MANUAL

ON-LINE PROCESS STREAM ANALYSIS
- SAMPLE TAKE-OFF AND TRANSPORTATION

DEP 32.31.50.10-Gen.

October 1995
(DEP Circular 44/99 has been incorporated)

DESIGN AND ENGINEERING PRACTICE

PREFACE

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Shell International Oil Products B.V. (SIOP)
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They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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1. INTRODUCTION

1.1 SCOPE

This DEP gives requirements and recommendations for the design and construction of systems for sample take-off and transport of the sample to on-line process stream analysers. This DEP is a revision of the DEP of the same number dated March 1992.

This DEP is one of a series of on-line process stream analysis DEPs.

The other publications are:

DEP 32.31.50.11-Gen.	Sample conditioning
DEP 32.31.50.12-Gen.	Analysers
DEP 32.31.50.13-Gen.	Analyser Houses

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C" as described in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants, exploration/production and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates, and ultimately pays for, the project. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions and abbreviations

Analyser application engineering	The activity of detailing the scope of the analytical measurement and its application.
Analyser data sheet	Compilation of technical details as a direct result of analyser application engineering.
Fast loop	Refers to a sample transport system that returns the waste sample to the process.

PEFS	Process Engineering Flow Scheme.
Piping class	An assembly of piping components, suitable for a defined service and design limits, in a piping system. MF piping classes are contained in DEP 31.38.01.12-Gen. EP piping classes are contained in DEP 31.38.01.15-Gen.
Process line	The piping used for transport of fluids (other than sample lines).
Sample	A representative portion of the product or process stream having all relevant properties of the product or the process stream itself.
Sample conditioning system	One or more devices that properly prepare a portion of the sample from the sample transport system for testing by the process analyser to meet the requirements of the analyser.
Sample line	The tube or pipe used for transporting the sample.
Sample pre-conditioning system	Consists of one or more devices that condition the sample (pressure, temperature, flow, change of state) such that it is suitable to be transported to the sample conditioning system. The sample pre-conditioning system forms part of the sample take-off system.
Sample probe	A device (usually in the form of a special tube) that is inserted into a defined point in the bulk of the process stream to extract a small portion as a sample.
Sample recovery system	A system that collects waste sample and/or by-products from the analyser system for the purpose to either return it to an assigned point of disposal or to a suitable point in the process.
Sample take-off connection	A piping connection for the extraction of the sample from the process line through which a sample probe may be inserted into the process.
Sample take-off point	The exact location from where the sample is extracted in the process, i.e. the location of either the tip of the sample probe or the pipe wall connection from where the sample fluid leaves the process piping.
Sample take-off system	The system that includes the sample probe and downstream components up to the connection with the sample transport system.
Sample transport system	A system used to transport a sample from the sample take-off, either to the sample conditioning system (and from there to the analyser) or directly to the analyser, and to return the waste sample, if any collected, from the sample conditioning system, either to a suitable point in the process or to a suitable utility system.
Sampling system	The complete system that includes the sample take-off, sample transport and sample conditioning systems.
Secondary loop	A circulating loop, part of the sample transport system, which is applied to reduce the lag time caused by components such as filters, coalescers, etc., and/or to reduce the quantity of a sample entering the analyser house. The secondary loop is part of the sampling conditioning system.
Single line sample transport	Refers to a sample transport system that returns the waste sample to a utility system.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (7).

2. INSTALLATION OF SAMPLE TAKE-OFF CONNECTIONS, SAMPLE PROBES AND SAMPLE PRE-CONDITIONING SYSTEMS

2.1 LOCATION

The sampling point shall be selected at a point in the process such that:

- the handling of the equipment will not impair the safety of personnel or the plant;
- a representative and timely information on the properties or composition of the process stream is obtained;
- it is optimised for accessibility;
- lag times of the process are minimised (e.g. whether to sample upstream or downstream of a process vessel, heat exchanger bank, etc.);
- temperature, pressure, or other conditions are as close as possible to the required specification for the analyser.

Particular care should be taken to avoid locations where there is a possibility of contamination, or where pockets of gas/vapour/liquid or hydrocarbon/water/dirt may accumulate in the process stream.

In order to ensure representative sampling, samples should normally be taken from a point where there is no possibility of having a two-phase situation.

Typically good locations for sample take-off and sample return connections are respectively the discharge and the suction side of pumps or compressors.

2.2 PRE-DESIGN ASPECTS

For each system it shall be decided separately whether piping or tubing shall be used for sample transport lines. Tubing shall be used unless:

- the required sample volumes to be circulated can not be accommodated;
- lag times become too long due to relatively small sample volumes.

For tubing, refer to Section 3.3.2.

Piping shall be in accordance with the piping class.

To avoid excessive distances between the sample take-off point and the analyser, the Contractor shall prepare, during the detailed engineering phase, adequate drawings for the routing of the system, the location of the sample take-off and return points, preconditioning system, booster pumps etc. For typical examples, see Appendix 4.

NOTE: Heating of sample transport lines shall be independent of process conditions (i.e. the heat of the process piping shall not be used to heat the transport line).

2.3 INSTALLATION OF SAMPLE TAKE-OFF CONNECTIONS AND TRANSPORT LINES

2.3.1 General

Analyser application engineering is a prerequisite before deciding on aspects covered in this DEP.

Sample lines, block valves at sample take-off/return points, booster pumps, emergency valves etc. shall be identified with the service (e.g. "sample from top of V-301", "sample final gas oil to tankage", etc.).

2.3.2 Selection of materials

The process conditions and the nature of fluid shall be taken into consideration when selecting materials.

AISI 316 stainless steel should be used for all wetted parts of the sampling system. Sample lines in piping shall adhere to the piping class.

The use of non-metallic materials require the Principal's approval.

2.3.3 Sample take-off connections

Sample take-off connections shall be installed in accordance with the branch table of the relevant piping class.

Taking a sample from a vertical process line is the preferred method.

Sample take-off connections for gaseous products in horizontal process lines shall be installed on the top of the lines.

Sample take-off connections for liquid products in horizontal process lines shall be installed on the side of the process line.

2.3.4 Sample shut off valves

Process shut-off valves shall be in accordance with the piping class and should be ball valves.

NOTE: Ball valves have a temperature limit, see the piping class.

2.3.5 Sample transport lines

If the viscosity of the sample is higher than 1 Pa.s at 30 °C (e.g. long residue), the size of the transport line shall be DN 25 minimum to avoid clogging.

Bituminous applications typically require short sample lines with a minimum size of DN 50.

Sample lines in piping shall be terminated at the analyser house by a welded flange with a cover flange. Sample lines in tubing are directly connected via a union or tube connector to the corresponding sample conditioning system at the analyser house.

Tubing (also "bundle tubing") shall be supported, e.g. by a ladder frame or U profile. The tubing shall be fastened by stainless steel clips (grade AISI 316). For ladder frames appropriate clips shall be used.

The ladder frame or U profile shall be routed along the structural steel and shall be supported to meet the load requirements.

For sample lines made of tubing, dual ferrule compression fittings shall be used.

The number of joints in sample transport lines shall be kept to a minimum. The method of jointing shall permit an unimpeded flow.

To enable easy detection of potential sources of leakage, the location of joints in insulated sample transport lines shall be clearly identified on the outside of the insulation.

2.3.6 Flushing (fluid) connections

Sample transport lines shall have flushing connections at the sample take-off and at the sample return point for the following services:

- products having a pour point higher than the minimum ambient temperature, in which case flushing oil shall be used as the flushing medium (see Appendix 3, Figure 3.10);
- products, as specified by the Principal, which are to be prevented from coming into contact with personnel.

The flushing medium inlet connection shall be immediately downstream of the sample take-off point. Block and bleed valves shall be provided if there is a risk of contamination of the process medium.

2.3.7 Sample pre-conditioning system

A booster device shall be installed if insufficient process pressure is available or if the sample viscosity is too high to achieve the lag times specified in the analyser data sheet. The selection of a booster is a matter of economy and could typically be a pump, compressor, eductor, etc.

2.3.8 Cooling, heating and winterization

Heat tracing by steam, hot water or electricity shall be applied to the sample take-off point, the pre-conditioning system and the sample transportation lines if at these points freezing or solidification of a liquid sample or condensation of a gaseous sample may occur at minimum specified ambient conditions. The sample temperature should be at least 10 °C higher than the highest possible dew point of the sample. Furthermore, heating may be applied:

- to reduce adsorption/desorption effects of trace components by the wetted surfaces of the sampling system (refer to 3.3);
- for liquid evaporation (refer to 3.2.);
- to control the sample temperature to the specification of the analyser or the sample conditioning system.

Cooling shall be applied to the sample take-off point, the pre-conditioning system and the sample transport lines if at these points evaporation of the liquid sample may occur at maximum specified ambient conditions. Furthermore, cooling may be applied :

- to improve the separation of liquids by coalescence;
- to control the sample temperature to specification of the analyser or the sample conditioning system.

The choice between electrical and steam trace heating shall be governed primarily by the required heating capacity followed by minimising life cycle costs.

Electrical trace heating shall be in accordance with DEP 33.68.30.32-Gen.

Steam heating shall be in accordance with DEP 31.38.30.11-Gen.

Heating components shall meet the area temperature classification as indicated on the area classification drawings.

Systems which may contain free sulphur shall be provided with temperature controlled heat tracing.

Cooling should be applied either by tap water or chilled water from a closed loop system.

2.3.9 Pressure protection

The pressure rating of selected components shall cope with the design conditions.

If the pressure in the system may exceed this condition, pressure relief valves shall be used; e.g. heated or heat traced lines which may be blocked in, shall be provided with a thermal relief valve. Relief fluids shall either be returned to the process or to the flare or to an assigned point of disposal. Disposal of relief fluids to a safe atmospheric location requires the Principal's approval.

These provisions are normally installed at the analyser house end of the sample transport system, unless they are to protect against excessively high pressures in the process. In that case, the relief valves shall be located at the sample take-off location.

2.4 CIVIL ASPECTS

Sample take-off connections and/or sample pre-conditioning systems shall be installed such that they are readily accessible from grade or from permanent platforms.

If a booster pump is required, it shall be installed at ground level on a concrete slab.

Insulation of sampling components shall be in accordance with DEP 30.46.00.31-Gen. or DEP 30.46.00.32-Gen. as applicable.

2.5 ELECTRICAL ASPECTS

DEP 33.64.10.10-Gen. shall apply.

Pumps and compressors shall have a local isolating switch, shall have adequate lighting and shall be provided with weather protection as required for that type of pump or compressor.

Electrical apparatus for use in gas hazardous areas shall have a type of protection as defined in IEC 79-14. Installation shall be in compliance with local regulations.

2.6 INSTRUMENTATION. COMMON ASPECTS FOR SAMPLE TAKE-OFF, PRE-CONDITIONING AND SAMPLE TRANSPORT LINES

See also Section 3.

Amended per Circular 44/99

Sample take-off and sample pre-conditioning systems shall be installed and mounted similar to instruments covered by DEP 32.31.00.32-Gen.

Sampling systems for two-phase products shall be designed in consultation with Principal.

Mounting direction and distances "M+L" (See Appendix 2) of sample probes shall be checked immediately after installation.

3. DESIGN OF SAMPLE PROBES, SAMPLE TRANSPORT LINES AND SAMPLE PRE-CONDITIONING SYSTEMS

3.1 SAMPLE PROBE SELECTION AND SAMPLE TAKE OFF CONNECTIONS

The mechanical design, engineering and construction criteria for sample take-off connections shall be in accordance with the specified piping class.

The mechanical design and construction of sample probes shall comply with the same code as the process piping. The sample probe shall be constructed in accordance with the examples of Appendix 2. If the examples of Appendix 2 are not considered fit for purpose, the Principal shall be consulted.

Unless otherwise specified by the Principal, a sample probe shall not be used for process lines of DN 80 or less.

The maximum allowable internal diameter of the probe is governed by the impact of the sample hold-up time on the overall response time, while the minimum allowable size is governed by the viscosity of the sample and the possibility of fouling, e.g. particle size of contaminants in the sample flow. Reference is made to the analyser date sheets for specific process data.

Impact tube sample take-off assemblies (Appendix 2, Figure 2.2) shall be used for cryogenic services; i.e. sample temperatures lower than -10 °C. The use of this type of sample probe requires the approval of the Principal. For estimation of the fluid velocity in the impact tube assembly it may be assumed that the average fluid velocity at the impact tube is approximately 1/3 of the fluid velocity in the process line.

The use of retractable probes is subject to the Principal's approval.

3.2 SAMPLE PRE-CONDITIONING

3.2.1 General

Sample take-off and transport systems shall be designed such that:

- a representative sample is ultimately delivered to the analyser;
- a minimum time-lag is obtained with a sample transport flow that shall not exceed 10% of the total process flow and should not exceed 300 litres/hour for a liquid sample or 300 litres/hour for a gaseous sample at standard reference conditions (101.325 kPa and 15 °C).

3.2.2 Design

Samples taken from process lines may require cooling, heating, pressure reduction or pressure boosting (refer Section 3.2.3).

Items for the pre-conditioning system shall be grouped together and shall be installed at or near the sample take-off point.

If heating is needed, the components should be installed in a heated box rather than heating and insulating the individual components. Where sample lines enter or leave the heated box, insulating grommets or similar shall be installed to avoid metal to metal contact with the enclosure.

All components selected for a preconditioning system should be rated for the relevant process conditions. When it is impractical to install the pre-conditioning system with the proper rating for the process conditions, a relief valve shall be installed after the pressure reducing valve in the pre-conditioning system.

The relief fluid should be returned to the process. If that is impractical, it shall be returned either to the flare system or to the drain system.

3.2.3 Sample pre-conditioning system components

For the components of sample pre-conditioning systems, the following shall apply:

1) For pressure reduction only:

   Pressure reduction of gas and vapour samples shall take place as close as possible to the sample take-off point, while the secondary pressure shall be chosen as low as practicable. The former reduces the hold-up time in the high pressure part of the sampling system and the latter reduces the amount of material circulating in the sampling system, thus overall reducing the time-lag of the sample.

2) For vaporisation of liquid sample:

   A vaporising device shall be used in combination with a pressure reducer if a liquid sample has to be analysed in the vapour phase (e.g. with chromatographs). The vaporiser may be an integral part of the pressure reducer (vaporising pressure reducer).

   The volume between the sample take-off point and the vaporiser shall be minimised in order to avoid a long sample lag time (when, for example, LNG is vaporised, its volume increase at 1 bar (ga) is approximately 635 times).

   The length of sample line between the sample probe and the sample pre-conditioning system shall be kept to a minimum while the insulation shall be continuous up to the vaporiser. Sufficient thermal insulation shall be applied to this section, so as to avoid flashing of the liquid prior to evaporation. The sample line diameter shall be as small as practicable.

   For cryogenic service, the pre-conditioning cabinet should be kept at a constant and elevated temperature, e.g. 30 °C, while the sample transport line downstream of the pressure reducer may require heat tracing, depending on the sample dew point at ambient conditions.

   The sample liquid flow to the evaporator shall be kept as constant as possible.

3) For preventing condensation of a gaseous sample:

   Either a vaporising pressure reducer or a separate vaporiser device (which shall be located upstream of the pressure reducer) is required if:

   • condensation (including retrograde condensation) may be expected upon pressure reduction. The sample shall be heated to a temperature well above the maximum temperature at which liquid and vapour coexist, while heating shall take place prior to expansion of the gas sample;

   • condensation (and subsequent freezing) or the formation of hydrates may occur on pressure reduction. The heat input shall at least compensate for the change in enthalpy upon pressure reduction.

4) A booster pump/compressor shall be used if either of the following conditions exist:

   • if the pressure at the sample take-off point is too low to create an acceptable lag time or if the sample might flash in the sample system (see 3.3.1, Liquid samples);

   • if the distance between the sample take-off point and the analyser location is too large to obtain sufficient velocity in the sample transport line with the available differential pressure.

The pump capacity should not exceed 10% of the minimum design flow for the relevant process line.

5) If rotameter type of flow indicators and flow regulating valves are installed:

   • metal tube type shall be used for hazardous products, as specified by the Principal;

   • a glass tube may be used for other services if the pressure does not exceed 1 bar (ga) and/or the flow is less than 5 l/h.

6) A pressure indicator shall be installed downstream of the pressure regulator. A pressure indicator should be installed upstream of the pressure regulator if no pressure indication is available within a distance of 5 m.

The design of sample pre-conditioning systems shall ensure that its components are readily accessible and can be removed with the minimum of disturbance to the system.

Sample pre-conditioning system components shall be shielded against cooling effects which may be caused by, for example, wind, rain, snow, etc.

3.3 SAMPLE TRANSPORT SYSTEMS

3.3.1 General design

If lag times are not specified in the analyser data sheet, the sample transport lines shall be designed for lag times of typically one minute or less.

The design of the sample transport system shall either take into account the presence of liquid in gaseous samples or vapour in liquid samples. The design shall therefore be either self-draining or self-venting.

To avoid flashing of the sample in the line, liquid samples in sample transport lines shall be at a pressure which is at least 20% higher than the absolute vapour pressure.

3.3.2 Specification of tubing for sample transport lines

1. General

   Sample transport lines using tubing shall be in accordance with DEP 32.37.10.11-Gen.

   If tubing needs to be installed over distances of more than 6 m it should be used from coils of the maximum practical length.

   Metallic contact between stainless steel (tube) and other metal parts shall be avoided. Non-metallic (e.g. Teflon or nylon) spacers shall be applied at fastening points if necessary.

2. The material

   Sample transport line material shall be selected to minimise the effects of adsorption/desorption (e.g. moisture) or chemical reaction with contaminants. In case of doubt, choice of material shall be subject to consultation with the Principal. In addition, heating (tracing) may be considered to avoid adsorption/desorption problems.

   The preferred type of tubing is seamless and in accordance with ASTM A 269 type 316.

   Sample transport lines for products in which traces of reactive compounds are to be measured (e.g. traces of hydrogen chloride, hydrogen sulphide, etc.) shall be treated to minimise chemical reaction between the sample and the tube. These sample lines shall be cleaned during commissioning (e.g. with solvent or pickling solutions) in accordance with the recommendations of the manufacturer of the analyser.

   Pre-insulated/pre-traced tubing shall be used for sample lines that need heating and/or winterization, unless its installation is impractical. The insulation material shall be in accordance with DEP 30.46.00.31-Gen.

3.3.3 The design of a single line sample transport system

See Appendix 3, Figures 3.1, 3.2, 3.3, and 3.4.

This system shall be considered if a suitable return point in the process is not available.

A balance shall be found between a short sample lag time and a minimum amount of sample disposed of via the by-pass.

3.3.4 The design of a fast loop system

1. General

   Sample conditioning systems form part of the fast loop. For details refer to DEP 32.37.10.11-Gen.

   The sample transport line sizes should be selected such that sufficient flow is created by the differential pressure between the take-off and return point in the process without the need for a pump or compressor.

2. Transport line lag time calculation

Lag time calculations should be performed by making use of a computer program which has been approved by the Principal. The results of lag time calculations shall be submitted to the Principal for approval.

3. Fast loops across plant equipment

Fast loops may be installed across certain plant equipment, e.g.:

- Pumps, because of the relatively constant differential pressure between discharge (sample take-off) and suction side (sample return);
- Process equipment: Differential pressure depends on the type of equipment.

As a design safety margin, the fast loop shall be calculated on the basis of 50% of the available pressure differential between sample take-off pressure and sample return pressure.

Fast loops shall not be applied across flow meters or control valves.

To minimise potential leakages and to keep the fast loop flow as high as possible, the number of joints shall be minimised, i.e. bends in pipes instead of elbows. The number of joints in sample transport lines shall be kept to a minimum. The method of jointing shall permit an unimpeded flow.

4. Booster-driven fast loops

These shall be applied in case of insufficient pressure. In case the vapour pressure of the sample is close to the process line pressures, fast loop pumps shall be installed close enough to the process line to prevent cavitation at the suction end.

The fast loop pump/compressor shall have sufficient capacity to create the required lag time.

Example:
Given:

Sample transport line length:	150	metres.
Sample lag time shall be within:	30	seconds.

Calculation:
Linear speed in fast loop: 150 / 30 = 5 m/s minimum.

Knowing the pipe diameter, the required volume flow rate per second can now be calculated.

An addition of 50% on the pump capacity should be applied.

5. Secondary loop

The driving pressure for a secondary loop is obtained from a restriction valve or a spring-loaded differential pressure valve in the sample conditioning system (see DEP 32.31.50.11-Gen.).

4. SAMPLE RECOVERY/DISPOSAL

4.1 GENERAL

Waste samples and/or by-products from the process of analysis shall either be returned to a suitable point in the process (e.g. pump suction) or to a suitable utility system (e.g. the flare system, fuel gas system or the oil-contaminated drain system), in which case the flare system option is preferred.

Details of the disposal of toxic waste samples is subject to the Principal's approval.

4.2 GASES

The handling of the gas samples may require intermediate processing by a sample recovery system if insufficient pressure is available to return the waste sample to a suitable utility system.

Waste samples and/or by-products of the process of analysis shall not be discharged to atmosphere unless approved by the Principal. Exemptions are air and moderate amounts of hydrogen (e.g. column vent of a gas chromatograph), nitrogen and other non-toxic and/or non-odorous compounds that are considered as safe and non-hazardous for the environment.

4.3 LIQUIDS

Liquid samples and/or by-products of the process of analysis shall be recovered by a liquid recovery system for either recovering, if economic, or safe disposal. The preferred point of disposal is the oil contaminated drain system, provided that such disposal does not cause adverse environmental conditions.

4.4 SHUTDOWNS

Provisions, e.g. relief valves, shall be made for disposal of gas or liquid from the sample transport system in case of a shutdown or emergency. Polluted samples may require special recovery vessels.

5. EMERGENCY ISOLATION AND SHUTDOWN

Sample transport lines should be equipped with pneumatically operated "spring to close/air to open" emergency shut-off ball valves. Fire safe ball valves shall be used (see DEP 31.38.01.11-Gen.).

The pneumatic lines to the ball valves shall be plastic tubing over the last 2.5 m of installation to facilitate automatic shutdown by melting of the tubing in case of a fire near the valves. The plastic shall be UV light resistant (i.e. black) polyethylene or polypropylene tubing or equivalent. Stainless steel tubing equipped at strategic locations with fusible plugs should be considered in situations where application of plastic tubing may give rise to nuisance, e.g. in situations where chemicals may weaken the plastic tubing.

The pneumatics shall be operated from an electrical solenoid valve.

It shall be possible to operate the solenoid valves remotely from a common contact in the Control Room and from an easily accessible common switch located on the outside wall at the door normally used to enter the Analyser House (see Appendix 4, Figure 4.3).

6. INSPECTION AND TESTING

The factory inspection and testing of the probe shall be done in accordance with DEP 62.10.09.11-Gen.

Field inspection and testing of the sample take-off and transport system, including pressure testing, shall be done in accordance with DEP 62.10.08.11-Gen. unless the liquid or gas used for pressure testing would interfere with the intended measurement. For example, sample transport lines for trace component analysis (moisture or other trace components) shall not be pressure tested with liquids.

NOTE: A full functional test shall be performed to verify that all sample emergency valves close upon a command from the emergency shutdown system.

7. REFERENCES

In this DEP reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest issue of each publication shall be used (together with any amendments/supplements/revisions thereof).

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Thermal insulation for hot services	DEP 30.46.00.31-Gen.
Thermal insulation for cold and dual-temperature services	DEP 30.46.00.32-Gen.
Piping - General requirements	DEP 31.38.01.11-Gen.
MF Piping classes	DEP 31.38.01.12-Gen.
EP Piping classes	DEP 31.38.01.15-Gen
Protective steam heating of piping systems	DEP 31.38.30.11-Gen.
On-line process stream analysis -	

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Instruments for measurement and control	DEP 32.31.00.32-Gen.
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Analysers	DEP 32.31.50.12-Gen.
Analyser Houses	DEP 32.31.50.13-Gen.
Instrument impulse lines	DEP 32.37.10.11-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.
Electrical trace heating	DEP 33.68.30.32-Gen.
Field inspection and testing of instruments and instrument systems	DEP 62.10.08.11-Gen.
Factory inspection and testing of instruments and instrument systems	DEP 62.10.09.11-Gen.

AMERICAN STANDARDS

Standard specification for seamless and welded austenitic stainless steel tubing for general service	ASTM A 269

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American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa 19103, USA.

INTERNATIONAL STANDARDS

Electrical apparatus for explosive atmospheres: Part 14: Electrical installation in explosive gas atmosphere	IEC 79-14

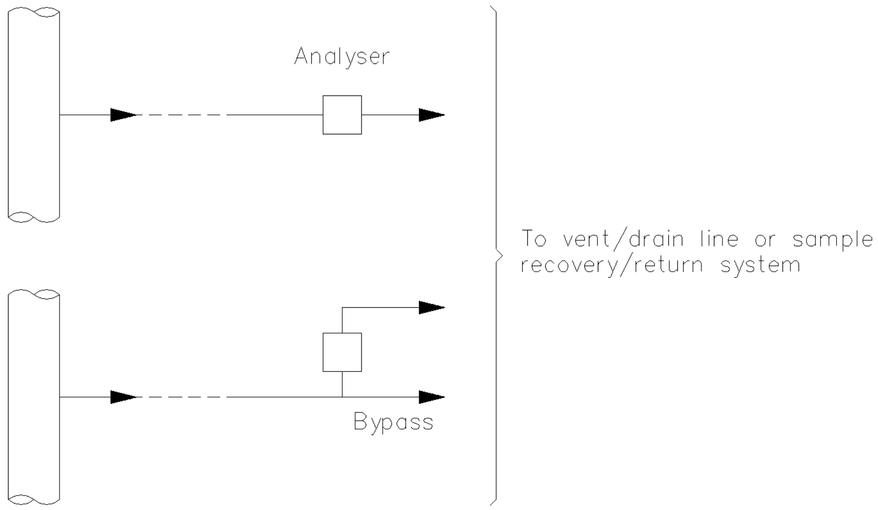
(other than mines)

Issued by:
Central Office of IEC
3, Rue de Varembé
CH-1211 Geneva 20, Switzerland.

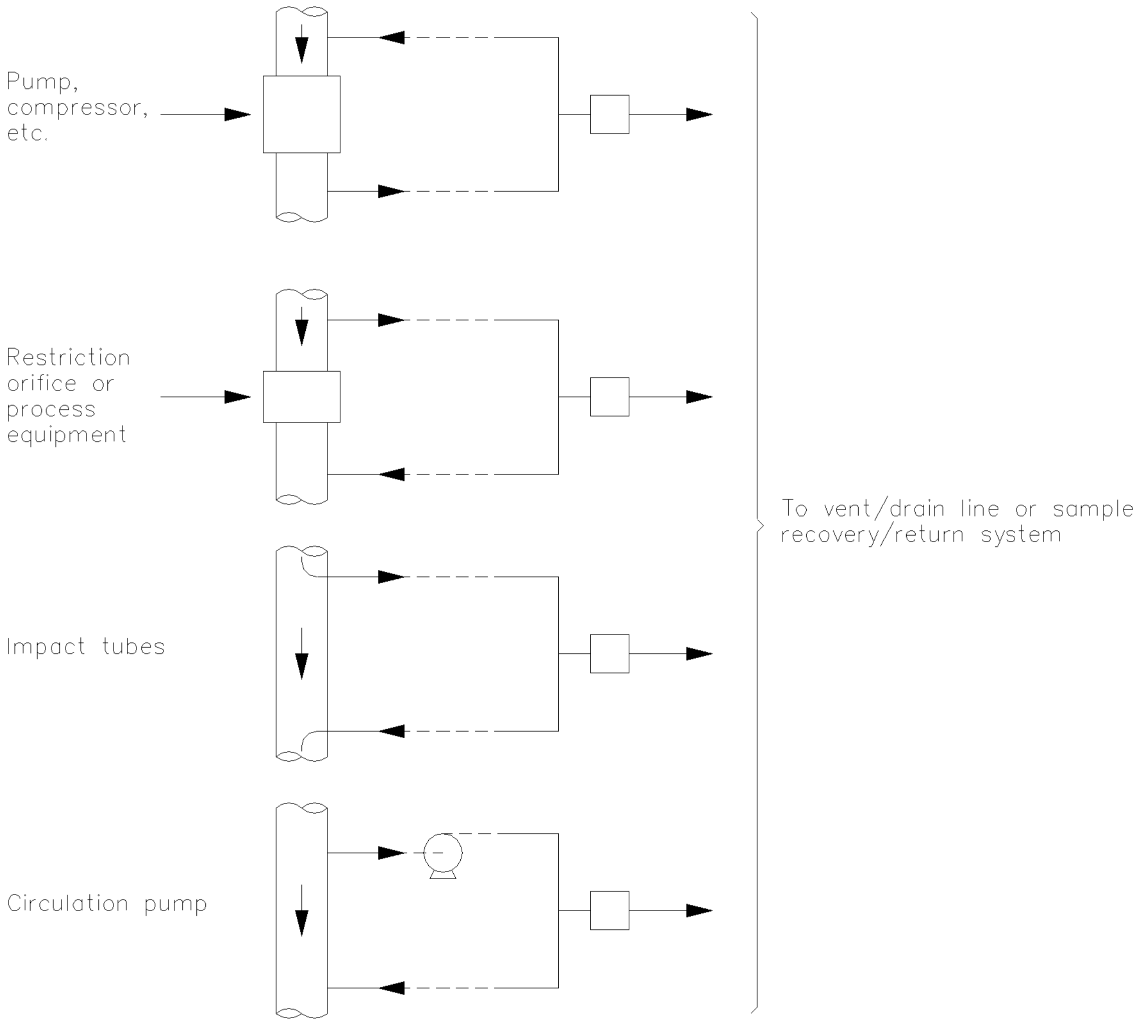
Copies can also be obtained from national standards organizations.

APPENDIX 1 TYPICAL ARRANGEMENTS OF ANALYSER SAMPLE SYSTEMS

SINGLE LINE SYSTEMS

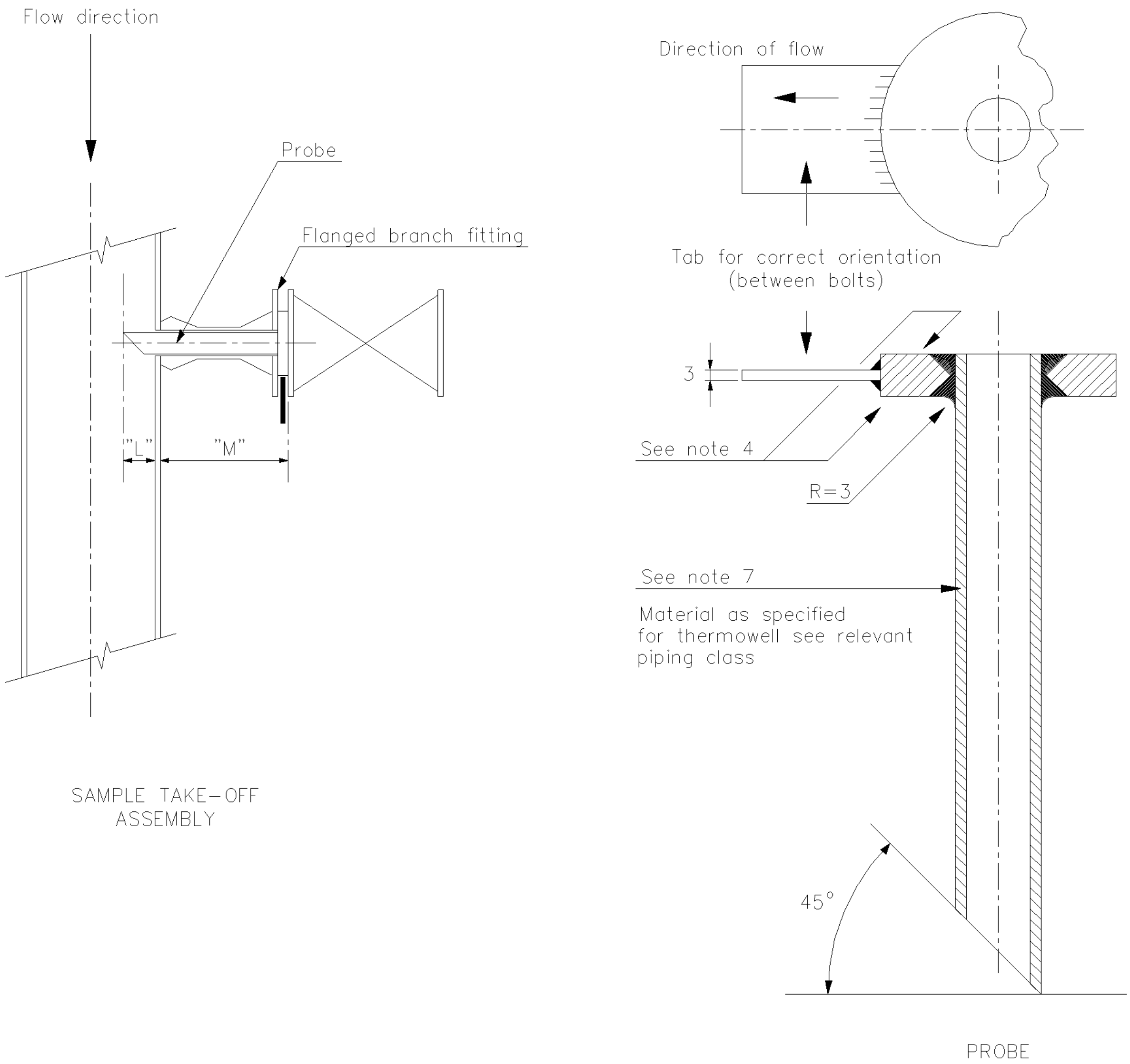


FAST LOOP SYSTEMS



APPENDIX 2 EXAMPLES OF SAMPLE TAKE-OFF ASSEMBLIES

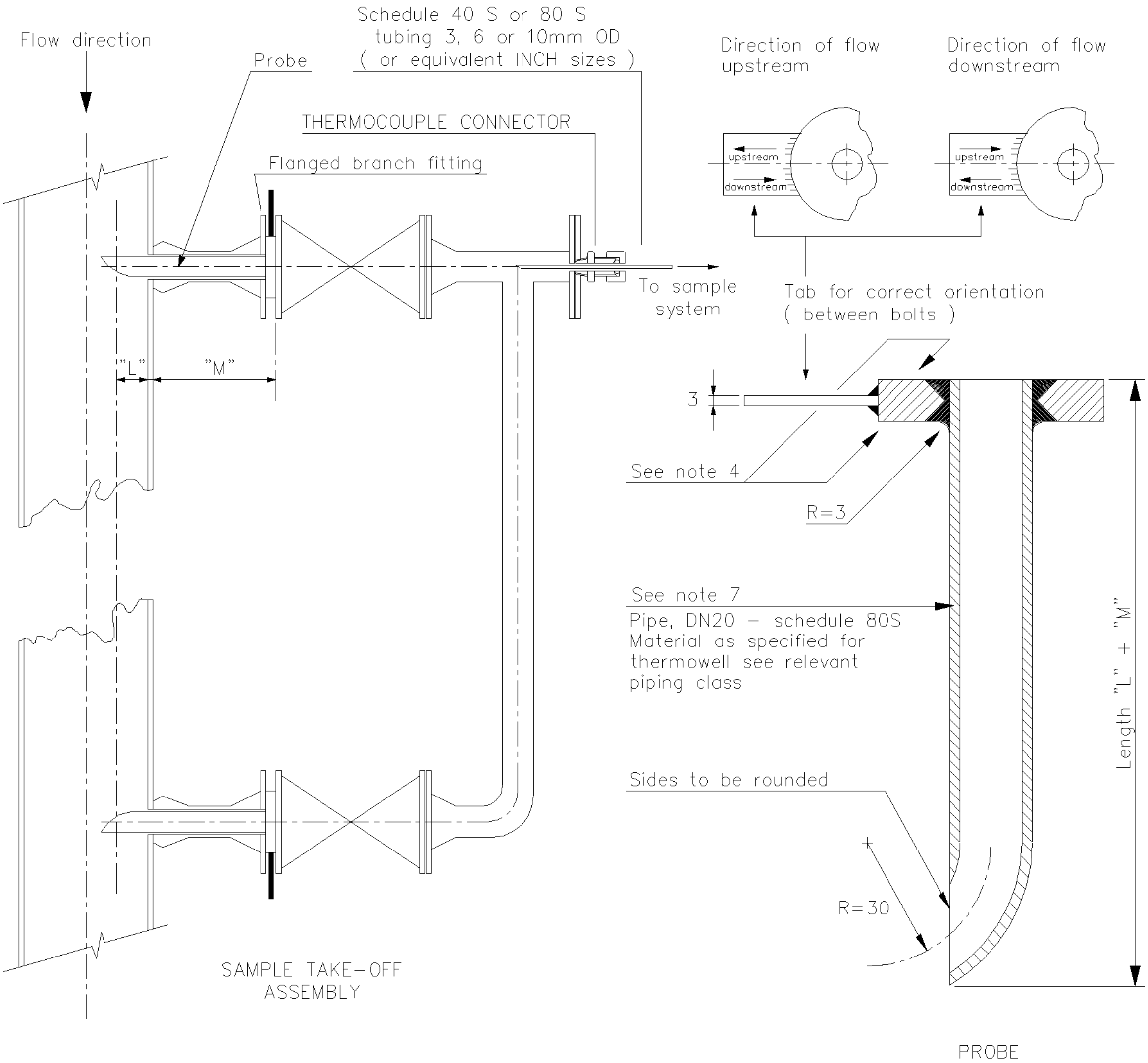
Figure 2.1 SAMPLE TAKE-OFF ASSEMBLY



NOTES:

1. Piping components as per relevant piping class.
2. Valve as specified in assembly for level gauge connections.
3. Flanged branch fitting as specified in assembly for temperature instrument connections.
4. The gasket contact area shall have a "smooth" finish as described by DEP 31.38.01.11-Gen.
5. Distance "M" depending on branch size and length.
6. Length "L" =0.25 x internal diameter of process line.
7. Probe material and diameter depending on application (to be specified on requisition)

Figure 2.2 IMPACT TUBE SAMPLE TAKE-OFF ASSEMBLY



NOTES:

1. Piping components as per relevant piping class.
2. Valve as specified in assembly for level gauge connections.
3. Flanged branch fitting as specified in assembly for temperature instrument connections.
4. The gasket contact area shall have a "smooth" finish as described by DEP 31.38.01.11-Gen.
5. Distance "M" depending on branch size and length.
6. Length "L" =0.25 x internal diameter of process line.
7. Probe material and diameter depending on application (to be specified on requisition)

APPENDIX 3 TYPICAL EXAMPLES OF COMPOSITE SAMPLE TRANSPORT SYSTEMS

Figure 3.1 SINGLE SAMPLE TRANSPORT LINE (GAS OR LIQUID SERVICE, TUBING)

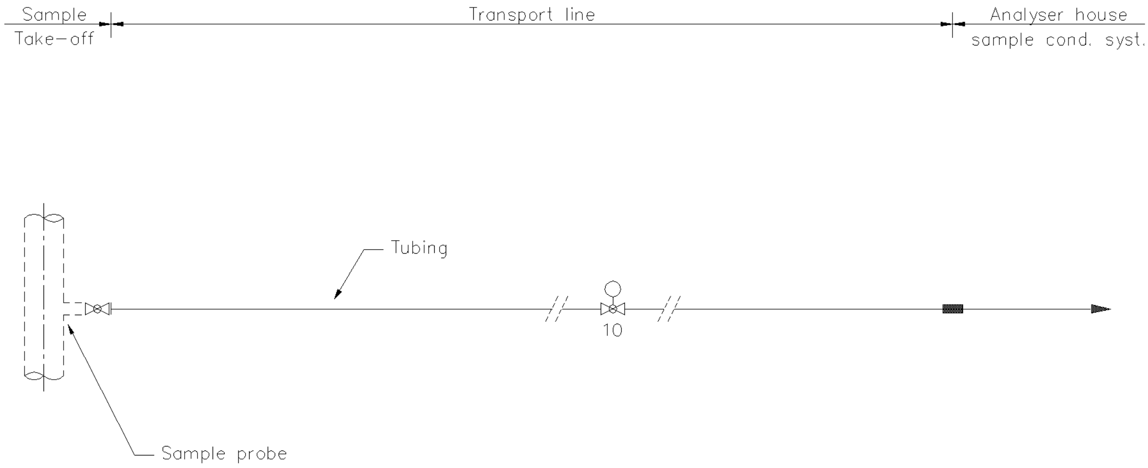
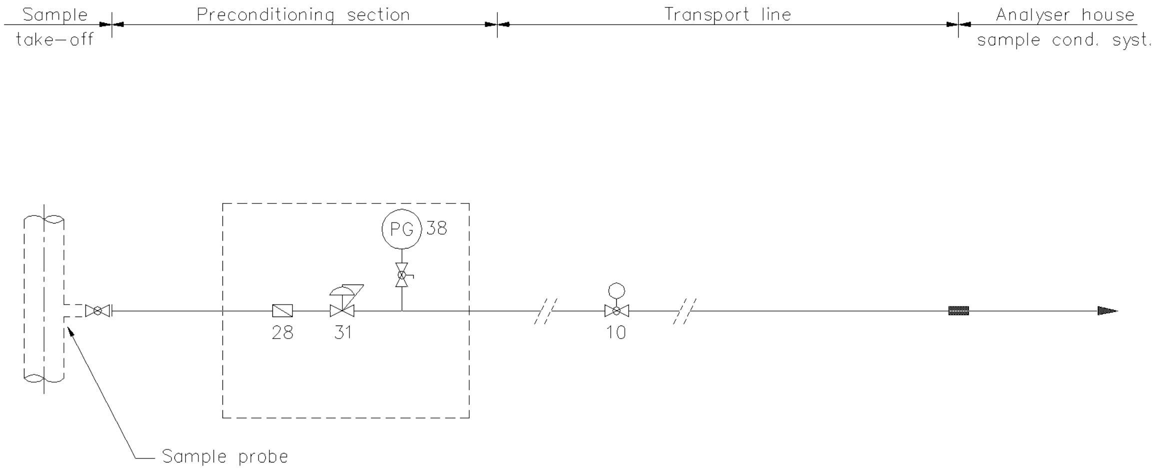


Figure 3.2 SINGLE SAMPLE TRANSPORT LINE WITH PRESSURE REGULATOR (GAS OR LIQUID SERVICE, TUBING)



NOTE:

1. Distance from sample take-off point to inlet of pressure regulator to be as short as possible in case of gas service.

Figure 3.3 SINGLE SAMPLE TRANSPORT LINE WITH BOOSTER PUMP (GAS OR LIQUID SERVICE, TUBING)

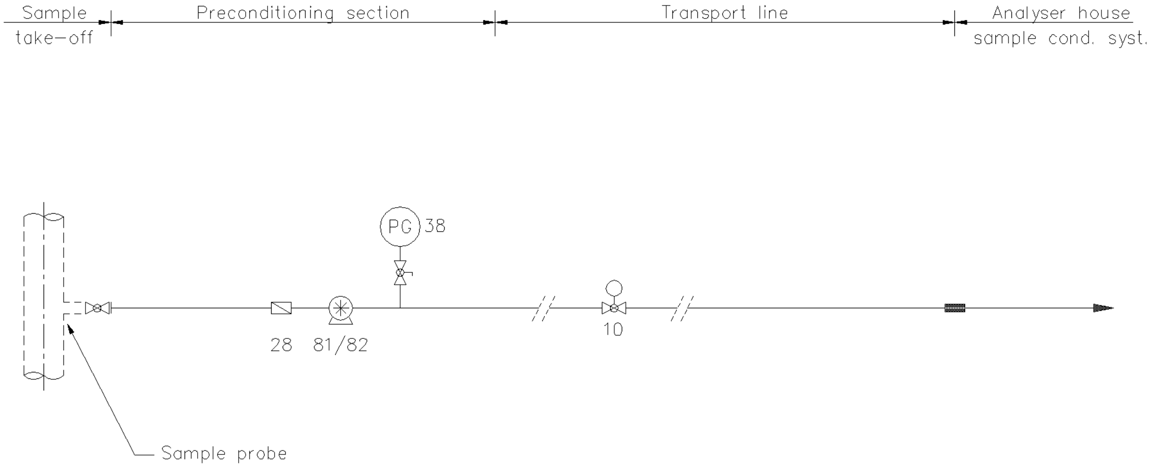
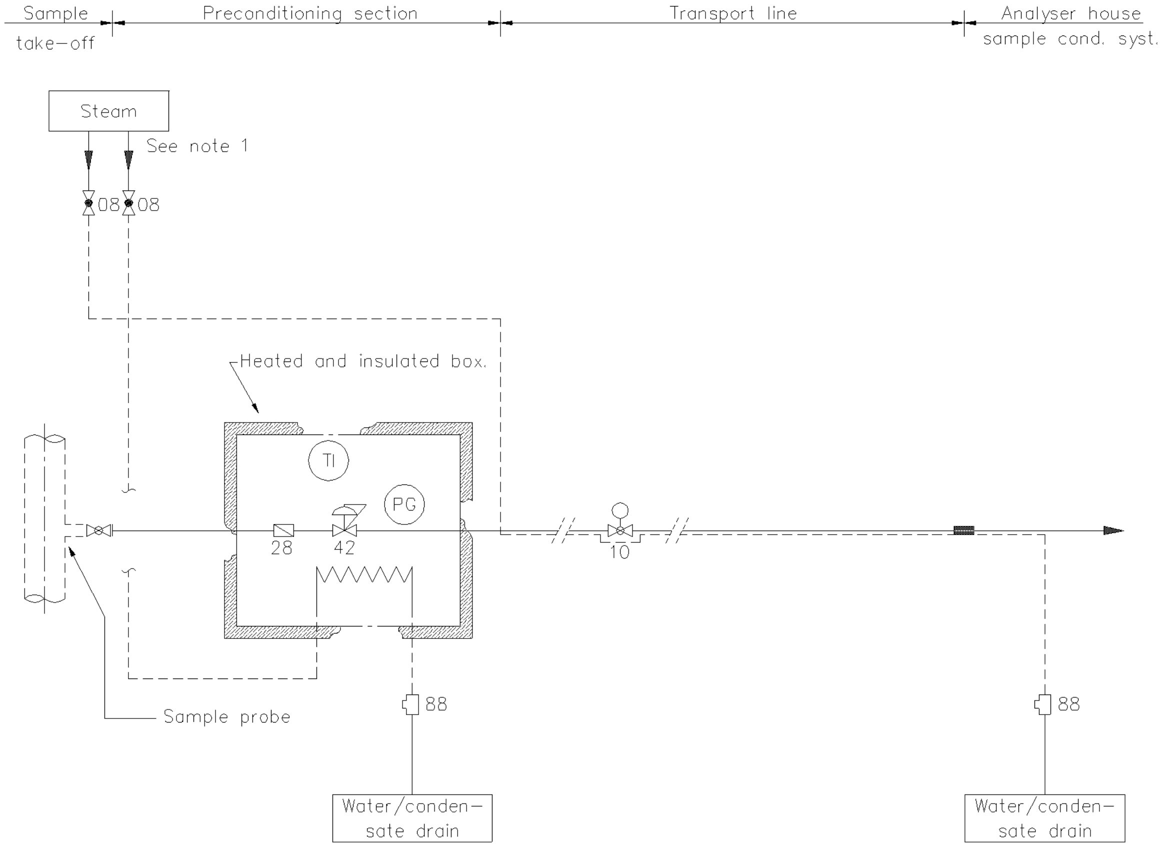


Figure 3.4 SINGLE SAMPLE TRANSPORT LINE WITH VAPORISING PRESSURE REGULATOR (LIQUID SERVICE, TUBING)



NOTES:

1. Heat tracing (e.g. steam or electrical) only required when specified on requisition.
2. Distance from sample take off assembly to preconditioning system to be as short as possible. Volume between probe and inlet vaporising pressure regulator has to be as small as possible

Figure 3.5 FAST LOOP SAMPLE TRANSPORT LINE (GAS OR LIQUID SERVICE, TUBING)

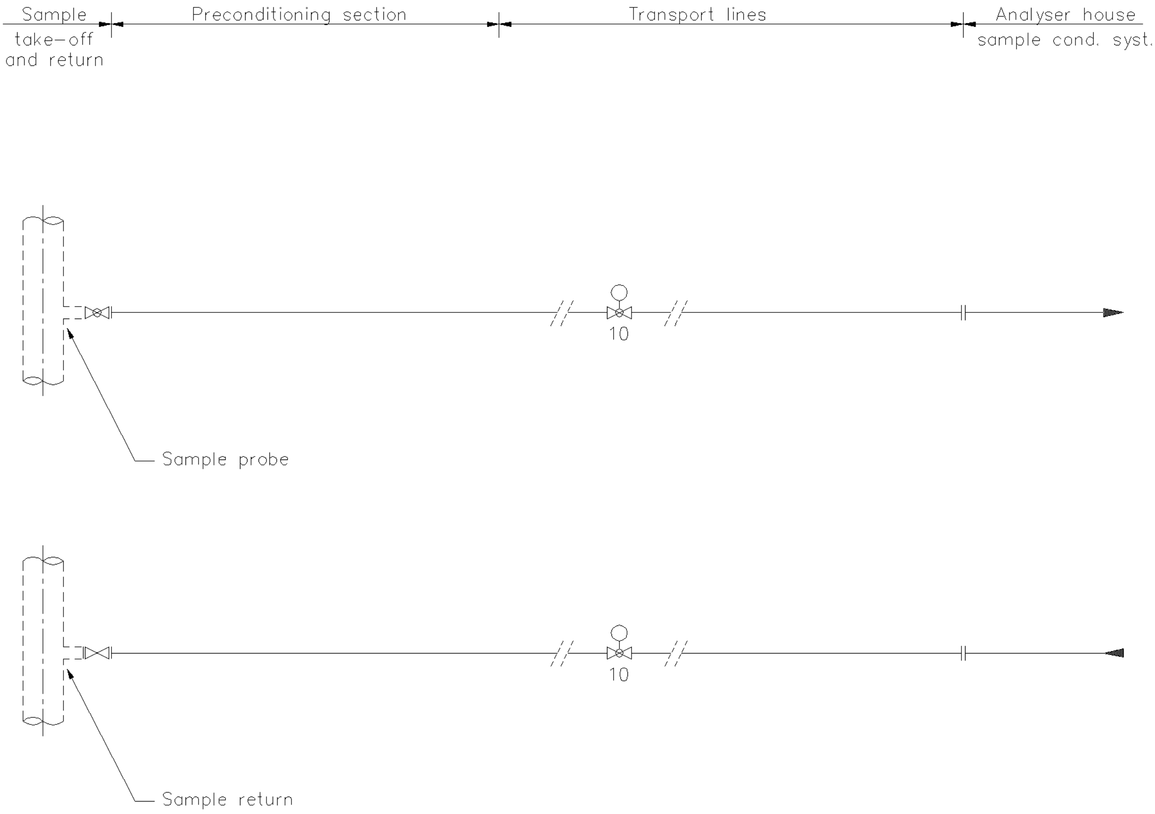
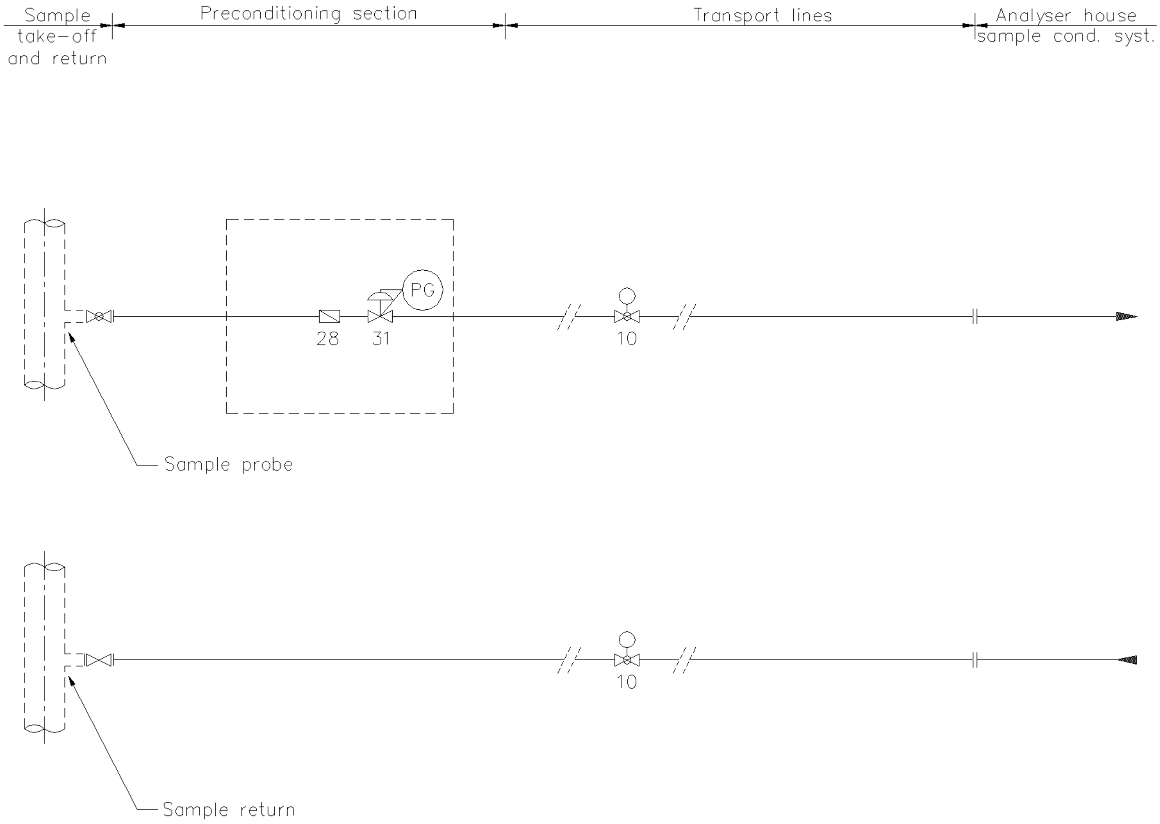


Figure 3.6 FAST LOOP SAMPLE TRANSPORT LINE WITH PRESSURE REGULATOR (GAS OR LIQUID SERVICE, TUBING)



NOTE:

1. Distance from sample take off assembly to preconditioning system to be as short as possible in case of gas service.

Figure 3.7 FAST LOOP SAMPLE TRANSPORT LINE WITH BOOSTER PUMP (GAS OR LIQUID SERVICE, TUBING)

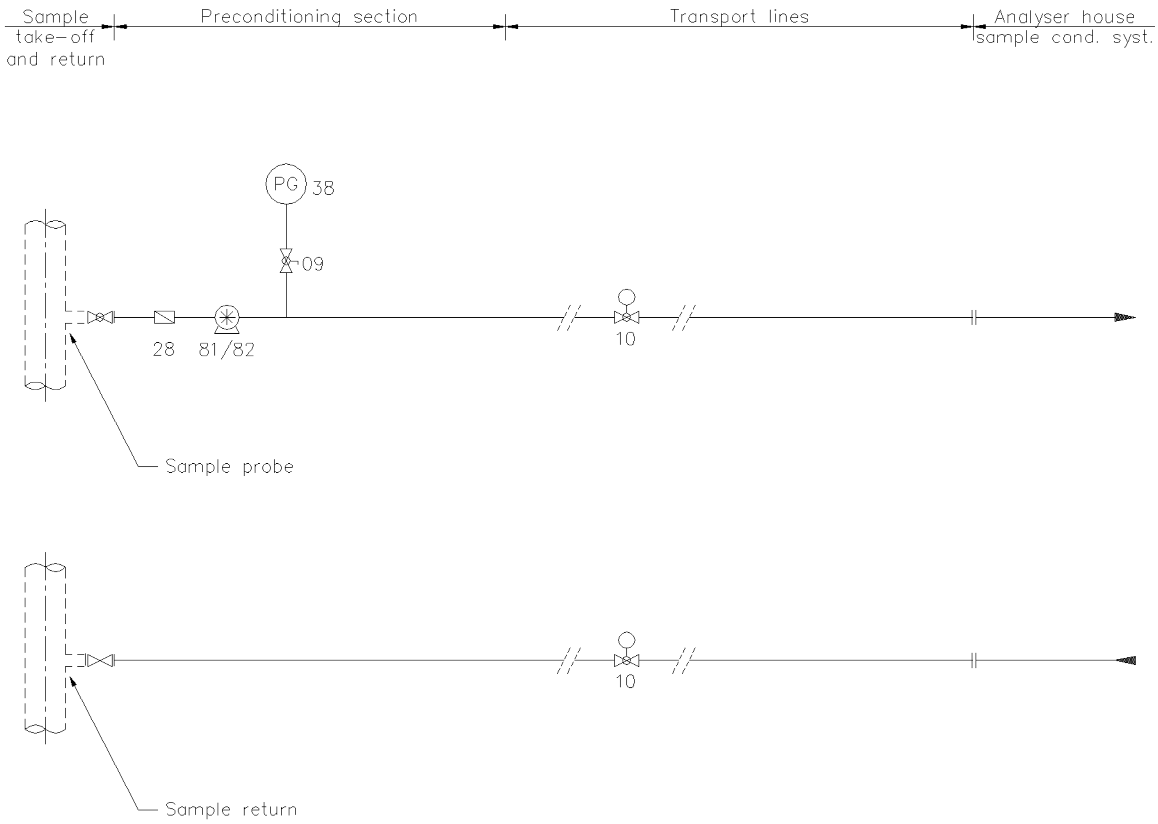
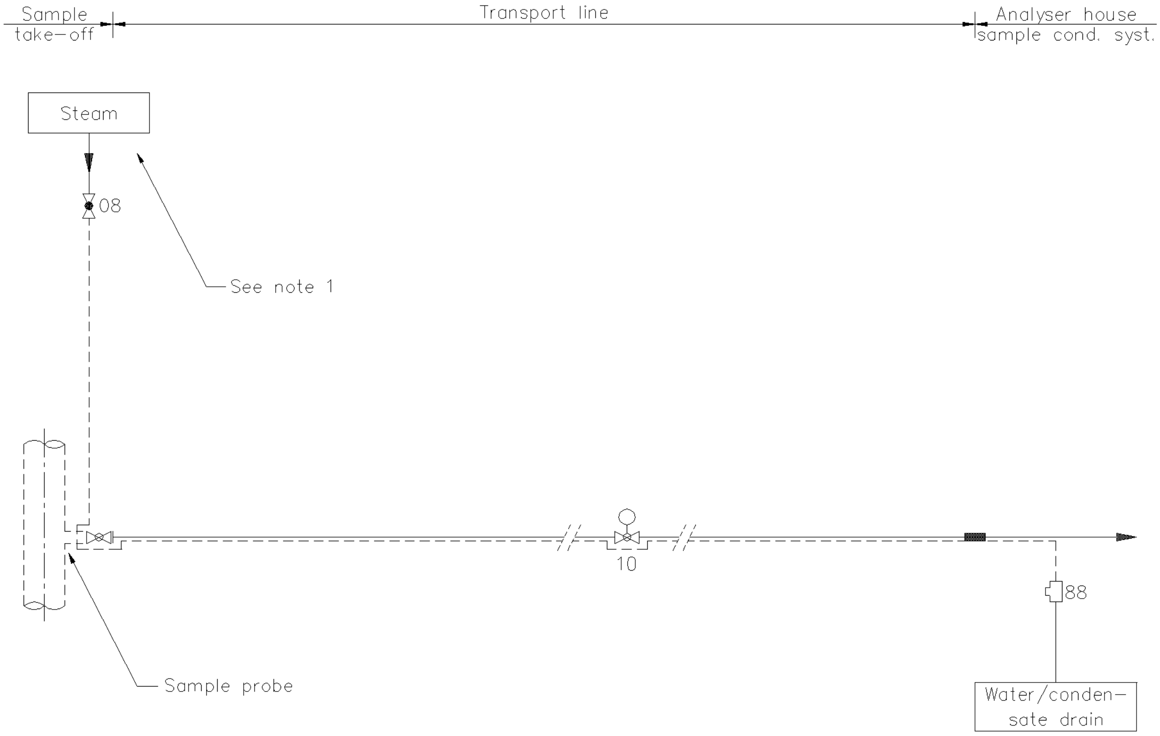


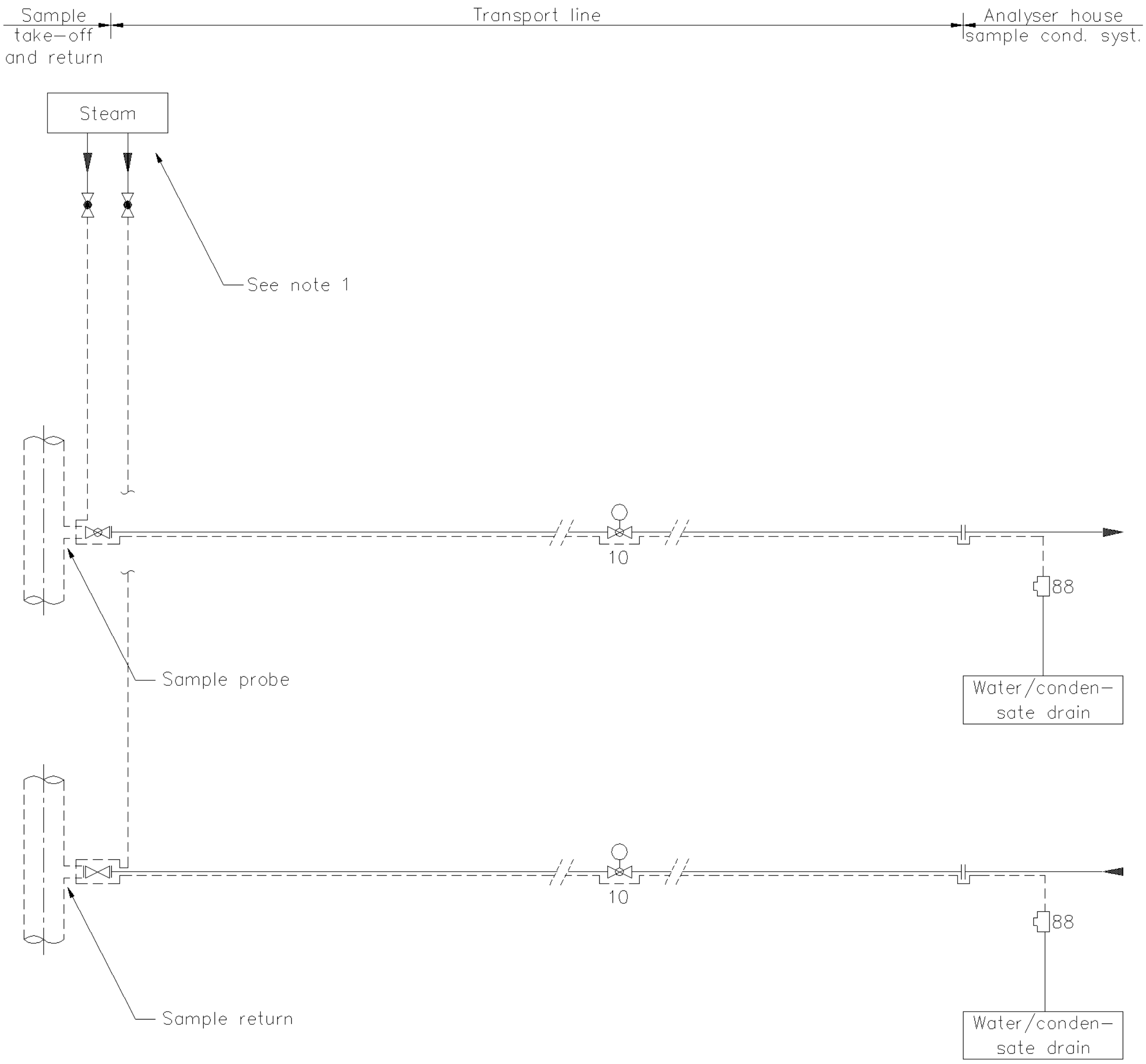
Figure 3.8 SINGLE SAMPLE TRANSPORT LINE WITH HEAT TRACING (GAS OR LIQUID SERVICE, TUBING)



NOTE:

1. Heat tracing (e.g. steam or electrical)

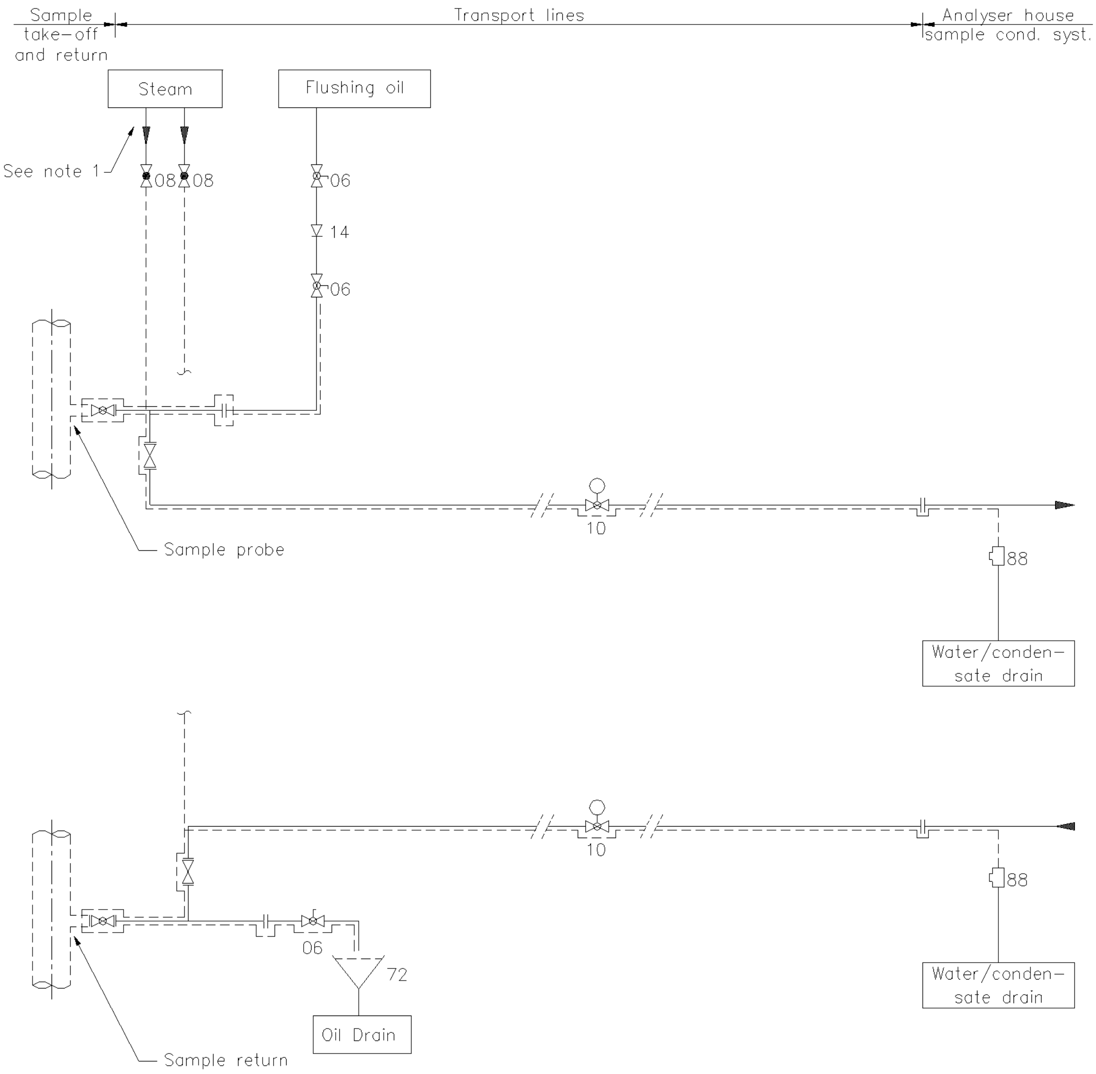
Figure 3.9 FAST LOOP SAMPLE TRANSPORT LINE WITH HEAT TRACING (GAS OR LIQUID SERVICE, TUBING)



NOTE:

1. Heat tracing (e.g. steam or electrical)

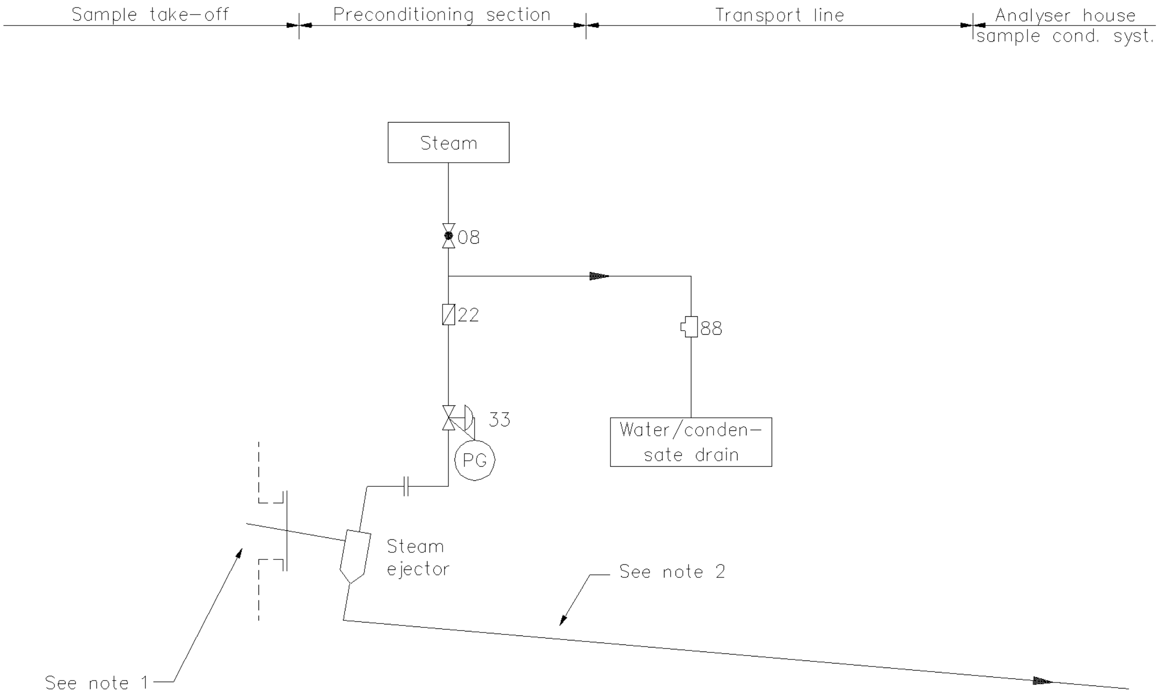
Figure 3.10 FAST LOOP SAMPLE TRANSPORT LINE (LIQUID SERVICE, HIGH POUR POINT PRODUCT, PIPING)



NOTE:

1. Heat tracing (e.g. steam or electrical)

Figure 3.11 SINGLE SAMPLE TRANSPORT LINE WITH STEAM EJECTOR S(LOW PRESSURE GAS SERVICE, TUBING)



NOTES:

1. Process sample connection form part of Mechanical Engineering.

2. Material of sample transport line to be in accordance with piping class, size and lenght of sample transport line as specified on requisition.
   Sample transport line to be sloping (min. grade 1 : 10)

3. Pressure of steam supply to ejector to be set at 2.5 – 3 bar ga.

4. Process sample connection and probe, excluding steam ejector, to be insulated.

Figure 3.12 LIST OF COMPONENTS

Item	Description	Size
06	Ball valve	12 mm OD 1/2 in OD
07	Isolate/vent valve	1/2 in BSPP 1/2 in NPT
08	Globe valve	12 mm OD 1/2 in OD
09	Ball valve	6 mm OD 1/4 in OD
10	Emergency shut-off valve spring to close air to open actuator	Depends on size of sample transport line
14	Check valve	12 mm OD 1/2 in OD
16	Relief valve	1/2 in BSPP 1/2 in NPT
17	Relief valve	6 mm OD 1/2 in NPT
21	Filter	1/4 in OD 1/4 in BSPP
22	Strainer	1/2 in BSPP 1/2 in NPT
28	In-line filter	6 mm OD 1/4 in OD
29	Tee-filter	1/4 in BSPP 1/4 in NPT
31	Pressure regulator	1/2 in BSPP 1/2 in NPT
33	Pressure regulator (steam)	
34	Filter/regulator	1/4 in BSPP 1/4 in NPT
38	Pressure/gauge	1/2 in BSPP 1/2 in NPT
42	Pressure regulator with vaporizer	6 mm OD 1/4 in OD
72	Funnel	1/2 in BSPP 1/2 in NPT
81	Sample pump	(for liquid)
82	Sample compressor	(for gas)
88	Steam-trap	
91	Vaporizer	

APPENDIX 4 TYPICAL DETAILS FOR THE ROUTING OF SAMPLE TRANSPORT SYSTEMS

Figure 4.1 SINGLE SAMPLE TRANSPORT LINES

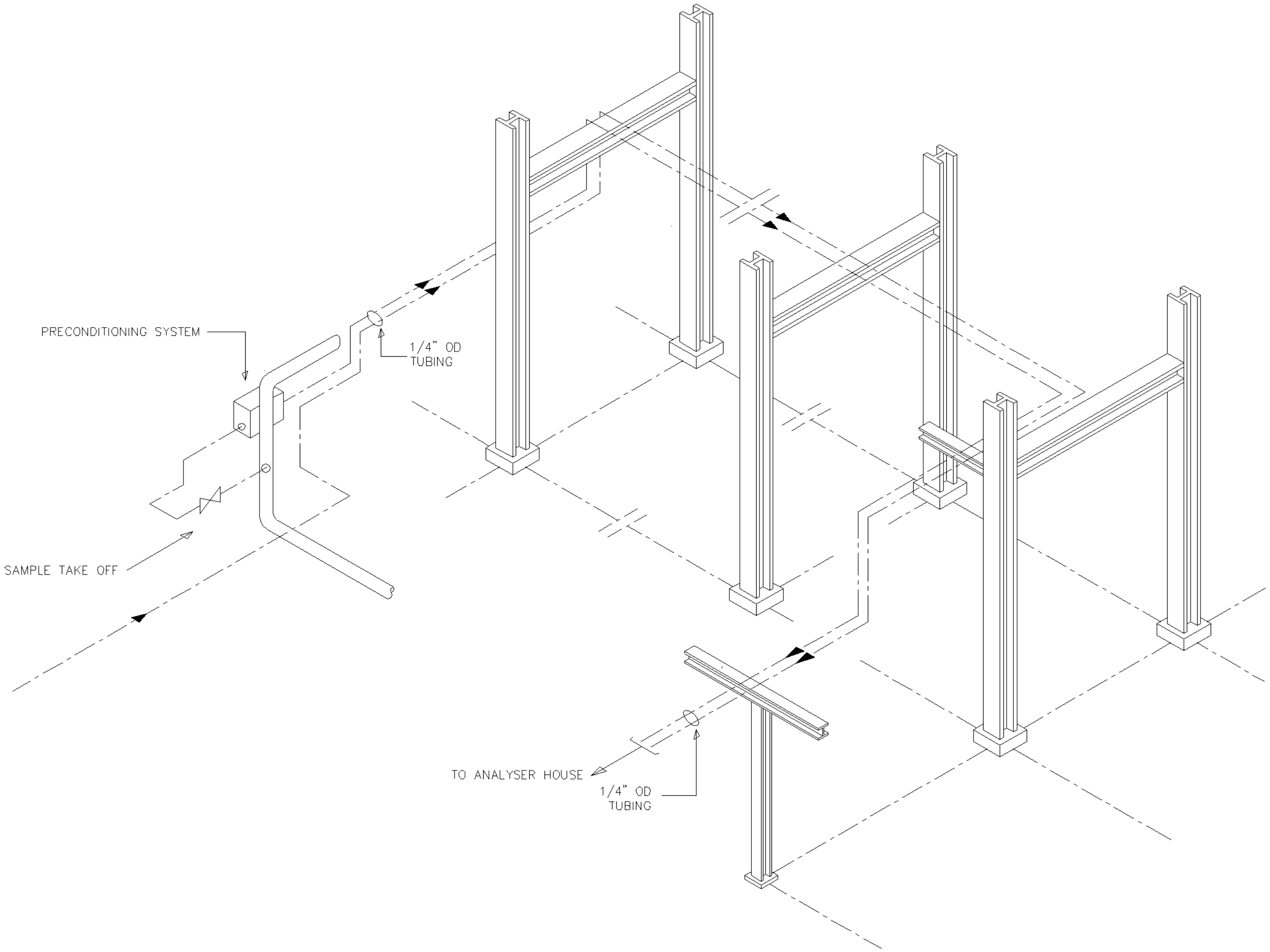


Figure 4.2 FAST LOOP SAMPLE TRANSPORT LINE

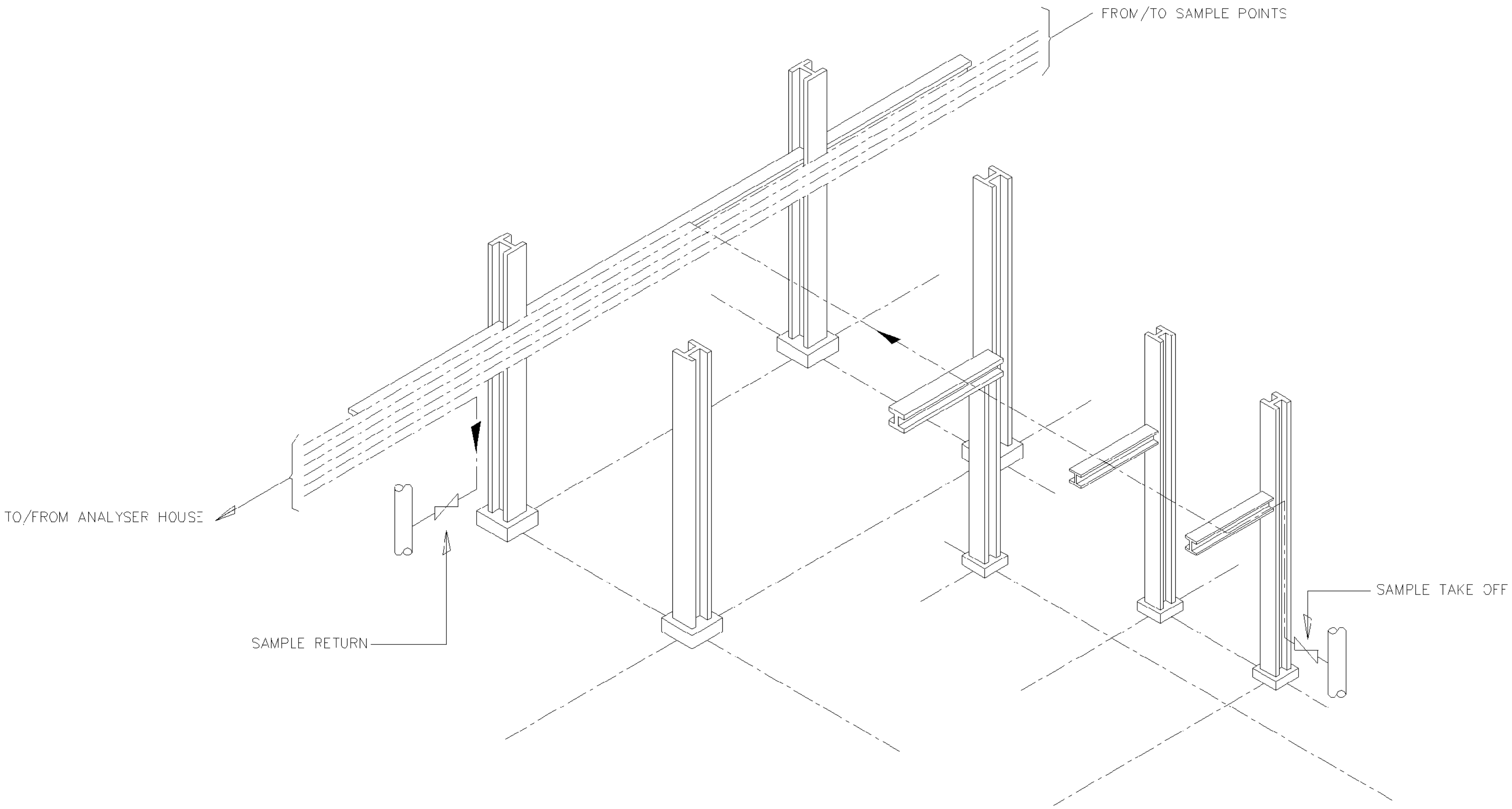


Figure 4.3 SAMPLE TRANSPORT LINES WITH EMERGENCY SHUT-OFF VALVES

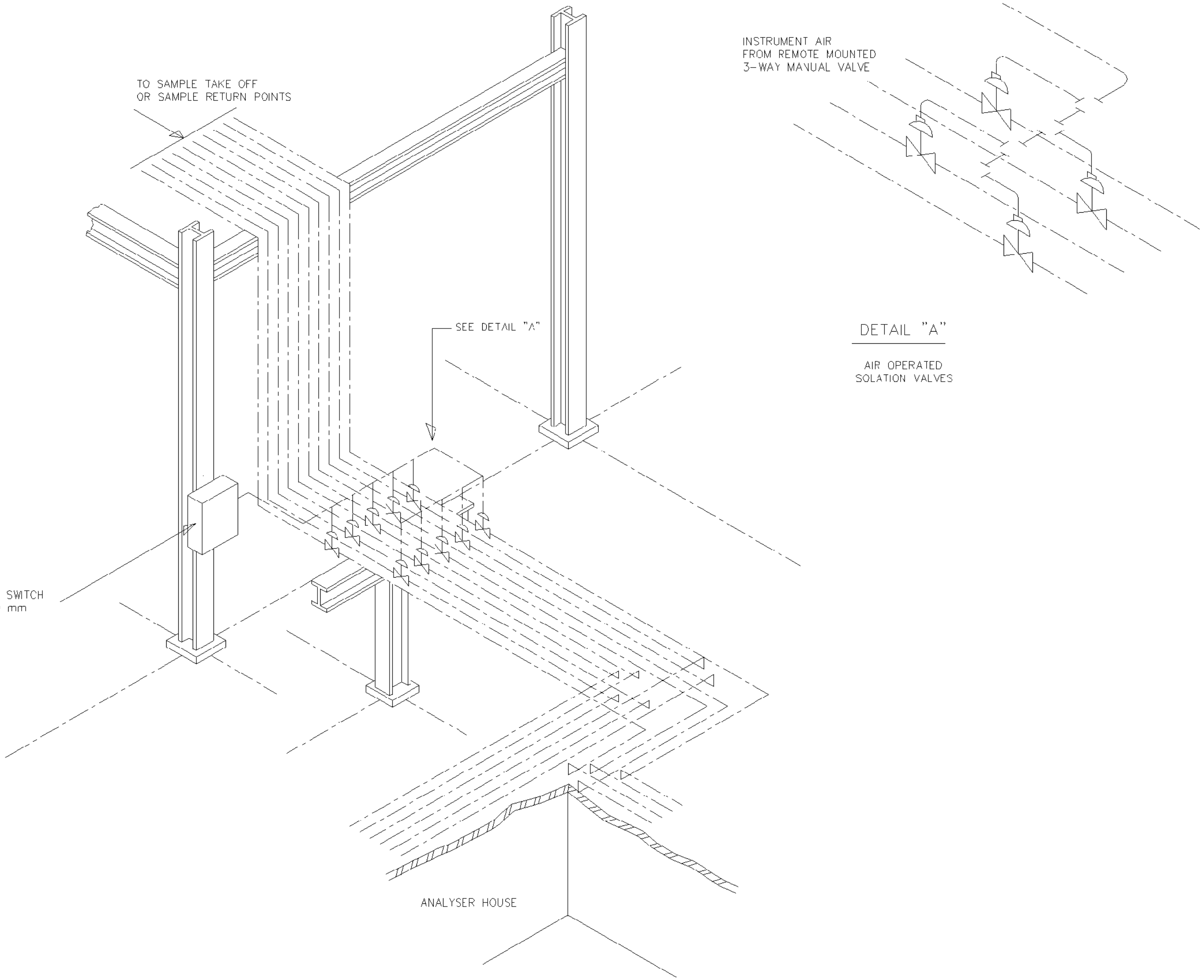


Figure 4.4 FAST LOOP SAMPLE TRANSPORT LINE FOR HIGH POUR POINT PRODUCT