Engineering Standard

SAES-J-100 31 December, 2003

Process Flow Metering

Saudi Aramco DeskTop Standards

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1 Scope

This standard defines the minimum mandatory requirements governing the design and installation of process flow instruments.

The requirements of this standard are additions, exceptions, modifications, or deletions to the requirements of Process Industry Practice PIP PCCFL001 *"Flow Measurement Criteria" (June, 1998)* as referenced in Section 5 of this standard.

2 Conflicts and Deviations

2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

2.3 Where the PIP Standard refers to *"Owner's approval"*, the Owner approval shall be Supervisor, Instrumentation Unit, Dhahran.

3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-J-002	*Technically Acceptable Instruments*
SAES-J-003	*Basic Design Criteria*

Saudi Aramco Materials System Specifications

34-SAMSS-117	*Turbine Flow Meters*

34-SAMSS-118	*Positive Displacement Meters*

Saudi Aramco Software

Oricalc 2	*Orifice Sizing Software*

Saudi Aramco Standard Drawings

AD-036004	*Orientation for Orifice Flanges*
AB-036094	*Standard Orifice Plates*
AC-036413	*Raised Face Orifice Flange Assembly*
AB-036414	*Ring Joint Orifice Flange Assembly*

Saudi Aramco Forms and Data Sheets

SA 3175-ENG	*Orifice Plate Detail for RF Flanges*
SA 8020-116-ENG	*Instrument Specification Sheet - Venturi Tube Specification and Calculation*
SA 8020-117-ENG	*Instrument Specification Sheet - Turbine Meters*
SA 8020-118-ENG	*Instrument Specification Sheet - Liquid Positive Displacement Meters*

3.2 Industry Codes and Standards

American Petroleum Institute

API MPMS 14.3.2	*Natural Gas Fluids, Concentric, Square-Edged, Orifice Meters, Specifications and Installation Requirements*

Process Industry Practices

PCCFL001	*Flow Measurement Criteria (Revision June, 1998)*
PCIDP000	*Differential Pressure Installation Details*

4 Design

4.1 Environmental Conditions

4.1.1 Process flow metering instrumentation shall meet the relevant requirements of SAES-J-003 pertaining to indoor and outdoor environmental conditions.

4.1.2 Technically acceptable vendors shall be used for process flow metering instrumentation per SAES-J-002.

5 Additions, Exceptions, Modifications, and Deletions to Process Industry Practice PCCFL001 *"Flow Measurement Criteria"*

The following paragraph numbers refer to Process Industry Practice PCCFL001 (PIP), which is part of this standard. The text in each paragraph is an addition, exception, modification, or deletion to PCCFL001 as noted. Paragraph numbers not appearing in PCCFL001 are paragraph additions inserted in numerical order.

PIP 3.2 (Addition) Saudi Aramco ISS form 3175-ENG shall be used as a substitute for ISA S20.21 - *Orifice Plate and Flanges*.

ISS form 8020-116 shall be used for Venturi Tubes.

ISS form 8020-117 shall be used as a substitute for ISA S20.24 - *Turbine Flowmeters*

ISS form 8020-118 shall be used as a substitute for ISA S20.25 - *Positive Displacement Flowmeters*

PIP 4.1.1a (Addition) Calculations shall be attached as an additional sheet(s) to the specification sheet.

PIP 4.1.1b (Addition) For Orifice and Venturi sizing, software calculations may be made using Oricalc2 or The Flow Consultant by R.W. Miller.

PIP 4.1.4 (Addition) Standard Conditions: The standard reference atmospheric conditions shall be 15°C (60°F) and 101.325 kPa (abs) (14.7 psia).

Engineering units of volume at standard reference conditions shall be standard cubic meters, with standard cubic feet in parentheses (scf).

PIP 4.1.5 Default Metering Uncertainty shall be 1%.

PIP 4.2.4 (Addition) Thermowells shall be located a maximum of 20 nominal pipe diameters downstream of the meter.

PIP 4.2.7 (Addition) Orifice Plates

PIP 4.2.7.1 Orientation shall be per Standard Drawing AD-036004.

PIP 4.2.7.2 All parallel pipe lines with adjacent orifice flanges or orifice fittings shall have a minimum spacing of 300 mm (12 in) between flange outside diameters if horizontal taps are required. Where this spacing is not possible or practical, taps may be reoriented per Standard Drawing AD-036004.

PIP 4.2.7.3 (Addition) Orifice flanges in adjacent lines shall be staggered so that no two pairs of orifice flanges are less than 1 m (3 ft) apart.

PIP 4.2.7.4 (Addition) Fabrication of Orifice Plates shall following Standard Drawing AB-036094.

PIP 4.2.8 (Addition) Interconnecting Piping

PIP 4.2.8.1 Interconnecting instrument piping (tubing) between the primary metering element and the measuring instrument shall be 0.5 inch AISI Series 300 stainless steel tubing minimum. Tubing wall thickness shall be 0.89 mm (0.035 inch) minimum. Applicable piping code and process requirements shall prevail.

PIP 4.2.8.2 Interconnecting piping shall be limited to a maximum length of 6 m (20 ft) for meters in control loops. Interconnecting impulse tubing between a differential flow element and a transmitter in compressor suction service shall be kept as close as possible or close coupled.

PIP 4.2.8.3 Interconnecting Seal liquid to protect flow meter impulse tubing and secondary measurement instrumentation from corrosive fluids or to provide a stable hydraulic measuring medium shall be free flowing but not volatile under normal process and external ambient conditions. Seal liquids shall not be miscible with nor react with the process fluid being measured. Seal liquids shall be selected so that their potential for contamination of the process fluid is acceptable.

PIP 4.2.8.4 (Addition) PIP PCIDP000 "Differential Pressure Installation Details" shall be used for interconnecting the flow Differential Pressure Instruments to the root valves of the differential producers.

PIP 4.6.2.c (Addition) Purging of impulse lines shall be considered only if other methods have failed to eliminate problems of condensation, vaporization, corrosion or plugging.

PIP 5.1.4 (Addition) Orifice plate thickness shall be fabricated per Standard Drawing AB-036094. The downstream edge shall be beveled at a 45 degree angle, as specified in Standard Drawing AB-036094.

Commentary Note:

The orifice plate dimensions / tolerances and bevels shown on drawing AB-036094 based on the guidelines of API MPMS 14.3.2.

PIP 5.1.5 (Addition) The use of a Drain or Vent hole shall be as follows:

Vertical Meter Run – No hole.

Horizontal Meter Run, Wet Gas or Saturated Steam – One drain hole, bottom location.

Horizontal Meter Run, Gas Entrained Liquid service - One vent hole, top orientation.

PIP 5.1.6 (Exception) For nominal sizes 14 inches and larger, a Class 150 minimum is acceptable. For CPVC piping Class 150 minimum is acceptable.

PIP 5.1.6 (Addition) All orifice flanges are to be weld-neck with an internal bore to match the internal diameter of the pipe. Any distortion resulting from the butt weld shall be removed and ground flush with the inside diameter of the pipe.

PIP 5.1.12(a) (Addition) Vertical office runs are acceptable for general process flow measurement. (Non-Custody / Royalty measurement.)

PIP 5.1.12(b) (Exception) Flange taps shall be used for all orifice meter installations. The tap connections shall conform to Standard Drawing AC-036413 or AB-036414.

PIP 5.1.15 (Addition) Table 1 shall be used for straight run requirements. For new orifice plate installations, a beta ration of 0.75 shall be assumed when determining the minimum length of straight piping required.

PIP 5.1.16 (Addition) Orifice bore beta ratios shall be between 0.20 and 0.70, except that a beta ratio of 0.75 is acceptable for orifice plates in 24 inches and larger pipelines that require low pressure losses.

PIP 5.1.19 (Addition) All double chambered fittings 12 inch nominal and larger shall be mounted in a horizontal line with chamber access fitting facing upward.

PIP 5.1.20 (Addition) Orifice plate orientation shall be per Standard Drawing AD-036004.

PIP 5.1.21 (Addition) Static pressure compensation, when required, shall utilize measurements taken from the downstream flange tap static pressure line.

PIP 5.2.1 (Addition) A flanged drop out spool section shall be provided upstream of the flow nozzle for inspection and maintenance.

PIP 5.2.5 (Addition) Pipe sections for the installation of flow nozzles shall be stamped with the number of the element, the element location in the pipe, the pipe internal diameter and the direction of flow.

PIP 5.6.7 (Addition) Viscosity compensated turbine meters shall not be used.

PIP 5.6.8 (Addition) All turbine meters and their installations shall comply with 34-SAMSS-117.

PIP 5.6.9 (Addition) Double pick-up coils are not permitted when their purpose would be to increase the metered pulse rate.

PIP 5.7.6 (Addition) Positive displacement type meters shall comply with 34-SAMSS-118.

PIP 5.7.7 (Addition) Positive displacement meters shall be sized to operate between 30% and 80% of the upper range value of the nameplate rating.

PIP 5.11 (Exception) Ultrasonics may be used without Owners approval for insertion type transducer flare gas measurement.

PIP 5.14 (Addition) Flow Switches

Vane (paddle) type flow switches shall not be used.

PIP 5.15 (Addition) Transmitters, Indicators

PIP 5.15.1 Field instruments (transmitters, indicators, I/Ps, etc.) shall be installed in an accessible location with centerline 1.4 m (nominal) above grade or platform as close as possible to the flow element.

PIP 5.15.2 Differential pressure transmitters (unless close coupled using manifolds) and bellows type meters shall not be installed on process piping but on a separate instrument stand or column. A 3-valve or 5-valve manifold close coupled to the instrument shall be used.

PIP 5.15.3 Multivariable smart transmitters shall be used for Temperature-Pressure compensated flow loops whenever possible.

PIP 5.15.4 The following electronic flow meters and transmitters shall be smart:

DP Head Transmitters

Magnetic Flow Meters

Coriolis Mass Flow Meters

Thermal Mass Flow Meters

Vortex Shedding Flow Meters

Revision Summary

31 December, 2003	Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with no other changes.