



GS 130-1

AUTOMATIC PIPELINE SAMPLING OF LIQUID HYDROCARBONS

September 1997

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AUTOMATIC PIPELINE SAMPLING OF LIQUID HYDROCARBONS (Replaces BP Std 232)			
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The experience behind this Guidance for Specification is in the statistical sampling of crude oil, with the objective of determining water content and density. It may also be applicable for sampling other hydrocarbons, for water content and property analysis. Additionally many concepts of this Guidance for Specification will be applicable for gas sampling. Caution should be observed when applying to sampling liquids other than crude oil and to sampling gasses.			
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

This Guidance for Specification defines all BP general requirements for Automatic Pipeline Sampling that are within its stated scope, and forms the basis of a specification to be adapted for each specific application.

This Guidance for Specification has been written to enable the non-specialist engineer to incorporate all the sampling knowledge gained by BP over many years of R&D. The sampling system concepts upon which this Guidance for Specification is based have been developed both from sampling theory and practice contained in international standards and from the results of field experimentation.

Representative sampling, and the subsequent analysis of liquid hydrocarbons transported by pipeline is an essential element in the fiscal or commercial measurement policy of an oil transfer facility.

Use of this Guidance for Specification will ensure that Automatic Pipeline Sampling equipment supplied to BP conforms with the best sampling practices, and that the relevant national or international standards are properly observed. Particular attention is given to measures for ensuring the safe design and installation of the sampling equipment and conformity with the Guidance for Specification's recommendations should ensure efficient, representative sampling with safe and reliable operation.

Application

This Guidance for Specification is intended to guide the purchaser in developing a 'fit for purpose' specification for enquiry or purchase.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number. Resolution of the 'Approval' actions is the responsibility of the purchaser's professional engineer.



This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Principal Changes from Previous Edition

This document is an update of BP Standard 232 (April 1991). No technical changes have been made, the update comprises only re-formatting into the Guidance for Specification (GS) style. This reformatting has necessitated that the alternatives presented in the main text of BP Std 232 be extracted into commentary text.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP Group Recommended Practices, to assist in the process of their continuous improvement.

For feedback and further information, please contact Engineering Practices Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

The experience behind this Guidance for Specification is in the statistical sampling of crude oil, with the objective of determining water content and density. It may also be applicable for sampling other hydrocarbons, for water content and property analysis. Additionally many concepts of this Guidance for Specification will be applicable for gas sampling.

Caution should be observed when applying to sampling liquids other than crude oil and to sampling gasses.

1.2 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this specification. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser. The quality system should ensure that the technical and QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials.

Further suggestions may be found in the BP Group RPSEs Introductory Volume.

2. VENDOR RESPONSIBILITIES

The responsibilities of the vendor shall include the following:-

- (a) Package design.
- (b) Preparation of equipment specifications (for procurement from sub-manufacturers).
- (c) Equipment procurement.
- (d) Package fabrication.
- (e) Component and system testing at the Vendor's premises.
- (f) Quality Assurance. (See 1.2).
- (g) Documentation.
- (h) Packing and Preparation for Shipment



- (i) Compliance with the referenced documents applicable to this Guidance for Specification.

The vendor may also be made responsible for site installation, testing and proving or any other site based activity deemed appropriate by BP and agreed with the vendor.

3. EQUIPMENT

- 3.1 This Guidance for Specification defines the minimum requirements for crude oil sampling equipment. The function of the equipment is to provide representative samples of crude oil for laboratory analysis.

Crude Oil is most commonly sampled but other liquids (or indeed gases) may also be sampled by equipment designed using this Guidance for Specification

- 3.2 The equipment should include the following major items (see Figure. 1):-

- (a) Jet mixing system
A jet mixing system is not always necessary
- (b) Scoop type sample probe
- (c) Pumped external loop
- (d) External loop sampler
This may be a flowcell sampler
- (e) Main pipeline flowmeter
- (f) Sampler controller
- (g) Sample Receivers
- (h) Other components as appropriate to the application

- 3.3 The equipment shall be supplied as a package, which shall contain the jet mix system and the pumped external loop with the sampler. The sample probe, jet nozzles, main line flowmeter, sampler controller, and the sample receivers shall be supplied as separate items.

- 3.4 The design and specification of interconnecting pipework and electrical cabling between the major components on the package and between the package and the separated items shall be the responsibilities of the vendor

The supply and fitting of the interconnecting pipework and electrical cabling between the package and the separated items shall be the responsibility of the vendor.

It may be economically advantageous, when both a jet mix system and an external loop sampling system are to be supplied by the same systems vendor, to combine the two systems into a single unit with common fast loop pipework.



However, with this arrangement care must be taken to reconcile the requirements for isokinetically proportioning the flow into the external loop suction (see 6.7.3) with the flow requirements for efficient jet mixing at low pipeline flowrates. This may not always be practicable.

Note also that for safety reasons it may not be advisable to include the jet mixer pump set within a sampler enclosure.

Care should be taken to fully define vendor responsibility.

- 3.5 The equipment package shall be supplied in a form suitable for installation with minimum site labour, and should require only the following site work.

- (a) Main pipeline tapplings and associated valves.
- (b) Installation and fixing of the field and control room equipment.
- (c) Connection of the inlet and outlet piping.
- (d) Connection of vent/drain piping.
- (e) Connection of utility supplies.
- (f) Glanding and termination of power and instrument cables from associated equipment, the control room and elsewhere.

Specify whether or not the Vendor's responsibilities include interconnections etc.

- 3.6 The vendor shall confirm his intent to comply with the requirements specified in the Specification and with the referenced documents.

Any deviation shall be justified by a clear statement that the necessary approval has been obtained from BP or other appropriate authority. If no deviations from the Specification are highlighted by the vendor, then compliance with all requirements will be binding.

- 3.7 Tenders shall include an estimate of the equipment package dimensions and its weight, both dry and when filled with fresh water.

These weights may become part of the contractual obligations.

An obligation to conform with weight estimates may be essential for offshore or jetty installations.

- 3.8 Materials for equipment used for sour service applications shall comply with the requirements of BP Group [GS 136-1](#).



4. DESIGN CONDITIONS

4.1 General Requirements

- * The pipeline sampling equipment and sampler controller will be installed in a location specified by BP.

Location should indicate exposure to the environment (exposed/open/enclosed) and the hazardous area classified by Zone, Gas Group and Temperature Class.

4.2 Environmental Data

- * The pipeline sampling equipment and sampler controller shall operate under environmental conditions specified by BP.

Environmental conditions include; Ambient Temperature, Wind Velocity and other conditions (e.g snow, icing, salt spray, wind blown sand, atmospheric H₂S, etc. as applicable)

4.3 Process Data

- * BP will specify the Process conditions of the liquid/gas to be sampled.

Process conditions include;

Fluid

Main Pipeline Size

Main Pipeline Schedule

Main Pipeline Velocity

Fluid viscosity

Fluid density

Operating Temperature

Design Temperature

Operating Pressure

Design Pressure

Fluid Vapour Pressure

Other Fluid

(e.g. Anticipated water content,

Wax deposition temperature,

High sediment content,

Corrosive constituents,

H₂S ,

Chemicals, scale inhibitors

Typical composition analysis),

Other Conditions

(e.g. Incidence and nature of water transients,

Shock/Vibration)

This is essential information for the vendor and the system performance may be prejudiced if insufficient or inexact data is given. Particular attention should be drawn to the precautions necessary if the sample contains corrosive constituents e.g. H₂S.



4.4 Utility Supplies

- * BP will specify the utilities that it will provide at the sampling package installation points.

Utility Supplies include:

*Electrical Power Supplies.
Instrument Air Supply
Cooling Water.*

5. SYSTEM DESCRIPTION

- * 5.1 The field sited package will be installed at a location specified by BP

Location description should indicate siting (concrete/hard standing) position, distance from main pipeline, grade level, distance below top of pipe and area available.

Specified location should be as close as possible to the selected sampling point so that bypass loop pipework may be kept short. Good access to the location is required so that full sample receivers can be conveniently removed.

- 5.2 The jet mixing and external loop package shall be frame mounted.

- * 5.3 The Enclosure construction will be specified by BP.

GRP or Stainless Steel are commonly specified.

GRP Enclosures should satisfy the requirements of [BS 4683](#) Part 3, [BS 5734](#), [BS 476](#) Part 7 & 8 and [BS 5501](#) Part I and the resin shall be free of amines.

For most pipeline applications the sampling equipment will require protection from the environment by housing in a weatherproof enclosure. However, there may be situations, e.g. offshore, where the sampling position is within a module or other housing which already provides adequate protection. In such cases the need for additional protection is left to the discretion of the design engineer. Note that it is essential to prevent the ingress of extraneous water, whether from rain or any other source, e.g. hosing, into receivers containing samples destined for water determination tests. Therefore in most applications, some protection for the receivers at least will be required. Where an enclosure is required specify the preferred material of construction. Generally GRP is the material presently preferred but stainless steel may be a requirement in some situations, e.g. offshore.

Note that in addition to the requirement to satisfy the Standards referenced above GRP materials must be free of amines since these, when combined with water and oxygen, can cause 'season cracking' of brass fittings.



5.4 The Jet Mixing System shall include as a minimum the following components:-

- (a) In line jet head. Vendor shall specify the stub size and flange rating.

The in line jet head may need to be suitable for live line insertion.

Jet heads suitable for live insertion and retraction will be required for pipelines which cannot be shutdown for the jets to be removed for inspection/servicing. Delete the reference to live line insertion if pipeline shutdown for this purpose will be tolerable.

Flange rating may be higher than pipeline specification.

- (b) Frame mounted pump and motor set complete with local valving, strainer, suction and discharge pressure gauges and with local on/off switch(es) and start/stop pump controls.
- (c) The system pipework shall be heat traced and/or lagged as appropriate. See 7.4.2.

Heat tracing or lagging will be required where the ambient temperature is likely to fall below the wax precipitation temperature of the sampled liquid or where its viscosity will rise to prevent free flow.

5.5 The External Loop Sampler System shall include as a minimum the following components:-

*

- (a) In line sample probe suitable for main pipeline and entry as specified by BP. (see figure 2)

The probe shall be supplied as separate item.

Vendor will require to know entry type (e.g. live line) and main pipeline details.

Jet heads suitable for live insertion and retraction will be required for pipelines which cannot be shutdown for the jets to be removed for inspection/servicing. Delete the reference to live line insertion if pipeline shutdown for this purpose will be tolerable.

- (b) Frame mounted external loop sampler unit complete with:-
- (i) Pump and motor set with local on/off switch and stop/start controls.
- (ii) External flow cell sampler unit
- (iii) Suction and discharge pressure gauges



- (iv) Strainer complete with differential pressure measurement

A high alarm may also be required.

- (v) External loop flow meter, metal body variable area type with associated manual flow control valve.

- (vi) Sample receiving system.

5.6 The Flow Proportioning Sampler Controller.

May be suitable for panel mounting in the control room, or for local mounting in suitable enclosure.

- * 5.6.1 The input signal shall be as specified by BP.

If the sampler is to be used with a custody transfer entering system then most proprietary flow computers will have, a suitable 4-20 mA output signal representing the total system flow rate. Otherwise use the output frequency signal direct from the in line flowmeter (see 5.7). Define the relationship between mainline flowrate and output signal frequency and voltage.

Output shall be suitable for control of the external loop sampler.

- * 5.6.2 The controller shall be capable of operating the sampler in a flow proportional manner over the BP specified range of collected sample sizes.

Typical requirements are;

10 litres over 24 hours at a given max pipeline flowrate and maximum sampling frequency

or

10 litres for a specified cargo discharging/loading at defined max pipeline flowrate and maximum sampling frequency.

The volume of sample required to be collected during the sampling period will depend upon the number and type of the laboratory analyses to which it will be subjected, plus sufficient surplus for a retention ample in case of dispute.

Generally for the water content and density tests normally carried out on stabilised crude oil sampled from continuous transfer pipelines or from tanker cargo loadings or discharges, a total quantity of about 10 litres is required. As a general guide the sampling frequency should be 10 000 grabs of 1 ml taken flow proportionately over the duration of the transfer. However, the optimum sampling rate can be influenced by such factors as the ratio of the peak water concentration in transient slugs and the average water concentration in the transfer (see 3.5).



In shared pipeline allocation systems samples of high vapour pressure crude oil are required for analytical tests to determine hydrocarbon composition and distillation range. For these tests the required quantity is typically between 1 and 3 litres. Because quality change in production systems is likely to occur only in the longer term, the collection period is usually extended - say between 7 days and 1 month, and thus the average sampling frequency will be correspondingly low, e.g. one 1ml grab every 3 minutes to give approximately 3 litres collected over 7 days.

In practice the sampling frequency will be proportional to flowrate and the figure quoted above is a typical average.

For production applications where dual samples are required, e.g. for both water determination/ density tests on a 24 hour basis, and hydrocarbon composition tests on a 7 day or monthly basis, it is recommended that the sampling equipment is duplicated e.g. by using two series connected samplers in the external loop. Previous experiences with sample switching systems based on a single sampling device have not been favourable and their use is discouraged.

Additionally, the sampler controller shall have, as a minimum, the following facilities:-

- (a) Provision for setting the batch transfer quantity or time over which the sample is to be collected.
- (b) Alarm generated on completion of sampling, both on time and quantity basis.
- (c) Test facility to permit testing of sampler operations when out of service.
- (d) Sampler start/stop trigger at adjustable preset flowrate from a manual switch.

Only required if very low flowrates for long periods of time are expected. The flowrate(s) at which the sampler should switch 'on' or 'off' will normally be at the flowrate below which the flowmeter signal becomes unreliable.

5.7 The main line flowmeter shall be an insertion turbine of trash resistant design. It shall be capable of live line insertion and provide a frequency output signal suitable for the controller specified in 5.6.

This requirement Is only applicable where a main pipeline flowrate signal is not available from a custody transfer metering system.

Crude oil pipeline transfers, especially from marine tankers, are likely to carry entrained quantities of fibrous materials which can quickly foul insertion type flowmeters of conventional design. This leads to loss of flow measurement and consequently, failure to collect a sample. To overcome this problem a large 6 inch blade 'trash shedding' insertion turbine meter has been developed. This is the preferred flowmeter for use with BP sampling systems.



- 5.8 The sample receiving system shall be suitable for collecting the total quantity of sample fluid defined in 5.6, with sufficient ullage to allow for the insertion and operation of a mixing device and for any subsequent thermal expansion. The receivers shall be suitable for collecting and maintaining the sample fluid in a representative state without contamination or degradation of its composition.

Also state form of receivers e.g. sample cans or PIM cylinders (or alternative), and capacity. See 6.14.

Consider also whether 2 receivers with auto change-over are required. The receiving system should have a 'receiver full' detection system with remote and local alarm.

Specify sample receivers of appropriate capacity (see 5.6.2) for stabilised crude oil, and high pressure piston receivers for high vapour pressure crude oils (see 6.14).

When sampling from continuously operating pipelines, on which sampling is being carried out on a 24 hour cycle, it can be advantageous to have an automatic receiver change facility, arranged to switch the sample flow into the standby receiver at a pre-arranged time or when sufficient volume has been collected in the duty receiver. Specify if this facility is required. Specify also if a 'receiver full' alarm is required at a local or remote location.

Note that when two cylinders are used to make up a 24 hour sample, care must be taken to ensure that the contents of both are thoroughly mixed together to form a properly representative total sample before analysis. Facilities must be provided in the laboratory for mixing the two together.

6. EQUIPMENT DESCRIPTION

6.1 General Requirements

- 6.1.1 All equipment and components shall comply with the relevant documents listed in Appendix B.

- 6.1.2 All field mounted electrical equipment shall be certified as suitable for use in a the specified hazardous area. Sampler control equipment shall be suitable for use the specified environment.

Sampler controllers will normally be mounted in a control room. Where they are field mounted they must be suitable for use in the area as classified.

- * 6.1.3 Ancillary equipment such as solenoid valves, junction boxes, cable etc. shall be specified by the vendor and subject to approval by BP prior to procurement.
- * 6.1.4 Nominated vendors equipment shall be subject to approval by BP prior to procurement.



6.1.5 The vendor shall be responsible for ensuring that all signals and other interconnecting items are mutually compatible.

6.1.6 Refer to Figure 1 for a schematic diagram of the recommended sampling system.

6.2 Process Pipework

*

All process pipework and fittings excepting small bore instrument piping (see 7.4) shall be Carbon Steel in accordance with the relevant documents of Appendix B. The external loop pump suction and the external loop piping downstream of the pump shall be specified by BP.

Define the Project Piping Specification reference if applicable.

Define the bypass loop pump suction piping diameter and schedule appropriate to the main pipeline size, as follows:-

*For line sizes less than but including
NPS 30 (DN 750) - NPS 1 (DN 25)*

*For line sizes greater than
NPS 30 (DN 750) - NPS 1 1/2 (DN 40)*

Piping downstream of the pump NPS 1 (DN 25)

6.3 Instrument Pipework and Fittings

6.3.1 Small bore instrument tube and fittings should generally be 1/4 inch OD (6 mm) stainless steel.

*

6.3.2 Flexible couplings between the sampler and sample receivers shall be of the quick-connect type with BP approved self-sealing couplings at both ends. Facilities shall be provided for depressurising locked in sample.

6.4 Process and Drain Valves

6.4.1 Process and drain isolation valves shall be ball or solid wedge gate valves with bolted bonnet.

6.4.2 Valves shall be pressure rated to full line rating.

6.4.3 Valves shall be lockable.

6.5 Jet Mixing System Equipment

For representative sampling it is essential that any water present in the crude oil is finely dispersed and uniformly distributed across the pipeline at the plane of the sample probe entry. Where complete homogeneity of the pipeline contents at all conditions of operation cannot be assured then a form of pipeline mixing is



required. In some special circumstances, static mixing devices may be suitable for creating adequate homogeneity in the pipeline but generally, of the various methods available, BP prefer jet mixing. For this a proportion of the main line flow is withdrawn and then reinjected under pressure back through nozzles into the bottom sector of the pipeline, upstream of the sampling point. Any separated water is thus lifted and distributed across the pipe.

The advantages of jet mixing over other forms of static or powered mixing are as follows:-

- (a) It is an efficient system creating good distribution at low pipeline flow rates with negligible pressure drop in the main pipe.
- (b) It is flexible. The jet pump may be turned off at high flow rates provided that adequate water distribution is produced by natural line turbulence without the need for the mixer. Positive confirmation that good mixing has been achieved will be required before this option can be used.
- (c) Only two flanged pipe stubs on the main pipeline are required for installation. These may be hot-tapped onto existing pipelines without the need for depressurising or draining.
- (d) The nozzle assembly may be inserted or withdrawn from the pipeline through a seal housing, allowing the line to be pigged or for inspection of the nozzles.
- (e) No moving parts are within the pipeline. The jet pump/motor unit can be mounted close to the pipeline in a position accessible for maintenance.

6.5.1 Jet Mixing Pump

Jet mix pump motors may be in the order of 50 HP for NPS 30 (DN 750) pipelines.

Remote control/indication/alarm of jet pump status may be required.

Consider worst case conditions. Generally, these will be represented by the lowest flowrate, lowest viscosity, lowest density and the highest water content. However other factors may apply.

Define if motor winding thermistor over-temperature protection is required.

The jet assembly may be inserted into a horizontal pipeline either from the top or the bottom. For top entry the jets are situated at the lower end of a longer tube which extends down through the pipe diameter to again displace the flow in the plane of the bottom pipe sector.

- 6.5.1.1 The jet mixing pump shall be of the centrifugal type in accordance with BP Group [GS 134-4](#) and shall be protected by a suitable strainer.



- * 6.5.1.2 The pump and its associated drive motor shall be adequately sized to fulfil the requirements for mixing under the worst pipeline conditions as specified by BP.

*Vendor will require;
Flowrate
Viscosity
Density
Water Content*

The vendor supplying the jet-mixing system shall be responsible for sizing the pump.

- 6.5.1.3 The pump drive motor shall be certified for use in the Hazardous area in which it is located.

Winding over-temperature protection may also be required

The pump motor shall be operated from a 440 v 3 phase 50 Hz power supply unless otherwise specified by BP and shall conform with the requirements of BP Group [GS 112-3](#).

- 6.5.1.4 The pump motor shall be controlled from a local start/stop button station.

Control of the pump motor from a remote point or indication/alarm of pump motor status are alternative options.

- 6.5.2 Jets

The jet energy shall be calculated using the procedures of [ISO 3171 Annex A](#).

The vendor supplying the jet mixing system is responsible for sizing the jets, the efficiency of mixing, and determining the distance downstream of the jets for the sample probe.

- 6.5.2.1 The jet assembly shall be suitable for live line insertion from the Top of the pipeline.

Live line insertion is not always required and insertion could be from any pipeline position.

Top entry is preferred, but if only bottom entry is practicable ensure that sufficient height above grade level is available and that there is a suitable drain away for any crude spillage.

Typically a clearance of 3.6 m is required for insertion of a retractable jet assembly into a NPS 24 (DN 600) pipeline.



Determine if a retractable jet assembly for live line insertion is required (see 5.4.1).

- 6.5.2.2 The jet assembly shall have flanged connections. The vendor shall specify the required main pipeline tapping size and flange size. Flanges and fittings shall conform with [ASME/ANSI B16.5](#).

Flange rating may be higher than pipeline specification

- 6.5.2.3 Jet entry pipes may be subject to vibration or eddy shedding caused by high fluid flow rates.

The probes should be checked for resonance effects due to vortex shedding

6.6 Sample Probe

- 6.6.1 The sample probe shall be of the retractable scoop entry type as Fig 2 and of length suitable for insertion to the centre of the pipeline through an intervening isolation valve, seal housing etc. The long radius bend will be machined with a 30 degree total angle internal chamfer (see Figure 2), to taper to minimum wall thickness at the sample entry point.

Either fixed or retractable probes are available (see Figure 2). Specify retractable probes for existing pipelines where live line entry will be necessary, where retraction may be required to allow line pigging or where other circumstances dictate. Otherwise specify fixed probes. A safety precaution, such as a securing chain, should be fitted to the probe to guard against its ejection under pressure when being withdrawn. Sufficient space should be allowed for fitting a suitable insertion/retraction device.

Define the pipeline diameter.

Define the size of the sample probe scoop entry as follows:-

*For line sizes less than but including
NPS 30 (DN 750) - NPS 1 (DN 750)*

*For line sizes greater than
NPS 30 (DN 750) - NPS 1 1/2 (DN 40)*

Sampler probes are inserted into the main pipeline through a flanged stub and an isolation valve. Design engineers should note that in crude oil lines deposits of sludge and scale can accumulate in the stub and valve bore. This can consolidate making it difficult to withdraw the probe after a prolonged period of use. It may also prevent complete closure of the isolation valve once the probe has been extracted..

The following procedures may help to deal with this problem:-

- (a) Apply fire main water pressure through a check valve to the purge connection on the sample probe seal housing to clear the deposits. The



recommended sample probe assemblies shown in Figure 2, show an appropriate NPS 1 1/2 (DN 40)

- (b) *Consider the use of ball type isolation valves on the pipeline stubs. These may close easier than gate valves in the presence of sludge, although the possibility of seal damage from scale must also be considered.*

6.6.2 The sample probe assembly shall have flanged connections. The main line tapping size and flange size shall be specified by the vendor. Flanges and fittings shall conform with [ASME/ANSI B16.5](#).

6.6.3 The sample probe shall be such that the scoop entry is at the pipe axis, or within a 0.1d semi-circle below the horizontal centre line. (See Figure 2)

Bottom or side insertion should be defined.

For horizontal pipelines the direction of insertion of the probe will depend upon the accessibility of the pipeline but should not be from above the horizontal centre line so that the exit flow is always sloping down. In an adequately mixed pipeline a representative sample is best obtained from within the 0.1d semi-circle below the pipeline axis.

The direction of probe entry into a vertical pipeline is immaterial but the scoop entry point must face upstream and should be on the pipe axis.

6.6.4 The sample probe shall be capable of live line insertion and withdrawal and shall be fitted with a safety device to prevent its ejection under line pressure

Specify if live line insertion of the sample probe is required. Note the recommendation for protection against probe blowout in 5.6.1.

6.6.5 The sample probe flange shall be marked to show the direction of flow into the scoop entry when it is facing directly upstream.

6.6.6 When retractable probes are used, the seal housing shall be fitted with a valved branch to enable flushing. Size to be as large as practicable, but shall not be less than NPS 1 (DN 25).

6.6.7 Sample probes may be subjected to vibration or eddy shedding caused by high fluid flow rates. The probes should be checked for resonance effects due to vortex shedding, using the procedure described in [EEMUA Publication No. 138](#).

6.7 External Loop Pump

6.7.1 The external loop pump shall be of the centrifugal type in accordance with BP Group [GS 134-4](#) and be supplied with restriction orifice at the discharge. It shall be protected by a strainer. (See 6.9).



A restriction orifice may be required at the external loop pump discharge to guarantee a minimum head if the restriction of the loop itself is not sufficient. The Vendor should be asked to carry out detailed pressure drop calculations for the loop design to verify whether or not a restriction orifice is required.

- 6.7.2 The external loop pump drive motor shall be for use in the hazardous area in which it is located. The pump motor shall be suitable for operation from a 440 v 3 phase 50 Hz power supply, unless otherwise specified by BP and shall comply with the requirements of BP Group [GS 112-3](#).

A winding over-temperature protection may also be required

The pump motor shall be controlled from a local start/stop button station.

Control of the pump motor from a remote point, or indication/alarm of pump motor status, are alternative options to be specified if required.

- 6.7.3 For tanker discharge/loading situations the pump shall be sized to provide 25% of the isokinetic flow velocity into the sample probe entry at the maximum expected main pipeline flowrate. The outside diameter of the probe shall be taken as the entry diameter.

- 6.7.4 For pipelines with near constant flow rates the pump shall be sized to provide approximately isokinetic flowrate at the sample probe entry.

6.8 Automatic Sampler

- * 6.8.1 The sampler shall be of the external loop flow cell type approved by BP and shall be capable of flow proportional operation over the full range of pipeline flowrates.

Flow cell type samplers, installed in an external loop are preferred over other types of sampling device for the following reasons:-

- (a) *Tests, have indicated that the water content of samples taken by an external loop cell sampler were in closer agreement with actual main pipeline water content than that of samples taken by an in-the-line sampler*
- (b) *Blockage of sampler upstream entry ports is less likely with flow cell samplers than with in-line types, which are susceptible to line trash.*
- (c) *The sampling mechanism of flow cell devices is installed external to the main pipeline and thus can be easily isolated and made accessible for maintenance.*
- (d) *Small bore low flow rate pipework between flow cell samplers and the associated receivers can be significantly shorter than with in-the-line*



samplers, thus reducing the probability of water drop-out or blockage due to waxing.

6.8.2 The repeatability of the sample grab volume over the full range of process conditions, especially viscosity and line pressure, shall be within +2% to -2%.

6.8.3 When installed in a pipeline the sampler shall be capable of providing an integrated sample which is representative of a 1% water in oil mixture passed through it to within +0.05% to -0.05% water in oil. Testing shall be by water injection according to para. 15, [ISO 3171](#).

Unless the vendor has a recirculatory hydraulic test circuit available it may only be possible to demonstrate capability of sampling to 5% accuracy by a field test using injected water. Nevertheless for contractual reasons the requirement should still form part of the system performance specification.

6.8.4 The sampler shall be of the bottom sample exit type.

6.8.5 The sampler shall be actuated pneumatically via a locally mounted electrical solenoid valve which is itself operated by signals generated by the sampler controller.

Provided that a local air supply is already available (or can be installed economically) pneumatically operated samplers are the preferred option. However the option of a hydraulically actuated sampler, supplied from a local electro/hydraulic power pack may be preferred if the cost of installing a suitable air supply is prohibitive.

6.9 External Loop Strainer

The External Loop pump strainer shall be an in-line coaxial type with mesh size as specified by pump manufacturer. It shall be positioned to allow easy access for removal/cleaning.

An in-line coaxial type strainer is mandatory to prevent water hold up in the strainer body. In applications where continuous sampler operation is imperative and where there may be particular problems with trash or debris in the main pipeline then consideration should be given to fitting a duplex strainer or a duplicate parallel strainer as standby.

6.10 External Loop Flow Indicator

The External Loop Flow Indicator shall be of the metal tube variable area type with magnetic follower, rated for the maximum external loop line pressure. It shall be capable of indicating external loop flowrate to within +10% to -10% over the full range of loop process conditions.

Facilities for a remote 'no flow' alarm may also be requested.



Consider the need for a remote indication/alarm in case of loss of external loop flow.

6.11 Bypass Loop Flow Control Valve

Bypass loop flow control will be by a manually adjustable flow regulator.

Alternatively bypass loop flow control may be by a rising plug or needle valve.

6.12 Strainer Differential Pressure Measurement

Differential pressure measurement across the strainer is required to warn of impending blockage. Measurement shall be by means of a local differential pressure gauge capable of withstanding 1.5 times full line pressure.

In some cases a differential pressure switch may also be required, with an alarm facility in the control room.

6.13 Pressure Measurement (General)

Local pressure indication shall be by Bourdon Tube type indicating gauges and comply with BS 1780, except for minimum diameter. This may be 63 mm. Pressure gauges shall be direct mounting with bottom connection.

6.14 Sample Receiving System

Depending on the sampled liquid one and two types of receiver shall be provided.

The type of sample receiving system to be specified will depend upon the vapour pressure of the crude oil to be sampled, and upon the laboratory test procedures to which the samples will be later subjected. Alternative receivers systems are available, as described in the main text.

(a) Receivers for General Stabilised Crude Oil Service

Simple cylindrical drumlike receivers of a type commercially available to the oil industry shall be supplied. They shall be of adequate capacity to contain the specified quantity of sample, with 10% additional ullage space.

The receivers shall be capable of withstanding at least 1.5 times the required sample pressure.

The internal surfaces shall be free from crevices which might entrap separated water and shall be of, or be coated with, an inert material which prevents clingage of the sample and which is immune to the crude oil constituents. Sample entry shall be through the top of the receiver. The entry pipe shall be provided complete with quick fit self seal connections for the flexible coupling from the sampling device.

A relief valve shall be fitted in the top of the receiver to maintain sample pressure and to minimise the loss of volatile components.

Receiver tops shall have a capped entry hole of sufficient diameter such that, on removal of the cap, a high shear mixing head (Ultra-Turrex type) may be inserted through the aperture to homogenise the receiver contents.

The receivers shall be provided with carrying handles and a facility for attaching a sample identification tag.

Receiver Pressure Rating Normally for stabilised crude oil the sample is maintained at a pressure 0.5 bar above its vapour pressure, (see below). Specify this value x 1.5.

Relief Valve. Enter the relief valve pressure setting - normally 0.5 bar above sample vapour pressure at the maximum temperature to be experienced by the receiver.

Receiver Tops. Alternatively (or additionally) self seal quick fit connections shall be provided in the top of the receiver to allow recirculation of the sample through an external 'pump around' mixing system. Of these, one shall be connected to a low entry suction tube extending to within 2 cm of the bottom of the receiver and the other to a return tube with its exit set normal to the receiver wall, below the sample surface level.

Re-useable/Expendable Receivers. The choice of receiver type depends upon local logistics and other circumstances. For example if the test laboratory is close at hand and if there is confidence that the receivers will be properly handled and cleaned before re-use, the re-useable receivers may be chosen. If however, the laboratory is remote or if proper cleaning cannot be guaranteed then expendable receivers may be the best choice.

(b) Receivers for High Vapour Pressure Crude Oils/Condensates

Receivers for high vapour pressure liquids shall be of cylindrical construction and rated to operate at 1.5 times the maximum specified pipeline pressure. The sample containing volume within the cylinders shall be adequate to contain double the specified sample volume, plus at least 10% ullage. Internal



piston(s) shall be fitted to maintain the sample above its vapour pressure when the back space behind the piston is charged with an appropriate inert gas. Fittings shall be provided to allow connection to an inert gas cylinder or other suitable back pressure source for on site charging. Pressure indication shall be provided to ensure that the piston is charged. (See 7.8.2).

No detectable leakage of inert gas shall pass the piston seals into the sample, neither shall any detectable concentration of a volatile sample liquid component pass back into the inert gas.

The receiver shall have the facility for internal mixing by forcing the sample contents through an appropriate sized orifice. Two designs of receivers are acceptable.

Option 1 (preferred)	Double chamber piston receivers, with the chambers divided by an internal barrier plate with mixing orifices. Mixing will be by piston shuttling enforcing sample transfer between chambers through the orifices.
Option 2 (with BP agreement only)	Single chamber piston receivers capable of coupling through a minimum volume connection to a only laboratory based duplicate receiver. Mixing will be by piston shuttling enforcing sample transfer between the chambers through the minimum volume connection.

Both types of receiver shall have an indicator showing the volume of sample contents.

Both types of receiver shall have a means of ensuring that the internal pressure remains constant within +10% to -10% of the charging pressure.

Sub-sample extraction after mixing shall be by syringe through a septum port connected internally through minimum volume to either a mixing orifice in Option 1 above or the inter chamber connection in Option 2. The septum shall be free from liquid leakage at test pressure.

Enter required sample volume (see 5.6.2). Enter back pressure gas. This should be an inert gas the presence of which in the sample would not, if detected, prejudice the accuracy of the composition analysis or other tests. Helium or argon are preferred gases.



Either double or single chamber piston receivers may be acceptable but at present the preference is for the double chamber design. This is because with single chamber receivers to be connected in the laboratory to a duplicate receiver for sample mixing, the interconnection may be by an initially empty pipe. Any initial vapourisation of sample within this pipe upon sample transfer must not significantly affect the accuracy of any subsequent sample analysis. A maximum empty pipe volume of 1 ml suggested if the single chamber receiver option is adopted.

With both types of receiver a bench mixing facility may be required in the laboratory into which the receivers may be installed for the application of alternating external pressure to shuttle the pistons.

Enter the required septum leak test pressure. This should be 1.5 times the maximum pressure applied to the cylinder during sampling or in any subsequent sample handling procedure.

Sub-sampling at high vapour pressure crude from pressurised receivers for full chromatographic analysis will normally be by syringe through a septum. However, there may be a requirement to release the sample into external pipework for entry into automatic analysis equipment e.g. automatic Karl Fischer apparatus. The designer should ascertain the laboratory test requirements before specifying the sample extraction route.

High vapour pressure crude oil samples, from which no vapour loss is tolerable and which will be later subjected to water determination, component analysis or distillation range tests, are collected in enclosed cylindrical receivers described under Alternative b.

A further consideration applying to both types of receiver is whether or not there is a need for a mixing facility within the receiver so that a homogenised sample is removed for analysis, or whether a form of external mixing can be applied.

7. PACKAGE DESIGN AND CONSTRUCTION REQUIREMENTS

7.1 General Requirements

The equipment to be mounted external to the pipeline described in Sections 4 and 5 shall be frame mounted.

Although the Specification defines the requirements for a jet mixing and bypass loop sampling system mounted on a single frame or contained within a single enclosure, there may be applications where, because of space constraints or because the system might be supplied by separate vendors, it may be preferable to have individual units or to house them in individual enclosures.

In these circumstances the basic requirements in the Specification for the individual package designs will be the same as for the combined system package.

The possible economic advantage of combining the jet mixing and external loop system in a common circuit has already been mentioned in 3.4. Such a combined system will of course be single-frame mounted or housed within one enclosure.



7.2 Package Construction

7.2.1 The overall dimensions of the package shall be such that the unit will fit into the available area specified in 5.1 with sufficient access space.

7.2.2 The enclosure shall be a self-rigid structure fabricated from marine grade GRP or an alternative material, as specified by BP and shall be fixed to a plinth or base frame fabricated from channel or beam sections. Enclosures of GRP material shall satisfy the requirements of the British Standards noted in 5.3 and the material shall be amine free.

The preferred fabrication material for enclosures is amine free marine grade GRP satisfying BS 476 Parts 7 & 8. However there may be applications where, because of the local environment an alternative material may be required e.g. Stainless Steel.

7.2.3 Equipment shall be mounted on the base frame or on rigid upright structures affixed to the base frame.

7.2.4 The floor of the base frame shall be designed to sustain the additional weight of personnel operating and maintaining the equipment within.

7.2.5 The level of the floor of the base frame relative to grade shall be such that full sample containers can be removed without excessive effort.

7.2.6 The package shall be freely ventilated.

7.2.7 The design of the enclosure doors, ventilators, service entries etc. shall be such as to prevent the ingress of rain, snow, seawater, blown dust or sand. as applicable

Minimum protection to IP55.

7.3 Equipment Installation

Items of equipment shall be installed within the package in accordance with the relevant referenced documents listed in Appendix B.

7.3.1 Flow cell samplers shall be installed in horizontal pipe runs with the sample port connection to the receiver(s) facing downwards.

7.3.2 The variable area flow indicator shall be installed in vertical pipe runs with upward flow.

7.3.3 All items of equipment including the sample receivers, shall be located within the overall dimensions of the enclosure and shall be readily accessible for operating and maintenance purposes.



- 7.3.4 Receiver vent pipes shall be run, without traps, to a vent outlet connection (see 8.4.1.1).

7.4 Process Connections and Pipework

7.4.1 General Require Standard

The enclosure/assembly shall be designed to minimise on-site installation work.

7.4.1.1 Process Connections

Inlet, outlet, vent and drain connections shall be to ANSI B16.5 The precise locations to be determined by the detailed equipment layout prepared by the vendor as part of the design submission.

The drain outlet connection shall be as low as practicable to allow total drainage of the process pipework as and when required.

The vent outlet connection shall be suitable for connection to external pipework leading to a safe disposal area and mounted high on the assembly/enclosure.

7.4.2 Process and Sample Pipework

Pipework from the sampler exit to the receiver(s) shall be as short as possible and have a downward gradient of at least 1:10. A maximum length of 1 m, with an internal volume of no more than 30 ml is required, unless otherwise approved by BP.

The system pipework within the package shall be as short as possible and designed to avoid low points at which separated water may collect, Drain and vent valves shall be provided at low and high points respectively.

Process pipework and fittings, with the exception of flexible connections to the receiver(s), shall be heat traced and/or lagged to minimise heat loss from the sample flow and to maintain the sample liquid in a free flowing state above its wax precipitation temperature.

Lagging, or where conditions require, heat tracing may be required to maintain the sample temperature above the wax precipitation point and, for high viscosity oils, to reduce the viscosity to a free flowing state e.g 100 cSt.

The design of the package shall be such that any expansion/contraction of pipework due to temperature change does not cause operating problems.



The design of the system shall be such that there is no hydraulic shock or consequential damage during operation.

Where necessary, piping runs shall be suitably supported.

Where quick release couplings are used provision must be made to depressurise them before decoupling.

7.5 Electrical Connection and Services

7.5.1 General Requirements

All electrical equipment shall be certified for use in the hazardous area in which it will be installed.

*** 7.5.2 Terminations**

All cables shall be terminated in junction boxes of a type approved by BP, supplied and mounted by the vendor in approved locations on the assembly or within the enclosure. Instrument and power cables shall be segregated and terminated in separate junction boxes.

Instrument cable screens shall only be earthed in the control room. Insulated terminals shall be provided in the junction box to maintain screen continuity and isolation from earth in the field mounted instrumentation.

One gland plate on each junction box, (preferably the bottom), shall be reserved for incoming cables, for which adequate cable transits (MCT) in the enclosure wall shall be provided. Sufficient space for armoured/lead sheathed cable shall be allowed.

7.5.3 Cables

- (a) Instrument and power cables shall be run in separate trays with minimum segregation.
- (b) Cable shall be supported on cable tray angle iron or unistrut for single cables, with the tray mounted on edge.
- (c) Cable strapping shall be PVC coated stainless steel. Alternatively, EVA coated stainless steel is acceptable.

7.5.4 Electrical Facilities



Isolation A separate local on/off switch(s) shall be installed for the isolation of each item of electrical equipment.

Lighting Enclosure lighting shall be provided.

Lighting will normally only be required within enclosures. However, consider the need for local lighting if the sampling equipment may require attention during the hours of darkness, e.g, for sample receiver change.

*

Heating Space heaters shall be provided to maintain the enclosure temperature at a level specified by BP.

Space Heating will only be required within enclosures.

Generally heating within enclosures will be required where the system is to be installed in an exposed situation or where low ambient temperatures prevail. Enter the required enclosure temperature (say 20°C), and the available power supply.

7.5.5 Earthing

Two earthing bosses with M12 studs shall be located one at each end of the base frame or enclosure, and comply with the requirements of [BS CP 1013](#). All electrical components and metal parts of the assembly, and cable armour/lead sheathing shall be electrically bonded to the earthing bosses. Cable armour is an acceptable earth bonding conductor.

7.6 **Pneumatic Requirements**

Not required if sampler is to be actuated electro/hydraulically

A connection to the utility instrument air supply shall be provided at an agreed location, to actuate the external loop sampler via the solenoid valve.

A filter/regulator assembly shall be supplied and fitted by the vendor. A pressure gauge shall be incorporated with the regulator.

Pneumatically operated samplers are the preferred standard option but if site compressed air is not available then a hydraulically operated device supplied from an electrical driven hydraulic power pack provides an acceptable alternative.



7.7 Electro-Hydraulic Requirements

An electro-hydraulic power pack, rated to supply oil pressure to meet the sampler manufacturers specification, shall be provided. The electrical components shall be suitable for safe use in the zone in which the system is to be installed and generally the hydraulic unit shall comply with the requirements of relevant section of BP Group [GS 134-1](#).

For applications where a pneumatic supply is not available, an electro-hydraulic system may be specified to activate the sampler. In such cases, ensure that the sampler itself is fitted with a suitable hydraulic actuator, that the electro-hydraulic power pack is adequately rated in terms of pressure and capacity, and that it is certified for safe use in the zone classification in which it will be used. BP Group [GS 134-1](#) specifies BP's general requirements for hydraulic power supplies.

7.8 Additional Functional Design Requirements

7.8.1 Pressure Relief

A Pressure relief valve at the sampler outlet shall be provided to protect the sampler and outlet lines against over pressure. A relief valve flow indicator shall indicate when the relief valve is lifted or passing. The valve shall relieve into a suitable relief line piped to a safe point which has been locally approved for use as a disposal area for the liquid being sampled.

7.8.2 Pressure Indication

A pressure indicator at the sampler outlet shall be provided to indicate sampler outlet pressure and also show when the sampler is in operation

Pressure gauges on the inert gas cylinder shall be provided to indicate cylinder back pressure on high vapour pressure crude samplers using pressure backed piston receivers. (See 6.14.(b))

7.8.3 Check Valves

Check valves shall be provided to prevent damage or malfunction due to reverse flow in pump discharge and sample loop return lines.

7.8.4 Temperature Indication

A bi-metallic type temperature indicator shall be installed in the bypass loop downstream of the sampler to confirm the efficiency of the heat trace/lagging system or, in an uninsulated system, to check that the sample temperature is above the wax point.



7.9 Fabrication

- 7.9.1 Fabrication shall be in accordance with the relevant referenced documents listed in Appendix B and commensurate with good engineering practice.
- 7.9.2 All items fabricated in carbon steel shall be prepared and painted in accordance with BP Group [GS 106-2](#). Other finishes shall only be used subject to approval by BP.
- 7.9.3 Flanged connections shall be used at any point where system components may have to be removed for maintenance, calibration etc.
- 7.9.4 Isolation and drain valves shall be located as close as possible to the related equipment.

8. INSPECTION, TESTING AND CALIBRATION

- 8.1 At regular intervals during package fabrication, BP require the opportunity to visit the vendor's premises to inspect work, verify progress and carry out any checks/tests deemed necessary.
- 8.2 The vendor shall provide a procedure to fully functionally test the system and verify its correct operation and shall submit this for BP approval at least 8 weeks before functional testing commences.

Specify at least two oils of minimum and maximum anticipated viscosities

- 8.3 The package functional tests shall be carried out with simulated input/output signals and using fluid of similar viscosity to the crude oil(s) to be sampled.
- 8.4 The completed package shall be comprehensively tested in accordance with the approved test procedure prior to the BP witnessed test and final inspection.
- 8.5 During the BP witnessed test, the vendor shall demonstrate, using the approved test procedure, that the equipment functions correctly and that it satisfies completely the requirements of this Specification. All test results shall be clearly and concisely recorded and copies submitted to BP.
- 8.6 After completion of testing, the system shall be completely flushed, using an approved cleaning agent and then purged and dried before being sealed for transport.



- 8.7 As part of the inspection/acceptance procedure, BP will require to examine and verify all certification relating to approvals, electrical safety, materials (pipe fabrication) and any other relevant documentation.

9. PACKING AND PREPARATION FOR SHIPMENT

- 9.1 Before shipment the vendor shall arrange for the packages to be weighed and shall provide a dry weight certificate and an estimate of final wet weight. These figures shall comply with the weight estimates forming part of the quotation, which shall not be exceeded.

Wet weight is defined as the weight of the system with all equipment and pipework filled to maximum capacity with fresh water.

- 9.2 Prior to shipment, any fragile component likely to be susceptible to damage in transportation, shall be removed and securely packed for separate shipment. The sample storage receivers or cylinders shall also be removed and packed separately. Pipe ends shall be sealed.

- 9.3 All packing shall be carried out in accordance with good shipping practice, and the requirements of [BS 1133](#).

- 9.4 Packages shall be amply provided with desiccant such as silica-gel to prevent condensation.

- * 9.5 Packed equipment shall be clearly labelled in accordance with BP's delivery instructions.

10. DOCUMENTATION

The Vendor shall provide as a minimum, the following package documentation:-

10.1 Design

- (a) Piping and instrumentation diagram.
- (b) Detailed hot tap and piping installation drawings.
- (c) Detailed equipment layout drawings.
- (d) Foundation and Fixing Requirements.
- (e) Equipment specifications.



- (f) Sample loop pressure drop calculations.
- (g) Pump sizing and jet energy calculations. (Jet and External Loop).
- (h) Electrical power requirements.
- (i) Heat consumption calculations.
- (j) Package enclosure weight calculations (wet and dry).
- (k) Flowrate calculations.

10.2

Fabrication

- (a) Vendor data (sub-vendor) for all equipment with copies of material test/traceability certificates, hazardous equipment approval certificates and calibration certificates where applicable.
- (b) Package fabrication drawings.
- (c) Instrument and electrical wiring diagrams.
- (d) Instrument and electrical schematic diagrams
- (e) Instrument hook-up drawings.
- (f) Fabrication detail drawings.
- (g) Welding Specification.

10.3

Inspection and Test

- (a) Inspection and pre-power-up test and calibration records.
- (b) Functional Test Procedure.
- (c) Functional Test Records and calibration certificates.
- (d) Package wet and dry weight certificates.
- (e) Pressure test certificates.



10.4 Package Equipment Manual

The vendor shall supply a Package Equipment Manual which shall include at least the following:-

- (a) Physical and operating description of the package.
- (b) Vendor data and certificates for all equipment.
- (c) Major design and fabrication drawings, including wiring diagrams.
- (d) Installation and commissioning procedures.
- (e) Equipment and component maintenance procedures.
- (f) Operational spare parts list (for 2 years) with part numbers.

10.5 Title Block

All documents shall bear a title block including at least the following information:-

Client Project Reference No.	
Equipment Specification No.	
Purchase Order No.	
Equipment Description	
Tag Number	

10.6 Progress Charts

As part of the proposal, the vendor shall provide a bar chart showing time scales for all major activities such as design, equipment and materials procurement, fabrication, testing, etc. Milestones for inspection visits and witness test shall also be shown on the bar chart.

10.7 Certification

BP will require to examine, as part of the final documentation dossier, the hazardous area certification for all electrical items. This shall exactly match the order and specification requirements.



11. EQUIPMENT VENDORS

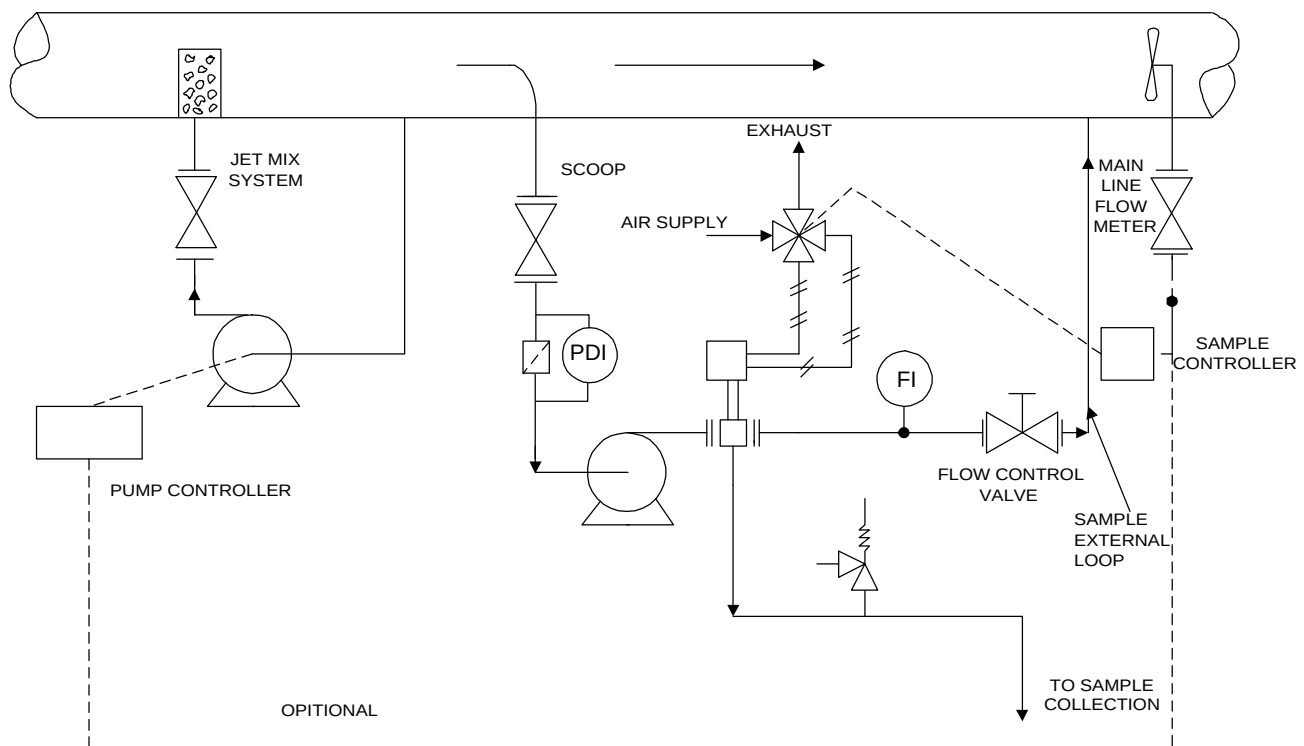
11.1 The contractor shall supply a list of vendors for the following equipment:-

- (a) Samplers
- (b) Sample receivers
- (c) Flexible couplings



RECOMMENDED SAMPLING SYSTEM SCHEMATIC

FIGURE 1



MAIN COMPONENTS :-

JET MIX SYSTEM	PUMP WITH OPTIONAL STOP/START CONTROLLED FROM MAIN LINE FLOW.
SAMPLER EXTERNAL LOOP	SCOOP TUBE - EITHER 1" OR 1/2" DEPENDING ON LINE SIZE. (LIVE LINE INSERTION POSSIBLE. COARSE STRAINER WITH D.P MEASUREMENT. CELL SAMPLER (OPERATION MAY BE HYDRAULIC) SAMPLER CONTROLLER. CONTROL MAY BE FROM METER STATION FLOW COMPUTER. SAMPLER COLLECTION SYSTEM WITH USER OPTIONS (e.g CAN WEIGH & CAN CHANGEOVER)
MAIN LINE FLOW	TRASH RESISTANT FLOWMETER (LIVE LINE INSERTION POSSIBLE) OR FROM METERING SYSTEM

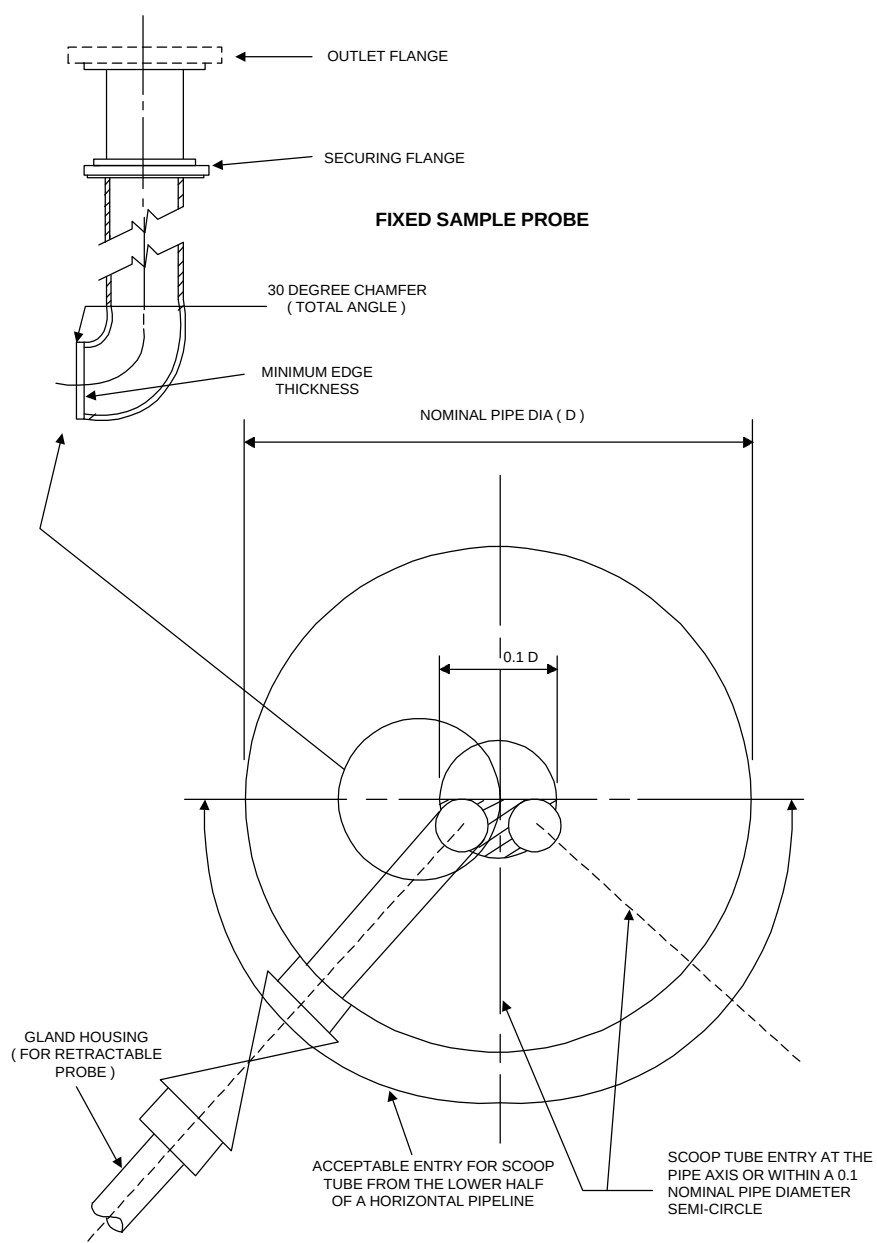


FIGURE 2

SCOOP TUBE ENTRY (HORIZONTAL LINE)

DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

In this BP Guidance for Specification, the following definitions apply:-

external loop:	a pumped flow loop taking suction from and returning to the main oil line.
external loop sampler:	an automatic sampler located within the external loop. (Sometimes referred to as a flow cell sampler).
homogeneity:	the degree of mixing of the non-miscible pipeline liquids. For crude oil and water the mixture is accepted as homogeneous if the ratio of the water concentration between the top and bottom of a horizontal pipeline is better than 0.9 over the specified range of main pipeline flow rates and water contents. For a vertical pipeline, the ratio is measured across a diameter inline with the last bend.
inline sampler:	an automatic sampler located within the main oil line.
jet mixing:	a technique using an external energy source to create homogeneous line conditions where a centrifugal pump takes suction from the main line and discharges back into the main line through jets specially designed and aligned to disperse and distribute the water.
profile testing:	an experimental programme to examine the variation in the concentration of the property of interest (usually water content in oil) across the diameter of the pipeline.



sampler controller:	the device that generates a signal to operate the sampler. This may be either on a time basis (time proportional) or after a set quantity of liquid has passed a particular point in the main oil line (flow proportional).
sample probe:	the suction probe at the inlet to the external loop.
Static mixing:	a technique using the energy in the pipeline liquid to create homogeneous line conditions. A system of plates or baffles divides and disperses the water. This method causes a flow dependent permanent pressure drop within the main oil line.

Abbreviations

API	American Petroleum Institute
BS	British Standard
DN	Nominal Diameter
EEMUA	The Engineering Equipment and Materials Users Association
EVA	Ethyl-Vinyl-Acetate
GRP	Glass Reinforced Plastic
IP	Institute of Petroleum
ISO	International Organisation for Standardisation
NPS	Nominal Pipe Size
OD	Outside Diameter
PIM	Piston Internally Mixed
PVC	Poly-Vinyl-Chloride



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

International Standards

[ISO 3171](#) Petroleum Products - Liquid Hydrocarbons - Automatic Pipeline Sampling

British Standards (BS)

[BS476](#) Parts 7 & 8 : Fire Tests on Building Materials and Structures.

[BS1133](#) Packaging Code
[BS1780](#) Specification for Bourdon Tube Pressure and Vacuum Gauges
[BS5501](#) Electrical Apparatus for Potentially Explosive Atmospheres Part I
[BS5734](#) Polyester moulding components for electrical and other purposes
[CP1013](#) Earthing

American Standards

[ASME/ANSI B16.5](#) - 1988 : Pipe Flanges and Flanged Fittings

Industry Standards

[EEMUA](#) Design and Installation of On-line
[Pub. No 138:](#) analyser systems. (Formerly OCMA INP-3).

BP Group Documents

[GS 134-1](#) Hydraulic Power Supplies
[GS 106-2](#) Painting of Metal Surfaces
[GS 136-1](#) Materials for Sour Service
[GS 134-4](#) Centrifugal Pumps to API 610
[GS 112-3](#) Low Voltage Induction Motors
[82.ER.0125](#) BP Report on vortex shedding
(report available from the Custodian of this document).

