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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION FOR INSTRUMENTATION

SECOND EDITION

MAY 2009

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IN THE NAME OF GOD

FOREWORD

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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1. SCOPE

- 1.1.** This specification defines NIOEC's general requirements for the design of field instrumentation, control and safeguarding systems.

Deviations from this specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced IPS and the international standards, shall be made through written consent and approval of NIOEC.

- 1.2.** Specific specifications for major instrumentation equipment, instrument installation, material and P&ID abbreviations, legends and symbols are covered in the following NIOEC specifications:

- NIOEC-SP-70-02 NIOEC Specification for Instrument Installation
- NIOEC-SP-70-03 NIOEC Specification for Instrument Installation Material
- NIOEC-SP-70-04 NIOEC Specification for Electric Motor Operated Valves
- NIOEC-SP-70-05 NIOEC Specification for Instrumentation Control Cables, Cable Trays, Conduits, Junction Boxes and Cable Glands
- NIOEC-SP-70-06 NIOEC Specification for Bidirectional Meter Provers
- NIOEC-SP-70-07 NIOEC Specification for Instrumentation & Control System Calibration, Inspection and Tests
- NIOEC-SP-70-08 NIOEC Specification for Process Control System (PCS)
- NIOEC-SP-70-09 NIOEC Specification for Safeguarding Systems
- NIOEC-SP-70-10 NIOEC Specification for Tank Gauging Equipment
- NIOEC-SP-70-11 NIOEC Specification for Instruments Of Fire-Fighting and Detection Equipment
- NIOEC-SP-70-12 NIOEC Specification for Volumetric Liquid Measurement Methods
- NIOEC-SP-70-13 NIOEC Specification for Electrical Power Supply and Distribution Systems
- NIOEC-SP-70-14 NIOEC Specification for Control Panels and System Cabinets
- NIOEC-SP-70-15 NIOEC Specification for Control Centers
- NIOEC-SP-70-16 NIOEC Specification for General Instrumentation Factory Inspection and Testing of Instruments and Instrument Systems
- NIOEC-SP-70-17 NIOEC Specification for Instrument Protection
- NIOEC-SP-70-18 NIOEC Specification for Pipeline Instrumentation
- NIOEC-SP-70-19 NIOEC Specification for Miscellaneous Instruments
- NIOEC-SP-70-20 NIOEC Specification for Pipeline Automatic Leak Detection System
- NIOEC-SP-70-21 NIOEC Specification for Programmable Logic Controllers

- NIOEC-SD-0100-1 to 4 NIOEC Standard Drawing for P&ID Symbols and Legends
- NIOEC-SD-0101-1/1 NIOEC Standard Drawing for P&ID Abbreviations

2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor/Contractor.

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

ANSI/FCI 70-2 "Control Valve seat Leakage"

API (AMERICAN PETROLEUM INSTITUTE)

API MPMS Chapter 5.2 "Measurement of Liquid Hydrocarbons by Displacement Meters"

API MPMS Chapter 5.3 "Measurement of Liquid Hydrocarbons by Turbine Meters"

API MPMS Chapter 5.6 "Measurement of Liquid Hydrocarbons by Coriolis Meters"

API MPMS Chapter 5.8 "Measurement of Liquid Hydrocarbons by Ultrasonic Flow Meters Using Transit Time Technology"

API RP 505 "Classification of Locations for Electrical Installations at Petroleum Facilities"

API RP 551 "Process Measurement Instrumentation"

API RP 553 "Refinery Control Valves"

API RP 555 "Process Analyzers"

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

ASME B 1.20.1 "Pipe Threads , General Purpose"

ASME B 16.34 "Valves-Flanged, Threaded and Welding End"

ASME B 16.36 "Orifice Flanges"

ASME B 16.5 "Pipe Flanges and Flanged Fittings"

IEC (INTERNATIONAL ELECTRO-TECHNICAL COMMISSION)

IEC 60079 "Electrical Apparatus for Explosive Gas Atmospheres"

IEC 60529 "Classification Of Degrees Of Protection Provided By Enclosures"

IEC 60534-2-1	"Industrial-Process Control Valves – Part 1: Control Valve Terminology and General Considerations"
IEC 60534-2-1	"Industrial-Process Control Valves – Part 2-1: Flow Capacity – Sizing Equations for Fluid Flow under Installed Conditions"
IEC 60584	"Thermocouples"
IEC 60751	"Industrial platinum resistance thermometers and platinum temperature sensors"

IPS (IRANIAN PETROLEUM STANDARD)

IPS-E-IN-100 Part I	"Engineering Standard for General Instrumentation"
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ISA (INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY OF AMERICA)

ISA MC 96.1	"Temperature Measurement Thermocouples"
ANSI/ISA 7.0.01	"Quality Standard for Instrument Air"
ANSI/ISA 75.01.01	"Industrial-Process Control Valves – Part 2-1: Flow Capacity - Sizing Equations For Fluid Flow Under Installed Conditions"
ANSI/ISA 75.02.01	"Control Valve Capacity Test Procedures"
ISA 75.05.01	"Control Valve Terminology"
ISA 75.11.01	"Inherent Flow Characteristics and Rangeability of Control Valves"
ISA 75.13.01	"Method of Evaluating the Performance of Positioners with Analog Input Signals and Pneumatic Output Second Printing"
ISA 75.17	"Control Valve Aerodynamic Noise Prediction"
ANSI/ISA 75.19.01	"Hydrostatic Testing Of Control Valves"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 5167-1	"Measurement of Fluid Flow By Means Of Pressure Differential Devices Inserted in Circular Cross-Section Conduits Running Full- Part 1: General Principals and Requirements"
ISO 5167-2	"Measurement of Fluid Flow By Means Of Pressure Differential Devices Inserted in Circular Cross-Section Conduits Running Full- Part 2: Orifice Plates"
ISO 5167-3	"Measurement of Fluid Flow By Means Of Pressure Differential Devices Inserted in Circular Cross-Section Conduits Running Full- Part 3: Nozzles and Venturi Nozzles"
ISO/TR 15377	"Measurement of Fluid Flow By Means Of Pressure Differential Devices - Guideline for the Specification of Orifice Plates, Nozzles and Venturi Tubes Beyond the Scope of ISO 5167"

NAMUR (NORMENARBEITSGEMEINSCHAFT FÜR MESS UND REGELTECHNIK IN DER CHEMISCHEN INDUSTRIE)

NAMUR NE 43	"Standardization of the Signal Level for the Failure Information of Digital Transmitters"
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NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

NACE MR0103	"Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments"
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ANSI/NACE MR0175/ ISO 15156	"Petroleum and Natural Gas Industries — Materials for Use in H ₂ S-Containing Environments in Oil and Gas Production"
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NIOEC SP(NIOEC SPECIFICATIONS)

NIOEC-SP-00-10	"Specification for Units"
NIOEC-SP-00-50	"Specification for Design Criteria for Process and Mechanics"
NIOEC-SP-00-55	"Specification for Piping & Instrumentation Diagrams (P&IDs)"
NIOEC-SP-00-75	"Specification for Pressure and Vacuum Relief Devices"
NIOEC-SP-50-08	"Specification for Winterizing & Heat Conservation"
NIOEC-SP-50-54	"Specification for Pig Launching & Receiving Trap"
NIOEC-SP-90-52	"Specification for Packing and Packages"
NIOEC-SP-90-02	"Specification for Welding of Plant Piping Systems"

NIOEC-SIP (NIOEC SHOP INSPECTION PROCEDURE)

NIOEC-SIP-70-01	"Shop Inspection procedure for Instruments"
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3. UNITS

International System of Units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

4. ABBREVIATIONS

Throughout this document the following abbreviations and acronyms are used:

CV:	Control Valve.
DCS:	Distributed Control System.
ESD:	Emergency Shutdown System.
F&G:	Fire and Gas Detection.
FAT:	Factory Acceptance Test.
FS:	Full Scale
HART:	Highway Addressable Remote Transducer.
IP:	Ingress Protection.
JB:	Junction Box

LAN:	Local Area Network
NPTF:	National (American) Standard Pipe Thread Tapered Female.
NPTM:	National (American) Standard Pipe Thread Tapered Male.
P&ID:	Piping and Instrumentation Diagram.
PCS:	Process Control System.
PD:	Positive Displacement.
PTFE:	Poly Tetra Fluoro Ethylene (<i>Teflon</i>).
SGS:	Safeguarding System.
SI:	International System of Units.
SIL:	Safety Integrity Level.
SPDT:	Single Pole Double Throw.
TC:	Thermocouple
UPS:	Uninterruptible Power Supply.

5. DESIGN BASIS

5.1. General

- a) Design of the instrumentation shall be such that adequate control and safety aspects of the plant during all phases of operation are guaranteed.
- b) The instrumentation shall be designed for fail safe operation of the plant, as determined by NIOEC.
- c) All safety and relief valves, control valves and flow meters shall be adequately sized in order to enable the instruments to cope with both normal operation conditions and the conditions existing during start-up, shut-down or permissible over capacity operation. The required over capacity shall be stated on the individual data sheet.
- d) Furnaces and boilers shall be provided with approved burner management systems, when specified by NIOEC.
- e) Instrumentation for major package units shall be of the same type and manufacture as for the main process unit, except when this is not practical; in such case written approval of NIOEC shall be required.
- f) The instrumentation for minor packages such as sampling systems, air dryers, etc. should be of manufacturer's standard design and type.

5.2. Instrument Accessibility

Instrument process connections shall be designed to be located for maximum convenience for operating and servicing of the instruments. Accessibility of the instruments shall be in accordance with the requirements of NIOEC-SP-70-02.

5.3. Instrument Air Supply

- a) All tubing for field-mounted pneumatic equipment shall be PVC coated copper tube unless otherwise specified (e.g.) stainless steel for corrosive atmosphere. Fittings shall be brass. The instrument air loop header shall be galvanized carbon steel pipe up to 1.5 inch and plain carbon steel for 2 inches and above.

- b) All field mounted pneumatic instruments shall be provided with individual valves for shutting off the air supply and each instrument shall have an individual air filter/regulator and gage.
- c) The main instrument air supply shall be furnished independent of the plant air supply without interruption from other general air user requirements.
- d) Instrument air quality shall be in accordance with the ISA 7.0.01. Dew point shall be at least 10°C below the Minimum Ambient Temperature. Instrument air shall be dry and oil and dust free.

5.4. Electrical Power Supply

The plant PCS, SGS, F&G System and Packaged units' instrumentation shall be fed with at least one electrical power feeder from the UPS. The UPS, which shall be dual redundant, shall be sufficiently sized to provide 230 VAC, 50 Hz power to all connected systems for at least 30 minutes.

All field instruments shall be supplied by the internal power supplies of the PCS, SGS, and F&G Systems.

For details reference shall be made to NIOEC-SP-70-13.

5.5. Instrument Protection

Instruments shall be protected to ensure proper and dependable operation under all operational and climatic conditions.

Instruments in the following conditions require special provisions:

- i) Instruments handling fluids which solidify (or have high viscosity) at 20°C. Such fluids shall not be allowed to enter the instrument, because shop repair would be impractical.
- ii) Instruments handling fluids which solidify at the lowest ambient temperature (including water at sub-zero temperatures). Such fluids shall not be allowed to enter the instruments or pressure piping to prevent malfunctioning and/or damage.

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

- iii) Instruments in gas measurement services, where hydrate formation may occur at low temperatures, and instruments handling fluids containing solids (including coke particles). Diaphragm seals shall be utilized to protect the instruments.

In addition, for the fluids containing solids the process connection shall be made large enough to prevent plugging.

Diaphragm seals shall be shown on the P&IDs.

For detailed requirements of instrument protection, including heat tracing reference shall be made to NIOEC-SP-70-02 and NIOEC-SP-70-17.

5.6. Environmental Protection

All field equipment shall be suitable for the ambient temperature as specified in the project documents and the material and construction shall be resistant to saliferous dust, insect attacks, and moisture and fungus growth. Sunshades shall also be provided for protection against sunlight wherever required.

Outdoor equipment (instruments, panels and enclosures) shall be watertight to IEC 60529, IP 65 as a minimum. Large size outdoor local panels, for which IP 65 may not be applicable, shall be pressurized.

5.7. Hazardous Area Classification

- a) All electrical instrumentation, panels, junction boxes and enclosures, which will be installed in hazardous areas, shall generally be of intrinsically safe type suitable for the hazardous area classification. For equipment that intrinsically safe type is not available or the working supply voltage precludes the use of intrinsically safe circuits, explosion proof or pressurized type may be specified.
- b) Hazardous area classification shall be as per API RP 505 and IEC 60079.
- c) For details on instrument selection in hazardous area, reference shall be made to IPS-E-IN-100 Part I.

5.8. Data Sheets

Unless otherwise specified, ISA instrument data sheets will be used for all instrumentation.

5.9. Instruments Symbols and Legends

Reference shall be made to the following documents:

NIOEC-SD-00-0100-1 to 4 "Standard Drawing for P&ID Symbols and Legends",

NIOEC-SD-00-0101-1/1 "Standard Drawing for P&ID Abbreviations".

6. FIELD INSTRUMENTATION

6.1. General

6.1.1. Transmitters

- a) Transmitters shall be smart type, commensurate with the type of the PCS, i.e., 4-20 mA type (HART support), Foundation Fieldbus or Profibus compatible type. Integral digital indicators shall be supplied for each transmitter.
- b) All transmitters (pressure, flow, temperature etc.) shall be provided with burnout protection.
- c) Alarm (burnout) and saturation current limits shall be NAMUR-NE-43 compliant as follows:
 - i) If the process variable applied to the transmitters falls outside of the lower or upper range settings, the output signal shall saturate at the following values:
 - ii) Under range; 5% of transmitter lower range

- iii) Over range: 2.5 % of transmitter upper range
- iv) The integral indicator shall flash to signify the "out of range" reading.
- v) In case of transmitter failure, the output shall be driven to less than 10 % of lower range or greater than 5% of upper range (user configurable), with the integral indicator displaying "Alarm" to indicate the failure status.
- d) Selection of transmitters shall be subject to their performance characteristics including the low figure of long term full scale drift, low figure of full scale temperature effect, their insensitivity to vibration, repeatability, hysteresis and overrange protection. The pressure and differential pressure instruments having diaphragm seals shall have high "spring rates" to minimise the error due to seal liquid expansion at elevated ambient temperatures.

6.1.2. Switches

Field mounted transmitters should be used in lieu of field mounted switches according to the following:

- For SGS services, SIL III transmitters shall be used.
- In case of voting systems, transmitters of types other than SIL III may be used.
- For PCS and alarming services appropriate type of transmitters or switches may be used.

6.1.3. Signal Levels

- a) All field mounted transmitters in connection with the plant PCS shall operate on 24 VDC, 4-20 mA signals and shall support HART protocol if PCS is of conventional DCS type, and shall operate on the appropriate digital signals if the selected PCS is of Fieldbus type (e.g. Foundation fieldbus or Profibus).
- b) All field mounted transmitters in connection with the plant SGS shall operate on 24 VDC, 4- 20 mA signals and shall support HART protocol.
- c) Field mounted switches, if any shall operate on 24 VDC, volt free contacts.
- d) Solenoid valves shall be intrinsically safe type operating on 24 VDC.
- e) Local loops, i.e., those not required to be connected to the PCS shall be pneumatic, operating on 0.2-1.0 Barg signal.
- f) Digital (serial) communication between field sensors and SGS shall be prohibited. For detailed requirements, reference shall be made to NIOEC-SP-70-09 section 9.1.

6.1.4. Power Supply

- a) The 24 VDC power to all field instruments shall always be supplied by the plant PCS and/or SGS. As such all transmitters shall be of "current sinking" type.

6.1.5. Accuracy of Instruments

Instruments shall conform to the following accuracies, unless otherwise specified in the detailed specification approved by company.

Instrument	Accuracy
Temperature Gauge	$\pm 1.0\%$ F.S. or Class 1 per EN 13190
Pressure Gauge	$\pm 1.0\%$ F.S.
Variable Area Flow Meter	$\pm 2.0\%$ F.S. $\pm 4.0\%$ F.S. (Metal tube purge meter)
Displacement Type Level Transmitter	$\pm 0.5\%$ F.S.
Pressure / DP / Temperature Transmitter	$\pm 0.2\%$ F.S.
Positive Displacement Type Flow Meter	$\pm 0.2\%$ of reading at relevant flow condition
Thermocouple	Class 1 as per IEC 60584
RTD	Class A as per IEC 60751
Mass Flow Meter	Better than $\pm 0.2\%$ of full scale (at liquid base)
Guide wire radar meter	± 3 mm (less than 10m) $\pm 0.03\%$ of measuring range (over 10m and less than 30m)
A/D Converter (cabinet mounting type)	$\pm 0.1\%$ span
D/A Converter (cabinet mounting type)	$\pm 0.3\%$ span
FF/P Signal Positioner	$\pm 0.5\%$ (for linearity)

6.1.6. Instruments Cable Entry

Instrument cable entry size shall be M20×1.5 for single pair cable connection with the appropriate cable gland. For instruments with other than single pair cable connection, appropriate size with the cable gland shall be specified.

6.1.7. Material

- a) All instrument wetted parts in connection with the process shall generally be AISI 316, unless higher grades are required by the process conditions. Instruments wetted part material in sour services shall comply with NACE standard MR0175.
- b) Unless otherwise specified in this document, material of Control valve bodies, ESD valve bodies, Orifice flanges, in-line flow instruments flanges and displacer type level instrument flanges shall conform to the piping flange/valve materials in accordance with the related NIOEC Piping Specification.

6.1.8. Pressure/Temperature Rating of Instruments and Valves

Minimum rating of inline instruments and control/safety valves shall be in accordance with the piping specification. However rating of orifice plates and orifice flanges, body and flanges of control valves, ESD valves and On/Off valves shall be ANSI 300 # minimum.

6.1.9. Impulse Lines

- a) In general, in ANSI flange class 300 and 600 services, all instrument impulse lines (hook ups) downstream of the first process isolating valve, shall be ½ inch OD, 316 Stainless Steel seamless tubing with wall thickness of 0.065 inch minimum, and 316 Stainless Steel, bar stock double-ferrule compression type fittings. Byte type fittings are not permitted.

- b) For ANSI flange class of above 600 , or cases where the impulse lines (hook ups) are subject to physical expansion, or the line classes as specified in NIOEC-SP-70-03, impulse lines (hook ups) shall be ½ " OD, seamless pipes.
- c) For service with pressure of greater than 40 Barg, fully butt-welded construction with heavy wall tubing or line pipe shall be provided.
- d) Tubing diameter for analyzer fast loop shall be selected considering the lag time calculation.

6.1.10. Manifold valves

- a) In addition to the process (or piping) isolation valve at the measurement take-off point, each pressure instrument (except diaphragm seal) shall be provided with a dedicated manifold valve to enable maintenance, in-site calibration, venting and draining. The manifold valves shall be provided as follows:
 - 2-valve for pressure gauges, pressure transmitters and switches.
 - 3-valve (double block and bleed type) for pressure gauges, pressure transmitters and switches in services of ANSI Class 900 and above.
 - 5-valve for DP type transmitters
- b) Process connection of the manifold valves shall be ½ inch NPTF. However but welded NPT connection may also be required as per project requirements.
- c) The manifold valves on Pressure and differential transmitters shall be bracket mounted type with the base bracket mounting holes such that the instruments can be directly connected to the manifold valves by flush mounting, and the assembly can be installed and supported on 2" stanchions by bracket mounted manifolds.
- d) As a minimum, material of the manifold valves shall be AISI 316 stainless steel.

6.1.11. Process Isolation Valve

Process isolating valves shall be sized as follows:

- a) Pressure Gauges, pressure switches, pressure transmitters on process lines: Globe valve, ¾ inch.
- b) Pressure Gauges, pressure switches, pressure transmitters on vessels: Flanged Globe valve, 1 inch.
- c) Orifice Plate isolating valves: Gate valves, ½ ", and Globe valve ½ " for ASME flange class 900 and above.
- d) Side mounted external displacer type level transmitters: Flanged Gate valve, 1-1/2 inches.
- e) Top mounted internal displacer type level transmitters or level switches: 6 inches flanged Gate valve (if specifically required in the project specification),
- f) Side mounted external displacer type level switches: Flanged Gate valve, 1 inch.
- g) Level gauges: Flanged ¾ inch gate valve on standpipes, and 1 inch flanged gate valve on direct vessel connections. For hydrogen service, the valve shall be 1 inch flanged gate valve, both on standpipe and on vessels. Level gauges shall be connected to the isolating valves through automatic gauge valves.

h) All level instruments except level gauge connections on 3" standpipe shall be the same as that of direct to vessel connections.

The process isolating valves are within the battery limit of the Piping discipline and the Instrument discipline battery limit starts at downstream of the valves.

6.1.12. Instrument to Process Connection

The following table shall be conformed for instrument to process connection size and type:

		Connection to Equipment				Instrument Connection	
		Vessel		Pipe		Size	Type
		Size	Type	Size	Type		
Pressure/DP Transmitter	Without Diaphragm Seal	1"	Flanged ¹	3/4"	Compression Fitting ²	1/2"	NPT
	With Diaphragm Seal	2"	Flanged	(1" , 1 1/2" , 2") ³	Flanged	1/2"	NPT
Pressure/DP Gauge or Switch	Without Diaphragm Seal	1"	Flanged ¹	3/4"	Compression Fitting ²	1/2"	NPT
	With Diaphragm Seal	1 1/2"	Flanged	(1" , 1 1/2") ³	Flanged	1/2"	NPT
Level Displacer Transmitter	External Side Mounted	1 1/2"	Flanged	-	-	1 1/2"	Flanged
	Internal Side Mounted	4"	Flanged	-	-	6"	Flanged
	Internal Top Mounted	6"	Flanged	-	-	6"	Flanged
DP Level Transmitter	Without Diaphragm Seal	1"	Flanged	-	-	1/2"	NPT
	With Diaphragm Seal	2"/3"	Flanged	-	-	1/2"	NPT
Level Gauge		1"	Flanged	-	-	1"	Flanged
Level Switch	External Displacer/ Float Type Side Mounted	1"	Flanged	-	-	1"	Flanged
	Internal Displacer/ Float Type Side Mounted	4"	Flanged	-	-	4"	Flanged
	Internal Top Mounted	4"/6"	Flanged	-	-	4"/6"	Flanged
Level Standpipe		3"	Flanged	-	-	-	-
Tank Gauging	Radar Level Transmitter	6"/8"	Flanged	-	-	-	-
	Thermo Element	4"	Flanged	-	-	-	-
DP Flow Transmitter		-	-	3/4"	Compression Fitting ²	1/2"	NPT
Thermo-well		1 1/2"	Flanged	1 1/2"	Flanged	1/2"	NPT

1- Connection to flanged globe isolating valve will be by blind flange with 1/2" threaded hole instrument hook-up tubing connection.

2- Connection to globe isolating valve will be by 3/4" NPT x 1/2" O.D. male connector (Compression Fitting) for instrument hook-up tubing connection.

3- Diaphragm seal type pressure gauge/transmitter on pipe connection size shall be specified according to diaphragm seal application and process requirements.

6.1.13. Instrument Nozzle Rating on Vessels

Minimum flange rating for instrument nozzles on vessels shall be as follows:

- a) Level instrumentation standpipes: ANSI 300 #.
- b) Pressure relief valve: ANSI 300 #.
- c) All nozzle sizes equal or lower than 1-½ inches: ANSI 300 #.

6.1.14. Welding

Any welding work related to the instrumentation shall be in accordance with NIOEC-SP-90-02.

6.1.15. Local Indicators

- a) Pressure switches (if any), back pressure valves, pressure reducing valves, pressure balanced type valves and blind type pressure transmitters or controllers (if any) shall be specified with local gauges mounted in proximity.
- b) If a transmitter or any of the above mentioned instruments, serving a control valve, has an integral indicator or a local gauge not readable from the location of the control valve, a supplementary readable indicator or gauge shall be provided.
- c) On all control loops connected to the PCS, and all transmitters connected to the SGS, a local gauge, i.e., pressure, temperature or level gauge, shall be provided and installed adjacent to the control loop transmitter, to verify transmitter reading.

6.1.16. Diaphragm Seals

- a) A diaphragm seal system consists of a pressure transmitter, one or two diaphragm seals, a fill fluid, and either a direct mount or capillary style connection Transmitter. Diaphragm seal systems should be considered when:
 - The process temperature is outside of the normal operating ranges of the transmitter and cannot be brought into those limits with impulse piping.
 - The process is corrosive and would require frequent transmitter replacement or specific exotic materials of construction.
 - The process contains suspended solids or is viscous and may plug the impulse piping.
 - The application requires the use of sanitary connections.
- b) All pressure elements with diaphragm seal shall have capillary bleeder. The entire system above the diaphragm, including the element shall be evacuated and entirely filled with an inert liquid. The bottom section shall be removable for cleaning.
- c) Where remote diaphragm seals are used, the capillary tube shall be stainless steel 316 with stainless steel 304 armor as a minimum. Seal liquid shall be selected such that the adverse effect of ambient temperature change be kept to the minimum possible.
- d) Where flush mounted diaphragm seals are used, a flushing ring with two 1/2" NPTF connections shall be provided for flushing valves connection.