

NORSOK STANDARD
COMMON REQUIREMENTS
FIELD INSTRUMENTS

I-CR-001

Rev. 1, December 1994

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1 FOREWORD

This standard has been developed by the NORSOK standardisation work group and agreed by the Norwegian industry for the widest possible national and international application.

Annex A is normative.

2 SCOPE

The standard identifies the requirements to field instrument design. It should be read in conjunction with I-CR-002 "Instrument Systems" and I-CR-003 "Installation of Electrical, Instrument and Telecommunication" as these standards deal with common instrument/electrical requirements.

3 NORMATIVE REFERENCES

ANSI B16.10	Face-to-face and end-to-end dimensions of valves.
ANSI B16.36	Steel orifice flanges
ANSI/FCI 70-2	Control valve seat leakage.
ANSI/ASME B1.20.1	Pipe threads general purpose (inch.)
API RP 520	Sizing, Selection, and Installation Of Pressure-Relieving Devices in Refineries, Part I and II.
API RP 526	Flanged steel safety relief valves.
API RP 527	Seat Tightness of Pressure Relief Valves.
API RP 670	Vibration, axial position and bearing temperature system.
API RP 678	Accelerometer-based Vibration Monitoring System.
ASME	Boiler and pressure vessel code - Section VIII, Div. 1.
ASME	Power Test Code 19.3-74 Thermowell strength calculations. Part 3.
BS 2915	Bursting Discs and Bursting Disc Devices
EN 50081-2	Electromagnetic compatibility generic emission standard
EN 50082-2	Electromagnetic compatibility generic immunity standard
IEC 534-2	Industrial process control valves. Part 2, section 1 and 2.
IEC 584-1	Thermocouples
IEC 751	Resistance Temperature Detectors (RTD)
ISA 75.01	Flow equations for sizing control valves.
ISO 1000 SI	Units and recommendation for the use of their multiples and of certain other units.
ISO 5167	Measurement of fluid flow by means of pressure differential devices - Part 1.

4 DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

The term instruments also includes actuated valves and safety valves.

4.2 Abbreviations

IFEA	Industriens Forening for Elektroteknikk og Automasjon (The Association for Electrotechnics and Automation in Industry)
LER	Local Equipment Room
SI	System International
HVAC	Heating, Ventilation and Air Conditioning
IR	Infra Red
UV	Ultra Violet
NPT	National Pipe Thread
RTD	Resistance Temperature Detector

Engineering units

Pressure	Bar
Level	% (normally related to min. and max. operational level)
Flow	Sm ³ /h (gas) - m ³ /h (liquid)
Temperature	°C

For other physical properties, SI units shall be utilized as per ISO 1000.

Instrument data sheets

IFEA Data sheets shall be used (Annex A).

5 FUNCTIONAL REQUIREMENTS

5.1 Instrument Supplies

Electrical supply to instrument panels in LERs: 230V a.c. 50 Hz (standard) or 24V d.c.

Electrical supply to field instruments: 24V d.c.

Electrical supply to instrument field panels: 24V d.c. (standard) or 230V a.c. 50 Hz.

Pneumatic main ring supply: Minimum 7 barg, maximum 10 barg.

Pneumatic instrument supply: 1.4 barg (standard) or as required.

Hydraulic main ring/instrument supply: Minimum 180 barg, maximum 210 barg.

Hydraulic supply for wellhead/downhole depending on reservoir pressure.

5.2 Signal Types

The following signal types shall be used:

Analogue input/output : 2 wire, 4 - 20 mA.

Digital input : Potential free contact.

Digital output: 24 VDC.

Signals between platform control system and other panels: Powered from platform control system.

Signals between instrument and electrical panels: Powered from instrument panels.

Position: Proximity switches with NAMUR interface.

Pneumatic signals: 0.2 - 1.0 barg.

Instrument field bus/digital communication may be used if the concept demonstrates economical savings and requirements to time response are satisfied.

5.3 Instrument Design Principles

Instrument performance/accuracy shall be sufficient to fulfill process/unit performance requirements.

Variation of instrument types and ranges (e.g. thermowell lengths/transmitter ranges) shall be kept to a minimum.

Analogue instruments shall be used for switch functions.

Smart type transmitters should be used. For each installation, the transferring protocols shall be harmonized.

Galvanic isolation barriers, preferably with full smart signal transmission capability, shall be used for I/O-signals.

For simple local control purposes only, the field instruments including controllers may be of a pneumatic type.

Local indicators and transmitters shall be combined with integral indication. Separate local indicators shall only be installed where local manual interaction is required.

Instruments shall meet requirements to EN 50081-2 and EN 50082-2 regarding electromagnetic compatibility.

Flange connection for inline instruments shall follow piping class and specification.

Pressure vessel design (e.g. accumulators for on/off valves) shall follow relevant NORSOK standard.

The most frequently used measuring principles (temp. measurement etc.) are specified in separate sections of this document. Other types may be used on special applications.

For field instruments not specifically dealt with in this standard, the design shall be based on recognized international standards where applicable.

5.4 Instrument Installation Design Principles

Pressure sensing instruments that can be clogged due to high viscosity fluids or hydrates or if the measurement can be affected by other factors, shall be equipped with chemical seals.

Pressure instruments should have individual process isolation valves.

Combined solutions may be used when not causing operational disadvantage/safety reduction during service of instruments etc.

Each pressure instrument with process connection should be fitted with instrument block manifold (2/5-valve).

Package suppliers shall terminate hydraulic and pneumatic tubing at skid edge with bulkhead male connectors or bulkhead unions.

Package suppliers should terminate instrumentation for project cable connection in junction boxes/panels at skid edge.

If functionality can be fulfilled, the following shall apply:

Field instrument process connection: 1/2 " NPT female.

Field instrument pneumatic connection : 1/4 " NPT female.

Field instrument hydraulic connection: 1/2" NPT female.

Field instrument cable entry: M20x1.5 ISO.

5.5 Instrument Materials

For instrument materials, the following apply:

- Control valves, safety valves and turbine meters.
 - Body according to piping material.
 - Internals according to vendor recommendation.
- Flow elements, temperature wells etc.
 - According to piping materials, but minimum 316 stainless steel.
- Offline instrumentation.
 - Tubes, tube fittings and bulk material: 316SS shall be used. Reduction of temperatures on dead legs shall be taken into account. Where 316SS still can not be used due to environmental and process conditions, titanium should be used.
 - Instruments: Housing shall generally be in sea water resistant material. Process wetted parts shall minimum be 316SS. For special services, vendor recommended material shall be used.

5.6 Air Supply Design

For users requiring filtered ring main pressure air supply, two air filters with isolation valves shall be provided in parallel before a distribution manifold.

For users requiring filtered reduced air supply, two air filter regulators with isolation valves shall be provided before a distribution manifold.

Each branch off shall be provided with a 1/2" isolation valve.

Minimum two spare branch offs with valve and plug shall be provided for each manifold.

Simplified air supply arrangements may be used for few and/or noncritical consumers.

5.7 Instrument Installation Bulk Materials

The selected compression tube fitting make shall be used throughout the whole installation.

Pressure ratings for compression tubes, tube - and pipe fittings, instrument valves and manifolds shall comply with the corresponding process requirements.

Tubing shall be in metric sizes.

Compression tube fitting threads: NPT to ANSI/ASME B1.20.1.

Standard tube sizes:		
Signal air, impulse tubing, instrument air supply to instruments and hydraulic supply	(below 413 barg):	10x1.5 mm
Signal air, impulse tubing, instrument air supply to instruments and hydraulic supply	(above 413 barg):	10x2 mm
Instrument air supply:		25x1.5 mm

The Supplier shall use the standard tube sizes and shall evaluate and advise if other outside diameters are required for any reason.

5.8 Temperature Measurements

5.8.1 General

Temperature measurements shall be performed by PT 100 RTD's/transmitters according to IEC 751.

Temperature transmitters shall be included within the sensor head except for motor winding temperature measurement and similar.

For temperature measurements above 600 degrees C, thermocouple material Chromel-Alumel, type K, in accordance with IEC 584-1 should be used.

Surface mounted temperature elements may be used if accuracy requirements are met.

5.8.2 Thermowells

Thermowells shall be of the flanged type, 1" or 2" (above pressure class 2500 and vessels).

For non-critical utility service, thermowells of threaded type can be accepted.

Thermowells shall not be longer than strictly necessary to obtain required accuracy and to avoid vibration "cracking".

Thermowell strength calculations shall be performed for process hydrocarbon systems according to ASME PTC 19.03.74 part 3, chapter 1.12 to 1.19 or equivalent.

Thermowell inner diameter suitable for TE/TI elements of 6 mm should be used.

5.8.3 Temperature gauges

Bi-metallic dial temperature gauges (diameter generally max. 100mm) shall be used for local indication.

Temperature gauges with capillary tubing should not be used.

5.9 Flow Measurements

5.9.1 General

Principle of orifice measurement should be evaluated for flow measurement for hydrocarbon liquid/gas, water and steam. However, measuring principles shall be selected according to application:

- high accuracy requirements.
- high rangeability requirements.
- low pressure-drop requirements.
- dirty fluids.
- large pipe sizes.
- low flows.

5.9.1 Orifice plates

Orifice plate shall be calculated, manufactured and installed according to ISO 5167.

Straight length requirements shall as a minimum satisfy the "0.5 additional uncertainty" requirements.

Welded neck orifice flanges to ANSI B16.36 with flange tapping is standard.

The orifice plates shall be stamped with tag. No and flow direction.

5.10 Pressure Measurement

5.10.1 General

If pulsating pressure is likely to occur, a pulsation dampener shall be used.

5.10.2 Local indicators

Local indicating pressure gauges shall be of the heavy duty, liquid filled Bourdon type with safety glass and with blowout device.

Pressure gauges should have housing diameter of max. 100 mm, bottom connection.

The pressure gauge shall be overpressure protected to min 130 % of range.

5.11 Level Measurement

5.11.1 General

Measuring principle shall be selected according to application.

Direct vessel mounted instruments with non-moving parts should be used.

Typical principles are:

- Direct flange mounted pressure/diff. pressure transmitters.
- Ultrasonic.
- Capacitive.
- Radioactive.
- Vibration forks.
- Microwave.

5.11.2 Local level indicators (Gauges)

Level gauges shall cover maximum and minimum operational levels.

Gauges with magnetic indicators should be used for hydrocarbon service.

If reflex and transparent type gauges are used, they shall have forged steel coloumn and toughened glass.

Level gauge glasses shall have flanged connections and shall be fitted with gauge valves including quick closing ball check valves.

The installation shall be fitted with process isolation, drain and vent valves complying with the piping and valves section.

Simpler solutions may be used on small and noncritical vessels.

5.12 Control Valves

5.12.1 Valve requirements

Sizing of control valves shall be made in accordance with the IEC 534/ISA 75.01 standards and/or the control valve Supplier's sizing computer program.

Globe valves should be used but depending on service conditions and application other types may be used.

The size of valves should be 1, 1.5, 2, 3, 4, 6, 8, 10 inch and higher.

When requirements to max. allowable leakage rate has to be set, ANSI/FCI 70-2 shall be applied.

Face to face dimensions shall be according to ANSI B16.10.

Arrow indicating direction of the flow shall be permanently marked on each side of the valve body.

Self-acting control valves shall be used only when a sufficient differential pressure exists.

5.12.2 Actuator requirements for control valves

Spring return pneumatic diaphragm/piston type actuators should be used.

Where service condition or valve design exclude the use of above mentioned principle, double acting pneumatic piston actuators should be applied.

Hydraulic or electric actuators may be used for special applications.

Actuator failure mode shall accomplish the valve position required (safe operating condition).

Use of a positioner shall be avoided if not required for the control application considering time-lags, non-balanced valves, split range, service, etc.

Electro/pneumatic positioners should be used for remote control.

5.13 Solenoid Valves

Solenoid valves shall not be used for direct operation in pipes with process media.

Solenoid valves should be used in signal/impulse lines for air and hydraulic.

5.14 Pressure Relief Valves/Busting Discs

All the pressure relief valves shall be sized in accordance with the information on the data sheet and the method outlined in API RP 520, part I and II, for sizing of pressure relief valves for hydrocarbon systems.

Flanged steel safety relief valves for hydrocarbon systems shall conform to API 526.

All relief valves for hydrocarbon systems shall have approval according to ASME (ASME Boiler and pressure vessel code).

Seat tightness of pressure relief valves shall conform to API 527.

The total effective flow area of the orifice(s) selected shall exceed the calculated area only by an amount as limited by standard orifice sizes available.

Before orifice sizes Q, R and T are implemented, the relief valve manufacturer shall critically evaluate these large sizes against process medium/conditions.

The number of relief valves shall be kept to a minimum in a multiple safety valve installation.

In a multiple safety valve installation, all orifices shall be equal.

Design, sizing and approval of relief valves for utility systems shall be done to a recognized international standard/institution.

Bursting discs shall be designed according to BS 2915 or equivalent.

5.15 On/Off Valve Actuators

Single-acting spring return operated actuators should be used for shut-down valves.

Hydraulic or pneumatic (at pneumatic main ring supply pressure) actuators may be used.

Double-acting actuators may be used when this proves beneficial based on an evaluation including weight, space and price. Hydraulic actuators should be used.

At nominal supply pressure the actuator's torque/thrust shall be 25% above maximum torque/thrust required at max differential pressure across the valve.

The actuator shall be provided with a local indicator showing the valve position.

Actuator failure mode shall accomplish the valve position required (safe operating condition).

Hydraulic accumulators shall be of the piston type, nitrogen charged, with piston position detection possibility.

Hydraulic accumulators, if needed, should be mounted integral with the valve control unit.

The valve control unit shall be installed close to the valve.

Devices for control of the speed in both directions shall be installed on the control unit. It shall not be possible to fully close the restrictors.

Electrical actuators may be used for non safety applications.

5.16 Choke Valves

Remote operated production choke valves should be provided with stepping actuator.

Each step for both directions shall be equal in length.

Manual operation in both directions shall be possible.

5.17 HVAC Actuators

Actuators for HVAC shut-off and fire dampers shall be of spring return type.

Pneumatic HVAC actuators shall be designed to operate properly between max 12.5 barg and min 5.6 barg air supply pressure.

The spring force shall be selected to keep the blade(s) in proper alignment, ensure air tightness in closed position and prevent chattering.

Actuators for HVAC pressure control dampers shall be provided with positioners.

5.18 Vibration Field Equipment

Vibration/proximity probes for vibration detection shall conform to API RP670 and API RP678 as relevant. Electrical installation shall conform to NORSOK installation standard I-CR-003 .

5.19 Fire & Gas Equipment

Fire and Gas detectors may be of the smart/addressable (e.g. field bus) type.

5.19.1 Smoke detectors

Detector shall not be sensitive to water-steam.

The application shall determine the detection principle to be used.

Very early smoke detection system (aspirating) may be used for cabinets in LER's.

5.19.2 Heat detector

Heat detectors shall not be installed unless no other detection principle can be utilized.

5.19.3 Flame detector

Detector shall be of the IR or combination IR/UV type.

Application shall determine the type to be used.

5.19.4 Gas detector

Line detectors (open path) shall be evaluated in combination with point detection.

Application shall determine the right principle (catalytic/infrared).

6 INFORMATIVE REFERENCES

None

ANNEX A INSTRUMENT DATA SHEETS (IFEA-IDAS) (Normative)

Instrument Data Sheet	Corresponding Process Data Sheet	
A01	ANALYSER	PR4
E01	RUPTURE DISK	PR3
F01	TURBINE AND POSITIVE DISPLACEMENT FLOWMETER	PR4
F02	ULTRASONIC AND VORTEX FLOWMETER	PR4
F03	MAGNETIC FLOWMETER	PR4
F04	VARIABLE AREA FLOWMETER	PR4
F05	MASS FLOWMETER	PR4
F06	PITOT TUBE AND ANNUBAR	PR4
F07	ORIFICE FLANGES AND PLATES	PR4
K01	INDICATING LAMP	NA
K02	INDICATING METER	NA
K03	POTENTIOMETER	NA
K04	PUSHBUTTON/HANDSWITCH	NA
I01	I/P AND P/I CONVERTERS	PR4
I02	PNEUMATIC CONTROLLER	PR4
L01	LEVEL INSTRUMENT ELECTRIC	PR6
L02	LEVEL INDICATOR	PR6
L03	LEVEL GLASS	PR6
P01	PRESSURE INSTRUMENT ELECTRIC	PR5
P02	PRESSURE INDICATOR	PR5
S01	FIRE AND GAS DETECTOR	PR5
T01	THERMOWELL	PR4
T02	TEMPERATURE INSTRUMENT ELECTRIC	PR5
T03	TEMPERATURE INDICATOR	PR5
V01	BLOCK VALVE HYDRAULIC/PNEUMATIC ACTUATOR	PR2
V02	CONTROL VALVE HYDRAULIC/PNEUMATIC ACTUATOR	PR1
V03	SOLNOID VALVE	PR1

V04	SAFETY/RELIEF VALVE	PR3
V05	BLOCK VALVE - ELECTRIC ACTUATOR	PR2
V06	CONTROL VALVE - ELECTRIC ACTUATOR	PR1
Y01	VIBRATION MONITORING INSTRUMENTS	PR5
Y02	WEIGHT LOSS PROBE	PR4
Z01	POSITION/DISPLACEMENT INSTRUMENT	PR5
X01	MISCELLANEOUS INSTRUMENT	NA

Process Data Sheet

PR1	CONTROL VALVE
PR2	BLOCK VALVE
PR3	SAFETY/RELIEF VALVE
PR4	INLINE/FLOW INSTRUMENT
PR5	LOCALLY MOUNTED INSTRUMENT
PR6	LEVEL INSTRUMENT