2 Thermocouples

Thermocouple assemblies shall be furnished with threaded heads. The heads shall consist of a case, screwed on cover and terminal block. The Thermocouple shall be screwed to the terminal block. Thermocouple assemblies shall be furnished with weatherproof screw type heads.

Unless otherwise specified, the assembly shall confirm to the following standards:

a. The heads shall be weather proof to IP-65 as per IEC-529 / IS-2147.

b. In case of flame proof construction, heads shall be flame proof as per IEC-79 / IS-2148 & weather proof to IP-65 as per IEC-529 / IS-2147.

c. Thermocouples shall be as per IEC-5842 / IS-7358 and shall have a wire size of 18 AWG for single and 20 AWG for duplex Thermocouples.

Thermocouples shall be magnesium oxide (MgO) filled undergrounded type, unless necessary otherwise, the type of Thermocouple shall be selected based on temperature.

Following guidelines shall be followed:-

Copper - Constantan (ISA-Type-T)	(-) 200 to 200°C
Chromel - Constantan (ISA-Type-E)	(-) 200 to 600°C
Iron - Constantan (ISA-Type-J)	0 to 600°C
Chromel -Alumel (ISA-Type-K)	600 to 1200°C
Platinum Rhodium- Platinum (ISA Type-S)	600 to 1600°C

A heat resistant and moisture proof gasket shall be fitted between the case and cover. The case shall be suitable for mounting terminal blocks for single or duplex type Thermocouple element assemblies. The Thermocouple assemblies shall be spring loaded. The thermocouple properties and limits of error shall be as per IEC-5842.

The terminals shall be permanently and legibly identified for their polarity. The terminal block shall be permanently and legibly marked with the ISA letter code to designate the type of Thermocouple. There shall be an extra terminal connected to the head for grounding, wherever required. The design of Thermocouple assemblies shall be such that replacement on line is possible.

Thermocouple shall be 316 Stainless Steel sheathed magnesium oxide insulated, ungrounded type, unless otherwise specified.

5.3 Name Plate

Each Thermocouple / RTD assembly shall be provided with a stainless steel nameplate attached firmly to it.

a. Tag number as per Purchaser’s Data Sheets.

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b. Thermocouple type as per ISA/ RTD element type.

6.0 FABRICATION AND TESTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Thermocouple & RTD. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing mentioned herein. Painting of Thermocouple & RTD Shall be in accordance with Company Painting Specifications.

7.0 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Pressure Switch shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the RTD'S And Thermocouples complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Pressure Gauge.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual inspection

b. Dimensional check

c. Functional test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Thermocouple & RTD as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

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The Site Acceptance Test (SAT), in general, shall demonstrate that the Switch functions correctly and properly in accordance with the specified requirements.

8.0 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Thermocouple & RTD shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9.0 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.

b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Pressure Switch, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10.0 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

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10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Bill of Materials including Vendor list, details of third party items;

c. Catalogues and Manuals;

d. Quality Assurance Plan;

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

e. Specifications, Data Sheets;

f. Bill of materials including Vendor list, details for third party items;

g. Catalogues, Manuals and relevant drawings and documents;

h. Dimensional drawings;

i. Calibration certificates;

j. Material test certificates;

k. Procedures for FAT;

l. Quality Assurance Plan;

m. Any Other documents.

10.3 Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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STANDARD SPECIFICATION
FOR
TEMPERATURE TRANSMITTER

VCS-SS-IN-5103_02

02	11.05.2022	SV	KNC	HK	GVW
01	18.01.2020	KS	VB	KNC	AD
00	23.05.2018	ND	UM	KP	AD
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	**If in soft and signed**

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REVISION RECORD

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.05.2018	Neha Dev	Udit Manichanda	K.Prasanth	Anupam Das	
01	18.01.2020					Format change and document numbering is revised.
		Karan Singh	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
IEC	International Electro technical Commission
NACE	National Association of Corrosion Engineers
HART	Highway Addressable Remote Transmission
PROM	Programmable Read only Memory
RTD	Resistance Temperature Detector
HHC	Hand Held Communicator
LCD	Liquid Crystal Display
IP	Ingress Protection

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1.0 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Temperature Transmitter.

2.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3.0 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

ANSI/ASME	ASME B 16.5 Steel Pipe Flanges and Flanged Fitting
	ASME B 16.20 Ring Joint Gaskets and Grooves for Steel Pipe Flanges
	ASME B1.20.1 Pipe Threads
IEC-529	Degree of Protection by Provided by Enclosures
IEC-60529	Degrees of protection provided by Enclosures (IP Code)
IEC-60770	Transmitters for use in Industrial Process control systems
IEC-60751	Industrial Platinum resistance thermometer sensors
BS-5345	Electrical and Instruments in Hazardous Areas.
IS-2147	Degree of protection Provided for Enclosures for Low Voltage Switch gear and control gear
IS-2148	Flameproof Enclosures for Electrical Apparatus
NACE MR-01-75	Material Requirement- Sulfide stress cracking Resistant Material for oil Field Equipment (Latest)

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

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4.0 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / ISO-15156 latest editions.

5.0 DESIGN

5.1 General

The temperature element type shall be as specified in the Data Sheets unless otherwise specified. The Temperature Transmitters should be "SMART' type suitable for analog signal transmission using HART protocol and have a non-volatile memory, unless otherwise specified. A self-diagnostic facility shall be available. The Transmitters shall be certified for use in a hazardous area classified as mentioned in Data Sheet. The Vendor shall supply the extension cable between the temperature element and the Transmitter. All field Transmitters shall have an accuracy of 0.25% of span and shall be provided with output meter / output gauge at the signal output. Burn out protection must be provided with Temperature Transmitters and trip amplifiers. Upscale or down scale protection shall be decided based on its application to ensure fail safe operation.

5.2 Element

If element is RTD, then RTD shall comply with IEC 60751. The RTD shall be three-wire type unless otherwise specified and shall have a resistance value of 100 ohms at 100°C.

5.3 Output

Transmitter output shall be 4-20 mA analog signals complying with HART protocol. The Transmitter power supply shall be normally 24 VDC, arranged for two wire transmission, with minimum power supply voltage of 12.5 VDC.

5.4 Electronics

The Transmitter electronics shall be solid state with appropriate smart circuitry. Printed circuit boards should be of a replaceable modular construction and shall be hermetically sealed or protected by a corrosion resistant coating. It should be supported against vibration in the case of plug-in type circuit boards. Signal wiring terminals and electronics shall be housed in separate compartments so that the electronics remain sealed during electrical connection to the signal cable. The electronics system shall be provided with environmental protection cover.

5.5 Calibration / Configuration

It shall be possible to perform on-line and remote set point configuration / calibration of the transmitter via a hand held communicator (HHC) The HHC shall be of easy to use and shall be suitable for use in the area classification specified in this Specification. The analog output of the transmitter shall not be affected during communication with the HHC. At least one number of hand held configurator shall be supplied as a minimum

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5.6 Adjustments

The zero and span of the Transmitters shall be adjusted through a hand held communicator (HHC). A facility for engineering unit selection shall be available from the hand held communicator. The zero and span adjustments shall be non-interactive and continuously adjustable.

5.7 Indication

The Transmitters shall be provided with integral digital output indicator with 4 digits, LCD readout. The output meter scale meter shall cover the range specified in the Data Sheets, with selectable indication either in the specified engineering units or in percentage value.

5.8 Performance

The Transmitter accuracy, including the combined effect of linearity, hysteresis and repeatability shall be equal to or better than as stated in the Data Sheets. With reference to IEC 60770, errors shall be expressed as percentage of calibrated span, unless stated otherwise

5.9 Temperature Compensation

The Transmitter electronics shall include for the temperature compensation. The sensor characterization curve shall be stored in PROM.

5.10 Transmitter Housing

The instrument housing shall be low copper aluminum coated with epoxy paint. The epoxy coating shall be as per the industry standard, and shall be done on dry blast clean surface. The ingress protection for the enclosure shall be IP 65 as a minimum. No aluminum in its un-anodized form shall be used. No copper or its alloys shall be used except in its plated or tinned condition. No plastic shall be used except with a UV filter. The unit shall be supplied in housing suitable for outside (field) mounting in service conditions mentioned in the data sheets. Transmitters shall be installed in a sunshade for protection against direct sunlight.

5.11 CABLE ENTRY / CONNECTION

The electrical signal cable entry shall be M20. Unused cable entries shall be plugged off in compliance with the specified electrical safety rating. Signal wiring terminals shall be of the screw type.

5.12 TAGGING

Transmitters shall be provided with an identification plate, with all data clearly stamped on a corrosion resistant plate permanently attached to each instrument by means of rivets or pins and shall indicate, as a minimum, the following:

a. Name of the Manufacturer or trademark.
b. Instrument tag number.
c. Serial number

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d. Year of manufacture
e. Range & calibration (including units of measurement)
f. Type of input
g. Electrical safety (Type of Protection)
h. Output signal.
i. All information on the nameplate shall be die- stamped or deep engraved.

6.0 FABRICATION

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Temperature Transmitter. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing mentioned herein. Painting of Thermocouple & RTD shall be in accordance with Company Painting Specifications.

7.0 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Temperature Transmitter shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Temperature Transmitter complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Temperature Transmitter.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual inspection
b. Dimensional check
c. Functional test
d. Any other relevant test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

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7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Temperature Transmitter as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Temperature Transmitter correctly and properly in accordance with the specified requirements.

8.0 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Temperature Transmitter shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9.0 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

I. Itemized recommended spare parts list for start-up and pre-commissioning.
II. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Pressure Switch, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

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All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10.0 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;
b. Bill of Materials including Vendor list, details of third party items;
c. Catalogues and Manuals;
d. Quality Assurance Plan;

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

a. Specifications, Data Sheets;
b. Bill of materials including Vendor list, details for third party items;
c. Catalogues, Manuals and relevant drawings and documents;
d. Dimensional drawings;
e. Calibration certificates;
f. Material test certificates;
g. Procedures for FAT;
h. Quality Assurance Plan;
i. Any Other documents.

10.3 Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
PRESSURE SAFETY RELIEF VALVE

VCS-SS-IN-5504_02

02	11.05.2022	SV	KNC	HK	GVW
01	18.01.2020	DG	VB	KNC	AD
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Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	**If in soft and signed**

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REVISION RECORD

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.05.2018	Neha Dev	Udit Manichanda	K.Prasanth	Anupam Das	
01	18.01.2020					Format change and document numbering is revised.
		Debayan Ghoshal	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

AARH	Arithmetic Average Roughness Height
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
FAT	Factory Acceptance Test
IBR	Factory Acceptance Test
ISO	International Organization for Standardization
MOP	Maximum Operating Pressure
NACE	National Association of Corrosion Engineers
NPS	Nominal Pipe Size
NPT	Nominal Pipe Thread
PSV	Pressure Safety Relief Valve
SAT	Site Acceptance Test
Sec	Section

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1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Pressure Safety Relief Valves along with its accessories.

2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

American National Standard Institute (ANSI) / American Society of Mechanical Engineers (ASME)

B1.20.1	Pipe Threads
B 16.5	Steel Pipe Flanges and Flanged Fitting
B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges
B 16.34	Valves- Flanged, Threaded and Welding End

American Society of Mechanical Engineers (ASME)

Sec-VIII	Boiler and Pressure Vessel Code Section VIII 'Pressure Vessels'
Sec-I	Boiler and Pressure Vessel Code Section-I 'Power Boilers'

American Petroleum Institute (API)

API-520	Sizing, selection and installation of pressure relieving devices in refineries Part I Sizing & Selection Part II Installation
API-521	Guide for Pressure Relieving and Depressurizing systems
API-526	Flanged Steel Pressure Relief Valves
API-527	Seat Tightness of Pressure Relief Valves
EN10204	Inspection Documents for Metallic Products
IBR	Indian Boiler Regulations

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

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Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / IS0-15156 latest editions.

5 DESIGN

5.1 Valve Design

5.1.1 The definitions of various terminologies used in Purchaser's Data Sheets are as per clause 1.2 of API RP 520 PART 1.

The design of pressure relief valves in steam service under IBR design code shall be governed by regulation 294 and regulation 295 of IBR. However where design code is specifically indicated as ASME SECTION-I, the valve design shall meet the pressure safety relief valve requirements specified in ASME SECTION-I.

Adequate support of relief valves shall be provided, since they are subjected to high reaction forces when they are relieving.

The Valve body, end connections shall be of the same material as the piping material Specification. The body and internal material shall meet the design temperature. Material selection should be in accordance with API STANDARD 526.

Pressure loss between the equipment / vessel nozzles and the inlet of the Valve shall not exceed 3% of the Valve set pressure.

5.2 Type and Selection of Safety Relief Valve

Safety Valves shall be primarily used for Compressible fluids and Safety Relief Valves shall be used for incompressible fluids.

Unless otherwise specified, the Safety Relief Valves shall be non-balanced closed bonnet direct spring-loaded type, i.e. conventional. For special applications pilot operated Safety / Relief Valves or air-assisted Relief Valves may be employed. Safety Valve sizing shall be as per API 520 and the allowable accumulation shall be as per ASME CODE. The Valve sizes, inlet/outlet connections, orifice area shall be sized as per API 526. The range of standard sizes used and the set pressure limits shall be sized in accordance with standard API 526.

The orifice designations, materials, area, end connection sizes and rating shall be as per API RP 526 for flanged steel Safety Relief Valves. Seat tightness requirements and testing shall be as per API RP 527.

Set pressure and accumulation pressure shall be as per the applicable pressure vessel design code:

ASME section VIII	Pressure Vessels
ASME section I	Power boilers / Steam generators

Generally the Thermal Relief Valve shall be modified or semi-nozzle type. Thermal Relief Valves shall have an orifice area of 0.11 Sq. in. and minimum size shall be 101 unless otherwise specified.

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Where a number of Relief Valves are provided in parallel, the set pressures may be staggered to avoid valve chatter.

The criteria for the selection of a Relief Valve shall be as given below:

5.2.1 Conventional Safety Relief Valve

The Blow down shall not exceed 3% of the valve set pressure as per standard ASME SECTION I and shall not exceed 7% of the valve set pressure as per standard ASME SECTION VIII.

a. Non-balanced spring-loaded relief valves

A conventional Pressure Safety Relief Valve shall be a self-actuated spring loaded Pressure Safety Relief Valve which shall be designed to open at a pre-determined pressure and protect a vessel or system from excess pressure by removing or relieving fluid from that vessel or system.

i. A conventional Safety/Relief Valve shall be used in the following cases:

ii. Back pressure (super-imposed and built-up) is constant.

iii. Superimposed back pressure is less than 5% and built-up back pressure is less than 10% of the set pressure with overpressure at 10%.

iv. Superimposed back pressure is less than 10% and built-up back pressure is less than 20% of the set pressure with accumulation at 21%.

For cases where a constant back pressure is exerted, the spring of the Safety Relief Valve should be selected and set for the difference between the set pressure (being the maximum allowable working pressure) and the constant back pressure. Spring-loaded Relief Valves connected to a closed discharge system shall always have a closed Bonnet.

Blow down ring shall be provided to adjust the blow down line within 2.5% to 7% of the Valve set pressure.

b. Non-balanced spring-loaded relief valves

A balanced Pressure Safety Relief Valve shall be a spring loaded Pressure Safety /Relief Valve which incorporates a bellows or other means of balancing the Valve disc to minimize the effects of back pressure on the performance characteristics of the Valve.

A balanced type of Safety/Relief Valve shall be provided when the variable back pressure (gauge) is higher than allowed for a conventional Valve.

The maximum superimposed and built-up back pressure (gauge) shall not exceed 65 % (Preferably 50%) of the set pressure (gauge) for relief of vapors or flashing liquids.

Safety/Relief Valves of the balanced type shall have a vented bonnet which shall be vented to atmosphere in such a manner as to prevent the ingress of rain and dirt. Hazards to personnel should be avoided. However, any flow from the vent should be visible.

Whenever the balanced bellow spring type Valve is used, there is always a potential risk of bellow rupture or damage. In such applications, the Valve with supplementary piston shall be provided. The outlet Valve line size shall be large enough to accommodate the internal drain or in case of the balanced bellow spring type Valve, the vent shall be directly routed to the flare atmosphere.

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5.2.2 Pilot – Operated Relief Valve

Pilot Design shall be inherently fail safe. Self-actuated Pilot operated Valves shall be of pop / modulating action and it shall be supplied with main Valve and pilot Valve completely piped and tubed along with other accessories specified such as back-flow preventer. Pilot-operated Safety Relief Valves may be used in a clean gas or liquid service where proper operation of the pilot Valve is always assured, provided that, where required, permission has been obtained from local authorities. The pilot Valve shall be of the non-flowing type. With this type, the flow through the pilot lines and pilot valve ceases immediately when the main valve opens, thus minimizing the likelihood of foreign matter being drawn into the small bore sections of the Valve.

Situations in which pilot-operated Safety Relief Valves are particularly suitable are:

a. Where the pressure loss between the protected equipment and the inlet flange of the Relief Valve exceeds 3 % of the set Pressure of the Relief Valve;

b. Where high back-pressures (50 % to 70 % of set pressure) are possible;

c. If the margin between the maximum operating pressure (MOP) of the protected system and the Relief Valve set pressure is less than 10 % of the relief valve set pressure.

The O-ring and diaphragm material of pilot shall be suitable for the pressure and temperature conditions specified in the data sheet.

All Pressure Safety Relief Valves in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connections shall be blinded / plugged after this degreasing process to avoid images of oil particles.

Normally pilot operated Valves are provided with soft seals which give a better valve tightness.

5.2.3 Rupture Disc

Generally Rupture discs shall be used where:

a. Relief loads caused by unexpected sources cannot be handled fast enough by Safety Relief Valves.

b. On the inlet side of a Relief Valve to protect the valve if the process fluid is extremely corrosive, or polymerizes, or to ensure against valve leakage of hazardous and toxic fluids.

When the rupture disc is used in association with the Safety Relief valve to protect the valve internals, the line pressure of rupture disc/valve void shall be monitored using Pressure gauge.

Unless otherwise specified, the bursting tolerance of the disc shall be as follows:

a. For bursting pressure of 1 bar gauge and above, tolerance shall be ±5% of the specified bursting pressure or less.

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b. For bursting pressures below 1 bar gauge Vendor's stated bursting tolerance is acceptable.

Where Vacuum services are encountered, Vendor shall provide vacuum supports. Retainer ring shall also be provided to hold the vacuum support and the rupture disc in place.

5.3 Valve Sizing

5.3.1 Sizing shall be carried out using the formulae mentioned in the following standards whenever the sizing code mentioned in the Purchaser's Data Sheets refers to these;

Sizing Code	Standard
API	API RP 520 Part I API RP 521
ASME	Boiler and Pressure vessel code Section VIII 'Pressure Vessels'. Boilers and Pressure vessel code Section-I. - 'Power Boilers'
IBR	Indian Boiler Regulations, paragraph - 293

5.3.2 Discharge Co-efficient

Following discharge coefficient values shall be used for sizing of Pressure Relief Valves;

a. For all Valves in gas, vapor or steam service with design code as ASME Sec VIII or ASME Section I discharge co-efficient of 0.975 as per API 520 shall be used.

b. For all Valves in steam service covered under IBR design code, discharge coefficient shall either be selected as per Regulation 293 or as tested and certified by IBR as per Appendix 'L' of IBR.

c. For Valves in liquid service, the discharge coefficient of 0.62 shall be used as per API 520. However Vendor may use the ASME certified valve coefficients when Pressure Safety Relief Valve with liquid trim design are offered.

d. For the selected orifice letter designation and inlet and outlet size of the Pressure Safety Relief Valve, relieving area of the valve offered by Vendor shall meet those in API-526.

e. The discharge capacity of the selected Pressure Safety Relief Valves shall be calculated based on certified ASME capacity curves or by using ASME certified discharge coefficient and actual orifice area. Higher valve size shall be selected in case pressure safety relief valve discharge capacity so computed, is less than the required flow rate.

f. For Pressure Safety Relief Valve covered under ASME SEC-I design code, the Valve design shall conform to ASME SECTION I requirements with selected area higher of the area calculated as per ASME SECTION I requirements and that calculated as per regulation 293 of IBR.

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5.4 Valve Construction

5.4.1 Body

a. The Valve body material shall be in accordance with the piping material Specification and rating with a minimum of ANSI 150 Ibs. Minimum inlet connections for flanged valves are 1-inch.

b. Flanges shall be integrally cast type, slip-on or weld-on flanges shall not be allowed, except as approved by the Company.

c. Unless otherwise mentioned, end connection details shall be as below:

   i. Threaded end connections shall be to NPT as per ANSI/ASME B 1.20.1.

   ii. Flanged end connections shall be as per ANSI/ASME B 16.5.

d. Flanged face finish shall be as per clauses 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ANSI/ASME B 16.5.The face finish as specified in the Data Sheets, shall be as follows;

125 AARH	125 to 200 AARH
63 AARH	32 to 63 AARH

e. For flanged Valves, inlet and outlet sizes and ratings and centre to flange face dimensions shall be in accordance with API-526. Dimensional tolerance shall be as mentioned therein.

f. Body drain with a plug shall be provided as a standard feature on every pressure relief valve.

g. For the pilot operated Pressure Relief Valves, where Vendor's standard model provides only semi nozzle design (i.e. the body is part of the inlet flow path), body material shall be of the same material as that of nozzle specified in Purchaser's Data Sheets, as a minimum.

5.4.2 Trim

a. The term 'trim' covers all the parts of the valves exposed to and in contact with the process fluid except for the body and bonnet assembly i.e. nozzle, disc, disc holder, stem etc.

b. Wherever stelliting of disc and nozzle has been specified, it stands for stelliting of the seat joint and the entire disc contour, unless otherwise mentioned.

c. For high temperature application, the materials for the internals shall be selected to avoid galling.

d. Pressure Relief Valves with design as per ASME Section I shall have two adjustable rings to adjust Valve over-pressure and blow down.

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e. Resilient seat, seals or O-rings wherever used shall be suitable for pressure and temperature conditions specified.

f. Gaskets wherever used shall be metallic type. Gaskets with asbestos filler or with asbestos bearing material shall not be used.

5.4.3 Nozzle Disc

a. The Valves shall be full Nozzle - full lift type. The nozzle shall be of forged construction. A full nozzle shall be used for conventional and balance bellows type, for Valve size 1" and larger. Semi-nozzle are acceptable for pilot operated PSV, in accordance with API RP-520.

b. Valves shall be of the full nozzle type of design with the exception as per clause 5.3.4 and Valves in Thermal Relief application.

c. Modified nozzle shall be provided for Thermal Relief Valve services for Valve sizes not greater than 3/4"x 1" unless otherwise specified.

d. The disc is a piston type held against process pressure by a spring, Disc, nozzle, guide and ring are Vendor's standard stainless steel as a minimum except where the line classification dictates a better material.

5.4.4 Bonnet & Spring

a. Lifting lever shall be provided whenever the fluid to be relieved is steam and air or water above 65°C.

b. Bonnet shall be of the closed type for all process applications in general. Open type bonnet shall be used only for steam and non-hazardous/non-toxic fluids. For all steam applications under design code IBR or ASME Section-I with open bonnet design, weather protection cover shall be provided.

c. Carbon steel springs shall be made corrosion resistant through plating/coating as per Manufacturer's standard design or as specified in the Purchaser's Data Sheets.

d. Spring material is carbon steel up to 230°C and tungsten steel for higher temperatures. The spring is adjustable for popping pressures within Code allowances above and below initial set pressure.

e. The spring shall be designed for specified set pressure and suitable for a minimum range of adjustment within +/-10% of set pressure specified for set pressure range below 17 bar and within +/-5% of set pressure above 17 bar.

f. The allowable tolerance in set pressures are as below:

   i. ±0.14 kg/cm2g for set pressure upto and including 5 kg/cm2g.

   ii. ±3% for set pressure above 5 kg/cm2g.

g. The springs of safety relief valves shall be protected with a suitable coating to prevent the occurrence of general corrosion and / or sulfide stress corrosion cracking.

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5.4.5 Cap

All Valves shall be provided with a cap over the adjusting bolt. Cap shall be of either bolted type or screwed type as specified in the Purchaser's Data Sheets with the cap material being the same as for the body. The cap and bonnet will be provided with lugs for wire seal after setting the Valve. Bolted cap will also be provided as per the requirements.

5.5 Name Plate

All Pressure Gauges shall be marked as per Manufacturer's standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

a. Tag number as per Data Sheet;

b. Manufacturer's serial number and / or model number;

c. Manufacturer's name / trade mark;

d. Nominal Flange size in inches and rating in pounds for both inlet and outlet;

e. Orifice letter designation;

f. Valve set pressure;

g. Cold Bench test set pressure.

6 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Pressure Safety Relief Valve. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein. Painting of Pressure Safety Relief Valve shall be in accordance with Company painting Specifications.

7 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Pressure Safety Relief Valve shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Pressure Safety Relief Valve complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Pressure Relief Valve.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

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The FAT shall be consisting of the following as a minimum:

a. Visual inspection

b. Dimensional check

c. Calibration

d. Cold bench set pressure test

e. Functional test

f. Non-Destructive examination of individual components of PRV.

g. Hydrostatic pressure Test

h. Seat tightness Test

i. Hardness test as per NACE MR01-75 (If Applicable)

j. Any other tests

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Pressure Safety Relief Valve as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Pressure Safety Relief Valve functions correctly and properly in accordance with the specified requirements.

8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Pressure Safety Relief Valve shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

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9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.
b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Pressure Safety Relief Valve, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Sizing calculations;

c. Bill of Materials including Vendor list, details of third party items;

d. Catalogues and Manuals;

e. Quality Assurance Plan;

f. Any other documents.

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company’s approval:

a. Specifications, Data Sheets;

b. Sizing calculations;

c. Bill of materials including Vendor list, details for third party items;

d. Catalogues, Manuals and relevant drawings and documents;

e. Dimensional drawings;

f. Detailed sectional drawings showing all parts with reference numbers;

g. Calibration certificates;

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h. Material test certificates;

i. Installation procedures for PSV and its accessories

j. Procedures for FAT;

k. Quality Assurance Plan;

l. Any Other documents.

10.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
GAS OVER OIL ACTUATOR

VCS-SS-IN-5505_02

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01	18.01.2020	DG	VB	KNC	AD
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01	18.01.2020					Format change and document numbering is revised.
		Debayan Ghoshal	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

ABBREVIATION

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ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
BS	British Standard
FAT	Factory acceptance Test
IEC	International Electro-technical Commission
OD	Outer Diameter
NACE	National Association of Corrosion Engineers
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
IP	Ingress Protection
ISO	International Organization for Standardization
SAT	Site Acceptance Test
SS	Stainless Steel
NPT	Nominal / National Pipe Thread

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1.0 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, inspection and testing, documentation, marking, packing and shipping of Gas over Oil Actuator along with its accessories.

2.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3.0 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

American Society for Mechanical Engineers (ASME)

ASME B 1.20.1	Pipe Threads, General Purpose (Inch)
ASME B31.3	Process Piping
ASME B 31.4	Pipeline transportation systems for liquid hydrocarbons and other liquids
ASME B 31.8	Gas Transmission And Distribution Piping Systems
ASME B16.5	Pipe flange and flange fittings Valves Flanged, threaded and weld ended
ASME Sec V	Non - destructive examination
ASME Sec VII Div-1	Rules for construction of Pressure Vessels
ASME Sec VIII	Boiler and Pressure Vessels code & Sec- IX
ASME Sec IX	Welding and Brazing qualification

American Petroleum Institute (API)

API 6D	Specification for Pipeline valves

British Standards

BS 5500	Unfired fusion welded pressure vessels

International Electro-technical Commission (IEC)

IEC 60079	Electrical apparatus for explosive gas atmosphere
IEC 60529	Degrees of protection provided by enclosures (IP Code)

National Association for Corrosion Engineers

NACE MR-0175	Material Requirements - Sulphide Stress Cracking Resistant Metallic Materials for Oilfield Equipment

3.2 Order of Precedence

In the event of conflict between Specifications, Data Sheets, related standards, codes etc., and the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

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4.0 MATERIAL

Materials selected shall be in accordance with the Data Sheets and Company's Standard specifications. For Corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / IS0-15156 latest editions.

5.0 DESIGN

The following design requirement covers the general requirements of Gas over Oil Actuator. But for the exact requirements and applications, the relevant specific project Specifications and design basis shall be referred and complied.

5.1 General

The basic requirements for Actuators are as follows:

a. Actuator shall be Gas over Oil type, quarter turn operation type.

b. Actuator torque shall be, minimum 1.25 times the maximum valves break torque required at full rated differential pressure of valve.

c. Vendor shall indicate actuator model no., valve torque and actuator torque figures in a tabular form along with the quotation. Vendor shall submit the form for Buyer's review.

The torque figure shall be expressed in Newton Metres (NM) and shall be given for the following valve positions:

i. Start to open torque (Breakaway torque)

ii. Lowest running torque during opening of the valve

iii. End of opening torque (Valve fully open)

iv. Start to close torque (Breakaway torque)

v. Lowest running torque during closing of valve

vi. End of closing torque (Reset torque, valve fully closed)

In addition, the maximum torque the valve shaft can withstand shall be stated. The results of the actuator sizing calculations, together with the selected actuator type / size and above stated torque figures, shall be submitted for approval.

d. Pneumatic/Hydraulic connections shall be of 1/2" NPT (F) size as minimum. Pneumatic tubing shall be SS-316.

e. Valve with actuator shall be suitable for installation in horizontal pipeline.

f. All Pneumatic tube fittings shall be of SS-316 and of SWAGELOK / PARKER make.

g. All accessories as applicable shall be mounted on the SS back plate, which in turn shall be mounted on the actuator.

h. Actuators shall be equipped with adjustable stoppers for opening and closing of the valves. At normal operating conditions these stoppers at the actuators shall be limiting the opening and closing of the valves.

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i. The actuator local control panel shall be weatherproof to IP-65 as better. The logic components / tubing inside the panel shall be of SS-316 materials as minimum. All the electrical components mounted inside the panel shall be intrinsic safe and shall be certified by a statutory body like UL / BASEEFA/FM or Equal.

Local/ Remote selector switch shall be provided on the actuator control panel for local/

Remote operation.

The Control logic shall enable the following:

a. Local and Remote operation of the Valve.

b. Local Function shall include open/close Push Button facilities.

c. Remote function shall facilitate remote closure and opening of the valve (without any manual intervention if all the process interlocks are met). In case electrical signal to solenoid valve fails, the valve shall remain in the last position and shall not be "Closed" i.e. "Stay Put Position".

d. Manual local hydraulic operation of the valve, with hand pumps, in case of non-availability of the pneumatic (gas).

e. High differential pressure inhibit switch shall inhibit the operation of the valve, when the differential pressure becomes high.

f. Close command (or open command) shall be inhibited during valve opening (or valve closing) and be made effective only after 100% opening (or closing) is achieved.

Gas storage tank and Hydraulic cylinders shall be sized so that the Actuator / operator shall be capable of minimum, two open & close operations in the event of loss of line pressure.

Vendor shall supply gas filter regulators to derive power gas pressure to required level for the operation of the logic. Actuator sizing shall be based on minimum gas pressure as indicated in Data Sheet.

Solenoid Valves shall be mounted inside the actuator control panel for the remote open/close operation of the Valve actuators. Solenoid Valves shall be intrinsically safe and certified.

Non-Contact Proximity type switches with NAMUR design shall be provided for indication of Valve position. These shall be mounted in intrinsic safe enclosure and certified.

High differential pressure inhibit switch shall be provided on the actuator control panel. The switch shall be intrinsically safe and certified.

All equipment and accessories shall be tropicalized and provided with anticorrosion protection, suitable for use in corrosive atmosphere.

Steel castings, if any, of actuators shall be radio graphically examined.

The opening / closing timings for gas over oil-actuated valves shall be 10-40 seconds unless otherwise specified.

Material for Studs shall be ASTM A193, Grade B7 and Nuts material shall be ASTM A 194 Grade 2H.

Vendor shall provide the following contacts for Purchaser's use.

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a. Local/Remote selector switch in REMOTE position & Local position.

b. High differential pressure

c. Valve OPEN indication

d. Valve CLOSE indication

All the contacts and the "Remote Open & Closed" commands shall be provided at a terminal block in the actuator control panel.

Vendor shall provide 6 Nos. plus one spare NPT (F) cable entry on the Actuator control panel, unless otherwise specified in data sheet.

5.2 Name Plate

Each Control Valve shall have a SS name plate attached firmly to it at a visible place, furnishing the following information:

a. Tag number as per Data Sheet

b. Body and port sizes in inches.

c. Stem travel in millimeters

d. Action on air failure

e. Spring range

f. Air supply pressure.

g. Manufacturer's model number for the Valve body, actuator and positioner.

6.0 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Gas over Oil Actuator. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein. Painting of Gas over Oil Actuator Shall be in accordance with Standard Painting Specifications/Manufacturer Standard.

All equipment's and Valves shall be coated with anticorrosive paints for a corrosive, near shore environment. Vendor in compliance with the written procedures recommended by the Manufacturer shall prepare his own coating procedures including surface preparation and application of coating and curing. Vendor's painting/coating system shall be submitted during detail engineering for Purchaser's review and approval. All material shall be new, clean and free from rust, pits and obvious defects.

7.0 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Gas over Oil Actuator shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing Plan for Proprietary items / Special items for Approval.

Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

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7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Gas over Oil Actuator complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Gas over Oil Actuator.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the

Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual Inspection

b. Dimensional check

c. Chemical and mechanical properties as per relevant material standards.

d. d. Calibration

e. Actuator functional test shall be carried out by mounting the actuator on a test rig and applying the pneumatic fluid pressure. The actuator shall be successfully stroked at least five times for open and close by suitably applying the pneumatic fluid pressure. Actuator position indication shall be checked for correct operations during the test.

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

g. All casting of pressure containing parts shall be radio graphically examined as per ASTM E94 and E186 / E280 or E446 as applicable, at quality level 2-2T. Category A, B or C defects shall not exceed the severity level for Class 2. Category D, E, F or G defects shall not be accepted.

   i. All forgings shall be ultrasonically examined to ASTM E609. Quality 1 will be the minimum level of acceptance.

   ii. All machined surfaces shall be liquid penetrant examined as per ASTM E165. Surface discontinuities shall not be acceptable.

   iii. Sealing areas within the actuator body shall be completely inspected by magnetic particle methods in accordance with ASTM E709. Surface discontinuities shall not be acceptable

Complete actuator housing with internals including the open / close hydraulic circuits of all actuators shall be subjected to a hydrostatic pressure test by applying 1.5 times the actuator design pressure for a minimum period of 2 hours. Chart recorder shall monitor pressure. No leakage shall be permitted during the hydrostatic test.

h. Valve / Actuator assembly test

i. Any other tests

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After testing of individual actuators has been completed, the actuators shall be mounted on Valves. Integrated Valve and actuator tests shall be carried out at the Valve Manufacturer's Works, in compliance with the requirements stated in Purchaser Specification for Ball Valves enclosed with the Material Requisition/Purchase Order.

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test. Following certificates shall be submitted by the Vendor:

a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the actuator pressure containing parts as per the relevant standards and Specifications.

b. NDT reports for radiography, ultrasonic, magnetic particle and liquid penetrate inspection.

c. Test report on operation of actuators including operating time.

d. Test report on hydrostatic test of actuators.

e. Test report on actuator/valve assembly tests.

f. All other actuator test reports and certificates as required by this Specification.

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

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the Gas over Oil Actuator as per the approved test procedure. A comprehensive test procedure in compliance with the Standard Specification shall be developed and issued to Company / Owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Gas over Oil Actuator functions correctly and properly in accordance with the specified requirements.

Actuator shall be mounted on the valve and tested as follows:

(For buried valves stem extension shall be installed before testing)

a. Cycle (open and shut) each valve with its actuator, at least five (5) times to ensure smoothness of operation. Valve / Operator shall be adjusted and tested for 100% opening and closing at actuator stoppers. It shall be tested for both Local/Remote operations.

b. Apply the actual differential pressure as given in the Data Sheet, across the Valve and check the Valve operation. Valve operation should not be jerky or binding. This shall be repeated at least 3 times and shutdown time noted at minimum supply pressure.

c. The electrical signal to the solenoid Valves on the actuator control panel shall be disconnected and Valve shall be tested for stay put conditions.

d. Test shall be witnessed by Purchaser or their representatives.

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e. Final testing and approval made by Purchaser's representative inspector shall not relieve the Manufacturer from his own responsibilities, guarantees and contract obligations.

8.0 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for Gas over Oil Actuator shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the job site.

After inspection and testing, equipment shall be completely free of water and dry before start of preparation for shipment.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9.0 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended spare parts list for start-up, pre-commissioning and two years operation as per the following:

a. Itemized recommended spare parts list for start-up and pre-commissioning.

b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Gas over Oil Actuator, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10.0 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

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a. Specification, Data Sheets
b. Bill of Materials including Vendor list, details for third party items
c. Catalogues and manuals
d. Test procedures
e. Quality Assurance Plan
f. GOOV sizing calculations
g. Outline drawings of the assembled unit, showing dimensions, dismantling areas and weights
h. Material of construction of all components of Valves
i. Site Planning, Erection and Installation Procedures

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and Specifications for the Company's approval:

a. Specifications, Data Sheets
b. Bill of Materials including Vendor list, details for third party items
c. Catalogues, manuals and relevant drawings and documents
d. Dimensional drawings
e. Calibration certificates
f. Material test certificates
g. Procedures for FAT
h. Quality Assurance Plan
i. Field test procedures for existing Valves
j. Functional diagram (pneumatic, hydraulic and electric) pointing out external connections.
k. Schematic drawing
l. GOOV Sizing Calculation
m. Torque Calculation
n. Wiring diagram along with TB details

10.3 Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing whichever is higher. Warranty shall apply to defective material workmanship and facility design. Warranty work shall be done at Owner's local facilities. The cost of correction/replacement of any warranty items shall be borne by the Vendor.

The job Specifications / Data Sheets shall be referred for any specific warranty /guarantee.

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STANDARD SPECIFICATION
FOR
INSTRUMENTATION CABLES

VCS-SS-IN-5801_02

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01	18.01.2020					Format change and document numbering is revised.
		Rakesh Bhardwaj	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
BS	British Standards
DC	Direct Current
DIN	Deutsches Institute for numbering
EPR	Ethylene Propylene Rubber
F&G	Fire and Gas
IEC	International Electro-technical Commission
IS	Indian Standards
PVC	Polyvinyl Chloride

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1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Cables along with its spares and accessories.

2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

IEC-332-3 Part 3	Tests on bunched wires and cables
IEC 584-3 Part	Extension and compensating cables – Tolerances identification system
IEC-60332 Part 3	Tests on electric and optical fibre cables under fire conditions - Test for vertical flame spread of vertically mounted bunched wires or cables
IEC-60331	Fire-Resisting Characteristics of Electric Cables
ASTM D 2863	Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (Oxygen index)
BS-5308 Part 1	Specification for Polyethylene insulated cables
BS-5308 Part 2	Specification for PVC insulated cables
DIN-50049	Document on Material Testing
IS-1554 Part 1	PVC insulated (heavy duty) electric cables-working voltage up to and including 110 V
IS-2633	Method for testing uniformity of coating on zinc coated articles
IS-3975	Mild steel wires, formed wires and tapes for armouring cables
IS-5831	PVC insulation and sheath of electric cables
IS-8784	Thermocouple compensating cables

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

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4 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Company's Standard Specifications. Type and material of extension Cable shall be as per IS-5831 and IEC 584-3 where applicable.

Cable cores shall be of annealed electrolytic tinned copper conductor with PVC jackets conform to IS-5831. Insulation shall be Mica-glass / EPR or silicon rubber for F&G. signal/control Cables. Armouring shall be of galvanized steel wire / strip armour conforming to IS-1554. Screening / shielding shall be of black Aluminium backed Mylar / Polyester foil.

5 DESIGN

The following design requirement covers the general requirements of Instrument Cables and accessories etc., but for the exact requirements and applications, the relevant, specific job Specifications and design basis shall be referred and complied.

5.1 Signal and Control Cables

5.1.1 Type – I (Single Pair / Triad Shielded Cable)

Each core shall be 1.5 mm2, made of 7 stranded annealed electrolytic copper conductor. Each strand shall be 0.53 mm dia.

Primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS-5831 Type-C. Thickness shall be 0.5 mm minimum.

A pair or triad shall have twisted cores and number of twists shall be not less than 10 per meter. Colour of core insulation shall be black-blue in pair and black-blue-brown in a triad.

Individual pair and triad shall be shielded. Shield shall be Aluminium backed by Mylar / polyester tape with the metallic side down helically applied with either side 25 % overlap or 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm2 multistrand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with Aluminium side of the shield.

Inner and outer jacket shall be made of extruded flame retardant 90°C PVC to IS 5831 - Type ST2. Oxygen index of PVC shall be over 30 %. Temperature Index shall be over 250°C. The thickness of the jacket shall be as per IS-1554 Part-1.

Inner jacket colour shall be black. Outer jacket colour shall be black, except for cables to be used in intrinsically safe systems it shall be light blue. A rip cord shall be provided for inner jacket.

Armour over inner jacket shall be of galvanized steel wire / flat as per IS-1554 Part-1.

Tolerance in overall diameter of cable shall be within ±2 mm over offered value.

5.1.2 Type – II (Multipair / Multitriad Cable with Individual Pair Shield and Overall Shield)

a. Generally the Cable shall be same as single pair shielded Cable except conductor sizes shall be 0.5 mm2 made of 7 strands of annealed electrolytic copper conductor. Each strand shall be of 0.3 mm dia.

b. Overall shield shall be of Aluminium backed up by Mylar / polyester tape helically applied with the metallic side down with either side 25% overlap or 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be similar to individual pair drain wire and shall be of the overall shield.

c. Overall twist of all pair / triads shall be as per Vendor's standard.

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d. A pair of communication wire shall be provided for multipair / multitriad cables. Each wire shall be 0.5 mm2 of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.

e. Pair identification shall be with numbers at interval of not more than 250 mm as per vendor's standards.

5.1.3 Type – III (Multipair / Multitraid Cable with Only Overall Shield)

a. These Cables shall be same as type-II cables except that the individual pair / triad shall not have shielding.

5.1.4 Type - IV (Multipair / Multitriad Cable with Individual Pair Shield and Overall Shield)

a. The Cable shall be same as Type II except conductor size shall be 1.5 mm2 made of 7 stranded annealed electrolytic copper conductor. Each strand shall be of 0.53 mm dia.

5.1.5 Type – V (Multipair / Multitriad Cable with Overall Shield only)

a. The Cable shall be same as type IV except that the individual pair / triad shall not have the shielding.

5.2 Fire and Gas Cables shall be fire resistant and shall meet all the Specifications mentioned above and:

a. Insulation shall be Mica-Glass / EPR or silicon rubber.

b. The inner sheath shall be applied with a low smoke fire resisting compound.

c. Suitable filler material (if necessary) shall be filled.

d. Outer sheath shall be made up of low smoke, heat and oil resistant and flame retardant material.

e. Circuit integrity of the Cable shall be maintained for a minimum period of 3 hours as per IEC-60331.

f. The outer jacket colour shall be orange.

5.3 Thermocouple Extension Cables

Type and material of extension cable shall be as per IS-5831 and IEC-584-3 where applicable.

5.3.1 Type – I (Single Pair Shielded Cable)

a. Each core shall be made of 16 AWG solid conductors.

b. Primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS 5831 Type C. Thickness shall be 0.5 mm minimum. Colour coding shall be as per IS-8784 Table-5.

c. The cores of the pair shall be twisted and number of twists shall be not less than 10 per meter. The pair shall be shielded. Shield shall be Aluminium backed by Mylar / polyester tape bonded together helically applied with the metallic side down with either side 25% overlap and 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm2 multistrand bare tinned annealed copper conductor. The drain wire shall be continuous contact with Aluminium side of the shield.

d. Inner and outer jacket shall be made of extruded flame retardant 90°C PVC to IS 5831- Type ST2. Oxygen index of PVC shall be over 30 %. Temperature index shall

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be over 250°C. The thickness of the jacket shall be as per IS-1554 part-1. Inner jacket and outer jacket colour shall be as per IS-8784. A rip cord shall be provided for inner jacket.

e. Armour over inner jacket shall be of galvanized steel wire/flat as per IS-1554 Part-I.

f. Tolerance in overall diameter of cable shall be within ±2 mm over offered value.

5.3.2 Type – II (Multipair Cable with Individual Shield and Overall Shield)

a. The Cable shall be same as single pair shielded cable except for following;

i. Each core shall be 20 AWG solid conductor.

ii. In addition to individual pair shield overall shield shall be provided. Overall shield shall be of Aluminium backed up by Mylar / polyester tape helically applied with metallic side down either side 25% overlap or 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be similar to individual pair drain wire and shall be in continuous contact with the aluminium side of the overall shield.

iii. Overall twist of all pair shall be as per Vendor's standard.

iv. A pair of communication wire shall be provided for multipair cables. Each wire shall be 0.5 mm2 of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.

v. Pair identification shall be with numbers at interval of not more than 250 mm as per Vendor's standard.

5.3.3 Type – III (Multipair Cable with Individual Pair Shield and Overall Shield)

a. The Cable shall be same as type II except conductor size shall be 16 AWG.

5.4 Electrical Characterstics

5.4.1 Cable parameters L/R ratio, capacitance shall conform to intrinsic safety requirements for IS cables. Limitations for cable parameter shall be as follows:

a. Maximum DC resistance of the conductor of the completed cable shall not exceed 12.3 Ω/km at 20°C for cables with 1.5 mm2 conductors and 39.7 Ω/km at 20°C for cables with 0.5 mm2 conductors.

b. Mutual capacitance between any core and screen shall not exceed 250 pF/m at 1 KHz. Capacitance between any cores or screen shall not exceed 400 pF/m at 1 KHz.

c. L/R ratio of adjacent core shall not exceed 40 μH/Ω for cables with 1.5 mm2 conductors and 25 μH/Ω for cables with 0.5 mm2 conductors.

d. Electrostatic noise rejection ratio shall be minimum 76 dBA.

e. Drain wire resistance including screen shall not exceed 30 Ω/km.

f. Core inductance shall not exceed 4 mH/Km.

g. Values shall be derived under the fault condition in the cable which produces the worst case parameters for intrinsic safe cables.

All Cables shall have insulation voltage rating of 600 / 1100 V.

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5.5 Name Plate

All Instrument Cable shall be marked as per Manufacturer's standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

a. Tag number as per Data Sheet;

b. Manufacturer's name;

c. Details of the Cable;

d. Length of the Cable in meters contained in the drum;

e. Gross weight;

f. Direction of rotation of drum for unwinding by means of an arrow;

g. Purchase Order number.

6 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Cables. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein.

7 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Instrument Cables shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Instrument Cables, complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Instrument Cables.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

7.1.1 Standard Type Test certificate shall be furnished for Cables similar to those being offered,

a. Cable shall be flame retardant to IEC-60332 part-III category A.

b. Cables required for F&G applications shall be as per IEC-60331.

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7.1.2 Standard Routing Test (to be carried out by the manufacturer during various stages of manufacturing, test certificates shall be furnished)

a. Insulation resistance, voltage test and spark test as per 8S-5308 part-ll and sheath test as per IS-5831;

b. Armor test as per IS-3975;

c. Cable capacitance, L/R ratio and inductance test;

d. Conductor resistance test in Ohms/km;

e. Thermo emf tests for thermocouple extension cables.

7.1.3 Standard Acceptance Test shall be carried out in the presence of Purchaser or his authorized representatives,

a. Continuity test;

b. Voltage test as per 8S-5308 part-II;

c. L/R ratio and capacitance values test;

d. Oxygen index test as per ASTM D 2863 latest edition;

e. Conductor resistance and drain wire resistance;

f. Dimensional check for overall diameter and under armor lover armor diameter;

g. Fire resistant test / certificate review (when specified);

h. Tests for uniformity of galvanization of armor as per IS-2633;

i. Check for drum length and overall length tolerances.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the Cables at site which shall be witnessed by the company / owner's representative. SAT shall be performed as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Cables functions correctly and properly in accordance with the specified requirements. SAT mainly consists of the following inspections:

a. Continuity test

b. Conductor resistance and drain wire resistance

c. Drum length and overall length tolerances

d. Any other test, if required.

8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor ensure that all Cables, associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

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Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Cables shall be dispatched in wooden drums, securely battened with take-off end fully protected against damage

The ends of the Cable shall be sealed with suitable PVC / Rubber caps to prevent ingress of moisture.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.
b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Instrument Cables for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Bill of Materials including Vendor list, details of third party items;

c. Catalogues and Manuals;

d. Quality Assurance Plan;

e. Any other documents.

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

a. Specifications, Data Sheets;

b. Bill of materials including Vendor list, details for third party items;

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c. Catalogues, Manuals and relevant drawings and documents;

d. Dimensional drawings;

e. Material test certificates;

f. Procedures for FAT;

g. Quality Assurance Plan;

h. List for spare parts for start-up and for 2 years of operation.

10.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS

VCS-SS-IN-5802_02

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REVISION RECORD

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		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
FAT	Factory Acceptance Test
IEC	International Electro-technical Commission
IP	Ingress Protection
IS	Indian Standards
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
SAT	Site Acceptance Test

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1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Junction Boxes and Cable Glands along with its accessories which include the following types:

a. Electrical junction boxes

b. Pneumatic junction boxes

c. Cable glands.

2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

ASME B1.20.1	Pipe Threads
DIN 50049	Document on Material Testing
IS 5	Colours for ready mixed paints and enamels.
IS 2147	Degree of Protection provided for Enclosures
IS 2148	Flame proof Enclosure of Electrical Apparatus.
IEC 529	Degree of Protection by providing Enclosures
IEC 79	Electrical Apparatus for Explosive Gas Atmosphere
EN 837	Pressure Gauges Part-t: Bourdon Type Pressure Gauges, Dimensions, Metrology, Requirements and Testing

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4 MATERIALS

Materials selected of the Junction Boxes and Cable Glands shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / IS0-15156 latest editions.

5 DESIGN

5.1 Junction Boxes

Junction Boxes shall be either of the following type as specified in Data Sheets.

a. Weather proof Junction Boxes.

b. Weather proof and flameproof Junction Boxes.

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The enclosure shall be as per IS-2147 and IP-65 for weather proof Junction Boxes and for flameproof it shall be as per IS-2148 suitable for the area classification specified.

Number of entries and locations shall be as per Data Sheets and all the cable entries shall be bottom entries.

Junction Boxes shall be provided with telephone sockets and plugs for connection of hand powered telephone set.

5.1.1 Electrical Junction Boxes

Material shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy)

Flame proof Junction Boxes shall have detachable cover which is fixed to the box by means of cadmium plated triangular head /hexagonal head screws.

Weatherproof Junction Boxes shall have doors which shall be hinged type and these shall be fixed by plated countersunk screws.

Flameproof Junction Boxes shall have a warning engraved/integrally cast on the cover as given below;

"Isolate power supply elsewhere before opening."

Terminals shall be spring loaded, vibration proof, clip- on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.

All terminals shall be suitable for accepting minimum 2.5 sq. mm copper conductor, in general. However, for power supply distribution boxes, terminal detail shall be as per job specification/data sheets.

The Junction Box shall be sized for termination of all cores and screens including spares without the need for more than 1 core per terminal. In addition a minimum of 10 % spare terminals shall be provided, unless specified otherwise in Data Sheet.

The Junction Boxes shall have sufficient space to ensure ease of termination. Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines;

a. 50 to 60 mm between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25 mm for each additional 25 terminals.

b. 100 to 120 mm between terminals for up to 50 terminals and additional 25 mm for each additional 25 terminals.

c. Bottom/top of terminal shall not be less than 100mm from bottom/top of the Junction Box.

Terminals shall be marked as per various types indicated in Data Sheets.

Shall be provided with external earthing lugs.

5.1.2 Pneumatic Junction Boxes

Pneumatic Junction Boxes shall be made of 3 mm thick hot rolled steel. They shall have necessary neoprene gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.

Single tube entries shall be suitable for 6 mm 0.0 copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in Data Sheets.

5.2 Cable Glands, Plugs and Reducers / Adaptors

Cable Glands shall be supplied by Vendor whenever specified.

Cable Glands shall be double compression type for use with armoured cables.

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The Cable Glands shall be of nickel plated brass material unless specified otherwise in Data Sheet.

The Cable Glands shall be weather proof. Whenever specified they shall also be flameproof and certificate from statutory body shall be furnished.

Cable Glands shall be supplied to suit the Cable dimensions indicated along with tolerance indicated in Data Sheets. Various components like rubber ring, metallic ring, metallic cone and the outer/inner nuts etc. shall be capable of adjusting to the above tolerances of Cable dimensions.

Each Cable Gland shall be supplied as a kit complete with locknut, shroud, and earth tag and sealing washer with proper identification of Gland size. Shrouds provided for additional protection to the Cable Gland termination. Earth tag shall be of nickel plated brass material.

Reducers/Adaptors shall be supplied as per details indicated in Data Sheets. They shall be nickel plated brass. These shall be weather proof in general. These shall also be flame proof wherever specified and certificate from statutory body for flame proofness shall be furnished.

Stopper plugs to seal spare cable entries in the Instrument Junction Boxes shall be provided wherever specified in Data Sheet. They shall be of nickel plated brass for metallic Junction Boxes and glass fibre reinforced polyamide for non-metallic junction boxes.

Plugs shall be certified flameproof when used with Flameproof Junction Boxes.

All Cable Glands and accessories such as reducers, adaptors, stopper plugs shall be stamped with type and size of Cable Glands, type and size of entry thread and the relevant approval details.

5.3 Name Plate

All Junction Boxes shall be marked as per Manufacturer’s standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

a. Tag number as per Purchaser's Data Sheets.

b. Type of enclosure such as terminal capacity, size, IP rating, serial no etc.

c. Name of Manufacturer.

d. Type of explosion protection (as applicable)

e. Name of certifying agency and certificate number

The Tag no shall be generally white character on red background for fire & gas, white character on blue background for intrinsically safe circuits and black character on white background for all other applications.

6 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Junction Boxes and Cable Glands .Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein. Painting of Junction Box shall be in accordance with Standard Painting Specifications.

Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale

Two coats of lead - free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.

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The colour shall be as specified in Data Sheets.

7 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Junction Box and Cable Glands shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like Certificate from statutory body for suitability to install in specified area classification, dimensional test report, material test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Junction Box and Cable Glands complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Junction Box and Cable Glands.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual inspection

b. Calibration

c. Functional test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Junction Box and Cable Glands as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Junction Box and Cable Glands functions correctly and properly in accordance with the specified requirements.

8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Junction Box and Cable Glands shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

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Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Each packing shall have its weight clearly marked on it and shall be identified with the contents, purchase order no and item number.

All entries shall be installed with plastic plugs to prevent unwanted material and insects entering the instrument junction boxes.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.
b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Junction Box and Cable Glands, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Bill of Materials including Vendor list, details of third party items;

c. Catalogues and Manuals;

d. Quality Assurance Plan;

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

a. Specifications, Data Sheets;

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b. Bill of materials including Vendor list, details for third party items;

c. Catalogues, Manuals and relevant drawings and documents;

d. Dimensional drawings;

e. Calibration certificates;

f. Material test certificates;

g. Procedures for FAT;

h. Quality Assurance Plan;

10.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
INSTRUMENT TUBE FITTINGS

VCS-SS-IN-5803_02

02	11.05.2022	SV	KNC	HK	GVW
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		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
BS	British Standards
FAT	Factory Acceptance Test
IS	Indian Standards
ISA	Instrument Society of America
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
NPT	Nominal Pipe Thread
SAT	Site Acceptance Test
SS	Stainless Steel

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1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of instrument tube fittings which includes the following types :-

a. SS compression fittings (for SS tube)

b. Brass compression fittings (for copper tube)

2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

American Society of Mechanical Engineers

ASME B1.20.1	Pipe Threads
ASME B 16.5	Steel Pipe Flanges and Flanged Fitting
ASME B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges
ASMEB16.11	Forged Steel Fittings -Socket Welding and Threaded

British Standards

BS-4368	Carbon and Stainless Steel Compression Couplings for Tubes -Part-IV

Instrument society of America

ISA RP 42.1	Nomenclature for Instrument tubing fittings

Indian Standards

IS-319	Specification for free cutting Brass Bars, Rods and Sections

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / IS0-15156 latest editions.

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5 DESIGN

5.1 SS Tube Fittings

Nomenclature of all Tube Fittings shall be as per ISA RP 42.1.

Fittings shall be of flare less compression type and four - piece (for double compression type) construction consisting of two ferrules, nut and body suitable for use on SS tubes conforming to ASTM A 269 TP 316 with hardness in the range of RB 70 to 79.

All the parts shall be of SS 316.

Hardness of the ferrules shall be in the range of RB 85-90 so as to ensure a hardness difference of the order of 5 to 10 between Tube and Fittings, for better sealing.

Nuts and ferrules of a particular size shall be interchangeable for each type.

Spanner hold shall be metric.

Threaded ends of Fittings shall be NPT as per ANSI B 1.20.1.

Vendor shall ensure that the ferrules and nuts supplied for fittings shall be suitable for the sample Tube which shall be supplied during manufacture.

Specific techniques like Silver plating shall be used over threading in order to avoid jamming and galling.

5.2 Copper Tube Fittings

Nomenclature of all Tube Fittings shall be as per ISA RP 42.1.

Fittings shall be of flare less compression type and of three- piece construction consisting of ferrule, nut and body suitable for use on copper tubes conforming to ASTM B 68/B 68M hardness not exceeding RB 50.

All parts shall be manufactured from Brass as per IS 319 bar stock and nickel plated.

For better grip, Vendor shall maintain hardness difference between tube and ferrule and indicate the same along with the offer.

Nuts and ferrules of a particular size shall be interchangeable for each type.

Threaded ends of Fittings shall be NPT as per ANSI B 1.20.1.

Spanner hold shall be metric.

Vendor shall ensure that the ferrules and nuts supplied for fittings shall be suitable for sample tube which shall be supplied during manufacture.

5.3 Name Plate

No separate nameplates are required on the Fittings. However, a Manufacturer's name / trademark should be punched on a visible place on the body of each Fittings for easy identification.

6 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Instrument Tube Fittings. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein.

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7 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Instrument Tube Fittings shall be carried out as per approved Inspection and Test Plan.

Type test for the products shall be according to 8S-4368 Part IV which shall necessarily include the following:-

a. Hydrostatic proof pressure test

b. Minimum hydrostatic burst pressure test

c. Disassembly and reassembly test

d. Minimum static gas pressure (vacuum) test

e. Maximum static gas pressure test

f. Hydrostatic impulse and vibration test.

The type test results shall be made available for scrutiny during inspection.

Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing

(FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Instrument Tube Fittings complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Instrument Tube Fittings.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.
The FAT shall be consisting of the following as a minimum:

a. Hydrostatic Test: SS Tube Fittings shall be subjected to hydrostatic test at the following pressures.

   For 6 mm Fittings, at 80 kg/cm2.
   For 1/2" Fittings, at 153 kg/cm2 or 400 kg/cm2 at 38°C, as specified in the Data Sheets. The ratings are based on usage in piping classes with flange ratings up to 600#, 900# and 1500# respectively.
   Brass compression Fittings shall be subjected to hydrostatic test at the following pressure:
   For 1/4" Fittings, at 10 kg/cm2, 3/8 " at 80 kg/cm2, at 38° C.
   During and after the hydrostatic test, the tubes shall not show any leaks or rupture.

b. Pneumatic Pressure Test: The Fittings shall be tested at 7 kg/cm2 of dry air. During and after the test, tubes shall not show any leaks or rupture.

c. Disassembly and Reassembly Test.

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d. Hardness verification. Test for hardness shall be done on parent material for the ferrules.

e. Dimensional test report

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Instrument Tube Fittings as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Instrument Tube Fittings functions correctly and properly in accordance with the specified requirements.

8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Instrument Tube Fittings shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.
b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Instrument Tube Fittings, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

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10 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Bill of Materials including Vendor list, details of third party items;

c. Catalogues and Manuals;

d. Quality Assurance Plan;

e. Any other documents.

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

a. Specifications, Data Sheets;

b. Bill of materials including Vendor list, details for third party items;

c. Material test certificates;

d. Procedures for FAT;

e. Quality Assurance Plan;

10.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor.

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Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
FIRE & GAS DETECTORS

VCS-SS-IN-5901_02

02	**11.05.2022**	**SV**	**KNC**	**HK**	**GVW**
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		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

BS	British Standard
CENELEC	European Committee for Electrotechnical Standardization
FG	Flammable Gas
F&G	Fire & Gas
FAP	Fire Alarm Panel
GGDS	Gas Gathering and Distribution Station
HSSD	High Sensitivity Smoke Detector
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
IR	Infra-Red
LASER	Light Amplification by Stimulated Emission of Radiation
LED	Light Emitting Diode
LEL	Lower Explosive Limit
MAC	Manual Alarm Call-point
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
PLC	Programmable Logic Controller
PO	Purchase Order
PPM	Parts Per Million
SCADA	Supervisory Control And Data Acquisition
SPIR	Spare Parts lists and Inter-changeability Record
SSL	Solid State Logic control system
UV	Ultraviolet
1ooN	one out of N (any number) logic voting principle

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2ooN	Two out of N (any number) logic voting principle
2oo3	Two out of Three logic voting principle
EPIC	Engineering, Procurement, Installation and Commissioning
UL	Underwriters Laboratories Inc., USA
FM	Factory Mutual, USA
LPCB	Loss Prevention Certifying Board, UK
VdS	Verband der Sachversicherer e.v, Germany
SSL	Scientific Services Laboratory, Australia
TUV	Technischer Uberwachungs Verein
NPT	Nominal / National Pipe Thread

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1.0 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, Name plate marking, inspection and testing, documentation, packing and shipping of Fire & Gas Detectors.

2.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3.0 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

British Standards

a. BS 6266, Code of Practice for Fire Protection for Electronic Data Processing Installations.

b. BS EN50014-39, Electrical Apparatus for Potentially Explosive Atmospheres.

c. BS 7430, Code of Practice for Earthing.

d. BS 6755, Testing of Valves - Part 2 Fire Type Testing Requirements.

e. BFPSA, British Fire Protection Systems Association: Code of Practice for Category 1 - Aspirating Detection Systems.

Instrumentation Systems and Automation Society (ISA)

a. ANSI/ISA-12.15, Installation, Operation and Maintenance of Hydrogen Sulphide Detection Instruments Part '1 &2

European Standards (EN)

a. EN 50054, Electrical apparatus for the detection and measurement of flammable gases.

b. EN 50018, Constructions and Testing Of Electrical Apparatus with Flameproof Enclosures.

c. EN 10204, Metallic Products Type of Inspection Documents.

d. BS EN 60529, Degrees of Protection provided by Enclosures.

International Electrotechnical Commission (IEC)

a. IEC 68-2-34, Vibration Testing for Electrical Apparatus.

b. IEC 61508, Functional safety of electrical/electronic/programmable electronic safety related systems

c. IEC 60801, EMC for Industrial Process Measurement and Control Equipment

d. IEC 61131, Programming Industrial Control Systems

International Organization for Standardization (ISO)

a. ISO-9001, Quality Assurance System - Edition 1994.

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National Fire Protection Association (NFPA)

a. NFPA 72, National Fire Alarm Code

Institute of Petroleum (IP)

a. IP 15, Model code of Safe Practice Part-15 (Hazardous Area Classification)

3.2 Order of Precedence

In the event of conflict between Specifications, Data Sheets, related standards, codes etc., and the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4.0 MATERIAL

The material used for the Fire & Gas Detectors shall be SS 316 as minimum unless and otherwise specified in the Specifications / Datasheets.

All field-mounted devices shall be certified for use in hazardous area Zone 1, Gas Group IIC, Temperature Class T6, Ingress Protection IP 65 or better and shall be suitable for dusty, saline, sand laden and H_2S Environment. All Detectors shall be microprocessor based.

Field mounted-detectors, manual alarm call points, beacons and sounders shall be suitable for the ambient conditions as mentioned as per Job Specifications.

Selection of makes and types of field detectors shall be based on Client Preferred Vendor List. Vendor shall indicate in his bid compliance with this requirement.

Detectors shall be installed in the plant areas and at the control buildings as indicated on the drawings referenced as part of this Specification.

No order shall be placed with any sub-Vendor until Client has given approval in writing, even when the Vendor is on Client's Preferred Vendor List.

5.0 DESIGN

The Fire & Gas Detectors and devices are responsible for the protection of facility, equipment and workmen in the Station or the pipeline. The Fire & Gas Detectors shall be intelligent type Detectors which shall alarm or trip depending on the level of

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severity. The Job Specifications / Data Sheets shall be referred for the exact requirements of the Fire & Gas Detectors.

5.1 Fire Detection

Fire Detectors shall be designed to detect one or more of three characteristics of fire, smoke, heat or radiation (flame). The prime function of a Fire Detector shall be to detect a fire in its early stage by one of its characteristic phenomena like combustion gases in fire infrared radiation from flame, rise of temperature due to fire and convert the same into an electrical signal for initiating the local and remote alarms.

a. The electronic circuit shall be of solid state and of failsafe design and virtually hermetically sealed to have resistance to humidity and corrosion and to prevent its operation from being impaired by dust and dirt.

b. The circuit shall be protected against usual electrical transients, electromagnetic and electrostatic interference (EMI & RFI) normally present at the functioning station.

c. Reverse polarity or fault in the field wiring shall not damage the Detector.

d. No moving parts subject to wear & tear shall be provided.

e. The response sensitivity shall also be field adjustable and not only from fire panel over a wide range to suit site conditions. It shall be possible to test the sensitivity of a detector in the field. The sensitivity / threshold value of detectors which are cross zoned must be compatible.

f. The visual (alarm) response of a Detector (by a LED) shall be clearly visible from the outside by a steady / flashing light of sufficient brightness.

g. The base plate of the Detector shall be suitable for mounting on a four way standard outlet box and a single junction box for terminating directly the field cable run in conduit. The field terminals shall be suitable for field wires of core size upto 1.5 mm2.

h. The Fire Detectors shall be plug in type. Suitable locking device shall be supplied along with each Detector. It shall be inserted into or removed from the standard base by simple push twist mechanism to facilitate easy exchange for cleaning and maintenance.

i. All types of Detectors offered shall have inbuilt electronic circuit for addressing capability for individual address on the fire alarm panel. In case of manual call points where the addressing capability is not an integral part, a separate addressable interface unit shall be provided.

j. All types of Detectors shall be suitable for connection in any particular loop / circuit with any other type of Detector. In case of non-addressable type of Detector or group of such Detectors shall also be suitable for connection in the same loop / circuit by providing suitable addressable interface units.

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k. The Detector shall confirm to relevant Standards such as IS, BS, NFPA, etc. Test certificates shall be supplied along with the tender.

The Fire Detection shall comprise of a variety of Fire Detection devices and sensors, including:-

a. Optical Flame Detectors.

b. Smoke detectors.

c. Thermal detectors.

d. Fusible plug loops.

e. Manual Alarm calls points.

5.1.1 Optical Flame Detectors

a. Optical Flame detectors shall be Infrared / Ultra violet (IR/UV) type and shall make use of such sensor, filters and / or design to reject phenomena such as electric arcs, heaters, artificial light sources, lightening and shall be completely" Solar Blind".

b. The detectors shall be able to detect all types of Flaming Fires.

c. UV detectors may be used where they are not exposed to external UV rays, such as in compressors and power generating enclosures.

d. Detectors shall be powered from 24 V DC, with a 4-20 mA signal loop to cover the calibrated range. Detector faults shall be signalled by a 4 mA signal. Sufficient margin shall be allowed between fault, normal and alarm levels to minimize spurious alarms.

e. Optical Flame Detectors shall have automatic, self-diagnostic circuitry that continuously monitors the optical surfaces, sensor sensitivity and electronic circuitry, and shall give fault status. Any Detector malfunction shall be alarmed on the Fire and Gas detection system panel and DCS.

5.1.2 Smoke Detectors

a. Smoke Detectors shall be installed indoors in all rooms, including concealed floor and ceiling voids.

b. The Smoke Detectors shall incorporate an integral LED indicator for confirmation that the unit is active.

c. Detectors that are not visible, such as ceiling void or under floor, shall be provides with remote LED's located in the room being monitored.

d. Two independent Smoke Detector loops shall be installed in each area where executive action is required on detection of fire.

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e. Ionization Smoke Detectors shall be used in general-purpose areas to provide early response to smouldering or flaming fires in their incipient stages. A Detector base shall be provided for connecting the individual Detectors to the Fire and Gas (F&G) control system.

i. This Detector shall be capable of detecting a fire both in its incipient or smouldering stages as well as invisible flames. To meet this requirement the Detector shall respond to visible combustion products in the form of smoke as well as in - visible particles, aerosols and pyrolysis products from a clear burning fire.

ii. The sensitivity / response threshold value, the design and construction of the detector shall be in accordance with IS - 11360, BS - 5445 Part - 7 (European Standard - EN54 - 7) or ANSI - UL. 268 as applicable. Test certificates for the same shall be submitted by the Vendor. The Detectors shall be marked with their normal sensitivity, sensitivity range listed spacing, radiation level of radioactive component etc. as per relevant standards.

iii. Ionisation type Detectors quickly respond to smaller smoke particles which are normally produced by rapidly developing fire. Ionisation type Detectors are ideal for fire involving flammable liquid, and easily ignited free burning material such as wood, paper and cellulose materials. In ionisation type Detector, the change of current flowing through an ionisation chamber due to smoke particles entering the chamber is used to sense the fire.

iv. This type of Detector comprises two ionisation chambers electrically connected in series each containing a radioactive source (emitter) generally Am 241 (Americium 241) with activity level not exceeding 1 - 5 µCi or Ra226 (Radium 226) with activity level 0 -1 µCi. One of the chambers is semi sealed and termed as 'reference chamber and the other is termed as 'smoke chamber. The air in the chamber is ionised. In the presence of voltage applied between electrodes in the chamber, the ionisation results in small current flow. Since the chambers are of identical design under normal condition, the applied voltage is distributed equally between the chambers. Smoke particles are comparatively larger than air. Movement of molecules icon is restricted when the products of combustion enter the smoke chamber, due to presence of smoke particles. Because of this, current flow in the smoke chamber reduces. However, the current in sealed chamber remains unchanged. This imbalance of current due to smoke in is used to trigger the associated electronic circuits to initiate the alarm.

v. Smoke Detectors shall remain in alarm state until reset by the fire and gas control system.

vi. Photoelectric smoke detectors shall be used in electric equipment and control room areas. A Detector base shall be provided for connecting the individual Detectors to the F & G control system.

vii. This Detector working on the light scattering principle shall be capable of detecting visible smoke from smouldering fires long before the fire breaks out into visible flame. It shall respond quickly to smoke that is optically dense. It

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shall detect the scattering / change in intensity of light by smoke particles in the light beam. The light source of SDO shall automatically adjust to compensate for possible effects of dirt and dust accumulation in the sensor. The smoke density in the chamber shall be measured by a symmetrical optical system. The Detector principle shall employ a multiple light pulse coincidence circuit, preventing false alarms.

viii. The normal sensitivity / response threshold value, the design & construction of this smoke detector shall be in accordance with IS - 11360, BS - 5445, Part – 7 (European Standard, EN - 54 - 7) or ANSI. UL. 268 as applicable. Test certificate for the same shall be furnished along with the Tender. Smoke Detectors shall be marked with their normal sensitivity, tolerance limits and listed spacing as per relevant standards.

ix. The optical type Detector is basically a photo electric Detector working on the principle of light obscuration & scattering. A beam of light from infrared LED travels across a light - tight chamber to a collector on the other side of the chamber. A photo cell senses no light as long as the air inside the chamber is clean. When the Smoke enters the chamber the light from the beam is reflected or scattered in all directions. Some of this scattered light reaches the photo cell which triggers to initiate fire alarm.

5.1.3 Thermal Detectors

a. Thermal Detectors shall be used in all indoor spaces including all rooms and equipment enclosures, including concealed floor and ceilings voids.

b. Rate of rise Thermal Detectors shall be used where an early warning of smouldering fires is required, such as storerooms and equipment rooms where air flow or high humidity may inhibit the response of Smoke Detectors.

c. Fixed temperature or rate compensated type Heat Detectors shall be used within areas unsuitable for Smoke Detection where a rapidly achieved high temperature can be expected, such as machinery rooms or equipment enclosures. These shall be set at approximately 12°C above maximum ambient temperature within the area.

d. Thermal Detectors shall remain in alarm state until reset by the fire and gas control system.

e. All visible Detectors shall incorporate an LED indicator as an integral part of the detector head or its mounting base. Concealed Thermal Detectors shall be provided with an LED "repeater" that is located in a visible location. Normally, unmanned equipment rooms or offices shall have indicators in the corridor. The Detector circuitry shall cause the LED to remain illuminated while the Detector is the alarm condition.

f. The sensitivity, setting, response grade, listed spacing, the design and construction of the Detector shall be in accordance with IS.2175, BS - 5445 - PART - 5 or

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(European standard EN - 54 -5 or 8) or ANSI - UL - 521 as applicable. Test certificates shall be furnished along with the Tender.

5.1.4 Linear Heat Sensing Cable

a. Linear Heat Sensor Cables shall be of temperature sensitive insulated wire type.

b. This Linear Heat Sensor shall be in the form of continuous Cables consisting of copper conductors / cores and shall be of analogue type.

c. Each core of analogue Linear Heat Sensor Cable shall be insulated with a color coded, negative temperature coefficient material. The cores shall be protected by an outer sheath of high temperature, flame retardant PVC insulation. Additional mechanical protection shall be provided over the cable in the form of bronze or tinned copper metallic braid. The outer sheath, as well as the metallic braid shall not affect the performance of the heat sensor.

d. The Linear Heat Sensor Cable for each zone / area shall be connected to an electronic interface unit, which shall sense the temperature variations by continuously monitoring the resistance of the negative temperature coefficient core insulation. The electronic interface unit shall be located suitably in the area being protected.

e. The analogue linear Heat Sensor Cable of every zone shall be continuously monitored for open and short circuit. A breakage, disconnection or a short between cores shall initiate a FAULT alarm on the fire alarm panel.

f. All necessary accessories and jointing kits for both end of line terminations and in line jointing shall be supplied.

g. Subsequent to an alarm / actuation due to a fire, the sensor cable shall automatically reset. In case a length of the sensor cable in the middle of a run gets damaged, it shall be possible to splice in a new cable for the length which has been damaged, without affecting the performance of the sensor in any manner.

h. The design of the analog, linear heat sensor cable and corresponding electronic sensing circuits shall be such as to allow a maximum length of atleast 1000 metres to be connected as a single cable for monitoring one-zone. However, in case different grades of analog linear heat sensor cables are available, considering the constraints of the maximum length required and the maximum ambient, the most sensitive grade shall be used. The system shall be designed to have an optimum sensitivity.

i. The linear heat sensor cable and the electronic interface unit shall be compatible with the microprocessor based addressable fire alarm panel, incorporating all the features required for the system.

j. Details of the setting procedure for the analogue linear heat sensor cable along with the necessary monograms shall be supplied by the Tenderer along with the

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Tender. Details of the response time of the linear sensor cable for different temperatures shall also be furnished.

k. For a given length of sensor cables it shall be possible to set the alarm temperature over a wide range by means of a setting switch or other means provided on the electronic interface unit. Provision shall also be made for setting the alarm temperature from the fire alarm panel.

l. The sensitivity, response time, type, the design and construction of the sensor cables shall be in accordance with relevant standards. All relevant details shall be marked on the electronic interface unit. Test certificate shall be furnished along with the Tender.

m. All relevant catalogues, technical literature installation procedures etc. shall be furnished along with the Tender.

5.1.5 Manual Alarm Call Point

a. Manual alarm stations shall be provided for following functions:

   i. Fire alarm.

   ii.

   iii. Platform Abandonment.

a. Manual alarm stations for fire alarm shall be located throughout all areas of the platform, especially at exits and in the main equipment rooms. These stations shall be located at easily accessible, well lighted, conspicuous areas and located no more than 30 meters apart.

b. Manual alarm stations- platform abandonment shall be located adjacent to each survival craft.

c. All manual alarm stations shall require a double action to activate the alarm. They shall be the break-glass, pushbutton type.

d. Each unit shall be surface mounted at a height of 1.4 meters and shall be provided with a striker connected to the station by a chain.

e. Each unit shall be wired to the F&G control system in the Control Room.

f. The manual alarm stations- Fire alarm shall be red in color & manual alarm stations- Platform abandonment shall be black in color.

5.1.6 Flashing Alarm Beacons

a. The Flashing Alarm Beacons shall be direct ignition, Xenon type. Flashing Alarm Beacons shall be powered from 24 V DC, -ve earthed supply or depending on project Specifications / manufacturing standards.

b. The Flashing Alarm Beacons shall have flashing speed of 60 flashes per minute.

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c. Separate Flashing Alarm Beacons shall be provided for visual indication of confirmed HC-H2 gas release & H2S gas release.

5.1.7 Sounders

d. Field Sounder shall be electronic type, and shall be powered from a 24 V DC, -ve earthed supply.

e. Field Sounder shall be provided for audible alarm for confirmed HC-H2 / H2S gas release.

f. Field Sounder shall be located near personnel rest room on Main deck of the platform.

5.1.8 High Sensitivity Smoke Detection System (HSSD)

The High Sensitivity Smoke Detection System shall be capable of detecting & analysing air-borne particles generated during the pre-combustion stage of an incipient fire, sampled through the protected zones via a network of air sampling pipes. The design of the smoke sampling zones shall be based on the principle of one smoke zone per room. The system shall comprise of a 200% balanced, air sampling network together with a detector & control unit with display & battery back-up power unit facilities, including display & historical logging.

5.1.9 Building Smoke Detection System

Where applicable a Building Smoke Detection System shall be provided for other building facilities not covered by HSSD System. The Building Smoke Detection System shall compose of a Fire Alarm Panel (FAP) and all of its accessories. The Building Smoke Detection System shall be of State of the Art, fully programmable, intelligent and addressable system. Details of the FAP and its accessories are as described below.

5.2 Gas Detection

The Gas Detection shall consist of Gas sensing devices or Detectors as required for protection of leakage of Gas.

5.2.1 H2S Detectors

Sensor Type	Electrochemical/Metal Oxide Semiconductor
Output Signal	Analog 4-20 mA
Range	TO BE PROVIDED
Accuracy	+/-2 ppm or better
Set point	TO BE PROVIDED
Housing	Manufacturer Std. (To suit Environmental Conditions)

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Cable entry	Metric (M20)

Malfunction and true alarms shall latch until manually reset and normal conditions are restored.

The Detector shall be fast and reliable. Preference shall be given to speed of response over precision. The Vendor shall indicate the response time of the Detector for the detection levels.

In general, the Detector shall be mounted integral to the transmitter. However, remote mounting of the sensor from the transmitter is acceptable on inaccessible locations.

The transmitters shall have fault monitoring Detection capability. A malfunction alarm shall be raised on under or over-ranging.

The Vendor shall supply a full set of support equipment, including test gas for calibration purposes for a period of 6 months. The support equipment shall contain all elements required for to calibrate for all the Detectors for a period of 2 years including commissioning.

5.2.2 Flammable Gas Detectors

Sensor Type	Infrared (Point Type)
Output Signal	Analog 4-20 mA
Range	0- 100 % LEL
Accuracy	± 3% LEL up to 50% LEL; ± 5% LEL for> 51% LEL
Set point	20 % and 50 % LEL
Housing	Manufacturer Std. (To suit Environmental Conditions)
Cable entry	Metric (M20)

Malfunction and true alarms shall latch until manually reset following the restoration of normal conditions. It shall also be provided with continuous self-testing/indication of fault due to dirty optics. Once fault is detected, the transmitter shall send a pre-set current output.

The transmitters shall have fault monitoring detection capability. A malfunction alarm shall be raised on under or over-ranging. The accuracy of the transmitter shall be ± 2% LEL at s 50% LEL and ± 5% LEL at ~ 50% LEL reading.

Detection shall be fast and reliable. Preference shall be given to speed of response over precision. The Vendor shall indicate the response time the detector for the Detection levels of 20% LEL and 50% LEL.

The Detector shall preferably be integral to the transmitter and shall have over range protection in case of sudden exposure to high hydrocarbon gases.

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Zero Drift shall be less than 2% of full scale over a period of 2 years.

The Vendor shall supply a full set of support equipment, including test gas for calibration purposes for a period of 6 months. The support equipment shall contain all elements required for to calibrate for all the Detectors for a period of 2 years including commissioning.

High-high flammable gas voting logic shall not latch the logic input.

5.3 Name Plate

a. The Tag Nos. for Detector and Devices shall be as per various layout of Buildings / areas enclosed.

b. All panels shall have Tag number and the same shall appear on the front and rear along with a descriptive name.

c. Each item shall be provided with a name plate or label designating the service of the particular equipment.

d. The shape and size of the plate and inscriptions shall be approved by Purchaser. Such name plates shall be anodized aluminium plates having engraved black lettering or the plate shall be of multi layered laminated plastic material with black lettering engraved on a white background.

e. The name plates shall be screwed to the body of the equipment.

6.0 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Fire & Gas Detectors. Vendor shall submit the required Specification, calculations, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein.

7.0 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Fire & Gas Detectors shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing Plan for Proprietary items / Special items for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydrostatic test, hazardous area certification test, Radiography test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Self Actuated Control Valve/ Regulators complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the F&G Detectors.

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FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual Inspection

b. Calibration

c. Functional Test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the Fire & Gas Detectors as per the approved test procedure. A comprehensive test procedure in compliance with the Standard Specification shall be developed and issued to Company / Owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the F&G System with its Fire & Gas Detectors functions correctly and properly in accordance with the specified requirements.

8.0 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for Fire & Gas Detectors shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the job site.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

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8.1 Rejection

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

9.0 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended spare parts list for start-up, pre-commissioning and two years operation as per the following:

a. Itemized recommended spare parts list for start-up and pre-commissioning.

b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Fire & Gas Detectors for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10.0 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Specification of Fire & Gas Detectors;

b. Bill of Materials including Vendor list, details for third party items;

c. Catalogues and manuals;

d. Quality Assurance Plan;

e. Any other documents (Project Specific).

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and Specifications for the Company's approval:

a. Standard Specifications, Data Sheets;

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b. Bill of Materials including Vendor list, details for third party items;

c. Catalogues and manuals and relevant drawings and documents;

d. Dimensional drawings;

e. Material test certificates;

f. Procedures for FAT;

g. Quality Assurance Plan;

h. Any other documents (Project Specific).

10.3 Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. Warranty work shall be done at Owner's local facilities. The cost of correction / replacement of any warranty items shall be borne by the Vendor.

The Job Specifications/Data Sheets Shall be referred for any specific warranty / guarantee.

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Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
REMOTE TERMINAL UNIT SYSTEM

VCS-SS-IN-5903_02

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		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

NFPA	National Fire Protection Association
IEEE	Institute of Electrical & Electronics Engineers
HART	Highway Addressable Remote Transmitter
FAT	Factory Acceptance Test
IEC	International Electro-technical Commission
PCS	Process Control System
ESD	Emergency Control System
RTU	Remote Terminal Unit
IP	Ingress Protection
EIA	Electronic Industries Association
SIL	Safety Integrity Level
CPU	Central Processing Unit
PVC	Poly Venial Chloride
F&G	Fire & Gas
ISV	Integrated System Vendor
EN	European Standard
BS	British Standard
SAT	Site Acceptance Test

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1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Remote Terminal Unit System.

2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

IEC 61131	Programming Industrial Control Systems
BS EN50014-39	Electrical Apparatus for Potentially Explosive Atmospheres
BS 7430	Code of practice for Earthing
EN 50018	Constructions and Testing of Electrical Apparatus with Flameproof Enclosures
BS EN 60529	Degrees of protection provided by Enclosures.
IEEE 802.3	Ethernet (TCP/ IP)
IEE STD C37.90.1	Surge with stand capability (SWC) tests for protective relay and relay system.
EIA RS232-C	Interface between data terminal equipment and data circuit -Terminating equipment employing serial Binary data interchange.
EIA RS 485	Electrical characteristics of generators and receivers for use in balance digital multipoint systems.
NFPA 70	National Electric Codes
NFPA 72	National Fire-Alarm Code

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4 REMOTE TERMINAL UNIT SYSTEM

4.1 General

This Specification defines the minimum requirement for design for RTU system. The RTU shall be composed of Manufacturer's standard hardware & software. The RTU shall be provided with redundant power supply capability. The RTU system shall have sufficient Spare capacity in wired spare, Input / Output & controller. The RTU shall be

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rated for field installation in hazardous area classification & environmental condition as per project design basis. The RTU Vendor / Supplier shall be responsible for the following but not limited to:

a. Configuration of RTU System;

b. Configuration of RTU based on Cause & Effect logic, P&ID's I/O schedule, narratives etc.;

c. Configuration of RTU to communicate to the' control and safeguarding systems;

d. Testing (FAT & SAT) of the system.

4.2 System Hardware

4.2.1 General

The RTU shall support local programming interface via a laptop. Communication to the smart field devices shall be performed utilizing HART or other acceptable protocol. The RTU shall have a field-proven availability in excess 99.9 % and. shall support redundancy of critical components such as power supply, CPU & Communication.

CPU:

The response time of the RTU i.e. the time from input change to output response (worst case: 2 x Cycle time), shall not be more than 1 second.

MEMORY:

The RTU memory shall be properly sized by the Vendor to not utilize more than 50% while the RTU is fully leaded. In Case of power loss the RTU shall maintain the configuration and logic for a minimum of 90 days. The memory shall be sized accordingly to store historization data for a minimum of 30 days. The history data shall be made available at request of the historization module and shall have no effect on operation of the RTU system.

INPUT / OUTPUT:

The I/O cards shall not be combined for the functionalities i.e. each card shall perform dedicated functionality w.r.t analog input, analog output, digital input, digital output. Mix configurable type input/output cards are not acceptable.

a. Digital Input

The RTU shall be able to utilize either internal or external power supplies. Intrinsically safe isolation amplifiers shall be required for solid state sensors. (E.g. proximity sensors) and I.S contact inputs (process switches, hand switches). The RTU shall have the capability to filter out contact debouncing & include electronic signal isolation Circuitry.

b. Digital Output

The RTU shall support continuous or configurable pulse outputs. Out puts shall be configurable with source power or dry contact. Relay outputs shall be dry contacts and electronically isolated per channel with minimum 1 Amp load.

c. Analog Input

The RTU shall be capable to support the following type of signals 4-20 mA, 1-5 VDC & 0-10 VDC. Signal Isolation shall be required. The RTU shall be able to support HART protocol and shall have no influence on the normal operation. Vendor shall demonstrate the fail safe operation of the HART functionality for both IS and non IS

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signals. The RTU shall support loop powered and field powered analog inputs. Analog inputs shall have incorporated open, short & out of range circuit detection. The range shall be software configurable per input channel. The analog resolution shall be 12 bits plus sign integer or better with accuracy of 5% of full range or better.

d. Analog Output

Each Analog output shall be standard 4-20 mA DC signal. Output channels shall be isolated independent and individually protected by fuse. The Analog output shall be powered by internal 24 VDC supply.

e. Pulse counter

The RTU shall be capable of supporting pulse input modules. The pulse input modules will be utilized to measure flow or other process. The pulses will be in a square wave with a frequency variance between 0 to 10 KHz.

f. Communication Ports

There shall be redundant communication to the PCS, ESD & F&G. The RTU shall include a minimum of two additional ports. The port will communicate to third party devices. The ports shall be configurable to communicate via RS 485 or RS 232. IEEE Ethernet ports or a combination of will also be acceptable.

g. Failure Mode

The RTU shall be capable to configure outputs (Analog, digital) to fail safe position on processor failure. Communication failure to PCS, ESD & F&G shall be configurable to hold last state if required. Loss of primary communication shall have no effect on data transition and normal operation. RTU diagnostics shall be made available to the PCS, ESD & F&G system.

4.3 Communication

The RTU shall support communication via Fiber-Optic, dial up. The RTU shall be capable to communicate via a combination of schemes such as point to point, multidrop, star or others. The RTU shall support Ethernet for networking. Vendor to provide data transmission speed for client approval

4.4 RTU Cabinet

The RTU shall be provided installed in front access, material & dimension as per datasheet. It should provide IP 65 protection. Cable ingress shall be from the bottom through a gasket / glanded plate. The RTU cabinet shall contain:

a. RTU rack, CPU & Input / Output card or RTU Expansion rack & cards;

b. Communication Equipment;

c. I/O Conditioning Equipment (terminal Strips, grounding strips, wiring channels etc.);

d. Internal DC / AC power Distribution;

e. Fuses, DC & AC Breakers to protect all power sources and power distribution lines;

f. Equipment and cabinet handles to facilitate maintenance and removal. of internal equipment;

g. Internal lighting provision as required for maintenance;

All fields I/O wiring shall terminate- at terminals or fuse holder terminal as appropriate to function. Power, control, input and safety related wiring shall be

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segregated. Each wire shall be marked on both sides of all terminals with a tag for the wiring source and destination points. Ground bars shall be provided in the cabinet:

4.5 Power Supply

Each RTU shall be capable to receive power from two sources by individual feeders, and each feeder input shall be capable for a less than 20 ms switch over without any interruption in the RTU. Each RTU power supply units shall be rated such that all output loads can be simultaneously energized without degradation to the RTU unit. Diagnostics & signalling facilities shall be provided to service / replace a faulty power supply unit. It shall be possible to isolate, disconnect, remove & replace a faulty power supplies without loss of operation. The RTU shall comply with surge withstanding capability tests as defined in IEEE STD C37.90.1 and lEC 61000-4 without any effect on the RTU functionality. The RTU power supply shall be capable for over current / voltage protection.

The main power available to the RTU from the UPS will have the following characteristics:

a. 230 VAC minas 15% & plus 10% single phase;

b. Frequency of 50 Hz, ±1%;

c. Harmonic distortion of 5% maximum THO, Linear Load.

4.6 Labeling

Terminal carrying voltages higher than 24 VDC shall be protected against accidental contact by removable cover plates and are labelled accordingly. Sockets terminals & main wiring shall be clearly identified in strict accordance with the system documentation. Earthing for screens, AC & DC system shall be segregated and identified.

Each RTU cabinet and all major system components, card files and individual card locations shall be clearly labelled and identified with tag numbers. Nameplate text plate shall be in the English language. In addition all equipment shall be identified with the manufacturer type, Serial number and buyers requisition number to facilitate future reference.

4.7 Earthing

All metallic equipment within the cabinets shall be connected to a single "common cabinet" safety Earth point. Each cabinet shall be provided with a M10 Earthing bolt for connection to the safety Earthing system. Screens for interconnecting cables shall be earthed on one side only. Vendor documentation shall include details of requirements for screen earth and if required computer earth.

Individually Earthing busses will be provided for the following equipment:

a. Cabinet Earthing + Cables shield.

b. Instrument shield.

c. A/C

5 RTU FUNCTIONALITY

a. The RTU shall be capable to automatically upload data up on request by the master station.

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b. The RTU shall be capable to operate and execute open loops, closed loops, logic sequence as defined by Input / Output listing. P&ID's, logic diagrams, cause & effects, and narrative etc.

c. The RTU shall be capable of remote download of configuration and programming. The RTU shall support on-line modification and download / upload of configuration and programming without degradation to the RTU operation. The capability of RTU reboot from a remote location shall be provided.

d. The RTU shall be designed to operate in standalone in case of loss of communication to the PCS, ESD & F&G. In case of loss of communication between the RTU & PCS, ESD & F&G the RTU shall archive the data to be pulled by PCS / Historizing module up on establishment of communication.

e. The RTU shall be capable to perform liquid or gas calculations and compensations internally and without utilizing an additional flow computer. The RTU shall also be capable of totalizing compensated flow.

f. Upon power up of the RTU, the RTU shall perform self-diagnostics and alarm for any errors and restore the data prior to the power down of the RTU.

g. The RTU shall perform communication check prior logic execution as select before execute. Vendor shall insure that no communication with error be executed. The vendor shall provide methods of communication check to client.

h. The RTU shall be provided with access password for configuration and program modification.

i. The RTU shall support first out and alarm reporting to PCS.

j. Shutdown functions and Input / Output related shall be SIL-3.

k. The RTU supplied shall possess the latest hardware and firmware.

l. It shall be possible to upgrade the RTU on-line without affecting the process.

m. The RTU shall have the capability to be configured to pass data from RTU to other RTU's.

n. The RTU shall be modular in design such that the same hardware is used for small or large system configurations, with expansion being based on plug-in modules.

o. Input / Output module location shall be software configurable.

6 SYSTEM AVAILABILITY

The RTU shall be subjected to careful component level system testing, prior to FAT. The availability of the RTU shall then be part of the system. The system availability is usually expressed in terms of two factors.

Mean Time Between Failures (MTBF).

Mean Time to Repair (MTTR)

The System Availability shall be guaranteed at least at 99.9%, in accordance with the availability criteria included in the ISV purchase order.

$$\text{System Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} \%$$

The MTBF shall be based on each module, subassembly, communication bus, Monitor, disc drive etc. whose failure might affect the normal operation of the system. The

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system. The system shall be designed such, that single component failures shall have minimum, possible effect on overall system availability. Availability calculation for each respective type of input and output shall be based upon reliability figures for an Vendors' hardware in the loop.

7 FABRICATION

Vendor shall obtain approval in writing from the purchaser before start of fabrication of RTU panel. Vendor shall submit the required specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing mentioned herein. Painting of RTU panel shall be in accordance with Company Painting Specifications.

8 INSPECTION AND TESTING

Vendor shall perform an inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for RTU system devices & panels shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing Plan for Proprietary items / Special items Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

8.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the RTU System complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the RTU system devices & panels.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

a. Visual inspection

b. Dimensional checks which shall be carried out as per the approved drawings.

c. Material checks in accordance with the appropriate instrumental standards & codes.

d. Simulation of the serial link interface to prove that the Modbus / Ethernet protocol is properly functioning.

e. Functional Test.

f. Calibration Test.

g. Paint checks.

h. Any other relevant test.

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

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8.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the RTU system devices as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the RTU Ststem functions correctly and properly in accordance with the specified requirements.

9 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for RTU system shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard 'Marking, Packing, and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

10 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.
b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of RTU System, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

11 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

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11.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Bill of Materials including Vendor list, details of third party items;

c. Catalogues and Manuals;

d. Quality Assurance Plan.

11.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

a. Specifications, Data Sheets;

b. Bill of materials including Vendor list, details for third party items;

c. Catalogues, Manuals and relevant drawings and documents;

d. Dimensional drawings;

e. Calibration certificates;

f. Material test certificates;

g. Procedures for FAT;

h. Quality Assurance Plan;

i. Any Other documents.

11.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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Energising Quality	**PROJECT NUMBER: C221052**	IGGL

SPECIFICATION FOR TIC PANEL			Total Sheets		10
Document No	C221052	00	IN	SS	5001

Indradhanush Gas Grid Limited

North East Gas Grid Phase-III of IGGL
Part D1 & D2

D1	09.12.2022	Issued for Bid	VK	DGM	KNC
A1	07.12.2022	Issued for Internal Review	VK	DGM	KNC
REV	**DATE**	**DESCRIPTION**	**PREP**	**CHKD**	**APPR**

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1.0 DEFINITION

Where used in this document, the following terms shall have the meanings indicated below, unless clearly indicated by the context to this order

PROJECT	North-East Gas Grid Phase-III of IGGL
OWNER	Indradhanush Gas Grid Limited
CONTRACTOR	VCS Quality Services Private Limited (VCSQSPL) the party to act for and on behalf of OWNER for the Detailed Engineering Services and Project Management.
VENDOR/ MANUFACTURER	Party, which manufactures and supplies equipment and services to the OWNER or to CONTRACTOR

2.0 INTRODUCTION

The Hydrocarbon vision 2030 for North East India (vision document), released by MoP&NG proposes detailed plan for Natural gas infrastructure development in North-East. The states covered in the vision document include Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura.

-M/s Indradhanush Gas Grid Limited (IGGL), a Joint Venture of IOCL, ONGC, GAIL, OIL and NRL, is in the process of implementing the North East Gas Grid (NEGG) with a vision to connect all the eight (08) northeastern state capitals and major consumption centers in the region. The NEGG will be connected to National gas grid at Guwahati through Barauni-Guwahati pipeline (already under execution by M/s GAIL).

M/s IGGL intends to lay pipeline along with terminal works for 11 which consist of 12" NB x 186 Km (approx.) in section-11 mainline. Main line taken from Siliguri DT to Gangtok RT in Section-11.

The brief scope of work includes supply of materials (other than free issue), pipeline laying work including but not limited to Construction Management, HSE & Quality Management, Survey, ROU management, clearing of ROU, grading, stringing, bending, welding (Manual), trenching, joint coating, lowering, crossings, crossings by HDD (wherever specified), Tie-ins, NDT and destructive testing, backfilling, laying of pipeline along-with OFC & HDPE ducts, TCP works, site restoration, hydro-testing, dewatering, swabbing, drying, nitrogen purging (as applicable), pre-commissioning, commissioning and Gas-in of pipeline including construction / installation of related facilities like scraper launching / receiving facilities and all piping works at dispatch / receiving terminals, I.P. Stations and piping works at Sectionalizing valve stations, Tap-off station & Injection points, etc. including associated Mechanical, Cathodic protection, Corrosion monitoring works, Electrical works, Telecom works, Firefighting works, Instrumentation, Civil works (including boundary wall and building works),

Architectural and Structural works at all stations, and Pipeline Information Management system. The scope of work has been divided into the following parts:

2.1 PROJECT DESCRIPTION

The scope of work has been divided into the following parts:

PROJECT TITLE: -SILIGURI-GANGTOK PIPELINE SECTION (SECTION-11)		
REF. SCHEMATIC DRAWING NO: -C221052-SGPL-PP-SCM-2001		
PART NO	**SPREAD NO.**	**SCOPE OF WORK**
PART-D1 (Length 44.2 km)	SPREAD-2B (Length 44.2 km)	Pipeline laying from **Ch. 59+800** Km to **Ch. 104+000** Km including associated works (Mechanical, Piping & Including Terminal works as per scope matrix) & One (01) SV stations.
PART-D2 (Length 46.3 km)	SPREAD-2C (Length 46.3 km)	Pipeline laying from **Ch. 104+000** km to **Ch. 150+300** Km. Intermediate Pigging Station (IP station) Lava, West Bengal at **Ch. 128+000** Km including associated works (Mechanical, Piping & Terminal works) at Two (02) SV stations.

Note: Chainage shown above are tentative and for reference purpose only, there may be change in Chainage shown as per site condition during execution.

This document covers details of work tendered, scope of work, scope of supply and other requirements pertaining to pipeline and associated facilities. All works and clauses of this document shall be applicable to all sections/parts unless specifically mentioned otherwise.

Details of associated Civil, Architecture, Structural, Mechanical, Piping, Instrumentation, Cathodic Protection, Corrosion Monitoring Works, Telecom Works, Electrical Works, Fire protection, water supply and Pipeline Information Management System (PIMS) works etc. are covered elsewhere in the Bid document.

3.0 TIC PANEL SPECIFICATION:

This Specification defines the minimum requirement for design TIC panel. The TIC shall be provided with redundant power supply capability. The TIC panel shall have sufficient Spare capacity in wired spare, Input / Output.

TIC panel shall be relay based control panel.

The panel shall be self-standing in dust & vermin proof, floor mounted, sheet steel enclosure. Minimum degree of protection for panel shall be IP 41 as per IS-2147.

Enclosure shall be fabricated with cold rolled cold annealed (CRCA) sheet steel of minimum thickness 1.5 mm with front of 2 mm and gland plate thickness shall be 3 mm.

Panel will have single front door & double rear door. Mounting height of equipment/components requiring operation and observation shall not be lower than 300 mm and higher than 1600 mm. Size of the panel cabinet shall be 2100 (including 100 mm base frame) (H) x 1000 (W) x 800 (D) mm. Panel shall be liberally designed. All components shall be so mounted that they are easily accessible for inspection & maintenance.

TIC panel should provide IP 54 protection for Indoor application and IP 65 protection for outdoor application

Color of panel: RAL 7032 for the panel exterior, semi glassy white for interior and black for the base frame.

The entire surface of panels and accessories, comprising front, rear, sides etc. shall be treated and painted as follows:

- All exposed surfaces including structures shall be shot blasted to SA2 and grinding done until they are smooth and free of scale, rust etc.
- Chemical treatment / Picling shall be done to remove rust, oil, entrapped impurities and other foreign materials.
- If necessary, suitable filler shall be applied to all pits and blemishes on the surface.
- The front surface of the panels shall be painted with three coats of sealing primer and surfacer. The entire surface shall be sanded between coats. Two coats of finish paint of high-grade lacquer enamel shall be given at shop.
- All other surfaces including those of accessories shall be painted with two coats of sealing primer and surfacer and two coats of lacquer enamel finish paint.
- A final coat of finish paint of high-grade lacquer enamel shall be given at site after assembly and filling of front panel but joints with suitable filler, to present and continuous panel surface. DFT of finished coat shall be 50µm.
- The finish of final coat shall be of semi-gloss texture to minimize light reflection

Panel shall have the following minimum accessories:

- Door switch
- Cable glands
- M.C.B.
- 15/5A Power supply socket
- Panel light
- Lugs

- Cooling Fan
- Panel Heater with Thermostat
- Terminal Blocks
- Digital bar graph single/dual channel indicator
- Indication lamps (LED)
- Push buttons & Selector switch
- Analog & digital Barriers/Isolators
- Signal Repeaters
- Miniature relays & internal relay circuits for GOOV operation
- Power supply unit etc.

20% spare or minimum one number (whichever is greater) of each type of Instruments, PB, indication lamp, relays, all hardware inside the panel etc. shall be provided for panel.

TIC panel shall be provided with document pouch.

Panels shall have a fully wired earthing system connecting all metal components back to one panel earthing point. Earthing cable shall be minimum 6 mm2 stranded copper and shall have a yellow/green sheath. Earth stud shall be brass, 10 mm OD, with a minimum 30 mm projection. Two brass nuts and washers shall be provided.

3.1 Panel Configuration

The panel shall be configured for instrumentation scheme as shown in the tender P&ID. The quantity of indicators, controllers, lamps, push buttons and selector switches, barriers and signal multiplier shall be selected accordingly to fulfil the operational requirement of instrumentation scheme as per PID requirements.

All the signals from hazardous area shall be routed through suitable isolator/ barriers. The isolator / barriers shall be capable of powering the two wire transmitters in the field. Signals, which are to be repeated to SCADA system, shall be routed through signal multiplier so that the same can be connected to SCADA system.

Panel shall microprocessor based digital type single/dual channel indicator, Push Button, 3 position selector switch, indication lamp etc. as per requirement.

All isolated 4 to 20 ma DC analog signal & potential free digital signal shall be available at terminal block of TIC panel for further hardwired communication with station RTU.

One set of spare schemes of each type of valve (GOOV), temperature indicator, pressure indicator, 3 position selector switches, isolator/barrier, signal repeater etc. shall be provided at TIC panel and duly wired up to the terminal block for future use (if required).

3.2 Minimum Specification/Data Sheet of TIC panel mounted Instruments

3.2.1 Panel Indicators

Function	Indication, Engineering Unit, Bar Graph Display
Type	Micro Processor Based, Fluorescent Display, with engineering unit.
Mounting	Flush mounted
Size	6” x 3” / 96 mm x 96 mm
Enclosure	General Purpose, WP to IP-41
Power Supply	230 VAC 50 Hz
Transmitter Power	24V DC field power for transmitters from I.S. Barriers
Display & Alarm	Fluorescent Bar Graph Display (in engineering unit) and key pad for configuration programming, set point etc.
Bar graph segment	100
Bar graph colour	Green
Numeric character	4 digit, 7 segment for process value (in engineering unit) and set value
Scale length	100 mm
Alarm status display	Yes
No. of Alarm	2 Nos.
No. of inputs	1 No.
Input Signal	4-20 mA dc
Output signal	4- 20 mA DC isolated
Indicator Accuracy	± 0.2% of span

3.2.2 Signal Multiplier & Barrier

Function	To repeat signal to RTU /SCADA
Type	Galvanically isolated
Signal	Analogue & Digital
Input	4-20 mA
Output	4-20 mA
Output drive capability	0-600 ohm
No. of channels	Two isolated output (minimum)
Accuracy	0.25% of full scale
Isolation Voltage	500VDC or higher

3.2.3 Power Supply Unit 24 VDC

Type	Solid state redundant
Input	230 VAC 50 Hz

Output	24 VDC
Current rating	As required
Line regulation	0.05%
Load regulation	0.05%
Stability	0.2% Under constant load
Transient recovery period	< 100 micro seconds
Auto tracking of the output	< 1% error
Indication	LED for SUPPLY ON
Fuse	To be provided on AC & DC lines
Output monitoring	Socket to be provided with adjustment facility
Protection	Short circuit and over load, potential free contact required for health signal of power supply

3.2.4 Selector Switch

Type	2/3/4 position stay put type with rotary level actuator
Face Dimension	32 x 32 mm (Maximum)
Contact configuration	4 pair of contacts
Contact addition	Add-on-block up to 4 each with 2 pairs of contact
Contact material	Hard silver alloy
Contact rating	230 V/ 5A
Utilization category	AC11 / DC11
Insulation Voltage	2 KV for 1 minute between terminals and earth
Mechanical life	1 million operations
Construction	Aluminium shrouding
Connection	Screw terminals
Enclosure class	IP-32

3.2.5 Auxiliary Relay

Type	Plug-in type with base/DIN rail mounted
Coil voltage	230/ 24 VDC
Contact configuration	2 NO & 2 NC (minimum), additional contacts as per requirement
Current rating	230V / 5A(A.C)/ 220V/2A (D.C)
Operating range	80 to 110% of rated voltage
Insulation	2 KV for 1 minute between terminals & earth.
Mechanical life	20 million operations
Enclosure	Transparent cover
Connection	Screw terminals
Mounting	Projection mounting inside panel/ DIN rail mounting
Fuse	To be provided on AC & DC lines

3.2.6 Indicating Lamp

Type	LED with built-in resistor
Face Dimension	32 x 32 mm (maximum)
Voltage	230 /24V DC
Watt	2.5 Watt (approximate)
Lamp and Lens	From front
Replacement	
Insulation	2 KV for 1 minute between terminals & earth.
Construction	20 million operations
Enclosure	Transparent cover
Connection	Screw terminals
Color	Red, Green, Amber, Yellow etc.

3.2.7 Push Button

Type	Shrouded square format
Face Dimension	32 x 32 mm (Maximum)
Contact configuration	2 NO + 2 NC
Contact addition	Add-on-block up to 4 each with 2 pairs of contact
Contact material	Hard silver alloy
Contact rating	500 V/ 10A
Utilization category	AC11 / DC11
Insulation Voltage	2 KV for 1 minute between terminals and earth
Mechanical life	1 million operation
Construction	Aluminium shrouding with plastic lens
Connection	Screw terminals
Enclosure class	IP-32
Color	Red, Green, Yellow, Black etc.,
Legend	Engraving

3.3 Panel Wiring

All wiring shall conform to API-RP-550 Part I Section 7 & 12. Different signal level cables shall be routed under false flooring with separation distances as recommended by API-RP-550 Section 7.

All wiring inside racks, cabinets and back of the panels shall be housed in covered, non-flammable plastic raceways arranged to permit easy accessibility to various instruments for maintenance, adjustments, repair and removal.

All wiring in the raceways shall be properly clamped. Total wiring cross-sectional area shall not exceed 50% of the raceway cross-sectional area. Rubber / plastic grommets shall be used for wire entry into individual instrument and entry / exit of wires through raceways.

Separate wiring raceways shall be used for power supply wiring, DC and low level signal wiring and intrinsically safe wiring. Parallel runs of AC and DC wiring closer than 300 mm shall be avoided.

Vendor can alternately offer prefabricated cables for interconnection between different cabinets and panels.

Wire termination shall be done using self-insulating crimping lugs.

No more than two wires shall be terminated on one side of single terminal. Such a practice shall be avoided as far as possible. The use of short-links for looping shall be avoided.

Terminal housing shall be strictly sized with considerations for accessibility and maintenance. Following points shall be considered:

Description	Distance
Distance between terminal strip and side of the cabinet parallel to the strip up to 50 terminals	Min 50 mm
Distance between terminal strip and top & bottom of the cabinet	Min 75 mm
Distance between two adjacent terminal strips	Min 100 mm
Addition distance for each additional 25 terminals	Min 25 mm
Distance between cable gland plate and the bottom of the strip	Min 300 mm

All terminal strips shall be mounted on suitable anodized metallic or plastic standoff.

No splicing is allowed in between wire / cable straight run.

Terminal strips shall be arranged group wise for incoming and outgoing cables separately.

Cabinet and rack layout shall be made considering proper accessibility and maintenance.

Entire panel wiring shall be cross-ferruled.

All the instruments, switches, relays, timer as required shall be in the bidder's scope to complete operational scheme.

Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
FIRE AND GAS DETECTION SYSTEM

VCS-SS-IN-5905_02

02	11.05.2022	SV	KNC	HK	GVW
01	18.01.2020	RB	VB	KNC	AD
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REVISION RECORD

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00	23.05.2018	Neha Dev	Udit Manichanda	K.Prasanth	Anupam Das	
01	18.01.2020					Format change and document numbering is revised.
		Rakesh Bhardwaj	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
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		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

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ABBREVIATION

NFPA	National Fire Protection Association
SCADA	Supervisory Control and Data Acquisition
IEC	International Electrotechnical Commission
EPIC	Engineering, Procurement, Installation and Commissioning
1ooN	One out of N (any number) logic voting principle
2ooN	Two out of N (any number) logic voting principle·
2oo3	Two out of three logic voting principle
PLC	Programmable Logic Controller
MCB	Miniature Circuit Breaker
MAC	Manual Alarm Call Point
RTU	Remote Terminal Unit
SIL	Safety Integrity Level
LED	Light Emitting Diode
PVC	Poly Venial Chloride
F&G	Fire & Gas
EN	European Standard
BS	British Standard
IP	Ingress Protection

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1.0 SCOPE

This standard specification establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of fire & gas detection system.

2.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3.0 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

IEC-61508	Functional safety of electrical/electronic / programmable electronic safety related system.
IEC-61131	Programming Industrial Control System
BS 6266	Code of practice for Fire Protection for Electronic data Processing Installations
BS EN50014-39	Electrical Apparatus for Potentially Explosive Atmospheres
BS 7430	Code of practice for Earthing
EN 50018	Constructions and Testing of Electrical Apparatus with Flameproof Enclosures
EN 10204	Metallic products type of inspection Documents
BS EN 60529	Degrees of protection provided by Enclosures
NFPA 70	National Electric Codes
NFPA 72	National Fire Alarm Code

3.2 Order of Precedence

In the event of conflict between specifications, data sheets, related standards, codes etc., and the order of precedence shall be as follows:

a. Data sheets;

b. Job Specifications;

c. Standard Specifications;

d. Codes and Standards.

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4.0 FIRE AND GAS DETECTION SYSTEM

4.1 General

This Specification generally covers overall F & G system general requirements and minimum technical requirements.

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The fire & gas detection systems shall be used to automatically detect fire, presence of toxic gas (H2S) and flammable gas.

The F&G systems shall be PLC-based, redundant and SIL-3 certified unless otherwise specified. For exact SIL requirement and its certification refer Project I&C design basis. The system shall employ separate processors with redundant I/O and bus structure, chassis and software, with all systems running in parallel.

Detector signals shall be separated into isolated paths via input module(s), and sent via separate paths to each processor, where 2003 voting is performed on the data.

Each processor shall execute its individual application program simultaneously and independently; verifying data, executing logic instructions, control calculations, clock and voter / synchronization signals and performing comprehensive system diagnostics and discrepancy monitoring. Outputs shall be sent to output modules where they are again voted (2003) to ensure logic and output integrity.

The system shall be self-monitoring to detect faults that may affect the operation of the system. The system shall be physically arranged so that a single failure in it is unlikely to cause critical impairment of the system's safety function.

The F&G panels shall drive the switched and fused outputs to visual and audible alarm devices in the field. The system alarms shall be generated upon a single detector, not only on voted signals.

The system shall also be used to monitor the Manual Alarm Call points (MAC) located in the plant areas as well as in the buildings

The systems shall be remotely monitored by the SCADA system via serial links. In addition to this, selected alarm signals as identified in the F&G I/O schedule shall be hardwired to the SCADA.PLC.

The fire and gas detection panels shall meet the following functional requirements, as a minimum:

a. Continuous monitoring of all detectors for alarms and circuit integrity conditions;
b. For H2S and flammable gas, a continuous readout of concentration shall be provided;
c. Generate outputs for sounders and beacons;
d. Generate potential free alarm outputs for connection to the SCADA PLC as specified;
e. Generate potential free trip signal outputs to diesel generator, power incomer/feeder, as specified in the Job Specifications;
f. Provide a serial link interface for communication with the SCADA system as specified;
g. Provide a serial link interface for monitoring of FACP where applicable;
h. Provide a graphical presentation of the station with LED indicating the location of gas or fire detection or AC activation or modification of existing if applicable;
i. Provide lamp test facilities;

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j. Provide logic functionality to achieve the above;

k. Alarm initiation shall be based on voted circuits where specified.

4.2 Input/ Output Requirements

4.2.1 General

The system shall be designed with a minimum of 30% installed spare capacity in I/O's. In addition spare card slots shall be provided.

Intrinsically safe barriers and signal isolators where required shall be installed within the F&G cabinet.

4.2.2 Digital Inputs

Digital input shall be fully redundant' (triplicated), fault-tolerant and testable. The SIL 3 level triplication shall be based on the project requirements.

Input cards shall be capable of accepting potential free contacts.

4.2.3 Analog Inputs

The 4-20 mA analogue input cards shall be fully redundant (triplicated), testable and able to connect 4-20 mA: current sinking or sourcing, 24 VDC. The SIL 3 level triplication shall be based on the project requirements.

Analogue inputs shall have incorporated open, short, and out-of-range circuit detection

4.2.4 Digital Outputs

The F&G system shall provide fault-tolerant potential free contact outputs for connection to the SCADA PLC. The output circuits shall be quad-voted and fully tested. Line monitoring shall be user configurable to detect-short and open circuit failures at the field side of the circuit.

The F&G system shall be able to provide low power outputs, e.g. lamps, if required, with a power consumption of approximately 3 Watt.

The F&G system shall also be able to provide dedicated 24 VDC high power outputs for sounders and flashing beacons. The outputs shall be fail-safe, testable and "short circuit" proof. Short-circuiting of one output shall not affect other outputs.

4.3 Interface Requirements

4.3.1 Hardwired

The F&G System shall be provided with the following potential free contacts, as a minimum:

a. 100N Manual Call Alarm;

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b. 100N H2S detection alarm per fire zone;
c. 200N H2S detection alarm per fire zone;
d. 100N Flammable gas detection alarm per fire zone;
e. 200N Flammable gas detection alarm per fire zone;
f. 100N Flame detection alarm per fire zone;
g. 200N Flame detection alarm per fire zone;
h. 100N Heat detection alarm per fire zone;
i. 200N Heat detection alarm per fire zone.

The contacts shall open on alarm or fault condition

4.3.2 Serial Link

The F&G system shall have a minimum of two serial links to communicate with other systems.

The serial ports shall comply with Modbus RTU / Ethernet communication protocol.

All indication and alarm signals within the F&G system shall be transmitted via serial link to the SCADA PLC for remote monitoring.

4.4 Minimum Requirements for F&G Cabinets

A standard panel from a reputable Manufacturer shall be used.

a. Vendor shall assume that the panel "'will be positioned against. a wall- unless otherwise specified All access required shall be possible from the front of .the cabinet. There should be easy access to terminations;
b. The panel shall be designed to house the following instrument / accessories Monitors/ controllers for Fire detectors, Alarm annunciator , relays / logic cards for shutdown / protection system, Pushbuttons /switches as required (including lamp. test pushbuttons), any other items which are not listed above but essential to make the system operational and to meet requirements specified in Job Specification;
c. Cabinet doors shall be of the window type so that alarms and status indications can be viewed without the need to open doors;
d. The cabinet shall have a minimum of IP-42 degree of Ingress protection, as per BS EN 60529, and shall be fitted with a tamperproof locking system;
e. The cable entry shall be from the bottom of the cabinet;
f. All required cooling, venting and air filtering facilities shall be included;
g. Suitable Cable clamps and rails shall be provided for all incoming cables for adequate cable connection stress relief;
h. All unused card locations shall be fitted with cover plates;
i. Galvanic isolators for intrinsically safe circuits;
j. A separate insulated IS earth bar;
k. The Vendor shall apply a universal method as per referred Codes & Standards, of allocating inputs, outputs and other components to the cabinet, to provide an easy maintainable system;

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l. The cabinet shall have lifting eyes to facilitate handling during transportation and installation;

m. Cabinets shall have 30% spare space;

n. Each cabinet shall be provided with a nameplate;

o. The nameplate made from Traffolyte engraved with black letters on white background;

p. Final tagging details shall be advised at order placement.

4.5 Wiring Details

a. The EPIC supplied field cabling shall terminate directly on the terminal strips in the pre-wired F&G cabinet.

b. All metallic equipment within the cabinets shall be connected to a single safety earthpoint. The cabinet shall be provided with a M8 earthing bolt for connection to the plant safety earthing system.

c. Terminals carrying voltages higher than 24 volts shall be physically separated and protected against accidental contact by removable cover plates and be labelled accordingly.

d. The Vendor shall supply all wire required for panel internal wiring. Interconnecting wires shall be standard copper conductor, with 600 volt rated fire retardant PVC insulation.

e. Stranded copper wire shall be installed, wire ends at terminal points shall be provided with suitable type wire crimp pins/lugs and markers.

f. All internal wiring, except cross-wiring of hardwired logic, shall be laid in PVC close slotted ducting with covering lid.' The wire ducting shall have a minimum of 35% spare capacity.

g. Terminal arrangements shall be such that all single cores (including spares) of the multicore cables can be connected in the same sequential order as the pattern and layout of the cores in the cable.

h. Separate Junction Boxes for IS and Non-IS signals shall be provided. Cable entries shall be located at the bottom and side only via removable gland plates. Suitable flameproof cable glands shall be used and spare cable entries shall be provided with plugs, labels shall be provided stating Junction Boxes contain IS circuits.

4.6 Marking

Terminals and (main) wiring shall be clearly identified in strict accordance with the system documentation. Earthing for IS, screens, AC and DC systems shall be segregated and identified.

The cabinet and all major system components, modules, boards, terminals,' blocks, cables, card files and individual card locations shall be clearly labelled and identified with a tag number. Individual wires shall be tagged with the terminal number. Nameplates shall be in the English language. In addition all equipment shall be identified-with the Vendor type and serial number to facilitate future reference.

The wiring shall be colour coded in accordance with the following standards

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24 V DC Power supply	Positive Negative	Red Black
24 V DC Digital signals	Positive Negative	Light gray (with "+" sleeve marker) Light gray (with "_" sleeve marker)
24 V DC Analog signals	Positive Negative	Purple (with "+" sleeve marker) Negative Purple (with "_' sleeve marker)
Intrinsic Safe signals	Positive Negative	Blue (with "+" sleeve marker) Blue (with "_" sleeve marker)

Panel wiring shall be sized in accordance with the following:

24 V DC Power output	Tinned ,stranded, 2.5 mm2" minimum and copper conductors 600V grade
24 V DC Digital signals	Tinned ,stranded, 1.0 mm2 minimum and copper conductors 600V grade
24 V DC Analog signals	Tinned ,stranded, 0.75 mm2 minimum and copper conductors 600V grade
Signal Earth	Yellow with black stripe
I.S Signal Earth	Yellow

Notice giving details of the wiring colour scheme shall be fixed to the inside of the cabinet, using a plastic-laminated sheet. A document holder shall be installed on the inside of the cabinet door

All power and signal wiring shall be clearly marked with reference codes and/or tag numbers.

All signal wires terminated to incoming or outgoing cabinet terminals shall be marked with the terminal number.

4.7 Power Supply Requirements

4.7.1 Power Supply Facilities

Two (2) secure 24 V DC power supply feeders will be available from the Plant UPS system.

DC Voltage	24 V DC (±5%)
Ripple at full load	100 mV PIP

The system shall be fed by the two main supplies with blocking diodes to allow uninterrupted supply in case one of the main feeders fails. A main feeder failure alarm shall be generated.

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The internal distributions of the 24 V DC supply shall be as per indicated standard. The F&G system shall supply the required power for 24 VDC digital output signals to sounders and beacons as well as to analogue input signals.

The power supply to the logic input and. output circuits shall be floating (non-earthed).

The main power supply to the cabinet -shall be protected and isolated by means of a thermal circuit breaker (MCB type C). Separate Mini Circuit Breakers (MCB type B) shall be provided for each power supply unit. Vendor shall guarantee proper selectivity.

4.7.2 Power Distribution Features

Within the F&G cabinet the power supply system shall have the following minimum features:

a. The provision of all the necessary power, voltage, frequency etc. That individual components and modules require, .with full redundancy.
b. Proper power distribution to all systems, with necessary isolation and fusing.
c. Isolation of individual racks within the cabinet.
d. Isolation of I/O cards within a "logic entity". Fuse blowout indication shall be provided, while it shall be possible to easily replace fuses.

4.7.3 Power Consumption

The Vendor shall submit a calculation of the estimated power consumption and heat dissipation of the F&G cabinet, two weeks after order placement.

5.0 FABRICATION

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Fire & Gas detection panel. Vendor shall submit the required specification, drawings & documents for approval. Also, Vendor shall refer the relevant codes and standards for manufacturing mentioned herein. Painting of Fire & Gas detection panel shall be in accordance with Company painting specifications.

6.0 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per project specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for F&G system devices & panels shall be carried out as per approved Inspection and Test Plan.

Vendor shall submit the Inspection and Test Plan for proprietary items / special items for approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process such as material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

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6.1 Factory Acceptance Testing

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, 'for review and approval, listing all the F&G system complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices' & panels.

FAT shall be carried out as per approved Inspection and Test Plan. FAT shall' be carried out prior to shipment of the F&G system devices & panels.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking' place.

FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT 'shall be consisting of the following as a- minimum:

a. Visual Inspection;
b. Dimensional checks which shall be carried out as per the approved drawings;
c. Material checks in accordance with the appropriate instrumental standards & codes;
d. Simulation of the serial link interface to prove that the Modbus / Ethernet protocol is properly functioning;
e. Functional Test;
f. Calibration Test;
g. Paint checks;
h. Any other relevant test.

A certificate to detail the results and records obtained during the FAT shall be 'made available for ratification by the Vendor on the date of test.

6.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the F&G system devices as per the approved test· procedure. A comprehensive test procedure in compliance with the Company Specification shall be developed and issued to Company / Owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the F&G system functions correctly and properly in accordance with the specified requirements.

7.0 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for F&G system shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

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Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

8.0 SPARES AND ACCESSORIES

The Vendor shall include recommended spare parts list for start-up, pre commissioning and two years operation as per the following:

a. Itemized recommended spare parts list for start-up and pre commissioning;

b. Itemized recommended spare parts list for two years operation;

Vendor shall recommend accessories and special tools required for operation and maintenance of F&G System, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

9.0 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

9.1 Documentation Required With Technical BID

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Specification, Data Sheets;

b. Bill of Materials including Vendor list, details for third party items;

c. Catalogues and manuals;

d. Quality assurance plan ;

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9.2 Documentation Required For Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and Specifications for the Company's approval:

a. Specifications, Data Sheets;

b. Bill of Materials including Vendor list, details for third-party items;

c. Catalogues, manuals and relevant drawings and documents;

d. Dimensional drawings;

e. Calibration certificates;

f. Material Test certificates;

g. Procedures for FAT;

h. Quality Assurance.

9.3 Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Generally Vendor shall provide warranty support for a period of 12 months from the 'date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective' material workmanship and facility design. Warranty work shall be done at Owner's local facilities. The cost of correction / replacement of any warranty items shall be borne by the Vendor.

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Energising Quality

VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION
FOR
OPTICAL FIBRE CABLES AND CONDUIT

VCS-SS-IN-5910_02

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ABBREVIATION

ASTM	American Society of Testing and Materials
CSTA	Computer Supported Telecommunication Application
FAT	Factory acceptance Test
DC	Direct Current
HDPE	High Density Poly Ethylene
ITU	International Telecommunication Union
OFC	Optical Fibre Cable
IEC	International Electro-technical Commission
IS	Indian Standards
PLB	Permanently Lubricated
SAT	Site acceptance Test
UV	Ultra violet

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1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Optical Fiber Cables (OFC) and Conduit / Ducts along with its spares and accessories.

2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the Item / Unit is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

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3 REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

ASTM D 1693	Standard Test Method for Environmental Stress Cracking of Ethylene Plastics
IS 12235	Methods of test for un plasticized PVC Pipes' for potable water supplies
IS 2530	Methods of test for polyethylene moulding materials and polyethylene compounds
IS 4984	Specification for high density polyethylene pipes for potable water supplies
IS 7328	High Density Polyethylene Materials for Moulding and Extrusion -Specification
IS 9938	Recommended colours for PVC insulation for LF wires and cables
ITU-T G 652	Characteristics of a single-mode optical fibre and cable

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

Krishna

4 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Company's Standard Specifications.

5 DESIGN & CONSTRUCTION

5.1 General

The fibre shall fulfil latest ITU-T Recommendation G-652 / G-655 for single mode optical fibres.

Total Number of Fibers	Project Specific
Type	G.652 or Composite (G.652+G.655)

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5.2 Geometrical, Optical and Physical characteristics of Optical Fibres

Mode field diameter	Vendor to Specify
Cladding Diameter	125 µm ± 1%
Mode field concentricity error	Less than 1 µm
Cladding non-circularity	Less than 2%
Cut-off wavelength	Vendor to specify and the project job specification shall be referred
Protective materials / coatings	Optical fibers shall be coated with UV cured double Acrylic Resin. It should not have any reaction with cladding or core material
Nominal Overall thickness	250 µm

The coatings should provide max. Resistance to micro bending & abrasion and ensure mechanical & optical strength. The coatings shall be easily stripped with mechanical tools.

5.3 Fiber Identification

The coating shall be in various colors in order to facilitate fiber identification. Fiber colors shall correspond to IEC publications. The colors shall be durable. The colors should have color fast properties also in the presence of other materials during the lifetime of cable. The coating and the color shall not react with surrounding jelly.

Each fiber and tube shall be identifiable thought the length of the cable in accordance with following color sequence:

Tube No.	Colour of Tube	Fibre Colour	Tube No.	Colour of Tube	Fibre Colour
1	Blue	Blue	7	Red	Blue
		Orange			Orange
2	Orange	Green	8	Black	Green
		Brown			Brown
3	Green	Slate	9	Yellow	Slate
		White			White
4	Brown	Red	10	Violet	Red
		Black			Black
5	Slate	Yellow	11	Pink	Red
		Black			Black
6	Black	Pink	12	Aqua	Pink
		Aqua			Aqua

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5.4 Transmission Characteristics of Fibres

Attenuation	The cabled fiber shall have attenuation coefficient 0.38 dB/km at 1310 nm wavelength region and 0.22 dB/km at 1550 nm wavelength region
Chromatic dispersion coefficient	• Less than 3.5 ps/nm.km at 1288 to 1339 nm • Less than 5.3 ps/nm.km for 1271 to 1360 nm
Polarization mode dispersion coefficient	Less than 0.5 ps / (km)1/2

5.5 Cable Construction

5.5.1 Design Life

ed operating life of cable: Better than 35 years

a. Drum length : 4 km +/- 5%

i. Cable weight in drum (for nominal drum length), to be provided by Vendor

ii. No splicing shall be permitted on any fibre in a drum length of the cable.

b. Protection Required

The cable shall be protected against damages from termite, fire, chemicals (such as oil & natural gas and other petroleum products), moisture and water, over the lifetime of the cable.

c. Construction Details of Cable

i. Strength member: Vendor has to specify the "strength member" (in case of metallic strength member, the same shall be provided with suitable chemical coating to prevent corrosion).

ii. Filling of cores: The stranded tubes shall be filled with moisture resistant jelly, which should be compatible with the coated fibre and the surroundings.

iii. Number of fibres per tube shall be two.

iv. Moisture barrier: Polymer coated Aluminium tape placed longitudinally over the loose tubes. The tape shall form a close fit around the cable core with a sealed overlap of 6 mm minimum. Alternatively, water swellable tape or water swellable powder may be provided over the tube.

v. Inner sheath shall be of MDPE. Thickness of inner sheath shall be 1.50 mm minimum Aluminium foil.

vi. Outer sheath shall be of HDPE with a thickness of 1.50 mm minimum.

vii. Electrical continuity of the respective metallic layers shall be maintained between the ends of the cable in each drum. The different metallic layers shall not be electrically shorted to each other.

viii. If Fibre Optic cable is to be buried directly into the soil/ground, a metal jacket or armouring shall be provided outside the cable. The project job specifications shall be referred for the exact requirement of the same. Also the metal portion of the cable have to be well grounded before entering building, to protect it from lightning strike effects ..

d. Mechanical Characteristics of Cable

i. Temperature :

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Installation & Operation	: 0°C to +60 °C
Storage	: 0°C to +60 °C
ii. Tensile strength for Cable	:9.81 W Newton (W is weight of 1 km of Cable in kg)
iii. Cable weight in kg/km	: Vendor to specify
iv. Minimum bending radius	: 20 x Cable Diameter

e. Average splice loss

5.6 Identification Marking

The outer surface of the cable shall be permanently & legibly marked with color in contrast to the outer sheath at regular intervals not exceeding one meter, with the following details:

- Name of client;
- Name of manufacturer;
- Part Number;
- "OPTICAL FIBRE CABLE";
- Year of manufacture;
- Drum No;
- Meter markings;
- No. of Cores.

All the marking over OFC shall be such that it should not be erased during field use.

The outer surface of each completed cable shall have sequentially numbered metric length markers spaced at regular intervals of one meter.

6 PERMANENTLY LUBRICATED CONDUIT

6.1 General

The HDPE conduit shall be permanently lubricated with an inner layer of solid permanent lubricant by co-extrusion method to minimize the internal coefficient of friction. The duct/conduit should have shallow groove for air cushioning. The co-extruded inner layer of above lubricant shall be continuous throughout the length of the HDPE conduit.

The HDPE conduits shall also be free of blisters. Shrink hooks, break and other defects. The internal and external pipe surfaces shall be smooth. Pipes shall not display any stress edged grooves or sink marks. The colour of the pipes shall be orange and be uniform throughout. The HDPE conduit shall unroll off the drums without snaking or waving having zero coil set. Following are the mechanical and dimensional specifications of HDPE conduit:

Pressure Rating	Minimum 6 Kg/cm2 and suitable for blowing at 6 Kg/cm2
Outer diameter	50 mm (50 mm + 0.4 mm)
Wall thickness	4.0 ± 0.3 mm with shallow groove

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Tensile strength	20 N/mm2 or better
Density	940.0 - 950.0 kg/cm at 27 Deg.C
Melt Flow index	0.4 to 0.95 gm/10 minutes at 90°C under 5 kg load
Intrinsic coefficient of friction	0.06 (max) when-tested with respect to Nylon
Impact strength	As per IS: 12235 (part 9)

The pipes should confirm to following IS specifications:

a. IS – 2530;

b. IS – 4984;

c. IS – 7328;

d. IS – 9938;

e. ASTM D -1693.

6.2 Conduit / Duct Construction Specification

6.2.1 Outer Layer

The base HDPE rein used for the outer layer of the PLB HDPE duct/conduit shall conform to any designation of IS - 7328 or to any equivalent standard meeting the following requirements, when tested as per IS - 2530. However, the manufacturers shall furnish the designation for the HDPE resin as permanently IS - 7328 as applicable.

Density	: 0.940 to 0.958 g/cc at 27 Deg.C
Melt Flow Rate (MFR)	: 0.2 to 1.1 g/10 minutes at 190 Deg.C & 5 kg load

6.2.2 Inner Layer

The inner lubrication material shall be of friction reducing, polymeric material which shall be integral with HDPE layer. The lubricant materials shall have no toxic or dermatic hazards for safe handling. In the finished PLB HDPE duct/conduit, the co-extruded layer of solid permanent lubricant shall be integral part with HDPE and shall be white in colour and clearly visible in cross- section of duct/conduit.

The inner layer of solid permanent lubricant shall be continuous all through and shall not come out during storage, usage and throughout the life of the duct/conduit.

6.2.3 Homogeneous Construction

The HDPE material used for this construction shall meet the requirements of project specification and relevant data sheets.

The raw material (s) used for the duct/conduit shall meet the following requirements:

a. The anti-oxidants used shall be physiologically harmless;

b. None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct/conduit;

c. Single pass rework material of the same composition produced from the manufacturer's own production shall be used and it shall not exceed 10% in any case;

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d. The raw material used for extrusion shall be dried the moisture content to less than 0.1%;

e. Suitable UV stabilizers shall be used for manufacturer of the duct/conduit to protect against ultra violet degradation, when stored in open for a minimum period of 8 months;

f. The raw material used in the manufacturer of the duct/conduit shall be such that the service life of the duct/conduit and all its accessories can be expected to be more than 50 years including the life of permanent lubricant.

6.3 PLB HDPE Conduit / Duct Accessories

The following accessories are required for jointing the duct/conduits and shall be supplied along with the duct/conduits. The manufacturers shall provide complete design details, procedure for method of installation and type/ grade of the material used for the accessories.

6.3.1 Duct/conduit Coupler (Fusion Type)

It is used to couple two duct/conduits. The design of this shall be simple, easy to install and shall provide airtight and water tight joint between the two duct/conduits by way of fusion technique. The coupler shall ensure that the two duct/conduits are fused smoothly without any step formation in the inner surface. The jointing shall meet the air pressure test of 10 kg/cm2 for a minimum period of 2 hours without any leakage.

6.3.2 End Plug

This is for sealing the ends of the empty duct/conduits, prior to installation of the Optical Fiber Cable and shall be fitted immediately after laying of the duct/conduit, to prevent the entry of any dirt, water, moisture, insects/ rodents etc.

6.3.3 Cable Sealing Plug

This is used to seal the ends of the duct/conduits perfectly, after the cable is installed in the duct/conduit, to prevent the entry of dirt, water, moisture, insects/ rodents etc. This is required at all places where cable has come out of the duct/conduit either for jointing or entry into the building as required. The sealing plug shall be capable of accommodating standard sizes of optical fibre cable taking into account the variation in diameter due to tolerance limits, etc.

6.3.4 End Cap

This cap is made of hard rubber, shall be fitted into both ends of duct/conduit coil after manufacturing the duct/conduit. This shall avoid entry of duct/conduit, mud and rainwater into the duct/conduit during the transit and storage.

6.4 Name Plate

The OFC duct / conduit shall be prominently marked with indelible ink, with the following information at intervals every meter to enable identification of the pipe. The size of ink markings shall be distinct, clearly and easily visible

a. Client name;

b. Client logo;

c. Manufacturer's name (Also can be abbreviated form);

d. Name of the duct/conduit with size;

e. Machine number / specific serial number of the duct/conduit;

f. Date of manufacturing;

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g. Sequential length marking at every meter.

All the markings over HDPE conduit shall be such that it should not be erased during field use.

6.5 Jointing Closures

Jointing closure shall be suitable for armoured and unarmoured optical fibre cables of all construction designs (slotted core, stranded tube, central tube). Jointing closures shall' have 4 entry ports to allow entry/exit of four optical fibre cables. The same shall have provision of blocking/sealing of the ports, if not in use.

The fibres and their storage shall be managed with proper bend radius controls and protection. The fibre organizer trays shall have provision of maximum 6 fibres per tray. The trays should be hinged in such a manner that if moved about the hinge, the fibres are not strained, kinked or stressed. Also, it should be possible to work on the fibres on one tray without disturbing the fibres on the other trays.

The jointing closure shall enable the metal parts of the cable and the internal metal parts of the closure to be maintained at earth potential.

The sealing of the entry ports, shall provide adequate sealing and shall be capable of withstanding an axial pull applied using 50 kg freely suspended weight of the cable, without using any additional clamps, etc.

Jointing closures should be Dust tight (No dust ingress) and protected against immersion in water (suitable for continuous immersion in saline water under 4-meter water-head). It should be complete with all accessories including splice cassettes splice protection and all other accessories including accessories for electrical continuity of metallic layer of optical fibre cable, etc. along-with instruction sheets.

The complete jointing closures including trays, joint protection sleeves etc. shall be sourcing form the above sub-vendors as a composite item.

7 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Optical Fiber Cables and Conduit / Ducts shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, and any other before Factory Acceptance Testing (FAT).

7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Optical Fiber Cable drums and OFC conduits.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

7.1.1 For Optical Fiber Cables

The following minimum tests shall be conducted at the factory for the acceptance of the cable:

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a. Core (mode field) diameter and concentricity error test;
b. Cut-off wavelength;
c. Attenuation coefficient at 1300nm, 1550nm, Spectral attenuation;
d. Chromatic dispersion at 1300nm, 1550nm, from 1530 to 1565nm;
e. Cladding: Diameter, Non circularity.

7.1.2 Tests on Completed Cables

a. Visual Inspection
   - Cable lay-up and fiber identification;
   - Identification and length marking on outer jacket;
   - Colour contrast of the marking with the outer sheath of the cables;
   - Overall diameter of the cable.

b. Tests for moisture barrier
   - Thickness of layers;
   - Extent of overlapping;
   - Electrical continuity of metallic layers;
   - Water swellable tape or power;
   - Water immersion.

c. Tests for corrugated steel tape armouring
   - Thickness of layers
   - Extent of overlapping
   - Electrical continuity of metallic layers
   - Electrical discontinuity between CSTA and moisture barrier

d. Other Tests
   - Attenuation at 1310 nm & 1550 nm Polarization Mode dispersion
   - Tensile performance: direct underground burial type OFC (with a tensile load of value T= 9.S1W Newton, where W = weight of 1 km 'Cable' in kg).
   - Crush (with 200 kg of load to be slowly placed and held for 60 seconds. The change in attenuation should not exceed 0.1 dB/km).
   - Impact (with a mass of 5 kg allowed to fall freely from 500 mm height on the cable sample 10 times repeatedly with a gap between one impacts to another approximately at 60 seconds. The change in attenuation should not exceed 0.05dB/km).
   - Torsion (with a weight of 7.5 kg attached to the stationery chuck and shall be subjected to 10 cycles. The change in attenuation should not exceed 0.05dB/km).
   - Bend (To be performed preferably with Procedure 1 (of IEC) with a mandrel diameter of 240 mm, where 0 is the diameter of the cable and testing shall be done with 4 turns of cable wrapped and then unwrapped for 10 complete cycles. The change in attenuation should not exceed 0.05 dB/km)
   - Snatch (with a load of 100 N. No damage to the fibre, sheath or to the other cable elements).

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- Kink Radius: 10 x Cable diameter. No kink shall occur.
- Temperature cycling (This test shall be performed with a cable length of 200 m.
- Temperature cycle shall be taken as (The change in attenuation should not exceed 0.1 dB/km)

At room temperature	1 hr.
At zero degrees temperature	12 hrs
At 65 degrees temperature	12 hrs
From 65 degrees to room temperature	1 hr

- Water penetration test
- Water immersion
- Sheath integrity (spark test). The sheath shall withstand a spark test voltage of at least 8 KV r.m.s. or 12 KV DC.

7.1.3 For OFC Conduits

A separate sample size for each of the tests shall be taken as stipulated at random from the samples already examined for dimensions and visual inspection. All the conduits shall be tested for compliance as per the requirements.

Following tests are needed to be done for acceptance:

a. Visual Inspection;

b. Dimension of Duct/conduits;

c. Tensile Strength & Elongation;

d. Reversion Test;

e. Environmental Stress Crack Resistance;

f. Impact Strength;

g. Crush Resistance;

h. Mandrel Test;

i. Ovality Test;

j. Coil Set Test;

k. Oxidation Induction Test;

l. Hydraulic Characteristics;

m. Internal Co-efficient of Friction;

n. Optical Fibre Cable Blowing Test;

o. Duct / Conduit coupling test by fusion technique.

7.1.4 For Jointing Closures

The following tests shall be conducted as a minimum:

a. Water Ingress Test;

b. Impact test;

c. Drop and topple test;

d. Pulling test;

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e. Static load test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the Optical Fiber Cables and Conduit / Ducts at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to Company / Owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Optical Fiber Cables and Conduit / Ducts functions correctly and properly in accordance with the specified requirements.

8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor ensure that all Cables, associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Conduits/Ducts shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning;

b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Optical Fiber Cables and Conduit / Ducts for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

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10 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

c. Standard Specification, Data Sheets;

d. Bill of Materials including Vendor list, details of third party items;

e. Catalogues and Manuals;

f. Quality Assurance Plan;

g. Any other documents.

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

a. Specifications, Data Sheets;

b. Bill of materials including Vendor list, details for third party items;

c. Catalogues, Manuals and relevant drawings and documents;

d. Dimensional drawings;

e. Material test certificates;

f. Procedures for FAT;

g. Quality Assurance Plan.

10.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing, whichever later Warranty shall apply to defective material workmanship and facility design. The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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ANNEXURE – 1

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1 INSTALLATION AND ASSOCIATED WORKS

1.1 Trench Excavation

OFC shall be laid at depth of 1 meter in the pipeline trench generally. At crossings, OFC installation depth shall be 1.5 meter typically. Refer to OFC installation standard drawing, SD-IC-033 for more information.

The trench shall be enlarged at the splicing points as needed to carry out the splicing works. The enlargement shall be carried out on the same side of the cable for the entire route.

1.2 Laying Bed Preparation

All works concerning the preparation of the laying bed shall be carried out by the contractor.

The laying bed of 10cm depth shall be made of sand or riddled earth obtained by passing through a sieve having meshes not exceeding 15 mm2, or of a natural soft around not requiring riddling.

1.3 Cable Laying

All works concerning the cable laying shall be earned out by the Contractor.

Contractor shall plan the cable-laying operation such that the complete drum-length of cable can be laid without cutting in-between.

The cable cable shall be carefully inspected for jacket defects as it is removed from the reel. If defects are noticed, the pulling operation shall be terminated immediately and the Construction Manager (Site Incharge) notified.

The Contractor shall establish section by section the ways and means for the cable laying taking into account the characteristics of the layout.

In all jointing locations including the normal joint at the end of the drum length and also at points of cable-cuts due to laying necessities, at least one of cable from each end of the cables at the joint location shall be left in a coiled form in the pit to allow for splicing and jointing of the cable. Minimum 15 meters of extra length of optical fiber cable shall be left at jointing locations for future maintenance.

At all telecom building locations (including terminals and intermediate stations) an extra length of about 20 meters of each cable shall be kept in a coiled form.

Contractor shall provide the necessary cable leading pipes for cable(s) entry inside the telecom room. All these leading-in-pipes shall be properly scaled to prevent entry of rodents, snakes, insects and foreign materials. At locations where the telecom room shall not be available, extra length of the cable shall be kept buried in ground near the proposed telecom room location.

If the splicing or termination operation does not follow immediately after the cable laying, all cable ends must be sealed carefully with heat-shrinkable end-caps.

Bi – directional “center pull” techniques shall be acceptable in order to accommodate long continuous installation length and shall be implemented as follows:

- From the midpoint pull the optical fiber cable into the conduit from the shipping reel in accordance with the manufacturer's specifications.
- When this portion of the pull is complete, remainder of the cable shall be removed from the reel to make the inside end available for pulling in the opposite direction.
- This is accomplished by hand pulling the cable from the reel and laying into large "figure eight 8”. The purpose of the figure eight pattern is to avoid cable tangling

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and kinking. This loop shall be laid carefully one upon the other (to prevent subsequent tangling) and shall be placed in a protected area. The inside reel end of the cable is then available for installation.

- In some cases, it may be necessary to set up a winch at an intermediate cable vault. The required length of cable shall be pulled to that point, and brought out of the cable vault and coiled into a figure eight "8".
- The figure eight is the then turned over to gain access to the tree cable end. This can then be reinserted into the duct system for installation into the next section.
- When power equipment is used install optical fiber cables, the pulling speed shall not exceed 30 meters per minute. The pulling tension, bending radius and twist limitation for optical fiber cable shall not be exceeded under any circumstances.
- Large diameter wheels, pulling sheaves. and cable guides shall be used to maintain the appropriate bending radius. Tension monitoring shall be accomplished using commercial dynamometers or load cell instruments.
- The pulling eye / sheath termination hardware on the optical fiber cables shall not be pulled over any sheave blocks.
- Under no conditional shall OFC be left exposed or unattended.
- Repair of cable jacket shall not be permitted. Jacket damage shall require removal and reinstallation of a new cable run at the Contractor's expense.

1.4 OFC Pressure Blowing Procedure in HDPE Duct

The cable laying consists in using a mechanical feeder to push a OFC into a HDPE duct, through which flows a powerful air-stream, generated by a compressor. This high speed airflow exerts a drag on the entire surface of the cable, assisting its progression. The cable is therefore being not pulled but pushed and carried in the air. It moves easily along inside the duct, following any undulations or change in direction, even if these are abrupt and/or frequent. As no tractive force is exerted at the front end of the cable, it is not subjected to the stress usually encountered with conventional methodize, like pulling with a shuttle or rope. After installation, the cable rests on the bottom of the duct.

This is also called Cable Jet method and provides lowest friction, lowest tension method of installing optical cables into sealed duct system as depicted in figure below.

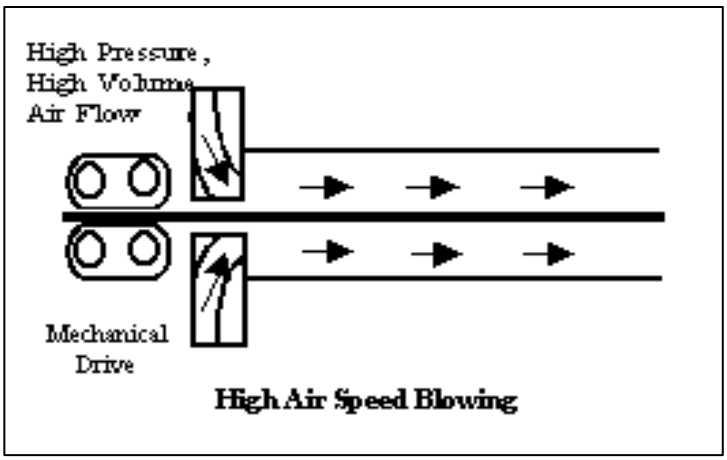

Figure 1: High Air Speed Blowing

In this process, duct shall be wide open and high air volume (300-600 cfm) is blown through it. This wind pushes on the cable and advances it forward at whatever speed

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pusher shall support. There is no pulling force on the front end of the cable, only a mechanical pushing force at the back and an air drag force distributed along its length.

The following are general steps required for the installation:

- The HDPE duct shall be in the range of 1075 m – 1500 m drums:
- Dielectric and seamless Accessories shall be used for jointing HDPE ducts. The jointing accessories shall withstand the pressure required to blow the cable.
- Suitable jointing tubes with indented rings, which mate with external corrugations, shall be utilized for all joints. Joints shall provide a watertight seal.
- During construction the ends of the conduit shall be closed to prevent foreign objects.
- Upon completion the ends shall be sealed to prevent ingress of water and using a plug.
- The Telecom contractor shall provide the sealing and it shall be achieved without use of glues, sealing compounds or foams.
- After its installation, the conduit shall be cleaned on the inside from any kind of material (earth, stones, etc.)
- Air blowing test shall be conducted to confirm the intact of the joints and no air leaks exist.
- The HDPE duct shall be provided in a 1075m – 1500m per drum. The Telecom Contractor shall advise for any preferable change subject to COMPANY approval.
- After duct installation, integrity testing shall be conducted to ensure proper duct installation.
- Using one blowing machine (Cable Jet), Up to 1500 or 2000m can be blown, depending on quality and characteristics of the cable, ambient temperature and profile of the trench.

1.4.1 Factor to be considered

Following important factors are to be considered in air assisted installation of OFC in order to obtain best performance in blown installations:

- **Flexibility of the cable:** A cable that is too flexible cannot be pushed properly without bunching up. While stiffer cables can be blown, some cables are designed specifically for blowing. Consult your cable manufacturer for recommendations.
- **Selection of cable:** Choosing the proper cable is important for optimal blowing. Although most fibre cables can be blown, some cables are designed specifically for blowing. Consult your cable manufacture for recommendations.
- Type of duct is another significant factor in optimized blowing. Smooth wall and longitudinal ribbed HDPE conduits are preferable.

1.4.2 Field Procedures

General field practices followed in air assisted installation of OFC are as listed below:

- Ensure that the duct system is properly installed with pressure tight splices. This shall be tested by sealing one end of the duct and pressurizing the duct using a sealed blowing machine. The duct shall not lose air pressure at any significant rate. Sand and projectiles can be blown from the duct, and poor-quality duct splices can fly apart.

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- For HASB, end cap the front end of the cable so that it does not hang up in the duct. Be sure that you have air seals to fit the OD of the cable you are installing.
- Clean, dry, and prove the duct. If it was not done previously, blow through a hard mandrel to establish that the duct is not crushed. Then blow a tight-fitting foam carrier through the duct at high pressure. The foam should travel through at approximately 100 ft/sec in a clean duct. If excess water or dirt comes from the duct, repeat the process. If necessary, dry the duct with dry airflow.
- For high air speed machines (no missile), inject the recommended amount of lubricant and spread it by blowing through another foam carrier. For piston type machine, majority of the lubricant are injected in front of the missile with some placed behind it.
- Hook the blowing machine to the duct. For HASP machines, hand pushes a hundred feet or so of cable into the duct. Close and seal the cable and air chamber on the blowing machine. Follow the machine manufacturer's instructions for all operations.
- Check all pneumatic and hydraulic hook-ups. Slowly turn up the air and watch it go.
- An after-cooler shall be sued for all for all pressure blowing (Cable Jet) installation, particularly when the cable is to be installed in high ambient temperatures (such as in Oman and the Middle East). The use of an un-cooled compressed air source can cause a dramatic increase in the coefficient of friction between the duct and the cable sheath.

1.4.3 Lubrication

HDPE duct shall be sufficiently lubricated by a water based lubricant approved by cable Manufacturer, as the cable is pulled into the duct.

Lubricant shall be applied at a rate to provide a continuous 10-Mil coating, as recommended by the manufacturer.

1.5 Jointing / Installation at Pull Box

The Pulling of the cable shall be hand assisted at each pull box. The cable shall not be crushed, kinked or forced around a sharp corner. Sufficient slack shall be left at each end the cable to allow proper cable termination.

The extra length of optical fiber cable shall be coiled and secured with cable ties ion the pull box. The contractor shall ensure that the minimum bending radius of the optical fiber cable is not compromised when preparing this stored cable slack.

Imprinted plastic – coated cloth identification forwarding tags shall be securely attached to the cables in at least two locations in each pull box / manhole.

When all cables at each pull box are securely racked, unused conduits and void area around conduit containing cables shall be sealed.

The joint enclosure shall support an optical fiber organizer and allow sealing-off the outer sheaths of the cable.

Contractor shall provide detailed procedure for jointing of the cable along with the details of the jointing pits to be used for housing the joint enclosure and the excess cable after jointing.

Splicing loss shall not be more than 0.1 dB / splice.

Contractor shall provide electronic marker & electronic indicator of approved make at each jointing location.

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1.6 OFC Splicing

Splicing of fibers shall be done by fusion splicing only. Splicing loss in each fiber in the joint location should be better than 0.02 dB (mechanical splice loss as shown in the splicing machine) & better than 0.1 dB at 1310 nm / 1550 nm as shown in the OTDR of each fiber.

Minimum 15 meters of extra length of optical fiber cable shall be left at jointing locations for future maintenance.

1.7 Crossing

Canal and river crossings shall be through a suitable casing pipe, provided as part of the pipeline laying. An additional pulling rope shall be kept inside to meet future requirements.

After installation, the casing pipe shall be cleaned inside of any kind of dirt and stones etc. Bituminized jute shall be used to close the ends of the conduit to prevent any dirt deposit. Similarly, bituminized jute shall be used to close the conduits ends after introduction of the cable.

Where crossing of existing underground pipelines and cables, pipes on sleepers, etc. occur, the same requirements for normal laying shall apply, the cable maintaining the normal position with respect to the pipeline.

1.8 Back Filling

Above the laid cable, a cover of 75 mm minimum depth of fine sand shall be provided by the Contractor. Above this cover a single layer of second-class brick shall be laid in a transverse manner over the cable laid in the trench. The bricks shall be fully soaked in water before being laid in the trench.

Minimum seven bricks per meter shall be laid with uniform spacing over the length of the laid cable.

A warning tape / mat made of PVC sheet of orange color with clear permanent print as "<Client Name>" minimum 150 mm wide and 0.1 mm thick shall be laid over the cable at regular interval of 1.5 meters.

Thereafter the trench shall be backfilled with the excavated earth. Normally, no mechanical protection shall be provided on the cable except at spiking points and rocky areas and as stated in particular cases.

The joints, relevant cable rings and other underground constructions shall be protected by bricks or concrete slabs to be supplied by the Contractor.

At the splicing points, the Contractor shall also take care to backfill the trench and to restore the relevant area and to repair any damaged works.

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ANNEXURE – 2

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1 HOP TESTING

After backfilling of the trench, optical fiber cable shall be tested for continuity and attenuation over the laid length.

The test shall be conducted both before and after the splicing. It shall be ensured that the cable attenuation does not exceed as recommended for G 655 or G 652 cables (excluding the splice loss) and the splice loss on each fiber shall be 0.1 dB per splice (max.). Test procedures mentioned herein are minimum requirements to be followed. However, Contractor shall provide the detailed procedure for cable testing.

Fiber optic cable test-results shall clearly provide the attenuation for each fiber in following aspects:

- Different Wavelengths (1310 nm and 1550 nm);
- Each cable section;
- Individual splice.

Total Attenuation = (wavelength (λ) loss dB/km x fiber length) + (connector loss x number of connectors) + (splice loss x number of splices).

Where,

L = Length of the cable between two nodes;

N = No. of joints between two nodes.

Result shall be within permissible limits. After hop testing results with average losses shall be recorded for each fiber and hop wise report shall be submitted as per approved procedure. Testing shall be witnessed jointly by Client and PMC. Contractor shall furnish as built documents and hop loss report hop wise.

2 FIBER LENGTH MEASUREMENT

2.1 Test Description

This test will check the continuity of the fibre from station to station and record the length of fibre. Average loss per kilometre of fibre length shown in dB/km shall be recorded for information only. Testing will be done from both ends and average loss will be calculated (for 310nm/1550nm/1625nm, as applicable).

2.2 Test Equipment

Following test equipment shall be used:

- Optical time Domain Reflectometer (OTDR);
- Patch cords;
- Pigtails

2.3 Procedure

Test procedure shall be as detailed below. Test formats (1A & 1B) shall be as depicted in Section 2.4 and 2.5.

- Power ON the OTDR and make the settings as required for the hop under test;
- Connections OTDR with patch cord to the connector in OTC;
- Make the Laser ON and observe the trace till it gets settled up to the end of the trace;

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- Store the results in the hard disk/floppy disk with proper identification of the fibre under test;
- Record the result in format provided;
- Repeat the procedure for the opposite direction;
- Repeat above steps for each fiber.

2.4 Format 1A

Fiber Length Measurement (G.652)

Date:-

Location A:

Location B:

Wavelength: 1310 nm & 1550 nm

Equipment Used

Tube No. / Color	Fiber No. / Color	Fiber Length (m)	Optical Loss dB/km		Average Cable Loss (dB/km)
			From A	From B	

2.5 Format 1B

Fiber Length Measurement (G.652)

Date:-

Location A:

Location B:

Wavelength: 1550 nm & 1625 nm

Equipment Used:

Tube No. / Color	Fiber No. / Color	Fiber Length (m)	Optical Loss dB/km		Average Cable Loss (dB/km)
			From A	From B	

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3 INSERTION LOSS MEASURMENT

3.1 Test Description

During insertion loss measurement, light is launched (LASER) in the fibre by using a LASER source from one end at the other end by using an Optical Power meter the received power is measured. Fiber loss is calculated by subtracting the receive power from the transmit power. This test also determines the fiber termination continuity on end-to-end basis as the measurement is done on both the ends of a link.

3.2 Test Equipment

Following test equipment shall be used:

- Power meter working on 1310 nm / 1550 nm / 1625 nm;
- Laser source working on 1310 nm / 1550 nm / 1625 nm;
- Patch cords;
- Pigtails;

3.3 Procedure

- Test procedure shall be as detailed below. Test formats (2A & 2B) shall be as depicted in Section 3.4 and 3.5.
- One power meter , one laser source and one unit of optical talk set is required at each station between which the link is to be tested.
- At location A, switch ON the laser source, set it to operating wavelength of 1310nm and connect it to the power meter (set at 1310nm for G.652 fibres) by two FC/PC patch cords (these FC/PC patch cords will be connected to each other with FC / PC coupler) and record the laser power transmitted. Subtract 0.5 dB (Coupler Loss) from this reading and record it in the test sheet (Appendix-2A & 2B) as 'Power transmitted'.
- Disconnect the power source and power meter by disconnecting FC/PC patch cords from the FC/PC connector. Do not disconnect patch cords from the power meter and power source.
- Connect the power source to the one of the fibres terminated in FTC at location A and the power meter to the same fibre under test in FTC at location B.
- Record the power received in test sheet.
- To establish communication between two stations A & B, optionally connect optical talk set to one of the fiber (e.g. No 12) at both the stations. When that particular fiber is due for testing connect the talk set to one on which testing is complete (e.g. No 1).
- Confirm on the talk set that the power received is recorded.
- Repeat the test for 1550nm.
- Connect the source to next fibre terminated in FTC at location A and power meter at location B.
- Repeat the same procedure with source at location B and power meter at location A.
- Continue the above process till all fibers are tested.
- Average loss of each fiber should be less than the average loss estimated.

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Above test procedure shall be repeated for G.655 fibers for 1550 nm / 1625 nm as required. Test formats (3A & 3B) shall be as depicted in section 3.6 and 3.7.

3.4 Format 2A

Insertion Loss Measurement (G.652)

Date:-

Location A:

Location B:

Wavelength: 1310

Equipment Used:

Cable Length (km) (L):

Number of splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) (037L + 0.07N + 0.5C):

Tube No. / Color	Fiber No. / Color	A-B		B-A		Average Insertion Loss (IL) (dB/km)
		Power Transmitted at A		Power Transmitted at B		
		Power Received at B	Insertion Loss (A-B) (dB/km)	Power Received at A	Insertion Loss (B-A) (dB/km)	

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3.5 Format 2B

Insertion Loss Measurement (G.652)

Date:-

Location A:

Location B:

Wavelength: 1550

Equipment Used:

Cable Length (km) (L):

Number of splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) (0.22L+0.07N+0.5C):

Tube No. / Color	Fiber No. / Color	A-B		B-A		Average Insertion Loss (IL) (dB/km)
		Power Transmitted at A		Power Transmitted at B		
		Power Received at B	Insertion Loss (A-B) (dB/km)	Power Received at A	Insertion Loss (B-A) (dB/km)	

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3.6 Format 3A

Insertion Loss Measurement (G.652)

Date:-

Location A:

Location B:

Wavelength: 1550

Equipment Used:

Cable Length (km) (L):

Number of splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) (0.244L+0.07N+0.5C)

Tube No. / Color	Fiber No. / Color	A-B		B-A		Average Insertion Loss (IL) (dB/km)
		Power Transmitted at A		Power Transmitted at B		
		Power Received at B	Insertion Loss (A-B) (dB/km)	Power Received at A	Insertion Loss (B-A) (dB/km)	

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3.7 Format 3B

Insertion Loss Measurement (G.652)

Date:-

Location A:

Location B:

Wavelength: 1625

Equipment Used:

Cable Length (km) (L):

Number of splices including Pigtails (N):

Number of Connectors (C):

Average Insertion Loss Estimated (dB/km) (026L+0.07N+0.5C):

Tube No. / Color	Fiber No. / Color	A-B		B-A		Average Insertion Loss (IL) (dB/km)
		Power Transmitted at A		Power Transmitted at B		
		Power Received at B	Insertion Loss (A-B) (dB/km)	Power Received at A	Insertion Loss (B-A) (dB/km)	

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Energising Quality	PROJECT NUMBER: C221052	IGGL

Specifications of Electronic Marker Locator			Total Sheets		7
Document No	C221052	00	IN	SS	5001

INDRADHANUSH GAS GRID LIMITED

NORTH EAST GAS GRID PHASE-III PIPELINE OF IGGL PART-D1 & D2

D1	09-12-2022	Issued for Bid	VK	DGM	KNC
A1	07-12-2022	Issued for Internal Review	VK	DGM	KNC
REV	**DATE**	**DESCRIPTION**	**PREP**	**CHKD**	**APPR**

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ABBREVIATION

OFC	Optical Fiber Cable

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1.0 INTRODUCTION

The Hydrocarbon vision 2030 for North East India (vision document), released by MoP&NG proposes detailed plan for Natural gas infrastructure development in North-East. The states covered in the vision document include Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura.

-M/s Indradhanush Gas Grid Limited (IGGL), a Joint Venture of IOCL, ONGC, GAIL, OIL and NRL, is in the process of implementing the North East Gas Grid (NEGG) with a vision to connect all the eight (08) northeastern state capitals and major consumption centers in the region. The NEGG will be connected to National gas grid at Guwahati through Barauni-Guwahati pipeline (already under execution by M/s GAIL).

M/s IGGL intends to lay pipeline along with terminal works for 11 which consist of 12" NB x 186 Km (approx.) in section-11 mainline. Main line taken from Siliguri DT to Gangtok RT in Section-11.

The brief scope of work includes supply of materials (other than free issue), pipeline laying work including but not limited to Construction Management, HSE & Quality Management, Survey, ROU management, clearing of ROU, grading, stringing, bending, welding (Manual), trenching, joint coating, lowering, crossings, crossings by HDD (wherever specified), Tie-ins, NDT and destructive testing, backfilling, laying of pipeline along-with OFC & HDPE ducts, TCP works, site restoration, hydro-testing, dewatering, swabbing, drying, nitrogen purging (as applicable), pre-commissioning, commissioning and Gas-in of pipeline including construction / installation of related facilities like scraper launching / receiving facilities and all piping works at dispatch / receiving terminals, I.P. Stations and piping works at Sectionalizing valve stations, Tap-off station & Injection points, etc. including associated Mechanical, Cathodic protection, Corrosion monitoring works, Electrical works, Telecom works, Firefighting works, Instrumentation, Civil works (including boundary wall and building works), Architectural and Structural works at all stations, and Pipeline Information Management system. The scope of work has been divided into the following parts:

2.0 SPECIFICATIONS FOR ELECTRONIC MARKER LOCATOR

Contractor shall provide electronic locating system suitable for field use to locate underground-buried OFC joint locations.

The system shall consist of:

a) Electronic marker (to be buried underground along-with OFC joints)

b) Marker locator (including probe & locator electronics)

The electronic markers shall be placed at all joint pit/inspection chamber locations (planned and unplanned). The electronic markers shall be lightweight and shall have a passive tuned resonant circuit, enclosed and sealed within a casing. The marker locator shall be able to locate the electronic markers with the help of audio and visual signals. The electronic locator system shall be capable of locating Cable and location

of sheath (earth fault) fault. The markers shall be of color suitable for Oil & Gas application.

The marker locator and the probe shall be of lightweight and portable enough to be carried (in suitable carrying case, to be provided) on shoulder. The locator shall be able to work on batteries (dry alkaline) for continuously 8 hours. The electronic locating system shall be able to work in saline atmosphere in coastal area and shall be protected against corrosion. The electronic locating system shall not be affected by any metal, alternating current, etc. The casing of the electronic marker shall be resistant to chemicals, minerals, water ingress and temperature variation normally encountered in underground environments. The material used for the manufacture of electronic markers shall be protected against any damage due to rodents or any other insects in the underground environment.

The marker should be detectable by marker locator unit from anywhere within radius of min. 2 meter from the centre of marker.

Each marker locator provided shall be complete with its set of accessories (i.e., necessary interfaces, connecting cables, software, etc). The electronic markers shall be buried underground 30 mm below the lid of each jointing pits and shall not be in direct contact with any metallic body.

Apart from the features stated above, the Electronic Marker Locator Unit should have the following additional features:-

- Locating conductor or sheath (earth return) faults.
- Tracing the path of underground cables and metallic pipes with estimated depth measurement.
- The Electronic marker locator unit with cable/ pipe locator & sheath fault locator shall consist of the following main sub-systems/ parts:
- Electronic Marker Locator/ Cable, Pipe Locator Unit (Receiver Unit)-Bidder can offer two separate units for electronic marker locator & pipeline /cable locators) to meet tender specifications.
- Transmitter Unit

3.0 GENERAL REQUIREMENTS

a. The Electronic Locator System shall be fully solid state and field proven employing state of the art technology.

b. The instrument shall be portable and light weight. The actual dimensions and weight of the instrument shall be furnished by the contractor.

c. All connectors and cables shall be of low loss, suitably shielded, reliable and of standard type to ensure failure free operation over long periods and under specified environmental conditions.

d. The mechanical design and construction of each card/ unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.

e. The instrument shall have self cooling arrangement without use of fans.

f. All controls, switches and indicators shall be clearly marked to show their circuit designation and functions.

g. Marker Locator Unit should have the facility of writing/ storing data in the electronic markers such as Joint no., Chainage, location, placement date etc. The locator should also have the facility to read the data stored in the ID electronic marker.

h. All required software along with cables, connectors and accessories shall be supplied with the unit for interfacing the Electronic Marker Locator Unit with Laptop/ Computer and storing/ downloading, uploading electronic marker related data.

i. The Electronic Marker Locator Unit shall be supplied with Transmitter, two sets of transmitter connection leads, capacitive coupler/ clamp, ground rod, earth frame for locating earth return faults, carrying case, cables, connectors and accessories complete in all respects required for carrying out the features/ functions as detailed in specifications.

j. Installation of Electronic Markers at OFC Joint Pit locations, writing/ storing data in the Electronic Markers during installation shall be the responsibility of contractor.

4.0 OPERATIONAL REQUIREMENTS

a. The Electronic Locator System shall be able to pin-point earmarked buried telecom facilities such as cables, joints etc. using the electronic markers.

b. It should also be able to locate the route of pipes/ cables with depth estimation, locating conductor or sheath (earth return) faults.

c. The Marker Locator shall generate and transmit a specific frequency signal to the buried electronic marker. The Electronic Marker, tuned to this frequency, reflects the signal back to the locator. The locator verifies the reflected signal picked up through the probe and the location is indicated with an audible & visual indication.

d. The instrument shall be provided with sensitivity control facility.

e. All switches / controls on front panel of shall have suitable safeguards against accidental operation.

f. The instrument shall be adequately safeguarded to prevent entry of dust, insects etc.

VOLUME II OF IV

STANDARD SPECIFICATION: CIVIL
(APPLICABLE FOR ALL SPREAD OF ALL PARTS)

I. STANDARD SPECIFICATION OF CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

S.No	DOCUMENT NAME	DOCUMENT No.
1	Standard specification for materials	VCS-CS-SS-6021, Rev -3
2	Standard specification for topographic survey of stations	VCS-SS-CS-6001, Rev -3
3	Standard specification for earth work in site grading	VCS-SS-CS-6002, Rev -3
4	Standard specification for earth work for underground piping	VCS-SS-CS-6003, Rev -3
5	Standard specification for roads and flexible pavements (up to WBM layer)	VCS-SS-CS-6004, Rev -3
6	Standard specification for concrete pavement	VCS-SS-CS-6006, Rev -3
7	Standard specification for flexible pavement with bitumen premix carpet	VCS-SS-CS-6007, Rev -3
8	Standard specification for RCC pipe culvert & ERC crossing	VCS-SS-CS-6008, Rev -3
9	Standard specification for gravel filling	VCS-SS-CS-6010, Rev -3
10	Standard specification for misc. Civil and structural works for underground services	VCS-SS-CS-6011, Rev -3
11	Standard specification for plumbing and drainage	VCS-SS-CS-6012, Rev -3
12	Standard specification for chain link fencing	VCS-SS-CS-6013, Rev -3
13	Standard specification for general scope	VCS-SS-CS-6020, Rev -3
14	Standard specification for earth work in foundations	VCS-SS-CS-6022, Rev -3
15	Standard specification for plain and reinforced concrete	VCS-SS-CS-6023, Rev -3
16	Standard specification for structural steel works	VCS-SS-CS-6024, Rev -3
17	Standard specification for steel structural works (tubular hollow sections)	VCS-SS-CS-6025, Rev -3
18	Standard specification for miscellaneous steel works	VCS-SS-CS-6026, Rev -3
19	Standard specification for brick masonry	VCS-SS-CS-6027, Rev -3
20	Standard specification for stone masonry	VCS-SS-CS-6028, Rev -3
21	Standard specification for demolition and dismantling	VCS-SS-CS-6029, Rev -3
22	Standard specification for miscellaneous items	VCS-SS-CS-6030, Rev -3
23	Standard specification for soil investigation	VCS-SS-CS-6031, Rev -3
24	Standard specification for RCC bored cast-in-situ piles	VCS-SS-CS-6033, Rev -3
26	Standard specification for testing of concrete piles	VCS-SS-CS-6034, Rev -3
27	Standard specification for floor finishing	VCS-SS-CS-6040, Rev -3
28	Standard specification for wood work	VCS-SS-CS-6041, Rev -3
29	Standard specification for plastering and pointing	VCS-SS-CS-6043, Rev -3
30	Standard specification for roof treatment	VCS-SS-CS-6044, Rev -3
31	Standard specification for white washing, colour washing, distempering, painting and polishing	VCS-SS-CS-6045, Rev -3
32	Standard specification for false ceiling, false flooring, underdeck insulation and partitioning	VCS-SS-CS-6047, Rev -3
33	Standard specification for acid proof tile lining	VCS-SS-CS-6048, Rev -3

Energising Quality

CS Quality Services Pvt Ltd

STANDARD SPECIFICATION
FOR
MATERIALS

VCS-SS-CS-6021

03	31.01.2022	NV	GDS	HK	GW
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Rev.	**Revision Date**	**Prepared by**	**Checked by**	**Approved by**	**Authorized by**	**Revision Description**
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
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ABBREVIATION

M	Metre
mm	Millimetre
IS	Indian Standard
MS	Mild Steel
PVC	Poly Viny Chloride
mm^2	Square Millimetre
RCC	Reinforced Cement Concrete
PCC	Plain Cement Concrete
BIS	Bureau of Indian Standard

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1.0 SCOPE

1.1 This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.

1.2 Whenever any reference to BIS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.

1.3 Apart from the BIS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.

1.4 In case of any variation/contradiction between the provision of BIS Codes and this specification, the provision given in this specification shall be followed.

1.5 All materials shall be of standard quality and shall be procured from renowned sources/ manufacturers approved by the Engineer-in-Charge. It shall be the responsibility of the Contractor, to get all materials/ manufacturers approved by the Engineer-in-Charge prior to procurement and placement of order.

1.6 Whenever called for by the Engineer-in-Charge all tests of the materials as specified by the relevant BIS Codes shall be carried out by the Contractor in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer-in-Charge for his approval. If so desired by the Engineer-in-Charge, tests shall be conducted in the presence of the Engineer-in-Charge or his authorized nominee.

1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant BIS Codes. In case BIS code is not available for the particular material, other codes e.g. BS or DIN or API/ASTM shall be considered. The decision of Engineer-in-Charge, in this regard, shall be final and binding on the Contractor.

1.8 Whenever asked for, the Contractor shall submit representative samples of materials to the Engineer-in-Charge for his inspection and approval. Approval of any sample does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant BIS Codes.

1.9 The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer-in-Charge from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/source at any stage of execution of work.

1.10 All costs relating to or arising out of carrying out the tests and submission of test reports and or samples to the Engineer-in-Charge for his approval during the entire tenure of the work shall be borne by the contractor and included in the quoted rates.

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1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer-in-Charge and shall not be used in the works till these are approved.

1.12 All rejected materials shall be immediately removed from the site by the Contractor at his own cost

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 WATER

3.1 Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS: 456.

3.2 Tests on water samples shall be carried out in accordance with IS: 3025 and they shall fulfill all the guidelines and requirements given in IS: 456.

3.3 The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.

3.4 The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/organic matter or an excess of acid, alkalies or any injurious amount of salts etc., beyond the permissible maximum limits given in IS: 456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.

3.5 Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.

3.6 Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydro testing and checking the leakage of liquid retaining structures also.

4.0 AGGREGATE

4.1 GENERAL

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4.1.1 Coarse and fine aggregates for Civil and Structural Works shall conform in all respects to IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense durable, clean and free from veins, adherent coatings, injurious amount of alkalies, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc.

4.1.2 Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineering-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.

4.1.3 Aggregates which may chemically react with alkalies of cement or might cause corrosion of the reinforcement shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.

4.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS: 2386 - Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS: 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS: 383 and IS: 2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS: 2430.

4.1.5 Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.

Separate sieve analysis and grading curves shall be prepared by the Contractor for any/all batches of coarse and fine aggregates, and submitted to the Engineer-in-Charge, whenever asked for, to ensure conformity with those submitted along with the mix design.

4.1.6 Whenever required by Engineer-in-Charge, the aggregates(coarse/fine) shall be washed and/or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.

4.1.7 Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

4.2 COARSE AGGREGATES

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4.2.1 Coarse aggregates are the aggregates, which are retained on 4.75mm BIS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).

4.2.2 These may be obtained from crushed or uncrushed gravel or stone as per clause 3.1 and may be supplied as single sized or graded. The grading of the aggregates shall be as per IS: 383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the contractor shall submit to the Engineer-in-Charge at least three sets of mix design and test results, each with different grading of coarse aggregates, proposed to be used. The Engineer-in-Charge may allow "All-in-aggregates" to be used provided they satisfy the requirements of IS: 383.

4.3 FINE AGGREGATES

4.3.1 Fine aggregates are the aggregates which pass through 4.75mm BIS sieve but not more than ten percent (10%) pass through 150 micron BIS sieve. These shall comply with the requirements of grading zones I, II and III of IS: 383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.

4.3.2 Fine aggregates shall consist of material resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or gravel sand. Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

4.4 SAMPLING AND TESTING

The Contractor shall carry out all tests including mix designs of concrete, at his own expense, at the start of work as well as during any stage of construction as required by the Engineer-in-Charge. Test shall be carried out in accordance with IS: 516-Methods of test for strength of concrete and IS: 2386-Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer-in-Charge. The method of sampling shall be in accordance with the requirements given in IS: 2430.

4.5 STORAGE OF AGGREGATES

4.5.1 Storage of all types of aggregates at site of work shall be at contractor's expense and risk and shall be stored as specified in IS: 4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.

4.5.2 The Contractor shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.

4.5.3 Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for at least 24 hours. The Contractor shall obtain prior approval of the Engineer-in-charge for the use of such aggregates and shall adjust the water content in accordance with IS: 2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the Contractor can make suitable adjustment in the masses as per IS: 456, for preparation of nominal mix concrete only.

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5.0 SAND

5.1 SAND FOR MASONRY MORTARS

5.1.1 The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS: 2116.

5.1.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts and coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

5.1.3 Unless found satisfactory as a result of further tests as may be specified by the Engineer-in-Charge, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS: 2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS: 2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS: 2386.

5.1.4 GRADING OF SAND

The particle size grading of sand for use in mortars shall be within the limits as specified below:

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS SIEVE DESIGNATION	PERCENTAGE	REF.TO
IS: 460(PART I)	PASSING BYMASS	METHOD OF
4.75 mm	100	IS: 2386(Part I)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be

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considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

5.1.5 SAMPLING AND TESTING

The method of sampling shall be in accordance with IS: 2430. The amount of material required for each test shall be as specified in relevant parts of IS: 2386. Any test which the engineer-in-charge may require in connection with this shall be carried out in accordance with the relevant parts of IS: 2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS: 2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

5.2 SAND FOR FILLING

Sand for filling shall meet the requirements of IS: 383 and shall be natural sand, hard, strong and free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer-in-Charge. Sand obtained from sea shores, creeks or river banks affected by tides shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS: 383 shall be allowed for filling.

6.0 CEMENT

Cement to be used for civil and structural works shall be one of the following. Specific requirement for the type of cement to be used shall be as shown in the drawings or as specified in the contract or as directed by the Engineer-in-Charge.

Specification for 33 grade ordinary Portland cement	IS: 269
Specification for Portland slag cement	IS: 455
Specification for Portland pozzolana cement (fly ash based)	IS: 1489 Pt.1
Specification for Portland pozzolana cement (calcined clay based)	IS: 1489 Pt.2
Specification for Masonry Cement	IS: 3466
Specification for high alumina cement for structural use	IS: 6452
Specification for rapid hardening Portland cement	IS: 8041
Specification for 43 grade ordinary Portland cement	IS: 8112
Specification for 53 grade ordinary Portland cement	IS: 12269
Specification for Sulphate Resisting Portland cement	IS: 12330

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6.1 STORAGE AT SITE

6.1.1 The storage of cement (lifted from the Owner's godown or procured by the Contractor himself) at the site of work shall be at contractor's expense and risk and shall meet the requirements of IS: 4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. In the event of any damage occurring to the quality of cement due to faulty storage or on account of negligence on the part of the contractor, such damages shall be borne by the contractor himself.

6.1.2 All approved cement shall be arranged in batches with type, brand and date of receipt fagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer/owner. The contractor shall maintain a register, on day to day basis, giving the details of the receipt/consumption, source of supply and type of cement etc. The register shall always be accessible to the Engineer-in-Charge for verification.

6.2 TESTS AFTER DELIVERY

Each consignment of cement supplied by Owner or contractor, shall, after delivery at site and at the discretion of the Engineer-in-Charge, be subjected to any or all of the tests and analyses, required by the relevant Indian Standard Codes. In case the cement is supplied by the owner, the contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. The contractor shall carry out and bear the cost of all tests and analyses required to ensure quality of cement before using in actual works, irrespective of the fact whether the cement is supplied by the Owner or procured by him.

6.3 REJECTION

The Engineer-in-Charge may reject at his discretion any cement, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement which is considered defective shall not be used and shall be promptly removed from the site by the contractor.

7.0 STEEL

7.1 GENERAL

All steel bars, sections, plates, and other miscellaneous steel materials, etc shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective BIS Codes.

7.2 REINFORCEMENT BARS

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Reinforcement bars, to be used for civil and structural works shall be one of the following or in combination thereof.

Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (grade I).	IS: 432
Specification for hard drawn steel wire fabric for concrete reinforcement.	IS: 1566
Specification for High strength deformed steel bars and wires for concrete reinforcement.	IS: 1786
Steel for general structural purposes (Grade A).	IS: 2062

7.3 STRUCTURAL STEEL

Structural steel to be used for general structural purposes shall be one of the following or in combination thereof.

Structural steel sections shall conform to following BIS Codes.

Steel tubes for structural purposes.	IS: 1161
Mild Steel Tubes, tubulars and other wrought steel fittings.	IS: 1239
Steel for general structural purposes (Grade A).	IS: 2062
Hollow steel sections for structural use.	IS: 4923

7.4 MISCELLANEOUS STEEL MATERIALS

Miscellaneous steel materials shall be conforming to the following BIS Codes.

Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (grade I) (For mild steel bars of anchor bolts, rungs, metal inserts, grating etc.)	IS: 432
Hexagonal head bolts, screws & nuts of product grade C.	IS: 1363
Technical supply conditions for threaded steel fasteners.	IS: 1367
Plain washers	IS: 2016
Steel wire ropes for general engineering purposes	IS: 2266
Mild Steel Tubes, tubulars and other wrought steel fillings. (For Hand rail tubular sections).	IS: 1239

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Steel chequered plates.	IS: 3502
Hexagonal bolts and nuts (M42 to M150).	IS: 3138

7.4.1 ANCHOR BOLTS

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS Codes mentioned above.

7.5 STORAGE

The storage of all materials at site of work shall be at the contractor's expense and risk and shall be done as per the requirements given in IS: 4082. The contractor shall maintain the proper records of receipt/consumption. The records shall always be accessible to the Engineer-in-Charge for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc, shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping. In case of any damage occurring to the material on account of faulty storage or negligence by the contractor, same shall be borne by the contractor himself.

7.6 TESTS AFTER DELIVERY

Materials supplied by the Owner or Contractor, shall, after delivery at site and at the discretion of Engineer-in-Charge, be subjected to any or all of the tests, required by the relevant BIS Codes. The Contractor shall carry out and bear the cost of such tests irrespective of the fact whether the material is procured by the Owner or the contractor. In case steel is supplied by the Owner, the Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

7.7 REJECTION

The Engineer-in-charge may reject at his discretion any material, not withstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded etc., due to improper storage, handling or transport. Defective materials shall not be used and removed from the site by the contractor at his own expense.

8.0 BRICK

8.1 GENERAL

Bricks for masonry works shall conform to IS: 1077 - Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0N/mm2). Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances etc. of common burnt clay building bricks shall conform to the requirements of IS: 1077.

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Bricks shall be hand - moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind.

8.2 TESTS AFTER DELIVERY

The Contractor shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS: 5454 and tests shall be carried out as per IS: 3495. The cost for carrying out any or all the tests shall be borne by the Contractor. The bricks, when tested, as per IS: 3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be up to the standards of the approved samples.

8.3 STACKING OF BRICKS

Bricks shall be stored at site as per the requirements given in IS: 4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a leveled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimize breakages and defacement of bricks. The supply of bricks shall be so arranged that as far as possible, at least two days' requirements of bricks are available at site at any time. Bricks, of different class, shall be stacked separately.

8.4 LOCAL BRICKS/CLASS 3.5 BRICKS.

Where shown on drawings, locally available bricks of nonmodular size (230mm x 115mm x 75mm) in place of bricks of modular size (190mm x 90mm x 90mm) can be used in case the bricks satisfy the other requirements of IS: 1077. Minimum compressive strength of these bricks shall not be less than 3.5N/mm2.

9.0 STONE

9.1 GENERAL

All Stones used for masonry works shall conform to the requirements of following BIS Codes.

Method of identification of natural building stones.	IS: 1123
Recommendations for dimensions and workmanship of natural building stones for masonry work.	IS: 1127
Recommendations for dressing of natural building stones.	IS: 1129

9.2 QUALITY OF STONES

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Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalies, vegetable matters and other deleterious substances such as iron, pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS: 1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS: 1124 shall not exceed 5 percent.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150 mm and in no case exceed 3/4th thickness of the wall. Height of the stone shall not be more than 300mm.

9.3 UNLOADING/STACKING

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS: 4082 and shall be stacked on a firm ground having adequate stop for drainage. The supply of stones shall be so arranged that as far as possible, at least two days' requirements of stone are available at site at any time.

10.0 ADMIXTURES

10.1 GENERAL REQUIREMENTS FOR ADMIXTURES

10.1.1 All concrete admixtures shall in general comply with the following BIS Codes unless otherwise stipulated in this specification.

Specification for integral cement water proofing compounds.	IS: 2645
Specification for other admixtures for concrete.	IS: 9103

10.1.2 Generally, admixtures shall have ISI certification marks. However, even in case of BIS certified admixtures, Engineer-in-Charge may require the Contractor to carry out and submit any or all the tests (as specified in relevant BIS Codes), from approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the contractor shall submit to the Engineer-in-Charge the type and/or proprietary brand of the admixture from only reputed manufacturers along with necessary test certificates from recognized and approved laboratories or any other document directed by Engineer-in-Charge for the latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer-in-Charge for his selection. In case, both the names are rejected, the contractor shall submit a fresh list of two manufacturers for approval by the Engineer-in-Charge.

The Engineer-in-Charge may direct the contractor to submit test results as required by IS: 2645 or IS: 9103 for any admixture proposed to be used in the concrete in any

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approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any BIS code for testing and acceptability criteria, relevant American, British or German Code shall be applicable.

10.1.3 Prior approval of the Engineer-in-Charge shall be obtained while using water reducing admixtures in the concrete (PCC/RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the design approving authority. Once approved, utmost care shall be exercised, at site by the Contractor to maintain the consistency in the quality of admixture and the concrete/ mortar so produced.

10.1.4 The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer-in-Charge. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in BIS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.

10.1.5 No admixture shall impair the durability of the concrete nor combine with the ingredients to neither form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has been established, strict check shall be maintained not to alter the proportions of ingredients and water-cement ratio of the Design Mix during execution.

10.1.6 The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.

10.1.7 Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

10.2 WATER PROOFING COMPOUNDS

10.2.1 Water proofing compounds shall be mixed with only ordinary Portland cement of grade 33, conforming to IS: 269.

10.2.2 The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.

10.2.3 The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS: 4031.

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10.2.4 Compressive strength of specimen at 3 days shall not be less than 160kg/sq.cm nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg/sq.cm nor less than 80% of the 7 days compressive strength prepared with the same cement, and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS: 4031.

11.0 WATER BARS (WATER STOPS)

11.1 PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion/contraction/construction joints. These shall be pre-formed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures. These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bar shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12 meters.

11.2 Performance requirements of P V C water bars shall meet the requirements of IS: 12200. These shall be of approved make and of ribbed/serrated/plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates/ drawings but in no case the thickness shall be less than 5mm and width less than 150mm. The joining of the water bars shall be carried out by vulcanising strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances.

12.0 BITUMEN/BITUMINOUS MATERIALS

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

Specification of Paving Bitumen.	IS: 73
Specification for bitumen mastic for flooring.	IS: 1195
Specification for Bitumen felts for water proofing and damp proofing.	IS: 1322
Specification for Bituminous compounds for water proofing and caulking purposes.	IS: 1834
Specification for preformed fillers for expansion joint in concrete pavements and structures.	IS: 1838

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Specification for bitumen mastic for use in water proofing of roofs.	IS: 3037
Specification for bitumen primer for use in water proofing and damp proofing.	IS: 3384
Specification for Bitumen Mastic for Tanking and Damp proofing.	IS: 5871
Specification for Glass fibre base coal tar pitch & bitumen felts.	IS: 7193
Code of practise for damp proofing using bitumen mastic.	IS: 7198
Specification for bitumen Mastic, Anti Static and electrically conducting grade.	IS: 8374

The type and grade shall be as shown on the drawings or as indicated in schedule of quantities or as directed by Engineer-in-Charge. Tests and acceptable criteria shall be as per relevant BIS Codes.

13.0 PVC PIPES

PVC Pipes shall conform to the requirements of IS: 4985.

14.0 WOOD/TIMBER

14.1 Wood recommended for platforms of cold vessels or below cold vessels/ exchangers shall be hard and shall be of group A, grade I, and shall have safe permissible stress of 7N/mm2 in compression, perpendicular to grains on outside location as per IS:883. General characteristics like durability, treatability etc. shall conform to IS: 883 and IS: 3629.

14.2 Timber required to be used for formwork shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of Wood/Timber shall be as per the requirements of IS: 4082.

For proper identification and selection of suitable timber for formwork, following codes shall be referred.

Classification of commercial timbers and their zonal distribution	IS: 399
Specification for ballies for general purposes.	IS: 3337
Specification for Ply wood for concrete shuttering work.	IS: 4990

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15.0 ANTITERMITE COMPOUNDS

15.1 Chloropyrifos emulsifiable concentrates (1%) conforming to IS: 8944 shall be used for treatment of soil for protection of buildings against attack by subterranean termites.

16.0 POLYSULPHIDE SEALANTS

16.1 Polysulphide Sealants shall conform to IS: 12118 and be of approved make. Test conditions and requirements shall be as given in the above referred BIS code.

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Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION
FOR
TOPOGRAPHIC SURVEY OF STATIONS

VCS-SS-CS-6001

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ABBREVIATION

m	: Metre
C/C	: Center to Center
U/G	: Underground
BM	: Bench Mark
GPS	: Global Positioning System
VCS	: VCS Quality Services Pvt Ltd

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1.0 SCOPE

This specification covers the requirements for carrying out topographic survey which mainly includes plotting of reduced levels (RL's), contours and ground profiles of the area identified in tender document or identified by CLIENT to generate requisite information for the design and field engineering activities

1.1 This specification covers the following works.

a. Preparation of contour survey maps, with spot levels.

b. Establishment of base line and grid system for defining the co-ordinates of the various areas.

c. Preparation of surveys, maps.

d. Electronic file for spot levels and contours.

1.2 The survey maps shall show all cross drainage works, U/G cables, pipes etc. irrigation structures, building, trees, electric, Telegraphic poles, transmission towers or, any other prominent physical feature.

1.3 Establish reliably High flood level and its source and indicate the source of information.

1.4 For sea shore locations, indicate tidal data such as low tide, high tide and mean tide levels.

1.5 Identify storm water disposal point as naturally existing as per site conditions.

1.6 The contractors shall identify Benchmark of the area and shall carry over level from Bench Mark to the site benchmark. This reference of BM shall be recorded on survey drawings.

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 PERFORMANCE REQUIREMENTS

3.1 All survey works shall be performed under the supervision of experienced persons deputed by the CONTRACTOR. The work shall be carried out as per the well-established, sound survey practices and standards and by qualified and competent surveyors under the direct supervision of qualified engineers and surveyors.

3.2 All measurements shall be in metric units.

3.3 The reading and noting shall be neat, legible and scorings and over-writing shall be duly initialed by the Contractor.

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3.4 All surveys shall be carried out with reference to the existing permanent bench marks using approved methodology and equipment e.g. GPS, Auto levels, High Precision Theodolite, etc.

3.5 The Contractor shall record all crossings, property lines, utilities, roads, railways, canals, streams, etc. that are inside the plot area or in the vicinity of 50m from plot boundary. Underground utilities within the boundary of the plot shall also be located as far as possible and staked. Generally the following shall be recorded:-

a. Bridges, storm water drains, culverts, headwalls, tunnels

b. Walls, fences

c. Field lines, overhead power lines, pipe lines. Obtain location, elevation, properties, and size of underground pipelines and utilities at 10 meter intervals and at the change in direction of the pipelines.

d. Locate underground pipelines and visible features, such as manholes, clean-outs, sumps and etc. in the field.

e. Buildings and other structures (such as transformers, tanks, towers, paved aprons)

f. Dumps, storage areas

g. Shorelines, streams, ditches, channels, and other drainage ways

h. Right-of-way lines

3.6 The corrections arising from the standard errors, variations in temperatures, pulls etc. shall be incorporated to the linear ground measurements.

3.7 The observations for the measurement of vertical distances on benchmarks and turning points shall be read nearest to 5 mm and for other nearest to 10mm.

3.8 The error for linear measurement shall not exceed 1:10,000 and for angular measurements, six seconds per station.

3.9 In case Survey is required to be carried out inside hydrocarbon plants / areas, all survey equipment's to be used shall be intrinsically safe suitable for use in hazardous area.

4.0 PRELIMINARY LOCATION SURVEY

The Contractor is expected to make himself aware of the general conditions of the terrain before starting the survey.

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4.1 Alignment and location surveys:

4.1.1 A preliminary survey for locating the outer boundary of the plot on the ground shall be carried out.

4.1.2 Contractor should check for terrain gradient by using hand Clinometer/ Total Stations.

4.1.3 Objects like, trees, poles (power, telephone and telegraph), walls, tube-wells or such other structures falling within the plot boundary should be marked.

4.1.4 Survey Control Points (SCP) shall be established in such a manner that the points are not disturbed during the duration of the fieldwork. Surveyor shall connect tie-in SCPs to the relevant Universal Transverse Mercator (UTM) Grid.

4.2 Staking of Plot Boundary

4.2.1 The plot boundary shall be staked by placing suitably painted marker stakes at Corners of plot and also at some Intermediate Points (IPs) between two corners.

4.2.2 All Grid station, marker stakes and pillars shall be numbered for easy identification.

4.3 Stakes and Markers

4.3.1 All marker stakes shall be pre-cast reinforced concrete blocks having dimensions 300x300x1000 mm deep, and shall be buried to a depth of 500 mm. The exposed surface of the blocks shall have a smooth finish and shall be painted with 'Post Office' red paint. All letters and figures shall be paint marked on the surface of the blocks in white.

4.3.2 On the top surface of the reinforced concrete blocks, a cross inside a circle shall be engraved at the center or a nail shall be put centrally inside an engraved circle, to indicate the exact position of the Intersection Point. The circle shall be of approximately 50mm diameter.

4.3.3 Where it is apprehended that the marker may get lost, damaged, flooded or vandalized, some adjoining markers and landmark locations may also be included.

5.0 BENCH MARKS

5.1 Permanent Bench Marks (BM) approx. at every corner of the plot shall be established and described.

5.2 Location of Bench Marks shall be established in the field by using reinforced concrete blocks. Exact position of BM shall be marked by a cross inside a circle or a nail put centrally inside an engraved circle on the top surface of the concrete block. The reduced level of the BM shall be paint marked on the concrete block. Letters "BM" shall precede the reduced level of bench mark recorded to the second place of decimal.

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5.3 Accuracy of the reduced levels of the Bench Marks shall be verified wherever possible by checking levels with the nearest permanent Bench Mark established by Survey of India, which shall be connected through geocoding system.

6.0 MEASUREMENT OF DISTANCES

6.1 Generally the chainage system shall not be adopted for surveying except in special circumstances and locations where use of Total Stations/Theodolite may not be permitted.

6.2 Distance between corner points of the plot should be measured and recorded. In addition, distance between intermediate points shall also be measured and recorded.

6.3 The true bearing of all straights shall be observed and recorded.

6.4 Check on distance measurements will be stadia method and also GPS based measurements at the time of leveling.

6.5 Standard chain survey format will be used for record keeping.

6.6 Distance of centerline of road/rail/canal etc. from boundary of plot should be noted.

7.0 MEASUREMENT OF HORIZONTAL ANGLES

7.1 Horizontal angles are to be measured to indicate the change in direction of plot boundary etc.

Theodolite reading direct to 10 seconds or better, shall preferably be used.

Angles shall be measured clockwise from back station to fore-station. Mean of two readings-one on face left and other on face right shall be taken as the horizontal angle.

8.0 REDUCED LEVEL

8.1 When the terrain is flat, reduced levels shall be recorded at 2.0 m c/c inside the plot area.

8.2 When the terrain is undulating, observation of reduced level shall be made at a sufficient number of points so as to give an accurate plotting of the ground.

8.3 Method of RISE and FALL shall be used to compute reduced levels of various points. Check on computation shall be made by using the following formula: Back site – Fore site = Rise- Fall = First R.L. – Last R.L.

8.4 All levels shall be with respect to Mean Sea Level (MSL).

9.0 ACCURACIES IN MEASUREMENT

9.1 Contractor shall incorporate corrections to the linear ground measurement due to differential corrections, standard errors, and variations from standard temperature.

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9.2 The error for angular closure for the work shall not exceed one minute per station and for linear measurements it shall be read to the nearest 0.005 M in case of surveys for which use of Total Stations/ high precision Theodolite is mandatory.

9.3 The error on closure for measurements on vertical distance to establish benchmarks shall not be more than 24 (K) ½ millimeters (where 'K' is the linear distance in KM). The error of MIS-closure in vertical distance shall be distributed linearly.

10.0 SURVEY NOTES, OBSERVATIONS AND COMPUTATIONS

10.1 The procedures followed both for field and office calculations shall be such that the results obtained shall be readily understood and retraceable.

10.2 All up-to-date notes and observations related to the basis for determination of boundary lines and corners shall be maintained by surveyor.

10.3 Survey records must contain schematic diagrams of all horizontal controls pertinent to the project showing all existing and established control points, bench marks, any triangulation station and boundary lines.

11.0 MAPS AND DRAWINGS

11.1 All maps and drawings shall be made on standard format. Contractor shall perform mapping and drawing work so as to contain all relevant data consistent with the survey notes and observations. Apart from RL's and contour of the plot area the drawings shall also contain details of roads, streets, highways, structures, all types of crossings, terrain, and all other details which will be required for the purpose of engineering design. Scale of the drawing shall be 1:250 or as directed OWNER/OWNER'S REPRESENTATIVE.

12.0 PRESENTATION OF FIELD SURVEY DATA AND DRAWINGS

Survey drawings shall contain the following data as a minimum requirement.

12.1 All features including, but not limited to roads and railroads, canals, that are located within a distance of 50m from the boundary of plot.

12.2 For the entire plot area, contours shall be plotted on the at 0.5 M interval and the RL's shall be taken at all points at interval of 2m c/c. Additional information like cultivated areas, barren land, areas prone to flooding, rocky areas and forests including access path/roads shall also be shown on the maps.

12.3 RL's of centerline and edges of road/railway crossings as well as RL's of bed of canals/river/streams shall be plotted. Distance from boundary of plot to center of road/rail/river/canal etc. should also be marked.

12.4 Drawing should also show location and details of other pipelines, cables (overhead and buried) utilities etc. within the plot area and also in its vicinity.

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12.5 In case of all rail, road, river, stream, canal, existing pipelines and utility crossings, the angle of crossing shall also be mentioned.

12.6 List of BM's and their northing, easting & elevations should be mentioned.

13.0 DOCUMENTS/DATA SUBMISSION

All drawings shall be prepared on AutoCAD/GIS based package. The documents shall be prepared on MS Office. In addition, hard copies of documents shall also be submitted.

14.0 PAYMENT

This clause shall be applicable for item tender rate only.

14.1 Payment for survey work shall be made on Area basis as per schedule of items Payment for grid stations, boundary pillars, and permanent pillars shall be made on unit basis as per schedule of items. No other payment shall be made. All connected works including supply of drawings and electronic files shall be considered as part of the total work.

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