



Exploration & Production

GENERAL SPECIFICATION

INSTRUMENTATION

GS INS 101

**Instrumentation engineering, supply and
construction general requirements**

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1. Scope

This document defines the minimum requirements for instrumentation engineering, supply and construction for onshore and offshore installations.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60364	Electrical installations of buildings
IEC 60529	Degrees of protection provided by enclosures (IP code)
ISO 5167	Measurement of fluid flow by means of pressure differential devices – Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full
ISO/TR 5168	Measurement of fluid flow – Evaluation of uncertainties
ISO/TR 3313	Measurement of fluid flow in close conduits – Guidelines on the effects of flow pulsations on flow-measurements instruments

Professional Documents

Reference	Title
API RP 520	Sizing, Selection and Installation of Pressure-relieving Devices in Refineries
API RP 521	Guide for Pressure-relieving and Depressuring Systems
API Std 526	Flanged Steel Pressure Relief Valves
API Std 527	Seat Tightness of Pressure Relief Valves
API Std 2000	Venting Atmospheric and Low-pressure Storage Tanks: Nonrefrigerated and Refrigerated
API RP 551	Process Measurement Instrumentation
API RP 552	Transmission Systems
API RP 554	Process Instrumentation and Control
API	Manual of Petroleum Measurements Standards
ANSI/ISA-7.0.01	Quality Standard for Instrument Air
ISA-20	Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves
ISA-5.1	Instrumentation Symbols and Identification

Reference	Title
ISA-5.2	Binary Logic Diagrams for Process Operations
ISA-5.3	Graphic Symbols for Distributed Control/Shares Display Instrumentation, Computer Systems
ISA-5.4	Instrument Loop Diagrams
ISA-5.5	Graphic Symbols for Process Display
ANSI/ISA-75.01.01	Flow Equation for Sizing Control Valves
ANSI/ISA-75.19.01	Hydrostatic Testing of Control Valves
NAS 1638	Cleanliness Requirements of Parts used in Hydraulic Systems

Regulations

Reference	Title
94/9/EC (ATEX 100 a ⁵ /ATEX 95 ⁶)	European Directive 94/9/EC (23/03/94) on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
1999/92/EC (ATEX 118 ⁵ /ATEX 137 ⁶)	European Directive 1999/92/EC (16/12/99) on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres

Codes

Reference	Title
ASME PTC 19.3	Thermowell calculation
ASME B 16.36	Steel orifice flanges

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS ELE 031	Design of earthing and bonding systems
GS ELE 051	Design and installation of lightning protection
GS ELE 311	Cable trays/ladders
GS INS 102	Instrumentation identification
GS INS 104	Design of the generation and distribution of instrument air or gas
GS INS 107	Design and installation of instrumentation links
GS INS 108	Instrumentation for the design of plant rooms and control rooms
GS INS 111	Design and supply of liquid custody transfer metering units
GS INS 137	Design and supply of on/off valve control panels
GS INS 146	Design of generation and distribution of hydraulic energy
GS INS 147	Design and supply of wellhead control panels
GS INS 900	Instrument hook-up diagrams
GS PVV 112	Piping material classes
GS SAF 253	Impacted area, restricted area and fire zones
GS SAF 261	Pressure protection and relief emergency shut-down and depressurisation

3. General instrumentation principles

3.1 Architecture and interconnecting principles

The standard instrument loop architecture consists of field instruments connected to junction boxes which in turn are connected to marshalling cabinets by means of multi-cores cables. Signals are then cross-wired onto control system card-image termination boards inside “system cabinets”.

Marshalling cabinets and system cabinets are normally installed in technical rooms when junction boxes are field located.

In some cases, when cost effective, remote Inputs/Outputs architecture may be foreseen with modules mounted inside field junction boxes or panels; the complete assembly shall be suitable for the corresponding hazardous area. Use of such systems shall be submitted to COMPANY approval.

Safety and process functions shall be done by different devices. Process connection points shall also be different.

3.2 Signals segregation

Instrumentation signals shall be segregated according to their nature and the system they belong to. Details are provided in [GS INS 107](#).

Upon project requirements, “safety” and “process” signals might have different routings.

3.3 Instruments supply

For standardisation of maintenance and operation, it is strongly preferred to source all the instruments of a particular type from the same MANUFACTURER.

As far as possible, the instrumentation for packages will be uniform with the general instrumentation, that is, same manufacturers, same technology.

4. Utilities

4.1 Electricity

There shall be a distribution board for each type and level of electrical supply: AC, DC, from UPS, ...

Transmitters and actuators shall be powered directly from the control systems or marshalling cabinets.

Transmitters shall be powered at 24 VDC.

Actuators shall be powered at 24 VDC except when long cable runs require 48 VDC.

4.2 Instrument air

The platform/site shall be equipped with a set of air compressors, dryers and buffer vessel.

Air capacity shall be sized to allow an autonomy consistent with electrical power supply autonomy on the different sites.

Operating pressure will normally be 7 barg. However, instruments and actuators shall be designed to work in the complete range from 5 barg to 10 barg at instrument inlet.

4.3 Instrument gas

Same design principles as above are applicable.

All instruments shall be specified taking into account the actual chemical composition of the gas including injected chemical products.

4.4 Hydraulic

Hydraulic energy will be reserved to specific applications where pneumatic actuators sizes are not compatible with installation constraints.

Hydraulic logic modules shall not be used.

Hydraulic lines shall be cleaned to class 6 of **NAS 1638** at start-up.

5. Instruments general requirements

5.1 Instrument earthing

Instrument earthing shall be in accordance with international rules and practices and with **GS ELE 031**.

5.2 Design and installation of lightning protection

The protection of electrical and electronic equipment against indirect effects of lightning shall be defined through the analysis and evaluation specified as per [GS ELE 051](#).

Need for anti-surge devices to protect each I/O individually and/or each transmitter may be foreseen, but the main guideline is to ensure equipotential earth network.

Mitigation of indirect effects may be achieved through installation rules such as:

- grounding of spare conductors within multicore cables on both sides,
- extensive use of underground paths and optical fibres,
- use of metallic cable trays grounded from place to place,
- reduce as much as possible cables loops (at the transmitter location and within the false floor of technical rooms).

5.3 Instruments identification

Instrument identification shall be in accordance with international rules and practices and with the [GS INS 102](#) based on [ISA-5.1](#).

5.4 Area classification/protection

All equipment must comply with the requirements of the specific hazardous area where they are installed

For any installation, [ATEX European Directive](#) shall be followed.

Specifically all field instruments shall be certified category 2 as per the [ATEX European Directive](#).

If some instrument/equipment is not available with such certification, it will be de-energized in case of gas detection.

For category 3 equipment, certification by Manufacturer is not accepted. A "Statement of compliance" shall be delivered by a Notified Body.

Preferred protection methods are Ex d, Ex e, Ex i, Ex m according to IEC standards. Use of protection mode Ex p and Ex n shall be limited to specific applications and submitted to COMPANY approval.

Intrinsically safe circuits shall be installed in accordance with IEC regulations. An IS loop calculation sheet shall be submitted for each installed IS instrument.

Technical rooms shall be pressurised and so be safe areas.

Concerning the instruments installed outside hazardous areas (e.g. restricted area), it is preferred to select the same type of instruments as those installed in hazardous areas, for standardisation of maintenance and operation, unless their quantity may justify different stock.

5.5 Enclosure protection/environmental aspects

Depending on the location of equipment, one of the following enclosure protection degrees shall be selected:

- Indoor: IP 21
- Indoor with water mist: IP 54

- Outdoor: IP 65

The equipment shall, in all respects, be suitable for operation in typical gas drilling/operation platform service conditions and in a humid, salt laden and corrosive atmosphere. Any electrochemical coupling and galvanic corrosion shall be avoided and accessories shall be of suitable type. Where necessary, the equipment will be designed to withstand offshore tropical environments.

Instrument technical rooms shall have a controlled environment.

5.6 General instrument characteristics

5.6.1 General

In the interest of flexibility and standardisation, the components shall be in accordance with following common characteristics:

- All sensors/transmitters and controlled final receivers shall be 4-20 mA 24 VDC.
- Sensors/transmitters shall be "Smart" type with a communication protocol based on the Hart standard.
- Valve electro-positioners shall be "Smart" type based on Hart protocol.
- Switches will be avoided. Threshold functions shall be based on analogue signals.
- Gas detectors shall be analogue. If "smart" type, communication protocol will preferably be Hart standard.
- Fire detection will generally be based on analogue sensors. If "smart" type, Hart standard shall be preferred. Use of discrete sensors shall be studied on a case by case basis.
- In buildings, use of addressable fire detectors shall be considered.
- For "smart" safety related instruments, access to configuration shall be protected by hardware means on the instrument itself.

Instruments using mercury are forbidden.

All inserted instruments (thermowells, vortex, Pitot tubes...) shall conform to [ASME PTC 19.3](#) calculations.

All instruments will be installed with vent and drain facilities and for hazardous and/or polluting fluids the vent/drain of instruments shall be piped to the vent/drain networks.

Instruments shall be insulated and/or heated and/or fitted with process separators when fluids characteristics and/or temperature conditions can alter performance and reliability of the system. The measurement capillaries shall be provided with heat insulation and mechanical protection.

In case of dual transmitters (one for Safety, one for Control) for the same process measurement, they shall have same range and span and the process connections will be fully independent but shall be close together to allow comparison of measurements. On vessels, level transmitters tapping points shall be at the same elevation.

Instrument technologies listed here below are the most common ones so this list is not exhaustive. Other types of instruments could be used according to the interest or context of the project.

5.6.2 Field buses

Use of field buses shall be studied on a case by case basis.

Protocol will be as per recognized international standards.

5.6.3 Instrument performance specifications

Figures given for electronic instruments accuracy in the following chapters include the combined linearity, hysteresis and repeatability errors.

5.6.4 Temperature

Thermowell type shall be one piece thermowell, bored from one piece solid bar stock or forgings, and shall include a retaining flange. Tapered thermowells with round tip shall be selected.

Thermowells arrangements are given in **GS INS 900**.

The thermowell standard material is SS 316L. Monel is recommended for seawater services. Other materials may have to be selected subject to the relevant piping class.

The cover flange shall always meet the relevant piping material requirements for material selection and dimension.

Thermowells shall be made in conformity with the **ASME PTC 19.3** calculations. Frequency and stress analysis calculations shall be supplied by the MANUFACTURER.

Pre-sizing of the well shall be performed by CONTRACTOR.

Test wells for general use shall be provided with screwed plugs permanently attached by stainless steel chain.

For pipe 4 inches or less, either an increase in pipe diameter to 4 inches shall be made (expander and reducer), or the thermowell shall be mounted in a T which replaces a pipe elbow.

Immersion length: the tip of the thermowell shall be located within the second third of the flow line diameter.

5.6.4.1 Temperature indicators

Bi-metallic temperature indicators shall be supplied as complete assemblies comprising: indicator, extension nipple and thermowell.

Scale graduations, zero adjustment and over-range protection shall be MANUFACTURER's standard. Accuracy shall be within ± 1 % of span.

Bi-metallic thermometers in service where vibration may be expected shall be either silicone filled or have other internal dampening means.

5.6.4.2 Temperature transmitters

Thermocouples and resistance temperature detectors shall be supplied as complete assemblies, comprising thermocouple or RTD. element, including terminal blocks, terminal head, extension nipple, thermowell, and converter incorporated in thermocouple or in RTD head, with a 4-20 mA output. The RTD/4-20 mA converter shall use a Hart communication protocol.

Thermocouples shall be mineral insulated, stainless steel sheathed execution.

The performance of the temperature measurement (sensor + transmitter) shall be at a minimum as follows:

- Accuracy ± 0.25 % of span.
- Temperature effect ± 0.02 % of span/10°C variation

5.6.5 Pressure

Over-range protection shall be provided for pressure instruments, pilots, gauges, etc that may be subject to pressures that could damage or change the calibration of the instrument.

Instruments shall be equipped with pulsation dampeners when required by process conditions, capable of being adjusted while instruments are pressurized.

Where capillaries are not used, differential pressure transmitters shall be provided with a close coupled 5-valve manifold 316 stainless steel.

All pressure instruments connections shall be installed with a block and bleed valve assembly. This assembly shall be of AISI 316 stainless steel material including the trim.

5.6.5.1 Pressure gauges

The over-range protection of the gauges shall be at least 25 % of the maximum rated pressure flange. The gauges shall have a minimum accuracy of ± 2 % at half range and ± 1 % at full scale.

Direct indicating gauges shall be chosen such that the normal operating pressure shall be between 30 % and 70 % of the full scale measuring range.

All pressure gauges shall be oil filled to avoid vibration.

5.6.5.2 Pressure transmitters

The performance of the instrument shall be at a minimum as follows:

- Accuracy ± 0.1 % of span
- Temperature effect ± 0.1 % of span/10°C variation

5.6.6 Flow

Generally for measurement of flow, square edge orifices plates with concentric entrances and flanges taps will be used. But for large ranges of flow measurement in gases or low viscosity liquids, a VORTEX meter will be used.

Measured operating flow range must be between 70 % and 80 % of calculated maximum flow range.

5.6.6.1 Orifices

Orifice plates shall be specified and calculated in accordance with international codes, standards and recommendations and mainly with:

- ISO 5167
- ISO 5168
- ISO/TR 3313

Flange tap connections shall be in accordance with ASME B16 36.

5.6.6.2 Differential pressure flow transmitters

The performance of the instrument shall be as follows:

- Accuracy $\pm 1 \%$ of span
- Temperature effect $\pm 0.1 \%$ of span/ 10°C variation

5.6.6.3 Vortex meters

For the design of the apparatus, the service conditions shall be defined specifically to cover different operating ranges, allowable pressure drop, specifying the physical properties of fluid handled (viscosity, vapour pressure, density, etc.).

The performance of the instrument shall be as follows:

- Accuracy $\pm 1 \%$ of flow rate
- Repeatability $\pm 0.25 \%$ of flow rate

5.6.6.4 Electromagnetic flowmeters

Electromagnetic flowmeter can be used on low resistivity liquid. Cable selection and electrical connection shall be done following the MANUFACTURER recommendations.

The performance of the instrument shall be as follows:

- Accuracy $\pm 0.5 \%$ of flow rate

5.6.6.5 Variable area meters

The armoured variable area flow meter shall consist of an all metal metering tube with a magnetic type extension attached to the float.

Glass tube types shall not be used.

Float limit stops to be provided for over-range protection.

The performance of the instrument shall be as follows:

- Calibration accuracy $\pm 2 \%$ of span
- Temperature effect $\pm 0.5 \%$ of span/ 30°C variation

5.6.6.6 Turbine meters

Turbine meters shall be used only on fluids fully in the liquid phase without solid particles.

The performance of the instrument shall be as follows:

- Signal repeatability $\pm 0.02 \%$ or better
- Meter linearity $\pm 0.25 \%$ or better

5.6.6.7 Mass flowmeters

Coriolis type flowmeters can be used on test separators liquid outlets or as alternative to turbine meters.

The performance of the instrument shall be as follows:

- Accuracy $\pm 0.15 \%$ of flowrate

5.6.6.8 Ultrasonic meters

Use of ultrasonic meters shall be studied on a case by case basis. The measuring principle shall be the "transit time differential method".

The performance of the instrument shall be as follows:

- Accuracy ± 0.5 % of flowrate

5.6.7 Level

Stand pipes, if exist, for level measuring instruments shall be provided with isolating, vent and drain valves.

For liquid/gas measurement, metering by differential pressure with separators and capillaries is strongly recommended.

5.6.7.1 Level indicators

Magnetic type indicators, with two-coloured flaps, are preferred. The reading scale position shall be adjustable.

Level glasses shall be of the transparent type, with illuminators when required by installation conditions. They shall be fitted with off-centred angle taps, with safety ball.

The maximum centre-to-centre distance for level glasses shall be 2000 mm, giving a visibility of 1760 mm. When greater ranges are required, several gauges shall be installed with and overlap of at least 50 mm.

5.6.7.2 Level torque tube

If required by process conditions the torque tubes shall have extensions or cooling fins.

Drain valves and venting plugs shall be provided.

The standard ranges of torque tube levels to be used shall be as follows:

- 356 mm (14") and 813 mm (32").

5.6.7.3 Level differential pressure transmitters

Sensors equipped with separators and capillaries are preferred.

For level measurements in atmospheric pressure tanks, a flanged hydrostatic pressure transmitter can be used, directly mounted on a three inch flange on the tank. A shut-off valve shall be provided for removal of this apparatus.

Each differential pressure level transmitter shall be provided with a close coupled 5-valve manifold AISI 316 stainless steel except where capillaries are used.

The performance of the instrument shall be as follows:

- Accuracy ± 0.10 % of span

5.6.7.4 Hydrostatic pressure level transmitter

The performance of the instrument shall be as follows:

- Accuracy ± 0.10 % of span

5.6.7.5 Capacitive/Admittance level transmitters

They can be used in some cases mainly on water base fluids or to measure interface level between water and oil. They have to be used only when differential pressure transmitter are not usable.

5.6.7.6 Radar level transmitters

Typical applications of level-radar measurement are wide measuring ranges like storage tanks gauging.

The performance of the instrument shall be as follows:

- Accuracy ± 0.15 % of span

5.6.8 Control valves

5.6.8.1 Valves and actuators

Actuators will be preferably electro-pneumatic or electric for top-side equipment and hydraulic for subsea one's.

All pneumatic control valve shall be fitted with electro-pneumatic positioner.

Noise levels for Control Valves shall not exceed 85 dBA at one meter downstream or from the pipe. Use of any downstream noise reduction device shall be submitted to COMPANY agreement.

Flanges and valves shall be in accordance with the piping class rating but minimum 300 lbs.

5.6.8.2 Sizing

Control valves shall be sized in accordance with [ISA 75.01.01](#) "Flow Equations for Sizing Control Valves" calculation method.

5.6.8.3 Mounting

For hydrocarbon service, the control valves body shall be flanged. Nevertheless, for low pressure water service, control valves may be of the sandwich type.

5.6.8.4 Control Valves Cv

The maximum Cv shall be calculated by increasing the maximum operating flow by 15 %. The minimum opening of the Control Valve shall not be less than 15 % of the full stroke at minimum flow conditions. The maximum opening shall not be more than 70 % at nominal flow conditions.

5.6.9 ON/OFF Safety valves

5.6.9.1 General

Safety valves definition and functional requirements are given in [GS SAF 261](#).

So ESDV's actuators shall be protected against the consequences of fire or explosion to the same level as on the valves themselves. Additional special protection precautions shall be taken so that their skin temperature do not exceed 70°C

Safety valves will be fitted preferably with spring return actuators. Use of double acting actuators shall only be considered upon space availability criteria.

Safety valves actuators shall be pneumatic or hydraulic.

The internal part of pneumatic actuators shall be protected against corrosion from atmosphere and power fluid.

Actuators shall be controlled by low consumption type solenoid valves.

The solenoid valves and other control devices shall be fitted inside a panel located close to the valve. The design and supply of the local control panel must be in accordance with **GS INS 137**.

When a valve needs to be controlled from two different systems, there shall be two solenoid valves.

The actuator shall be sized to provide at least 130 % of the maximum operating torque at any point of the valve stroke, and for the specified closing time. The maximum operating torque shall generally consider the maximum allowed service differential pressure, unless otherwise specified in the project specification. This safety factor can be larger if required in the project specifications.

Two limit-switches shall be installed, one for open position, one for closed position. Analogue transmitters can be considered as an alternative.

If an hydraulic or pneumatic accumulator is to be used for closing the valve, it must comply with the following requirements:

- The accumulator shall be installed as close as possible to the valve.
- The accumulator shall be sized to allow 3 strokes of the valve. (close, open, close)
- The accumulator and associated tubing shall be protected against impacts and pick-ups.
- Hydraulic accumulators shall respect design requirements as per **GS INS 146**.

The typical closing time for safety valves is 1 seconds per inch of valve diameter with a maximum of 15 seconds for valve below 20 inch.

The typical opening time for safety valves (> 20") is 2 seconds per inch of valve diameter.

5.6.9.2 Blow Down Valves

Upon special conditions, like high service pressure, control valve type BDV may be used instead of ball valve. The design for the body and the actuator shall be based on the control valve specifications

5.6.10 ON/OFF valves

XV valves are normally operated by Process Control System (PCS) for closing and opening.

Actuators can be pneumatic, hydraulic or electric.

Actuators can be double acting or single acting spring-return depending on the required action upon control signal failure.

Two limit-switches will be installed, one for open position, one for closed position.

General considerations about torque, opening and closing time, ..., as per safety valves, are applicable.

5.6.11 Pressure safety valves

The safety relief valves shall meet the requirements of [API RP 526](#) and shall be of direct-acting, angle pattern, full nozzle entry and high capacity type.

Conventional spring-loaded safety relief valves shall be used when there is no back-pressure or when the back-pressure is constant.

Balanced bellows safety relief valves shall be used when there is a variable back-pressure, when the built-up back-pressure during discharge is greater than 10% of the set pressure or in case of corrosive or fouling process fluid.

Pilot-operated relief valves shall be used in case when accurate settings or quick opening/closing are required, for high pressure service or large flow-rates applications. Tube fittings shall be standardized with the whole project instrumentation (e.g. same manufacturer) and therefore specific requirements introduced in the datasheet.

Use of diaphragm type pilots is forbidden unless it is demonstrated that leakage from process to atmosphere is technically impossible.

Safety relief valves shall be sized and designed according to [API RP 520](#) and [ASME code section VIII](#).

Weight loaded relief valves according to [API Std 2000](#) shall be considered for low pressure services.

Relief valves materials shall be in accordance with Piping material classes as per [GS PVV 112](#).

5.6.12 Bursting disks

Bursting disk shall be used when fast response is required or to protect relief a downstream installed valve from corrosive fluid.

Further details about use and design of bursting disks are given in [GS SAF 261](#).

5.7 Units

Unless local rules apply, metric units shall be employed with charts and scales as follows:

Process Variables		Units	Scales
Flow	Liquids	m ³ /D m ³ /hr	Direct reading
	Gases	Nm ³ /hr	Direct reading
Level	General Tank gauge	% meter or %	0-100 Linear 0-100 Linear
Pressure	Above Atmospheric	barg.	Direct reading
	Below Atmospheric	bara	Direct reading
	Differential	mbar	Direct reading
Analysis			Direct reading
Temperature	General	°C	Direct reading

5.8 Instrument accessibility

Each instrument is a working location and as such it is necessary that all intervention on the instrument can be carried out under the best safety and efficient conditions.

All permanent work stations and their means of access shall be shown on piping drawings and/or on the models.

5.9 Instrument installation

Hook-up drawings shall be made by CONTRACTOR in accordance with international recommendations, [API RP 551](#) and [GS INS 900](#).

Instrument process connections shall be according to [GS PVV 112](#).

Above 70 barg, all non-inserted instruments shall be connected via “double block and bleed” assemblies.

6. Tubes, cables, junction boxes, field terminal cabinets, etc.

6.1 Tubing and fittings

Fittings and tubing shall be provided in accordance with process piping and instrument general specifications [GS INS 107](#) and [GS INS 900](#).

All threaded connections will be of NPT type.

6.2 Cables

Interconnecting from technical room to field mounted instruments shall be made by multicables to junction boxes and then by individual cables.

Electric instrument cable overhead runs shall be protected in accordance with the area classification where they are located, as follows:

- Armoured cables laid on continuous rigid supports or on cable trays.
- Metal conduit protected cables only if required by codes.

All cables shall be at least flame retardant (IEC 60332), except for safety related systems such as fire & gas detectors, emergency/fire push-buttons, public address, telephone, etc, for which the cables shall be fire resistant (IEC 60331).

Cables insulation material will suit with the hydrocarbon environment.

All cables inside accommodation or normally manned rooms shall be halogen free.

6.3 Wiring

6.3.1 Cable trays

All cables shall be run on cable trays or ladders.

Cable tray supports shall be of carbon steel and painted according to the general painting specifications. Cable trays shall never be fixed to piping.

Cable trays materials shall be selected according to environmental conditions. Some examples are given below:

- they shall be of galvanised steel or aluminium, in dry onshore areas,
- they shall be of 316 stainless steel in damp areas, corrosive and offshore environments.

Cable trays of synthetic materials shall be conductive and fire resistant.

Cable trays shall be edge mounted or covered whenever a risk of mechanical damage exists due to dropped objects, fire or falling incandescent pieces. This shall also apply when cables are exposed to ultraviolet radiation.

See **GS ELE 311** for cable trays and ladders detailed requirements.

6.3.2 Routing

Cable routing system shall be arranged in accordance with the following:

- Electric instrument cable trays/ladders shall be distinctly separated from power and lighting cable trays/ladders.
- Cable crossing at the same height is forbidden.
- Power cables will pass across signal cables at right angle and on different level.
- Interconnecting from technical room to field mounted instruments shall be made by multicables to junction boxes and then by individual cables.

All cables crossing construction walls shall be sealed with MCT (multi cable transit) suitable for the classified area.

6.4 Junction boxes

Junction boxes shall be made of fibreglass reinforced polyester and be as a minimum of safety "Ex e" type with protection degree IP 65.

All out/incoming cabling shall be provided with compression suitable cable glands certified for the classified area.

Cable glands for junction boxes shall be metallic, nickel plated brass, and covered with heat shrinkable plastic shrouds. Certified plastic PE could be used with formal COMPANY approval.

Cable entries shall be designed in such a way that no transmission of stress into the individual terminal shall occur.

All cables cores (including spares) must be connected on terminals.

When fire resistant cables are used, exposition to fire will be carefully taken into consideration for the lay out of the concerned junction boxes.

6.5 Field Terminal Cabinets (FTC) in technical rooms

Marshalling cubicles located in technical room shall have bottom cable entry. Due to that, the technical room shall be equipped with a raised floor (see [GS INS 108](#)).

Cables clamping facility shall be provided in the bottom of cabinets.

Marshalling cabinets internal layout shall be such that signals of the same type shall be grouped on contiguous terminal blocks.

Terminal blocks shall be cage clamp type, 2 conductors disconnect ("knife" type) with test points or 4 conductors disconnect. They shall allow plug-in resistor modules for HART communication or fuse modules for outputs to solenoid valves.

6.6 Identification, tagging and labelling

6.6.1 Instruments tagging

All instruments will be labelled in two ways: on the instrument itself and close to the instrument (location label).

The label on the instrument shall be made of an engraved stainless steel plate, attached to the instrument with a SS316 wire. Letters shall be 5 mm high.

The location label shall be an engraved Trapholyte plate screwed on the instrument support. Letters shall be 15 mm high.

Trapholyte plates shall be coloured depending on the part of the control and safety systems they are connected to:

- HIPS instruments: yellow background with red letters,
- Fire & Gas System, Safety Shutdown System and Process Shutdown System: red background with white letters,
- Process Control System: white background with black letters.

All accessories, screws or rivets shall be in stainless steel.

6.6.2 Cables and tubes

Cables and tubes shall be labelled at both ends and at all wall or bulkhead penetrations.

Marking will be made of punched SS316L labels attached with stainless steel fasteners.

Use of slip-on pre-printed shrinkable sleeves shall be reserved to applications where risk of corruption of marking with dirt is very limited; it shall be submitted to COMPANY approval.

6.6.3 Junction boxes and local cabinets

Junction boxes and field cabinets shall be labelled using engraved Trapholyte plates. Letters shall be 15 mm high.

Plates shall be coloured as follows:

- 'Process' junction boxes: white background with black letters.
- 'Safety' junction boxes: red background with white letters.
- 'Intrinsic Safety' junction boxes: blue background with white letters.

All accessories, screws or rivets shall be in stainless steel.

Inside cabinets, instrument labels shall follow the requirements of chapter 6.6.1 with the exception of letter size which can be reduced to 10 mm.

6.6.4 Colour coding for instrument connections

Unless local rules apply, colour coding for instrumentation electrical connections will be as follows:

- Power supply 220 VAC:
 - Black (live)
 - Blue (neutral) (compulsory)
 - Yellow/Green (Earth) (compulsory)
- Power supply 48 VCC or 24 VCC:
 - Red (+)
 - Blue (-)
- Analogue signal:
 - Red (+)
 - White (-)
- Pt 100 Temperature:
 - White / Red / Blue

7. Instrumentation software tools

Instrumentation engineering database software will be used for creating the instruments data base, data sheets and electrical connections.

CONTRACTOR delivery shall include supply of the native files of the "as built" database.

The Instrument loop drawings shall be automatically generated from the instrument database by software, in MicroStation or compatible CAD format.



CONTRACTOR delivery shall include supply, in the electronic format, of the printable drawing files and interface template files full library in native format.

This database will also include packages instruments, with special mark for data transmitted to control systems, whatever the link type (serial, hardwired).

The record of all changes will be ensured.

When project development requires different Engineering Contractors, common using rules shall be defined to issue a same and whole database: database structure, fields syntax, instruments description,...

In case of development of "brown fields", the current database will be extended to prevent any confusion.