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Manual Sampling Systems

GP 03-02-07

Scope

- 1) [I] This Global Practice (GP) covers the design and installation of facilities to obtain samples of liquid and gaseous materials from piping and process equipment, and fluidized solids particles from regenerator catalyst and coke transfer lines.
- 2) [I] Where an asterisk (*) is used in a Practice, it indicates either of the following:
 - a) Additional information is required for adequate definition of individual requirements. Usually this information will be provided in the Job Specification; if not, it must be developed by the Purchaser during execution of the work.
 - b) A decision or approval by the Owner's Engineer is required.

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1. Required References

[I] This Section lists Practices and Standards that are generically referenced and assumed to be a part of this document. Unless otherwise specified herein, use the latest edition.

1.1. Global Practices–ExxonMobil Engineering Practices

GP 03-06-01	Piping for Instruments
GP 03-10-01	Piping Selection and Design Criteria
GP 03-18-01	Piping Fabrication Shop or Field
GP 15-08-02	Sample Transport and Sample Conditioning Systems for Process Stream Analyzers

1.2. Exxonmobil Data Sheets

Exxonmobil Data Sheets	ExxonMobil Data Sheet Home Page
D030207C01	Manual Sampling Systems - Manual Sampling Systems
T030207C01	Manual Sampling Systems - Manual Sampling Systems

1.3. ASME–American Society of Mechanical Engineers

ASME B31.3	Process Piping
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1.4. ASTM–American Society for Testing and Materials

ASTM D 1265	Standard Practice for Sampling Liquefied Petroleum (LP) Gases (Manual Method)
ASTM D 4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products IP Designation: IMPMS (Chapter 8.1)
ASTM D 5842	Standard Practice for Sampling and Handling of Fuels for Volatility Measurement



2. Definitions

[I] The following are definitions of terms specific to this GP:

Term	Definition
Volatile Sample	Any sample that has a dry vapor pressure in the range of 2 to 16 psia (13 to 105 kPa)
Toxic Sample	Any sample that will be harmful to humans through dermal exposure or classified as Respiratory Exposure Hazard Class R1, R2, or R3 by ExxonMobil Biomedical Sciences, Inc. (EMBSI)
Hazardous Sample	Any sample that is not permitted to be discharged into the atmosphere or into an open drain by any applicable authority

3. System Design

- 1) [I] Sampling facilities shall be designed to meet the following objectives:
 - a) Be representative of the process in terms of composition and time lag
 - b) Be safe for personnel by providing protection against dermal and respiratory exposure
 - c) Be environmentally friendly by providing appropriate containment of process fluids
- 2) * [S] Types of sampling facilities will be specified per Table 1.
- 3) [C] The sampling system shall be specified using datasheets [D030207C01](#) for documentation requirements and [T030207C01](#) for the design specifications.

[E] To minimize discharge to the atmosphere and the disposal of purged samples, a fast-loop design with the return line connected to an appropriate process point is preferred.
- 5) [C] If a process analyzer with a sample transport and conditioning system is planned or available for this sample stream, then the manual sampling system shall be incorporated into the sample system of the process analyzer. Such systems shall be designed according to [GP 15-08-02](#), and the design and supply of the manual sampling system shall then be in the scope of the supplier of the sample transport and conditioning system. Any exceptions shall be reviewed by the Owner's Engineer.
- 6) [I] If a suitable source of pressure drop is not available, the use of a pump or an eductor is acceptable. The selection of the pump and the utility consumption rates shall be subject to approval by the Owner's Engineer.
- 7) [C] The use of proven proprietary type sampling systems and valves are acceptable and encouraged if the benefits and cost are favorable compared to the standard designs referenced in Table 1.
- 8) [S], [I] The selection of the proprietary sampling system and valves plus installation details shall be submitted for approval by the Owner's Engineer.
- 9) [O], [S] If a "ram-type" valve is specified:
 - a) The piston shall extend approximately 1 in. (25 mm) into the pipe or vessel.

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- b) The valve shall have an indicator to show the position of the piston.
 - c) No block or check valves shall be installed in the sampling line for asphalt or materials of like viscosity.
- 10) [O], [S] For low-pressure gases where the maximum pressure at the sample point is 3 psig (21 kPa), inflatable Mylar bags may be used as sample containers. If the sample material is flammable, the area within 5 ft (1.5 m) of the bags is to be designated a Class 1, Division 2 (US) or Zone 2 (Europe). The Owner shall provide safe storage, such as laboratory fume-hoods or other well-ventilated areas, for sample bags awaiting analysis.
- 11) The sample station design for collecting low-pressure sample using inflatable bags shall be as per Figure 10 or Figure 11.
- 12) Type B sampling facilities are recommended for all volatile hydrocarbon samples unless ASTM D 5842 procedures are followed.

Table 1: Sampling Facilities

Use	System Type	Reference	Auxiliaries	Sample Cooler or Heater
Gas	A	Fig. 1	Fig. 5—Sample Tap	As required.
Liquids: Volatile or Hazardous or Toxic	B	Fig. 2	Fig. 5—Sample Tap	Cooler to be commercially available type or per Fig. 8.
Liquids: Non-Volatile and Non-Hazardous and Non-Toxic	C	Fig. 3	Fig. 5—Sample Tap Fig. 6—Sample Discharge Fig. 7—Sampling Funnel	Heater to be commercially available types or designed for the specific service.
Fluidized Solids Particles	D	Fig. 4	Fig. 5—Sample Tap *(Details to be specified) Fig. 6—Sample Discharge Fig. 9—Sample Enclosure	Not required.
Low Pressure Gas Sampling Using Bags	E1 or E2	Fig. 10 or 11	None	As required.
Note: See Appendix for Figures				

3.1. Cooling/Heating for Liquid and Gas Samples

- 1) [S] Sample coolers shall be used if required to cool the sample to 140°F (60°C) or lower, but:
- a) Not below a temperature that would result in a viscosity greater than 500 cP
 - b) Not to a temperature less than 25°F (14°C) above the pour point and the freezing point of the sample.
- 2) [C] The use of a horizontally installed finned pipe heat exchanger is preferred over a water-cooled heat exchanger.
- 3) [O] The design of air coolers shall take into account the hottest months of the year as well as local heat sources.



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- 4) [I] The sample cooler or heat exchanger heat duty calculations and required cooling water flow rates shall be documented for review by the Owner's Engineer.
- 5) [R] Coolers for tar, asphalt, residuum, and waxy streams shall use co-current flow of water and the fluid being sampled, and a water pre-heater, to avoid plugging of the cooler.
- 6) * [R] For samples having a pour point or a freezing point above the lowest ambient design temperature, or having a viscosity greater than 500 cP at the lowest ambient design temperature, sample heaters shall be used to ensure its flow into the sample container. Heaters shall raise the temperature of the sample to 25°F (14°C) above the pour point or freezing point of the sample, or lower the viscosity to 500 cP.
- 7) [O] Temperature indicators for the process sample exiting the cooler shall be provided. Coolers for tar, asphalt, residuum, and waxy streams shall have temperature indicators for both exiting process sample and coolant.

3.2. Lighting

[O] A minimum in-service illumination level of 20 ft candles (215 lux) shall be provided for sampling facilities. If lighting is provided specifically for the sampling system, a local switch shall be provided.

4. Sample Connections

- 1) [S], [O] The final locations of sample points shall be governed by the following considerations for personnel safety and accessibility:
 - a) They shall be convenient to normal operating locations as far as practicable.
 - b) The sample points preferably shall be accessible from ground level. If this is not practical, they shall be accessible from permanent platforms.
 - c) At least two escape routes shall be available for personnel.
 - d) They shall allow personnel to stand upwind, based on the prevailing wind pattern.
 - e) They are not to be in areas of possible contamination if a spill of a hazardous material should occur (e.g., they shall not be in areas inside pump toewalls).
- 2) [O] Sample tap positioning shall be per the following:
 - a) Liquid or gas streams—Sample taps shall be not closer than 20 pipe diameters downstream or 10 pipe diameters upstream from the junction of two streams. Where two-phase flow can exist, sample taps shall be no closer than 12 pipe diameters downstream from a pressure reducer.
 - b) Fluidized solids streams—Sample taps shall be not closer than 8 pipe diameters downstream or 2 pipe diameters upstream from a junction of two fluidized solids streams, an elbow, valve, or other flow disruption.
- 3) [O] Sample tap orientation shall be per the following:
 - a) Where possible, sample taps should be installed in vertical lines with upward flow for liquids or downward flow for gases or vapors.
 - b) If sample taps are installed in horizontal lines, side entry is preferred for liquids and top entry for gases or vapors.
- 4) [S] Process vents and drains shall not be used as sample connections.

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- 5) [O] Sample connections shall not be used for the installation of indicators or other instruments that are extraneous to the sampling operation.
- 6) [R], [O] Sample systems shall be designed with sample cylinder connections for interchangeable (identical), site-approved, sample cylinders. Cylinders must meet the pressure rating of the system.
- 7) [S] All sample cylinders shall have an ullage dipleg to allow for thermal expansion.

5. Piping

5.1. Design

- 1) [I] After selection of an appropriate source of pressure drop, the hydraulics calculations shall be performed to select smallest size pipe or tubing that will result in maximum 60 seconds transport delay between the sample takeoff point (at the process pipe) and the sample collection point. Transport delay calculations shall take into account any sample cooler or heater between the two points. The hydraulics calculations shall be submitted for review by the Owner's Engineer.
- 2) [S] Sample piping shall be as short as possible and shall be adequately supported and braced to minimize the possibility of damage by vibration, accidental impact, or reaction forces caused by valve operation. For long sample piping runs, expansion loops shall be provided to minimize warping or damage due to temperature variations.
- 3) [S] Soft sealed ball and plug valves shall not be used as block valves on lines discharging to the atmosphere.
- 4) [S] For sample fluids that may plug or corrode the piping if left standing, provision for manual flushing of both the sample supply line and the sample return line shall be made. The selection of flushing fluid shall be reviewed with the Owner's Engineer.

5.2. Materials

- 1) * [R] The materials for sample systems shall be as per [GP 03-06-01](#). Any exceptions shall be approved by the Owner's Engineer.
- 2) * [S] If there is a possibility that the sample stream temperature can be below -20°F (-29°C), including when the low temperature results from flashing, all materials shall have suitable low-temperature properties.
- 3) [S] Sample heaters and coolers shall be designed for the pressure/temperature conditions of the stream being sampled. Materials of construction shall be suitable for the process fluid.

6. Testing

- 1) [S] Hydrostatic testing:
 - a) All piping shall be hydrostatically tested per ASME B31.3.
 - b) Austenitic stainless steel piping and tubing shall be tested and flushed with water having less than 500 ppm (500 mg/L) of chlorides. Potable water will meet this requirement. The piping and

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