حديد الإمارات
emirates steel
a SENAAT company إحدى شركات صناعات

Integrated Management System

Engineering Standards

Instrumentation Engineering Standards

PRD-IN-GS-001

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1. PURPOSE

The purpose of the ES Engineering Standards is to provide information and guidelines for the design, erection, installation and commissioning of plant and equipment across ES Sites.

2. SCOPE

The standards referenced in this document are issued to all contractors and form an integral part of the contract documentation.

Compliance is mandatory by all Contractors, ES Departments and personnel, whilst designing, erecting, installing and commissioning plant and equipment within ES sites, and any deviations require the explicit written approval of ES.

3. DEFINITIONS / ABBREVIATIONS

ES - Emirates Steel

MOC - Management of Change

4. RESPONSIBILITIES

VP of Marketing & Strategy - Is responsible for approving the Standards, and delegating members of his department to review them on a periodical basis, and / or write new standards when deemed necessary.

Projects Construction Manager - Is responsible for ensuring that all projects undertaken within ES comply with these standards.

Engineering Manager Projects - Is responsible for revising the Standards as requested by the projects and operations departments.

5. DESCRIPTION

5.1 GENERAL REQUIREMENTS

This section of the Standard covers matters concerning design, fabrication, installation and commissioning of instrumentation systems.

Individual types of instruments are specified within the relevant section of this Document, as are installation and commissioning details.

Reference should be made to other relevant Sections of Emirates Steel Site Conditions and Engineering Standards, especially Section 5 "Electrical Equipment" and Section 10 "Piping".

5.1.1 DRAWINGS AND DOCUMENTATION

a. PROCESS AND INSTRUMENT DIAGRAMS (P&IDS)

Each instrument shall be identified by symbols on the Contractor's P&ID drawings in accordance with International Standards Organisation (ISO) or Instrument Society of America (ISA) practices or alternative practices approved by Emirates Steel and shall be entered onto an Instrumental Installation Schedule and arranged in numerical order. This schedule shall show services, specification numbers, hook-up drawing numbers and location drawings.

b. INSTALLATION DRAWINGS AND SCHEDULES

The installation drawings and documentation supplied by the Contractor shall include graphical symbols to a mutually agreed Standard.

c. DATA SHEETS

The Specification of all instruments listing technical data shall be entered on standard forms generally conforming to the ISA standard format.

d. CALCULATIONS

The Contractor shall furnish flow measurement and control valve calculations. The latter shall include acoustic noise calculations.

e. INSTRUMENT AIR AND PROCESS PIPING

The Contractor shall provide drawings for all instrumentation applications as detailed under the following headings:

f. SCHEMATIC HOOK-UP DRAWINGS

These shall be provided showing typical piping arrangements for each instrument or group of instruments together with tag numbers and installation materials. These hook-up drawings shall consist of: -

- Instrument electrical and purge air piping
- Process impulse piping
- Instrument stands and supports.

g. INSTRUMENT LOCATION LAYOUTS

Instrument tapping points in pipelines and vessels shall be detailed on the plant layout drawings. Locations of field instruments shall generally be indicated in special instrument location drawings. The position of all instruments, switches, control valves, solenoid valves control panels, junction boxes, and the like shall be identified, showing all tag numbers.

Appropriate symbols shall be used on these layouts to depict the different types of instrument installed.

h. PIPING ROUTES

These shall show the main piping routes for both specific plant areas and general plant areas, for example iron making, steelmaking, mill areas and the like.

i. INSTRUMENT WIRING

These drawings shall be similar to the piping drawings but shall show electronic, control, alarm cabling and/or thermocouple and resistance thermometer cabling together with approximate locations of relevant instruments and junction boxes.

Circuit or loop diagrams are required for all electric or electronic instruments showing the equipment, its location and all terminations and wire numbers. Function diagrams and elementary wiring diagrams shall be provided for complex loops or shutdown systems.

j. INSTRUMENT POWER SUPPLIES

These drawings shall show the location of field instruments requiring power supplies superimposed on plant area layouts.

k. BLOCK DIAGRAMS

Cable block diagrams shall indicate the cabling between initiating devices and actuators as well as supply cabling.

Cables, junction boxes and instruments with their tag numbers shall be shown. These diagrams will be supplemented by a complete cable schedule.

l. PANEL DRAWINGS

Dimensional layout schematics and technical drawings shall be supplied for panels.

m. HEAT TRACING

Heat tracing and/or insulation where required shall be clearly shown on the typical hookups and indicated on the P&ID.

n. CABLE SCHEDULES

These schedules shall list all the cables, lengths, sizes, connection points and relevant technical information.

o. CONTROL ROOM LAYOUT

These drawings shall show the configuration of wiring in control rooms and its connection to equipment.

p. TEST AND INSPECTION CERTIFICATES

All instrumentation supplied shall be provided with manufacturers' test certificates and inspection certificates as appropriate together with installation and site test instructions.

q. OPERATING INSTRUCTIONS

Operating instructions and maintenance manuals shall be provided in accordance with Section 9 of ESI Site Conditions and Engineering Standards.

5.1.2 INSTRUMENT NUMBERING AND TAGGING

All instruments shall be identified by a numbering system to be agreed with Emirates steel. The Contractor shall use such tag numbers in all his documentation.

The Contractor shall tag all instruments in his supply with a rigid stainless-steel tag stamped with the Emirates Steel agreed tag number. The tag shall be permanently affixed to the instrument by the Contractor with drive pins or epoxy resin adhesive in such a manner that it is not necessary to remove the tag to install or service the instrument.

Characters shall be 3 mm high minimum. Tag plates shall be fixed to the body of the instrument and not on removable plates or covers.

5.1.3 INSTRUMENT QUALITY AND SPARE PARTS

The instrumentation and control equipment shall be chosen to operate satisfactorily within the appropriate site seismic, design and climatic conditions.

All spare parts shall continue to be available for a period of at least 10 years after production of components has ceased.

5.1.4 STANDARDIZATION

Standardization of equipment is required on type and make of instruments to the maximum extent feasible throughout the project. Consideration shall also be given to standardize on measurement ranges.

5.1.5 DESIGN CRITERIA

1. CONTROL VOLTAGE SUPPLY

The control circuits shall be protected with miniature circuit breakers (MCB) equipped with auxiliary contacts. The auxiliary contacts of all devices of the same circuit group, e.g. control voltage, transducers, measuring devices, alarms, space heater, electronic equipment supply, etc. shall be wired to group alarm terminals. The group alarms shall be connected to a common alarm monitoring system.

2. CONTROL VALVE ACTUATION

The final activation of control valves should generally be pneumatic, the positioners having 4-20 mA input and pneumatic output, or alternatively electrical motor actuation with position feedback. Profibus positioners configured with HMI shall be preferred. In applications where vibration is to be expected, pneumatic systems should have a

separate I/P converter, installed away from the valve, and an all-pneumatic positioner. Pneumatic positioners shall be equipped with pressure gauges.

3. INSTRUMENTATION GROUPING

For optimum performance, instruments and allied equipment shall be grouped and located wherever possible in the relatively clean environment of plant control rooms.

4. INSTRUMENT CONSTRUCTION

All plant mounted instrument items shall be constructed in a suitably rugged manner and/or suitably protected to withstand the normal wear and tear of iron and steel plant environment.

5. PLANT AND PERSONNEL SAFETY

Instrumentation systems shall be designed to ensure maximum safety for both plant and operatives.

'Fail safe' features shall be designed into all instrumentation systems to take effect in the event of loss of instrument air and/or the electrical supply.

In any area where potentially explosive atmospheres are liable to exist, certified instrumentation shall be connected into intrinsically safe loops equipped with either safety barriers or intrinsically safe input/output units. The installation shall conform to the requirements of the appropriate DIN Standards.

5.1.6 MEASUREMENT UNITS

SI units shall be employed. The preferred units are as follows:

Flow	-	Liquid	m^3/h or 1/s (litres/sec.)
Flow	-	Steam or vapours	kg/h
Flow	-	Gas	Normal m^3/h / S m^3/h (for NG)
Pressure	-	Gauge	bar (= 105Pa)
Pressure	-	Draught	m bar / mmAq.
Pressure	-	Vacuum	m bar
Temperature	-		°C
Level	-		% of range
Weight	-		kg or tonne
Density	-		kg/m^3
Heat/energy	-		J or kWh
Analysis	-		% by volume for gases
Analysis	-		% by weight for solids

Normal (reference) conditions, for calculation of pressure differential flow devices and for instances where flow is to be measured in mass terms (that is pressure and temperature corrected) shall be 1.01325 bar at 15°C.

5.2 Compressed Air Supplies

5.2.1 SCOPE

This Section of the Standard covers details of the instrument compressed air supply. See EMIRATES STEEL Standard 04-050 – Compressed Air systems for further information on compressed air systems.

5.2.2 INSTRUMENT AIR SUPPLY SYSTEM

The primary source of compressed air for instrumentation shall be the general plant oil free air distribution network. Each major plant section shall have an instrument air receiver with downstream filters and dryers. Instrument air quality should comply, at least with ISO 85731 2.2.2 unless agreed otherwise with Emirates Steel.

The air in the receiver shall be at a nominal pressure of 7 bar gauge, depending on equipment to be serviced. The Contractor to confirm design pressure with EMIRATES STEEL.

The equipment and network shall include pressure switches to allow air supply service to be monitored via the automation system.

5.2.3 STANDBY INSTRUMENT AIR COMPRESSOR

An alternate instrument air supply shall be provided for each designated area. This shall either be via standby instrument air compressors, filter & dryer or a connection to an existing system in a designated adjacent area. Changeover to the alternate source shall be automatic upon failure of the main instrument air supply.

5.2.4 INSTRUMENT AIR RECEIVER

An instrument air receiver shall be provided to furnish sufficient air storage to allow for at least five minutes operation of all control instruments, including air loaded actuators, after air plant failure.

Pneumatic actuators should be designed based on a 4-bar supply being available to ensure continued operation even under reduced pressure conditions.

The air receiver shall be provided with a pressure gauge and safety valve (as required by the applicable codes) and an automatic drain valve with bypass manual drain valve.

The receiver shall be internally coated with anti-corrosion material.

5.2.5 INSTRUMENT AIR DRYER AND FILTERS

The air dryers shall be of the absorbent desiccant type, twin vessel, with automatic regeneration. Refrigerant driers may be offered subject to agreement with EMIRATES STEEL. The method of refrigeration shall be subject to approval from EMIRATES STEEL.

Dryers shall be located adjacent to the plant area standby compressor.

The filters shall be provided with differential pressure indicators, fault monitoring switches and automatic drains.

The prefilter, dryer and after filters shall each be provided with isolating and bypass valves to facilitate servicing.

The pressure drop throughout the entire drying and cleaning system shall not exceed 0.7 bar at maximum flow condition.

5.3 Pressure Measurement

5.3.1 SCOPE

This Section of the Standard covers the general applications and engineering requirements for pressure measuring instruments, and differential pressure instruments for general duty.

5.3.2 GENERAL REQUIREMENTS

The electrical connections shall be via a suitable cable gland. The process connections shall be NPT threaded and where necessary shall suit manifolds.

5.3.3 PRESSURE TRANSMITTERS

Pressure transmitters shall be of the strain gauge, resistive, capacitive or any other system suitable to the process to be measured.

Electrical connection shall be 4-20 mA, two wires, or agreed field bus.

Transmitters shall preferably be ‘smart’ type. The communication protocol with the smart transmitters shall be approved by EMIRATES STEEL.

Wherever possible, wetted parts shall be 316 stainless steel. Where low pressure ranges or the nature of the pressure medium makes this impossible, appropriate alternatives shall be employed.

Transmitters shall be capable of withstanding overpressures equal to 130% of maximum range.

The pressure transmitter shall have a minimum performance of:

Repeatability:	±0.1% of span
Accuracy:	±0.5% of full scale, including hysteresis, linearity, and repeatability, unless otherwise specified.

The housing shall be completely weatherproof to IP65 with a durable, protective paint finish.

5.3.4 DIFFERENTIAL PRESSURE TRANSMITTERS

Differential pressure transmitters shall be in accordance with clause 3.3 except that the transmitter shall be capable of withstanding overpressure to the full rated static pressure on either side of the diaphragm without calibration shift.

Electrical connection shall be 4-20 mA, two wires, or agreed field bus.

Transmitters shall preferably be ‘smart’ type. The communication protocol with the smart transmitters shall be approved by EMIRATES STEEL.

A 5-way manifold should be attached to the transmitter. Material should be stainless steel 316 or other material suitable to process.

5.3.5 PRESSURE GAUGES - PROCESS

Pressure gauges shall generally be selected so that normal operating pressure is approximately in the middle of the range. However, the minimum range of the gauge shall be at least 1.2 times the maximum design pressure of the process line or vessel.

The gauge case for all oxygen applications and those gas applications where line pressures exceed 60 bar shall be of brass or die cast aluminium alloy construction with a screwed retaining ring, weatherproof in design, and equipped with interior baffle plate, blow out device and safety glass.

The dials for all gauges shall generally be 100 - 160 mm in diameter and shall have micrometer adjustable pointers, white laminated plastic dials with black numerals and markings and 270° rotation.

The minimum accuracy shall be ±1% of the scale range.

Where Bourdon tubes are used, they shall comply with the relevant standard. The material shall be selected to suit the process fluid and shall generally be 316 stainless steel, monel or bronze. The gauge connection shall be at the bottom.

Pressure gauges for pulsating applications shall be equipped with damping devices to protect against wear and fatigue. Where pressure gauges are installed in process lines or vessels measuring condensable vapours including steam, pigtail siphons shall be used. Pressure gauges installed on pump discharge lines or on lines where vibration is encountered shall be oil/glycerine filled. Alternatively, gearless spiral wound Bourdon tube gauges could be used.

5.3.6 RECEIVER GAUGES (FOR SIGNALS IN RANGE 0.2 - 1 BAR)

Receiver gauges shall be the same as process pressure gauges but with the following exceptions: -

Bourdon tubes, sockets and tips shall be manufactured from phosphor bronze and the gauge connection shall be at the back for panel mounting and at the bottom for field mounting.

5.3.7 PRESSURE SWITCHES AND DIFFERENTIAL PRESSURE SWITCHES

Pressure switches shall have an internally adjustable set-point and a reference or calibrated scale. The materials of construction in contact with the process medium shall be chemically resistant to the process liquid or gas.

The differential shall be adjustable, and the switch shall have a repeatability of ±0.5% of overall range.

Switches shall preferably have hermetically sealed contacts. Switch contacts must be suitable for use with 24V DC control systems and 110V AC circuits, minimum rating 5A.

The case shall be weatherproof with a durable, protective paint finish.

5.3.8 RECEIVER PRESSURE SWITCHES (FOR SIGNALS IN RANGE 0.2 -1 BAR)

Receiver pressure switches shall be the same as process pressure switches, but the element and connection shall be manufactured from phosphor bronze and the pressure switch connection shall be at the bottom.

5.4 Flow Measurement

5.4.1 SCOPE

This Section of the Standard covers the general applications and engineering requirements for flow instruments.

5.4.2 STANDARDS

The following Standard is referred to in the text:

ISO/R 5167: 1980: Measurement of Fluid Flow by Means of Orifice Plates and Nozzles (DIN 1952)

5.4.3 PRIMARY ELEMENTS

Generally, a concentric square edge orifice plate shall be used for all flow measurement of clean fluids except where other considerations such as pressure loss, lack of straight pipe requirements or size precludes their use. A conical entry orifice shall be used for applications involving slow moving, high viscosity fluids. Flow measurement must be through Pressure & Temperature compensation unless agreed with EMIRATES STEEL.

Orifice carriers or corner tapped flanges shall generally be employed in pipes between 50 mm and 150 mm diameter and wherever conical entry orifice plates are installed.

In pipes exceeding 150 mm diameter with square edge orifice plates, impulse tapping's shall be inserted at a distance of one diameter upstream and half a diameter downstream of the orifice. (Defined as D and D/2 tapping's).

For flows in pipelines below 50 mm diameter electromagnetic, vortex, ultrasonic or (where the flow media allows) turbine type meters are preferred.

In ducts or pipelines carrying dirty liquids or gases, or where only a limited pressure drop can be tolerated, differential pressure flow measurement should not be adopted unless either of the following is provided: -

(a) A standard venturi assembly,

(b) A venturi shaped fabricated duct.

Pilot tubes and similar devices will normally be used only for test measurement in large air or gas carrying ducts.

For measurement in vertical pipes the primary element shall be installed with flow upwards for liquids and downwards for wet gases and steam.

5.4.4 ORIFICE AND VENTURI LOCATIONS IN PIPELINES

The minimum requirements for straight runs of pipe shall be in accordance with ISO/R 5167 (DIN 1952).

Straightening vanes shall not be used except with the approval by ESI.

5.4.5 ORIFICE FLANGES

The orifice flanges shall be slip-on PN40 as a minimum rating. They shall be stamped with rating, material and, after installation, with the upstream mean internal pipe diameter.

5.4.6 ORIFICE PLATES

Orifice plates shall be manufactured from 316 stainless steel for general service. Special alloys shall be used where 316 stainless steel is not suitable for service conditions.

Orifice plates shall be designed and manufactured in accordance with ISO R 5167.

The following inscription shall be stamped on the upstream side of the tab for square edge orifice plates:

- Tag number
- Orifice diameter
- Material

Eccentric orifices may be used in wet gas and suspended solids applications. The following inscription shall be stamped on the upstream side of the tab for eccentric orifice plates:

- Tag number
- Orifice diameter
- Material
- Tab to be clearly stamped ECCENTRIC.

5.4.7 ORIFICE SIZING

Orifice bore calculations shall be presented as shown in Appendix A. Alternative presentations are acceptable if they demonstrate all steps in the calculation and include source references for equations.

Orifice meter differential ranges shall be specified in mbar.

5.4.8 DIFFERENTIAL PRESSURE TRANSMITTERS FOR FLOW DUTY

Transmitters shall give a 4-20 mA DC output proportional to differential pressure or agreed field bus.

Square root extraction & Pressure-Temperature compensation shall be performed in software on the control system. In addition to the standard requirements for differential pressure measurement, transmitters shall have a minimum performance of: -

Repeatability: ±0.05% of full scale

Accuracy: ±0.25% of full scale.

A five-valve manifold, material 316 stainless steel, shall be located at the transmitter.

Transmitters shall preferably be 'smart' type. The communication protocol with the smart transmitters shall be approved by EMIRATES STEEL.

5.4.9 MAGNETIC FLOW METERS

Magnetic flow meters are preferred for measurement of volumetric flow rate of electrically conducting liquids.

The flow meter shall be pressure tested with the pipework to design conditions and calibrated over the complete range. The magnetic flow meter (transmitter and converter) shall have a minimum system performance of:

Repeatability: 0.25% of full scale

Accuracy: ±1.0% of full scale.

The detector head and flanges shall be manufactured from 316 stainless steel with PTFE lining material. The electrode material shall also be manufactured from 316 stainless steel. The end connections shall be flanged, in accordance with the pipe system concerned.

Installation shall be strictly in accordance with the manufacturer's recommendations, especially regarding earthing and bonding to prevent extraneous electrical influences on the measurement.

Tools and equipment for setting-up, ranging, testing and diagnostics shall be provided to suit each type of meter supplied.

5.4.10 VORTEX FLOW METERS

Vortex flow meters are acceptable for measurement of flow rate of non-conducting liquids and gases.

The flow meters shall be pressure tested with the pipework to design conditions and calibrated over the complete range. The meter shall have a minimum system performance of:

Repeatability: 0.25% of full scale

Accuracy: ±1.0% of full scale.

The head and flanges shall be manufactured from 316 stainless steel. The end connections shall be flanged in accordance with the pipe system concerned.

Installation shall be strictly in accordance with the manufacturer's recommendations on upstream and downstream pipework.

5.4.11 ULTRASONIC FLOW METERS

Ultrasonic flow meters will be accepted only for measurement of flow rate of liquids where absolute accuracy is not required, and the characteristics of the fluid are suitable over the long term. The manufacturer's recommendations for design and installation shall be followed closely.

Flow meters shall be pressure tested with the pipework to design conditions and calibrated over the complete range. The meter shall have a minimum system performance of:

Repeatability: 0.5% of full scale

Accuracy: ±2.0% of full scale.

Materials shall be 316 stainless steel unless otherwise agreed. End connections shall be flanged in accordance with the pipe system concerned.

5.4.12 TURBINE FLOW METERS

Turbine meters may be used in clean service for accounting purposes, where high rangeability is required or in pipes below 50 mm diameter carrying suitable fluids, for example oil or good quality water. The body and connecting flanges shall be 316 stainless

steel and end connections shall be flanged, in accordance with the pipe system concerned.

A suitable strainer shall be installed not less than ten (10) pipe diameters upstream of the turbine meter and straight pipe requirements, upstream and downstream shall be the same as for orifice plates.

The turbine meter shall be pressure tested to design conditions and hydraulically flow calibrated over the whole range. It shall have a minimum system performance of: -

Repeatability: 0.1% of actual flow rate over the linear flow range.

Accuracy: ±0.2% of actual flow over the linear flow range.

5.4.13 VARIABLE AREA FLOW METERS

Variable gap flow meters may be provided for services under either of the following conditions:

- The fluid is clean.
- Where a linear flow rate indication is required locally.

For safety reasons, glass tube variable gap meters shall not be used for measuring fluids that contain strong acids of alkalis, steam or other fluids that could injure personnel or create fire hazards.

Variable gap meters, except purge meters and those in streams that can be temporarily interrupted, shall have isolating and bypass valves. They shall be mounted vertically, be free of piping stress, not exposed to excessive vibration and shall be readily accessible for maintenance purposes.

The accuracy of the flow meter shall be within ±2% of maximum flow.

5.4.14 INDICATING DEVICES

Where local indication is required digital liquid crystal display units, suitably housed, shall be provided, connected in series with the 4-20 mA loop or agreed field bus. Indicators shall be configured for signal conditioning (scaling, square root extraction, etc.) to display flow directly in engineering units to discrimination no greater than 0.25%.

5.4.15 FLOW SWITCHES

The requirements regarding the selection and application of flow measurement and the standards for pressure switches shall generally be observed for flow switch selection and installation.

Flow switches with hinged vanes should where avoided where they may be subject to wear or fouling by debris in the process stream. The use of heat dissipation type sensors should be considered for general application with safe process media.

5.5 Temperature Measurement

5.5.1 SCOPE

This Section of the Standard covers the general engineering requirements for temperature measuring instruments.

5.5.2 STANDARDS

The following Standards are referred to in the text: IEC 584: Thermocouples - Reference Tables; Tolerances. IEC 751: Industrial Platinum Resistance Thermometers and Sensors.

5.5.3 GENERAL REQUIREMENTS

Design shall be in accordance with the requirements and recommendations of the above Standards.

5.5.4 THERMOCOUPLES

In general, thermocouples shall be used for temperature sensing elements for temperatures up to 1500°C. For special application like molten metal temperature, temperature range will vary above 1500°C and disposable type thermocouples (R or S type agreed with EMIRATES STEEL) shall be used.

Measurements using thermocouples shall comply with the International Thermocouple Reference Tables in IEC 60584.

Calibration curves shall be provided by the manufacturer with a minimum of 3 points plotted within the working range of the instrument.

Where surface temperature measurement is required, thermocouples shall be adequately attached to the surface at the correct distance from the hot junction. Consideration shall be given to thermal insulation around the hot junction in cases where the environmental temperature may cause an unrepresentative signal. For the critical application such as Liquid metal temperature measurement, where cold junction temperature could not be constant, auto temperature compensation provision shall be inside measuring unit.

Thermocouples shall be installed in protecting sheaths and in accordance with Clause 11. The thermocouple's head assembly shall be weatherproof, and the base equipped with inside thread and moisture resistant gasket.

Wherever the application allows, the unit will be held in an adjustable socket with a 25mm (1 inch) male thread. The thermocouple junction shall press tightly against the bottom of the sheath to minimize measurement time lag.

5.5.5 RESISTANCE TEMPERATURE DETECTORS

Resistance temperature detectors shall be used for measuring temperatures in the range 0 - 600°C.

Resistance elements shall comprise platinum wire wound elements and will generally be of the 3-lead type. However, 4 lead elements may be installed for those applications requiring the very highest accuracies.

Resistance temperature detectors shall be in accordance with IEC 751.

Where such sensing elements are used in liquid filled pipelines or tanks, suitable thermo wells shall be installed.

5.5.6 RADIATION PYROMETERS

Radiation pyrometers shall generally be used for measuring higher temperatures and particularly those in excess of 1500°C. Either total or two colour radiation types may be installed.

They shall be provided with adjustable support assemblies to enable accurate alignment. Water cooling shall be supplied for units mounted in hot locations.

Detecting heads shall be designed to enable easy removal for cleaning of the window lens and clean oil-free air purging systems shall be provided to maintain the main window lenses in a clean condition. Purging shall be continuous. Closed-end sighting tubes of a suitable material may be employed in atmosphere measurement applications, for example, the high temperature zones of reheat furnaces.

5.5.7 SUCTION PYROMETERS

Suction pyrometers may be used for special applications where it is necessary to measure hot gas accurately. Generally, however, such instruments shall be used for test purposes only.

5.5.8 TEMPERATURE TRANSMITTERS

Transmitters shall be provided with the means of detecting a broken thermocouple or signal line. They shall usually drive up scale, depending upon plant safety requirements, and this shall initiate an alarm.

All temperature measuring instruments shall be provided with automatic cold junction temperature compensation.

Temperature transmitters for thermocouples shall be suitable for rack mounting within control panels. Those for resistance temperature detectors shall be head mounted. Temperature transmitters shall be smart type.

5.5.9 SIGNAL RANGE

All temperature transmitters shall have 4 - 20 mA outputs or agreed field bus connection.

Transmitters shall preferably by 'smart' type. The communication protocol with the smart transmitters shall be approved by EMIRATES STEEL.

5.5.10 DIAL THERMOMETERS

Dial thermometers shall be of the bi-metallic or filled types provided with thermo wells where appropriate. Mercury filled instruments are not acceptable. Stems shall be selected to ensure the minimum length of free stem external to the thermo well.

The gauge case shall be of all stainless-steel construction, weatherproof in design and equipped with safety glass.

The gauge dial shall be 100 - 150 mm in diameter and shall have an external zero adjusting screw, white laminated plastic dials and black numerals and markings.

The mounting thread, a separate compression fitting, shall be $^{1}/_{2}$ inch NPT male. In filled thermal systems the temperature indicators shall be fully compensated. Gas filled capillary tubing shall be stainless steel with stainless steel helical armouring. Mercury is not acceptable.

5.5.11 PROTECTIVE SHEATHS

Thermocouples and resistance thermometers shall be protected by metallic or refractory sheaths, the materials of which shall be suitable for both the appropriate temperature level and working atmosphere. Where refractory sheaths in excess of 750 mm long are to be

inserted through furnace walls, that section within the wall and external to it shall be cemented within a length of heat resisting steel.

Where sensing elements form part of a protective alarm or fast acting control system, sheath material and thickness shall be carefully selected to ensure the minimum thermal lag possible. Where this leads to problems connected with the mechanical strength of the sheath, a suitable support structure shall be provided.

5.5.12 THERMOWELLS

Thermo wells shall be used in all applications involving the temperature measurement of fluids in pipelines, tanks and other vessels in order to facilitate, without plant shutdown, removal of the sensing element.

All screwed connections (other than electrical entries) shall have NPT threads. All flanged connections shall be to the appropriate standard for the pipe system concerned.

Thermo wells shall be fabricated from 304 stainless steel bar stock or similar and/or forgings. Fabricated units are not acceptable except for the flanged parts. The thermo well shall be screwed 15 mm ($^1/_2$ inch) NPT and test thermo wells shall be fitted with a brass plug secured to the main unit by a chain.

Where thermo wells are installed in vessels and tanks horizontally, the unsupported immersion length will not generally exceed 450 mm.

Every thermo well shall be stamped with an appropriate tag number, its length and its material.

5.6 Level Measurement

5.6.1 SCOPE

This Section of the Standard covers the general applications and engineering requirements for level instruments.

5.6.2 GENERAL REQUIREMENTS

The electrical connections shall be via a suitable cable gland.

All piping screwed connections shall have NPT threads. All flanges shall be to Standards appropriate to the system concerned.

Systems shall generally operate at 110V or 230V 50 Hz or 24V DC and shall include facilities for remote read-out or logging. Transmission systems shall operate at 4-20 mA DC.

Transmitters shall preferably by 'smart' type. The communication protocol with the smart transmitters shall be approved by EMIRATES STEEL.

Instrument enclosures shall be completely weatherproof.

Switches shall have contacts suitable for use in 24V DC alarm and control circuits.

5.6.3 LIQUID LEVEL MEASUREMENT (INCLUDING LEVEL SWITCHING)

1. LEVEL MEASUREMENT IN SMALL TANKS AND VESSELS

External displacement float type instruments shall normally be provided for liquid level applications with ranges equal to or less than 1200 mm. For open tanks or sumps, the equipment may be top mounted but, in this event, precautions must be taken to eliminate surface turbulence.

Where control valves in level service are equipped with a bypass valve or a handwheel and the vessel level gauge glass (where installed), is not clearly visible from the control valve, then a separate indicator showing the level transmitter output shall be located adjacent to the bypass or handwheel.

External displacer process connections shall be DN50 PN10 (minimum). For water applications the float chamber shall be fabricated from carbon steel, the displacer from 304 or 316 stainless steel and drain and vent connections shall be provided.

2. LEVEL MEASUREMENT IN TANKS AND VESSELS EXCEEDING 1200 MM DEPTH

For closed vessels with measuring depths of more than 1200 mm the level transmitter shall generally be ultrasonic, radar or differential pressure type.

The element material and associated parts in contact with the media shall be 316 stainless steel or similar.

In the case of differential pressure applications, the transmitter shall be capable of withstanding overpressure to the full rated static pressure on either side of the diaphragm without calibration shift.

Differential pressure or pressure transmitter shall have a minimum performance of: -
Repeatability: ±0.1% of full scale
Accuracy: ±0.5% of full scale

3. LEVEL MEASUREMENT IN LARGE STORAGE TANKS

Ultrasonic or radar level transmitters shall be used for large storage tanks. Float level indicators with graduated tape and internal guides where applicable may be agreed with EMIRATES STEEL.

A standpipe running the full depth of the tank shall be installed where necessary. The standpipe shall be internally smooth, free of rust and both welding and drilling burrs. The instruments shall be easily accessible from the tank platform.

Local indicator units shall be so constructed that remote transmission of liquid level can be added without having to empty the tank or make major changes in the original equipment. High- and low-level limit switches shall be included as standard.

5.6.4 LEVEL MEASUREMENT OF SOLIDS IN BUNKERS

1. CAPACITANCE LEVEL INSTRUMENTS

The application of capacitance (dielectric) type level measuring devices shall be limited to materials whose moisture content is reasonably stable.

Care shall be taken in the location and mounting of probes to avoid damage when material transform, and processing is taken place. Appropriate means of protection against static electricity shall be adopted.

Continuous level measurement equipment shall be capable of providing local and remote indication.

2. ULTRASONIC AND RADAR LEVEL MEASURING INSTRUMENTS

Ultrasonic systems may be used for applications subject to acceptance by EMIRATES STEEL.

3. NUCLEONIC LEVEL MEASURING INSTRUMENTS

Nucleonic level equipment shall only be adopted by agreement with EMIRATES STEEL. Equipment shall conform strictly to local Ionizing Radiation Regulations.

Radiation sources shall be design such that a discreet radiation beam can only be emitted from the source and that radiation in all other directions is adequately shielded.

The source itself shall be either shuttered or capable of non-manual withdrawal into its shielded housing, for safety reasons.

Nucleonic level equipment shall be installed strictly in accordance with the manufacturer's instructions. All obligations of the supplier shall be met with respect to procedures for replacement and disposal of radioactive material over the life of the equipment.

4. ELECTROMECHANICAL WEIGHT DISPLACEMENT LEVEL MEASUREMENT INSTRUMENTS

Mechanical instruments shall only be provided by agreement with EMIRATES STEEL where other types are unsuitable.

All materials used for parts of the system in contact with the process material shall be selected for resistance to corrosive and/or abrasive wear. The top works housing shall be dust-tight and weatherproof.

Auxiliary switch contacts shall be provided to operate under full, intermediate and low-level conditions.

5. WEIGHT LEVEL MEASUREMENT

Level may be inferentially determined by weighing the container and its contents.

5.6.5 LEVEL SWITCHES (MEASUREMENT OF SOLIDS)

1. ROTARY PADDLE SWITCH TYPE

The paddle and other parts that come into contact with the materials shall be selected for resistance to chemical and abrasive action of the media.

When mounted on the side of hoppers the switches shall be located at a point where there is a free flow of material both to and away from the paddle but out of the direct line of charged material.

2. DIAPHRAGM TYPE LEVEL SWITCH

Diaphragm type switches may be used in applications involving powdered or granular materials. The diaphragm shall be complete with an anti-abrasive coating. This type of unit shall not be employed in closed vessels where pressure or suction conditions might be present.

An internal partition shall be included to protect the diaphragm against overloading and to prevent the hopper contents coming into contact with the electrical enclosure.

5.7 Weight & Quality Measurement

5.7.1 SCOPE

This Section of the Standard covers the general applications and engineering requirements for weighing systems.

5.7.2 WEIGHING INSTRUMENTS - GENERAL

1. SYSTEM

a. Detail engineering for all weighing applications, including the mechanical design, must be verified by a specialized weighing equipment supplier.

b. The accuracy specification of all items of weighing equipment shall be agreed with EMIRATES STEEL. It is of prime importance that the accuracy of all systems shall be maintained for long periods without the necessity for frequent calibration and maintenance checks.

c. Weighing equipment for goods reception and despatch to and from EMIRATES STEEL shall meet the requirements of the appropriate UAE or International Standards. Weighing equipment shall be based on resistive or magneto-elastic load cell technology.

d. All electronic weighing systems shall incorporate automatic compensation for changes in temperature and to ensure that uneven and shock loadings, dampness and wind age have negligible effect.

e. Batch weighing applications shall include automatic tare facilities. As a general principle, 'weigh-out' systems are preferred to 'weigh-in' systems.

f. All weigh systems shall incorporate features to facilitate accurate calibration. Where practicable, test weights shall be used and means to apply them shall be incorporated into the design. Where test weight checking would prove to be impracticable, other check systems shall be incorporated.

g. All electronic load cell signal processing equipment shall incorporate easy checking facilities involving a signal injection from test sources, such as simulation of load cells and test load application.

h. Vital controls, including calibration adjustment devices, shall be made inaccessible to operating personnel. Automatic zeroing adjustment systems shall be limited to a range of 0.5% to limit the possibility of error injection. An alarm shall be generated if the signal is outside this range.

i. All weighing equipment (non-automatic weighing instruments) shall comply with the recommendations OIML R 76-1 and OIML R 76-2 as issued by the "Organisation Internationale de Metrologie Legale"

j. Capacity of the weighing system shall be selected according the maximum expected load and smallest possible increment.

k. The accuracy of the complete system shall be given in units of weight (i.e. 998kg ± 1kg) or in units of minimum increment (i.e. at full load ±0.75 d, where d = increment).

l. The weighing systems shall be SCHENCK or equal. As far as practicable, weighing equipment shall be standardised across the project.

m. Site calibration report shall be provided after test weigh calibration by OEM.

n. For Belt scales /Belt weigh feeders' provision of material drop test shall be provided.

2. TOTALIZERS & DISPLAYS

a. Remote digital read-out equipment shall include: -

- Digital read-out
- Suitable equipment to suppress interference from external sources
- Cabinets for the system electronics designed and located to facilitate access for maintenance purposes
- Data communication with the automation system using a site standard field bus network.

b. Totalizer/displays shall be freely programmable for capacity, increment and zero tracking range.

c. Displays shall provide good readability on all areas. This is to be selected depending on illumination in the area on actual working environment.

d. Automatic and manual zero setting and taring shall be possible.

e. Communicated to the automation system along with weight data.

f. Calibration shall only be done through keypad entries or by authorised computer access.

g. Password protection shall be provided. Facility for changing the password by authorized persons only to be provided.

h. Installation supervision, site commissioning, site training shall be provided by weighing system supplier.

i. Weighing system electronic cubical shall be located inside enclosed/control room.

5.7.3 LOAD CELLS

1. Adequate number of load cells shall be provided, depending on the size of the weighing platform/container and capacity of the system.
2. Suitable rated field junction boxes shall be provided for interconnection of load cells and totalizer. The junction boxes shall be located in easily accessible locations to facilitate maintenance.
3. Load cells for commercial weighing shall have minimum of 0.02% accuracy.
4. Load cells shall be suitable for the harsh environment in which they are installed.

5.7.4 ROAD AND RAIL WEIGHBRIDGES

Weighbridges shall be compression load cell operated. Access manholes and adequate drainage shall be included.

The weighbridge structure shall permit sufficient self-alignment and horizontal movement to ensure that excessive side loads are not transferred to the load cells, and in the case of road weighbridges to allow traffic to drive askew on or off the weighbridge. The load cells shall be coupled to the platform via a free motion unit packed with grease and protected against the ingress of dust and moisture. The platform should preferably be located by bumper stops rather than tie rods.

The load cells shall be capable of withstanding up to 150% overload before recalibration proves necessary. They shall be able to withstand 500% of capacity load without physical failure.

Road weighbridge platforms shall be constructed from mild steel chequered plate designed to shed water. Concrete with asphalt top surfaces shall be provided.

A push button operated zero balance device shall be incorporated for manual adjustment to take account of accumulation of rain or hail and spillage of material that may be deposited on the weighbridge.

The accuracy of a complete road or rail weighbridge system shall be within plus or minus 0.02% of the weighbridge rating.

Rail and wagon tippler weighbridges shall be designed so that accurate alignment of the bridge and external rails is assured.

Shroud plates shall be fitted where spillage of material cannot be avoided.

5.7.5 WEIGHING-IN MOTION (RAILWAY WAGONS)

Weighing in motion weighbridges shall be load cell operated.

The weighbridge structures shall be of sufficient rigidity to inhibit the generation of low frequency vibrations. Cover plates shall be included to allow easy access to the load cells for maintenance purposes. The weighbridge pits shall be provided with suitable drainage.

Means shall be included to ensure that wagons passing over the weighbridge at excessive speed shall be detected and recorded and shall initiate an alarm.

When weighing in motion the accuracy of individual wagon weights shall be within plus or minus 0.5% of the weighbridge capacity. Under static conditions accuracy shall be within plus or minus 0.15%.

5.7.6 TIPPLER WEIGHBRIDGES

Wagon tippler weighbridges shall be supported on load cell units positioned so as not to infringe the actual tippler and to be readily accessible for maintenance.

The weighbridge structure shall permit sufficient self-alignment and horizontal movement to ensure that excessive side loads are not transferred to the load cells. In addition, precautions shall be taken to protect the load cell against shock loads when the tippler unit is returned to the weighbridge.

5.7.7 BELT WEIGHERS

The belt weighers shall generally have a maximum error of 0.5% of the totalized load for any flow rate between 50% and 100%.

The load cell and the load application arrangement shall, where possible, be above the conveyor belt to prevent fouling from material spillage. The field mounted equipment, excluding load cells, shall be contained in a weatherproof and dustproof cabinet. Low level heaters shall be incorporated to eliminate dampness and all cable terminal boxes shall be gasketed to effect a thorough seal.

All bearings used throughout shall be 'sealed for life'.

The speed of the belt shall be detected using a pulse or tachogenerator. Material feed to a weigh belt should not be allowed to fall below 30% of design flow rate. The installation of intermediate holding hoppers, with controlled outflow, shall be used where batched materials are weighed for costing purposes.

Calibration test weights shall be built into the equipment where practicable as shall permanently available electronic facilities to check the measuring and indicating circuits.

5.7.8 WEIGHING OF BUNKERS/HOPPERS

Weigh measurement of process materials contained in bunkers/hoppers shall be achieved using load cells and the tension type is preferred.

The accuracy of bunker/hopper contents weighing shall be within plus or minus 0.15% of system capacity unless otherwise agreed by EMIRATES STEEL.

5.7.9 CRANE WEIGHING

Transducers shall be either compression load cells or magneto-elastic cells and shall be mounted in a manner to ensure protection from both mechanical damage and radiated or converted heat.

Where load cells are used on hot metal cranes, they must be mounted between the crane sheave assembly and the ladle beam.

Permeability modulating transducers, if used, shall be circular and form an integral part of the beam. In this case, the sheave pin shall be supported concentrically within the transducer.

On smaller cranes, load cells shall generally be mounted immediately above the snatch block to avoid inaccuracies that would arise from the weighing of varying rope lengths.

The associated instrumentation shall be of a rugged compact modular construction with low weight and limited dimensions for ease of location and mounting on the crane.

The accuracy shall be within plus or minus 0.15% of full range at any value of load.

5.8 Control Valves

5.8.1 SCOPE

This Section of the Standard defines the design requirements and assembly features of control valves.

5.8.2 DESIGN AND SERVICE

1. **CONTROL VALVES FOR GENERAL SERVICE**

   Top and bottom guided, balanced cage trim globe, or characterized ball valves shall be generally used for high pressure, tight shut-off, control applications.

   Double port valves may be used where tight shut-off is not required. In all cases, the trim shall be replaceable from the top of the control valve.

2. **CONTROL VALVES FOR HIGH CAPACITY APPLICATIONS**

   Butterfly valves may be installed for sizes 200 mm or larger.

   Characterized ball valves may be used where appropriate in pipeline 80 mm or above.

3. **CONTROL VALVES FOR POTENTIAL CAVITATING, FLASHING, EROSIVE SERVICE AND HIGH NOISE LEVEL APPLICATIONS**

   Valve using frictional paths, multiple port cages, vortex flow or other methods of velocity and noise control shall be used.

4. **CONTROL VALVES FOR ABRASIVE MEDIA**

   Valves in lines carrying abrasive materials, for example, lime powder suspended in air or oxygen, shall be of specialized construction and full details must be submitted to EMIRATES STEEL for approval.

5.8.3 MATERIALS OF CONSTRUCTION

Body material shall be in accordance with the appropriate Piping Specification. Cast iron valves shall not be used.

For control valve application, excluding oxygen service, in the temperature range -65°C to +300°C and a maximum pressure drop of 15 bar, the trim material shall be austenitic stainless steel.

For valves working under conditions of high temperature, frequent on/off cycling, erosion, or where cavitation may occur, Satellite facing shall be applied to the valve plug and seat.

5.8.4 VALVE SIZES

The minimum body size shall be 25 mm (1 inch). Below this, the valve shall be fitted with a reduced inner valve trim.

All fanged valves except ball, butterfly or special designs shall have face-to-face dimensions according to DIN Standards.

5.8.5 CONNECTIONS AND RATING

25 mm and 40 mm

Screwed 600 lb. DIN 19212 minimum unless flanges are specified in the specific Piping Specification.

50 mm and Larger

150 lb. ANSI RF minimum.

5.8.6 BONNET

1. HIGH TEMPERATURES

A cooling extension shall be provided for control valves operating at elevated temperatures.

2. LOW TEMPERATURES

For cryogenic services, valve bodies shall be provided with an extended bonnet to maintain the packing at ambient temperature and to provide a configuration for insulating the valve body.

5.8.7 GLAND PACKING

Teflon or similar packing shall be used on all valves operating at temperatures up to 230°C. At 230°C, a high temperature semi-metallic packing shall be used.

5.8.8 INDICATION OF DIRECTION OF FLOW

Flow direction shall be prominently displayed on the valve body in the form of a casting, stamping or place.

5.8.9 ACTUATION OF CONTROL VALVES AND DAMPERS

For linear actuated control valves, spring opposed diaphragm or piston actuators are preferred. Dually loaded pneumatic or hydraulic piston, electric or other actuators may be used by agreement with EMIRATES STEEL where a special service or valve design requires it.

Springs shall be fully enclosed and have linear characteristics permitting full stem travel for air pressure ranges of 0.2 to 1 bar or 0.4 to 2 bar, in actuators without positioners.

Springs shall be corrosion resistant and have a readily accessible adjusting nut. Non-standard springs shall not be used.

Valve yokes shall preferably be made of high strength cast or ductile iron.

Diaphragms shall be manufactured from nylon reinforced neoprene of Buna N.

The fail position of the valve shall be determined by an analysis of the process. It may be 'fail open', 'fail closed' or 'fail locked'.

Piston actuators shall be sized to supply the required force using air at pressure not exceeding 6 bar but must be suitable for pressures up to 8.5 bar.

In vital fail-safe systems, volume air tanks should be mounted adjacent to the actuator or oversized air headers may be installed to ensure at least 3 full operations of valve/damper travel in the event of air supply failure.

Actuators for pipeline valves shall be sized for positioning the valve against 1.25 times the maximum differential pressure that may develop under normal or start-up operation. The maximum differential pressure shall be assumed to be the maximum upstream pressure with the control valve fully closed and its outlet vented to atmosphere.

Where butterfly or rectangular dampers are used in ducts carrying gases or fume, they will be counter-weighed to positively shut off or move to some other position in accord with plant safety requirements in the event of loss of air or electrical supply.

Electrical actuators shall include limit switches and torque switches connected to prevent jamming. Switches and position feedback devices shall be 24 Vdc circuits with wiring and connections segregated from the motor power connections. Motors shall have built-in winding over temperature sensors.

5.8.10 CONVERTERS

Electro-pneumatic converters shall be used in conjunction with all pneumatic positioners in applications where vibration is to be expected. Converters shall not be mounted on the actuator assembly.

5.8.11 VALVE POSITIONERS

Electrical position feedback shall be provided on all valves with electrical actuation. Pneumatic valve positioners or electrical feedback shall be specified wherever the application calls for the accurate positioning of pneumatically actuated valves.

Unproven, prototype first-off equipment or components are not acceptable. Only proven equipment may be used. Positioners shall preferably be installed in the direct acting mode but shall be of the type which can readily be reversed by an internal or external device.

Pneumatic valve positioners shall have full bypass assemblies, input, output and supply pressure indicators and it shall be possible to stroke the valve/damper over its entire range with the positioner in the bypass position.

All positioners, volume boosters, boosters, booster relays, simply relays and filter regulators shall be mounted and piped on the valve body/actuator assembly where possible.

All instrument air connecting tubing shall be seamless, annealed copper tubing covered by a flame-resistant PVC sheath.

5.8.12 SELF-ACTING CONTROL VALVES

The use of a self-contained or pilot operated regulators should be limited to applications where the controlled variable is pressure or temperature directly sensed by the regulator or pilot and operating conditions do not require variable proportional band, automatic reset and/or rate action or frequent changes of desired value.

5.8.13 NAMEPLATE DATA

All control valves shall have stainless steel nameplates, preferably mounted on the operator yoke assembly.

The following information shall be shown on the nameplate: -

- Valve serial number
- Order number
- Instrument tag number
- Valve model number
- Maximum pressure in bar (body rating)
- Valve stroke length (stem travel in mm)
- Action air/opens or air/closes.

5.8.14 ISOLATING AND BYPASS MANIFOLDS

Isolating and bypass valves shall be provided for the following conditions: -

- For steam reducing stations (main headers).
- For all valves where inability to operate would endanger plant equipment and personnel.

- For a critical service when shutdown cannot be tolerated.

Isolating and bypass valves shall generally not be provided for the following conditions: -

- For control valves in emergency or intermittent service.
- For systems operating in parallel, where the shutdown of one or more streams is acceptable.
- For applications where process time constant make operation under manual control impracticable for the period required to replace or repair a control valve.
- On any application where shutdown of the process is acceptable.
- Where bypass installations could become obstructed or freeze.

5.8.15 MANUAL OPERATION APPLICATION

A facility for manual operation shall be provided for the operation of all control valves that do not have isolating and bypass valves and where local manual control is necessary for operating continuity.

A mechanically coupled hand wheel shall be provided where operation of the valve may be required for emergency use. Where local operation is required for production purposes, a local operator control station shall be provided in a position convenient to personnel.

1. SIDE MOUNTED HANDWHEELS

Side mounted hand wheels used for globe valves shall be as follows:

- They may be integral or attached by bolts or clamps.
- They shall be of the locking type with declutching hand wheel.
- They shall be capable of limiting travel in either direction, but not necessarily both at the same time.
- The operating force required shall be limited to 22 kg on the rim of the hand wheel.

2. MANUAL OPERATION OF QUARTER TURN VALVES

Quarter turn valves using linear diaphragm or linear piston actuators should utilize hand wheels as for globe valves.

Hand wheels shall be provided on high torque electric or rotary pneumatic motor actuators. A manual clutch shall be fitted to prelude hand wheel rotation during normal operation or motor rotation during manual operation.

3. VALVE ACOUSTICS

The Contractor is required to call the attention of EMIRATES STEEL to any valve which is expected to create a sound level in excess of 80 dBA measured at a point one metre distance from the valve under operating conditions.

The Contractor shall employ one or more of the under mentioned methods of reducing the noise: -

- Select a valve of an improved design.
- Change the piping configuration.
- Install diffusers, silencers or baffles.
- Install acoustic lagging.

5.9 Instrumentation Installation

5.9.1 SCOPE

This Section of the Standard defines the methods to be used for the installation of measurement and control instruments and related accessories.

5.9.2 INSTRUMENT INSTALLATION GENERAL

The installation shall generally conform to BS 6739 or equivalent.

Materials and fittings shall be standardized for specific projects by agreement with EMIRATES STEEL.

Sufficient space shall be provided around all instrument and instrument panels to provide for ease of installation, removal and maintenance. Where used, instrument houses shall be of sufficient size to provide for these requirements.

Instruments and their connections shall always be accessible from ground level, platforms or walkways. The centre line of pedestal mounted instruments shall be approximately 1.4m above ground or platform level.

Transmitters and local controllers shall not be mounted on lines or equipment subject to vibration.

Instruments shall be fitted with temporary protection if installed before completion of other plant in the area and shall be suitably protected against any damage or wear resulting from the normal wear and tear associated with the industry.

5.9.3 INSTRUMENT PROCESS CONNECTIONS IMPULSE PIPING (PRESSURE FLOW AND SAMPLING)

Impulse piping shall be selected by material and size to suit the particular application, that is the nature of the process media, its pressure level and the distance from the impulse tapping to the sensing element. In larger pipes and ducts where D and D/2 tapping's are

used the isolating cocks shall generally be inserted directly into a tapped boss in the pipe or duct.

For most applications involving 12mm OD (3/8-inch nb) impulse lines (but not for steam applications) the isolators shall be gland packed cocks. For 15 mm OD ($^1/_2$ inch nb) mild steel impulse lines, a full way valve with female threaded outlets for standard 15 mm OD ($^1/_2$ inch nb) piping shall be installed.

For liquids, gases and analyzers, in general, lines pipe should be made of stainless-steel seamless tubes, as per DIN 2391 (6 to 12 mm OD), unless otherwise specified or due to process requirements.

For smaller pipes where orifice carrier rings or tapped flanges are used, the run from the tapping coupling to and including the first isolating valve shall generally conform to Section 10 of this Standard.

Tubes should be joined to equipment and together using high pressure compression fittings. All pipe works should be given the appropriate slope to avoid trapping gases or liquids in the line.

All gas pipe work should be provided with condensation bottles and draining facilities at the lower point of the line.

Automatic condensation bottles should be installed whenever it is possible.

Prior to final instruments connection, all pipe works should be thoroughly cleaned with compressed air or other suitable media in accordance to the process to be measured.

Downstream of the first isolating valve the pipework shall be, as a general guide, as follows: -

1. **Liquids and Gases (At pressures up to 18 Bar)**
   12 mm OD (3/8-inch nb) solid drawn copper. Above 18 bar, install tube as in Section 10 of this standard.
2. **Steam**
   12 mm OD (3/8-inch nb) solid drawn steel tube.

3. **Combustion Air, Products of Combustion and Other Gases Normally at Low Pressures**

   15 mm OD ($^1/_2$ inch nb) mild steel tube.

4. **Gas Sampling for Analyzers**

   Solid drawn stainless-steel tube to DIN 2391. The tube size 6mm - 12mm O.D. is to be in conformity with the particular instrument requirements.

5. **Atmosphere Sensing (for extra low-pressure applications such as furnace pressure measurement**

   Mild steel tube as Section 10 of this Standard. Size will normally be 35 mm OD ($1^1/_4$ inch nb) minimum dependent on distance to sensing element.

6. **Hydraulic and Other Extra High-Pressure Applications**

   Such systems, operating in excess of 12 bar shall include pipework and fittings that conform to Section 10 of this Standard.

7. **Oxygen Pipework**

   This shall be thoroughly degreased with trichloroethylene or an equivalent grease solvent.

   Any applications outside the range of those listed above shall have their impulse piping requirements determined by agreement with EMIRATES STEEL.

   For off takes from pipes or ducts carrying dirty gases or from other locations where buildup of dust deposit and/or other materials is liable to cause blockages, pipework crosses shall be installed. These shall be used for 'rodding-out' purposes. Compression fittings shall be used with copper pipes and the olives of these shall be lightly smeared with graphite grease during assembly (but not for oxygen applications). Forged fittings shall be used with steel pipework.

8. **Orifice Plates and Venturis**

   The primary element shall be easily accessible and ample clearance around the process or utility line and the primary element shall be allowed for installation and maintenance.

   Primary elements when installed horizontally shall have a minimum vertical height of 1.0m from floor or platform level and shall preferably be located at a point where pressure and temperature conditions are reasonably constant.

   The pressure tapping's for horizontal pipes shall be located as follows: -

   For liquids: horizontal

For gases: top
For steam and other condensable vapours: horizontal

To obtain an accurate flow measurement a minimum length of straight pipe shall be provided upstream and downstream of primary elements. These shall conform to ISO/R 5167 (DIN 1952).

No thermowell shall project into the upstream pipe within 20 pipe diameters of the primary element.
Differential flowmeters (including transmitters) shall be mounted respective to the orifice fittings as follows:

Liquid service:	below
Wet or dry gas:	above
Steam or other condensable vapours:	below

A five-valve manifold of 316 stainless steel shall be located at the meter and be accessible for service requirements.

9. Magnetic Flowmeters

Detector heads and converters shall be stored in a clean dry area until required for installation and protecting covers should not be removed until erection of the equipment is imminent. They should not be stood on their end flanges. Under no circumstances should a bar be used through the detector head for lifting.

The detector head may be mounted either horizontally or vertically and it shall be supported directly by a concrete or metal cradle. Alternatively, it may be supported by the pipeline provided the latter is supported close to the detector head and can carry the additional weight. Flow may be in either direction through the unit.

There shall be at least five pipe diameters of straight pipe upstream of the detector head.

To permit checking for zero flow, the detector head shall be installed so that flow can be stopped with a full tube. Where a continuous process cannot be shut down, an isolating and bypass piping arrangement shall be installed.

The process liquid should always be at earth potential. Each side of the detector head shall be bonded to the earth terminal of the detector head and connected to the plant earthing system.

10. Temperature Sensors

A 25 mm (1 inch) nb coupling, threaded NPT female and welded into the process line or vessel, shall be provided generally for temperature measuring devices, including thermocouples, bi-metal thermometers, filled capillary systems, and resistance elements (with protective thermowell).

Thermowells shall be installed in elbows where possible in order to allow maximum stem immersion. Where this is not practicable, they may be installed in straight runs of pipe. Minimum size of pipe incorporating thermowells shall be 80 m. Thermowells are to be placed in top of horizontal lines or in 45-degree angle of vertical lines whenever possible. (See Clause 5.12).

11. Liquid Level – General Application

Standpipes are to be used to minimize the number of vessel nozzles where numerous level instrument connections are made to the same vessel.

Standpipes shall have a minimum pipe size of 50 mm (2 inch) OD and gate valves for venting and draining shall be provided. Drain valves shall be piped to drain headers. Each individual instrument shall be provided with a gate type isolating valve. The first isolating valve shall be installed as close as possible to the vessel or standpipe.

12. Level Gauges

Vessel or standpipe connections shall be 20 mm (3/4 inch) threaded NPT.

Where standard level gauge valves do not conform to the applicable Piping or Vessel Specification, gate valves shall be substituted.

13. Displacement Type Level Instruments

Level measuring instruments shall have their own dedicated vessel connections.

(a) **External Float**

50 mm (2 inch) 10.3 bar (150 lb.) RF (minimum) ANSI flanged nozzles shall be provided for externally mounted displacer type floats. The mid-range of the instrument shall be at the control level in the vessel.

(b) **Internal Float**

100 mm (4 inch) 10.3 bar (150 lb.) RF (minimum) ANSI flanged nozzles shall be provided for internally mounted displacer type floats. Provision should be made on the vessel for access to the internal parts, for example, a manhole.

14. Float Tank Gauges

Liquid level instruments should be located sufficiently far from the suction and filling lines to minimize the effect of turbulence. A stilling well shall be installed in tanks with excessive turbulence.

Outside the tank, sufficient bracing shall be provided to mount the equipment rigidly.

5.9.4 INSTRUMENT AIR SUPPLY PIPING

The main instrument air supply piping headers shall be galvanized carbon steel, in accordance with the Piping Specification. A 25 mm (1 inch) gate valve, threaded NPT female, shall be provided for all branch lines.

All main and sub-headers are to be provided with low level drain points. Header piping size shall be determined in accordance with table shown below:

Number of Outlets	**Nominal Pipe Sizes**	
	Inch	**mm**
1 – 6	$^1/_2$	15
7 – 25	1	25
26 – 50	$1^1/_2$	40
100	2	50

Individual outlets shall be 15 mm ($^1/_2$ inch) schedule 80 galvanized pipes. A 15 mm ($^1/_2$ inch) bronze gate valve shall be used at the header with a 15 mm ($^1/_2$ inch) globe valve directly ahead of the filter reducing station.

Local instruments shall be supplied with instrument air from individual air filter regulator units. Instrument air supply piping will be sized to avoid excessive pressure drops under maximum consumption conditions. The specified pressure shall always be available at all instruments.

5.9.5 SIGNAL TRANSMISSION SYSTEM GENERAL

This section describes the installation of all transmission piping between transmitters and receivers, controllers and valves and all other pneumatic devices in the instrumentation system. It also describes piping which is supplied as part of pre-assembled items such as valve positioners, pressure pilots and similar devices.

1. INSTRUMENT PNEUMATIC PIPING

All instrument piping shall be installed using a minimum number of fittings and shall be run neatly and be securely braced and bracketed. Soldered or braced connections shall not be used. Tubing shall be run with 90-degree angle bends and be continuously supported where possible. In no case shall unsupported lengths of any tubing run exceed 500 mm. Tubing shall be supported with steel angles or channels.

All tubing bends shall be made with suitable bending tools. Ends shall be cut square and be free from burrs.

Due precautions shall be taken with respect to materials used for brackets and other supports and installation methods used, to minimize the effects of galvanic corrosion.

Multi-tube bundles may be used in installations where large numbers of pipes exceed lengths over 20m. These multi-tubes shall be terminated in pneumatic junction boxes.

Instrument air piping and fittings between instrument air sub-header isolating valves and instruments, and downstream of transmitters shall be as follows: -

(a) Tubing

Single copper tubing covered by a flame-resistant PVC sheath. The tubing shall be seamless and soft annealed.

(b) Fittings

Type -compression Material -brass

(c) Multi-tube

Instrument multi-tube and fittings shall be used from junction boxes to control panels.

The multi-tubing shall consist of spiraled multiple copper number coded tubes (for maximum flexibility) covered overall by a flame-resistant PVC sheath.

The pipes shall be seamless and soft annealed 6 mm OD. Each individual copper tube shall be legibly number coded at 50 mm intervals.

Fittings shall be as for single pipes.

2. TUBING BUNDLE INSTALLATION

Instrument pneumatic pipes and multitube bundles run between the plant control room and the plant junction boxes or transmitters shall be routed overhead wherever possible, supported in cable tray.

Manufacturer's recommendations shall be followed for the specific type of tubing being installed particularly regarding the maximum allowable pulling tension and the minimum installed radius. Sufficient slack shall be allowed within the installation to take care of normal expansion and contraction of the copper tubing.

A minimum of 10 percent spare tubes shall be supplied with all tube bundles. The spare pipes shall be capped to prevent ingress of moisture or dirt.

3. PNEUMATIC TERMINATIONS

In the instrument panel or cubicle, pneumatic signal lines shall be terminated on mounting plates using bulkhead fittings.

In the plant, multicore tubing shall be terminated in a junction box similar to that used for electrical cables but provided internally with bulkhead couplings mounted in a gland plate.

To minimize the length of individual lines, the termination point of multi-core tubes shall be as close as possible to the relevant instruments.

5.9.6 INSTRUMENT CABLE INSTALLATION

1. CABLE TRAYS

Instrument cables run between the plant control room and the plant marshalling boxes and elsewhere within the plant shall be routed overhead where possible, supported in cable trays.

Cable trays shall conform to the appropriate Electrical Standard. Cable tray installation shall comply with the following: -

(a) Each run of cable tray shall be completed before the installation of cables.

(b) Supports shall be provided to prevent stress on cables where they enter or exit at tray termination points.

(c) Cable trays shall be permitted to extend through fire break partitions, walls or platforms only if adequate barriers are installed to limit fire risk.

Such barriers shall be of the multi-cable transit type consisting of a frame into which blocks may be inserted enabling cables of various diameters to be sealed.

2. SEPARATION OF CABLES ON TRAYS

The following precautions are necessary to minimize interference in signal cables: -

- Signal cables shall not be run in the same cable tray as power cables.
- Communication, control and instrumentation cables shall be run segregated from all power cables. The segregation distances shall be such as to avoid interference under all possible conditions.
- Where it is impossible to segregate cables far enough apart to avoid interference then other protective screening measures shall be taken (e.g. metal conduit or trunking installation).

3. EARTHING

Cable Installations in Hazardous Areas

Cable glands and electrical junction boxes shall be suitable for the appropriate area classification.

5.9.7 CONTROL VALVES AND DAMPER ACTUATORS ACCESSIBILITY

All control valves and damper actuators shall be installed so that they are readily accessible for maintenance purposes. Special platforms, with amply clearances for maintenance operations, shall be erected when it proves impractical to locate such devices in locations accessible from floor or other existing platform levels.

1. CLEARANCE

Sufficient clearance shall be provided above and below the control valve so that the bottom flange and plug or the top works and the plug, may be removed with the valve body in situ. Extra clearance shall be required where heat radiating fins or other accessories are used.

5.9.8 INSTRUMENT HOUSINGS

In general, all instruments located outdoors shall be installed within a weatherproof /dustproof housing unless the instrument is specifically intended to be suitable for outside installation by its manufacturer. In such cases, a sun shield shall be provided over each instrument or group of instruments.

Local instruments (transmitters, controllers and similar items) located in particularly adverse environmental positions, shall be installed within similar housings.

5.9.9 PROTECTION IN LOW AMBIENT TEMPERATURE CONDITIONS

This section covers the protection of piping and instrument equipment against temperatures which would cause interference with operation and/or damage to the instruments.

Where practical, instruments shall be installed in heated buildings to simplify protection requirements and facilitate maintenance.

Where the heating of impulse lines is necessary, full use shall be made of any process heat by including the first part of the impulse lines inside the lagging, or by installing protective covers over the process pipe, the impulse lines and the instruments. Where this is not possible, external heat sources such as steam or electrical heat tracing shall be installed in such a manner that maintenance and removal of instruments can easily be accomplished.

The use of seal liquids as an alternative to impulse line heating shall be subject to special agreement with EMIRATES STEEL.

Differential pressure instruments having factory filled bellows or diaphragm assemblies and filled system temperature instruments shall be specified with a fill material which does not require modifying for low temperature conditions.

5.10 Testing

5.10.1 SCOPE

This Section of the Standard covers the requirements for the site testing and calibration of instrumentation equipment.

5.10.2 STANDARDS

The following Standards are referred to in the text: -

ISA-RP 7.1 Latest Revision	Instrument Society of America (Pneumatic Control Circuit Pressure Tests)
CBM PE ** CC1/P: 1937	Instrument Installation Test Procedure; Council of British Manufacturers and Contractors

5.10.3 REQUIREMENTS

All equipment shall be tested at the Contractor's works and be approved before transit to site. Such works tests shall be sufficient to confirm that the equipment can meet the performance required.

Final details of both the content and extent of these tests shall be agreed with EMIRATES STEEL.

The acceptance tests shall, where possible, be carried out on site during the pre-commissioning period. These tests shall be witnessed by EMIRATES STEEL and shall be

adequate to satisfy them that the installed system and equipment are satisfactory and comply with the performance and reliability requirements.

5.10.4 METHOD OF TESTING AND CALIBRATION

The Contractor shall furnish all labour, tools, material, equipment and services required to completely commission all instruments, including control valves and analyzers prior to plant start-up. The Contractor shall perform all testing in accordance with Instrumentation Testing Procedure Document -CBM PE CC1P/1 and manufacturers' instruction manuals.

The Contractor shall provide and maintain all tools and equipment in first-class condition and in sufficient quantities to assure successful performance and completion of the required work.

If instrument air is not available during commissioning the Contractor shall supply at his own expense instrument quality air or gas from a suitable compressor and dryer or bottled dry air or nitrogen.

The Contractor shall calibrate all instruments over the full operational range and check that instruments operate to the specified accuracy. Items shall be calibrated individually and, where appropriate, as part of a loop.

The Contractor shall submit a calibration report on each instrument and loop. Each calibration report shall have a unique report serial number with coded references to plant, service, and type of measurement, as agreed with EMIRATES STEEL. Each calibration shall be made under the supervision of EMIRATES STEEL.

For primary elements such as orifice plates, venturis, thermocouples and resistance bulbs, certification from the approved manufacturer will be accepted.

All pneumatic control lines shall be tested in accordance with ISA-RP7.1 having previously been disconnected and blown through with clean, dry instrument air.

5.10.5 TEST-REPORT

At the completion of the work the Contractor will submit to EMIRATES STEEL certification that all instruments, valves and control systems have been commissioned and are in operating condition in accordance with the contract drawings and specification. The

Contractor shall also attach a signed label to all instruments so calibrated, with the date of calibration and calibration report serial number thereon.

6. SUPPORTING DOCUMENTS

NA

7. REVISION HISTORY

Issue No.	Date	Page/s	Cause of Revision
0	17.11.2019	All	First Issue