CONNECTIONS TO THE BEARING HOUSINGS

The supply of lubricant to the bearing must take into account the type of bearing and its position. The hole downstream of the tube connected to the bearing housing must have a diameter according to its length. As a guide, the recommended diameter is 0.5 mm for lengths of approximately 5 mm, which increases linearly with the increase in length by one tenth of a millimetre for each additional millimetre of length. This hole must allow the lubricant jet to be projected towards the internal bearing ring and reversed towards the outside by the centrifugal force.

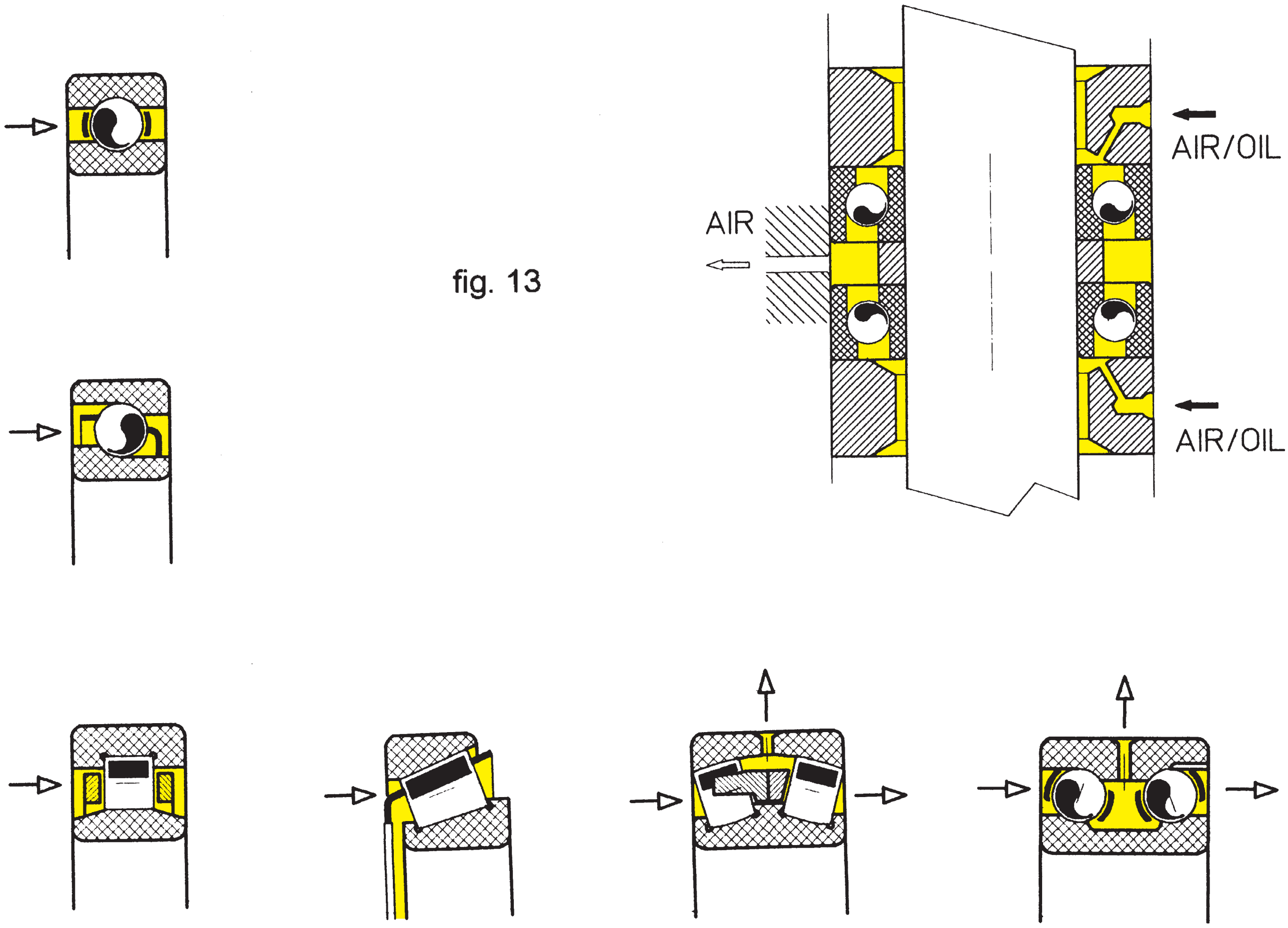


fig. 13

The jet must never be directed at the ball or roller cage. In the case of bearings at an angle, the supply must correspond to the direction of the load. Each bearing requires its own injection point; only in some cases – with low loads and speeds – is it possible to have a single injection for a pair of bearings.

To avoid lubricant deposits in the lower part of the bearing, and to avoid generating over-pressure in the housing, it is advisable to include a 4-6 mm diameter **drainage hole**.
It is necessary for the bearing housings to receive an **air flow** with a **pressure of at least 0.5 bar**. However, pressures exceeding 3.5 bar should be avoided, in order not to nebulise the lubricant. At the equipment outlet, the delivery and therefore the pressure of the air at the different housings can be adjusted individually and is monitored by a minimum pressure switch. This is illustrated in fig. 13.

LUBRICANT DEMAND

The lubricant demand over a certain period can only be determined by considering the working parameters and therefore the operating conditions of the component to be lubricated. However, the parameters given in literature are acceptable, and these are summarised below:

$$Q = d \times l \times \alpha$$

Where:

Q	=	Lubricant demand (mm^3/h)
d	=	Internal diameter of the bearing (mm)
l	=	Width of the bearing (mm)
α	=	Dimensionless correction coefficient, whose value is: **0.01** for oblique ball bearings, see fig. 14a; **0.02** for flat ball bearings, see fig. 14b; **0.03** for roller bearings, see fig. 14c.

It must be emphasised that the values resulting from the use of this formula are considerably lower than those normally taken into account by the manufacturers. This is due to the fact that the known parameters are calculated for the use of oil mist systems and therefore take into account the considerable losses of these systems. However, **in the case of minimal lubrication, the entire delivery of the pump is projected onto the bearing races without mist formation and therefore without any losses**.
As far as the lubricant injection frequency is concerned, i.e. the duty cycles of the pumps, 6-12 operations an hour have proved ideal in practice.
This allows the lubricant to be distributed uniformly over the internal walls of the tubes and proceed more or less slowly to the housings, thereby achieving a continuous flow to the bearings.

A table on page **46** shows the ways of stabilising the various frequencies of the lubricating cycles in relation to the needs of the housings as a function of time.

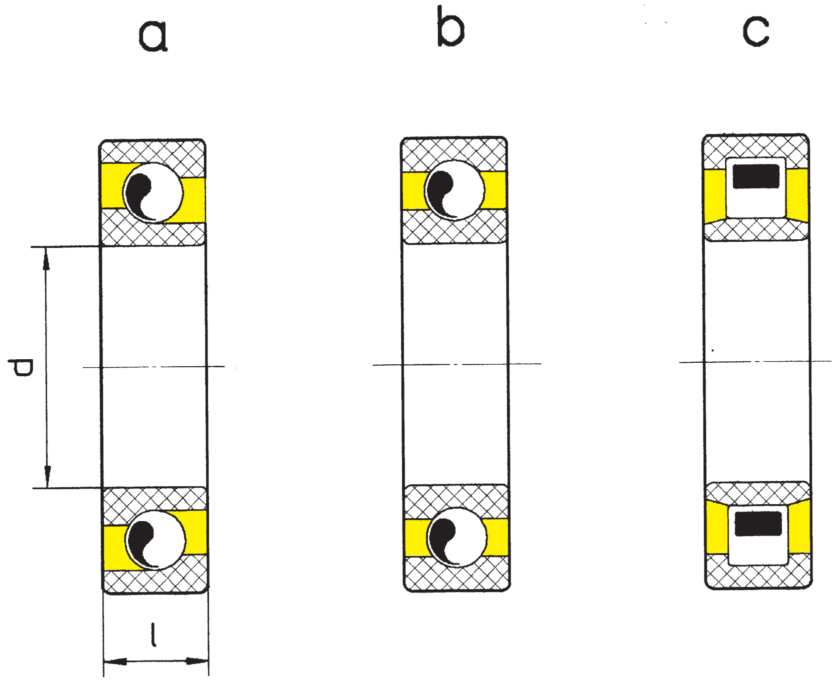


fig. 14

LUBRICATING OILS

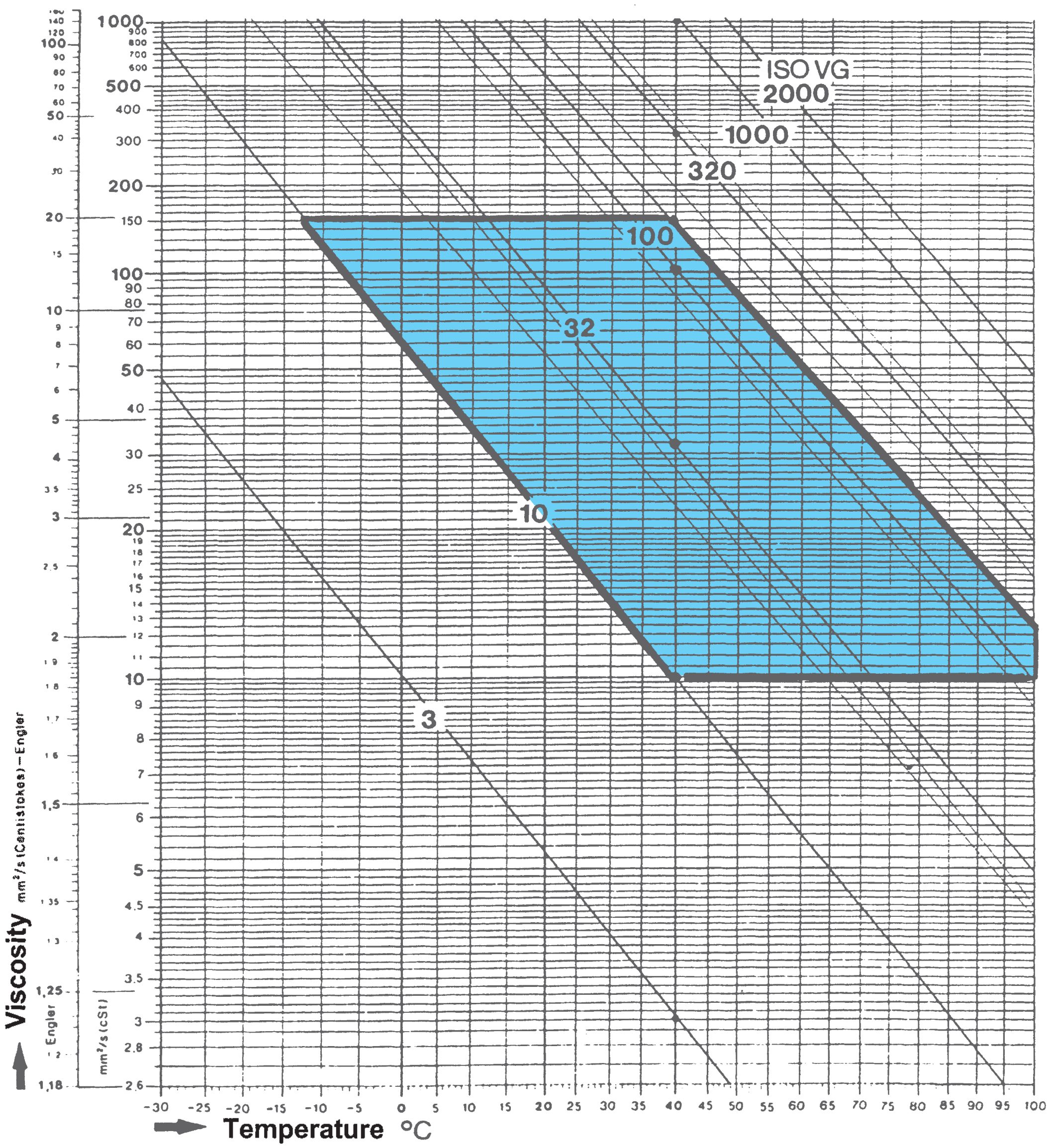
Oils in **ISO** classes **VG 10** to **ISO VG 150** may be used.
EP additive oils can be used for heavy duty applications. We do not recommend the use of oils with additives in suspension, as these may produce solid deposits. The graph on the following page shows the variation in viscosity in relation to temperature for the oils normally used.

INSTALLATION AND START-UP PROCEDURES

The following information assumes that the operator is familiar with the following documents listed here, which contain a detailed analysis of the functional characteristics and of the components. Therefore, a sequence of operations to guarantee the correct use of **MIXAIR 2** is described below.

ENGLER GRAPH – mm²/s

VISCOSITY COMPARISON



The above diagram shows the **viscosity** changes using two different scales – **Engler** and **mm²/s** (cSt) - as a function of the temperature of the usual oils used.
Four comparative curves are given, which correspond to four viscosity indices, **ISO VG**, as follows:
10-32-100-150 cSt.
As can be seen, the ISO VG index is equivalent to the viscosity of the lubricant in cSt with reference to a temperature of 40°C.

The coloured area of the graph defines those oils compatible with the 055 system – minimal air-oil lubricating system.

1) Location of the System

Preferably, it should be installed near the points to be lubricated, attached to a wall of the machine.
There must be sufficient space at the bottom for the electric wiring and for the pipework.
It must be possible to top up the tank in the upper section without any problem.
Please refer to table 1 and fig. 15 for the dimensions.

MODELS	H_1	H_2	H_3	L_1	L_2	L_3
MIXAIR 2 1-4 pipes	280	300	200	280	300	80
MIXAIR 2 5-8 pipes	280	300	200	280	400	110

Table 1

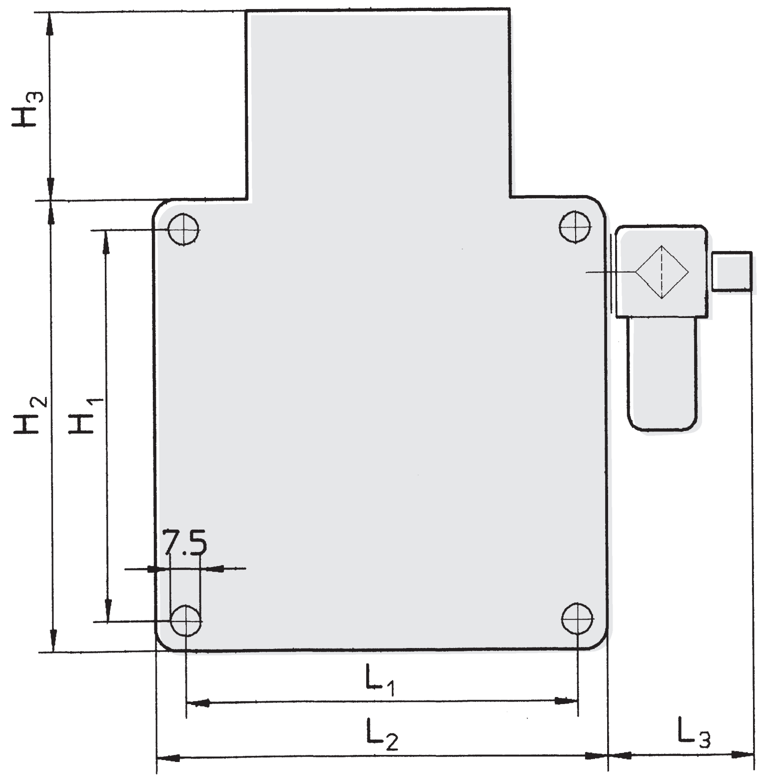


fig. 15

2) Filling the tank

The choice of lubricant depends on the technical options of the manufacturer. The following limitations must also be taken into account:

- from **ISO VG 10** to **ISO VG 150**;
- oils with additives in suspension not recommended;
- oils with **EP** additives may be used.

The lubricant must be absolutely pure, from closed or sealed containers. The tank must be filled to approximately ¾ of its capacity through the filler neck with filter. Make sure that no foreign objects are introduced during the filling operation and that the surrounding area is kept clean.
See graph on page 16.

3) Connecting the compressed air supply

A solenoid must be installed upstream of the connection to the system. This valve will open before the machine starts in order to establish the working conditions of the unit. The pressure required in the compressed air line is between **5 bar** and **8 bar**. The volume of air available should be **770 Nl/min** for units of up to 4 micro-pumps and **1600 Nl/min** for units of up to 8 pumps. Rapid connectors are provided for the air inlet: **10x8 mm tubes** for units consisting of up to 4 micro-pumps and **12x10 mm tubes** for units of up to 8 pumps.

4) Venting/bleeding

At this point, the unit is only connected to the supply line for the benefit of the micro-pumps. The pressure control valve – fig. 4, Item 6, page 5 – is **pre-set to 0 bar** and will only then require one operation to take it to the required pressure in the mixing circuit. Now proceed to open valve **R** in figure 4 to make sure that the oil flows from the tank to the aspiration manifold located underneath the micro-pumps. Open bleed valve $\mathbf{S_1}$, Fig. 16, page 19, by turning it in the anti-clockwise direction.
You will now see the oil rise slowly and then descend from the small drainage tube **T**. Continue until the oil is free from air bubbles.

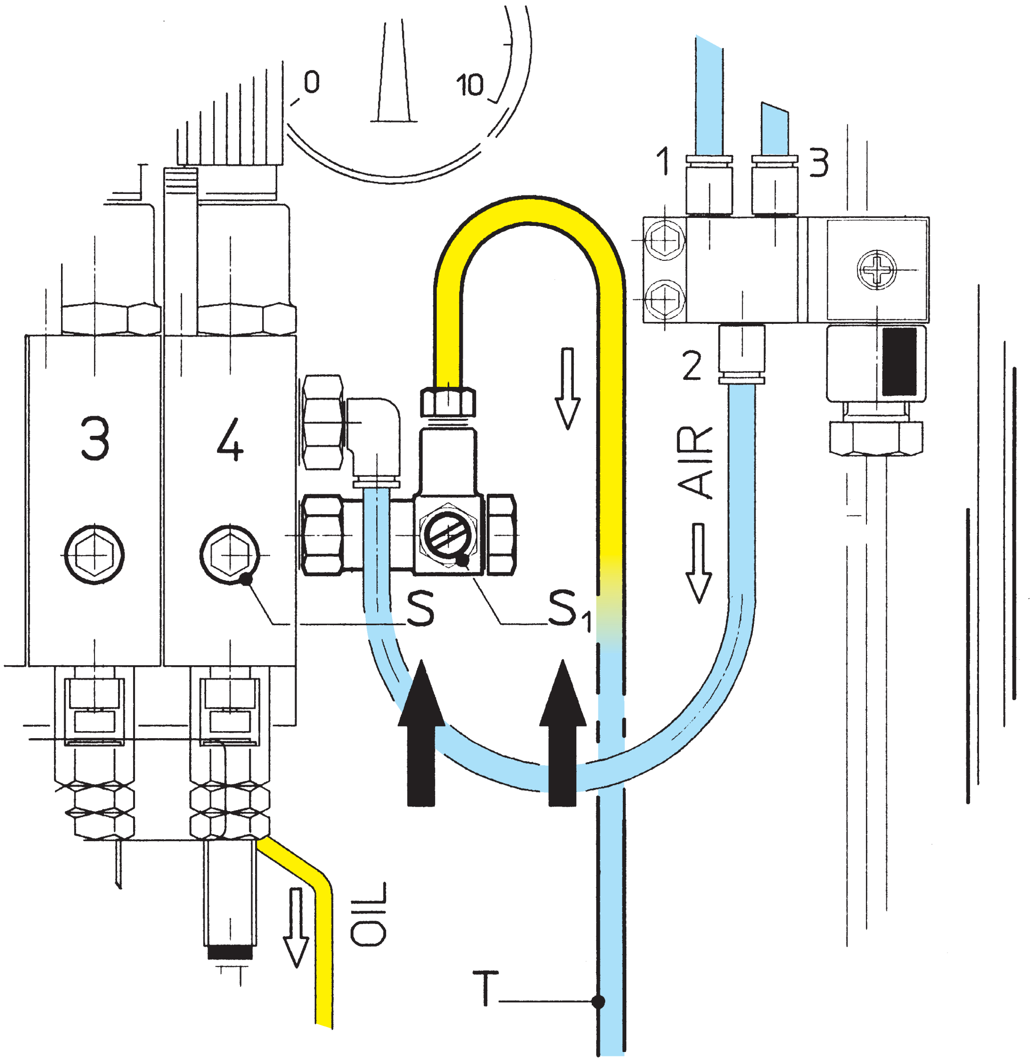


fig. 16

5) Electrical connection – standard and HT version

The **14** way multi-pin connector allows the connection for the mains supply and the remote control of the signals.
As can be seen in fig. 17, we have in particular:

Pins 1 and 2)
To be used for switching on. The voltage must correspond to the rated voltage. The programmer will be switched on before the machine starts up.

Pins 3, 4 and 5)
Change-over contact of a relay supplied by the program if:
- there is no supply at the controller

- no oil delivery from one or more micro-pumps means:
  3-4 contact closed
  5-4 contact open

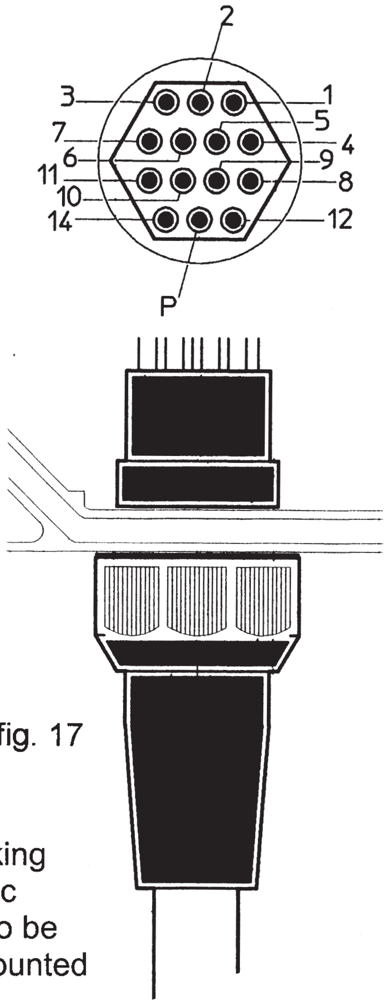


fig. 17

STANDARD AND ALT VERSIONS

1-2	SUPPLY (Rated voltage)
3	ALARM
4	ALARM
5	ALARM
6-7	MACHINE CONTACT
8-9	EXTRA CYCLE BUTTON
10-11	AIR PRESSURE SWITCH, 6 BAR
12-14	MIXER AIR PRESSURE SWITCH
P	EARTH

Pins 6 and 7)
If you want the lubrication cycles to coincide with the working cycles of the bearing housings to be lubricated, the electric spindle bearings, for example, then these contacts have to be used. The logic applied means that the working time is counted when the contact between the two pins is open.
Pins 8 and 9)
An extra automatic lubricating cycle can be obtained by using the push button on the front of the programmer (**manual**).
This can also be done by remote control by using contacts 8-9.
Pins 10 and 11)
These contacts will be used to monitor the presence of air from the mains. Since the pressure switch is set at 5 bar, it will be NC in the presence of air whose pressure exceeds 5 bar.
This has to be used to stop the machine, because the lack of air of sufficient pressure will prevent the correct functioning of the lubricating system.
Pins 12 and 14)
Each of the supply lines downstream of the mixing manifold is controlled by a pressure switch. The contact is closed if the pressure in the supply lines exceeds the set threshold – **minimum admissible pressure**. This allows the machine to be stopped through lack of the minimum conditions required for correct lubrication.
Pin P)
Terminal used to earth the programmer.

6) Using the level monitors

The level contacts on MIXAIR 2 are both change-over contacts, where:

1) contact **open** in the presence of lubricant
2) contact **closed** in the presence of lubricant
3) **common** contact, fig. 18.

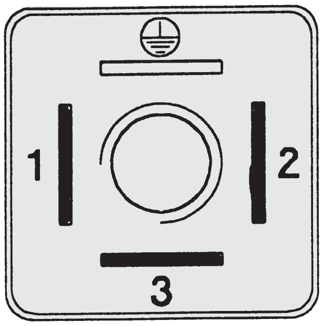


fig. 18

The first **MINIMUM LEVEL** produces a signal, which we call “standby” or “warning”, which means that the tank must be topped up soon. The second signal is a **real alarm** which has to **stop the machine immediately** to prevent **pollution of the air in the pipes used exclusively for the oil. Because of the compressible nature of this fluid, introducing air into these pipes would produce accidental and incorrect signals.**
This would have to be remedied by **repeating the start-up procedure** described in number 2) on page **18** followed by venting/purging of the MIXAIR 2 unit.

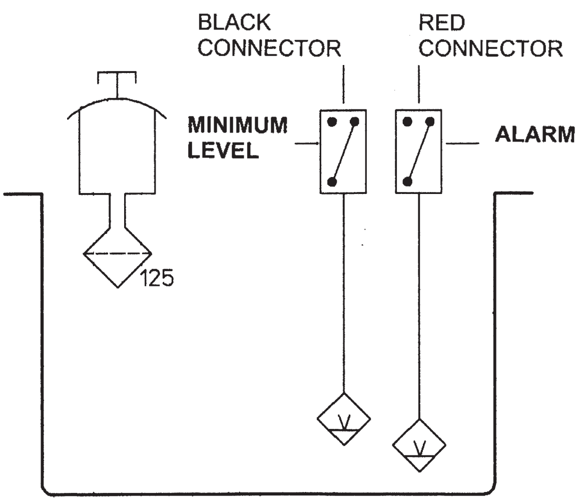
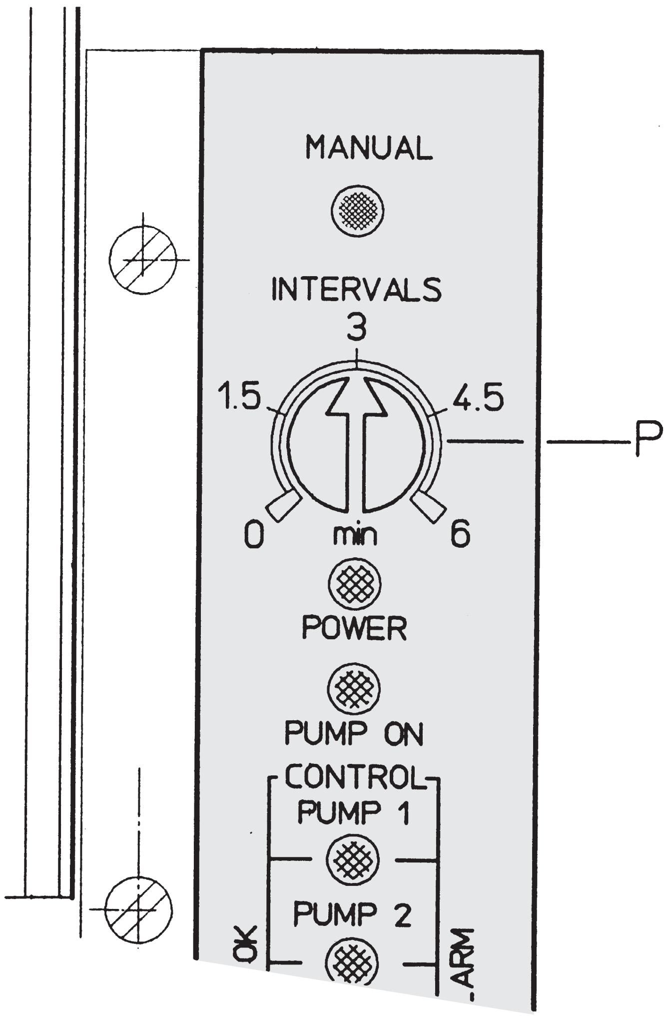


fig. 19

7) Initial start-up of the micro-pumps

At this stage, we have already connected the compressed air and made the electrical connections with lubricant in the tank. We now have to switch on the unit. **All the LEDs will light up**. We can then proceed to prime the micro-pumps. **We prevent the automatic operation** by setting knob **P**, fig. 20, at the end of the scale, **so that the micro-pumps can be operated manually**. Therefore, each of these must be **set to the maximum delivery** by turning the red knob in the clockwise direction until the stop.
Perform a certain number of operations by pressing the **manual** button. Normally, the pumps are primed immediately and the LED corresponding to the pump primed will then be green. In any case, if any small air bubble is still present near the aspiration apertures, it will be enough to operate the vent **S**, fig. 16, with which each pump is equipped. Simply undo the screw and close it once priming has been completed. **All the LEDs will then become green**.
Please remember that the pump delivery **will become visible** after repeated operations, when **micro-drops of oil** appear in the capillary tubes.



8) Connecting the pump pipes to the housings

Transparent polyamide tubes are used with a diameter of 6x4 mm. The, minimum length must not be less than 1 m and the maximum length, not more than 12 m.
Always create a few coils with a horizontal axis along the tube to create a lubricant reservoir when the system is not operating, fig. 12, page 11.
Then connect the tubes to the unit, see fig. 21, leaving the end connections to the housings free in each case. A simulator nozzle, provided for each unit, see fig. 22, is fitted to this end of the tube at this stage.
The set-up at this stage is similar to the final set-up and therefore all the operating tests can be carried out.

fig. 21

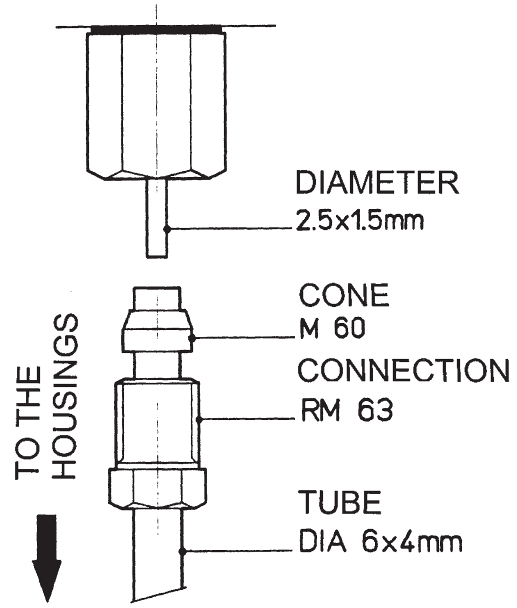
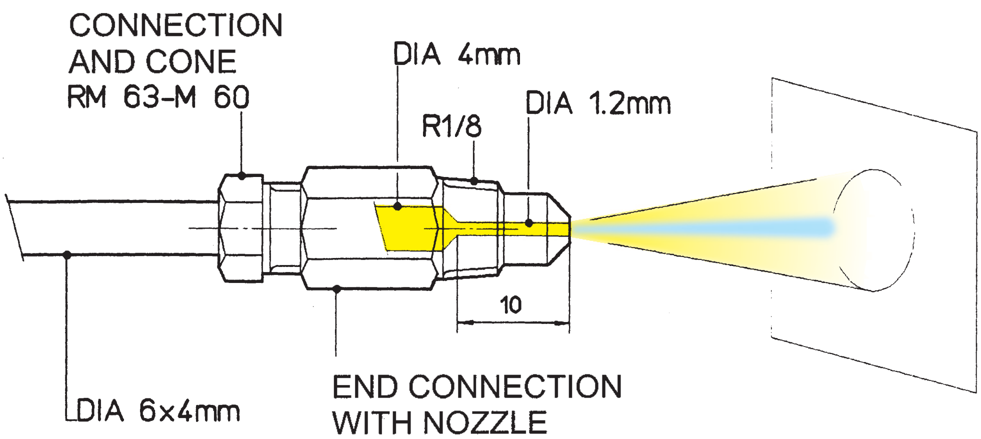


fig. 22



Remember, the air pressure control valve, item 6, fig. 4, page 5, is set to 0 bar. However, it can be increased to a pressure of 2 bar at this stage.
We now have an **air pressure at the mixing manifold** and can operate the micro-pumps numerous times by allowing the lubricant **to flow along the walls of the tubes** as far as the nozzle. We can then see the projection of the **micro-particles from the nozzles** provisionally installed and if we insert a piece of blotting paper, an increasingly intense deposit will form.

9) Controlling the pump delivery

First of all, you must establish the **lubricant demand** as a function of time and the duty cycle of the pumps. Then proceed as described in Fig. 8 on page 7 concerning the pump delivery. Remember that the pump delivery **is reduced by 7 mm^3/revolution** (0.7 mm^3 each pulse) by rotating the knob in the **anti-clockwise direction**. This allows the quantity of oil specified to be achieved accurately for each housing in relation to the duty cycle.

10) Controlling the air flow

When the pump delivery and the duty cycles have been established, we then have to establish the volume of **lubricant** which each housing will receive **as a function of time**. It is already known that this lubricant flows along the supply tubes, transported by a low pressure air flow which acts as the vector. In practice, an oil film proceeds along the tube walls in a spiral movement until the flow arrives at the nozzle, **undergoes a rapid acceleration** and is projected onto the bearing races.
To make sure that this all happens correctly, the air flow has to be set correctly for each tube. Then, when the preliminary tests described in 7 have been carried out, and the unit has stopped, you have to remove the provisional nozzles from the tubes and **connect** these **to the housing connections**.
Then, remembering how the **compressed air** from the mains can be set to a pressure between **0.5 bar and 5 bar**, make sure that the individual tubes are set as required. The plunger valves at the manifold and the following pressure gauges are used here.
The recommended pressure is around 0.5 bar, so you have to turn the screws to obtain this value. However, a different value can be obtained at the manufacturer's discretion. In any case, the following tables give an **indication of the pressure and delivery values** that can be obtained downstream of the pipes according to the values upstream and the length of the pipes themselves.