

Recommendations for

Centralized lubrication systems

Systèmes de lubrification centralisés —
Recommandations

Zentralschmiersysteme

Committees responsible for this British Standard

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British Institute of Management (Asset Management Group)
Chartered Institute of Management Accountants
Chartered Institution of Building Services Engineers
Consumer Policy Committee of BSI
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Institute of Marine Engineers
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Institution of Electrical Engineers
Institution of Incorporated Executive Engineers
Institution of Mechanical Engineers
Institution of Plant Engineers
Ministry of Defence
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The following bodies were also represented in the drafting of the standard, through sub-committees and panels:

Advanced Manufacturing Technology Research Institute
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Foreword

These recommendations have been prepared under the direction of the Quality, Management and Statistics Standards Policy Committee, and are a revision of BS 4807 : 1972, which is superseded and withdrawn.

It has been found desirable to give recommendations on installation, commissioning and maintenance to improve availability of the asset by ensuring that the centralized lubrication system serving it is adequate, reliable and economically viable.

These 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. Consultation should take place between the user, the equipment designer and the lubricant supplier when the design of new systems is contemplated.

In this revision of BS 4807 the clauses concerning recommendations for pumps, reservoirs, temperature control, filtration and system control have to a large extent been rewritten. In particular, the clauses on pumps and reservoirs have now been structured for ease of reference to particular aspects of these system parts. The recommendations for reservoirs, which in the previous edition were spread over three clauses, have been brought together within one clause. Additional terms have been defined and in the clause dealing with the classification of systems the descriptions of the various total-loss systems have been extended and their operation illustrated by means of pressure-time graphs. The classification of circulating systems according to capacity has been dropped, however.

Compliance with a British Standard does not of itself confer immunity from legal obligations. Attention is drawn in particular to the Health and Safety at Work etc. Act 1974, and other statutory requirements referred to in the text.

Recommendations

1 Scope

This British Standard gives recommendations relating to centralized oil and grease lubrication systems with respect to installation practice, commissioning, pipework and components.

NOTE 1. Specific recommendations relating to system design and to the design and manufacture of proprietary items of equipment such as pumps, metering valves, etc., are excluded.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1 centralized lubrication system

A system in which two or more lubrication points are served with the same lubricant from a common source. Centralized lubrication systems can be classified according to the manner in which the systems are actuated:

- (a) hand operated. The actuation of the system is by hand.
- (b) partly automatic. The actuation of the system is triggered by hand and then proceeds automatically (e.g. push button actuation).
- (c) fully automatic. The actuation of the system is triggered by time cycle control or by machine cycle control, and then proceeds automatically.

2.2 total equivalent length of pipe

For the purposes of calculating pressure drop this equals the total of the lengths of straight pipe plus the sum of the pipe length equivalent of associated fittings in the relevant part of the system.

2.3 pressure drop

The difference in pressure of a medium before and after an event, e.g. having flowed through a length of pipe.

2.4 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.

2.5 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.

2.6 Newtonian behaviour

The property of simple liquids where the rate of shear is proportional to the shearing stress. This constant proportion is the viscosity of the liquid.

2.7 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.

2.8 apparent viscosity

The ratio of shear stress to rate of shear of a non-Newtonian fluid.

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

2.9 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.

2.10 shear stress

The stress which is applied to the lubricant to induce flow.

2.11 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.

2.12 strainer

A device for removing coarse particles from a lubricant.

2.13 filter

A device for removing fine particles from a lubricant in order to obtain the required degree of cleanliness in the system.

2.14 unit of pressure

The unit of pressure adopted in these recommendations is the bar.¹⁾

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

2.15 lubrication cycle time

The time interval during which a pressure rise occurs in the main line and also during which the delivery of a given volume of lubricant to the lubrication point takes place. These two processes can take place simultaneously, or they may be staggered in time in relation to one another.

NOTE. A release of pressure following on the pressure rise is essential for the proper functioning of the lubrication system in the case of some lubrication systems. The magnitude of the pressure rise results automatically from the sum total of all the pressure drops (resistances) between the pressure generator and the wear point. The time of the pressure rise does not coincide on all lubrication systems with the running time of the pump.

¹⁾ 1 bar = 10^5 N m^{-2} = 10^5 Pa = 14.5038 lbf/in².

2.16 relief time

The time interval during which the release of pressure necessary to actuate the lubricant metering devices occurs mechanically/hydraulically.

2.17 pause time

The time interval from the beginning of the pressure decrease to the beginning of the following pressure build-up in the main line.

2.18 duty cycle time

The time interval from the beginning of one lubrication cycle to the beginning of the next one.

2.19 lubrication time

The running time of the pump in a continuously operating system.

2.20 dwell time

The time in which a quantity of lubricant will remain in the reservoir under normal running conditions.

dwell time (in min) =

$$\frac{\text{volume of lubricant in reservoir (in L)}}{\text{rate of circulation (in L/min)}}$$

3 Classification of system by principle of operation

NOTE. See figure 1.

3.1 General

Centralized lubrication systems are divided into two main categories:

- (a) *total loss*, in which none of the lubricant fed to the lubrication point is returned to the system;
- (b) *circulating*, in which the lubricating medium, after use, is collected and returned to the reservoir.

3.2 Total-loss systems**3.2.1 General**

Total-loss systems are subdivided into:

- (a) *intermittent*
 - (1) volumetric (oil and grease), where a constant measured quantity of lubricant is mechanically fed at intervals to individual points of application;
 - (2) proportionate (oil only), where a number of points of application are simultaneously charged with lubricant, the quantity to each point being regulated by a restrictor as described in 3.2.6; and
- (b) *continuous*, i.e. proportionate (oil only) (see 3.2.8 for a particular application).

3.2.2 Two-line (intermittent volumetric)

In two-line systems, the lubricant is alternately forced via a directional control valve to each of two main lines to which metering devices (usually hydraulically operated piston valves with adjustable stroke limiters) are connected at intervals. The metering devices are operated by the alternate rise and fall in lubricant pressure in the main lines, allowing the metered quantity of lubricant to be delivered to the lubrication point.

The lubrication points of a two-line system are subdivided into two sets. Lubricant is fed to the first set of points during the partial lubrication cycle time A1 and to the second set during the partial lubrication cycle time A2 (see figure 2). A two-line metering device is connected to two main lines and feeds a lubrication point of the first set via a first (lubrication point) feed line, and a lubrication point of the second set via a second (lubrication point) feed line. The pump only runs during the partial lubrication cycle times A1 and A2. When lubrication cycle A1 is complete the pressure rises, operating a cycle completion switch which stops the pump, and a change-over valve switches the flow from main line 1 to main line 2, putting main line 1 into relief. At the same time the system controller/timer starts the pause cycle C. The pause cycle is always the same for each main line.

3.2.3 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.

The lubrication cycle time (A) in a progressive plunger system is identical with the pump running time and is circumscribed by the necessity of having to supply the prescribed volume of lubricant at least once to all the lubrication points of the system. During the pause time (C), a certain pressure relief takes place in the main lines and in the secondary feed lines. (See figure 3.)

	Total-loss lubrication systems	Circulating lubrication systems
Restrictor systems		
Single-line systems		
Two-line systems		
Multiline systems		
Progressive plunger systems		
Oil mist systems		

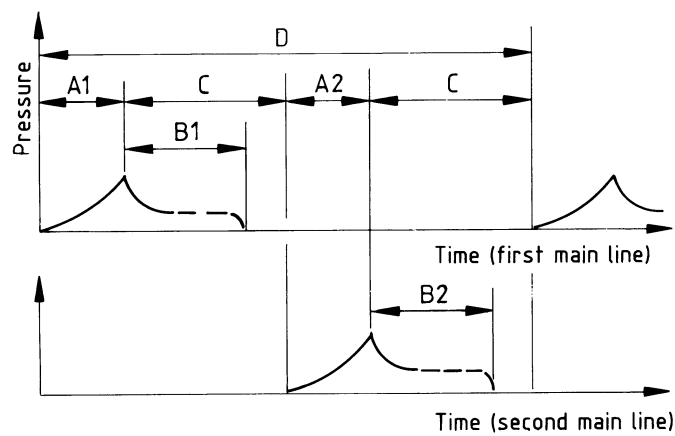
Key

A Pump with lubricant reservoir
 B Lubrication point
 C Restrictor
 D Metering device with injectors
 E Relief line
 F Pressure line

G Relief valve
 H Main line
 K Feed line
 L Change-over valve
 M Compressed air line
 N Secondary feed line

O Oil mist appliance
 P Progressive plunger metering device
 R Return line
 S Two-line metering device
 V Restrictor

Figure 1. Centralized lubrication systems

**Key**

A1 lubrication cycle time, line 1

A2 lubrication cycle time, line 2

B1 relief time, line 1

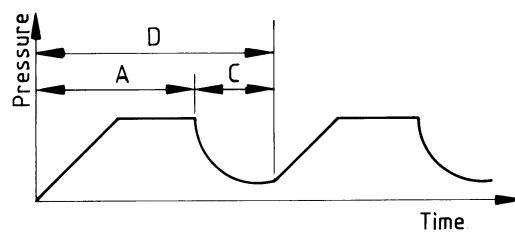
B2 relief time, line 2

C pause time

D duty cycle time

$$D = A1 + A2 + 2C$$

$$B1 < C \quad B2 < C$$

Figure 2. Two-line system operation**Key**

A lubrication cycle time

C pause time

D duty cycle time

Figure 3. Single-line progressive system operation

3.2.4 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.

As the pressure builds up in the main line, the lubricant pressure overcomes the resistances which can arise up to the wear point, and for a short time the prelubrication injector metering device delivers a metered quantity of lubricant (see figure 4).

When the preset pressure is attained the pressure will level out while the pump runs on. The relief time (B) commences when the pump is switched off. During the relief time (B) the pressure in the main line drops to a lower figure, and simultaneously a metered quantity of lubricant is made ready for the next cycle in the injector metering device. The time interval between lubrication cycles is given by pause time (C).

3.2.5 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.

During the time when the pump is running, the preparation of a metered volume of lubricant takes place in the after-lubrication injector metering device, and this volume of lubricant is subsequently delivered to the lubrication point

(indirectly) at the commencement of the relief time (B) by the force of a pressure spring in the metering device (see figure 5). The subsequent delivery of lubricant to the lubrication point takes place over a longer period of time depending upon the frictional resistance of the system.

3.2.6 Single line incorporating restrictors (continuous or intermittent proportionate)

Control is obtained by the use of calibrated or adjustable restrictors (e.g. fixed or variable orifices, control valves) which become proportionately effective when the line is pressurized.

While the pump is running, all the lubrication points of the system are fed. The running time of the pump is termed 'lubrication time' (E). The lubrication time (E) and the pause time (C) are grouped together into one duty cycle (D) (see figure 6).

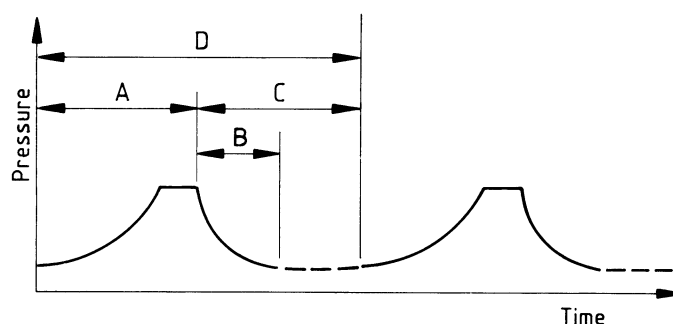
3.2.7 Direct feed (intermittent volumetric)

This type can give a sequential or semi-continuous feed.

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

3.2.8 Oil mist/aerosol systems (continuous proportionate)

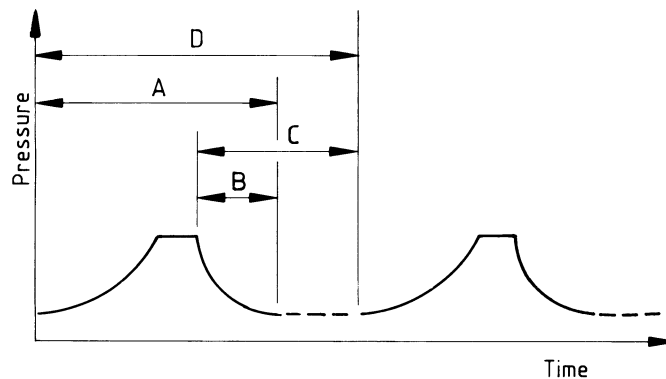
In this type of system, minute particles of lubricating oil, suspended in an air stream, are generated at a central point, and piped to the lubrication points where the oil mist is converted back to useful oil through specially designed devices.



Key

- A lubrication cycle time
- B relief time
- C pause time
- D duty cycle time
- $B \leq C$

Figure 4. Single-line spring reset system operation

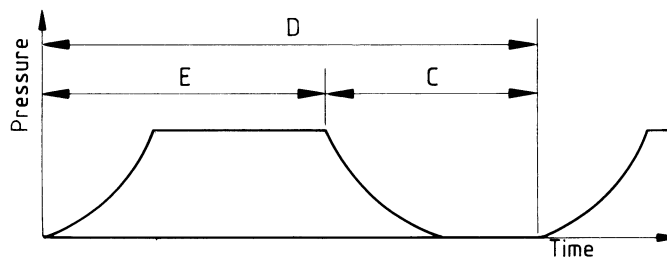
**Key**

A lubrication cycle time

B relief time

C pause time

D duty cycle time

 $B \leq C$ $A \leq D$ **Figure 5. Single-line spring actuated system operation****Key**

C pause time

D duty cycle time

E lubrication time

Figure 6. Operation of single-line system incorporating restrictors**3.2.9 Air/oil systems (intermittent volumetric)**

This system consists of a pump delivering oil direct or via manifolds to a reservoir unit where fixed quantities of oil are intermittently injected into an air stream feeding each lubrication point. The air can also act as a cooling medium. The oil is not atomized but is forced through the small bore pipework by the flow of air.

The pressure-time graph is basically the same as that depicted in figure 4 and described in 3.2.4.

3.2.10 System combinations

Combinations of several centralized lubrication principles of operation in one centralized lubrication system are possible. For example, where in a two-line system a number of lubricating points are grouped closely together, the supply from a

single metering device can be subdivided to feed these points by using a single-line progressive system.

3.3 Circulating systems

Circulating systems are generally continuous and are all subdivided as follows:

- (a) volumetric (small-capacity systems only);
- (b) proportionate.

The lubricant is recirculated to the lubricant reservoir through the return line after it has passed through the wear points, in order to be used again repeatedly. Circulating lubrication systems are generally used in cases where a removal of the heat generated at the wear point has to be achieved in addition to the reduction of abrasive wear.