TECHNICAL SPECIFICATION

OIL MIST LUBRICATION SYSTEMS

DEP 31.29.00.30-Gen.

December 1995
(DEP Circular 21/99 has been incorported)

DESIGN AND ENGINEERING PRACTICE

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell International Oil Products B.V. (SIOP)
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Shell International Exploration and Production B.V. (SIEP)
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Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

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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NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design of oil mist lubrication systems which serve pumps, side entry mixers and small compressors, and their electric motor or general purpose steam turbine drivers, located in close proximity to each other. Lubrication systems for internal combustion engines and gas turbine drivers are excluded from the scope of this DEP.

This DEP is a revision of the DEP with the same number dated December 1983.

This DEP shall be used in conjunction with data/requisition sheet DEP 31.29.00.93-Gen.

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 defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants and, where applicable, in exploration and production facilities 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

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/Vendor** 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 the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

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 (9).

2. GENERAL

2.1 APPLICATION

Oil mist lubrication systems may be considered in areas and/or applications where hydrocarbon emissions are within local environmental constraints.

The maximum benefits of oil lubrication in terms of enhanced bearing reliability resulting from high standards of lubrication quality control and the prevention of ingress of water and other contaminants into the bearing housing, can be achieved using either a 'pure mist' dry sump lubrication system or a 'purge mist' wet sump lubrication system. The 'purge mist' system is applied by retaining the conventional constant-level oil arrangement and using 'purge mist' to pressurize the housing and to compensate for any oil loss from the constant-level oiler.

If oil mist lubrication is specified or will be applied the design of bearing housings and of the oil mist lubrication distribution system shall comply with this DEP.

2.2 PERFORMANCE

Compliance with this DEP does not relieve the vendor of his responsibility for ensuring that the system and equipment furnished are properly designed and constructed and suitable for the service intended. The required lifetime, reliability and availability of the system shall be specified by the Principal and agreed with the Vendor.

2.3 CONFLICTING REQUIREMENTS

In the case of conflict between documents relating to the enquiry or order, the following hierarchy of documents shall apply:

Upper level: purchase order and variations thereto

Second level: data/requisition sheets and drawings

Third level: this DEP

2.4 SYSTEM DESCRIPTIONS

2.4.1 Oil mist lubrication system

An oil mist lubrication system is a means of distributing atomized oil drops (of 1 to 3 µm) from a central mist generator to a number of lubrication points using a dry, low-pressure (nominally 50 mbar (ga)) air stream. The normal concentration of oil mist in the transport air is of the order of 6 ml/m^3.

2.4.2 Pure oil mist systems

Pure oil mist systems, also referred to as 'pure mist' or 'dry sump' systems, utilize a continuous oil mist flow through the bearing housing to deliver clean oil directly to the bearings; and to maintain an outward flow of air from the housing to prevent the ingress of moisture and other corrosive contaminants. The need for an oil sump is eliminated.

2.4.3 Purge oil mist systems

Purge oil mist systems, also referred to as 'purge mist' or 'wet sump' systems, use reclassified oil to maintain a constant level of oil in the sump to lubricate the bearings. The air purges the bearing housing and prevents the ingress of moisture and other corrosive contaminants.

2.5 SYSTEM SELECTION

A 'purge mist' system shall be selected for equipment with bearing housings fitted with rolling element bearings or sleeve bearings, provided with an oil sump and a constant-level oil arrangement.

A 'pure mist' system shall be selected for electric motors fitted with rolling element bearings. However, before proceeding with such a system, the vendor shall check with the motor manufacturer that the motor is suitable for such a form of lubrication.

2.6 SYSTEM DESIGN DATA

The purchaser shall provide the vendor of the oil mist lubrication system with sufficient data relating to the equipment which is to be lubricated to enable him to design the system required. For each consumer on the system, this information should include the item number of the equipment, its manufacturer's type/model identification, the shaft diameter, the make and designation and the description of the radial and thrust bearings, the speed of rotation and the power consumption. The purchaser shall also indicate which equipment is subjected to frequent stop/start and/or shock loading.

The vendor shall also be provided with a plot plan of the facility.

3. BASIC DESIGN

3.1 GENERAL

The design concepts discussed in this section apply not only to the lubrication of equipment with rolling element bearings but also to the lubrication of equipment with sleeve bearings.

The vendor of the oil mist lubrication system is in all cases responsible for coordination, and he shall establish with the rotating equipment manufacturers the oil mist lubrication requirements for each item of equipment.

3.2 SYSTEM DESIGN

Each oil mist lubrication system shall consist essentially of an oil mist generator to produce and control the oil mist, a network of distribution lines to convey the oil mist to the points of lubrication (the consumers), and reclassifiers to coalesce the oil at the bearings.

Provision shall be made for venting the oil mist from each bearing housing, and drains shall be provided to drain the coalesced oil in the case of 'pure mist' systems or to collect any overflow from 'purge mist' systems.

The oil mist generator shall be designed for a capacity of 125% of the rated requirements of the system, and it shall be capable of operating satisfactorily at 50% of its designed capacity.

Distribution lines to the consumers shall be designed to ensure that coalescing of airborne particles of oil is kept to an absolute minimum, for example by using swept bends instead of pipe bend fittings to avoid impingement.

The velocity of flow in the oil mist distribution lines shall not exceed 3 m/s.

The design of the distribution system shall ensure that a homogeneous mixture of air and oil reaches all consumers, including the most remote, with sufficient pressure to impart a velocity to the mist adequate to generate turbulent flow through the inlet fittings at the points of lubrication. Such turbulent conditions are needed for the satisfactory wetting of the surfaces to be lubricated.

Clean and dry air is required for generating and transporting the atomized oil.

The Principal will provide an air supply at a pressure between 3 bar (ga) and 7 bar (ga) from an appropriate instrument air header to the point of location of the oil mist console via piping installed solely for the oil mist lubrication system.

The reclassifiers shall be located at the ends of the branch lines to the consumers, see detail A of Appendix 1. The reclassified oil shall be fed to the individual bearing housings via feeder lines which shall be not more than 1 m in length.

The oil mist console (control cabinet) and all electrical equipment and components within the system shall be suitable for the area classification, gas grouping and temperature classes specified in the data/requisition sheet.

3.3 DISTRIBUTION PIPING

A typical arrangement of the distribution pipework in an oil mist lubrication system is shown in Appendix 1.

The oil mist generator shall be located in a position central to the system.

The length of pipe run from the oil mist generator to the most remote consumer shall not exceed 100 m.

Oil mist headers shall be run to slope continuously and downwards towards the oil mist generator for a distance of at least 15 m in order to allow coalesced oil drops to drain back into the generator. The gradient of this slope should not be less than 1:50.

Beyond this minimum distance of 15 m, the oil mist headers should continue to slope towards the oil mist generator. However, if such an arrangement is not possible, the headers may slope downwards towards the consumers with a similar gradient, or they may

be run horizontally. In any event, low points where oil could collect shall be avoided.

The vendor shall advise if it is necessary for certain headers to be drained, including those which run horizontally, and the location of the drain points which are needed.

The riser from the oil mist generator shall enter the main header at the bottom.

Branch headers shall be taken from the top or from the side of the main oil mist header.

Branch lines and feeder lines to individual bearing housings shall be run to slope continuously and downwards towards the equipment.

Feeder lines shall be run direct to the point of lubrication with a minimum number of bends. If the consumer is an electric motor or generator with insulated bearings, an insulation piece shall be mounted in the feeder line, close to the bearing housing.

Sharp changes in direction in the distribution pipework, for example the use of 90° elbow fittings, should be avoided wherever possible.

All distribution pipework shall be smooth internally and free from all projections. Prior to making up the pipework, care shall be exercised to ensure that it is clean throughout the system.

Cut lengths of pipe and tubing shall be reamed and de-burred at each end and then blown clean. All fittings shall be blown clean.

If piping or tubing is to be stored prior to making it up, then all open ends shall be taped up. Care shall be taken to ensure that no damage occurs during the period of storage.

All threaded connections shall be coated with lubricating oil before making the connections. Care shall be taken to avoid excessive use of thread sealing compounds or PTFE tape to make up the joints. The first two threads of threaded connections shall be free of any sealing compound or PTFE.

Following assembly of the distribution pipework but prior to the fitting of the reclassifier nozzles, the system shall be flushed clean using a suitable solvent. Alternatively, the system may be blown with steam, then dried with nitrogen or warm instrument air.

There shall be no valves in oil mist headers or in any of the branches (except as defined below).

Except in the ideal situation where the main oil mist header slopes continuously and downwards towards the oil mist generator, a DN 20 drain line shall be installed at the closed end of this header, and connected to the bottom of the header. The drain line shall be fitted with a block snap valve and a reclassifier which can serve as an oil drain point.

A similar arrangement shall be provided at the closed ends of all branch pipes forming individual consumer oil mist manifolds.

Materials of construction for oil mist distribution pipework shall be as follows:

Main header - DN 50 Schedule 40 galvanized carbon steel pipe, threaded API.

Branch header - DN 25 Schedule 40 galvanized carbon steel pipe, threaded API.

Branch lines - DN 15 Schedule 40 galvanized carbon steel pipe, threaded API.

Feeder lines - 10 mm. O.D. Series 300 type stainless steel tubing with 0.035 in. minimum wall thickness, or armoured flexible hose of similar bore and material.

Accessories - all reclassifiers and tube fittings shall be steel or stainless steel or alternative material.

3.4 COMPONENTS AND ACCESSORIES

3.4.1 Oil mist generator

The oil mist shall be generated by means of either a vortex chamber or a venturi nozzle.

3.4.2 Oil mist console

The oil mist generator shall be enclosed in a stainless steel or galvanized carbon steel cabinet, which shall be freestanding and provided with a hinged door with a locking `tee' handle.

The cabinet shall be weather-proofed and vented, and shall be mounted on steel legs such as to permit on-stream inspection of the oil mist generator through windows without the need to mount a ladder. All exposed steel surfaces shall be primed and finished in accordance with manufacturer's standards.

3.4.3 Reclassifiers

For 'pure mist' applications, mist or spray reclassifiers shall be used.

The mist/spray issuing from the feeder lines shall be directed straight at the rolling element bearing itself.

For 'purge mist' applications, reclassifiers shall be of the condensing type in order to limit the amount of oil mist vented off into the atmosphere.

Each lubrication point shall have its own reclassifier.

3.4.4 Bearing housings

For 'pure mist' systems, an oil sight bottle incorporating a drain valve shall be fitted to the drain connection of the housing in order to monitor, and subsequently drain, any accumulation of oil.

Existing constant-level oiler connections in the housing shall be plugged.

For 'purge mist' systems, an oil level sight assembly with overflow level control shall be provided to maintain a maximum oil level in the bearing housing.

3.4.5 Air

The air supplied to the mist generator shall be clean and dry; instrument air shall be used for this since plant air is normally not suitable for long term, trouble-free operation.

3.4.6 Air filter

An air filter/water separator shall be provided for the inlet air supply. It shall be capable of removing 100% of particles of size 10 μm and larger, and shall be suitable for a normal working pressure of 7 bar (ga).

The filter shall be installed adjacent to the oil mist generator and automatic drains shall be piped to a suitable location outside the oil mist console.

3.4.7 Air regulator

An air regulator shall be provided to control the pressure of the air supply within the oil mist distribution system. The regulator shall be capable of accepting inlet air supplied at pressures within the range of 3 bar (ga) and 7 bar (ga).

There shall be no block valve upstream of the air regulator.

3.4.8 Air heater

A thermostatically controlled electric heater shall be provided to maintain the inlet air at operating temperature, and to limit the air temperature to a maximum of 65 °C in order to prevent oxidation of the oil mist.

3.4.9 Oil selection

At least the following factors shall be evaluated in selecting the oil for mist lubrication.

- viscosity of the oil at the temperature in the venturi nozzle;
- surface tension of the oil;

- compliance of the properties of the selected oil with the lubricant requirements specified by the supplier of the system and by the manufacturers of the connected equipment;
- wax formation tendency of the oil at low ambient temperature, to prevent blockage of the reclassifiers.

3.4.10 Oil reservoir

An oil reservoir shall be provided which shall be sized for a minimum of 48 hours continuous operation at the rated oil mist production capacity.

The reservoir shall be located within the oil mist console and shall have a valved drain piped to a suitable location outside the cabinet.

3.4.11 Oil filter

For pumped refilling of the oil reservoir, an inlet oil filter shall be provided and installed upstream of the oil reservoir. It shall be capable of removing 100% of particles of size 20 µm and larger.

Connections to the oil make-up drum shall be such as to prevent sand or dust entering the system. For gravity feed arrangements, a 50 mesh-SWG.33 fine strainer shall be used.

3.4.12 Oil heater

A thermostatically controlled electric heater shall be provided to maintain the viscosity of the oil within an acceptable range by controlling the temperature. The temperature of the oil shall be controlled to a maximum of 43 °C.

4. INSTRUMENTATION AND CONTROL

4.1 INSTRUMENTATION

Amended per Circular 21/99

The vendor shall make provision for monitoring the following systems, and shall supply the necessary instrumentation unless otherwise specified in the data/requisition sheet.

All instrumentation and connections for instruments shall comply with the requirements of DEP 32.31.09.31-Gen. and DEP 32.31.00.32-Gen.

4.1.1 Air system

Provision shall be made to monitor the following:

- inlet supply pressure
- outlet supply pressure downstream of the air regulator
- air heater outlet temperature.

4.1.2 Oil system

Provision shall be made to monitor the following:

- reservoir oil level
- reservoir oil temperature
- oil supply pressure
- oil mist generator outlet pressure to main header
- oil flow to oil mist generator.

4.1.3 Isolating valves

Isolating valves shall be provided for all level indicators and for all pressure indicators.

4.2 CONTROL

The vendor shall include the following controls within his scope of supply:

- An air pressure regulator to control the pressure within the oil mist distribution system. The regulator shall be capable of accepting inlet air supplied at pressures within the range 3 to 7 bar (ga).
- An oil flow valve to control the density of the oil mist.
- An air by-pass valve to control the oil mist pressure without increasing the oil output.

Automatic control of the oil level in the reservoir of the oil mist generator.

4.3 ALARM

If specified on the data/requisition sheet, individual alarm lights shall be installed for the following functions:

- low oil mist outlet pressure
- high oil mist outlet pressure
- low reservoir oil level
- high reservoir oil level
- low air supply temperature (air heater outlet)
- high air supply temperature (air heater outlet)

- low oil temperature (oil heater outlet)
- high oil temperature (oil heater outlet)
- low oil flow to the oil mist generator.

Alarm lights for each malfunction shall be panel-mounted and located within the oil mist console. 'First out flashing' type of alarm annunciation should be used.

The individual alarms shall be connected to the Principal's remote alarm system.

The actuation of the remote alarm in the plant control room shall also be indicated locally by a red light mounted on the top of the oil mist cabinet. Normal operation of the oil mist lubrication system shall be indicated by a green light mounted on the top of the cabinet.

The alarm and normal operation lights shall be clearly visible in all horizontal directions.

The area classification and the supply voltage for the alarm/indicator system shall be specified in the data/requisition sheet.

5. INSPECTION AND TESTING

5.1 INSPECTION

The manufacturer shall state in his proposal the inspection methods which will be applied and shall give details of the quality control procedures set up in his manufacturing facility.

The Principal shall indicate if, and to what extent he will witness the Manufacturer's inspectons.

5.2 CERTIFICATION

The Manufacturer shall provide certificates of compliance (ISO 10474, type 2.1) in which it is confirmed that the materials of construction used for all equipment, piping and components are in accordance with the requirements of the purchase order.

For electrical equipment, the Manufacturer shall provide certificates of conformity stating that the electrical apparatus complies with the relevant standards for apparatus for potentially explosive atmospheres, with respect to the area classification, gas grouping and temperature classes specified in the data/requisition sheet.

5.3 TESTING

The oil mist generator shall be tested in accordance with the manufacturer's standard shop test.

5.4 PREPARATION FOR SHIPMENT

Preparation for shipment and the procedures to be followed shall be in accordance with the requirements of the inquiry and of the purchase order, and the supplements appertaining thereto.

Generally, machined surfaces shall be coated with a suitable rust preventative, ends of piping and tubing shall be sealed and protected, and all pipes and tubes shall be braced and secured to prevent damage during shipment.

6. ROTATING EQUIPMENT ADAPTATION

6.1 GENERAL

It will be necessary to carry out certain modifications to the standard bearing housing arrangements of rotating equipment in order to adapt the equipment for operation on an oil mist lubrication system.

Centrifugal pumps may already have provision for oil mist lubrication in accordance with API Std 610 if so specified when purchased.

The vendor of the oil mist lubrication system shall verify the details of necessary modifications with the rotating equipment manufacturer. Shielded or sealed bearings shall not be used. The rotating equipment supplier shall inform the Principal about the modifications required.

Oil mist inlet connections to bearing housings shall be at least 1/4 in. NPT.

Bearing housing arrangements shall allow for the free exhausting of air.

6.2 'PURE MIST' APPLICATIONS

A typical arrangement of bearing housing connections for a pump showing the relative positions of the oil mist inlet and the oil level sight assembly (3.4.4) is shown in Appendix 2.

The bearing housing shall be vented via labyrinths or through end cover vents in such a way that the oil mist shall first pass through the bearings.

If provided, end cover vents shall be located in such a way as to prevent the entry of rain water.

6.3 'PURGE MIST' APPLICATIONS

A typical arrangement of bearing housing connections for a pump showing the preferred location of the oil mist inlet is shown in Appendix 3. Alternatively, the oil mist inlet may be located at the top of the bearing housing. With such an arrangement, the balance line connection to the side-mounted sight bottle is still required.

Oil rings or flingers shall be retained.

The bearing housing shall be vented in such a way that the oil mist shall first pass through the bearings.

The vendor shall advise if it is necessary to improve the venting by the provision of additional vent holes in the end cover. Any additional vents should be located above the centre line of the bearing and arranged so as to prevent the entry of rain water. For sleeve bearings, the vendor of the oil mist lubrication system shall make recommendations as to the location of the reclassifier fittings and vents.

7. VENDOR'S DATA

7.1 PROPOSALS

The vendor shall submit his proposal for the oil mist lubrication system(s) required, which shall include the following:

1. Copies of the relevant data/requisition sheet(s) completed to the fullest extent possible, at the time of submission.
2. A comprehensive description of the oil mist lubrication system proposed and of the function of each component.
3. A preliminary outline drawing, fully dimensioned.
4. A summary of the oil and air requirements supported by calculations detailing the requirements of each lubrication point.
5. A schedule of the materials of construction for the complete system(s).
6. A description of the manufacturer's quality control procedures and standard shop tests.
7. Recommendations for the type and grade of Shell lubricating oil(s) to be used in the oil mist lubrication system(s).
8. List of selected instruments to be provided by the vendor.

In his proposal, the vendor shall include the supply of the following items for each oil mist lubrication system required:

1. Oil mist generator.
2. Oil mist console, including provisions for venting and weatherproofing.
3. The required number of reclassifiers.
4. Air filter/water separator, including drainage arrangement.
5. Air regulator.
6. Air heater.
7. Oil reservoir, including provision for draining to the outside of the cabinet.
8. Oil filter, including provisions for connection to oil make-up drum.
9. Oil heater.
10. Distribution pipework, including main oil mist header, branch lines and feeder lines.
11. The flow, pressure and level controls specified (4.2).
12. The necessary instrumentation, unless otherwise specified, for the monitoring of the air and oil systems.
13. When specified, the alarm/indicator system, including tie-in to principal's remote alarm system.
14. All necessary modifications to the bearing housings of the rotating equipment concerned.
15. All necessary support brackets and fixings for pipework and components, and for instrumentation where applicable.

7.2 CONTRACT DATA

7.2.1 Drawings

The number of copies of drawings/schedules/forms required and the time within which these have to be submitted shall be specified in the purchase order.

7.2.2 Project coordination

In addition to the information contained in his proposal, the vendor shall provide further detailed information which shall include the following:

1. Dimensional drawings of the oil mist lubrication system, including details of all external connections.
2. A schematic diagram of the oil mist generator system.
3. The oil mist generator system wiring diagram.
4. The documents for controls and instrumentation as specified in DEP 32.31.09.31-Gen.
5. A bill of materials.
6. A list of recommended spares.
7. An operating instruction manual which shall include:
   - all details necessary for the installation and operation of the system
   - the operating ranges of the instrumentation
   - the settings for the alarms/indicators.

8. 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).

Amended per Circular 21/99

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Data/requisition sheet for centralized oil mist lubrication systems	DEP 31.29.00.93-Gen.
Instruments for measurement and control	DEP 32.31.00.32-Gen.
Instrumentation for equipment packages	DEP 32.31.09.31-Gen.

AMERICAN STANDARD

Centrifugal Pumps for General Refinery Services	API Std 610 Eighth Edition, January 1996

Issued by:
American Petroleum Institute
Publications and Distribution Section
1220 L Street Northwest
Washington, DC 20005, USA.

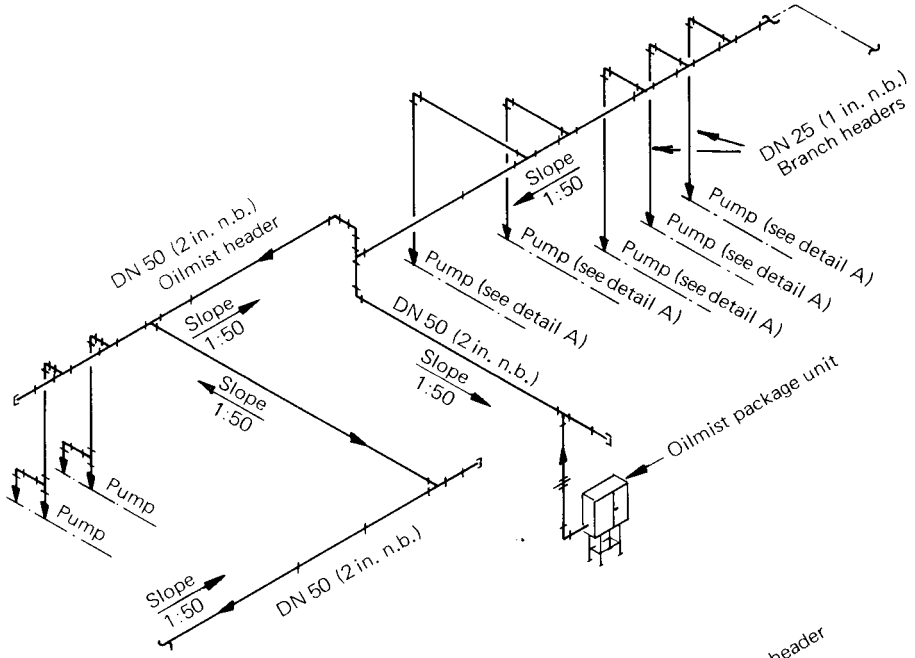
INTERNATIONAL STANDARDS

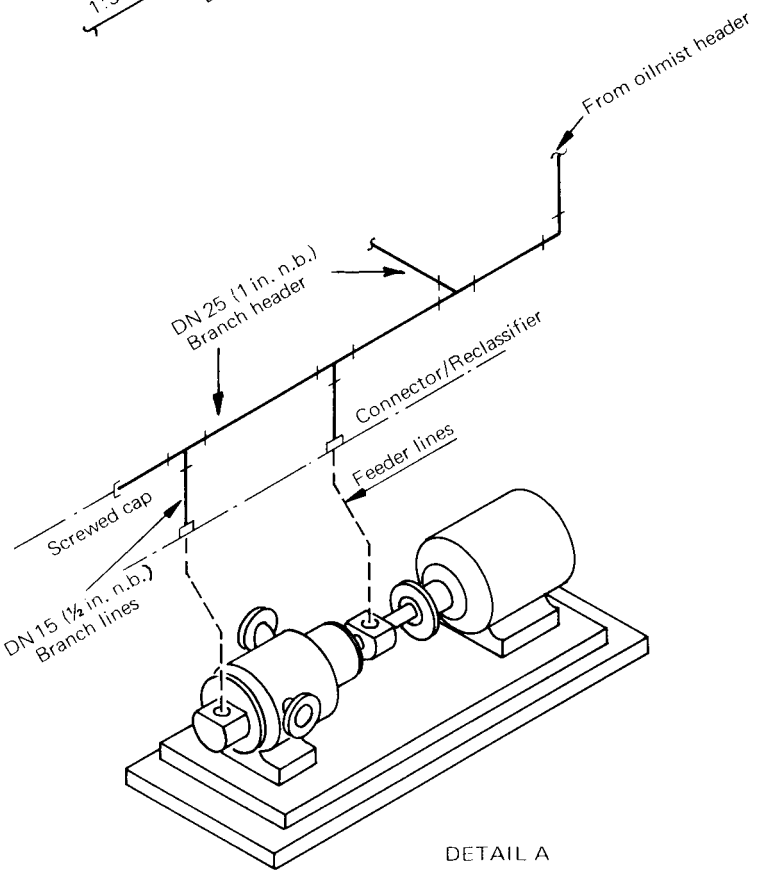
Steel and steel products - Inspection documents	ISO 10474

Issued by:
International Organisation for Standardisation
1, Rue de Varembé
CH-1211 Geneva 20
Switzerland.

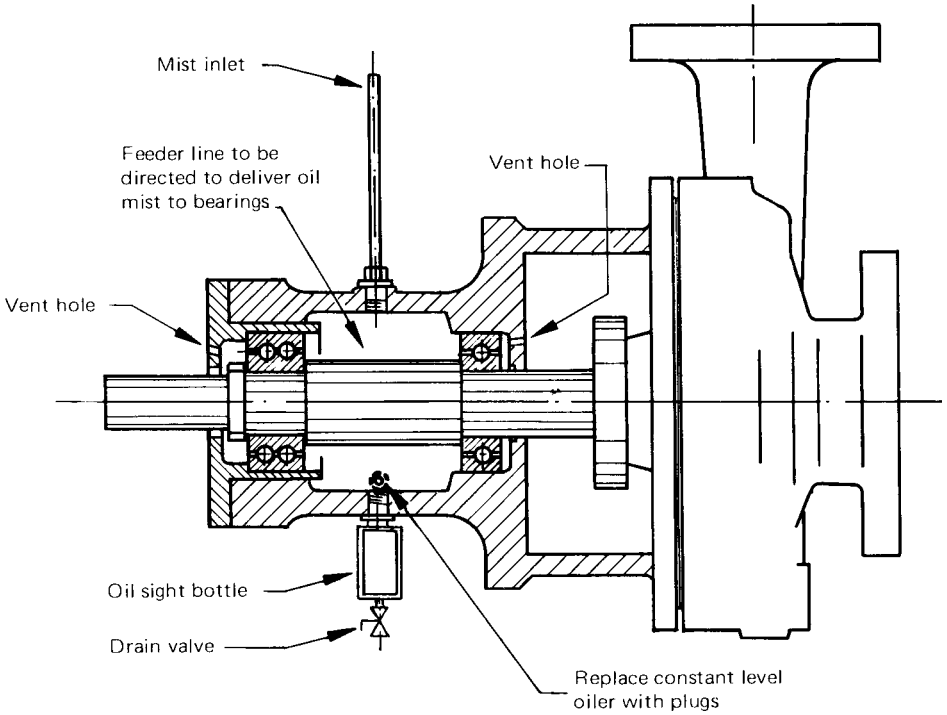
Copies can also be obtained from national standards organizations.

APPENDIX 1 TYPICAL ARRANGEMENTS FOR OIL MIST DISTRIBUTION PIPING

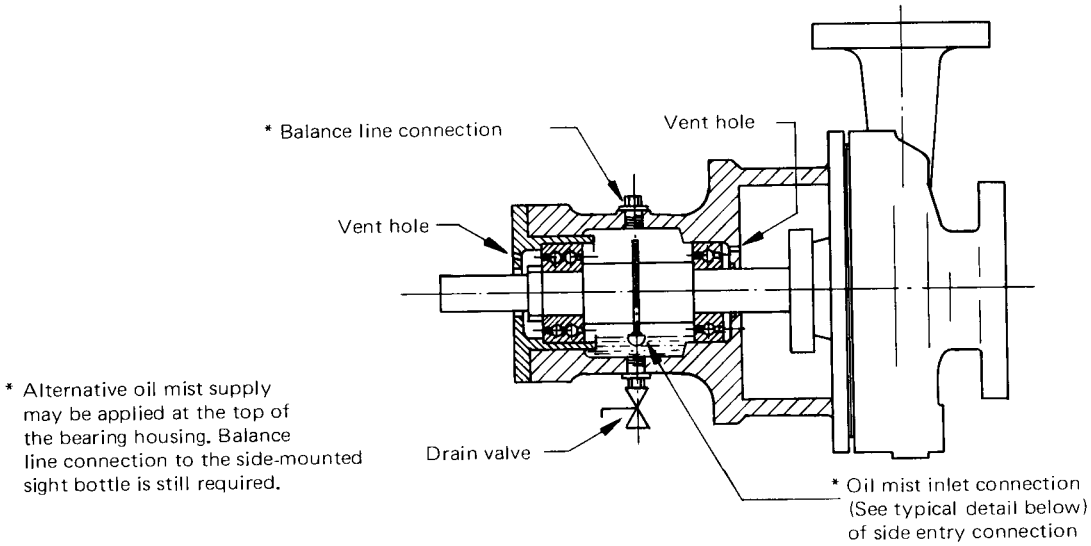




APPENDIX 2 TYPICAL ARRANGEMENTS FOR BEARING HOUSING CONNECTIONS - PURE MIST APPLICATIONS



APPENDIX 3 TYPICAL ARRANGEMENTS FOR BEARING HOUSING CONNECTIONS - PURGE MIST APPLICATIONS



* Alternative oil mist supply may be applied at the top of the bearing housing. Balance line connection to the side-mounted sight bottle is still required.