

RECOMMENDATIONS FOR CENTRALIZED LUBRICATION AS APPLIED TO PLANT AND MACHINERY

BS 4807 : 1972

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BRITISH STANDARDS INSTITUTION

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The Institution desires to call attention to the fact that these recommendations do not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 5000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook, which may be purchased from BSI Sales Department. It may also be consulted in many public libraries and similar institutions.

These recommendations make reference to the following British Standards:

- | | |
|----------------|---|
| BS 21. | Pipe threads. |
| BS 143 & 1256. | Malleable cast iron and cast copper alloy screwed pipe fittings for steam, air, water, gas and oil. |
| BS 219. | Soft solders. |
| BS 885. | Brass tubes for general purposes 70/30 arsenical brass, aluminium brass. |
| BS 980. | Steel tubes for automobile purposes. |
| BS 1123. | Safety valves, gauges and other safety fittings for air receivers and compressed air installations. |
| BS 1387. | Steel tubes and tubulars for screwing to BS 21 pipe threads. Heavyweight. |

Printed in England by WELBECSOON PRESS LIMITED, London, S.W.11.

- BS 1740. Wrought pipe fittings, iron and steel (screwed BSP thread).
- BS 1965. Butt-welding pipe fittings for pressure purposes.
- BS 2017. Copper tubes for general purposes.
- BS 2051. Tube and pipe fittings for engineering purposes.
Part 1. Copper and copper alloy capillary and compression tube fittings (for use with fractional o.d. sizes of tubes).
- BS 2779. Fastening threads of BSP sizes.
- BS 3223. Calcium-base greases.
- BS 3601. Steel pipes and tubes for pressure purposes. Carbon steel: ordinary duties.
- BS 3602. Steel pipes and tubes for pressure purposes. Carbon steel: high duties.
- BS 3605. Steel pipes and tubes for pressure purposes. Austenitic stainless steel.
- BS 3799. Forged steel pipe fittings, screwed and socket-welding for the petroleum industry.
- BS 3832. Wire braid reinforced rubber hose, type 2, and hose assemblies fitted with end couplings.
- BS 4099. Colours and their meaning when used for indicator lights, annunciators and digital readouts in industrial installations.
- BS 4368. Carbon and stainless steel compression couplings for tubes.
- BS 4412. Lubrication symbols.
- BS 4504. Flanges and bolting for pipes, valves and fittings. Metric series.
- BS 4586. Spiral wire reinforced rubber hose and hose assemblies fitted with end couplings.
- PD 6428. Information on factors affecting the selection of lubricants.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on these recommendations:

Committee reference MEE/165

Draft for comment 70/115



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CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision these recommendations were prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

- Associated Offices Technical Committee
- Association of Consulting Engineers
- Association of Hydraulic Equipment Manufacturers
- Association of Mining Electrical and Mechanical Engineers
- British Chemical Plant Manufacturers' Association
- British Compressed Air Society
- *British Electrical and Allied Manufacturers' Association
- British Gear Manufacturers' Association
- British Internal Combustion Engine Manufacturers' Association
- British Mechanical Engineering Confederation
- British Pump Manufacturers' Association
- British Steel Industry
- Crown Agents for Oversea Governments and Administrations
- *Department of Employment and Productivity (H.M. Factory Inspectorate)
- *Department of the Environment
- *Department of Trade and Industry
- Department of Trade and Industry—National Engineering Laboratory
- Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
- *Engineering Equipment Users' Association
- *Gas Council
- Institution of Civil Engineers
- *Institution of Gas Engineers
- Institution of Heating and Ventilating Engineers
- *Institution of Mechanical Engineers
- Institution of Mechanical Engineers (Automobile Division)
- *Institution of Plant Engineers
- *Institution of Production Engineers
- Locomotive and Allied Manufacturers' Association of Great Britain
- London Transport Executive
- *Machine Tool Trades Association
- Ministry of Defence
- *Ministry of Defence, Army Department
- *National Coal Board
- National Physical Laboratory (Department of Trade and Industry)
- Royal Institute of British Architects
- Telecommunications Engineering Manufacturing Association
- Water-tube Boilermakers' Association

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of these recommendations:

- Association of Supervisory and Executive Engineers
- Coal Preparation Plant Association
- Engineering Employers' London Association
- Federation of Manufacturers of Construction Equipment and Cranes
- Institute of Petroleum
- Institution of Electrical Engineers
- Institution of Works Managers
- Machine Tool Industry Research Association
- Management Consultants' Association
- Production Engineering Research Association of Great Britain
- Society of Motor Manufacturers and Traders Ltd.
- Society of Service Managers
- 'Maintenance Engineering' and individual experts

RECOMMENDATIONS FOR CENTRALIZED LUBRICATION AS APPLIED TO PLANT AND MACHINERY

FOREWORD

These recommendations have been prepared under the authority of the Mechanical Engineering Industry Standards Committee.

It has been found desirable to lay down installation and maintenance requirements in order to improve plant availability by ensuring that a given centralized lubrication system is adequate and reliable in use together with being economically viable.

The recommendations are intended to meet the needs of people who use complete centralized lubrication systems, and also those who buy proprietary parts in order to build their own systems. This is a general guide and not a design specification. It is recommended that consultation should take place between the user, the equipment designer and the lubricant supplier when the design of new systems is contemplated.

RECOMMENDATIONS

1. SCOPE

These recommendations deal with centralized oil and grease lubrication systems for plant and machinery with respect to installation practice, system pipework and ancillary equipment.

Specific recommendations relating to system design and to the design and manufacture of proprietary items of equipment such as pumps, metering valves, etc., are considered to be outside the scope of this publication and are therefore excluded.

NOTE. The titles of the British Standards referred to in these recommendations are listed on page 2.

2. DEFINITIONS

For the purposes of these recommendations the following definitions apply:

(1) *Centralized lubrication system.* A system in which two or more lubrication points on a machine or group of machines are served with the same lubricant from a common source.

(2) *Total equivalent length of pipe.* For the purposes of calculating pressure drop the total lengths of straight pipe plus the total of the pipe length equivalent of associated fittings in the relevant part of the system.

(3) *Pressure drop.* The difference in pressure of a medium before and after an event, e.g. having flowed through a length of pipe.

(4) *Laminar flow* (also known as *streamline*, *viscous*, or *straight line flow*). A type of flow in which there is a continuous steady motion of the particles, the motion at a fixed point always remaining constant.

(5) *Turbulent flow.* A type of fluid flow in which there is unsteady motion of the particles, the motion at a fixed point varying in no definite manner.

(6) *Rheological properties.* Properties relating to rheology, the science of the deformation and flow of matter.

The following is a list of rheological terms and properties of paramount importance in grease flow and in some instances in oil flow:

- a. *Newtonian behaviour.* The property of simple liquids by which the rate of shear is proportional to the shearing stress. This constant proportion is the viscosity of the liquid.
- b. *Non-Newtonian behaviour.* The property possessed by some fluids and many plastic solids including lubricating greases, of having a variable relationship between shear stress and rate of shear.
- c. *Apparent viscosity.* The ratio of shear stress to rate of shear of a non-Newtonian fluid.

NOTE. This changes with changing rates of shear and temperature and must therefore be reported as the value at a given shear rate and temperature.

- d. *Shear rate.* (Newtonian fluids). The rate at which a series of adjacent layers of lubricant move with respect to each other. In circular pipe flow it is proportional to the mean linear velocity of flow divided by the radius of the pipe and is thus expressed as reciprocal seconds.
- e. *Shear stress.* The stress which is applied to the lubricant (whether oil or grease) to induce flow. For the flow of any type of material in a tube of circular cross section the shearing stress at the wall of the tube is given by:

$$F = \frac{PD}{4L}$$

where F = shearing stress,
 P = pressure drop,
 L = length of tube,
 D = diameter,

in consistent units.

f. Yield stress (or yield value). The minimum stress required to produce flow. It is indicated by the intercept on the shear stress axis of the prolongation of the straight portion of the curve of shear stress versus shear rate.

(7) *Strainer*. A device for removing coarse and impure particles from a lubricant.

(8) *Filter*. A device for fine filtration of a lubricant in order to obtain the required degree of cleanliness in the system.

Further definitions are given in PD 6428.

NOTE. The unit of pressure adopted in these recommendations is the bar (1 bar = 10^5 N/m²).

Pressures quoted in these recommendations are gauge pressures and not absolute pressures, i.e. a reading of zero bar = atmospheric pressure.

3. CLASSIFICATION OF SYSTEM BY PRINCIPLE OF OPERATION

Centralized lubrication systems are divided into two main categories:

(1) *Total loss*, in which none of the lubricant fed to the lubrication point is returned to the system.

(2) *Circulating*, in which the lubricating medium, after use, is collected and returned to the (oil) reservoir.

3.1 Total loss systems are subdivided into:

- (1) *Intermittent* a volumetric (oil and grease)
b proportionate (oil only)
(2) *Continuous* a proportionate (oil only)

3.1.1 Two line (intermittent volumetric). Two supply lines are connected to a pumping unit which through a manually or automatically operated reversing valve pressurizes and relieves each line in turn. Piston type metering valves connected across the supply lines are actuated by the differential of pressure in the two lines.

Oil or grease may be used in both lines, or one line can be specifically used as the actuating line with hydraulic fluid as the medium.

3.1.2 Single line progressive (intermittent volumetric). This incorporates a single supply line from a pump unit via which a series of piston type metering valves are pressure actuated consecutively.

3.1.3 Single line spring reset (intermittent volumetric). A single line from a pumping unit is connected to injectors which operate by line pressure each time the line is pressurized. After each operation the line is relieved of pressure and a spring in the injector resets the measuring piston ready for the next cycle.

3.1.4 Single line spring actuated (intermittent volumetric). A system in which a spring loaded chamber in the injector is loaded with lubricant by pressure

from the main line by pumps and when pressure is relieved from the main line the spring pressure injects lubricant into the bearing.

NOTE. The above methods of application may be varied on occasion by replacement of the springs by other means of propulsion.

3.1.5 *Single line incorporating restrictors* (continuous or intermittent proportionate). Control is obtained by the use of calibrated or adjustable restrictors which become proportionately effective when the line is pressurized by a given volume of lubricant.

3.1.6 *Direct feed (intermittent volumetric)*. This type can give a sequential or semi-continuous feed.

This consists of a pumping unit having one or more pumping elements from which a separate line is run to individual bearings.

3.1.7 *Aerosol systems (continuous proportionate)*. An aerosol consisting of minute particles of lubricating oils suspended in compressed air is generated at a central point and piped to the points of application where the aerosol is converted back to useful oil through specially designed restrictors.

3.2 *Circulating systems*. Circulating systems are all subdivided as follows:

- Continuous* (oil only) a. volumetric (small capacity systems only)
- b. proportionate

The system should have bypass relief valves capable of returning a full flow to a reservoir.

3.2.1 *Large capacity*. Large capacity systems handle volumes of oil up to several hundreds of litres per minute at pressures normally in the region of 3.5 bar*.

Systems can vary from a single pump and tank to highly specialized arrangements incorporating twin tanks and pumps, pressure vessel, cooler, filter and oil/water separators. Metering may be effected by such means as orifice plates, regulating valves, sprays or pipe sizes.

3.2.2 *Medium capacity systems*. These systems usually handle oil in the region of 5 litres to 15 litres per minute, but operating pressures are generally higher than in large capacity systems.

The varying methods of metering lubricant quantities to the bearings include metering piston pumps, needle valves, spring return valves and sequential operating piston type metering valves. As in large capacity systems the oil is collected after use and returned to the reservoir or return tank.

3.2.3 *Small capacity systems*. These systems usually handle oil at the rate of up to 5 litres per minute. There are also some very small capacity systems which meter a few drops to each bearing.

* 1 bar = 10^5 N/m².