

## Systems, Symbols, Functions, Planning, Installation

A VOGEL centralized lubrication system performs the task of supplying individual lube points or groups of points with varying amounts of exactly metered lubricant from one central location to meet their different needs.

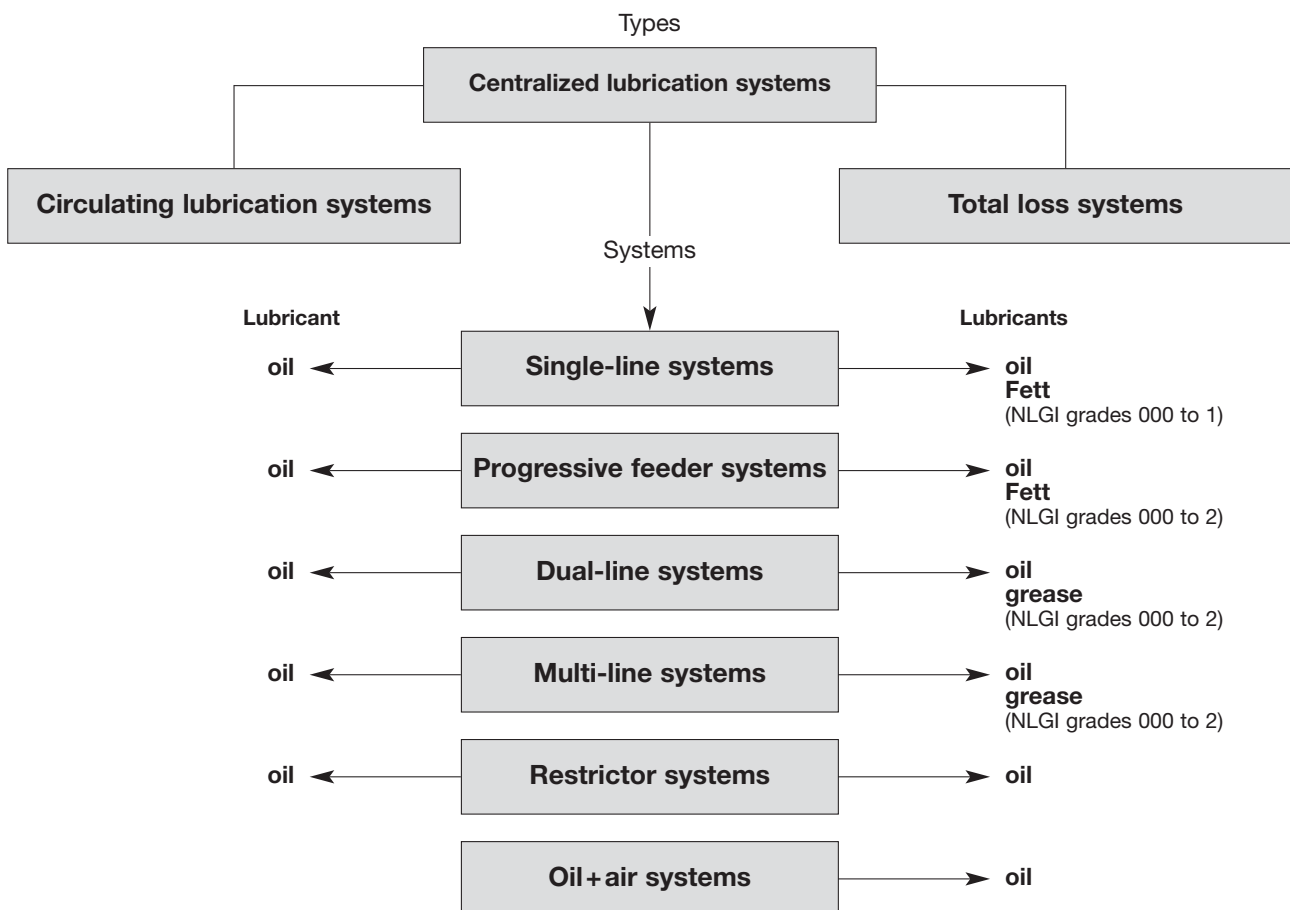
Oil and grease of NLGI grades 000 to 2 are used as the lubricant.

Care taken during the installation, start-up and maintenance of the central lubrication system will help to enhance the operating readiness and life of your machines. The central lubrication system must be given the same attention as all the other sophisticated equipment on a machine.

The many years of experience we have had in the field of central lubrication technology for machines and systems will help you solve the problems you encounter when planning and using such installations.

The members of our field service will be pleased to advise you.

### Centralized lubrication systems, an overview (based on DIN ISO 1219 and/or DIN 24271)



## Single-line total loss lubrication system

For relatively small, consumption-oriented amounts of oil per lube point and intermittent oil delivery.

- The oil delivery units are manually, mechanically, hydraulically or pneumatically actuated piston pumps or intermittently operated gear pumps.
- The lubricant is metered out by piston distributors installed in the tubing system. Exchangeable metering nipples on the distributors make it possible to supply every lube point with the requisite amount of lubricant per stroke or pump work cycle. The metered quantities range from 0.01 to 1.5 ccm per lubrication pulse and lube point. The amount of lubricant to be fed to the lube points can also be influenced with the number of lubrication pulses.
- An oil return line from the lube point to the oil reservoir is **not** required on total loss lubrication systems.

The basic layout of a single-line total loss lubrication system is always the same:

### pump, piston distributor

**main line** (connection: pump – distributor),

**secondary line** (connection: distributor – lube point).

Automatically operated systems also come with **control and monitoring units, pressure switches, float switches, indicator lights.**

### Gear pumps

Because of their electric drive, gear pumps are especially well suited for automatic systems with monitoring and safety equipment; they can also be put to advantageous use on remote control systems operated by pushbutton.

See example of system, diagram 1.



Model MFE

### Piston pumps

Piston pumps have a limited delivery volume per stroke, as a result of which there are limits on the metered quantities and size of a system.

Piston pumps are used in the form of manually, mechanically, hydraulically or pneumatically actuated pumps.

See example of a system, diagram 2.



Both groups of pumps, piston and gear pumps, have a hydraulic **pressure-relief device** that lowers the pressure of the lubricant in the main line (10 - 45 bars) to a residual pressure ( $\approx 0.4$  bars) via a relief valve after the lubricant has been delivered. This process causes the distributors to reverse.

### Piston distributors

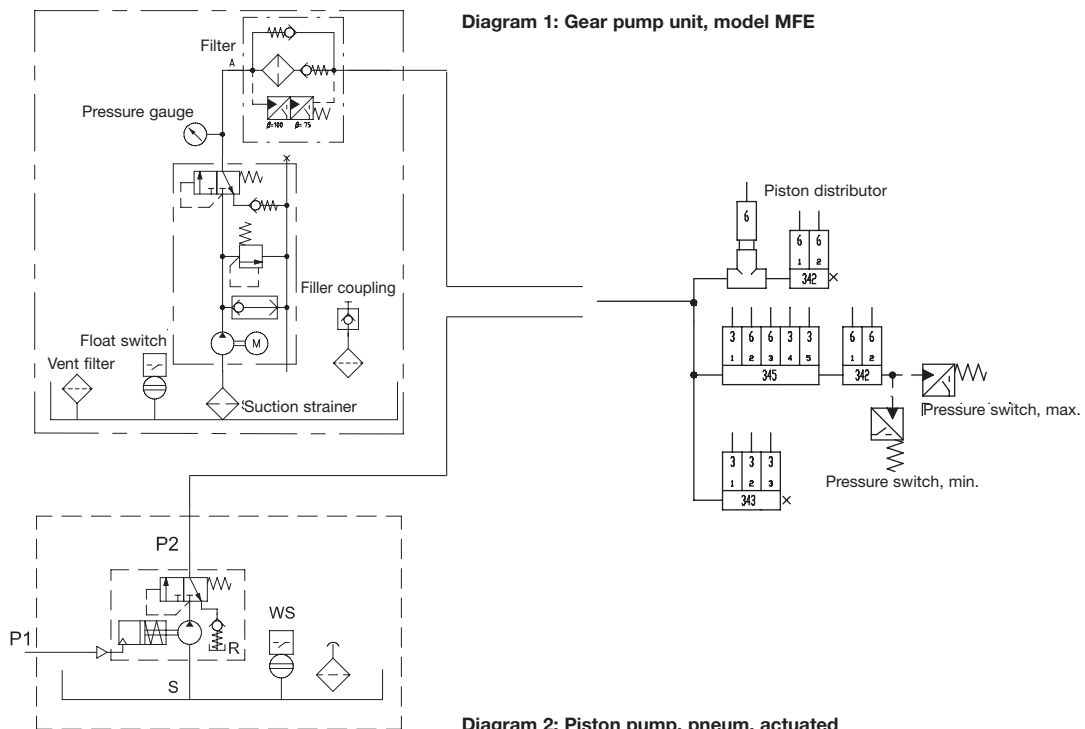
Piston distributors meter out and distribute the oil delivered by the pump (e.g. oil or grease of NLGI grades 000 or 00). The quantities of lubricant for the individual lube points are determined by exchangeable metering nipples. The metered quantity is shown on the individual nipples.



Four groups of distributors that differ in terms of metering ranges and sizes can be chosen from to comply with the amounts required and space available. A mixture of the different distributor groups can be used in one system.

See leaflets 1-1108-US, 1-1110-US, 1-1202-US, 1-1203-US, 1-5001-US, 1-5015-US

### Examples of systems



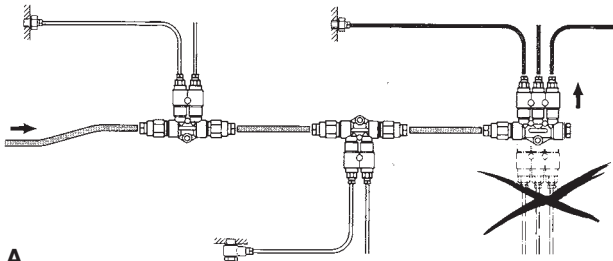
**Planning, installation and maintenance**

- Determine the number of lube points.
- Assume the amounts of oil required per lube point and the total amount of oil required per stroke (with piston pumps) or work cycle (with gear pumps).
- Select the distributors in accordance with the metering range and space available. A distinction must be made between oil-only distributors and those also suitable for fluid grease.
- Choose pumps in accordance with the type of actuation and system capacity. \*)
- Determine the type of control for automatic systems (time- or load-dependent) and any monitoring system that might be required.

When installing a system, lay out the main lines and distributors in such a way that air in the system can escape on its own via the lube points.

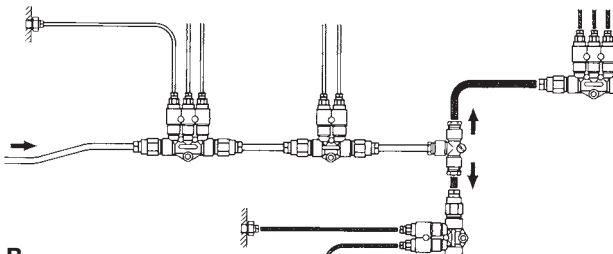
To do so, install the distributors at suitable places and at the end of the system so that the outlets to the lube points (Fig. A) **point upward**.

If possible, lay the main line from the pump to the distributors so that it **rises**.

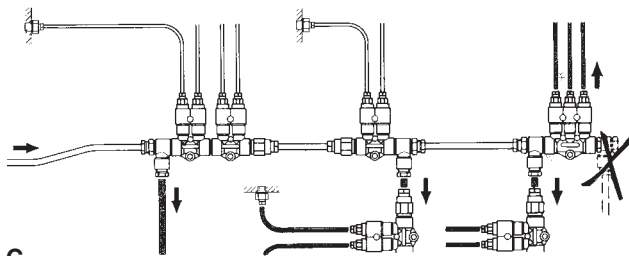


**A**

If lines have to be laid to distributors beneath them, proceed in accordance with Fig. B or C.



**B**

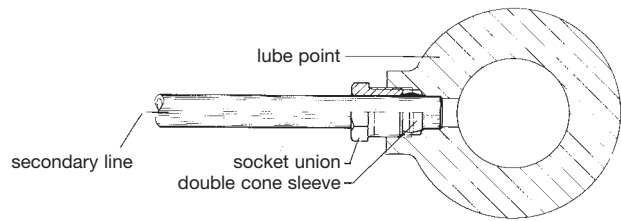


**C**

Check the resistance in the main line, particularly in regard to the relief process, when especially large and widely branched systems are involved and when high-viscosity oils are used.

The considerations required for the planning must be confirmed with a test setup if pure calculations do not lead to the goal.

Every distributor outlet may be connected to only **one** lube point! The socket unions must be tightened but not overtightened! Maximum of 1 1/2 turns! (A **hard** stop cannot be felt since the double cone sleeve and tube are slightly deformed when tightened.)



Do not connect the secondary line (connection: distributor – lube point) to the lube points until bubble-free oil emerges from the tubing after repeated actuation of the pump. It may be necessary to refill long secondary lines.

If one secondary line is blocked or broken, that will have no influence on the remaining lube points.



When the lever is pulled on systems with a manually actuated piston pump, it meets with resistance (oil cushion). The lever must not be pulled all the way to the hard cam stop but must be briefly held in place at the pressure point. This ensures all the distributors are completely filled (cf. system capacity). If a very small volume is involved, it may be possible to move the lever only a short distance; excessive force should not be used.

The layout of the distributors and lines is good if the system bleeds itself via the distributors while it is being filled by repeated actuation of the pump - without having to open the ends of the main line.

**\*) System capacity**

When planning systems it must be remembered that the calculated capacity of the distributor system must not exceed 2/3 of the delivery rate per stroke or work cycle of a pump in order to ensure the reserve required for the pressure build-up in the system.

The system capacity is comprised of the following:

- total output of all distributors in the system,
- + 25 % of this value,
- + 1 ccm per meter of main line (expansion loss).

**Notice!**

All products from VOGEL may be used only for their intended purpose. If operating instructions are supplied together with the products, the provisions and information therein of specific relevance to the equipment must be observed as well.

In particular, we call your attention to the fact that hazardous materials of any kind, especially the materials classified as hazardous by EC Directive 67/548/EEC, Article 2, Par. 2, may only be filled into VOGEL centralized lubrication systems and components and delivered and/or distributed with the same after consultation with and written approval from VOGEL.

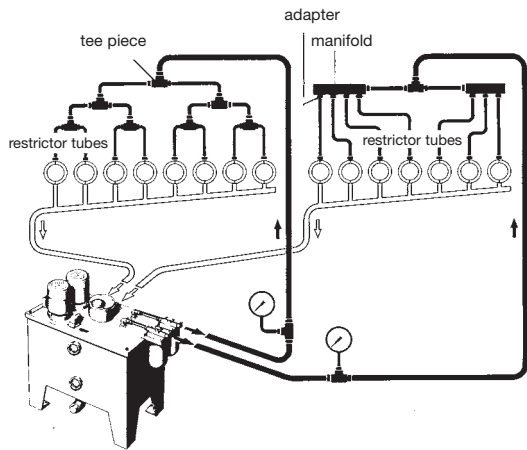
All products manufactured by VOGEL are not approved for use in conjunction with gases, liquefied gases, pressurized gases in solution and fluids with a vapor pressure exceeding normal atmospheric pressure (1013 mbars) by more than 0.5 bar at their maximum permissible temperature.

## Circulating lubrication system

For relatively large amounts of oil (also for heat dissipation) per lube point and continuous oil supply.

- The delivery units are gear, gerotor, piston and vane pumps.
- The lubricant is apportioned to the lube points via restrictor tubes, metering valves, adjustable metering valve distributors, flow control valves, progressive feeders and multi-circuit gear pumps, from which as many as 20 lines can be connected directly (or via flow volume dividers) to the individual lube points.

### Circulating lubrication with single-circuit gear pump units Oil distribution via restrictor tubes



Branches of lines established with tee pieces, or manifolds with adapters.

The more symmetrical the layout of the tubing network the more even the distribution of oil via the restrictor tubes.

Tubes with the largest possible diameters should be laid from the pump to the branch-off points.

When different amounts of oil are required by the individual points, the respective amount can be arrived at by changing the length or diameter of the restrictor tubes.

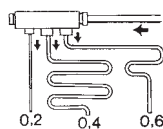
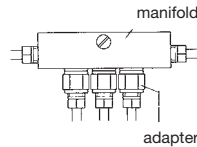
When an uneven distribution of lubricant is involved, the resistance of the individual restrictor tubes must be adjusted by varying the tube diameters and lengths so that they produce an equally large pressure loss among each other with different discharge volumes. Since there are limits on the extent to which tube diameters can be varied, the fine adjustment must be done via the lengths, e.g. by installing them in bends or spirals.

Systems with restrictor tubes are reliable in operation and not sensitive to dirt.

#### Example

1.2 l/min is to be split up into 0.2, 0.4 and 0.6 l/min.

Oil viscosity = 175 mm<sup>2</sup>/s  
(cf. pressure loss table at Q = 0.2 l/min)



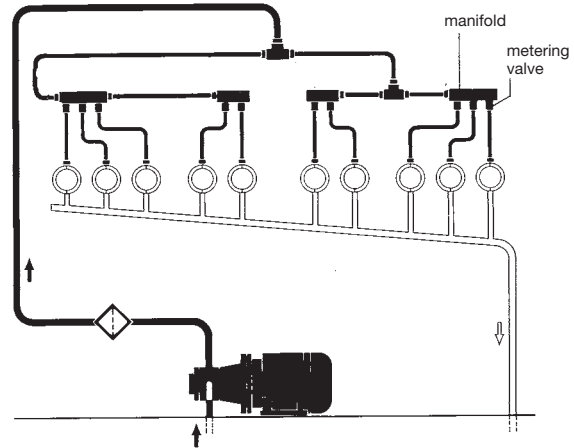
For tubes

4 x 0.7; 0.5 m long and Q = 0.2 l/min,  $\Delta p = 4.68 \cdot 0.5 = 2.3$  bars  
6 x 0.7; 2.4 m long and Q = 0.4 l/min,  $\Delta p = 0.48 \cdot 2 \cdot 2.4 = 2.3$  bars  
6 x 0.7; 1.6 m long and Q = 0.6 l/min,  $\Delta p = 0.48 \cdot 3 \cdot 1.6 = 2.3$  bars

See leaflet 1-5006-US

- When oil is distributed via restrictors and multi-circuit pumps, the lube points are supplied with a continuous flow of oil in previously determined amounts. Progressive feeders, on the other hand, are pulsed. Different amounts of oil can be adjusted with progressive feeders by selecting different sizes of feeder sections.
- An oil return line from the lube point to the oil reservoir must be provided for in the case of circulating lubrication systems.

### Circulating lubrication with single-circuit gear pump unit Oil distribution via metering valves



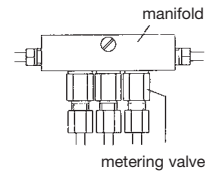
Oil quantities per lube point approx. 0.2-230 ccm/min.

Metering valves can be combined on manifolds or screwed into the threads of the individual lube points.

A microfilter must be installed upstream from the systems. Filters with replaceable cartridges, among others, are suitable. If the flow of oil is to be ensured even when a filter is clogged, it is possible to provide for a by-pass protected by a safety valve.

The pressure losses occurring in the tubing must always be known when a system is designed.

This pressure loss table will provide an impression of the influence various factors have.



Tube designation on external diam. x wall thickness	Operating viscosity of oil [mm <sup>2</sup> /s]	Pressure losses $\Delta p$ [bars] per meter of tubing								
		Flow rate Q [l/min]								
		0.05	0.1	0.2	0.5	1	2.5	4	6	9
2.5 x 0.5	32	1.93	3.86	7.71	-	-	-	-	-	-
	100	6.02	12.05	-	-	-	-	-	-	-
	320	19.28	-	-	-	-	-	-	-	-
	1000	-	-	-	-	-	-	-	-	-
4 x 0.7	32	0.21	0.43	0.85	2.14	4.27	-	-	-	-
	100	0.67	1.33	2.67	6.67	-	-	-	-	-
	320	2.14	4.27	8.54	-	-	-	-	-	-
	1000	6.67	13.35	-	-	-	-	-	-	-
6 x 0.7	32	0.02	0.04	0.09	0.22	0.44	1.09	1.74	2.62	3.92
	100	0.07	0.14	0.27	0.68	1.36	3.41	5.45	8.17	12.26
	320	0.22	0.44	0.87	2.18	4.36	10.90	17.44	-	-
	1000	0.68	1.36	2.72	6.81	13.62	-	-	-	-
8 x 1	32	0.01	0.02	0.03	0.08	0.15	0.38	0.60	0.90	1.36
	100	0.02	0.05	0.09	0.24	0.47	1.18	1.88	2.82	4.24
	320	0.08	0.15	0.30	0.75	1.51	3.77	6.02	9.04	13.56
	1000	0.24	0.47	0.94	2.35	4.71	11.77	18.83	-	-
10 x 0.7	32	-	-	0.01	0.02	0.04	0.09	0.14	0.21	0.32
	100	-	0.01	0.02	0.06	0.11	0.28	0.45	0.67	1.00
	320	0.02	0.04	0.07	0.18	0.36	0.89	1.43	2.14	3.21
	1000	0.06	0.11	0.22	0.56	1.12	2.79	4.46	6.69	10.04
12 x 1	32	-	-	-	0.01	0.02	0.05	0.08	0.12	0.18
	100	-	-	0.01	0.03	0.06	0.15	0.24	0.37	0.55
	320	0.01	0.02	0.04	0.10	0.20	0.49	0.78	1.17	1.76
	1000	0.03	0.06	0.12	0.31	0.61	1.53	2.44	3.66	5.49

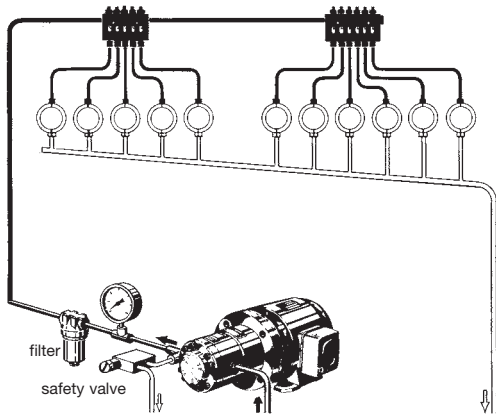
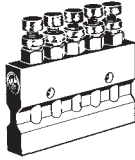
**Circulating lubrication with gerotor unit**  
**Oil distribution via metering valve distributors**

The flow rate per lube point is adjustable.

We make a distinction between:

**metering valve distributors**  
**for flow rates in the range of drops**  
 quantity per outlet: 0...10 ccm/min

**metering valve distributors**  
**for continuous flow rate**  
 quantity per outlet: 10...1000 ccm/min  
 or 10...2000 ccm/min



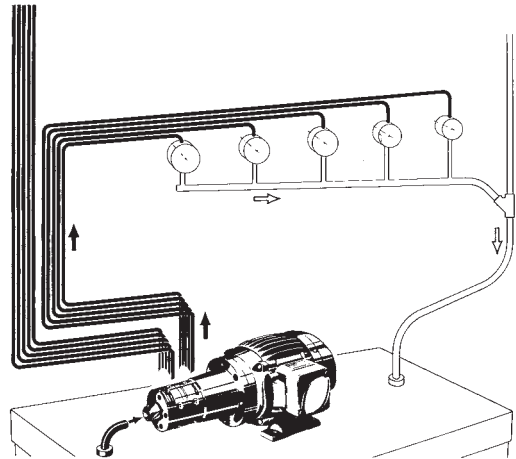
**Circulating lubrication with multi-circuit gear pump unit**  
**Oil distribution via multi-circuit pumps**

**Multi-circuit gear pumps ensure an even distribution of oil, even in the case of varying back pressures.**

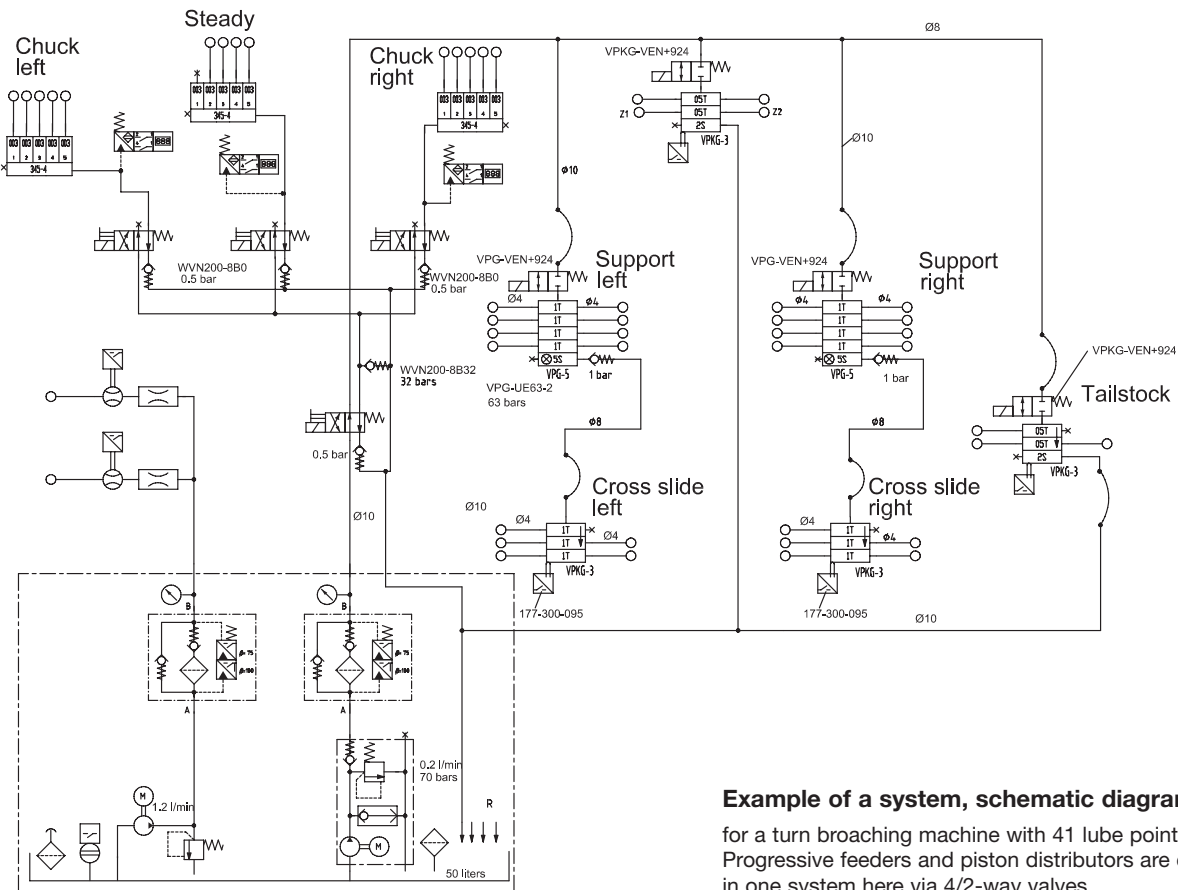
One delivery circuit of the pump is assigned to each lube point.

The layout of the tubing system and the tubing resistance values are mostly of no significance for the distribution.

**2 to 20 delivery circuits per pump**  
**0.015 to 1.2 l/min per delivery circuit**



**Group lubrication** makes it possible to lubricate and monitor groups of machines and production lines from one central location. The monitoring possibilities range from a simple pressure-gauge display and flow indicator to pressure- or flow-dependent control and signaling units as well as electronic monitoring of the lube points.



**Example of a system, schematic diagram**  
 for a turn broaching machine with 41 lube points. Progressive feeders and piston distributors are combined in one system here via 4/2-way valves.

### Progressive feeder systems

Central monitoring of all feeder outlets at low cost is easy in progressive feeder systems.

Metered quantities of lubricant are fed progressively in predetermined order from the feeders to the lube points either directly or via a secondary downstream feeder. The lubricant does not leave the respective feeder until the preceding one has discharged its volume. If a lube point does not accept any lubricant – regardless of the reason – or if a secondary feeder is blocked, the entire lubrication cycle is interrupted, which can be used to emit a signal.

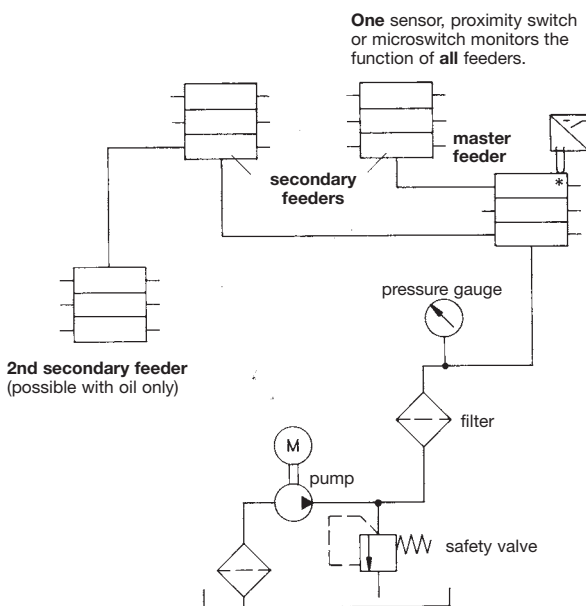
**Characteristic features:**

- Universal application in regard to mode of operation and lubricants.
- Central monitoring of functions of all feeders possible at low cost. \*
- Rugged feeder design.
- Low susceptibility to breakdowns due to fitted pistons without springs or compressive seals.
- Number of cycles: max. 200/min (this can be used to calculate the maximum possible oil quantity per outlet in circulating lubrication systems).
- Exact apportioning of the lubricant, even if back pressure encountered at the lube points.
- Maximum number of lube points about 100; several hundred in the case of ring-circuit systems with in-line metering pumps.
- Pressures: 30 -100 bars in the case of circulating oil systems; max. 250 bars in the case of grease systems.
- The price of progressive feeder systems is between that of single-line systems and dual-line (grease) systems.

The planning, especially any changes in the metered quantities of individual lube points at a later date or changes in the number of lube points, requires more time and effort than with single-line and dual-line systems.

\* With single-line and dual-line systems only central monitoring of the main line is possible, including individual monitoring of any number of selected lube points.

**System with progressive feeders**



See leaflet 1-0107-1-US

### Dual-line systems

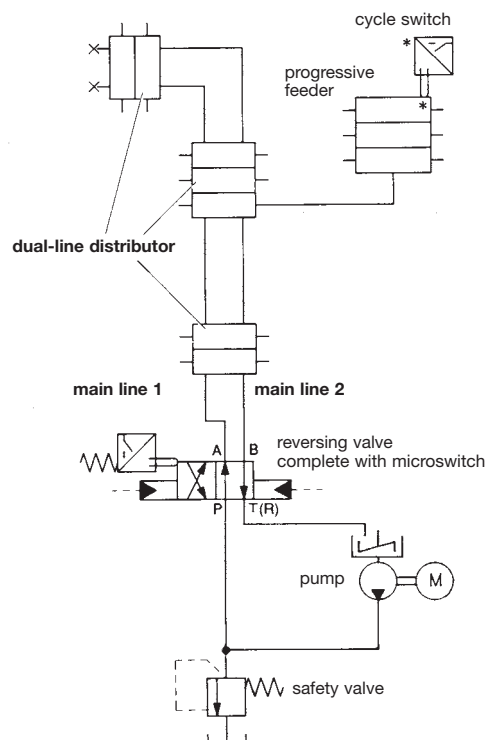
Dual-line systems are central lubrication systems with two main lines. They are preferably used for grease, but they are also suitable for oil.

All the distributors of a system are pressurized at the same time. That means lower pressure losses in comparison to progressive feeders. Nor are the pistons spring-loaded as with single-line systems. Instead, the “reset” of the delivery piston is simultaneously the 2nd delivery stroke, which takes place at full pump pressure. That is why this system is especially suitable for extended systems and more viscous types of grease. Assemblies with or without compressive seals are available for light and heavy-duty operating conditions.

**Characteristic features:**

- For systems operated in rough conditions.
- 300 to 1000 lube points or more!
- Length of main line 100 meters or more; depends on consistency of the lubricant.
- Distribution points can be easily added and removed.
- Metered quantities are easy to change.
- Easy to plan.
- Complicated due to double main line.
- Suitable for all oils and grease up to NLGI grade 2.
- Exact apportioning of lubricant.
- Can be combined with progressive feeders.
- Reversing units for change of main line, with hydraulic or electrical actuation.
- Range of pumps similar to that of progressive systems, but pressure is much higher.

**Dual-line system**



See leaflet 1-0012-US

### Hydrostatic Lubrication

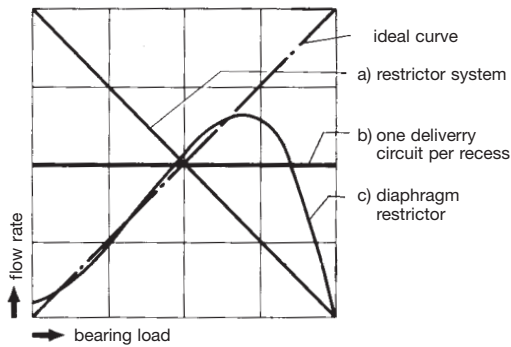
In the case of hydrostatic bearings the oil pressure conforming to the carrying force is produced in pumps outside the bearings, the oil being fed under this pressure to the recesses, from which it flows out through the bearing gap.

Three systems with different characteristics are available:

- a) restrictor system
- b) one pump delivery circuit per recess (multi-circuit pump system)
- c) diaphragm restrictors

This sequence also corresponds to the stiffness of the bearing assembly.

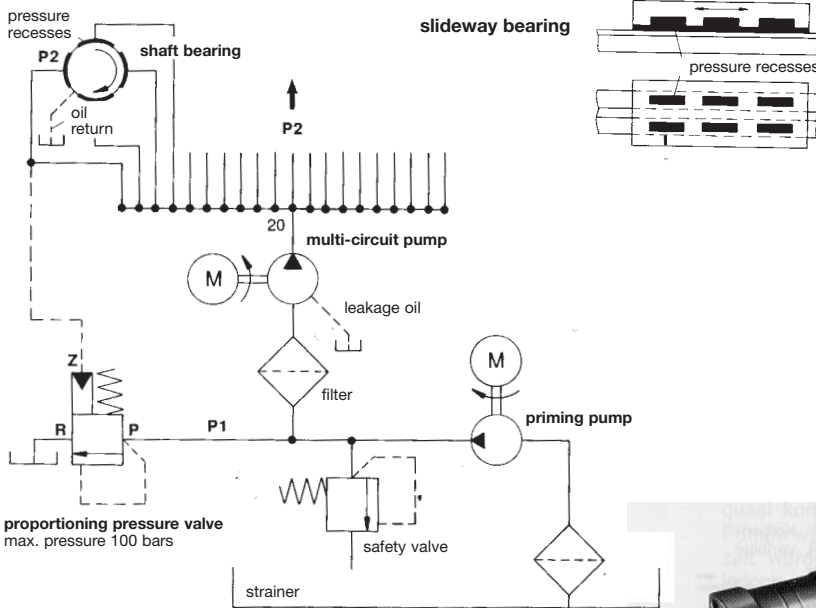
**Diagram**



The diagram shows the characteristic flow curves of the three systems. If there is to be no change in the bearing's oil gap when the load on the bearing increases, the oil flow must rise in proportion to the load. That is expressed by the "ideal curve". The three technically possible systems deviate more or less from this curve. The bearing stiffness therefore drops when the deviation increases.

$$\text{stiffness} = \frac{\text{load (kg)}}{\text{gap change (\mu m)}}$$

Generally, the oil supply system and pumps will be selected at the same time as the bearings are calculated. In this respect it is necessary to take the efficiency of the pumps into account as well.



**System b) one pump circuit per recess (multi-circuit pump system)**

This system has a relatively good curve, and the costs are within reasonable limits, which is why this system is chosen most often.

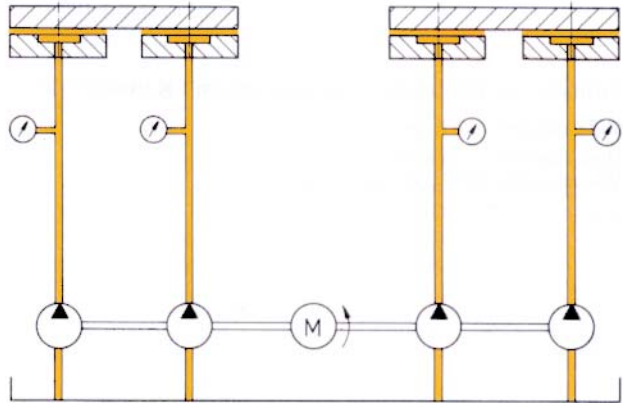
The lower the delivery rate per circuit the lower the oil viscosity, and the greater the pump pressure the more the delivery rates of the circuits differ from each other.

The difference in pressure in a multi-circuit pump can be limited by using a **priming pump**, which benefits the evenness of the oil flow.

The total output of the multi-circuit pump and the requisite recess pressure per delivery circuit, with due consideration given to the permissible difference in pressure, determines the selection of this priming pump.

The recess pressure can be kept within the desired limits via the recess size, and a medium-viscosity oil should be striven for, with the exception of a few special tasks.

In the case of bearing assemblies that are subject to great fluctuations in pressure it is possible for the priming pressure to be adjusted to the respective pressure of a characteristic recess with the help of a **proportioning pressure valve**.



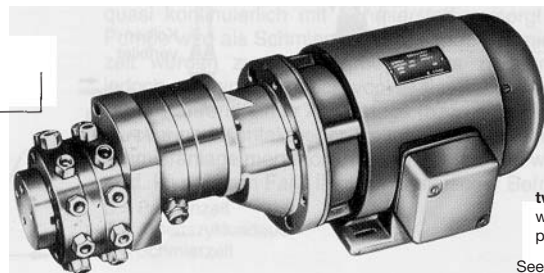
The priming pump supplies the multi-circuit pump with oil.

In the starting phase the proportioning pressure valve keeps pressure P1 at approx. 2.5 bars. The surplus oil is returned via R.

If pressure P2 rises, priming pressure P1 is also accordingly increased via the valve so that the difference in pressure is kept roughly constant. The difference in pressure between P2 and P1 should not exceed 4-7 bars, depending on the delivery rate of the distributing pump.

**Tube connections:**

From P1 to P, from P2 (a "characteristic" pressure recess) to Z and from R to the oil reservoir.



twenty-circuit unit with built-in priming pump

See leaflet 1-1204-US

### Minimal quantity lubrication

Minimal quantity metering systems for the lubrication of tools, oiling of joined parts, spraying or wetting of surfaces and the lubrication of chains.

These systems can also be put to successful use for the oiling of compressed air used in pneumatic drives, like cylinders the lubrication of which often poses problems in layouts with a large number of branch lines.

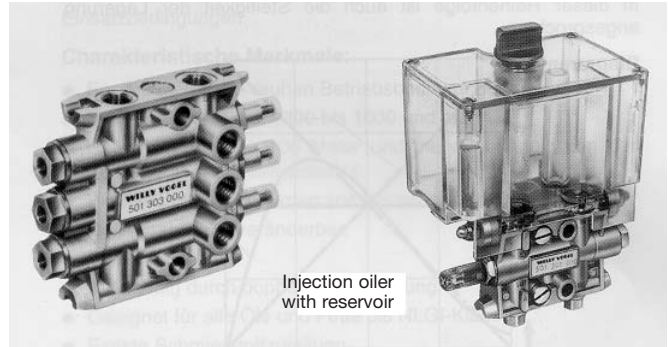
The aforementioned tasks are very different. Nevertheless, it is almost always possible to find an optimum solution with the existing components.

The following are available:

#### Injection oilers, 1- and 3-way (can be coupled in groups)

##### Injection oiler with reservoir

(see leaflet 1-5012-4-US)



#### Single-line central lubrication systems with piston distributors

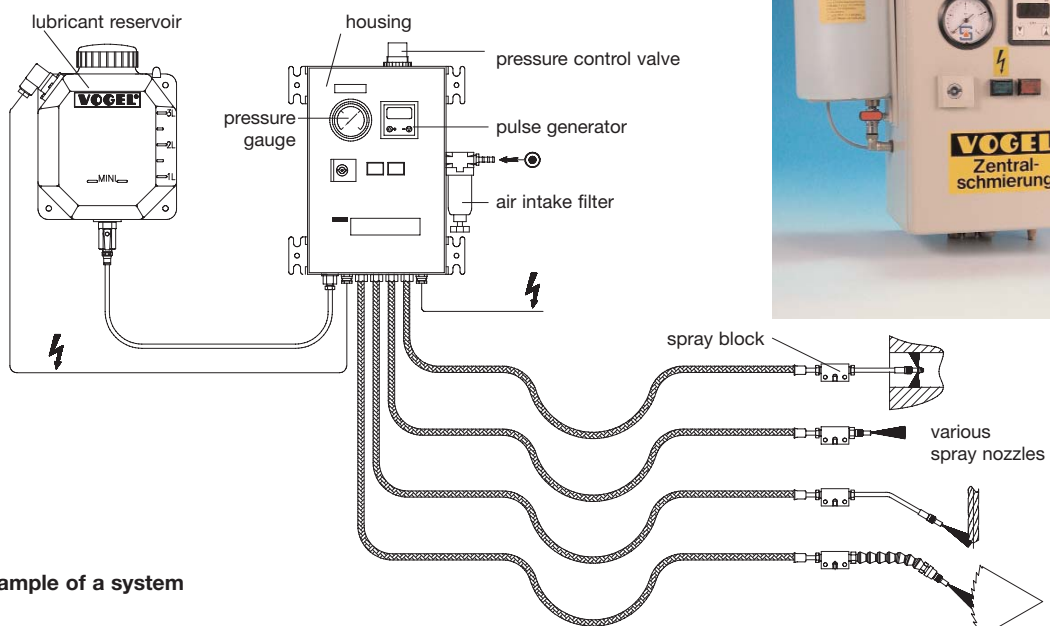
Mixing heads without integrated metering unit  
(see leaflet 1-5012-5-US)

Mixing valves without integrated metering unit  
Mixing valves with integrated metering unit  
(see leaflet 1-5012-5-US)



#### VECTOLUB Minimal Quantity Lubrication for chains, cutting tools and dies

(see leaflet 1-5012-2-US)



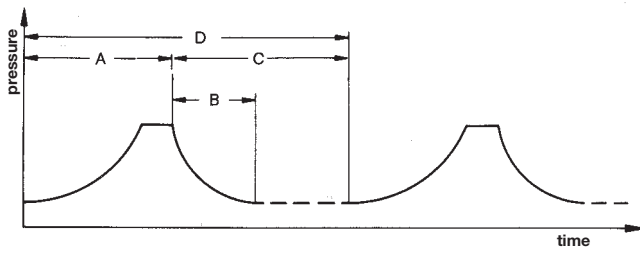
Example of a system



Pressure curves in the main lines of central lubrication systems

(to DIN 24 271)

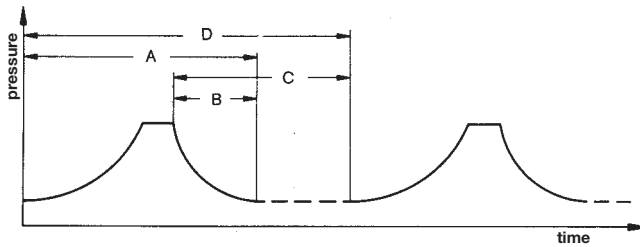
Single-line system with single-line prelubrication distributor



Due to the lubricant pressure resulting from the pressure build-up in the main line, a metered quantity of lubricant is briefly fed-up (directly) from the single-line prelubrication distributor to the lube point after overcoming the resistance that can occur all the way to the friction point. When the pressure of the system's safety valve is reached, the pressure does not continue to rise while the pump is still running. The pressure-relief time (B) begins when the pump stops. During the pressure-relief time (B) the pressure in the main line is reduced to a residual pressure with the help of a pressure-relief valve, a metered amount of lubricant for the next lubrication cycle being readied in the single-line distributor by spring force. The interval at which one lubrication cycle follows the next is determined by the interval time (C), which can be preselected with, for example, the help of a timer.

- A = lubrication cycle time
- B = pressure-relief time
- C = interval time
- D = work cycle time
- $B \leq C$
- $A + C = D$

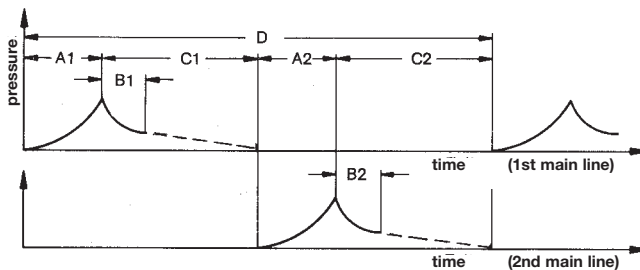
Single-line system with single-line relubrication distributor



When the pump is running, a metered amount of lubricant is readied in the single-line relubrication distributor, this quantity subsequently being passed on (indirectly) to the lube point by the force of a pressure spring in the distributor when the pressure-relief time (B) commences. The discharge of lubricant to the lube point takes a while, depending on the resistance encountered up to the friction point.

- A = lubrication cycle time
- B = pressure-relief time
- C = interval time
- D = work cycle time
- $B \leq C$
- $A \leq D$

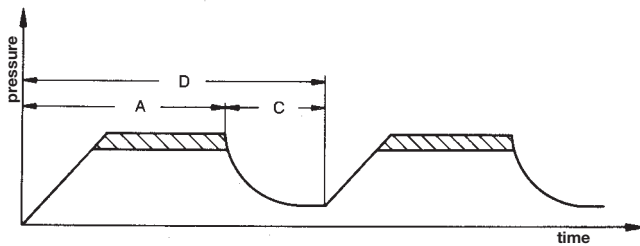
Dual-line system



The lube points of a dual-line system are divided up into two groups, one of them being fed with lubricant during partial lubrication cycle A1, the other during partial lubrication cycle A2. A dual-line distributor is connected to two main lines, feeding a lube point of the first group via the first secondary line and a lube point of the second group via the second secondary line. The pump only runs during partial lubrication time A1 or A2 and is stopped, for example, by a pressure switch. The redirection of the flow of lubricant to the other respective main line is done with a reversing valve. The respective main line is relieved of pressure to a certain extent during partial interval times C1 or C2. It is possible for the cycles in the two main lines to overlap. In extreme cases cycle A2 can follow directly on cycle A1.

- A = lubrication cycle time
- C = interval time
- D = work cycle time
- B1 = pressure-relief time
- B2 = pressure-relief time
- C1 = partial interval time
- C2 = partial interval time
- $C \leq 0$
- $C = C1 + C2$
- $A = A1 + A2$
- $A + C = D$
- A2 = partial lubrication cycle time

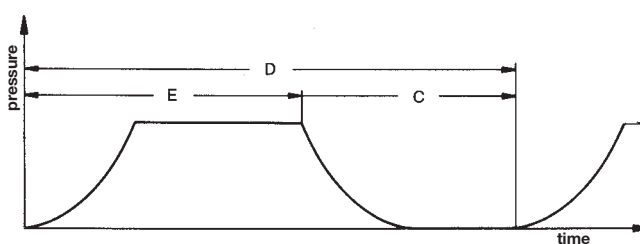
Progressive feeder system



The lubrication cycle time (A) in a progressive feeder system is identical with the pump running time and is limited by the fact that all the lube points of a system must be supplied at least once with the specified amount of lubricant. The pressure in the main and secondary lines is relieved to a certain extent during the interval time.

- A = lubrication cycle time
- C = interval time
- D = work cycle time
- $A + C = D$

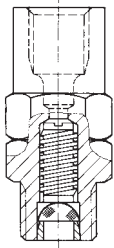
Metering valve system and multi-line system



As long as the pump is running, all the lube points of a system are supplied more or less continuously with lubricant. The running time of the pump is called the lubrication time. The lubrication time and interval time are combined to form a work cycle. It is, however, only sensible to speak of a work cycle when the central lubrication system is started and stopped several times in the course of a workday (or shift), e.g. by a timer. Otherwise, continuous operation is involved.

- C = interval time
- D = work cycle time
- E = lubrication time

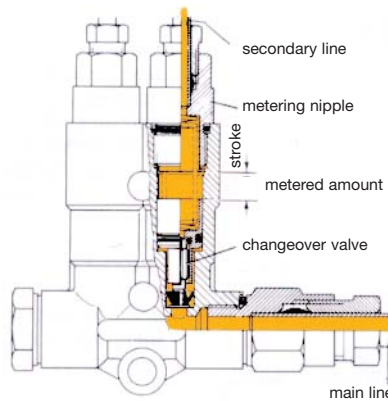
**Drawings showing the function and basic design of some equipment**



**Metering valves  
Group VD**

0.2 to 230 ccm/min  
Relatively small amounts of oil are fed to the lube points with metering valves. Short bores and small diameters are easily clogged. This is why a long thread with the largest possible rectangular profile has been selected.

See leaflet 1-5006-US



**Piston distributor**

Group 320: 0.01 to 0.16 ccm/stroke  
Group 340: 0.01 to 0.16 ccm/stroke  
Group 350: 0.1 to 0.6 ccm/stroke  
Group 390: 0.2 to 1.5 ccm/stroke

**Function:**

The quantity of oil intended for the lube point is located in front of the piston. When the central lubrication pump starts delivering oil, the piston moves, and the oil in front of it is delivered at the pump pressure (10 - 45 bars) in the direction of the lube point. After the pressure in the main line is relieved, the distributor piston returns to its initial position, allowing a quantity of oil to flow into the metering chamber once again via its changeover valve.

See leaflet 1-5001-US

**Progressive feeder**

The lubricant supplied is divided up in the predetermined ratio via the specified distributor outlets. The piston diameter and piston travel determine the output.

A piston cannot deliver its lubricant until the preceding piston has discharged its quantity of lubricant.

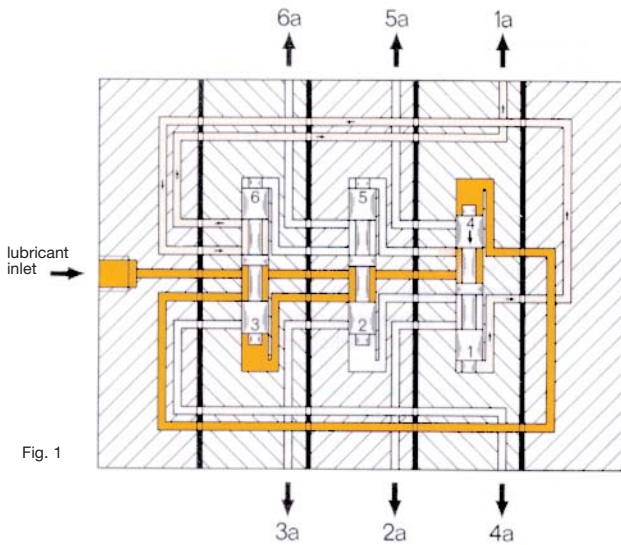
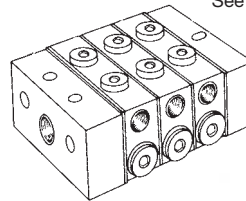


Fig. 1

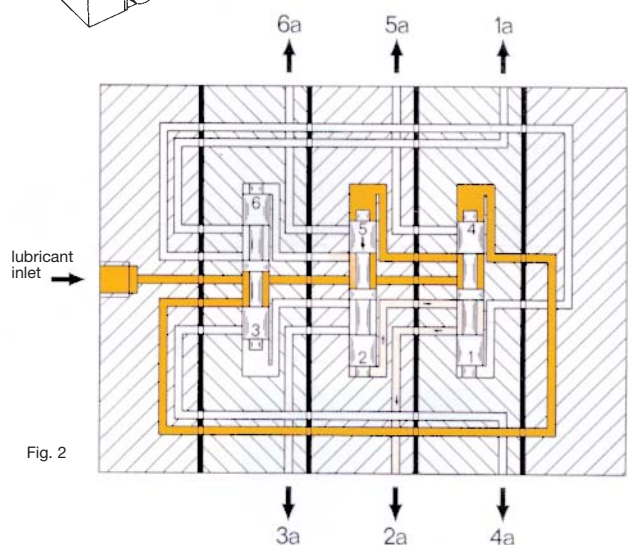


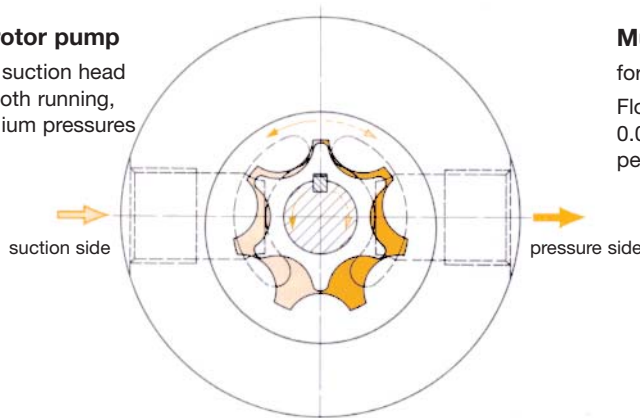
Fig. 2

In Fig. 1 piston side 4 is under pump pressure, piston side 1 has delivered to outlet 1a. The connection between the main line and piston side 5 has opened due to the motion of piston 1/4.

In Fig. 2 piston side 5 is pressurized, and piston side 2 is delivering via outlet 2a. Piston side 6 is the next to be pressurized, etc. See leaflet 1-0107-US

**Gerotor pump**

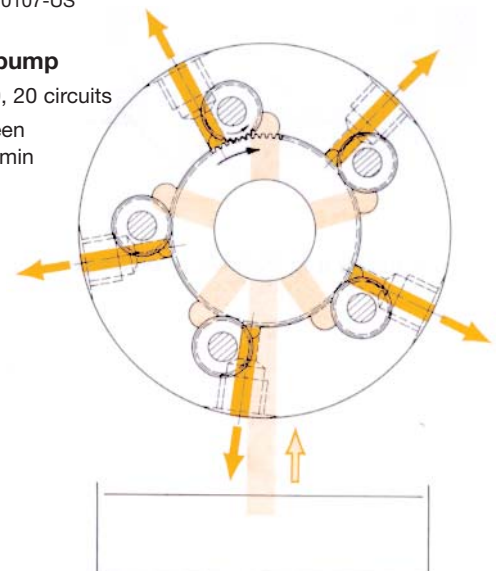
1 m suction head  
smooth running,  
medium pressures



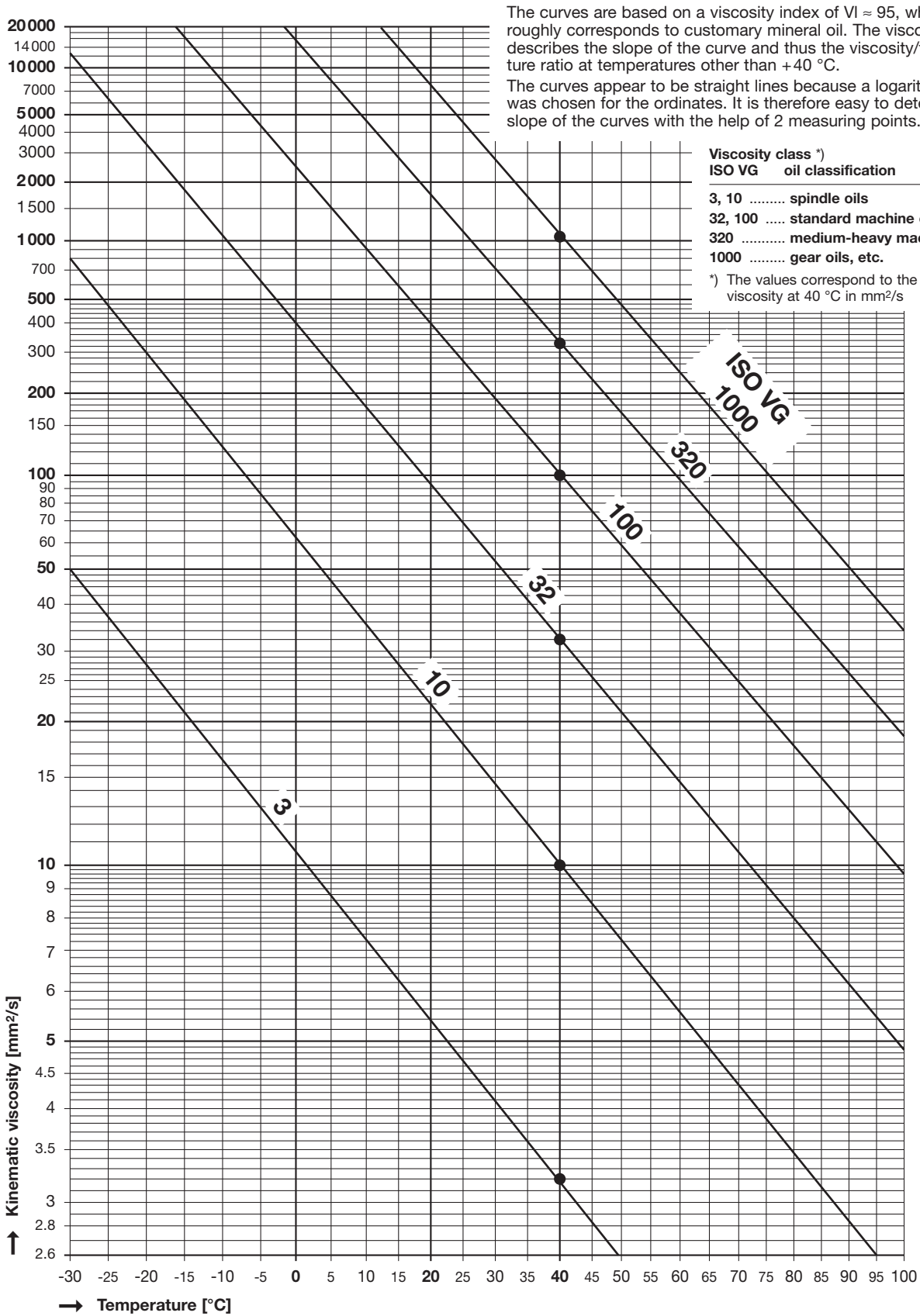
See leaflet. 1-1204-US

**Multi-circuit pump**

for 2, 4, 5, 8, 10, 20 circuits  
Flow rate between  
0.015 and 1.2 l/min  
per circuit



**Viscosity / temperature relationship of oils with different basic viscosities**



**Please note:** the change in the viscosity of oil is incomparably greater at lower temperatures than in higher temperature ranges. For example, there are the following changes in viscosity for an oil with a rated viscosity of 100 in different temperature ranges at the same temperature difference:

at  $+80\text{ }^\circ\text{C}$  =  $18\text{ mm}^2/\text{s}$   
 at  $+75\text{ }^\circ\text{C}$  =  $21\text{ mm}^2/\text{s}$   
 change of  $3\text{ mm}^2/\text{s}$

vs.


at  $+10\text{ }^\circ\text{C}$  =  $875\text{ mm}^2/\text{s}$   
 at  $+5\text{ }^\circ\text{C}$  =  $1450\text{ mm}^2/\text{s}$   
 change of  $575\text{ mm}^2/\text{s}$

**Graphic symbols for the representation of central lubrication systems in technical drawings**

(Excerpt of examples from our production program. Further symbols can be found on the Internet at: [www.vogelag.com](http://www.vogelag.com))

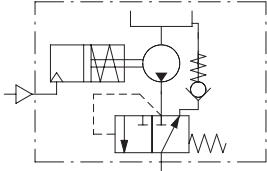
**General**

**Lube point**  
This where lubricant is fed to the friction point.

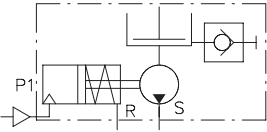


**Pumps**

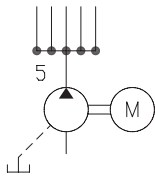
**Piston pump, pneumatically actuated, with grease reservoir**  
Example: PF-289  
See leaflet 1-0015-US



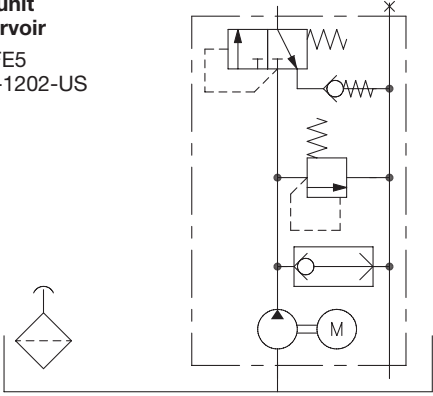
**Piston pump, pneumatically actuated, with grease reservoir**  
Example: PFP-23-2  
See leaflet 1-0107-4-US



**Multi-circuit gear pump unit with oil reservoir**  
Example: ZM505-BW51  
See leaflet 1-1204-US



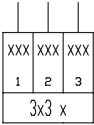
**Gear pump unit with oil reservoir**  
Example: MFE5  
See leaflet 1-1202-US



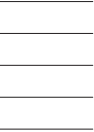
**Please note:** The symbols shown were taken from DIN ISO 1219 and DIN 24271 or were composed using the basic symbols shown there.

**Distributors**

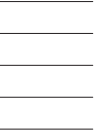
**Piston distributor (single-line distributor)**  
Example: 353-... (3-way)  
See leaflet 1-5001-US



**Metering valve distributor, adjustable**  
Example: 242-034.00 (3-way)  
See leaflet 1-5006-US



**Progressive feeder**  
Example: VPM-4 (8-way)  
See leaflet 1-0107-1-US

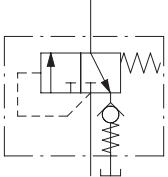


**Valves, switches**

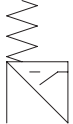
**Safety valve, adjustable**  
Example: WVN200-10E25  
See leaflet 1-0103-US




**Pressure relief valve**  
Example: 202-275-2  
See leaflet 1-0103-US



**Pressure switch**  
Example: DS-W20  
See leaflet 1-1701-US



**Float switch**  
Example: WS33-2  
See leaflet 1-1702-US




A brand of the SKF Group

**Willy Vogel AG**  
Motzener Strasse 35/37  
12277 Berlin, Germany  
P.O. Box 970444 · 12704 Berlin  
Tel. +49 (0) 30 72002-0  
Fax +49 (0) 30 72002-111  
[info@vogel-berlin.de](mailto:info@vogel-berlin.de)  
[www.vogelag.com](http://www.vogelag.com)

**Willy Vogel AG**  
2. Industriestrasse 4  
68766 Hockenheim  
Germany  
Tel. +49 (0) 6205 27-0  
Fax +49 (0) 6205 27-132  
[info@vogel-berlin.de](mailto:info@vogel-berlin.de)  
[www.vogelag.com](http://www.vogelag.com)

**Vogel France SAS**  
Rue Robert Amy, B.P. 70130  
49404 Saumur cedex  
France  
Tel. +33 (0) 241 404 200  
Fax +33 (0) 241 404 242  
[info@vogelfrance.com](mailto:info@vogelfrance.com)  
[www.vogelfrance.com](http://www.vogelfrance.com)