



**HELLENIC GAS  
TRANSMISSION  
SYSTEM OPERATOR**

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**TECHNICAL JOB  
SPECIFICATION**

**610/5**

**REVISION 0**

**DATE 05/04/2011**

## **HIGH PRESSURE (HP) TRANSMISSION SYSTEMS**

### **TECHNICAL REQUIREMENTS FOR INSTRUMENT ERECTION**



HELLENIC GAS TRANSMISSION SYSTEM OPERATOR

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QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

0	05-04-2011	FIRST ISSUE	PQ DPT.	V.G.
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**REFERENCE DOCUMENTS**

Job Spec. No. 610/6  
[Testing calibration and alignment of Instrumentation]

ELOT EN 10272  
[Stainless steel bars for pressure purposes]

ELOT EN 13445  
[Unfired pressure vessels]

EN ISO 4414  
[Pneumatic fluid power - General rules and safety requirements  
for systems and their components]

ELOT EN 61508  
[Functional safety of electrical/electronic/programmable electronic  
safety-related systems]

ELOT EN 61010-1  
[Safety requirements for electrical equipment for measurement,  
control and laboratory use - Part 1: General requirements]

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## 1.0 SCOPE

Scope of this requisition is to establish the general technical specifications to be followed by Contractor in performing the instrument erection works.

Instruments calibration activities (both bench and field) and loop checking activities are covered on **Job Specification No. 610/6**.

## 2.0 GENERAL

All works subject of this specification shall be done in accordance with the following prescriptions:

- a) All requisitions, drawings, diagrams, etc. containing information necessary to carry out the instrument erection, issued either by Owner or packages by Manufacturer/Vendor's or, when necessary, by instrument suppliers.
- b) All legislation and regulations, (codes) in force in EU.
- e) The instructions given by Owner / Instrument Supervisor.
- d) The prescriptions established in the subsequent paragraphs of this specification.

In case of contradiction between this specification and all other source of information, the final decision will be taken by Owner.

It is Contractor's responsibility to remake or modify, at his expenses, these installations which are not in accordance with the above prescriptions.

## 3.0 PROCESS CONNECTIONS

One isolation gate valve shall be installed in each instrument primary connection, located as close is possible to the vessel or line. In any case the valve's outlet shall be at a distance less than 225 mm from branch connection. Size and type of primary connections shall be as indicated on attachment "A" of this specification.

Primary connections up to the first block valve will be provided by others. It is Contractor's responsibility to check type, size, material, position and in general the suitability of the connections with the service and their accordance with the documentation at their hands.

Piping downstream primary connections shall be stainless steel tubing **X3CrNiMo 19-11-2 (1.4404)** as per **ELOT EN 10272**, unless otherwise specified and shall be run for maximum convenience in operating and servicing instruments. Instrument installation shall be according to the following general rules, unless others requirements are requested by other documents:

- a) Piping shall be oriented in order to avoid aisles or platforms obstructions.
- b) Position of instrument shall be generally in accordance with installation

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drawings. However it is Contractor's responsibility to assure instruments accessibility, lack of undesired vibrations and they are easily visible from associated final control points.

- c) The mounting location for differential type flow instruments and pressure instruments with relation to primary connections shall be as indicated on the following TABLE 1.

FLUID	INSTRUMENT LOCATION	
	Line-Mounted	Pedestal Mounted
Liquids	Level with or below primary connection	Below primary connection
Non-Condensing Gases	Level with primary connection	Above primary connection (1)
Steam/Condensing Vapors	At least 2 in. (50mm) below primary connection	Below primary connection
Cryogenic Liquids	Level with primary connection with the connection to the instrument being beyond the 100% vapor point (usually 12 in. (300 mm) from the line or vessel)	Above primary connection

- d) Meter leads between primary connections and instruments shall be of the minimum possible length, compatible with the above criteria, shall be adequately supported and shall be suitably spaced from hot lines.
- e) Meter leads shall be run avoiding liquid (or gas) accumulation in the lowest (or highest) points with drain (or vent) valves installed where necessary.
- f) Piping and fittings shall be screwed, welded or flanged as indicated on hook up sketches.

Welding electrodes, teflon tapes or sealing, compounds needed for piping tightness shall be approved by Owner / instrument-Supervisor.

**Note (1)**

If necessary to mount below take-off primary connection, make primary connection horizontal and:

- for liquid filled vertical legs, provided fill connections and (for displacement type) seal pots, or
- for gas filled vertical legs provide heat tracing, knock out pots or drain pots with drain valves as dictated by the amount of condensate expected.

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- g) Whenever practical, bends shall be used instead of fittings in pressure and differential pressure meters leads.
- h) Meter leads shall be sloped a minimum of 10% toward the instrument or connection, depending on their relative position.
- j) Sufficient flexibility shall be provided in meter leads to allow for expansion of lines or equipment to which they connect.
- k) If dissimilar metals are welded Owner welding specifications shall be followed.
- l) Siphons or "pigtail" condensate seals shall be provided for steam or other hot condensable vapors when the instrument is mounted above the primary connection, allowing condensate drainage to the process. Siphons protect the instrument from thermal damage and errors due to temperature. In any case all these installations are subject to Owner's approval.
- m) Drain and/or vent valves shall be located and oriented in safe position.
- n) If the instrument connection is smaller than the connecting piping then the connecting piping shall be reduced at the instrument.
- o) The instrument installation shall provide a mechanism for depressurizing piping down stream of the primary connection's isolation valve when it is closed.
- p) Suitable manifolds are necessary for all instruments connected to primary connections through impulse lines for checking zero and for putting the instrument into or out of service.

#### 4.0 TEMPERATURE INSTRUMENTS

The installation shall be done in accordance with the general rules outlined in the previous paragraphs. Thermowells installed in a threaded connection shall be tack welded to prevent removal of the thermowell. Where flange mounted thermowells are required the flanged thermowell shall be constructed from a single forging or fabricated and certified to meet **ELOT EN 13445** requirements.

#### 5.0 FLOW AND PRESSURE INSTRUMENTS

The installation shall be done in accordance with general rules outlined in the previous paragraphs and in particular:

- meter leads shall be run, when vertical, as close as possible each other.

Rotary meters, positive displacement meters, and in general all measuring devices inserted directly in the lines, will be installed by others. It is Contractor's responsibility to check for:

- a) Item number, service, type of meters in accordance with instrument material requisition.
- b) Correct installation and compliance to the manufacturer instructions and recommendations.
- c) Compliance to general rules outlined in the previous paragraphs.

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## 6.0 LEVEL INSTRUMENTS

Level instruments shall be checked, before installation by Contractor for:

- Item number, type, material, service, range and center to center connection in accordance with instrument material requisition.

Level instrument shall be installed in accordance with general rules outlined in the previous paragraphs. In particular the installation of level instruments, Varec type or similar, shall include all needed accessories (anchor weight, guide cables, auxiliary structures, etc.) to have the level system correctly working.

The installation of level instruments includes preparation and arrangement of all the necessary materials block and drain valves, fittings, etc., including, where required, also the stand-pipe-all in accordance with hook-up sketches provided by Construction Management, unless otherwise specified and/or stated in the above mentioned sketches.

## 7.0 CONTROL VALVES

Control valves shall be usually installed by others. Nevertheless it is Contractor's responsibility to check for correct installation and compliance to the instrument material requisition.

Contractor shall provide:

- a) all pneumatic and electric connections either before the hydraulic test and washing of lines or after these operations.
- b) all temporary protections necessary to avoid any damage of the pneumatic and electric connection fittings.
- c) the verification of the packing and gaskets tightness during the start-up of the units.

## 8.0 SAFETY VALVES

Safety valves shall be installed by others but it is Contractor's responsibility to check the compliance to the instrument material requisition.

## 9.0 ANALYZERS SPECIAL INSTRUMENTS AND ACCESSORIES

All those instruments not listed in the above paragraphs, such as: analyzers, speed meters, boosters, solenoid valves, etc. shall be checked out and installed. Contractor shall follow the instructions and recommendations established by Manufacturer as well as by Owner / Instrument Supervisor.

## 10.0 MAIN INSTRUMENT TUBING AND/OR CABLES RACKS

The main instrument tubing and/or cables trays shall be prefabricated and installed by Contractor using adequate materials to have the requested rigidity and bearing capacity.

The assembling of the trays shall be done in field by means of connecting all prefabricated pieces by suitable accessories unless otherwise required.



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The distance between the supports shall be adequately spanned to give the adequate strength capacity to the rack.

Anyway, spanning and type of supports and racks shall be submitted to Instrument Supervisor for approval.

Before fixing instrument tubing or cables, the racks shall be painted with minimum two coats of primer surface.

Trays for instrument tubing and for electrical cables shall be separate each other.

The route of the main trays shall be deducted from the instrument layout, but it is Contractor's responsibility to check that the racks:

- a) are adequately spaced from hot pipes and other equipment which are to be insulated or protected.
- b) run without crossing ladders or platform, walkways, etc.
- c) All other secondary trays, which run from the main racks to the instruments, shall follow the same general rules outlined in the previous paragraphs.

## 11.0

### CONTROL ROOM

Instrumentation works to be done in the control room are as follows:

- a) Panel board erection and assembly.
- b) Checking the correct location and identification of instruments and their relevant pneumatic terminals (if applicable).
- c) Connection of all incoming or outgoing electrical signals either by multi cable or single wire.
- d) Checking the correct location and identification of instruments and their relevant connections.
- e) Where terminals blocks are located in separate wall mounted boxes Contractor shall provide in addition to the above interconnecting wiring between boxes and single instrument.
- f) Installation and connections (electrical or pneumatic) of all other instruments and accessories which are to be located in the control room including supplementary boxes, the construction and installation of needed supports, brackets, etc. instrument cables racks and all works required for proper wire connection and function of the instrumentation system.

It is Contractor's responsibility to provide all necessary and temporary protections to avoid any damage to the instruments, accessories and all the existing furniture in the Control room during works and up to the acceptance by Owner Instrument /Supervisor.

## 12.0

### PNEUMATIC CONNECTIONS

Pneumatic signals shall be copper tubing unless otherwise specified.

Single or multiple copper tubing shall be connected to the instruments or bulkheads bars by means of compression fittings. Connections shall be absolutely tight, free of leakage; no sealing compounds will be used. Tools and methods of execution

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shall be approved by Owner / Instrument Supervisor.

Copper tubing shall be duly supported and protected by steel racks in its entire length. They shall also be adequately spaced and fixed either when running on the multiple racks or on the single steel angle.

Multi-cable copper tubing shall run underground in trench and/or above ground in racks.

The route of each multi-cable will be in one piece, between field junction boxes and the Control room. No intermediate junction is permitted.

Careful attention shall be paid in bending and fixing multi-cable to avoid any internal or external damage of it.

Multi-cables will be adequately protected as per specific job requirements and documentation when running underground, as well as between trenches and junction boxes.

Each single copper tubing including spares shall be duly identified at both ends, either in junction boxes or in Control room by tag number. Spare tubing ends shall be finished with plugged compression fittings.

### 13.0

#### **ELECTRICAL CONNECTIONS**

Contractor shall install instrument electrical wiring either from single users to junction boxes or from junction boxes to Control room including thermocouples, alarms and safety circuits, power supply and electronic signals unless otherwise specified.

In general separate channels and routing will be provided for different applications as described in specific job documentation.

When wiring is running in conduit the following general rules shall be followed unless otherwise specified by other requirements.

- a) At maximum two bends between fittings are allowed.
- b) Conduit shall be filled not more than 40-60 % of its capacity.
- c) Fittings shall be introduced every 30 m of conduit rectilinear running.
- d) When conduits run vertically, suitable drain and vent openings shall be provided.
- e) The connection to each instrument shall be effected by means of flexible conduit of suitable length to allow easy disconnection and dismounting.
- f) Seal fitting shall be provided at each user and at each conduit entering to junction boxes and the Control room.
- g) No interruption is allowed for thermocouples and shielded wires, except where specifically indicated on the approved drawings. In any case interconnections of different pieces of wires shall be made inside fittings or junction boxes.  
Where shielded cable are used the electrical continuity of shields as well as of conductors shall be guaranteed.
- h) Conduit and relevant fittings shall be in accordance with the area classification.

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Condulet fittings may be used where specifically indicated on the drawings, only for thermocouple applications.

- j) Conduit shall be suitably supported in accordance with the criteria established in **para. 10**.

When wiring runs without conduit protection, the following wiring system is to be generally used, unless otherwise specified.

- a) Between Control room and main junction boxes located in the field, the multi-cable will be above ground in cable trays.
- b) From junction box to primary element the cable will be overhead and supported by insulated or/and galvanized iron channels.

Signal cables will not run in same trenches as power cables. It is Contractor's responsibility:

- To lie-down multi-cables in the underground trench as well as the installation of the cables running overhead in the iron channels.
  - To furnish the wash sand and to fill-up the cable trench Concrete covers of the trenches shall also be provided by Contractor.
  - To furnish and to install all supports and galvanized iron channels and/or other type, accordingly to the job documentation.
  - To install and to check that iron channels and signal cables must be separated by at least 60 cm from parallel running pipes, less tolerated for short distances.
- c) The size of the cable trays shall be selected so that not more than one cable row is to be installed on each channel.

#### 14.0

#### INSTRUMENT PROTECTION

Instrument protection shall be provided by Contractor and shall include all steam tracing, sealing and condensate pots, liquid or gas purging, shelter for direct sun exposure, etc. as indicated by specific job requirements.

Steam tracing shall be made in accordance with the following general rules :

- a) All secondary piping from main header to the single users shall be rigid pipe. Main header and main block valve shall be provided by others. Contractor shall install all secondary net-work including block valves for every user.  
Material shall be conforming to piping specification.
- b) Instruments and/or meter leads will be traced by means of tubing suitably bended.
- c) Provision for easy instrument dismounting shall be provided.
- d) Steam traps shall be installed in general for every single user except when grouping more than one instrument will not obstacolate the correct performance of the steam tracing. Steam traps will be provided by others.

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Instrument flushing and/or purging will be done in accordance with the following general rules:

- a) All secondary piping from the flushing oil main header to the single user shall be rigid pipe, unless otherwise specified. Main header and main block valve shall be provided by others.  
Contractor shall install all secondary network including block valves for every user. Material shall be conforming to piping specifications.
- b) Provision for easy instrument dismounting shall be provided.

All electronic instruments field mounted shall be protected by a proper shelter from direct sun exposure. Contractor to provide both materials and installation of these shelters.

#### 15.0 INSTRUMENT SUPPORTS

Supports for instruments shall be in accordance with Owner typical drawings, which are to be used as a guide. It is Contractor's responsibility to select the appropriate supporting depending on the application.

Single instrument as far as possible shall be grouped together and shall be installed on multi instruments pedestals. Installation of instruments and accessories directly to the main structures and/or equipment shall be avoided.

Position of the support will be selected taking into account all eventual fire proofing, insulating etc requirements.

Where required by job drawings Contractor shall provide to the fabrication and installation of small local panels. The instrument cut-out of steel plate will be done by using appropriate tools.

The use of "flame" is **not permitted**.

Local panel shall be adequately supported where necessary.

Either instruments supports or local panels shall be finished with two coats of primer surface.

#### 16.0 INSTRUMENT AIR SUPPLY

The main instrument air supply shall be furnished without interruption from other general air user requirements. The instrument air supply shall be distributed with following characteristics:

- Minimum Operating Pressure	4.4 bar
- Normal Operating Pressure	6.9 bar
- Design Pressure	10.3 bar
- Operating Temperature	30 - 40°C
- Design Temperature	70 °C
- Dew point	-20° C at system pressure

Subdistribution from main header to single users will be through air distribution pots, with isolating valve for each tap and drain valve.

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## 17.0 ACCESSIBILITY

Connections shall be located for maximum convenience when operating and maintaining the instruments. The following general rules shall be followed, unless limited by other requirements in the design of the unit:

- a. Connections shall be oriented so that instruments or piping will not cross aisles or platforms.
- b. Control valves shall be accessible from the ground, platforms, or permanent ladders. Clearance shall be allowed between the top of the diaphragm and the underside of the nearest obstruction above it for the removal of the diaphragm. Special clearance shall not be provided for removal of valve trim. Clearances for handwheel operators and valves positioners shall be considered in accordance with the valve Manufacturer/Vendor's drawing.
- c. Primary measuring elements for instruments operating in conjunction with control valves shall be located so that the instrument can be mounted close to the control valve without excessive length of meter leads. Local instruments operating in conjunction with control valves shall be located, when feasible, so that they are visible from the control valves. When not feasible, a receiver gauge shall be mounted visible from the control valve.
- d. Connections for local pressure gauges, dial thermometers, and test wells shall be located so that gauges will be at a visible level and test points will be readily accessible.
- e. Orifice for pedestal mounted flow meters (except in air or gas service or underground lines) shall be located at a minimum elevation of 2150 mm above grade or platform to allow the meter leads to slope to the instruments.
- f. Orifices and line mounted flow elements, as well as thermocouples, which are located lower than 6700 mm above grade shall be accessible from portable ladders. Above 6700 mm they shall be accessible from walkways, ladders, platforms, and/or portable platforms.
- g. Clearance shall be provided at orifices for valves, pots, or instruments which may be located at the line.
- h. Connections on vessels for gauge glasses and level instruments shall be orientated to minimize the effect of inlet and outlet streams on the instrument.
- j. Gauge glasses and level instruments shall be adjacently located and, if possible, the gauge glass shall be visible from any valve which controls the level in the vessel.
- k. All instruments requiring adjustment shall be accessible for maintenance from grade, walkways, and ladders.

## 18.0 MATERIALS

Contractor shall furnish all materials for instrument erection as outlined in the job documentation.

Materials shall be suitable for the operation specified, shall be of high quality and resistant to the environment that will be installed.

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In particular electrical materials shall be strictly in accordance with area classification.

Materials shall be included in the Contract order on forfeit basis. Contractor shall make a careful estimate of the materials needed for the complete job. No difference between the actual and Contractor's estimate quantities will be recognized, unless it is approved with contractual documents variations.

**19.0** **FIELD INSPECTION AND TESTING OF INSTRUMENTS**

Field inspection and testing of instruments shall include the following:

**19.1** **ALL INSTRUMENTS**

- a) All items are to be inspected for possible damage during transportation. They shall be compared with instrument requisitions and purchase orders to assure conformity with materials for construction, connection size, rating and orientation; range, dimensions, proper identification, e.t.c.
- b) Instruments shall be suitably stored in warehouse or protected prior to installation.
- c) All instruments requiring bench calibration, as per **Job Specification No. 610/6**, shall be tested before the installation and calibration forms shall be filled-up and signed by both Contractor and Supervision.
- d) All items shall be installed in accordance with the appropriate Owner drawings or standards, or the packages of Manufacturer/Vendor, or Manufacturer drawings or standards. An installation drawing shall be available at the job site for each item.
- e) After instruments are installed, they shall be cleaned with clean dry air and all shipping stops shall be removed. Instruments shall be protected against paint and mechanical damage.
- f) All controllers shall be checked for proper action (i.e. direct or reverse).
- g) Seal fluid and mercury, where required, shall be installed.

**19.2** **TEMPERATURE INSTRUMENTS**

Temperature primary elements shall be checked before installation, by Contractor for:

- a) Item number, service, type and material of wells in accordance with instrument material requisitions.
- b) Immersion length in accordance with pipe diameter.
- c) Fluid direction versus well inclination.
- d) Accessibility and easy removal possibility for the primary element and associated instruments.
- e) Check for proper joining of thermocouple wires, of elements in wells, proper polarity throughout the thermocouple circuit to the instrument. A thermocouple loop shall be checked from the thermocouple head to its receiving instrument by means of a wire continuity test.

**19.3** **FLOW INSTRUMENTS**

Process taps, orifice plates, flanges and instruments shall be checked by

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Contractor for:

- a) Size, type and correct location.
- b) Correctness of inside welding and diameter of the pipe to match flanges.
- c) Item and indications engraved on the orifice plate and flanges.
- d) Orifice plate bore shall be measured and compared with orifice data sheets.

#### **19.4 CONTROL VALVES**

A visual inspection shall be made to ensure valves are installed in accordance with the specified or recommended direction of flow.

#### **19.5 SAFETY VALVES**

- a) Visual inspection.
- b) Valves set pressure shall be tested by Contractor. If necessary calibration will be performed in presence of Owner /Supervisor and the relevant calibration sheet will be signed by CONTRACTOR/ Owner /Supervision.
- c) Valve tightness shall be checked by Contractor except if otherwise specified.

#### **19.6 PANEL BOARDS AND CONSOLE DESKS**

- a) Structural steel and racks shall be checked for correct installation, interconnection between panels and assembly.
- b) For electrical wiring/pneumatic piping shall be checked: correct location and identification of terminals as well as electrical continuity and air leaks. (Same procedure as per **para. 19.7** and **19.8**).
- c) Panel layout and instruments cut- outs shall be checked.
- d) All instruments mounted in Control room shall be checked in accordance with previous paragraphs.
- e) All necessary electrical supply and/or distribution devices for instrumentation shall pass functional test.

#### **19.7 PNEUMATIC PIPING**

All supply and signals lines shall be tested as follows:

- a) Lines to be cleaned by blowing out with clean dry air.
- b) Pneumatic system testing shall be carried-out in accordance with **EN ISO 4414**.
- c) All pneumatic terminals shall be checked for proper identification.
- d) During pressure testing pneumatic users shall be disconnected.
- e) All leakages shall be eliminated.

#### **19.8 ELECTRICAL WIRING**

In general Electrical transmission system testing shall be carried out in accordance with **ELOT EN 61508** and **ELOT EN 61010-1**.

- a) The insulation test for the wiring will be made between:

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- Each single core and the screens.
- The cores.
- Each core and earth.
- Screens and earth.

The insulation test will be made considering the cable characteristics and vendor recommendation (maximum applicable voltage) and shall be made on each piece of cable before any connections to the junction boxes and/or the equipment.

- b) The continuity test will be made after all the intermediary connections, checking the electrical continuity of each single signal line, including the screen continuity.
- c) Where required for function and in accordance with Manufacturer recommendation total loop impedance shall be checked.
- d) All electrical and thermocouples terminals shall be checked for proper identification.
- e) All thermocouples junctions in Control Room shall be checked for correct polarity and emissivity.
- f) Special cable (analyzer, photoelectric cells, inductive/capacitive meters, etc.) could require special tests which will be prescribed by Owner construction management.

#### **19.9 PRIMARY INSTRUMENT LEAD LINES**

- a) Instrument lead lines between the first block valve and the instruments to which they are connected, shall be pressure or leak tested, disconnecting the instruments process connections and closing the primary block valves.

Instruments lead lines with a design pressure equal to or greater than 70 kgr/cm<sup>2</sup> shall be subjected to the same test pressure as the piping or equipment to which they are connected.

Instruments lead lines with a design pressure less than 70 kgr/cm<sup>2</sup> may be leak tested with air or nitrogen to a pressure of 7 to 10 kgr/cm<sup>2</sup>.

During this test any leakages and/or faults shall be eliminated. After the pressure test the lead lines shall be blown.

- b) Any fabricated piece (manifolds, piping manometric set etc.) by Contractor at site shall be pressure tested as above **point a)** prior to be installed.
- c) Steam tracing, flushing and sealing systems, shall be pressure tested and cleaned before insulation.

Any required deviation from the above, resulting from special application's conditions (e.g. cryogenic installations as supplementary part of a high-pressure Pipeline) shall be submitted to Owner for approval.



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**20.0** **PLANT START-UP ASSISTANCE**

Contractor shall make available to Owner, instrument technicians, fully competent for the instrumentation installed, for the assistance to the plant start-up.

**21.0** **COMPLETION OF THE WORKS**

The prescriptions outlined in the above paragraphs are not covering all and every possible needed works to achieve the instrumentation system erection. Eventually missed details shall be carried out, considering the above specification as a basis. In any case, it is Contractor's responsibility to assure correct positioning, installation, testing and all other necessary works to guarantee proper operability of the whole instrumentation.

It is Contractor's responsibility to make available at the end of works, a complete set of "red marked" and final copies of all drawings, diagrams, etc. corrected "as built".

For the electric drawings relevant to control panels, cabinets, local panels, etc. Contractor shall provide the updating of the originals and the subsequent reissuing of the "as built" drawings.

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ATTACHMENT "A"

**CONNECTIONS FOR INSTRUMENTS ON VESSELS AND PIPING**

Temperature Wells

Piping and Vessels DN40 flgd. (7) 1  
Duct or stack DN15 scrd.

Orifice Piping

Flanged Taps (below class 900 ) DN15scrd. (3)  
Flanged Taps (class 900 and above) DN20 scrd.(3)  
Pipe Taps DN20scrd.or S.W.  
  
(3) (8)

Pressure Taps (including diff. press.)

Piping DN20scrd.or S.W.

Vessels (2)(3)(4)  
Duct, Stack, or Heater Wall DN25 flgd. (7)  
DN40 scrd. (with sleeve thru refractory if required)

Level Instruments

External Displacer DN40 flgd. (7)  
Internal Displacer DN100flgd.(7)  
Diff. Pressure Taps DN25 flgd. (7)  
Diff. Pressure with Dip Tube DN100flgd. (7)  
Diff. Pressure, Flange Mounted  
Flush Diaphragm Mfr. Std.  
Diff. Pressure, Flange Mounted  
Extended Diaphragm Mfr. Std.  
Internal Ball Float  
3 1/2" O.D. Ball DN100flgd. (7)  
5" O.D. Ball DN150 flgd. (7)  
Level Switches, Internal Float DN100 flgd. (7)  
Level Switches, External Float DN40flgd.(7)  
Dielectric Probe and Conductivity Mfr. Std.

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### Gauge Glasses

Gauge Glass only	DN25 flgd. (7)
Gauge Glass and Displacer	DN50 flgd.
Gauge Glass Standpipe	DN40 flgd.

### NOTES:

1. If screwed or socket weld connections are not permitted, DN 40 flanged connections shall be furnished.
2. If screwed or socket weld connections are not permitted, DN 25 flanged connections shall be furnished.
3. For horizontal meter runs, orifice taps shall preferably be located on the horizontal centerline for liquid and steam services, and on the top vertical centerline for gas services. Where piping clearances are a factor, taps may be located 45 degrees from the horizontal centerline, above or below as indicated by the location of the differential pressure measuring device.
4. The type of connections for pressure taps shall conform to the appropriate piping specifications.
5. Materials of construction shall be as per the piping specification.
6. No back-welding of threaded connections shall be permitted.
7. Ratings of all flanged connections shall conform to the appropriate piping or vessel specification.
8. DN 15 hole drilled in pipe wall.
9. Connections for multipoint thermowells, retractable purged and skin temperature thermowells shall be selected to suit manufacturer's standard equipment.