

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	General Specification for Instrumentation								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0053	Rev. D05	Page 1 of 33

General Specification for Instrumentation

AFC

APPROVED FOR CONSTRUCTION

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NISOC Ref. Letter: 01/2294/134765

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F Number: 709575

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Class: A

Status:

- IDC: Inter-Discipline Check
- IFC: Issued For Comment
- IFA: Issued For Approval
- IFR: Issued for Review
- AFD: Approved For Design
- AFC: Approved For Construction
- AFP: Approved For Purchase
- IFI: Issued For Information
- AB-R: As-Built for COMPANY Review
- AB-A: As-Built –Approved

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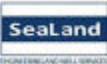



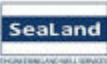

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1. INTRODUCTION

National Iranian South Oil Company (NISOC) plans to conduct an integrated project includes several sub-projects to preserve and increase production of Gachsaran oil fields located in south of Iran Khuzestan and Bushehr provinces as follow:

- 1) Revamping of Production and Desalting Units of Bibi Hakimeh 1&2
- 2) Fabrication & Installation a Preheater, Stripping Column and Related Equipment for Nargesi Production Unit



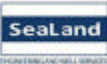

The purposes of first sub-project are primary study of equipping and extension of Bibihakime-2 desalting unit to achieve 110,000 SBPD desalted crude oil, and necessary modifications in Bibihakime-2 desalting & production units and Bibihakime-1 production unit so that the new plants will be able to process crude oil with 22% water cut. Therefore, National Iranian South Oil Company (NISOC) has announced this project.

The purpose of second sub-project is crude oil sweetening in Nargesi plant by new design and necessary modifications in existing facilities. National Iranian South Oil Company (NISOC), on behalf of the National Iranian Oil Company (NIOC) is responsible to exploit oil and gas from onshore fields in the south district of Iran. According to management of planning & international affairs of National Iranian Oil Company (NIOC) pronouncement, H₂S content of exported crude oil shall be shortly decreased to 15 ppmw and the RVP specification of the exported oil shall be in the specified allowable range; Accordingly, NISOC has decided to fulfil a project, investigating and probing required equipment and operational conditions to meet the desired crude oil specifications of sulfur content and RVP for Nargesi production units.

2. SCOPE

This specification defines the minimum requirements used for measurement and control of process variables and defines the rules for the selection, design and installation of instruments of “Revamping of Production and Desalting Units of Bibi Hakimeh 1&2” and “Fabrication & Installation a Preheater, Stripping Column and Related Equipment for Nargesi Production Unit” sub-projects.

All instruments and components, as far as mechanical characteristics and electrical characteristics and performances are concerned, shall confirm to the present specification.

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3. DEFINITIONS

Within the context of this document, the following definitions are applicable

Owner/Client	: National Iranian south oil company (NISOC)
Title	: Development Plan of 28 Reservoirs/ BIBI HAKIMEH Oilfield (EPC)
Contractor	: Mashin Sazi Arak/ Sealand Engineering and Well Services JV
Consultant	: Soroush Energy Pooya
Will:	Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.
May:	Is used where a provision is completely discretionary
Should:	Is used where a provision is advisory only.
Shall:	Is used where a provision is mandatory.

4. ENVIRONMENTAL CONDITIONS

4.1. Site Condition




All the environmental data used in this document and is expected to be considered, shall be obtained from “Process Design Basis for Bibi Hakimeh Production Unit No.1_BH-17-SM-100-PR-DB-0158”, “Process Design Basis for Bibi Hakimeh No.2_BH-17-SM-100-PR-DB-0564” and “Process Design Basis for Nargesi_BH-18-SM-100-PR-DB-0002”.

4.2. Tropicalization

The instruments shall be tropicalized to eliminate mildew, fungi and other detrimental effects of a tropical environment and dust, if needed. Electronic circuit boards shall be suitably protected against corrosion and humidity by applying a protective coating, where deemed necessary. Packaging shall be suitable for shipment and storage under tropical conditions.

4.3. Ingress Protection

All field mounted equipment shall be suitable for the environmental conditions. Particular attention shall be paid to possible effects of corrosion, vibration, humidity, and extremes of temperatures.

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5. CONFLICTS AND DEVIATIONS

Any conflicts between this specification and other applicable specifications, engineering standards, industry standards, codes, etc., shall be resolved in writing by the Owner or Owner's Representative.

6. REFERENCES

6.1. Project Documents

Instrument & Control/Safety System Design Criteria_BH-17-SM-100-IN-DC-0052

Process Design Basis for Bibi Hakimeh Production Unit No.1_BH-17-SM-100-PR-DB-0158

Process Design Basis for Bibi Hakimeh No.2_BH-17-SM-100-PR-DB-0564

Process Design Basis for Nargesi_BH-18-SM-100-PR-DB-0002

Piping and Instrumentation Diagrams (for All the Units)

6.2. References standards




The latest issue of the following codes, standards and regulations shall form part of this specification. In the event of revision of any such document written clarification shall be sought before proceeding with the work.

In general, IPS shall be followed for instrumentation. Any conflict between IPS and following standards shall be brought to the notice of the Client and approved by Client case by case.




Instrumentation shall be designed and fabricated in accordance with engineering codes and standards as follows:

➤ IPS Standards

IPS-C-IN-100	General
IPS-C-IN-110	Pressure Instruments
IPS-C-IN-120	Temperature Instruments
IPS-C-IN-130	Flow Instruments
IPS-C-IN-140	Level Instruments, Construction and Installation Standard

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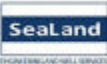

IPS-C-IN-160	Construction And Installation Standard for Control Valves
IPS-C-IN-190	Transmission Systems
IPS-C-IN-200	Installation Standard for Instruments Air System
IPS-E-EL-110	Electrical Area Classification
IPS-E-GN-100	Engineering Standards for Units
IPS-E-IN-100	General Instrumentation
IPS-E-IN-110	Pressure Instruments
IPS-E-IN-120	Engineering Standards for Temperature Instruments
IPS-E-IN-130	Flow Instruments
IPS-E-IN-140	Engineering Standards for Level Instruments
IPS-E-IN-160	Engineering Standards for Control Valves
IPS-E-IN-180	Electrical Power Supply & Distribution System
IPS-E-IN-190	Engineering Standard for Transmission Systems
IPS-E-IN-200	Instrument Air System
IPS-E-PI-221	Piping Material Selection
IPS-E-PR-230	Engineering Standard for Piping and Instrumentation Diagram
IPS-E-SF-860	Air Pollution Control
IPS-G-GN-210	General Standard for Packing and Packages
IPS-G-IN-210	Instruments Protection
IPS-G-IN-220	Control Centres
IPS-G-IN-250	Distributed Control System
IPS-G-IN-260	Alarms and Protective Devices

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IPS-G-SF-900	Noise and Vibration Control System
IPS-I-IN-100	Inspection Standard for General Instrument System
IPS-M-IN-110	Material Standard for Pressure Instruments
IPS-M-IN-120	Material Standard for Temperature Instruments
IPS-M-IN-130	Material And Equipment Standard for Flow Instruments
IPS-M-IN-140	Level Instruments, Material and Equipment Standard
IPS-M-IN-150	Receiving Instruments
IPS-M-IN-190	Material Standard for Transmission Systems
IPS-M-PI-110	Material And Equipment Standard for Valves
IPS-M-PM-211	Material And Equipment Standard for Reciprocating Compressors for Instruments
IPS-M-EL-190	Electrical Heat Tracing
IPS-M-EL-270	Wires and Cables

➤ API Standards

2530	Orifice Metering of Natural Gas and other Related Hydrocarbon Fluids, AGA report No. 3
RP 500 A/B/C	Recommended Practice for Classification of Locations for Electrical installation in Petroleum Refineries
RP-550	Manual on Installation of Refinery Instrument and Control Systems PART-I: Sections 3, 7 and 10: Process Instrumentation and Control Section 4: Pressure Instruments Section 6: Control Valve and Accessories,

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Section 9: Process Instrumentation and Control Instrument air System

Section 11: Electrical Power Supply

Section 13: Alarms and Protective Devices



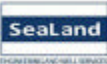
PART-II: Process Stream Analysers, Sections 1 through 11

PART- III: Fired Heaters and Inert Gas Generators

RP-551	Process Measurement Instrumentation
RP 553	Refinery Control Valves
RP 521	Pressure Reliving and Depressurizing Systems
RP 540	Electrical Installation in Petroleum Refineries
RP-7.1	Control Circuit Pressure Test
RP-7.7	Recommended Practice for Producing Quality Instrument Air
RP-12.1	Electrical Instruments in Hazardous Atmosphere
RP-12.2	Intrinsically Safe and Non-Incentive Electrical Instruments
RP 12.6	Recommended Practice for Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations

➤ IEC Standards

IEC-79-10	Classification of Hazardous Areas (2015)
IEC-529	Enclosure of electrical system

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➤ BS Standards



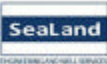
BS 646 (2013)	Cartridge Fuse-Links (Rated up to 5A) for A.C. & D.C. Services
BS 1362 (2012)	General Purpose Fuse Links for Domestic and Similar Purposes (Primarily for Use in Plugs)
BS 1414	Steel Wedge Gate Valves Flanged and Butt-Welding Ends
BS 1515-Part I	Fusion Welded Pressure Vessels
BS 1560	Steel Pipe Flanges and Flanged Fittings for the Petroleum industry
BS 1655	Flanged Automatic Control Valves for the Petroleum Industry
BS 1780	Specification for Bourdon Tubes Pressure and Vacuum Gages
BS 1794	Chart Ranges for Temperature Recording Instruments
BS 6147-1982	Differential Pressure Transmitter with Electrical Outputs 2012
BS 6169	Volumetric Measurement of Liquid Hydrocarbon

➤ ASME Standards

PTC 1 9.3	Performance Test Code-Temperature Measurement
PTC 19.5.4	Instruments and Apparatus, supplement to ASME Power Test Codes
B40.1	Gages-Pressure Indicating Dial Type Elastic Element 2013

➤ ISA Standards

S5.1 (2009)	Instrumentation symbols and identification
S5.4 (R1991)	Instrument Loop Diagrams
S5.5 (1985)	Graphic Symbols for Process Control

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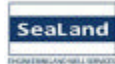

S 12.4	Practice for Instrument Purging for Reduction of Hazardous Area Classification
S 18.1	Annunciator Sequence and Specification
S37.3	Specification and Test for Strain Gage Pressure Transducer
ISA-RP-75.06	Control Valve Manifold Design
S37.6	Specification and Test for Potentiometric Pressure Transducers
S 61.1	Industrial Computer System FORTRAN
S 61.2	Industrial Computer System FORTRAN Procedure for File Access and Control of File Contention
S 72.01	PROWAY-LAN Industrial Data Highway
75.01.01 ANSI / ISA	Flow Equations for Sizing Control Valves 2007
75.02 ANSI / ISA	Control Valve Capacity Test Procedure 2008
75.03 ANSI / ISA	Face-to-Face Dimensions for Flanged Globe Style Control Valve Bodies (ANSI Class 125, 150, 300, 600) 1985
75.04 ANSI / ISA	Face-to-Face Dimensions for Flangeless and Control Valve Bodies (ANSI Class 150, 300 and 600)" 1985
ANSI / ISA 75.05.01	Control Valves Terminology 2005
ANSI/Mc 96.1	Temperature Measurement: Thermocouples

7. BASIC PRINCIPLES



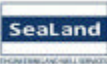

7.1. Acronyms and Abbreviation

The following abbreviations are commonly used in this document:

AI	Analog Input
AO	Analog Output

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ANSI	American National Standard institute
API	American Petroleum institute
ASTM	American Society for Testing and Material
ATEX	Atmosphere Explosible
AWG	American Wire Gauge
BMS	Burner Management System
BS	British Standards
CENELEC	European Committee for Electrical Standardization
CPU	Central processing Units
CCR	Central Control Room
dBA	Decibel Absolute
DC	Direct Current
DCS	Distribute Control System
DI	Digital Input
DO	Digital Output
DPDT	Double Pole Double Throw
EEX	Europe Explosion Proof
EMC	Electromagnetic compatibility
EMI	Electromagnetic Interference
ESD	Emergency Shut Down
EWS	Engineering Work Station
FAT	Factory Acceptance Test
FGS	Fire and Gas System
F.S.	Full Scale
HMI	Human Machine Interface
I&C	Instrumentation and Control
IEC	International Electrotechnical Commission
I/O	Input/output
IP	Ingress Protection
IPC	Industrial Personal Computer
IPS	Iranian Petroleum Standard
I.S.	Intrinsically Safe
ISA	International Society of Automation

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ISO	International Standard Organization
JB	Junction Box
MCC	Motor Control Center
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NACE	National Association of Corrosion Engineering
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NPT	National Pipe Thread
OWS	Operator Work Station
OD	Outside Diameter
LED	Light Emitting Diode
P&ID	Piping and Instrumentation Drawing
PCS	Process Control System
PLC	Programming Logic Controller
RFI	Radio Frequency Interference
RTD	Resistance Temperature Detector
SI	System International of Units
SPDT	Single Pole Double Throw
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply
UV	Ultra Violet

7.2. Units of Measurement

Generally, International System of units (SI) shall be used. All dimensions and ratings shall be metric. Except for the temperature, which shall be in degrees Celsius instead of Kelvin, and for pipes and fittings threads, which shall be in inches of NPT.

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Variable			Units
Temperature			Celsius degree (°C)
Pressure Relative			Psig or Barg
Pressure Absolute			PsiA or barA
Level			m or mm, % of range
Flow vapor nitrogen	Liquid		kg/h or m ³ /h m ³ /h or Sm ³ /h(l) or kg/h m ³ /h or Sm ³ /h(l) or kg/h
	Gas	or	
	Air	or	
Analysers			pH, molar%, ppm % LEL
Density Liquid Gas			Kg/m ³ kg/m ³ .Or.kg/Sm ³ (l)

8. EQUIPMENT IN HAZARDOUS AREAS

8.1. Regulations

Instruments and equipment located in a hazardous area shall be certified to meet the electrical area classification (as per hazard classification); any certified equipment shall be stamped according to the protection and the relating code and shall be delivered with a conformity certificate issued by a recognized laboratory.

It shall not be assumed that the packaging of individually certified components makes a certified unit. A third-party certification must be provided.



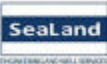

Gas Group classification and ignition level (class) will be corresponding to existing classification.

Explosion proof protection type shall be used in all hazardous areas.

EExd or EExia will be preferably used for Zone 1 and 2 installations.

For flame proof and explosion proof instruments, certifications by recognized authorities in country of origin (PTB, BASEEFA, etc.) shall be provided.

Standard industrial instrument, having enclosures suitable for indoor or outdoor location of this regions and meet other design specifications, will be used in non-hazardous area.

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In order to standardize, all instrument shall be certified for zone according to hazardous Area.

Protection Systems

Material shall have certification from recognized laboratories for different normalized systems of protection such as:

- System with explosion-proof housing (mode d) according to IEC 60079-1
- System with increased safety (mode e) according to IEC 60079-7
- System with intrinsic safety (mode i) according to IEC 60079-11
- System with internal over pressure (mode p) according to IEC 60079-2

A copy of official certificate (and also translation in English) shall be provided with the material.

Enclosure protection




Field instruments shall be weather proof at minimum IP65 according to IEC-60529 requirements or NEMA 4 according to NEMA 250 requirements (for non-hazardous areas shall also be applied).

9. VOLTAGE/PRESSURE REQUIREMENTS

Electric supply (UPS Supported):	110 V AC, 50 Hz
Electric supply (Non-UPS Supported):	230 V AC, 50 Hz
Electric measurement signal:	4 to 20 mA (DC)
Instrument Discrete input:	Supervisory and system control voltage
Electrical interface discrete input:	24 V DC
Solenoid control signal:	24 V DC
Electrical interface discrete output:	24 V DC
Relays:	24 V DC

10. PNEUMATIC SUPPLY

The operating range for pneumatic signal transmission shall be 0.2 to 1 Barg.

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All the pneumatic components of instrument system shall be designed for the instrument air supply conditions as are stated in the documents “Process Design Basis for Bibi Hakimeh Production Unit No.1_BH-17-SM-100-PR-DB-0158”, “Process Design Basis for Bibi Hakimeh No.2_BH-17-SM-100-PR-DB-0564” and “Process Design Basis for Nargesi_BH-18-SM-100-PR-DB-0002”.

- Instrument air specification of Bibi Hakimeh Production Unit No.1




Specification	Value
Dew Point @ 100 psig (°C)	- 14
Supply Temperature (°C)	Max. 50
Normal Supply Pressure (min/max) (barg)	2.7-4

- Instrument air specification of Bibi Hakimeh Production and Desalting Unit No.2

Specification	Value
Dew Point @ 100 psig (°C)	- 14
Supply Temperature (°C)	Max. 50
Normal Supply Pressure (min/max) (barg)	2.7-4

- Instrument air specification of Nargesi production unit

Specification	Value
Maximum Supply Pressure (barg)	10
Normal Supply Pressure (barg)	8
Minimum Supply Pressure (barg)	4

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Design Pressure (barg)	10
Supply Temperature (°C)	60
Design Temperature (°C)	95
Minimum Temperature (°C)	-6
Dew Point	-40 °C @ 8 Barg
Quality	Dust free-Oil free

11. INSTRUMENT GENERAL REQUIREMENTS

This specification is to be taken as minimum requirements. Contractor may propose alternative solutions.

All the materials shall be suitable for the application and process conditions. All the wetted parts shall be in compliance with NACE, if Required.

All materials and equipment shall be new and unused, of current manufacture, of the highest grade and shall be free from all defects and imperfections.

All material supplied under this specification shall be adequate for the proposed service.




Proper consideration shall be given to their function with regard to the environmental conditions, corrosion and chemical attack.

Each instrument and accessories shall have a 30mm x 75mm 316SS nameplate with Contractor tag number, model no., serial no., set range and span engraved in 6mm high x 0.3mm deep bold characters. The nameplate shall be permanently attached to each item. Wiring and spot welding are not acceptable methods of permanently attaching nameplate.

12. INSTRUMENT PROTECTION

Instrument installation shall ensure proper and dependable operation under all operational and climatic conditions. The following conditions require special provisions:

- Fluids which solidify (or have high viscosity) at 20°C. Such fluids shall not be allowed to enter the instrument, because shop repair would be impractical.

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- Fluids which solidify at the lowest ambient temperature (including water at sub-zero temperatures). Such fluids shall not be allowed to enter the instruments and pressure piping to prevent malfunctioning and/or damage.
- Gas measurement services, where hydrate formation may occur at low temperatures.
- Fluids containing solids (including coke particles):
 - For solidifying fluids, or gases with hydrate formation, diaphragm seals shall be utilized.
 - For the fluids containing solids, a diaphragm seal may also be applied provided that the process connection is large enough to prevent plugging.
 - For all other cases, a suitable purge medium shall be applied through the instrument and its piping.




Where the above provisions are not practical, heating of impulse lines, instrument valves and instrument wetted parts shall be adopted and due care shall be taken such that the instrument is not overheated.

13. TEMPERATURE INSTRUMENTS

13.1. Thermowell

The following requirements shall be satisfied:

- ✓ Made from a turned and drilled solid bar stock in 316 stainless-steel (where the properties of the fluid are such that it requires other material, the thermowell material shall be suitable for the duty).
- ✓ Maximum immersion length: As a preliminary values, 150 mm if the pipe diameter less or equal than 4" (minimum pipe diameter 4"), 200 mm if pipe diameter is more than 4" and less or equal than 8", 300 mm if the pipe diameter is more than 10", 500 mm if the thermowell is installed on equipment. Final value will be specified in the individual data sheets.
- ✓ 316-SS separable well, from solid bar stock, screwed (1 in.) NPT external thread and (1/2 in.) NPT internal thread. Rating 100 Barg, unless otherwise specified in related data sheets. (As per IPS-M-IN-120.sec.4.2)
- ✓ Process connection: 1 1/2" Flanged Type for pipe connection and 2" Flanged Type for vessel connection.

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13.2. Thermal Sensors

The following requirements shall be satisfied:

- ✓ Element: Resistance temperature detectors (RTDs) operate on the principle of change in electrical resistance on the detector wire as a function of temperature. Two types of detector wires are generally used in resistance elements, nickel for ranges up to (315°C) and platinum for ranges up to (800°C). A third type, copper, is used in large motor windings up to (150°C). (PT-100 is preferred). Resistance temperature elements are available in many configurations, with the most common type being a tip-sensitive construction. Even though most resistance elements used in the petroleum industry are mounted in a thermowell, the elements shall be used bare when very fast (5-6 second) response times are required.
- ✓ Electrical connection: 3 wires type for RTD used on process general Application, according to need.
- ✓ Electrical connection: M20x1.5 (IPS-M-IN-120)
- ✓ Hazardous Area Protection (ATEX): EEx"i ", Switch: EEx"d"
- ✓ Ingress protection degree: IP 65

13.3. Temperature Transmitters




These transmitters are microprocessor-based type, and compatible with a variety of temperature sensors, including 2, 3, and 4-wire RTDs, thermocouples and other resistance and millivolt inputs. (As per IPS-M-IN-120)

The sensor type is software selectable from the hand-held terminal (HHT). It provides either 4-20 mA standard signal, and/or digital signal.

Note: Sunshade shall be provided for transmitters which exposed to direct sunlight.

13.3.1. Functional Specifications

- ✓ Isolation: The input is galvanically isolated from the output and ground.
- ✓ Inputs: RTD (PT 100), or type J or K thermocouple, as specified in related data sheets.
- ✓ Outputs: Two-wire 4-20 mA, linear with temperature or linear with input, or digital output signal superimposed on 4-20 mA signals. Hart Protocol shall be supported.
- ✓ Power Supply: 24 V DC ± 0.5 V into max. 600 Ω .

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- ✓ Reverse Polarity Protection: Shall be provided.
- ✓ Local Limitations: Minimum load shall be 250, Ω manufacturer's standard to be followed.
- ✓ Indication: Signal indicator shall be provided, with accuracy better than $\pm 2\%$.
- ✓ Hazardous Area Protection (Atex): EEx"ia"
- ✓ Temperature Limits:
 - Ambient: -5° to $+55^{\circ}\text{C}$.
 - Storage: 0° to $+120^{\circ}\text{C}$.
- ✓ Loss of Input/Failure Alarm: If self-diagnostics detect a sensor burn out or gross transmitter failure, the analogue signal shall be driven either below 4 mA or above 20 mA to alert the user (high or low alarm signal shall be user-selectable by internal jumper).
- ✓ Humidity Limits: 0-100%, and shall meet the requirements of SAMA 31.1 section 5.2.

13.3.2. Physical specification

- ✓ Electrical Connection: M20 \times 1.5.
- ✓ Materials of Construction:
 - Electronic housing: Low-copper aluminium, NEMA 4X, or IEC-code IP 65.
 - Paint: Epoxy-polyester.
 - Cover O-rings: Buna-N.
- ✓ Mounting: Normally shall be direct mounting or shall be with brackets for 2-inch stand pipe mounting, as specified in related data sheets.
- ✓ Name Plate: Stainless-steel data plate fastened to electronics housing with stainless-steel screws. Includes the following information:
 - a) Instrument tag No;
 - b) Manufacturer's serial No., model No;
 - c) Temperature range;
 - d) Max. Working temperature;
 - e) Electrical, pneumatic power supply (if applicable);
 - f) Over range protection temperature.

13.3.3. Performance specifications

- ✓ Accuracy: Better than $\pm 0.1\%$ of calibrated span for analogue signal,

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- ✓ Stability: $\pm 0.1\%$ of reading or 0.1°C whichever is greater, for six months.
- ✓ Repeatability: Better than 0.05% of calibrated span.
- ✓ Ambient Temperature Effect: Shall be better than 0.2% of span.
- ✓ Power Supply Effect: Less than $\pm 0.005\%$ of span per volt.

13.4. Temperature Switches




The following requirements shall be satisfied:

- ✓ Element: Bimetallic or filled-type,
- ✓ Process connection: 1 1/2" Flanged Type for pipe connection and 2" Flanged Type for vessel connection.
- ✓ Electrical connection: M 20x1,5
- ✓ Hazardous Area Protection (ATEX): EEx"d"
- ✓ Hermetically sealed snap type Double-pole double-throw contact (contact rating 24VDC),
- ✓ No measure indication,
- ✓ Minimum repeatability: $\pm 1\%$ of full scale.
- ✓ Thermo well: 150 mm if the pipe diameter less or equal than 4" (minimum pipe diameter 3"), 200 mm if pipe diameter is more than 4" and less or equal than 8", 300 mm if the pipe diameter is more than 10".

13.5. Temperature Gauge

The following requirements shall be satisfied:

- ✓ Element: Bi-Metal or liquid filled system if service conditions dictate,
- ✓ Casing in Stainless-steel, Die-cast aluminum, safety glass front with gasket,
- ✓ Indication scale: sunlight resistant with black graduation on white background in $^{\circ}\text{C}$ Orient able head,
- ✓ Dial: 150 mm diameter (no plastic dial),
- ✓ Process connection: 1 1/2" Flanged Type for pipe connection and 2" Flanged Type for Vessel Connection,
- ✓ Accuracy: $\pm 1\%$ full scale
- ✓ Normal operating temperature between 25% and 75% of the selected range.
- ✓ Gauges shall have internal mechanism for zero adjustment and calibration purposes.

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- ✓ The scale ranges of liquid, gas and vapor filled thermometers shall be selected from those specified in the Table (as per IPS-M-IN-120).

Table 1: scale ranges for liquid and gas

Scale Range	Scale Range
-160°C to +30°C	0°C to +160°C
-100°C to +20°C	0°C to +250°C
-30°C to +70°C	0°C to +400°C
0°C to +100°C	50°C to +650°C
+20°C to +120°C	

14. FLOW INSTRUMENTS




14.1. Orifice Plates

The following requirements shall be satisfied:

- ✓ The calculation of orifice plates shall be in accordance with the ISO 5167.
- ✓ 316 stainless-steel as a minimum,
- ✓ Maximum orifice bore to inside pipe diameter ratio of 0.75 and a minimum of 0.2 considering "flange taps" orifice type,
- ✓ Orifice plate thickness:

Table 2: Orifice plate thickness

Pipe size Nominal diameter (inch)	Plate Thickness (mm)
$d < 8"$	3.2
$8" < d < 14"$	6.5
$14" < d < 24"$	10
$24" < d < 30"$	15

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- ✓ Stamped with tag number, bore diameter, outside diameter, orifice material, up-stream side, Construction, calculation and sizing according to the ISO 5167,
- ✓ Primary elements shall be sized for used with differential transmitters having one of the following ranges in mbar:

0-12.5, 0-25, 0-50, 0-75, 0-100, 0-125, 0-250, 0-500, 0-1000

Differential pressure range shall normally be 0.25 bar (100" water column),

- ✓ Flow element accuracy $\pm 0.5\%$,
- ✓ Orifice flange to be supplied by piping (Min. rating is ANSI #300)

Note: Restriction orifice plate shall be the same as metering orifice plate with following exception:

- ✓ The minimum line size is 1/2"
- ✓ No weep hole is permitted.

14.2. Flow Transmitter

Differential pressure transmitter in conjunction with orifice plate shall be used as first choice for all flow measuring applications.

It shall be referred to section 16.1.

Note: Sunshade shall be provided for transmitters which exposed to direct sunlight.

14.3. Variable Area Flow Meters

Variable area flow meters may be used for small flow rates where local indication, recording and/or controlling is required. They may also be used where rangeability, nonlinearity, viscosity or the hazardous nature of fluid makes the differential pressure type instrument unsuitable.

Variable area flow meters shall be of metal tube type in principle.




Variable area flow meters shall be installed so that repair, maintenance and replacement will not disturb the operation of the plant.

15. LEVEL INSTRUMENTS

The smart (CPU based) differential pressure transmitter may be preferably used instead of external displacement transmitter.

15.1. Displacer Transmitters

The following requirements shall be satisfied:

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- ✓ Floater, torque tube, plunger in 316 stainless-steel as a minimum,
- ✓ Plunger chamber in carbon steel,
- ✓ Orientale chamber head,
- ✓ Process connection, 2" min flange rating is # 300,
- ✓ Electrical connection: M 20x1,5,
- ✓ Output signal: 4-20 mA (DC),
- ✓ Hart protocol compatible,
- ✓ Power supply through 4-20 mA (DC) signal, two wires
- ✓ Standard range: 356 /813/1219/1524/1829/2134/2438/2743/3048mm,
- ✓ Accuracy: $\pm 0,5\%$ of calibrated range,
- ✓ Zero and span adjustment included and accessible from outside,
- ✓ Drain valve: 3/4" NPT (F),
- ✓ Vent top with plug: 3/4" NPT (F).

Internal displacement type level transmitters shall be used only when external type is not feasible. They may also be used on pressure vessels under special conditions of extreme temperatures, high viscosity, liquids that could boil in an external casing, corrosion, or where other similar process conditions dictate their use.

The design selected shall permit removal of the instrument without the need of entering the vessel for dismantling.

Stilling wells shall be used where the liquid being measured is subject to turbulence.

Displacement type level instruments shall be provided with cooling or warming extensions to protect the instrument casing when required.

Note: Others types of level transmitters such as capacitance, ultrasonic, magnetic or float type should be used to fulfil specific process conditions.

Note: Sunshade shall be provided for transmitters which exposed to direct sunlight.

15.2. DP Level Instrument




Differential pressure instruments may be used for level applications.

It shall be referred to section 16.1.

Note: Sunshade shall be provided for transmitters which exposed to direct sunlight.

15.3. Level Switches

The following requirements shall be satisfied:

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- ✓ Float type with external case and dry magnetic ball,
- ✓ Float in 316 stainless-steel as a minimum,
- ✓ Magnetic coupling between float stem and electrical switch,
- ✓ Float cage in carbon steel,
- ✓ Process connection, 2" or flange according to piping class, min flange rating #300,
- ✓ Electrical connection: M 20x1.5,
- ✓ Hermetically sealed snap type single pole double throw contact (contact rating 24VDC),
- ✓ Drain valve: 3/4" NPT (F).

15.4. Gauge Glasses

Gauge glasses shall be either transparent for coloured liquids, or with reflection for uncoloured liquids and steam.

The following requirements shall be satisfied:

- ✓ Process connection: flanged type according to piping class, min flange rating #300,
- ✓ Connection type: connection higher aid and lower connection and side connection
- ✓ Union connection to change the orientation of the gauge glass,
- ✓ Light for transparent level that shall meet the electrical area classification, and electrical connection shall be M 20x1.5 and power supply 230V AC 50 HZ.
- ✓ Event top with plug: 3/4" NPT (F),
- ✓ Drain valve: 3/4" NPT (F),
- ✓ Eccentric valve with safety device to ensure tightness to operating pressure if the glass breaks.





Tubular level should be used on recipient at atmospheric pressure or very low-pressure containing water or non-inflammable and non-corrosive products. Length shall be less than 1500 mm.

16. PRESSURE INSTRUMENTS

16.1. Pressure Transmitter/Differential Pressure Transmitter

These transmitters should be used for absolute, relative or differential pressure measurements.




The following requirements shall be satisfied:

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- ✓ Element: Diaphragm or capsule, force equalizer, capacitive, inductive or micro displacement type,
 - ✓ Each wetted part shall be in stainless-steel 316L as a minimum,
 - ✓ Wetted parts of pressure instruments shall be in compliance with NACE, if Required.
- ✓ Process connection: 1/2" NPT M,
 - ✓ Electrical connection: M 20x1,5
 - ✓ Output signal: 4-20 mA (DC),
 - ✓ Power supply through 4-20 mA (DC) signal, two wires, 24VDC
 - ✓ Hart protocol compatible,
 - ✓ Accuracy: ± 0.4 % of full scale,
 - ✓ 2 ways' block manifold for relative or absolute measurement, 5 ways' block for differential measurements shall be 316 stainless-steel, screwed 1/2" NPT, including Isolated Valve.
 - ✓ Mounting support: 2" pipe,
 - ✓ Zero and span adjustment included and accessible from outside,
 - ✓ Over pressure of at least 30% full scale,
 - ✓ Vent and drain plugs for differential measurement,
 - ✓ Rangeability: shall be better than 5:1

Note: Hand Held Terminal/Communicator shall be provided the following requirements for Hart protocol transmitters:

- ✓ Microprocessor based
- ✓ Memory internal
- ✓ Ram
- ✓ VGA, Color, Touchscreen Display
- ✓ Keypad with function key,
- ✓ Rechargeable battery,
- ✓ Battery operation time up to 25 hours,
- ✓ Input voltage 100-240 VAC for Battery charger,
- ✓ Environmental usage 0°C to 55°C,
- ✓ Enclosure rating IP65,

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Note: Sunshade shall be provided for transmitters which exposed to direct sunlight.

16.2. Pressure Switches




The following requirements shall be satisfied:

- ✓ Element: diaphragm, stainless-steel capsule or piston,
- ✓ Process connection: 1/2" NPT M,
- ✓ Electrical connection: M 20x1,5
- ✓ Hermetically cable snap type single-pole double-throw contact (contact rating 110 V DC, 200 mA),
- ✓ The pressure switches may be specified as double pole double throw (DPDT) type switches. The switch type shall generally be DPDT with 5 rating at 24Vd.c. unless otherwise specified in data sheets. (As per IPS-M-IN-110)
- ✓ 2 ways' block manifold shall be 316 stainless-steel, screwed 1/2" NPT, including Isolated Valve.
- ✓ Repeatability: $\pm 1\%$ of full scale,
- ✓ The accuracy of the pressure switch assembly shall be better than 1.0% of the calibrated span. (As per IPS-M-IN-110)
- ✓ Adjustable dead band,
- ✓ With graduate scale,
- ✓ Damper or separator when needed
- ✓ Overpressure of at least 30% full scale,
- ✓ Each wetted part shall be in 316 stainless-steel as a minimum,

16.3. Pressure Gauges

The following requirements shall be satisfied:

- ✓ Element: Bourdon tube in 316 stainless-steel (or Diaphragm for low or differential pressure),
- ✓ All pressure gauge wetted parts in 316 stainless-steel as a minimum,
- ✓ Case material: AISI316 stainless-steel, screwed ring (face plate) type,
- ✓ Dial: 63/100/150 mm diameter (no plastic dial),
- ✓ Indication scale: sunlight resistant with black graduation on white background,
- ✓ Units: Barg or psig as specified,
- ✓ Process connection: 1/2"NPT M,

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- ✓ Accuracy: $\pm 0,5$ % of full scale,
- ✓ 2 ways' block manifold shall be 316 stainless-steel, screwed 1/2" NPT, including Isolated Valve.
- ✓ Damping device on pulsating pressure,
- ✓ Blow-out disk and safety glass,
- ✓ Overpressure of at least 30% full scale,
- ✓ Normal operating pressure between 50% and 80% of full scale.

17. I/P CONVERTER

The I/P converter uses an electromagnetic force balance principle to change electrical signals into pneumatic signals. Typically, a 4 – 20mA input is converted into a 0.2~1 Barg (3 – 15 Psig) output. Its purpose is to translate the analog output from a control system into a precise, repeatable pressure value to control pneumatic actuators/operators, pneumatic valves, dampers, vanes, etc...

Ingress protection degree:

- ✓ Field mount housing, Min.: IP 65
- ✓ Control room housing, Min.: IP 20




18. JUNCTION BOXES

18.1. Identification

Each junction box shall be identified according to the type of signals sent through the cables.

Separate junction boxes shall be provided for:

- ✓ Cables carrying intrinsically safe analogue signals,
- ✓ Cables carrying intrinsically safe digital signals,
- ✓ Cables carrying low level analogue signals (RTD, thermocouple),
- ✓ Cables carrying 4-20 mA (DC)/ 24 VDC analogue signals.
- ✓ Cables carrying 24 VDC digital signals,
- ✓ Cables carrying fire and gas analogue signals (detection and protection),
- ✓ Cables carrying fire and gas digital signals (detection and protection).

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18.2. Arrangement

The cables shall enter and exit junction boxes via the bottom and/or the side. Top entry for cable is not allowed.

The junction boxes shall hold one multiconductor cable (entry from bottom). Terminals used for intrinsically safe applications shall be light blue colour.

One spare input shall be provided for each junction box. This spare input shall be equipped with a screwed plug.

18.3. Equipment

The junction boxes shall contain:

- ✓ A Traffolyte label (light blue background with black lettering for intrinsically safe signals and white background with black lettering for others) with letters of 8 mm high as a minimum, fixing of label shall not invalidate certification of box,
- ✓ A label identifying the terminal block,
- ✓ Screw clamp type terminals suitable for 2.5 mm² conductor size, 20% spare terminals in each junction box,
- ✓ Sufficient number of terminals to ensure continuity of shielding (for instrument earthing),
- ✓ Earth connectors to ensure continuity of electrical earthing.

18.4. Protection System

Junction Boxes shall be considered Eex'd' type for N.I.S signal and Eex'e' for I.S signal at hazardous area.




18.5. Enclosure System

The protection levels of the equipment housing are defined by the IEC-529. It shall be at least IP 65.

18.6. Installation and Connection

The junction boxes shall be spreads across the installations to achieve the shortest possible distance between them and the instruments served.

They shall be installed roughly 1.30 m above floor level.

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All multi-conductor cable shall be loaded to a maximum 75%. All spare capacity (multiconductor cable) shall be fully installed and connected.

In this way, the terminal block size shall correspond to the multi-conductor cable size. No more than 2 conductors per terminal is allowed.

19. CABLES

Three kinds of cables are to be considered:

- ✓ Individual cables,
- ✓ Multi-conductor cables
- ✓ Cables installed in building.

For more details, refer to “Instrument & Control Cables Specification”.

19.1. Cable Gland

➤ Material

Cable gland of aluminium based alloy shall not be allowed. Nickel-plated brass cable glands shall be provided.




➤ Construction

The following requirements shall be satisfied:

- ✓ Sealing of the outer sheath of the cable,
- ✓ Sealing of the inner sheath of the cable,
- ✓ Double compression type,
- ✓ Anchoring of the armor protection of the cable,
- ✓ For individual cables:
 - Screwed connection 1/2" of 3/4" NPT M of EEx 'd/e' devices,
 - ✓ For multi-conductor Cables:
 - Screwed connection NPT M for EEx 'd/e' devices,
 - Cable gland diameter shall be defined according to cable size.

20. INSTRUMENT HOOK-UP

On-line instruments or those in close proximity are to be installed in accordance with the safety and operating criteria, with a view to accessibility for operations and maintenance staff and in line with the recommendations of API RP-550 and IPS Standards. Details will be provided in instrument Hook-up Diagrams.

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20.1. Instrument Impulse

Instrument impulse line shall be type 1/2" inch OD, 316 stainless-steel.

Tubing connection will be mainly 1/2" NPT M x 1/2-inch OD or 1/2-inch OD x 1/2-inch OD double ferrule compression fitting (swage lock type).

Impulse lines are to be kept to a practical minimum length and arranged so that any movement of the pipe does not exert any force on the connection or the instrument.

Impulse lines shall be run, in general, with a slope of not less than 10 cm per 1 m to ensure self-venting or self-draining, as appropriate to the application, back to the process line.

When leads are parallel, the connections shall be staggered.

20.2. Instrument Air Supply

The total air for all instruments is filtered, dried and pressure regulated.

Each instrument using air shall be equipped with its individual isolating valve, its individual coalescent filter, and locally pressure regulated (pressure reducer and regulator).

Air supply headers shall be in accordance with the relevant piping specifications.

Branch tubing shall be 316 stainless-steel, 1/2" OD for control valves, On/Off Valve, and regulators.

Tube fittings shall be twin ferrule compression type 316 stainless-steel.

20.3. Support

For maintenance reasons, the transmitters shall be installed roughly at 1.30 m above floor level on 2" pipe support.



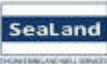

Any support component shall not be installed on removable part.

20.4. Block Manifold

Pressure and differential pressure transmitter shall be installed with a block manifold directly mounted on the transmitter.

Purge connection on block manifold shall be connected with fittings and 30 cm V shaped at its end.

Pressure gauge shall have either an instrument block and bleed valve, or a 2 ways' block manifold remotely mounted as a pressure transmitter.

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21. TAGGING OF INSTRUMENT

All instruments shall be tagged for identification by means of stainless-steel plate permanently attached to the instrument with screws or drive pins at the factory. Letters of 8 mm high is required.

22. SPARE PARTS AND SPECIAL TOOLS

The instruments ordered under this specification shall fulfil the following requirements:

22.1. Spare parts

Pre-commissioning and commissioning and two years spare parts will be purchased together with the equipment. Vendor shall recommend item and quantities of spare parts in his bid proposal/quotation.

22.2. Special tools

The vendor shall supply all special tools necessary for the main and auxiliary equipment (e.g., calibration facility...) for installation, pre-commissioning, commissioning and maintenance.

Vendor shall prepare and submit an adequate and comprehensive list of above-mentioned special tools in bid stage, subject to owner/contractor/consultant review/approval.