







Technical Standard No. FB-J-5401

FIREBAG PROGRAM PROCESS INSTRUMENTATION AND CONTROL SPECIFICATION

SUNCOR ENERGY INC.

CANADA

1	5-Sep-06	Issued for Implementation				
Rev	Date	Document Status	Originator	Engineer	Reviewer	Approver

TECHNICAL STANDARD

Subject:

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Number:

FB-J-5401

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1**REVISION HISTORY**

Rev	Date	Description
1	5-Sep-06	Issued for Implementation
B	23-Nov-05	Issued for Internal Squad Check
A	22-Sep-05	Draft – Issued for Review
This Standard is based on Suncor Energy Inc. Standard No.0401 Rev.4 and has been developed specifically for use on Firebag Projects.		

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1.0 GENERAL

1.1 SCOPE

This standard defines the general standards to be used for the engineering, design, and application of process instrumentation and control systems to be provided for Suncor Energy Inc. Firebag Program facilities located at Fort McMurray, Alberta.

- 1.1.1** Note: API Recommended Practices listed shall be used as the basis of Suncor Firebag Program Technical Standard FB-J-5401 Process Instrumentation and Control Specification except as noted herein. Paragraph numbering is consistent with referenced API Standards. API referenced standards are:

API RP 551	Process Measurement Instrumentation, May 1993
API RP 552	Transmission Systems, October 1994
API RP 553	Refinery Control Valves, September 1998
API RP 554	Process Instrumentation and Control, September 1995

Additions are made only to the sections or paragraphs where an exception is taken or supplementary information is added. A continuation of the sub-paragraph numbers beyond those employed in the standards, indicate a supplement to that paragraph. Each Standard or Practice is treated separately with an overall Title Heading identifying the referenced document and in the same order listed above.

1.2 RELATED PUBLICATIONS AND STANDARDS

Delete
NFPA 70 National Electrical Code

Replace Remainder with:

ANSI

B40.1 Direct Reading Pressure Gauges

ANSI ISA

5.1 Instrumentation Symbols and Identification

84.01 Application of Safety Instrumented Systems for the Process Industries

API

MPMS 4 Proving Systems

MPMS 5 Liquid Metering

MPMS 5.1 General Considerations for Measurement by Meters

MPMS 5.2 Measurement of Liquid Hydrocarbons by Displacement Meters

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MPMS 5.3 Measurement of Liquid Hydrocarbons by Turbine Meters
MPMS 5.4 Accessory Equipment for Liquid Meters
MPMS 6 Metering Assemblies
MPMS 14.3-1 Orifice Plate Detail
MPMS 18 Custody Transfer

API

RP 2350 Overfill Protection for Petroleum Storage Tanks

ASME

PTC 19.3 Temperature Measurement
MFC-3M Measurement of Fluid Flow in Pipes

ASTM

A632 Specifications for Seamless and Welded Annealed Tubing for General Service

CSA

B51 Boiler, Pressure Vessel, and Piping Code, Part 1, 2 and 3
C22.1 Canadian Electrical Code

IEC 61511-1 (2003-01) Functional Safety – Safety Instrumented Systems for the process industry sector – Part 1: Framework, Definitions, System, Hardware And Software Requirements

IEC 61511-2 (2003-07) Functional Safety – Safety Instrument Systems for the process industry sector – Part 2: Guidelines For The Application of IEC 61511-1

IEC-61511-3 (2003-03) Functional Safety – Safety Instrumented Systems for the process industry sector – Part 3: Guidance For The Determination Of The Required Safety Integrity Levels

Suncor Firebag Technical Standards

FB-J-5400 Instrumentation & Controls Design Criteria
FB-J-5402 Instrument Identification and Numbering
FB-J-5403 Instrument & Control Panels
FB-J-5404 Instrument Installation
FB-J-5405 Instrument Inspection, Calibration and Test Procedures
FB-J-5406 Instrumentation for Package Units Vendor's Instructions
FB-J-5411 Fired Heaters Instrumentation
FB-J-5413 Indicating Pressure Gauges
FB-J-5420 Instrument Cable, Wire, Junction Box, and Rack Numbering
FB-J-5421 Basic Process Control System (BPCS)
FB-J-5426 Safety Instrumented Systems (SIS)
FB-L-5201 Piping Design and Plant Layout

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FB-L-5202	Piping Material Specifications
FB-L-5203	Valves
FB-P-5501	General Electrical Design
FB-P-5506	General Electrical Installation Requirements
FB-P-5511	Electric Heat Tracing

Suncor Standard Sketches

513-13	API Plan 52 Systems for Dual Mechanical Seals with Non-Pressurized Buffer Fluid
513-14	API Plan 53 Systems for Dual Mechanical Seals with Pressurized Barrier Fluid
54-45-10	Standard Sheath Type Thermocouple Assembly

1.3 UNITS OF MEASUREMENT

For non Upgrader projects, refer to the units for that plant. The units of measurement to be used for Upgrader Projects are as follows:

Hydrocarbon Liquid Flows	Sm ³ /h or SI/min (at Barometric Pressure and 15°C)
Water Flows	Sm ³ /h or SI/min (at Barometric Pressure and 15°C)
Gas Flows	Sm ³ /h (at Barometric Pressure and 15°C)
Steam Flows	kg/h
Process Levels	0-100% or actual value (meters to 1/100 resolution)
Tank Levels	Meters to 1/1000 resolution (mm)
Pressure	kPag
Temperature	°C
Viscosity	cP
Density	kg / m ³
Calibrated D/P Range	mm W.C. or mm H ₂ O

1.4 PROCESS MEASUREMENT INSTRUMENTATION - GENERAL

1.4.1 Instruments in direct contact with the process medium shall have a valid Canadian Registration Number (CRN) for the province of Alberta.

1.4.2 All instruments shall be Canadian Standard Association (CSA) approved for the Electrical Area Classification in which they are installed.

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- 1.4.3** Where practical foundation fieldbus compatible instrumentation shall be utilized for the Basic Process Control System (BPCS) I/O. Loop powered, 4-20 mA_{dc}/Hart compatible instrumentation shall be installed for the Safety Instrumented System (SIS) I/O and where fieldbus compatible instrumentation is unavailable. The use of foundation fieldbus instrumentation for safety system applications is not permitted.

1.5 ELECTRICAL

1.5.1 Certification

All electrical materials and equipment shall be certified to meet the requirements of the Canadian Electrical Code by one of the “Canadian Accredited Certification Organizations” identified in Suncor Firebag Standard FB-P-5506 – General Electrical Installation Requirements, and shall bear a certification label indicating that they have been so certified.

1.5.2 Intrinsically Safe

Intrinsically safe instrumentation shall not be used if explosion proof equipment to perform the same functions is available. Written approval of the Suncor Instrument Engineer is required to use intrinsically safe equipment.

1.5.3 Purged Enclosures

Purged enclosures shall not be used if enclosures to meet the electrical classification are available and/or if the enclosure can reasonably be moved to an area whose electrical classification matches the enclosure.

1.5.4 Field Contacts

Field contacts are to be hermetically sealed to avoid exposure to ambient conditions. Mercury switches are not to be used without written approval by the Suncor Instrument Engineer.

1.5.5 Power Supply

24 vdc shall be supplied from the BPCS or SIS I/O processors to power field instruments. A 24 vdc/120 VAC UPS shall be provided at each controller area for primary BPCS and SIS power. Power supplies of 24 vdc shall be supplied in each MCC building. HMIs shall be supplied from 120 V/60Hz UPS. Analyzers shall be supplied with 120 VAC utility power, not UPS. Refer to Firebag Standard FB-P-5506, General Electrical Installation Requirements for Power Cabling Requirements.

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1.6 SEPARATE CONTROL AND SHUTDOWN SYSTEMS

Individual instruments will be provided for the BPCS and SIS systems. A dedicated signal shall be supplied to each system, to reduce common mode failures

This separation means that pressure transmitters used for control shall be fed from separate taps into the process from pressure transmitters used for shutdown systems. In the case of taps across an orifice plate, the plate and flanges may be common, but the taps shall be separate. In the case of a vortex meter, a single unit containing 2 separate shedder bars with an individual transmitter for each will be provided.

Transmitters will be preferred over switches for control, shutdown and alarm.

1.7 NUCLEAR GAUGES (RADIOACTIVE SOURCE DEVICES)

The purchase, handling and storage of nuclear gauge (radioactive source devices) shall be as per Suncor Radiation Safety Manual. The product manufacturer should be consulted regarding the specific application requirements.

2.0 FLOW

2.1 SCOPE

2.2 GENERAL

Add – Vortex meters are preferred over orifice type meters. Orifice meters shall be used only when absolutely necessary.

2.2.1 Categories

2.2.2 Transmission Practice

2.2.3 Accessibility

Add – Flow transmitters shall be mounted at a height of 1.07 m (4'6") above grade, platform, walkway or other permanent accessible location.

2.2.4 Local Indication

Add – In general, transmitters shall be supplied complete with indicators. LCD indications shall be legible throughout the entire ambient temperature range to which they are exposed. Winterization provisions may be required.

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1**2.2.5 Vibration****2.2.6 Pulsation****2.2.7 Purging & Sealing****2.2.8 Piping**

Replace with – Process connections to the transmitters shall be by electrically heat traced/insulated tubing bundles. Tubing shall be ½" minimum 316 seamless Stainless Steel per ASTM A632 with wall thickness of 0.049". Refer to Firebag Program Technical Standard FB-P-5511, Electrical Heat Tracing.

Add – Inline instruments 203 mm (8") and smaller shall be installed with 300 # ASME raised-faced flanged connections as a minimum.

Add – Thermowells shall be installed and minimum of 5 pipe diameters downstream of any flow meter.

Add – The installation of flow conditioning devices may only be considered with expressed approval from the Owner.

Add – All flow measurement calculations shall be submitted to the Owner. Calculation methods used, other than those specifically mentioned within this technical standard, shall be approved by the Owner prior to use.

2.3 MEASUREMENT DEVICES

Add – The measuring device range should be such that the normal flow indication is approximately at the center of a square root chart (i.e. roughly 70 – 75% of maximum design range).

2.3.1 Differential – Pressure Meters**2.3.1.1 Primary Elements****2.3.1.1.2 Orifice Plate**

Add – With orifice plates using flange taps, beta shall be between 0.20 and 0.75. Calculate the orifice bore to the nearest 1/8 inch while maintaining a differential of 2540 mm W.C. (100 in WC).

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Orifice plates shall be manufactured and bore size calculated in accordance with either the API 14.3 or ASME MFC-3M using the flowell sizing program. A copy of the calculation shall be furnished to the owner as part of the data sheet for the orifice plate. Unless another differential range is required due to pressure drop limitations. When measuring high velocity fluid with limited upstream straight run, the orifice may be sized for a differential higher than 2540 mm W.C. (100 in W.C.) if an orifice is sized for a differential less than 2540 mm W.C. (100 in W.C.) an increase in straight run pipe may be required.

To avoid plugging of the sensing line, pressure taps shall not be connected to the bottom of the pipe or flange. Pressure taps in liquid or steam service shall be installed on the 90° horizontal side of the pipe or flange. Horizontal run tubing shall be installed sloping towards the transmitter with a minimum slope of 1:10.

Pressure taps for gas service shall be installed on the 90° vertical plane up from the pipe or flange. Instrument tubing shall slope back towards the process line with a minimum slope of 1:10.

Alternately, the pressure taps in steam service may be installed at a 45° angle below the horizontal plane with the tubing sloped at least 1:10 back towards the process line.

Add – Orifice flange taps shall be NPS ½" and shall not be used for separate static pressure measurement. Pipe section lengths upstream and downstream from the orifice plate for services that are not for custody transfer shall be determined by referring to ASME MFC-3M Table 2.

Temperature, pressure and/or density measurements shall be considered when metering gas flows in custody transfer applications. Removable orifice plate holders shall be installed for custody transfer applications of orifice plate measurement. Flow elements installed for the following services shall have flanged calibrated meter tubes on the upstream and downstream sides, only when required by the flow measurement accuracy specification. Such installations shall be identified on the P&ID. The flanged pipe section lengths shall be manufactured per API Manual of Petroleum Measurement Standards. It is recommended that all meter runs be based on a beta ratio (d/D) of 0.7.

- a. Streams to and from other companies (custody transfer).
- b. Interplant process and utility flows for accounting purposes.
- c. Services where frequent cleaning of the upstream line is necessary for meter accuracy.

Orifice flanges on meter runs shall be minimum 300 ANSI with ½" NPS taps. Each meter run shall conform to the material and pipe schedule as indicated in the Suncor Firebag Program Technical Standard FB-L-5202 – Piping Material Specifications.

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In general, meter runs are preferred to be installed in horizontal pipe. If required, they may be installed in vertical runs based on the following guideline, for liquids, the direction of flow shall be upwards and for gas and steam, the direction shall be downwards. A minimum of 20 pipe diameters upstream and 5 diameters downstream will be required unless otherwise approved by Suncor's Instrument Engineer. Meter runs shall not be installed in lines under 2".

2.3.1.1.4 Elbow Meters

Elbow taps shall not be used.

2.3.1.1.6 Pitot Tubes and Pitot Venturis

Add – Averaging type pitot tubes shall be used only where specified. They shall be considered for use in the following services:

- a. Reduced permanent pressure loss is required.
- b. Duct flow measurement.
- c. High velocity measurements where an orifice plate differential pressure will exceed 5080 mm W.C. (200 in W.C.).
- d. Pipe sizes 4" and larger (reduces install costs).

They shall not be specified where differential pressure generated is less than 25.4 mm W.C. (1 in W.C.) for normal flows. Its is preferred that pitot tube differentials not be less than 254 mm W.C. (10 in W.C.). In critical applications, they shall be installed in such a manner that they are removable under pressure without interrupting fluid flow. Harmonic vibration calculations are required for all pitot tubes. Upstream and downstream straight run requirements shall be based on the manufacturer's recommendations.

2.3.1.1.7 Flapper or Target Meters

Add – Flapper type flow switches and target type flow meters are not to be used.

2.3.1.2.2 Diaphragm Transmitters

Replace 3rd sentence: The transmission signal will be foundation fieldbus compatible or 4-20 mA/Hart. The meter range should be such that the normal flow indication is approximately at the center of a square root chart (i.e. between 70-75% of maximum design flow).

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1**2.3.1.2.3 Bellows Meters**

Replace 3rd sentence: Bellows-type flow meter may be used for local indication only, where freezing or carryover does not present a problem.

2.3.1.3 Installation**2.3.1.3.2 Meter Location**

Replace with – Flow transmitter shall be remote mounted at a convention height of 1.37 m (4.5') feet above grade, platform, walkway or other permanent access point. Ensure that vibration of supporting piping will not impact operation of this instrument. Remote mounted transmitters shall be provided with provisions for a 2" pipe mount installation.

2.3.1.3.3 Impulse Lines

Replace 2nd sentence: For liquid measurement the lines should slope down at least 1 inch per 10 inches from the orifice taps. Add: Loops in instrument tubing shall be avoided. Impulse lines shall be self draining.

Add to end of section – DP cells will normally be mounted in flexpacks or heated enclosures and connected to the orifice flange primary isolation valves by heat traced tubing bundles. ½ inch 316 SS tubing per ASTM A632 with a 0.049-inch wall thickness is to be used as a minimum.

Instrument tubing routes shall avoid external sources of heat (i.e. steam piping, hot process lines, etc). Tubing shall be banded or clamped to the channel at 914 mm (3') intervals and be supported to within 203 mm (8") – 305 mm (12") of the instrument or process tap point. Tube fittings shall typically be Swagelok. Refer to Suncor Firebag Program Technical Standard FB-J-5404, Instrument Installation for project specific tubing installation guidelines.

2.3.1.3.4 Meter Manifolds

Delete second paragraph: Describe multiple valves in place of manifolds.

Add – Valve manifold selection at the transmitter shall be based on the need to have double block and bleed protection for removal of differential and pressure transmitters. Manifold shall be used to mount the transmitter.

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2.3.2 Variable Area Meters

2.3.2.2 Installation

Replace last paragraph - Rotameters for all process services shall be specified to be armoured. This included air, water, or nitrogen if these fluids are purging into hydrocarbon services.

2.3.3 Magnetic Flowmeters

2.3.3.1 Add – Magnetic flow meters shall be flanged type. Slip on flanges are not allowed in many applications (refer to piping standard 202).

Electrical conductivity limit should be carefully considered in selection of Magnetic flow meter. Power draw should be considered in selection of power supply, 120V ac is preferred.

2.3.4 Turbine Meters

2.3.4.1 General

Add – A minimum backpressure must be maintained to prevent cavitation. API Manual of Petroleum Measurement Standards, Chapter 5.3 recommends a minimum backpressure equal to twice the delta pressure at maximum flow plus 1.25 times the absolute vapour pressure at operating conditions.

Turbine meter shall be installed in accordance with Suncor Firebag Standard FB-L-5201.

Add - Turbine meters shall only be used in clean, non-corrosive, single phase process conditions. Pulsing or surging flow conditions should be avoided.

Flashing liquids will create gas pockets causing the turbine to over spin reducing accuracy and potentially damage.

The upstream & downstream straight run dimensions should be, as a minimum, the same as an orifice meter run with a 0.7 beta ratio.

2.3.5 Positive Displacement Meters

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2.3.6 Vortex Meters

2.3.6.1 General

Add - Within the limitations defined in 2.2.4.1, vortex meters are preferred wherever they are more cost effective on a life-cycle basis. Enhanced turndown, low temperature withstand, accuracy, and simplified installation compared to orifice meters are reasons for this preference. Do not use vortex meters in an application where the Reynolds Number may drop below 10,000 for liquids and 50,000 for gases.

Vortex meters may be used on clean low viscous, non-abrasive fluids. Allowable pressure drop and accuracy should be reviewed before installing a vortex meter in a gas service. Note, Vortex meter are typically unsuitable for low density gases.

The vortex meter sensor shall be of the design such that it can be replaced without breaking the process seal.

Where a vortex flowmeter one size smaller than the line size is required, integral reduced vortex meter tube shall be specified. The use of integral dual meter is permitted.

2.3.6.2 Installation

Add – The design of the process piping for the Vortex Meter installation shall be so, that the meter body will remain full, with no entrapped air. In a vertical piping installation process liquid flow shall be upward and process flow shall be downward when measuring gas / vapour and steam. If space allows the preferred vortex meter orientation in horizontal pipe, is that the meter bluff body be horizontal (parallel to the ground) with the integral electronics housing beside the pipe. For reasons of heat dissipation, minimizing line vibration effects and to minimize entrained solids striking the bluff body.

2.3.7 Mass Flow Meters

2.3.7.2 Mass Flow Meter - Coriolis

Add – Ensure that vibration of the meter installation will not impact operation of coriolis meters. Special mounting may be required for large meters.

2.3.8 Ultrasonic Flowmeters

Transit-time ultrasonic flowmeters are mainly used for clean liquid and gas. Doppler ultrasonic flowmeters are used with dirty liquid and gas. For high accuracy applications, Multipath ultrasonic flowmeters are preferred. Use of ultrasonic flowmeters shall be restricted to applications where conventional flow meters could not be used.

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3.0 LEVEL

3.1 SCOPE

Replace last paragraph with five types of instrument that are covered:

- a. Locally mounted indicating gauges, including tubular gauge glasses, armoured-type gauge glasses, magnetic type gauges, and differential pressure level indicators.
- b. Level transmitters including displacement, differential pressure, nuclear, ultrasonic, radar, and capacitance types.
- c. Level Switches
- d. Tank gauging
- e. Accessories including seals and purges, gauge glass illuminators and weather protection.

3.2 GENERAL

3.2.1 Introduction

3.2.2 Accessibility

Delete in first paragraph – For maintenance purposes, rolling platforms are frequently used when free access is available in the area below the instruments.

Add at the end of second paragraph – Internally mounted level devices shall not be used without written permission from Suncor Instrument Engineer.

3.2.3 Readability

3.2.4 Connection to Vessels

Replace first paragraph with – Level instrument connections must be made directly to vessels or standpipes and not to process flow lines or nozzles.

If a bottom vessel connection must be used for level measurement to avoid pockets, extend nozzle 76.2 mm (3") vertically into the vessel.

Add – Vessel flanged connections shall be 2 inch 300# minimum unless the vessel or piping specifications exceeds the minimum. Bridle connections to vessels shall be 3" minimum.

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3.2.5 Multiple – Instrument Mounting

Replace entire section with – When two or more instruments, one of which may be a gauge glass, are required for any applications, they shall be mounted in such a way as to minimize the number of openings in the vessel. Suggested methods are covered in 3.3.3.3 and 3.4.2.3.

Add – Each instrument that must be removed for maintenance without shutting down the process shall be equipped with double block and bleed valves between it and any part of the process that may not be shut down.

Add – Fabrication and installation of level standpipes shall be under the piping scope of work.

3.2.6 Block Valves

Add – Block valves supplied by the piping engineering department shall be installed between vessel and the bridle.

3.2.6.2 Replace with: Standpipe connections to the vessel shall be as a minimum 3", 300#. Piping shall supply a block valve between the vessel and flange connection.

Level gauges mounted to the standpipe shall have 3/4", 300# flanged connections as a minimum.

Level transmitters mounted to the standpipe shall have as a minimum, 2" as a 300# flanged connections.

Block valves shall be provided between the standpipe and the flange connection.

3.2.7 Strain Relief

3.2.8 Vibration

3.2.9 Drains and Vents

Replace with – Drain valves shall be installed on the bottom connection to level instruments and gauge glasses. In hazardous service, drains should be piped away from the instrument to a safe area of disposal. Vent valves shall be installed on the top connection to level instruments and gauge glasses.

Add – Drain & vent valves shall typically be 3/4" in size. Although normally under Piping's scope of work, installation of vents & drain valves may be installed by the instrument supplier during manufacture.

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3.3 LOCALLY MOUNTED INDICATING GAUGES

3.3.1 General

Level gauges shall be provided wherever liquid level controllers, transmitters, or switches are installed, and shall cover a minimum of 50.8mm (2") beyond the range of the level instrument. Vessel and bridle nozzles for displacement level transmitters with side connections must be jig set. All direct reading liquid level gauges and accessories shall be suitable for the service and operating pressure and temperature conditions shown on the instrument specification sheet.

3.3.2 Tubular Gauge Glasses

Replace with – Tubular gauge glasses may be used in certain non-critical application such as chemical injection storage facilities provided the glass is suitably protected. Usage should be limited to services where the temperature is below 93°C (200°F), the pressure is below 15 psig, and the material is non toxic and non hazardous.

3.3.2.1 Length

Add – Tubular gauge glasses should never exceed 762 mm (30"). If a range greater than 762 mm (30") is required, use multiple overlapping gauge glasses.

3.3.2.2 Protection

The tubular gauge glass shall be protected by sheet metal, plastic, or safety glass protectors and shall be mounted on the side of the vessel away from the most likely source of damage. However, the gauge must be easily visible to the operator.

3.3.3 Armoured Glass Gauges

3.3.3.1 Application

Add - Certain codes, including Alberta Boilers Safety Code for steam boilers, require glass level indicators.

3.3.3.2 Gauge Assemblies

Replace with - Multiple section gauge glasses are made up of 2 to 3 standard length sections and can be connected to the vessel in the same manner as a single gauge. These assemblies shall be a maximum of 3 sections with a combined overall length of 1.07 m (42"). Expansion loops shall be provided where needed to account for thermal expansion and contraction.

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3.3.3.3 Multiple – Gauge Mounting

Large ranges of level are observed by the use of overlapping gauge glasses. The mounting of overlapping gauge glasses on a standpipe is shown in API RP551 Figure 7 except that a maximum of 3 sections may be used. Each gauge glass section shall overlap the next by a minimum of 2".

Interface observation requires the use of transparent gauge glasses. API RP551, figure 8 shows two acceptable methods of mounting multiple gauges on horizontal vessels where liquid/liquid and liquid / vapour interfaces are to be observed. Connection to the vessel must be arranged so that there is always one connection in each phase of the interface that is being measured.

3.3.3.4 Protection of Gauge Glasses

Add - Mica shields shall be added to all glass gauges in steam service or in services where glass is subject to etching by the process.

3.3.3.5 Gauge Valves and Ball Checks

Add – Gauge valves with ball checks shall be specified for armored glass gauges and shall be of OS&Y construction. When gauge valves are provided with ball checks, the ball in the lower valve is to be the vertical type and the one in the upper valve is to be individual is to be the horizontal type. Each valve that is provided with a ball check shall be furnished with a permanent, securely fastened, corrosion resistant metal tag. Tag shall be indented or embossed with the following wording "With Internal Ball Check."

3.3.4 Magnetic Gauges

3.3.4.1 Application

Replace with – Magnetic level indicators are preferred and shall be used where conditions allow. They should be used with dirty or viscous fluids or where glass failure will release toxic substances or flammable liquids. They may be applied over longer lengths than glass gauges and may therefore result in simpler installations. Mounting is similar to mounting of a gauge glass. Valving is similar to that for gauge glasses. Gauge valves with ball checks are not required for magnetic level indicators. Refer to API RP 551 Figure 9.

Magnetic level gauges shall be provided with the bottom flange to provide access for removal/installation of the float.

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3.4 LEVEL TRANSMITTERS

Add – All transmitters, installed for Suncor Energy Inc, Firebag Projects, shall be equipped with local indicators. Unless stated otherwise.

Add – Each level instrument will require removal block valving for maintenance without shutting down the process.

3.4.1 General

Replace first paragraph with – Level transmitters on Suncor Firebag projects utilize an electrical output system that uses a wide variety of measurement principles, including displacement, differential pressure, nuclear radiation, ultrasound, and capacitance / radio frequency.

3.4.2 Displacement Transmitters

3.4.2.1 General

Replace section with – Electronic displacement type level transmitters shall be used for level spans of 1.22 m (48”) or less, unless process conditions prohibit their use. Other types of level instruments shall be used for ranges greater than 1.22 m (48”) with written permission of Suncor Instrument Engineer.

Displacement type level instrument shall not be used in high viscous process conditions, services where the instrument will be subjected to plugging or sticking, or services with agitated fluids.

3.4.2.2 Applications

3.4.2.3 Mounting of External – Cage Displacement Transmitters on Vessels

Replace with – External cage displacement transmitters shall be mounted to vessels by means of nozzles, block valves, and pipe fittings per Suncor Firebag Program Technical Standard FB-L-5202.

Transmitter installations shall be provided with gauge glasses in parallel. The visible part of the gauge glasses shall overlap the range of the transmitter by at least 50.8 mm (2”), top and bottom.

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3.4.2.4 Connection to Vessels

Pressure gauges or Pressure Points are to be installed on the vent connections of all standpipes.

Replace first paragraph with – For Suncor process applications, level transmitters process connections shall be 2", 300 ASME RF as a minimum.

3.4.2.5 Installation of External – Cage Displacement Unit and Standpipe

3.4.2.6 Internal Displacers

3.4.3 Differential – Pressure Transmitters

3.4.3.1 General

3.4.3.2 Low-Displacements Transmitters

Delete first two paragraphs

Replace with -

- a. Connections to the vessel may be by pipe fittings of the proper service, refer to Suncor Firebag Program Technical Standard FB-L-5202, Piping Material Specifications, or by means of ½ inch seamless 316 stainless steel tubing bundles and tubing fittings. Vessel connections shall be a minimum of 1-inch.
- b. A flange connected direct tank mounted transmitter may be used for viscous fluids or slurries. Various diaphragm materials are available and the diaphragm may be mounted flush with the inside of the vessel.
- c. Differential Pressure cells with capillary seals are not to be used in critical applications.
- d. Bellows and other high displacements sensors shall not be used. Filling Tees, and not seal pots, are to be used where external seals are required for low displacement (diaphragm type) transmitters.

3.4.4 Replace with – Bubbler Differential – Pressure Level Transmitter

These systems have proven to work well in Suncor Upgrader applications. Ensure that the design allow the bubbler tubing to be rodded.

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- 3.4.4.1 Add: A gas purge compatible with the process medium may be used in a bubbler – type level measurement system.

The gas purge is required on the high pressure side of the differential pressure transmitter for the installation to work.

A rotameter with an integral flow regular should be installed on the purge stream to provide a constant flow.

Purge gas introduced into a vessel containing organic vapours must be removed without venting it to atmosphere.

- 3.4.4.2 Precautions

3.4.5 Nuclear Level Transmitters

- 3.4.5.1 General

Add – Suncor uses multiple neutron backscatter nuclear level switched for level determination on cokers.

Add – Suncor uses continuous measurement nuclear level transmitters for other difficult level applications.

- 3.4.5.2 Operations

- 3.4.5.3 Precautions

- 3.4.5.4 Installation

3.4.6 Ultrasonic Level Transmitters

Replace with – Conditions at Suncor Energy Inc, Firebag SAGD Projects Fort McMurray are generally not amenable to level measurement by ultrasonic means. Ice build up on transducers is a primary reason. Do not use the technology for level measurement here without written approval of Suncor Instrument Engineer.

3.4.7 Capacitance/Radio – Frequency Level Transmitters

Replace with – Capacitance type level transmitters have not been successfully applied at Suncor Energy Inc, Fort McMurray. Do not use this technology for level measurement here without written approval of Suncor Instrument Engineer.

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3.4.8 Add – Radar Level Transmitters

Radar level measurements of tank contents has been very successfully applied at Suncor Energy Inc. Firebag SAGD Projects Fort McMurray. This is the preferred measurement method for measuring tank levels here. Float tape type level transmitters are not acceptable.

3.4.8.1 Operation

Add – A beam of microwaves is reflected off the top of the liquid level. The time taken to reach the surface and return to the radar transducer is measured and is converted to distance, which is then subtracted from the distance to the bottom of the tank. Care must be taken to mount the transducer on a section of the tank roof that has no large structural beams beneath it. Heating of the transducer to prevent ice build up must be considered.

3.4.8.2 Precautions

Add – Although the principle is simple, the quality of the product varies widely among manufacturers. Ensure that equipment supplied has been successfully tested at site before specifying it.

3.5 LOCALLY MOUNTED CONTROLLERS

Delete this Section

Refer to Section 7.2, this standard.

3.6 LEVEL SWITCHES

3.6.1 General

Replace with – In general, level transmitters are preferred instead of level switches. The signal shall be taken to the BPCS or SIS and software values shall be selected to trip alarms or shutdowns.

Level signals that are to be used as part of the Safety Instrumented System (SIS) shall have separate connections to the process, independent of connections that are used for other instruments.

3.6.2 Installation of float switches

Add: Where used, level switches are installed in the same manner as displacement level transmitters.

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1**3.6.3 to 3.6.4**

Delete these sections.

3.6.5 Overfill Protection

Replace with – Level alarms shall be provided on tanks in accordance with API RP 2350 in order to prevent tank overflow. Float type level switches, if used, shall use porcelain or equivalent material that cannot produce a spark when the float comes in contact with a floating roof.

3.6.6 Drainage Systems

Add: All drainage systems carrying material to the sewer through a level control system shall be provided with a separate low level alarm in the interface level to prevent hydrocarbon drainage.

3.7 TANK GAUGING

Replace this section with – Tank gauging shall use radar level transmitters for Suncor Energy Inc., Firebag SAGD Projects at Fort McMurray. Float and cable systems have not been successful at site.

3.8 ACCESSORIES**3.8.1 Seals and Purges**

Seals and purges are used to prevent the process fluid from entering the instrument or connecting lines and causing improper operation or damage resulting from temperature, vapourization, condensation and viscosity effects; corrosion; or sedimentation. Refer also to Section 6 of this document.

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3.8.2 Seals

Proper selection of instruments can simplify sealing procedures, often making sealing unnecessary. The liquid used for sealing should be immiscible with and of a different density from the process fluid. Figure 3.8.1 (below) shows several arrangements for sealing instruments from the process. Sealing tees are preferred over sealing pots.

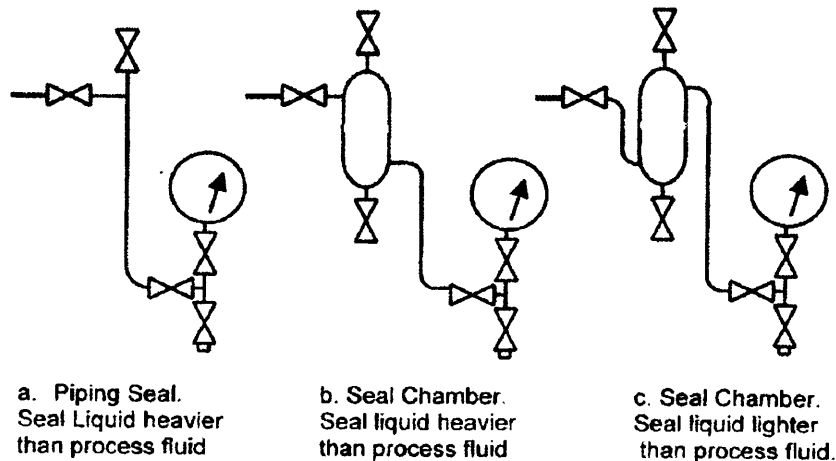


Figure 3.8.1 Seals

3.8.3 Gauge Glass Illuminators

Illuminators shall be used on all transparent gauge glasses. They shall be back illuminated, using fittings from the gauge manufacturer that meet the hazardous area classification. Consideration shall be made for the insulation and heat tracing required on the gauge glass. Illuminator shall be powered from a lighting panel.

3.8.4 Gauge Glass and Magnetic Level Indicator Scales

Each gauge glass, multiple gauge glass, or group of gauge glasses that is installed to confirm the level in a related level transmitter shall be equipped with a scale mounted to the side of the gauge glass. This scale shall be divided into 100 equal parts, and shall be marked at 10% points.

The 0% point of the scale shall correspond to the 0% point of the transmitter. The 100% point of the scale shall correspond to the 100% point of the transmitter. If the gauge glass is installed to confirm the level in more than one level transmitter that operate over different ranges, the gauge glass shall be equipped with one such scale for each level transmitter and the scale shall be identified with the tag number of the transmitter to which it refers.

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Scale requirements for magnetic level indicators are identical to scale requirements for gauge glasses.

4.0 PRESSURE

4.2 GENERAL

4.2.1 Introduction

Replace second sentence with – Where applicable, the material discussed in 4.2.2 through 4.2.12 should be considered a part of each of the subsequent discussions.

4.2.3 Accessibility

Delete last sentence – A rolling platform is sometimes used where free access is available to the space below the instrument.

Delete API RP551 Figure 19. Suncor requires individual process tap points. Suncor does NOT use common process connections for two measurements.

4.2.4 Local Indication

Replace first paragraph with – Where local indication is desired, it should be provided with directly connected process pressure gauges, output indicators, or both.


4.2.7 Purging and Sealing

Replace first three sentences in paragraph 3 with – In general, pressure measuring instruments with capillary tubes is discouraged however where it is necessary to use capillary filled units, care should be taken to isolate the capillary from any variable heat source such as heat tracing or process piping. Provision for isolation and calibration through bleed ring with two connections for drain/flush and calibration should be provided.

4.2.8 Piping

4.2.8.1 Size and Design

Replace entire first paragraph – The root valve process connection for the instrument should be furnished and installed in accordance with piping and material specifications, see Suncor Firebag Technical Standard FB-L-5202. When the pipe is selected, ¾ inch Schedule 80 minimum pipe and fitting should be used. When tubing is selected, ½ inch (except 3/8 inch or ¼ inch may be used in panels or for analyzer sampling), seamless stainless steel of 0.049 wall thickness should be used. Tubing runs shall be installed by the instrumentation contractor.

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Add – The root valve installed by piping shall be a gate valve in all services except HP BFW and steam. For these services a Y patterned globe valve shall be installed.

Replace entire second paragraph – Block and bleed instrument manifold or gauge valves shall be provided between the process root valve and the instrument to protect personnel who are required to repair or remove the instrument while in process pressure. The root valve isolating the process shall be supplied by the piping group based on the Suncor Firebag Technical Standard FB-L-5202 and the individual line classification. Depending on the process conditions and medium, the line classification may specify a double block and bleed valve arrangement. Refer to Suncor Firebag Technical Standard FB-L-5202 Piping Material Specifications.

4.2.8.4 Long Connections

Delete 2nd paragraph.

Note: Suncor does not generally use one common process connection for two or more measurements.

4.2.9 Add – Refer to Suncor Firebag Program Technical Standard FB-J-5416, Winterized Enclosures for heated winterization requirements.

4.2.10 Element and Socket (Wetted) Materials

Replace entire 4th sentence – Bronze or any copper based material is not allowed

4.2.11 Range Selection

Add – Normal operating pressure should be approximately 50% of the full scale range; or the maximum operating pressure should be approximately 75% of the full scale range, whichever dictates. However; in no case shall the full scale reading be less than the applicable relief valve setting plus 10%. Range selection shall be the vendor's standard scale range. Consider the use of overpressure protectors.

4.3 PRESSURE GAUGES AND SWITCHES

In general, pressure transmitters are preferred over local switches. Switches are only to be used in applications where a suitable transmitter is not available and only with the written approval of Suncor Authorized Representative.

4.3.1 Add – Bellows type pressure elements are to be used for low-pressure applications only where Bourdon type elements would not be suitable.

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1**4.3.5 Change section name to – Instrument Construction**

All direct mounted indicating pressure/vacuum gauges shall conform to ANSI B40.1 for Grade 2A gauges. Gauges shall have an accuracy of ½% of full-scale reading over the entire scale.

4.3.5.1 Add section - Case

Aluminum alloy, stainless steel or phenolic, weatherproof, coloured black. All gauges shall have a solid front wall with blowout back or disc, and a removable dial cover.

4.3.5.2 Add section – Movement

Movement shall be stainless steel, low friction coefficient, vibration resistant with calibration adjustment and lock.

4.3.5.3 Add Section - Pointer

Micrometer, readily adjustable (with positive lock) from front of case.

4.3.5.4 Add section – Dial

For process gauges, minimum 4-1/2inch diameter laminated plastic or plastic coated metal, white face with black figures.

4.3.5.5 Add section - Window


Plastic (heat resistant acrylic) with gasket separating dial cover and gauge ring.

4.3.5.6 Add section – Pressure Elements

- Type C Bourdon tube, 316-L SS minimum with alloy socket and tip, welded at socket and tip and stress relieved. The bourdon tube shall be capable of withstanding pressure over ranges 1.3 times the maximum scale reading without losing calibration.
- Vacuum and low pressure gauges may use diaphragm construction.
- Critical Vacuum and Low Pressure Gauges – 316- L SS minimum element and socket to vendor standards.

4.3.5.7 Add Section – Overpressure Pin

All gauges shall have a pin or stop below the zero point to prevent an over pressure reading beyond one revolution of the pointer.

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4.3.5.8 Add Section – Stem Connection

½ inch NPT (male) located at the bottom of the gauge case, unless specifically limited by vendor's standards.

4.3.6 Add section – **Special Services**

4.3.6.1 Ammonia or Oxygen

Gauges for use in ammonia and oxygen service require special construction. The vendor shall be made aware of the services in which these gauges are to be installed. These gauges shall be plainly marked (by the vendor) for the services intended, and the oxygen gauge shall be absolutely free of grease, oil or any other substance which reacts explosively with oxygen.

4.3.6.2 Remote Mounted Gauges

Remote mounted gauges in services with noxious, toxic or flammable liquids or gases shall be provided with an excess flow check snubber.

4.3.6.3 Draft Gauges

Draft gauges for refinery heaters shall be of the dry pointer type.

4.3.6.4 Material Considerations

Design and materials of construction of the diaphragm seal, chemical protector, pulsation snubber and excess flow check snubber including fill fluids, assembly bolts, nuts and gasket shall be specified for compatibility with the existing service, operation and installation conditions, which shall be listed on the instrument data sheet.

4.3.7 **Pressure Switches**

(Note: The use of transmitters is preferred over switches where applicable)

4.3.7.1 Pressure switches shall be capable of resetting themselves within approximately 4 to 5% of their maximum range. Low pressure applications may require smaller differentials. The pressure switch shall operate above the 50% point of the operating range to provide the best accuracy.

The pressure switch shall operate above the 50% point the operating range to provide the best accuracy.

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- 4.3.7.2 Pressure switches shall be provided with adjustments for readily resetting the set point. Hermetically sealed, SPDT contacts shall be supplied whenever available.
- 4.3.7.3 Measuring elements shall be specified for the type for the type pf operating service.
- 4.3.7.4 Pressure switches are to be selected which have acceptable hysteresis when DPDT contacts are used.
- 4.3.7.5 Pressure switches shall not be connected directly to the process in prestating or vibrating, service.

4.4 PRESSURE TRANSMITTERS

4.4.1 Connections

Replace the last sentence: The instrument process connection and tubing impulse line shall be ½ inch.

Add: Typical electrical connection shall be ½" F-MPT.

4.4.2 Installation Considerations

Add to a) Horizontal sections of the tubing shall be installed with a minimum slope of 1:10


Add to b) All transmitters shall be supplied with 2" pipe mountable support bracket.

Add to c) Gas process taps shall be installed 90° horizontally off the pipe. Angled process taps (up to 45°) shall only be used if absolutely necessary.

4.4.3 Differential Pressure Transmitter

4.4.4 Overrange Protection

Add: Over range protection shall be supplied on all transmitters. Transmitters shall be able to withstand over range pressures equivalent to 150% of maximum span as a minimum.

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5.0 TEMPERATURE

5.1 SCOPE

Add as second paragraph – Normally, all temperatures shall be indicated and historized on the BPCS system. Resistance temperature devices (RTD's) are preferred over thermocouples for process temperature measurements where the temperature range permits. Heaters and tubeskin temperature measurement shall be taken by thermocouples.

Add as third paragraph – In general, temperature transmitters are preferred over temperature switches. Switches are only to be used in applications where a suitable transmitter is not available and only with the written approval of Suncor Authorized Representative.

Add as fourth paragraph – Where local indication is desired, it should be provided with directly connected process temperature gauge, local indicator or both.

5.2 THERMOWELLS

5.2.3 Immersion Length

Replace 4th paragraph with – Calculation for vibration effects shall be provided for each thermowell. Calculations shall be based on Brock or Murdock Formula as referenced in ASME PTC 19.3.

Thermowells in vessels shall extend at least 6" into the vessel in order to avoid temperature errors due to cooler skin temperature. Consider effects of tray maintenance caused by this immersion length. All Thermowells installed in vessels shall be flanged.

5.2.4 Materials

Add to this section – Refer to Suncor OSG STD 0202 for thermowell materials based on pipe classification.

Add to this section – Services with a combination of high velocity, high temperature, and high particulates require stellite coated thermowells to reduce erosion. Such services as heater pass outlets in diluent recovery, vacuum tower and coker plants should have thermowells with such coating. Other services with the conditions noted above should consider stellite coating as well.

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5.2.5 Construction

Replace with – Where flanged thermowells are specified, they shall be 2" size, except in certain clad vessels where 3" nozzles are required to provide sufficient clearance for the thermowell. See Suncor Drawing DD0A-J-100-1 for flanged and Suncor Drawing DD0A-J-100-2 for 1" NPT thermowell design and DD0A-J-100-5 for Stellite coated thermowell design. Sketches based on these drawings are in Section 12 Sketches.

The type of thermowell, flanged, threaded or socket weld, will be identified in the individual line specification (See Suncor Firebag Program Technical Standard FB-L-5202).

Add – Where the pipe diameter is less than 3", the line shall be swaged up to 3" minimum. All test wells shall be supplied with a plug & chain.

5.3 THERMOCOUPLE TEMPERATURE INSTRUMENTS

5.3.1 Add – Both thermocouples and RTD's shall be provided as spring loaded sensors. Each sensor shall contain a single element.

5.3.2.2 Fabrication

Add to end of this section – Thermocouple Type K (ungrounded) are preferred over Type J elements. Shield grounding shall be at only one point in the loop.

5.3.2.3 Installation

Delete entire 3rd paragraph – There are applications . . .

5.3.3 Tube Surface Temperature Measurement

5.3.5 Extension Wires

Replace 2nd paragraph with – For thermocouple extension wire and cable, refer to Suncor Firebag Program Standard FB-P-5506, General Electrical Installation Requirements.

Add at end of section – Extension wiring that is close to furnaces / heat sources shall be specified with high temperature insulation.

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5.3.6 Signal Conditioning

5.3.6.3 Multiplexing

Replace last sentence with – Multiplexed thermocouple and RTD signals may be used for monitoring and alarms, but for control and shutdown signals, each sensor shall be supplied with an electronic transmitter.

5.3.6.4 Check well requirements

Add at end of section – Separate thermowells shall be used for control systems and for safety instrumented systems. Check wells shall be provided as follows:

For control and shutdown point – use one thermocouple for control and another one (or more depending on redundancy) for shutdown. Each thermocouple shall be in a separate thermowell.

For a control point – use one thermocouple in a separate thermowell. Provide a plugged check well nearby.

For an indicate, record and/or alarm point – use one thermocouple in a separate thermowell. A check well shall not be required.

For a shutdown point – use one (or more, depending on redundancy) thermocouple for the shutdown point. Also provide a check thermocouple for indication purposes in the control room. Each thermocouple shall be in a separate thermowell.

For custody transfer applications, a measurement well and separate check well are required. Temperature points, which are both indicated and recorded, may use a dual thermocouple installed in a common thermowell.

5.4 RESISTANCE TEMPERATURE MEASUREMENT

5.4.1 Application

Add at end of section – When an RTD is specified, it should be platinum type rated at 100 ohms at 32 deg. F.

5.4.1.1 3 wire RTD

RTDs are to be of the 3-wire design unless 4-wire design is justified on accuracy of extension wire length basis.

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1**5.4.3 Extension Wires**

Replace last paragraph with – Refer to Suncor Firebag Program Standard FB-P-5505 for extension wire specification.

5.4.4 Resistance Transmitters

Add to end of section – Electronic transmitters shall be used in Control and Shutdown loops.

5.5 DIAL THERMOMETERS FOR TEMPERATURE MEASUREMENT

Add to end of section –

Bimetallic, heavy duty, corrosion resistant dial type thermometers (5 inch minimum diameter) may be used on process and water temperature points required for survey purposes and not covered by thermocouples. Dial shall be black printing on a white background.

Metal case, glass type midget thermometers may be used on temperature points subject to vibration or abuse, such as water temperatures on individual compressor cylinder outlets, engine and compressor water temperatures.

5.6 FILLED SYSTEM TEMPERATURE INSTRUMENTS**5.6.2 Applications**

Add to end section – Filled system temperature instruments may be used on air cooled condensers and storage tank heater systems. Capillary systems should be avoided and applied only with written permission of Suncor Instrument Engineer.

5.6.3 Self Actuating Temperature Regulators

Do not use without written permission of Suncor Instrument Engineer.

5.6.4 Temperature Transmitters

Delete entire section.

Add – Temperature transmitters may be installed locally or remotely but must be operator accessible. Engineering shall discuss the location of locally mounted transmitters with Suncor's operation department prior to installation.

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6.0 PROCESS AND ENVIROMENTAL PROTECTION

6.3 SEALS

6.3.1 Diaphragm Seals

Add to end of section – Transmitters with diaphragm seals are not to be used in critical applications.

6.3.2 Liquid Seals

Add to end of section – Gas purges are to be used in preference to liquid seals. Where liquid seals are required, the sealing fluid should be compatible with process temperature, ambient conditions and of higher density.

6.4 PURGES

6.4.3 Rate of Flow

Add to end of section – Each purged loop shall be provided with a properly sized rotameter. The adequate purge flow rat guideline refers to API 551 – section 6.4.3.

6.5 HEATING

Add to beginning of section –

Other factors being equal, instruments that are able to operate down to minus 50 deg C temperatures are preferred to instrument heating systems. This factor shall be considered in specifying instrument heating systems.

Instrument tubing shall be maintained at temperature defined in the Line Designation Table for the process line.

6.5.2 Steam Heating

6.5.2.1 General

Add to beginning of section –

Electrical heating for instruments is preferred over steam heating. Steam heating may be considered for projects if infrastructure is in place and steam is the most economical alternative.

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1**6.5.2.2.2 Instrument Housings**

Replace the first two paragraphs with – Winterizing of instruments is to be determined at the flow diagram review and indicated on the P&ID. Standard pre-fabricated hard – sided instrument enclosures with integral heaters shall be supplied where needed.

6.5.2.2.3 Tracing Methods and Materials

In paragraph 3, replace first sentence with – Carbon steel tubing sized for the particular service shall be used to carry the heating steam except in high temperature applications where decarburizing of the steel may take place.

6.5.2.3.1 Steam tracing for High Pour Point Materials

Replace sentence 3 with – Heat transfer cement may not used.

6.5.3 Electrical Heating**6.5.3.1 General**

Replace first paragraph with – Electrical heating is preferred over steam for instrumentation at Firebag.

6.5.3.2 Electrical Tracing for Warming Services**6.5.3.2.1 General**

Add to end of section – Ensure that the self – timing cable can withstand the maximum temperature that it may be subjected to due to process or steam out temperature and/or cleaning steam temperature.

6.5.3.3.2 Instrument Housings

Add to end of section –

When transmitters are selected to be housed in electrically heated enclosures, the following applies;

Electrical power for enclosures heater shall be supplied for a Heat Tracing Panel.

Enclosures shall have local electrical disconnect switches.

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Electrically traced tubing bundles are to be used to connect the transmitters to the primary process isolation valves, the bundle tracers being powered from the transmitters enclosures. Mineral insulated tracers are to be used when there is a risk that the tracers could be exposed to maximum operating temperatures in excess of 120 deg C, or where intermittent steam – out temperatures exceed 215 deg C tracer power off. Self – limiting tracers are to be used for all applications where their temperature will not exceed 120 deg C (consider steam cleaning and steam warm up in calculating this temperature). The main process line tracers are to be used to winterize the process primary isolation valves.

7.0 AUTOMATIC CONTROLLERS

7.1 SCOPE

The function of automatic controller in the process control loop is to compare the measured process variable with the desired value if the variable, called set point, and generate error signal. The error (deviation) signal produces a change in controller output that repositions the final control element to move the process variable to the set point. The error signal is thereby minimize or reduced to zero.

All process sensors and final elements shall be connected with the BPCS for control function. All type of control modes and application like:

- a. On-off control
- b. Proportional plus integral plus derivative control (PID)
- c. Proportional plus integral control plus Inverse Rate
- d. Cascade control
- e. Ratio control
- f. Feed forward control
- g. Override control
- h. Control interfacing with computer

Will be executed in the BPCS.

7.2 SINGLE / DUAL LOOP CONTROLLER

7.2.1 General

Single / dual loop controller may be used in the following application with the written approval of Suncor Instrument Engineer.

- a. Small additions to existing single controller based systems.
- b. Local panel applications such as compressor panels.

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- c. Small non-critical applications where remote locations and/or economic considerations dictate this as the best approach.
- d. Compressor Anti surge Control.

Where single / dual loop electronic controls are used, compatibility with future conversion to BPCS should be considered in the specification and design of such system. Pneumatic controller will not be used.

7.2.2 Location of Single / Dual Loop Controllers

- a. Controller can be mounted on.
- b. Control room panels or rack either integral with, or detached from indicating instrument.
- c. Local panel.
- d. Near the point of measured measurement or control or both.

7.2.3 Factors Affecting Consideration Location

The following points should be considered for the location of controllers:

- a. Convenience to operating personnel.
- b. Convenience to maintenance personnel – accessibility for servicing, frequency of need for servicing, and so forth.
- c. Safety of personnel and equipment.
- d. Vibration effect on equipment and performance.
- e. Corrosion caused by surrounding atmosphere and process fluid.
- f. Accessibility in the event of fire.
- g. Protection from mechanical damage.
- h. Radiation from sun or hot equipment.
- i. Installed cost because of location.

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7.2.4 Miscellaneous Control Requirements

For critical process application, when available, a separate “by – pass station” shall be mounted in each control panel section for manual control of final element while its controller is being replaced or repaired.

8.0 AIR SUPPLY SYSTEM

8.1 GENERAL

For proper instrument operation, instrument air shall be oil and dust free, sufficiently dry to prevent condensation of water, and of a minimum pressure of 690 kPag.

Dew point shall be – 57 degree Celsius at 690 kPag as a minimum.

8.2 DISTRIBUTION SYSTEM

8.2.1 Instrument Supply Piping

Instrument air header preferably shall be constructed of galvanized steel or thin-wall stainless steel pipe. Headers shall be capped or valved at the end to allow for future system expansion. All takeoffs shall be from the top of the header and approximately 20% spare connection shall be provided. Provision shall be made for blowing out the header.

Each air – consuming instrument is to have its own isolating valves and air filter with regulator. The valve shall be equipped with a locking / latching mechanism for locking the valve in the open position or in the closed position to prevent unintentional or accidental opening or closing. A tee shall be provided before the isolating valve and filter regulator as future provision to supply air to other user may be kept plugged as a spare. Only stainless steel tubing is to be used downstream of the final air filters. All piping 1” and smaller is to be schedule 80.

8.2.1.1 Line Sizing

Lines in the distribution system should be sized in such a manner that the maximum pressure drop between the dryer outlet and most remote consumer does not exceed 35 kPag when all consumers are taking air at a maximum rates. A minimum pipe size of ½ “ NPS should be used for takeoffs to individual consumer except where many instruments are in close proximity and are connected to one header.

Air supply tubing is to be 3/8” O.D. x 0.035 wall thickness 316L stainless steel. All tubing fittings shall be 316 stainless steel per approved Vendors List. Following table can be used as a guide in line sizing for both main and branch headers.

Table 8.2.1.1
Line Sizing Guide for Pipe Headers

Pipe Headers	Number Pilots	Nominal Pipe Size (Inches)
Main	80	1 ½
	150	2
	300	3
Branch	4	½
	10	¾
	25	1
	80	1 ½

9.0 ALARM AND PROTECTIVE DEVICE / SYSTEMS

9.1 BPCS ALARM SYSTEM

9.1.1 General

The Basic Process Control System, (BPCS), is designed for normal operation of the process. The BPCS shall receive signals from field process sensors. These signals shall be used to control the process. In addition, the BPCS shall evaluate these signals and shall generate pre-shutdown alarms to draw attention of the operator whenever selected process parameters exceed predetermined values.

The BPCS alarm system shall be located in the Central Control Room and shall include visual indications to the operator as well as audible indications to gain the attention of the operator. The visual indication shall include a flashing red signal that changes to a solid red signal when acknowledged by the operator. The audible indication shall be in the form of an electronically generated tune on the operator cable. A process condition that returns to normal before being acknowledged shall continue to flash until acknowledged. Acknowledging the alarm also causes the audible alarm to quiet.

Different sounding alarms in the control room may be used to indicate different parts of the plant. There will be a common distinction to have shutdown alarm operate a different audio signal than other alarms. Loudness shall be sufficient to attract attention, but not significantly louder than necessary.

All alarms shall be logged, both electronically and on a dedicated alarm printer in (or adjacent to) the Central Control Room. The log shall include the time of initiation of alarm, the time of acknowledgement of alarm and the time that the process parameter in alarm returned to a non-alarm state.

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9.2 DEDICATED ALARM SYSTEMS

9.2.1 General

For certain package units that are located remote from a DCS, a dedicated alarm system may be employed. These systems may only be installed with written approval of Suncor Instrument Engineer.

Dedicated alarm systems shall provide visual and audible indication of the alarm, shall provide acknowledge buttons that operate essentially the same as noted in the DCS Alarm System section above, and shall have provision for on line testing of each alarm. Another push button shall be provided for testing the alarm lights and where practical, for testing the other components of the system. Equipment selection shall be made in consultation with Suncor Instrument Engineer. These systems shall operate on 24VDC. The larger of 20% spare or 10 spaces minimum shall be provided in the original design.

To extent possible, design of alarms shall be fail safe. Broken or disconnected wires, failure of instrument air, or de-energized relays shall result in an alarm condition. Visual and audible alarms shall be powered by UPS, or by multiple sources of utility power.

10.0 SAFETY INSTRUMENTED SAFETY, (SIS)

10.1 SAFETY INTEGRITY LEVEL (SIL)

Suncor Energy Inc requires that a Safety Integrity Level, (SIL), assessment be done in conjunction with the HAZOP for each project. This procedure identifies, evaluates, and documents those process upsets that are so serious that the Basic Process Control System is not sufficiently reliable to protect against them. Each of these situations must be considered to determine if changes to the process, or if additions of mechanical protection, can reduce the seriousness of the upset. If not, a Safety Instrumented System, with the required integrity defined by the Safety Integrity Level, must be provided to protect personal safety, reduce economic loss or prevent environmental damage. This SIS when activated, shall over-ride the BPCS and bring the equipment and process to a safe condition.

In the process industry, SILs of "a" 1, 2 and 3 are identified by ANSI ISA 84.01 and by IEC 61511. SILs of 2 or 3 require the addition of a Safety Instrumented System (SIS), to reduce the risk to acceptable levels. A SIL of "a" is sufficiently low that the protection can be acceptably provided by the BPCS.

The SIS shall shut down the process in an orderly manner that will provide personnel safety and minimize damage and wear to the equipment involved. The system shall be designed to expedite that restart of shut down equipment or affected units.

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The design shall consider nuisance shutdowns. Each Safety Instrumented Function shall be evaluated for reliability and the calculated reliability shall be documented. System and individual element testing frequency requirements shall be calculated and documented, and procedures for on line testing shall be provided as part of the SIS design.

10.2 SIS HARDWARE REQUIREMENTS

The hardware of the SIS shall be separate from the hardware of the BPCS. This includes field sensors and actuators process connections for the field sensors, and the programmable hardware that solves the SIS logic.

10.2.1 SIS Field Sensors

SIS field sensors shall be separate from the BPCS sensors that measure the same parameter. This separateness shall extend to process connections that are different from the process connection of the BPCS. Certain instruments, like orifice meters and vortex meters may share the same signal generating device, but must use separate signal measuring devices.


Wiring for SIS sensors shall be run in cables, conduits and junction boxes that are separate from the wiring for BPCS sensors.

Transmitters, rather than switches, are preferred for SIS field sensors. If switches are used, they must be hermetically sealed and must use no mercury.

Transmitters, rather than TC or RTD signals, are required for SIS sensors. 4 – 20 ma signals are to be used for SIS. SIS shall be programmed to generate trip points from the analog signal from the sensor. HART protocol superimposed upon the 4-20 ma signal is preferred. Digital protocols that share a wire pair among more than one sensor and / or that protocols that share a wire pair among more than one sensor and / or that interrupt the transmitter signal are not acceptable.

Hardwired manually operated Emergency Shut Down, (ESD), switches shall have one pole to effect the shutdown directly and a second pole to instruct the SIS to effect a shutdown. This will provide a log of operator based ESD initiation.

SIS field sensors and their associated wiring shall have indication or a warning tag to indicate that tampering with the equipment may initiate a shutdown.

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10.2.2 Field Actuators

Field Actuators, which may include solenoids, valves, or motors, shall be separate from solenoids, valves or motors that are part of the BPCS.

Wiring for SIS actuators shall be run in cables, conduits and junction boxes that are separate from the wiring for BPCS sensors. SIS field actuators and their associated wiring shall have indication or a warning tag to indicate that tampering with the equipment may initiate a shutdown.

10.2.3 Logic Solving Hardware

High quality hard – wired relay systems, may be used for very simple systems with the written approval of the Suncor Instrument Engineer. It is not expected that there will be systems simple enough to apply relay solutions at Firebag.

Programmable electronic systems will be used for nearly all of the logic solving hardware in Suncor SISs. These may consist of one or more Programmable Logic Controllers (PLC)s a dedicated BPCS or much more likely, a purpose built SIS. Whichever of these is used, the reliability of the SIS must be certified by TUV for the highest SIL that has been identified for the process. That is to say that for a process that has been evaluated and found to have 33 SIL1 functions, 5 SIL2 functions and 1 SIL3 function, the SIS logic solving hardware must be TUV certified for SIL3.

Although Suncor's requirement is for an SIS that is operationally independent of the BPCS, certain non-operational functions of the SIS may be accomplished by the BPCS. For example, the Human Machine Interface (HMI), will be implemented by the BPCS. This is considered to be non – operational because the SIS is capable of shutting down the system even if the BPCS fails. Another non-operational function includes logging. Each shutdown event must be logged by a Sequence of Events (SOE) recorder that is capable of recording the trip time to the nearest 1 millisecond. This must be done by SIS, since BPCS is incapable of such time precision. This function also requires that the SIS be continuously synchronized to the BPCS clock. To accomplish this logging, the SIS must time stamp each shut – down event and send a message to the BPCS that identifies the trip event and the time of occurrence of the trip event. The BPCS will then include this information in its historian. For these and other reasons, Safety Instrumented Systems must have a proven record of interfacing with the type of BPCS that will be used on the project.

The SIS hardware shall be powered by two power supplies, one of which shall be based on a battery supplied UPS.

SIS inputs / outputs shall be optically isolated.

10.2.4 SIS Element Redundancy

Depending on the SIL for each Safety Instrumented Function (SIF), consideration may be given to the need for redundancy of each element. Arithmetic formulae allow calculations to be made of the reliability of the SIF. If the reliability of the sensor appears to be limiting the overall system reliability, consider redundant sensors in a voting arrangement. Be aware, however, although one out of two voting will increase the likelihood of a safe system, it will also increase the likelihood of a nuisance shut-down. A similar situation exists with actuators, but while using two out of three voting for sensors may be affordable, the same solution may not be affordable for valves.

If highest SIL required for a process is SIL1, the logic solving hardware may be accomplished by a single PLC or a second BPCS dedicated to the SIS function. For SIL2 or SIL3, built for purposes SIS will be needed. Such devices are designed with 2 out of 3 voting input and output signals, and have extensive self diagnostics. Equipment that is available for use as logic solving hardware in Safety Instrumented Systems are type tested and certified by TUV, a German testing agency, against DIN, IEC or ISA standards. Use of a SIS logic solving device with less than SIL3 certified rating requires written approval by the Suncor Instrument Engineer.

10.2.5 SIS Diagnostics, Testing and Maintenance

Each SIS logic solving hardware will have a self diagnostic program. The results of this program, including alarms and status reports must be made available to the plant operator on a pre-established schedule. In addition, certain diagnostics of the sensors, wiring and actuators may be required. Examples of this would include open circuit or short circuit testing of wiring from the SIS to the sensor or solenoid. If such diagnostics are installed, reports must be available to the plant operator. Alarms indicating failure or impending failure of parts of the SIS shall be sent to the BPCS for logging.

As part of design, each safety instrumented function shall have a testing interval calculated and documented and a testing procedure written and approved. The testing interval shall be determined in conjunction with operations, Maintenance, Engineering and Risk Management. If testing interval is less than the expected plant turn-around interval, the testing procedure must provide for testing while the plant is operating. The testing procedure must include the entire loop including sensor(s), wiring, logic solving hardware and field devices.

Certain elements of the SIS may have a requirement for more frequent testing than other elements in order to meet the SIL requirement. If so, the design shall include testing intervals and testing methods written and approved for each of these elements. These tests shall be developed assuming that the testing will be done without shutting down the plant.

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Maintenance and calibration of individual SIS sensors and actuators shall be facilitated by a Maintenance By Pass switch system. This system shall reside in the BPCS, shall be enabled by a hardware key and password, and shall be time limited. The intent is that a device that is scheduled to be maintained on a particular day will have its By Pass switch enabled. The BPCS shall log the time of enabling, and shall generate an alarm if the By Pass is not deactivated within the predetermined time. In addition, the process graphic shall indicate any device that is in By Pass mode so that the operator will be aware of the By Pass.

11.0 TRANSMISSION SYSTEM

11.1 SYSTEM FOR ELECTRICAL SIGNALS

11.1.1 General

The choice of cable / tray systems versus conduit should be made based on an economic analysis. The most cost effective method that meets technical requirements shall be implemented.

The remainder of this specification is to be read in conjunction with the applicable sections of Firebag Program Technical Standard FB-P-5506, "General Electrical Installation Requirements". In the event of a conflict, the latter takes precedence.

11.1.2 Regulatory Codes and Recommended Practices

The instrument wiring shall conform to the local rules and regulations of the jurisdiction within which the equipment is installed and with the latest requirements of the Canadian Electrical Code CSA – C22.1.

Intrinsically safe wiring shall only be used with the approval of the Owner's Instrument Engineer and when explosion – proof equipment is not available.

11.1.3 Engineering Factors for Wire Type Selection

In general, shielded instrument transmission wire shall be provided for 4 – 20mA DC signals, thermocouples, RTD's, analyzer signals, vibration monitors, tachometers, turbine meters, and other low voltage devices.

Shielding of alarm and field switch contact wiring is not required; however, it is felt that for the small incremental increase in cost and added flexibility (e.g., use in transmitting some analog signals along with the discrete signals from a remote location), shielding shall be considered for alarm and field switch multiconductor cables. Suncor Instrument Engineer shall provide written ruling for this based on project complexity.

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The intent of this requirement is to provide maximum flexibility in the future, when a remote analog type signal must be transmitted into the control room and no existing 4 – 20 mA DC wiring spares are available. In this case, a pair of the alarm / field switch multiconductor cable may be used for transmission of this analog signal, because it is already shielded and interferences between pairs will be negligible. However, single pair armoured cable for alarm and field switches shall not require shielded wire.

11.2 INDUSTRIAL PROCESS CONTROL WITH MILLIAMPERE SIGNALS

The standard current analog signal shall be 4 – 20 mA at a nominal 24VDC.

Single and multipair cable for analog current signals shall conform to Firebag Program Technical Standard FB-P-5575, "Power, Control and Instrumentation Cables". Special consideration for voltage drop shall be made in determining wire size for long runs.

Analog voltage signal wiring shall have individual shields and drain wires. HART signals, which include a low current digital signal superimposed on an analog signal, shall be treated as analog signals for purpose of this discussion.

Discrete signals (i.e. on/off) need not have individual shields and drains unless specified by the associated equipment vendor.

11.3 INDUSTRIAL PROCESS CONTROL AND COMPUTERS

Performance, reliability and warranties of process computers and DCS systems are closely tied to wiring and grounding practice and materials. Manufacturer's recommendations and site installation manual shall be followed explicitly when installing or maintaining wiring associated with these systems.

11.4 LOW IMPEDANCE SENSORS TO INDUSTRIAL PROCESS CONTROLS

Thermocouple extension wire shall conform to the specifications outlined in Firebag Program Technical Standard FB-P-5575, "Power, Control, and Instrumentation Cables". Wiring between pH/ORP electrodes and the preamplifier shall have lengths minimized and specifications meeting or exceeding manufacturer's recommendations.

Thermocouple extension wiring shields are always to be grounded at the instrument and never to the head. Grounded thermocouple are not to be used.

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11.5 GUIDES ON SEPARATION

Separate cables, conduits, and junction boxes are to be provided for the following:

- a. SIS LV Analog Signals.
- b. BPCS LV Analog Signals.
- c. SIS LV Discrete Signals.
- d. BPCS LV Discrete Signals.
- e. Thermocouple Signals.
- f. Intrinsically Safe Signals.
- g. Fire Alarm Signals.
- h. Gas Detection Signals.
- i. 120V Signals.