

# Recommendations for the compressor installation & servicing

## 1. INSTALLATION AND DRIVE

The compressor should be installed in the stream of cooling air far from the engine heat radiant parts - if necessary please apply the thermal screen.

The compressor support should be rigid, and made of sheet of the min. thickness 8 mm. The flatness of the above mentioned sheet should have the tolerance of 0,1 mm taking into consideration the length of the maximum distance of the fixing holes - otherwise the deformations that cause the internal stresses of compressor body could damage the body or bearings.

The fixing screws applied in compressor should be from 8.8 resistance group.

While fixing the compressor with flange, the engine transmission cover should be rigid enough. The application of the additional support could be necessary for the big single and two-cylinder compressors with flanges.

The compressor should be fixed in such a way that its total vertical deviation during the continuous running should not exceed the allowable deviations taken from the compressor offer drawings. While stipulating the total deviation, please take into consideration:

- the deviation determined by the way of fixing the compressor in relation to the engine:
- the vertical engine deviation
- the limiting gradient of the vehicle continuous running resulting from the assignment

The above mentioned allowable compressor deviation should not be exceeded as the oil level gauge in compressors with their own oil may show the wrong values or the rotating compressor parts may not reach the oil level what will consequently diminish or exclude the splash lubrication. Such situation may also influence the compressors with the circulation lubrication system by causing the oil return disturbances - from the compressor down to the engine oil sump. This may cause the increasement of the ejected oil with the compressed air.

The compressor must be installed in the place protected from dust, what is very important for the life of crankshaft seals. While installing the compressor please secure the respectively big space over the compressor in order to enable easy cylinder head disassembly and easy access to the valves. The easy access to the oil level gauge, oil filter (oil refilling) and oil return hole (periodical oil exchange) is essential for the compressors with their own oil.

The compressors are divided into two groups :

- the compressors driven by the gear wheel (flange fixing) or
- the compressors driven by the V-belt (compressor base fixing).

The full utilization of the compressor possibilities is achieved when the transmission ratio is selected in such a way that the compressor runs at the maximum revolutions of the continuous duty, while the engine revolutions comply with the maximum power or the engine revolutions are limited by the speed governor. If the above mentioned selected ratio gives the compressor air output that highly exceed the needs and simultaneously, the application of the compressor with the smaller piston displacement is not sufficient then the transmission ratio of the compressor with bigger piston displacement will have to be diminished down to the level that will be optimal for the required output. Such compressor revolution reduction positively influences its life.

The producer recommends the final compressor user to apply the compressor which is driven separately from the generator, injection or water pump drive because the V-belt drive gives the opportunity to limit the belt tension what will prolong the life of the compressor crankshaft bearings. The application of pulley with as big as possible diameter (for example - for the belt width of 12,5 mm, the pulley diameter should not be smaller than 165 mm) will prolong the life of bearings and belts. The center distance (of pulleys) should not be less than 600 mm. The belt stretcher or the system of shifting the compressor by the stretcher should be applied for the belt tension.

The holes in pulleys or in toothed wheels should be made in accordance with the recommendations taken from the offer drawings.

The examples of such hole-made is shown at the drawings No 1 and 2.

The distance a **max** = 60 mm where "a" is a symmetry plane distance of the extreme V-belt or the toothed rim on the drive wheel counting from the plane of the shaft tail-end (cone) base on which the wheel is fixed.

FABRYKA OSPRZĘTU SAMOCHODOWEGO "POLMO" ŁÓDŹ S.A.

93-126 Łódź ul. Przybyszewskiego 99

tel./ph.:+48 42 250 37 00, polmo@polmo-lodz.com.pl



The application of the belts of exactly the same length constitutes the condition for the specified torque transmission. This is essential in case of application of several belts running in parallel. Even slight differences of length or elasticity of the individual belt may substantially diminish the torque transmitted by the gear.

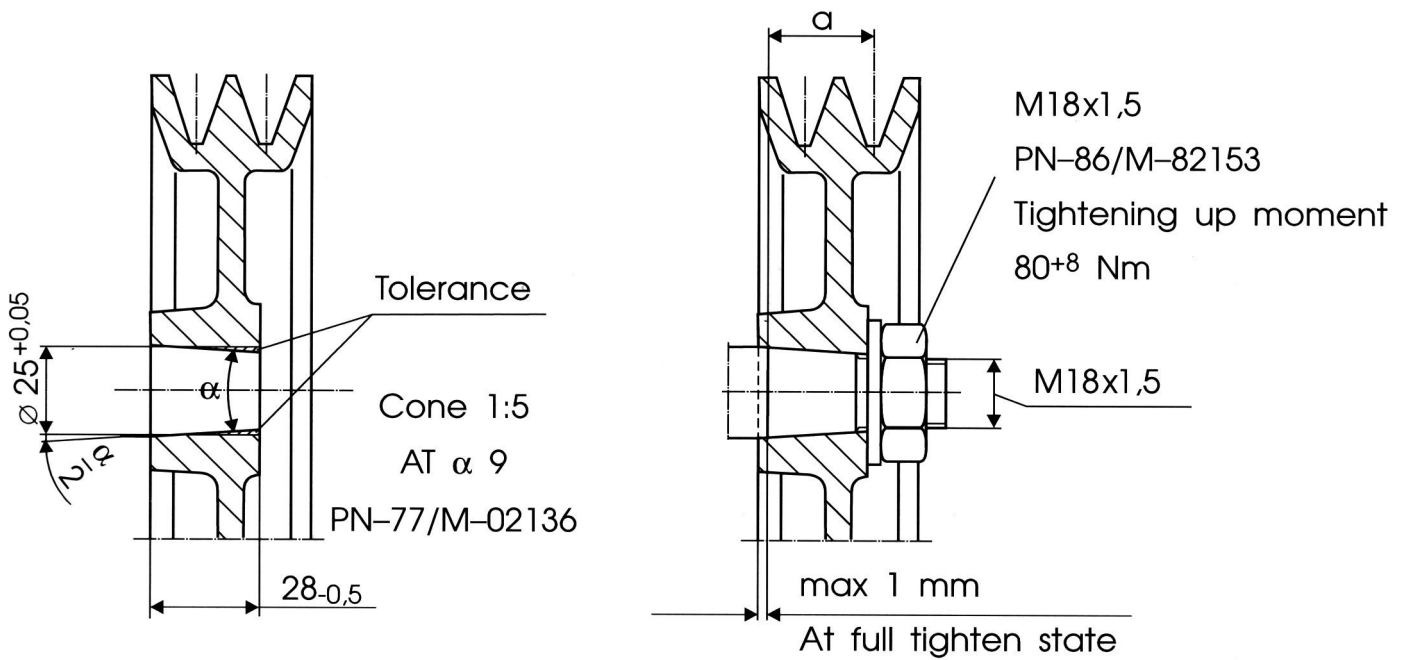


Fig. 1

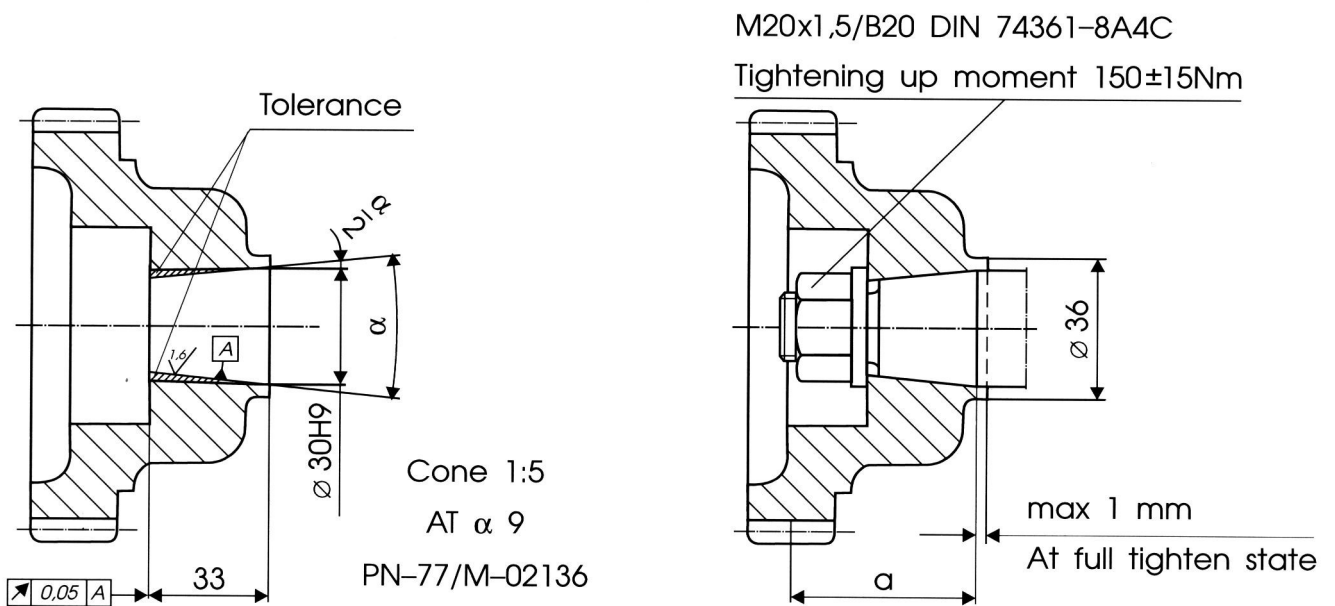


Fig. 2

For the same reasons the damage of one of the belts requires the change of the whole belt set. However, the new set should be of the exactly the same length. Despite this, the final user must obey the instructions given by the producer of the applied belts. The belts are usually stretched after the first working hour. The further V-belts adjustments should be done after each 10,000 -15,000 km.

The power taken from the maximum of the instantaneous driving moment during the compressor running at 500 r.p.m. and the forcing pressure resulting from the application of compressor, constitutes the basis for the calculation of the compressor drive belt transmission. The average power input

stipulated on the offer drawings should not be taken as a basis for belt transmission calculation because the real compressor driving moment may vary and it may reach even negative values (taking into consideration the crankshaft angle of rotation function).

## 2. SUCTION SYSTEM

The air sucked in by the compressor must be filtered. The filter used for the engine suction system is usually applied for the above mentioned purpose.

The application of the separate filter requires the place that enable the access of the clean air - without, dust, mud or other impurities. The suction hose which links the filter and suction port of the cylinder head should have the passage as big as possible but not less than  $\varnothing 15$  mm with the length not bigger than 1 m and as much as possible rectilinear.

This will guarantee the suction resistance as small as possible what will directly influence the compressor output. The suction hose attached to the engine filter or to the hose that links the above mentioned filter and suction manifold should not be orthogonal but fixed on at the very small angle (which is as much as possible parallel to the suction direction of the engine). This hose should be installed in front of the engine crankcase venting hose and in front of engine turbocharger as far as it possible. The most convenient place for attaching the suction hose is the direct attachment of the above mentioned hose to the filter. The attachment of the suction connector just in front of turbocharger (which causes the vacuum) may cause the poor and insufficient compressor load consequently badly influence the compressor running and output. Moreover, such a attachment of the suction connector increases the quantity of the ejected oil in forcing air. The additional tank of the capacity of 1 l connected with the compressor suction hose should be applied if the above mentioned system is not sufficient for the better suction noise stoppage (if required).

The individual air dry filter or with the oil bath (in case if there is a very small air pollution only) should be applied if the compressor suction attachment to the engine filter is not possible. The filter size depends on the compressor size. The compressor input vacuum should be as small as possible.

If the final compressor user wants to obtain the high compressor efficiency at the small level of the ejected oil with the forcing air then possibly smallest compressor input vacuum will have to be guaranteed. The vacuum level of 500 mm H<sub>2</sub>O for the application of the filters with the pollution indicator (up to 600 mm H<sub>2</sub>O) must be obeyed during the whole compressor use.

The application of fibre seals (which are not heat-proof) are not allowed to be applied for the sealing of the cylinder head suction port connecting elements. The metal seals such as aluminium made in accordance to the BN-70/3611-09 or DIN7603 standards are recommended. The flexible vacuum-hose should be applied for the connection with the filter in order to diminish the forces that influence the compressor cylinder head. The right  $\varnothing 20-22$  mm connector with thread of M 26 x 1,5 (or of  $\varnothing 16-18$  mm and thread M 22 x 1,5) should be applied for the cylinder head suction ending - see fig 3. If it turns out that the hose bend is necessary please apply the bend radius of at least 40 mm.

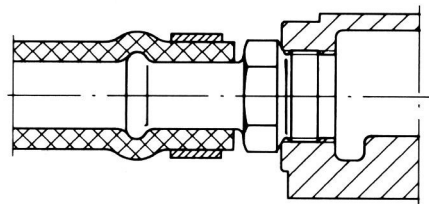


Fig. 3

## 3. FORCING SYSTEM

The connecting hose that links the pressure port of the cylinder head and pressure regulator should have the passage not less than  $\varnothing 15$  mm and such wall thickness which will secure the proper pressure resistance applied in system. The length of the pressure conduit should be of 2 m up to 2,5 m (max. 5 m). The hose should be fixed far from the heat radiant engine parts. The above mentioned hose should be scrolled or single-loop shaped and installed in the stream of cooling air (if possible) in order to keep the temperature of the pressed air in the pressure regulator input port at the level which does not exceed 100°C.

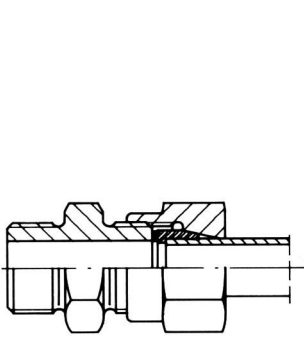


The allowable pressure level of the forcing socket amounts to the max 0,07 MPa during the idle running of the compressor. The applied hoses must be free from any stresses, flexibly put and attached to the engine connecting clips.

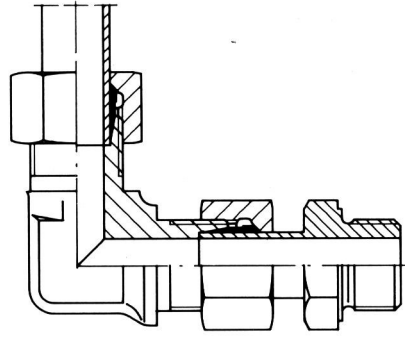
The pressure conduit parts are to be made of flexible conductor with the proper mechanical and heat resistance (for example - flexible reinforced teflon conductor) in order to lower the vibration passed from the compressor and engine to the pressure regulator.

The pressure conduit should be diagonally fixed (with direction from the compressor to the regulator) in such a way that the water condensate has no opportunity to remain in conduit. Moreover, the water condensate should be protected from drifting into the compressor.

The accumulated carbon deposit may diminish the passage of the conduit. Hence, to avoid such situation, the conduit behind the compressor should be straight (Fig. 4) and without any sharp bends. The application of elbows and joints presented on fig. 5 should be limited because of the above mentioned reasons.



**Fig. 4**



**Fig. 5**

The fibre seals should not be applied for the sealing of joints. Such seals are not heat-proof and the best solution for the final user is to applied the metal seals made of copper or aluminium according to the BN-70/3611-09 or DIN7603 standards.

#### **4. COOLING**

The water, air as well as the oil cooled compressors should be installed in the stream of the cooling air produced by the engine fan and stream of the air made by the movement of the vehicle (if possible).

The rate of the cooling development should be defined in such a way that the temperature measured 50 mm far from the cylinder head outlet at the maximum load does not exceed 493 K (+ 220 °C) while the vehicle is in motion and at ambient temperature 293 ± 5 K (20 ± 5°C). The short - time increasement of the above mentioned temperature is allowed during the loading of empty vehicle tanks only.

The maximum compressor load of the compressor used for the traction purposes appears:

- at the maximum revolutions of the continuous duty,
- while the system reaches its maximum allowable leakage level and
- during the maximum consumption of the compressed air resulting from the running of the particular system circuits.

The compressor cylinder head, valve plate and cylinder are cooled by air or by liquid (water or oil). The cooling level of the air cooled compressors is defined by the speed of the stream flow of the cooling air and by the ambient temperature.

The flow speed should be measured directly on the compressor cylinder head (up to 100 mm counting from the external compressor rib outline). The required average cooling air flow speed depends on the compressor size (measured by the compressor piston displacement  $V_H$ ).

For  $V_H \leq 160 \text{ cm}^3$  - 4 m/s at the forcing pressure  $p \leq 0,8 \text{ MPa}$

- 6 m/s at the forcing pressure  $p > 0,8 \text{ Mpa}$

For  $V_H > 160 \text{ cm}^3$  - 6 m/s despite the forcing pressure level.

The cooling level of the water cooled compressors is defined by the output of the cooling water and by the temperature measured on the compressor inlet.

The required quantity of the cooling water should be  $v \geq 4 \text{ dm}^3/\text{min}$  and its temperature measured at compressor inlet should be  $\leq 85^\circ\text{C}$ . If this temperature is higher the overpressure in the

water system should be created in order to lower the steam production. The maximum allowable overpressure in the cooling spaces of the cylinder head and valve plate amounts to 0,1 MPa. The special attention must be paid to the proper venting of the cooling spaces. The cylinder head should not be the highest point of the cooling system. The flow of  $\geq 6 \text{ dm}^3/\text{min}$ . measured on the compressor cylinder head inlet at the oil cooling temperature  $\leq 120^\circ\text{C}$  should be guaranteed for the compressors cooled by oil.

## 5. LUBRICATION

The various types of lubrication are applied for the different types of compressors:

- (a) splash lubrication with the manual oil topping up TH (the German marking).
- (b) splash lubrication with the connection to the engine oil pressure - TD (the German marking).
- (c) circulation system lubrication with the manual oil topping up - TD (the German marking).
- (d) circulation (or mix splash & circulation) system lubrication with the connection to the engine oil pressure - UD (the German marking).

The engine oil (used for the engine that cooperates with the particular compressor) should be applied for the compressor lubrication. Simultaneously the (a) & (c) type lubricated compressors should be topped up with the engine oil selected from the usually applied diesel engine oils.

Please apply the oil of the quality which is in accordance to the API classification CC or CD grade of the following viscosity:

- SAE 40 for the ambient temperature from 0 up to  $+60^\circ\text{C}$
- SAE 40 for the ambient temperature from -5 up to  $+50^\circ\text{C}$
- SAE 40 for the ambient temperature from -5 up to  $+40^\circ\text{C}$
- SAE 40 for the ambient temperature from -25 up to  $+30^\circ\text{C}$

The quantity of the topped up oil and its level should be kept during the compressor use and should be in accordance with the catalogue instructions.

The oil level should be checked and refilled every day. While checking the vehicle should be kept on the horizontal plane. The first oil change should be done after 1,000 km or 20 compressor working hours. The next oil changes should be after each 25,000 km or after each 500 working hours. After the first oil change the final user is obliged to check all fixing screws and nuts and if necessary please tighten them according to the instructions taken from the service manual.

The same please apply to the joints, air compressed hoses, cooling liquid and oil in the compressors of (b), (c) and (d) types. The (b) and (d) type compressor should be connected with the engine compressed lubrication system by the oil hose made of the weldless pipe that  $\varnothing 6 \times 1$ . The lubricating oil must be filtered and its temperature should not exceed  $120^\circ\text{C}$  - measured at the inlet into the compressor. The oil pressure during the engine working running should be  $0,3 \pm 0,2 \text{ MPa}$ . The pressure drop down to the minimum of 0,06 MPa is allowed during the idle running of the heated up engine on condition that the increasing running speed is followed by the immediate increase of pressure. The compressors lubricated by the oil engine system must have the proper oil return (outlet) in every vehicle working conditions. That is the reason why the hose that connects the bottom of the compressor crankcase with the oil sump should have that  $\varnothing 15 \text{ mm}$  on the whole length. Moreover, if possible, it should be wider and should be sloped towards the engine. The engine oil sump inlet should be above the engine oil level and the oil outlet should not be interrupted by the any of the rotating parts (toothed wheels or the engine shaft cranks). The overpressure in the compressor crankcase should not exceed 150 mm  $\text{H}_2\text{O}$ .

The fulfilment of the above mentioned recommendations guarantees the proper compressor crankcase venting. This will directly influence the quantity of the oil that goes over the compressor piston and which is blown-out with the compressed air into the system later on.