



NYBORG - MAWENT

82-200 Malbork, ul. Ciepła 6

tel.: (055) 646-63-00, fax.:(055) 646-63-09

www.nyborg-mawent.com

Operation and Maintenance Manual

CENTRIFUGAL FANS



Contents

1. INTRODUCTION..... 3
 1.1. **Purpose of the Operation Manual**..... 3
 1.2. **Recipients** 3
 1.3. **Disclaimer**..... 4
 2. APPLICATION AND CONSTRUCTION OF FANS 4
 3. TRANSPORTATION AND STORAGE 6
 4. PREPARATION FOR INSTALLATION..... 8
 5. FANS FOUNDATION.....11
 6. CONNECTING FANS TO INSTALLATION.....14
 7. ASSEMBLY INSTRUCTION FOR FLEXIBLE CONNECTORs15
 8. ELECTRICAL INSTALLATION.....17
 9. COMMISSIONING AND OPERATION18
 10. MOTORS20
 11. PERIODICAL INSPECTIONS, MAINTENANCE AND OVERHAULS21
 11.1. **General and safety guidelines**.....21
 11.2. **Maintenance of bearings in the motor**22
 11.3. **Maintenance of rolling bearings in the bearing mounting of the fan**.....22
 11.3.1. **Notes to the top up lubrication schedule**24
 11.3.2. **Limit values of bearings temperature**.....26
 11.3.3. **Total replacement of lubricant**.....26
 12. HEAT-RESISTANT FANS28
 13. TYPES OF SHAFT SEALINGS.....29
 13.1. **Standard sealing**29
 13.2. **Simmering type shaft sealing**.....29
 13.3. **Shaft seal with lubricant barrier**30
 14. WORK HEALTH AND SAFETY REGULATIONS.32
 15. POSSIBLE MALFUNCTIONS AND TROUBLESHOOTING34
 16. TERMS AND CONDITIONS OF WARRANTY.....37
 17. DISASSEMBLY AND DISPOSAL.....39
 18. EQUIPMENT INSPECTION FORM40
 19. EQUIPMENT CARD.....44

1. INTRODUCTION

. This Operation Manual is aimed at defining rules for the proper operation of radial fans with respect to transport, installation, commissioning and maintenance of radial fans.

Failure to read and understand the Operation Manual may result in fans' failure and is potentially hazardous for the personnel.



This manual and its annexes must be read and observed by personnel responsible for the transport, installation, operation, maintenance and repair of the fan, and must be observed for safety and health protection.

1.1. Purpose of the Operation Manual

This operation manual applies to the fan only and therefore does not cover electrical equipment such as electric motors and other drives. A fan driven by electric motor or other electrical equipment does not become an electrical appliance.

This manual does not apply to radial fans that are designed for operation in potentially explosive environment. Separate operating instructions are issued for fans intended for use in potentially explosive environment.

The operating and maintenance instructions from the manufacturers of electrical drives and other auxiliary equipment must be observed during the installation, commissioning and maintenance of these devices. The scope of delivery may also include accessories and components not mentioned in this manual. Please refer to the operating instructions of the respective manufacturer, Nyborg Mawent will assist you in obtaining the relevant instructions, if needed.

The present guidelines must be observed in order to ensure the proper, failure-free operation of fans and achieve the rated operation parameters. Fans produced by Nyborg-Mawent S.A. are inspected for their parameters and failure-free operation, therefore, first of all, the reasons for any troubles with the installation shall be looked for in the installation itself. In case of any fan's malfunction and defects, please contact Nyborg-Mawent S.A. specifying the details of the fan (type, serial no. and year of production), operational conditions and circumstances in which the malfunction has occurred.

1.2. Recipients

The Operation Manual is intended for people who carry out installation and commissioning of fans, as well as the maintenance of the device and keep it in a proper technical condition. These people must be adequately qualified to perform the above mentioned activities.

1.3. Disclaimer

In order to ensure further fans' improvement, Nyborg-Mawent S.A. reserves the right to modify the construction and technical parameters of the device. Therefore, no liability will be accepted for any claims resulting from data, drawings and guidelines contained in the present Operation Manual.

Nyborg-Mawent S.A. is not responsible for any losses resulting from any use inconsistent with the device's intended use, misuse, improper operation or unauthorised repairs of the fan.

This manual should be read carefully and completely before any action is taken, and in case of any questions or doubts, please contact Nyborg-Mawent S.A. for assistance. This manual shall be kept near the fan, in a place accessible to the user at all times. It should be protected against external factors to ensure its legibility and completeness.

2. APPLICATION AND CONSTRUCTION OF FANS

Centrifugal fans are used for conveying mixtures of vapours and gases in general ventilation and various technological processes in many industry sectors, in construction, agriculture and industry.

They are used in the following systems:

- general ventilation of buildings,
- blower systems for furnaces,
- process systems,
- pneumatic conveying systems, when a fan is in a pressing mode and conveyed material do not pass through the fan (except for conveying fans).

A separate group is centrifugal conveying fans, which are used for transporting various materials, e.g. wood shavings, fibrous and leather waste, textile or paper offcuts, shive, dry fodder, etc.

Centrifugal conveying fans are used in the following industries:

- timber industry,
- textile industry,
- rettery,
- chemical industry.

Marking and intended use of fans, as well as their overall dimensions, assembly dimensions and parameters are included in relevant technical and commercial brochures provided by Nyborg-Mawent S.A.

Centrifugal fans are intended to be installed in ducts in a suction or pressing line or both, suction and pressing lines. In case of fan's installation in a suction line only or in a pressing line only, the suction or pressing stubs which were not used shall be secured with appropriate caps, e.g. net caps, meeting relevant requirements.

Centrifugal fans manufactured by Nyborg-Mawent S.A. are designed to keep the noise emission hazard reduced to the lowest possible level, taking into consideration the technical development and availability of noise-reducing measures, especially at the source of noise generation. The sound pressure level depends on the operation point of the fan. We recommend checking the sound pressure level and, in case of excessive noise, using a silencer (if not already used) and/or applying individual noise protection measures for personnel. **However, if lower noise level is required on site, it is necessary to apply suitable noise insulated chambers, noise insulated casings, screens, silencers, etc.**

Observe the health and safety regulations, safety provisions and recognised rules and guidelines compliant with the available technical knowledge and practice. All applicable safety regulations must be observed when working on the fan. Failure to observe the safety regulations may damage the fan and may threaten the health and life of people.



Personnel present in the vicinity of the fan shall wear personal protection measures, i.e. hearing protection adequate to noise parameters and individual features. Failure to use hearing protection may result in loss of hearing, balance disorders, communicating problems. The fan does not exceed the allowable noise level value provided for in the regulation of the Ministry of Labour and Social Policy dated 6 June 2014 on the highest allowable concentrations and intensity of hazardous factors present in work environment (J./L. No. 2014, item 817).

Operating personnel must always wear hearing protection in the vicinity of the fan.

3. TRANSPORTATION AND STORAGE



The fan is suitable for in-plant transportation – called hereinafter the transport – only in the assembled condition, as it was delivered from Nyborg–Mawent S.A. The fan can be transported by transportation means in accordance with work health and safety regulations stipulated in the 2007/30/EC directive.

Centrifugal fans are screwed to pallets. Only appropriate equipment shall be used for fans' transportation. Never lift a fan using connection cables, electric cabinet or motor. When unpacking, check the fan for mechanical damages.

Before the assembly, fans shall be stored in dry and well-ventilated rooms. The storage temperature shall not drop below 5°C and shall not exceed 40°C, relative humidity shall not exceed 70%. Fans shall be handled and transported on pallets, using covered means of transport, without excessive bumping. Fans shall be firmly and reliably screwed to a pallet. During transport and storage, fans shall be protected against mechanical damage.

Do not store fans in places, where they can be exposed to adverse atmospheric conditions. Storage period shall not exceed one year. For longer storage periods before the first commissioning, consult the producer. During downtime period, fan shall be protected against vibrations or impacts in order to avoid bearings' damage. Also, it shall be remembered to regularly rotate the impeller. After the fan's storage or downtime longer than 1 year, replace lubricant in the fan's bearing mounting.

For vertical transportation, the fan must be suspended as shown in Figure 1, using the specially provided lugs on the housing and the mounting holes in the foundation base. Lift and transport the fan using suitable lifting device or transportation means. The weight of the fan must always be checked with the manufacturer. The length of the lifting slings must allow for even load distribution. It is not permitted to lift the fan using elements other than those shown in Figure 1.

Never use motor lifting elements for fan's transportation.

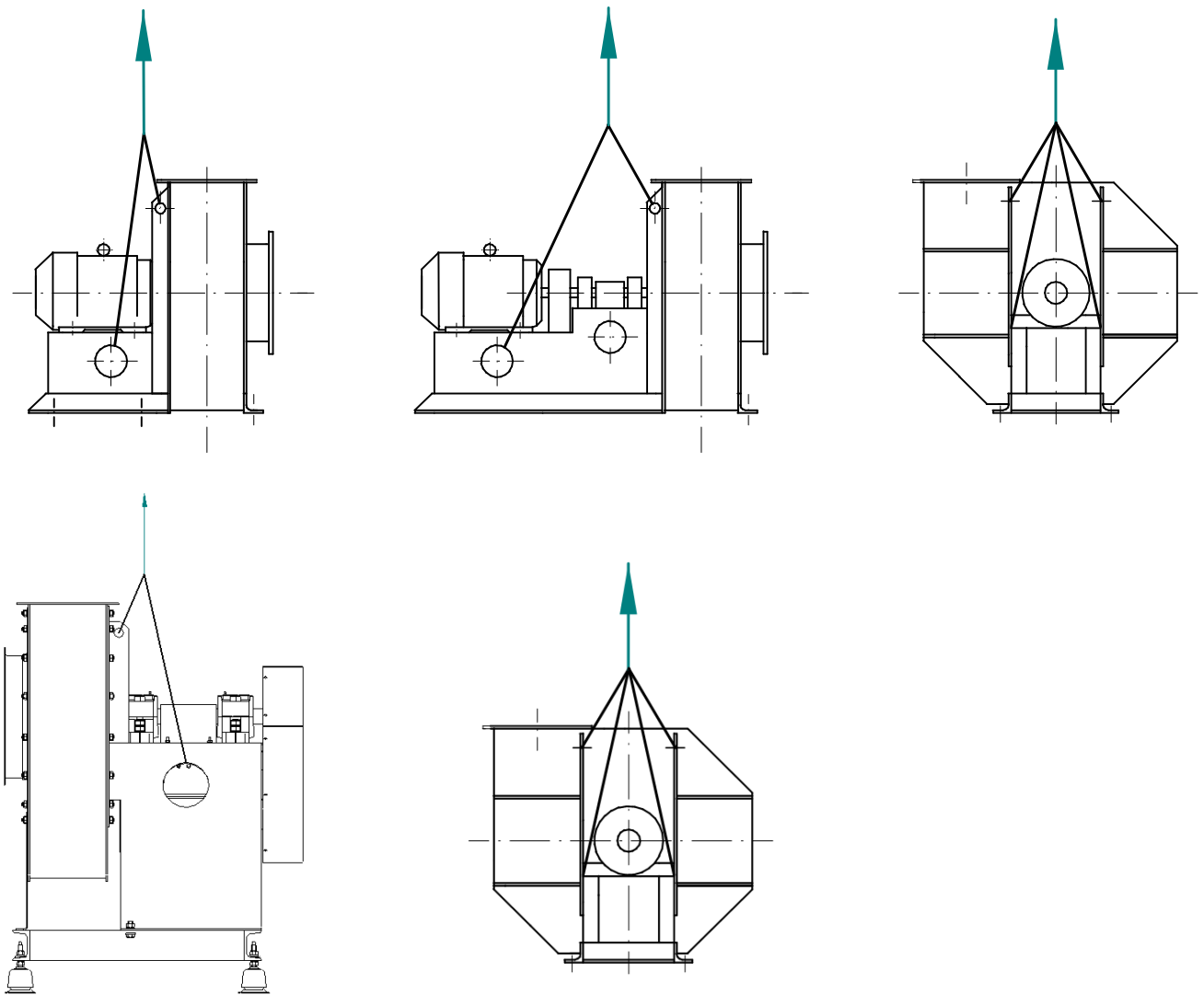


Figure 1. Transportation of fans.



The purpose of all the above mentioned guidelines is to eliminate the risk of fan's falling down which could result in injuries to the operating personnel and device's deformations which could lead to the decrease of minimum allowable distance between the impeller and not moving parts, creating, in turn, potential damage hazard.

4. PREPARATION FOR INSTALLATION



Installation works including electrical connections, commissioning, operation, maintenance, repair and dismantling may only be carried out by qualified personnel who are required to have basic mechanical and electrical knowledge as well as technical expertise and appropriate means and tools. In order to ensure work safety, these activities may only be carried out by qualified technicians or by the person who instructs and supervises the personnel performing the operation.

They must have knowledge on the following: currently applicable occupational health and safety regulations

- currently applicable work safety provisions
- guidelines and recognised rules of technical knowledge

Moreover, the qualified technicians must:

- be licensed to carry out the required work,
- be able to assess the works from a safety point of view, recognise possible risks and be able to avoid them,
- read and understand this operation manual before starting work

Before connecting fans to ventilation and power supply systems, be sure to:

- check whether a fan has not been subject to damage, contamination or corrosion during transport or storage,
- check whether electrical motor has not been damaged (follow the guidelines of the Operation and Maintenance Manual of the electrical motor),
- check whether screw connections have not been loosened, and first of all, check screws which fasten a motor and bearing mounting to the foundation base and a screw which protects the fastening of impeller.
- check whether the impeller of a fan rotates freely without any friction against elements of fan's casing and whether relevant clearance is maintained – 's' dimension (Fig. 2)

$$s > 1 \text{ mm} \quad \text{for} \quad D_o \leq 250 \text{ mm}$$

$$s > 2 \text{ mm} \quad \text{for} \quad D_o > 250 \text{ mm}$$

where D_o – inlet diameter of a fan,

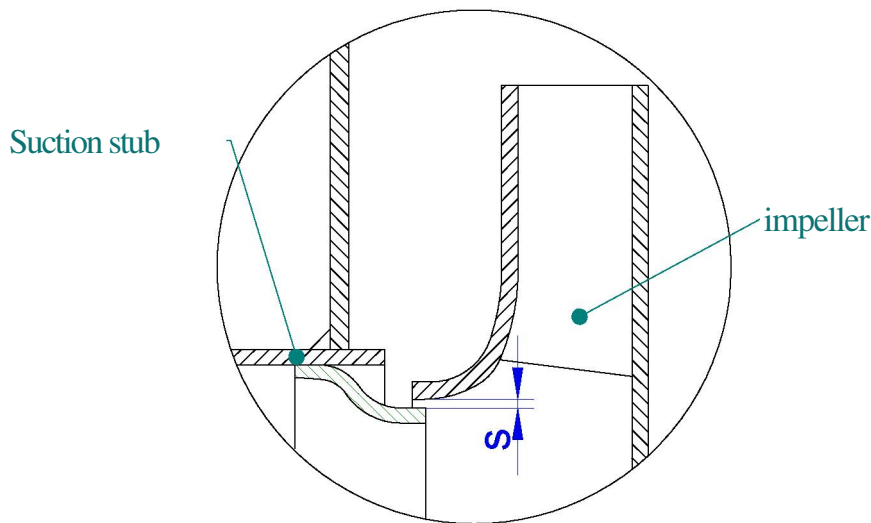


Figure 2. Entry gap

- check for the compliance of a span and diameter of foundation screws with the holes in the fan's foundation base and the alignment of connection holes of inlet and outlet stubs with relevant holes for screws of relevant ducts,
- with the belt drive, check the correctness of alignment of the fan and electrical motor. Axes of fan's and electrical motor's shafts shall be parallel to each other, and grooves in pulleys must be aligned so as the V-belts are perpendicular to the axes of shafts. Allowable non-parallelism of grooved pulleys' faces shall not exceed 1 mm/m of distance between pulleys and the tolerance of mutual dislocation of pulleys' grooves shall not exceed 0.2 mm/m of the distance between pulleys – 'a' dimension (Fig. 4). Depending on the intensity of fan's operation, periodical inspection of V-belts is recommended (tension, surface condition, etc.) (Fig. 3). Such inspection shall be performed always before the first or each subsequent start-up of a fan after a prolonged downtime period. The first inspection of belts tension shall be carried out after a few days from the commissioning and then once a year, unless the conditions require otherwise. Tension of V-belts shall be compliant with generally available recommendations and standards of V-belts' producers.

NOTE!
Do not exceed the allowable
tension of belts.

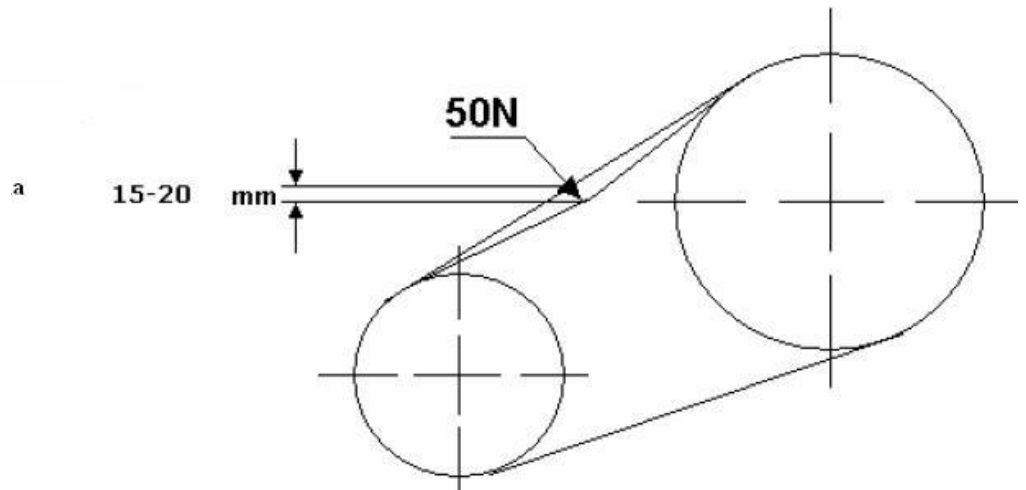


Figure 3. Measurement of belt tension

- check, by rotating the fan's impeller, whether elements of belt transmission operate without any friction against the transmission's cover.



Note. Never operate a fan with the guard of a belt transmission removed.

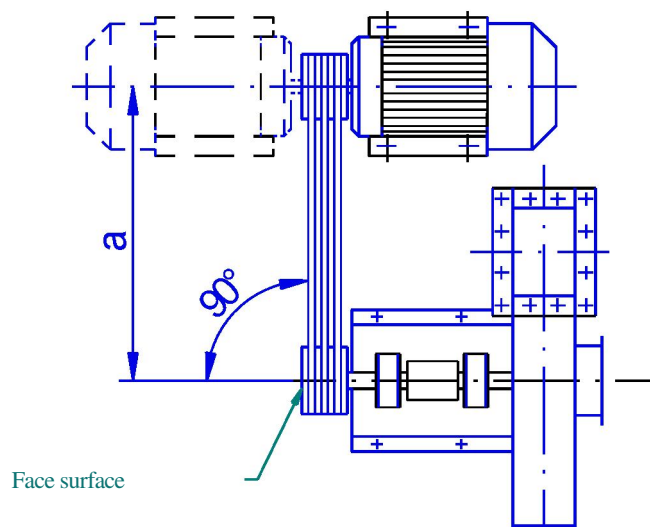


Figure 4. Clearances at belt drive.

- with clutch drive – during the inspection of the elastic element (Fig. 5) of membrane clutches, the following shall be looked for:
- fatigue cracks in the element's connection joints,
 - discolouration of elastomeric insert,
 - cracks of elastomeric insert's surface,

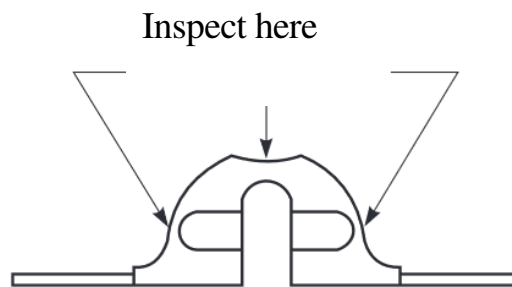


Figure 5. Spots of clutch inspection.



Note. Never operate a fan with the guard of a clutch removed.

5. FANS FOUNDATION



The location where the fan is to be mounted, such as steel structure, foundation plate and others must be designed for the weight of the fan and the load of the foundation and must ensure the operation and shutdown of the fan free from shocks or vibrations. Check and consider the dimensions of the foundation with the fan dimension drawing and the foundation layout to ensure that there is sufficient space for installation, maintenance and repair operations. Check whether there is sufficient space at the inlet of the cooling air for motor.



If the installation site is not properly levelled, the fan may become unbalanced, which increases the risk of crushing or cutting off body parts. As standard, the fans are equipped with vibration isolators, the purpose of which is the compensation of the unit's own vibrations. The fan is delivered with vibration insulators, disassembled for the transportation. As an option, the fan can be mounted without vibration insulators (rigid).

Mounting the fan to the foundation:

- Rigid: the fan is directly mounted to the ground using appropriate fastening technology (heavy-load anchors, concrete anchors) using holes in the base and a support.

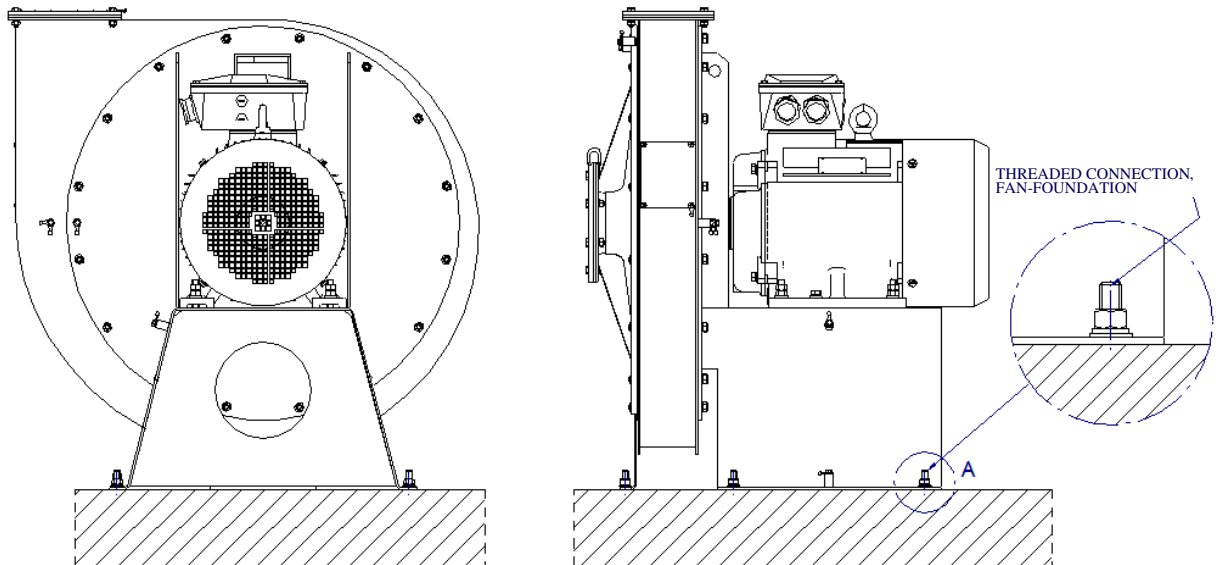


Figure 6. Rigid mounting of the fan

- Flexible: the fan is indirectly mounted to the ground through vibration insulators assembled to the fan's base or frame, reducing the vibrations transmitted to the ground (Fig. 7).

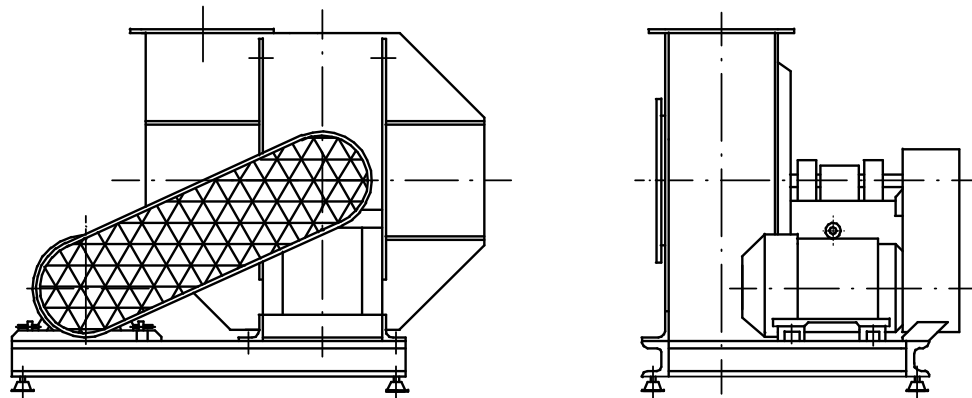


Figure 7. Fan unit.

Basic parameters of vibration insulators used by Nyborg-Mawent S.A.:

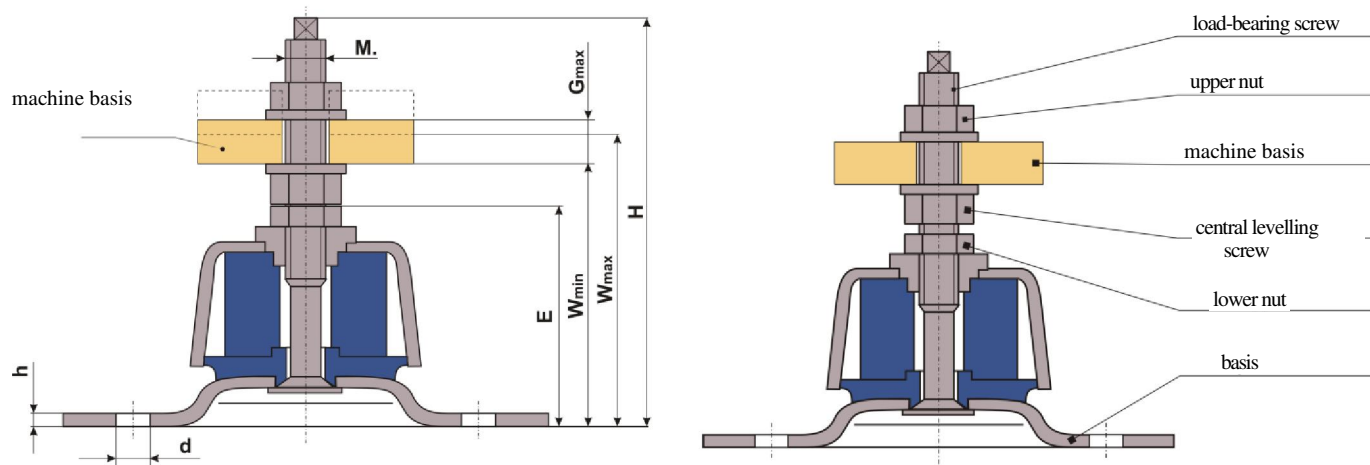


Figure 8. KA type vibration insulator

Type and size	Dimensions (mm)													Max. deflection (mm)	Weight (kg)
	A	B	C	D	d	E	H	h	M	S	Wmin	Wmax	Gmax		
KA-50	136	80	108	68	10	70	135	2,5	M12	7	85	90	25	4	0.6
KA-90	225	130	175	115	18	115	225	3	M20	11	135	145	50	7	2.4

Table 1. Dimensions of KA type vibration insulators.

Before the mounting is started, determine the precise location of the fan unit to be mounted on the vibration insulators and determine the location of vibration insulators. Position the base of vibration insulators with two fastening holes on the floor.

Insert screws or anchors into these holes to screw the vibration insulator's bases to the floor. Holes for screws fastening the vibration insulators to the floor can be drilled before the unit's assembly or during the assembly.



The choice of the appropriate fastening technology is up to the installer.

Pay attention to the tightening torque values of the fastening elements - see Table 3.

Ensure that the location of the holes is aligned with the holes in the load-bearing frame of the fan in order to ensure its proper positioning. The load-bearing frame of the unit has round holes and the machinery shall be put on the frame from the top onto the screws of vibration insulators. For that version of the assembly, vibration insulators shall be positioned on the floor in places aligned with the position of the unit's load-bearing frame and possibly, preliminary screwed. Before installing the fan unit the upper nuts and washers shall be removed from vibration insulators and central levelling nuts and washers shall be set to one, the lowest possible level. Then, place the fan unit on top of thus

positioned vibration isolators. Level it carefully, insert washers and screw on upper nuts, securing the fixed position of the unit.

During assembly, pay attention not to loosen the lower counter nuts of vibration insulators; therefore, while tightening the other nuts, it is recommended to secure the load bearing nuts of vibration insulators against loosening by holding their square heads with a wrench. When changing the position of central levelling nuts from previously determined level (during lifting or lowering the fan unit), turn the all nuts by the same number of rotations in order to maintain equal load of all vibration insulators. All vibration insulators are equally loaded when the distance (gap) between the vibration insulator's frame and base is equally maintained.

6. CONNECTING FANS TO INSTALLATION

When connecting the fan to the pipelines, flexible connectors (Fig. 9) must be used, both on the suction and the pressing side. Flexible connectors (compensators) prevent the transmission of own vibrations of the fan to the pipelines and the reverse. Compensators shall be located directly on the inlet and outlet stub of the fan (except for the connection of the fan's flow regulators). While assembling the fan on vibration insulators, compensators shall be applied on both, suction and pressing lines of the fan. To enable the compensator to eliminate tensioning forces present in the installation, it must be installed in a non-tensioned condition.

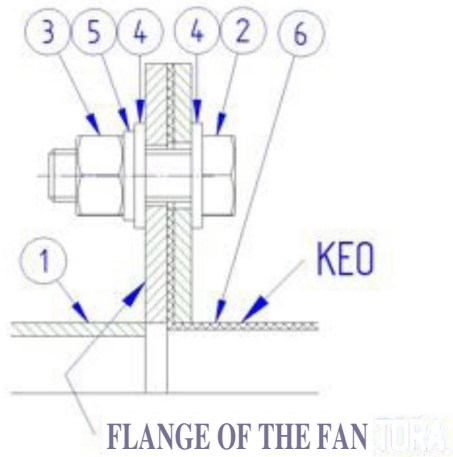


Note: The connected installation must not exert any load or strain on the fan. The fan and the components are not self-supporting structures.

7. ASSEMBLY INSTRUCTION FOR FLEXIBLE CONNECTORS

Note: Compensators shall not be installed until cable installation is finished!

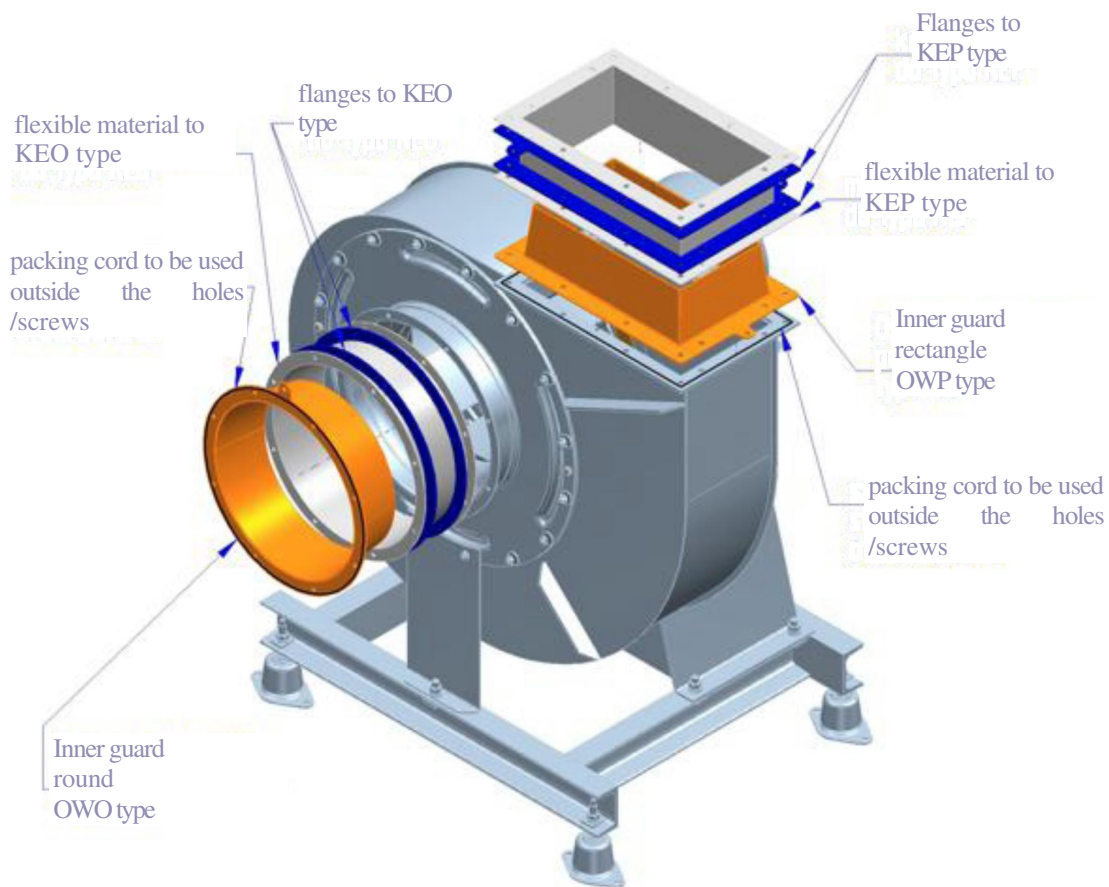
Compensator must not be installed in a tensioned or displaced position, ±5% displacement is allowed in relation to the compensator’s height.



CONNECTING ELEMENTS FOR VERSIONS

- **STANDARD AND HEAT-RESISTANT**
pos. 2-4 – material 41Cr4, FeZn5
pos. 5 – material 65G, FeZn5
- **CORROSION-RESISTANT and HEAT- AND CORROSION-RESISTANT**
pos.2-5 - material 316L (A4)

6	Flexible connector	
5	Spring washer	PN-M 82008
4	Round washer	PN-EN ISO 7091
3	Nut	PN- EN ISO 4032
2	Screw	PN- EN ISO 4017
1	Inlet/outlet of the fan	
No.	Part description	Drawing or standard number



Proper order of assembling inner guards together with flexible connectors

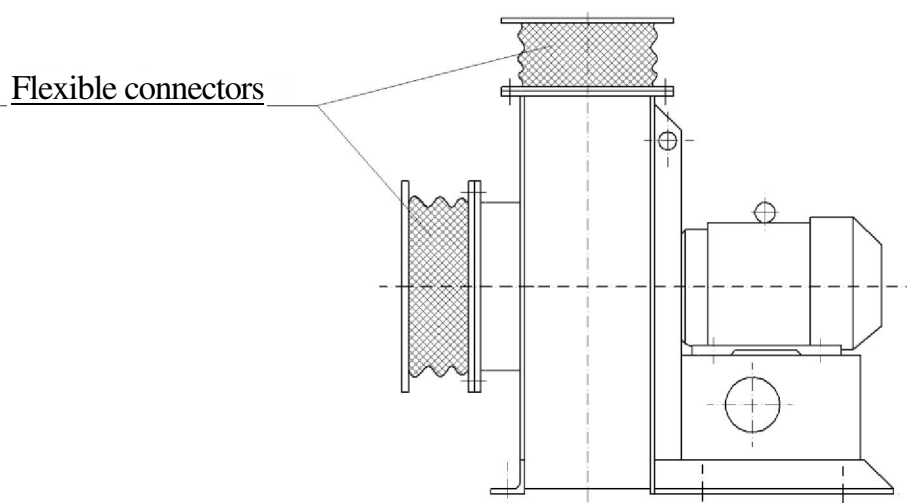


Figure 9. Location of flexible connectors.

Flexible connectors are assembled by sliding the loose flanges on the flexible material - the flexible material overlaps the flange forming a seal between the connection flange and the fan/duct. If inner guards are used, place a packing cord under the guard flange during assembly.

Tighten all fastening screws uniformly.

Pay attention to the tightening torque values of fastening elements - see Table 3.

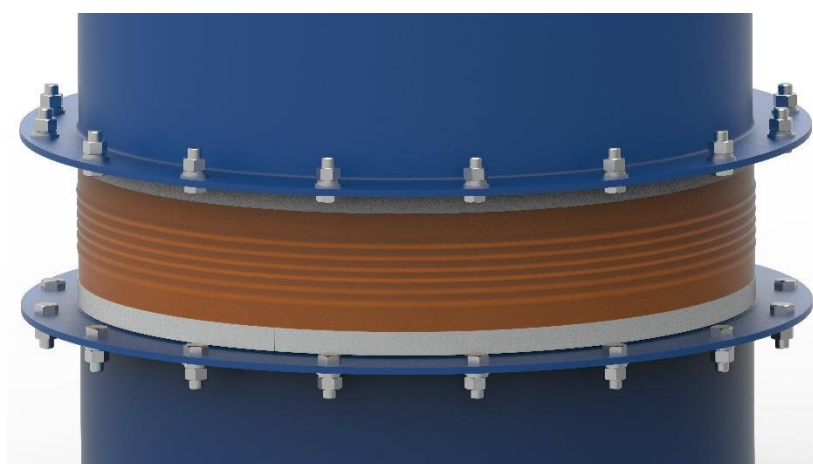


Figure 10 Assembly of flexible connectors.

Screw connections of flanges shall be assembled so as the heads of screws were located on the side of flexible textile (Fig. 10).

In case of prolonged storage period, without installation, compensators must be stored in a safe place.

Depending on the place of installation and load, round and/or square inner guards shall be applied:

- at temperature exceeding 90°C
- at flow rate exceeding 30 m/s
- at pressure exceeding 10 000 Pa
- with aggressive or abrasive media
- when installed on the suction side (to ensure that the compensator is correctly positioned and does not reduce the section of fan inlet under negative pressure)

When installing the inner guards, always observe the direction of flow (see arrow in Fig. 11).

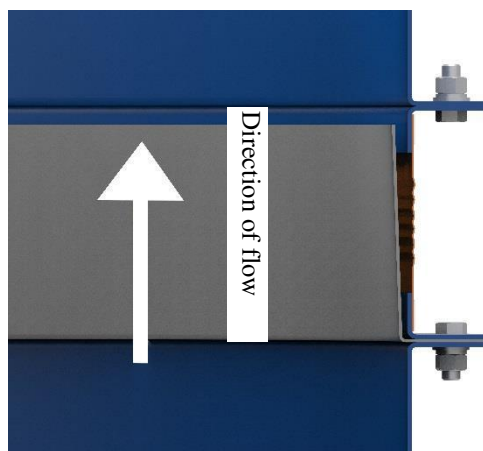


Figure 11. Assembly of inner guard.

It is recommended to check whether the inner dimensions of ducting connected to the fan correspond to relevant inner dimensions of the inlet and outlet openings of a fan in order to ensure the rated parameters of fan's operation. Inner diameters of gaskets between flanges shall be equal to inner diameters of flanges.

Minimal length of a straight section of inlet or outlet pipeline measured from any obstacle during free operation shall be equal to at least 3 diameters of the fan's inlet.

8. ELECTRICAL INSTALLATION



Electrical work must be carried out by a qualified worker (see section 4) and in accordance with local regulations. Before starting work, ensure that the power supply is switched off and cannot be switched on again. This also applies to auxiliary power circuits, e.g. anti-condensation heaters.

Ensure that the supply voltage and frequency are the same as those marked on the nameplate. The permissible voltage deviation is $\pm 5\%$ and the frequency deviation is $\pm 2\%$, in compliance with the requirements of IEC60034-1.

Wiring diagrams for the main power supply and accessories, such as PTC thermistors or heaters, are located inside the terminal box.

Connections must ensure the continued electrical safety of both the main supply and the grounding. Crimp connections are recommended to be made in accordance with the requirements of IEC 60352-2.



Note: Never operate a fan without appropriate grounding!

9. COMMISSIONING AND OPERATION



Commissioning and operation works must be carried out by a qualified worker (see section 4) and in accordance with local regulations.

Before the first fan's start-up, check the following:

- correctness of the assembly,
- tightness of screw connections,
- insulation resistance of the electrical motor winding. Motor, in case it is wet or stays idle for a period longer than 24 hours, shall be first well dried. Check the grounding condition, operation of switch, meters and other auxiliary and protection devices. If the inspection proves to be satisfactory, connect the motor to power supply.

During the first start-up (about 1 minute) check that the direction of rotation of the impeller is compliant with the direction indicated by the arrow placed on the housing of the fan or motor - the correct direction of rotation generates air flow in the installation in the correct direction - or compare it with the direction of rotation of the motor ventilator.



If the direction of rotation of the impeller is incorrect, disconnect the power supply, wait for the impeller to stop and swap the two phase wires in the motor box.

Then assess whether the fan operation is quiet, without excessive vibration (Table 2) and noise.



In case of excessive vibrations and noise, stop the fan immediately, determine the cause and eliminate it.

If the trial start-up is completed satisfactory, then start the fan up for the period of 8 to 12 hours. In that time the motor's temperature increase cannot exceed the allowable temperature increase for the

insulation class stipulated on the motor's nameplate, and the temperature increase for rolling bearings shall not exceed **60K (60°C)**, in relation to ambient temperature. After the trial run-up period, the fan must be switched off and the internal fan components (housing and impeller) shall be inspected. Check that there is no contamination of the impeller and housing, and if this is not the case, remove the contaminations.

Fan with belt drive shall be switched off after approx. 2 hours of operation and the tension of V-belts shall be adjusted (in accordance with section 4).

Steady and even whir of the fan and motor indicates their correct operation. Sounds of friction or whistling, rotation drop, excessive heating of motor or smoke from the motor indicate the fan's malfunction. In case any of these symptoms are noticed, switch off the fan immediately. Never switch the fan on again before all the reasons of malfunction are eliminated. If the fan's commissioning proves to be satisfactory, the fan can be handed over for operation.



Note. Never operate a fan without its relevant guards, adequate for its version, type of drive and connection to installation: belt transmission's guard, inlet's or outlet's guard, coupling's guard, bearing mounting shaft's guard, cooling impeller guard.



Fan operation with an open inlet/outlet may pose a hazard for health and life of persons in the vicinity. Approaching an open fan inlet/outlet can result in a risk of disability. Looking into the interior of a running fan can cause injury to the face, eyes and limbs. It is the responsibility of the installer to assess the need for and choose whether to install nets.

Operation and maintenance of electrical motor shall be compliant with the motor's Operation Manual.

Basic maintenance ensures the correct and failure-free operation of a fan. Therefore, fan's operation shall be monitored, and in case any excessive vibrations, impeller's friction against the casing, uneven whir are noticed, immediately turn the fan off, perform the inspection and remove any failures. Allowable efficient vibration rates were presented in the Table 2 in accordance with ISO 14694:2003 for G6.3 impeller balancing class.

Rigid fastening – a type of fastening, where a fan is so rigidly fastened to the frame and the ground that further increase of this rigidity has no significant influence on the frequency of own fan's vibrations.

Flexible fastening – fan is fastened using flexible connectors (vibration insulators), reducing the vibrations transmitted from fan to the ground.

Status	Vibration rate V_{ef} [mm/s]	
	Rigid fastening	Flexible fastening
Start-up	4.5	6.3
Alarm	7.1	11.8
Switch off	9.0	12.5

Table 2. Allowable efficient values of vibration rates for centrifugal fans.

In case malfunctions cannot be removed on its own, contact Nyborg-Mawent S.A., specifying fan’s details and malfunctions that occurred.

10. MOTORS

For the manufactured fans we use electric motors in standard version, i.e. they are suitable for ambient temperatures from -20°C to +40°C and altitudes ≤ 1000 m. They are CE marked in accordance with the 2014/35/EU Low Voltage Directive.

Check that the drain holes and plugs are facing downwards. For motors mounted outdoors and not running 24 hours a day, it is advisable to open the drain holes to allow ventilation of the motor –this will ensure the motor is dry at all times.

Make sure that the terminal box is clean and dry. Close unused glands. Check the terminal box seal before reassembly.

Inspection and maintenance of electrical motor shall be performed in accordance with the motor’s Operation Manual.

More information about the use of electric motors is available on the motor manufacturer's website or you may contact your Nyborg - Mawent S.A. representative.

11. PERIODICAL INSPECTIONS, MAINTENANCE AND OVERHAULS

11.1. General and safety guidelines



Inspections, maintenance and overhauls of the fan can be performed only after switching the fan's motor off and complete stopping the fan's impeller and motor, except for the maintenance of the bearings in the fan's bearing mounting described in section 11.2.

Each time before starting the inspections, maintenance and overhauls, ensure that the motor is not connected to any live cables and it cannot be started.

In case the fan's surface is hot, wait until it cools down to the temperature allowing for safe work. In case fan conveys media hazardous for human's health, use adequate personnel's protective measures during the inspections, maintenance and overhauls of the fan.

Intervals between fan's inspections and overhauls depend on fan's operational conditions and are defined in this operation manual; the maintenance personnel is, however, required to adapt the inspection intervals to actual conditions present in the specific installation. Fans are reliable machinery subject to their proper operation and maintenance. Each operating fan shall be subject to periodical inspections, not less often, however, than:

- **After each 500 hours of fan's operation, carry out the following:**
 - check the condition of the impeller and clean it from sediment, if necessary,
 - check and tighten screws fastening the elements of a fan (table 3),
 - check the tension of belts (drive 2).
- **After each 1500 hours of fan's operation, carry out the following:**
 - check the condition of impeller,
 - clean it from any possible sediments,
 - check and tighten screws fastening the elements of a fan (table 3),
 - measure the fan's vibrations,

If any damage or malfunctions are noticed, stop the fan's operation immediately. In case malfunctions cannot be removed on its own, contact Nyborg-Mawent S.A., specifying fan's rated data and malfunctions that occurred.

Thread size	Tightening torque [Nm]	Deviations [%]	
		Lower limit	Upper limit
M 5	5.9	0	+ 10
M 6	10.6		
M 8	26.9		
M 10	46.3		
M 12	79		
M 16	169.7		
M 20	331.6		
M 24	575.9		
M 30	1450		

Table 3. Tightening torques for screws.

11.2. Maintenance of bearings in the motor

The rolling bearings of the motor are lubricated by the motor manufacturer. The bearing and lubricant type is identified on the motor’s nameplate.

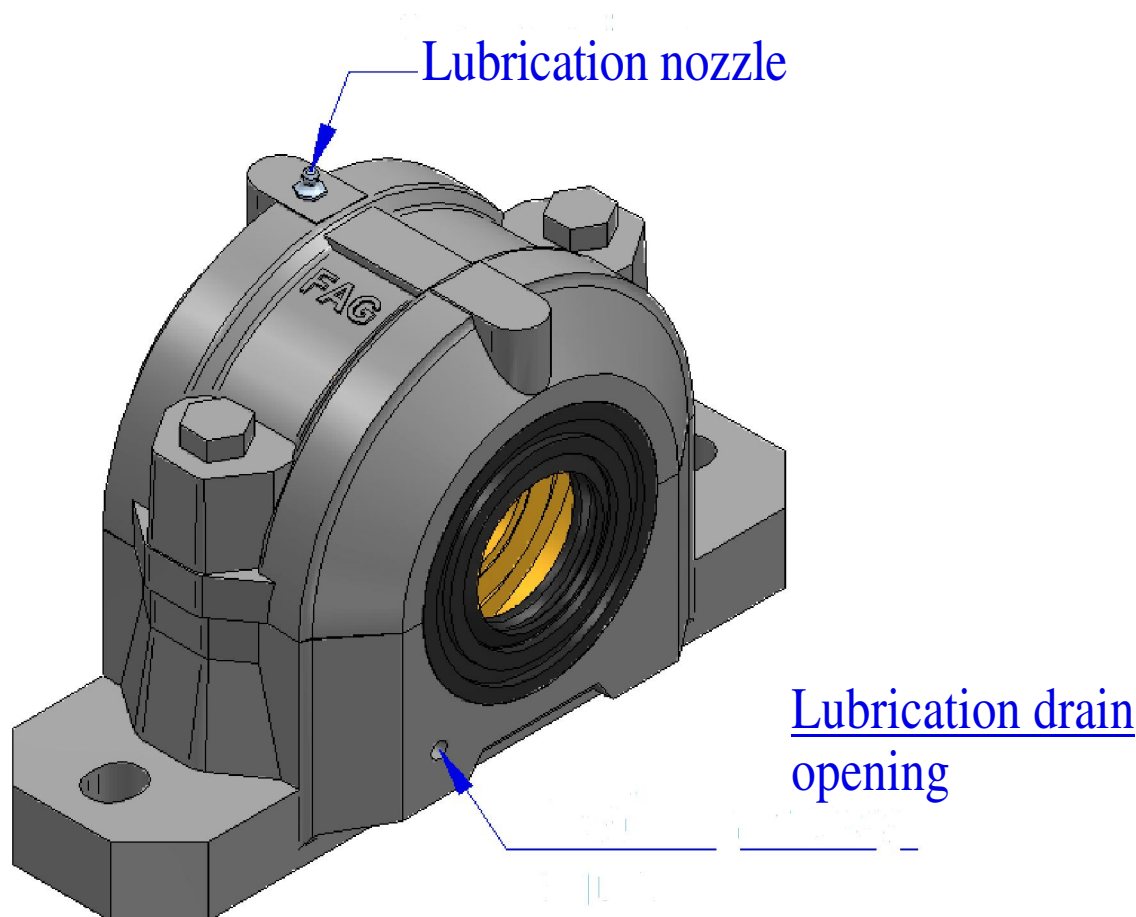
Top up lubrication – see the instruction of the motor’s manufacturer.

11.3. Maintenance of rolling bearings in the bearing mounting of the fan

This chapter describes standard bearing mounting. If a different bearing mounting is used, this is described in a separate order-specific manual.

If increased bearing/s temperature (see chapter 11.3.2 *Limit values of bearings temperature*) and/or unnatural running noises and/or vibrations (see Table 2 *Permissible effective vibration rates for centrifugal fans*), immediately switch off the fan to prevent further damage.

In case defects cannot be removed on its own, contact Nyborg-Mawent S.A., specifying the rated details of the fan (type, serial no., and year of production), operational conditions, malfunctions that occurred and circumstances in which the malfunctions occurred.



Before starting any lubrication operations, lubrication nozzle and area around bearing mounting unit shall be well cleaned. Never use high pressure cleaning jets for that purpose.

Roller bearing shall be lubricated during the operation through M10x1 lubrication inlet from the impeller's side and from the drive's side with the specified quantity and type of lubricant.



Top up lubrication schedule, quantity and quality of lubricant are specified in the Table 4.

Waste lubricant shall be disposed of in accordance with relevant environment protection laws and regulations.

Temperature of a bearing increases after the top up lubrication and drops to normal value after the lubricant reaches operational consistency.

Table 4. Schedule of top up lubrication of bearings

Roller bearing	Housing	Top up lubrication schedule (manhours)			Quantity of lubricant ¹ (g)	Amount of top up lubricant per a roller bearing (g)	Lubricant
		n=3000rpm	n=1500rpm	n=1000rpm			
	SNV						
1307K-C3	080	2640	3120	3240	80	10	Arcanol MULTI3 FAG
1309K-C3	100	1680	2000	2080	180	15	
1311K-C3	120	1260	1440	1560	270	20	
1315K-C3	160	1080	1320	1440	650	40	
22218-E1-K-C3	160	800	1320	1800	650	40	Arcanol MULTITOP FAG
22318-E1-K-C3	190	-	1400	1760	950	60	

¹ Quantity of lubricant at the first installation or top up lubrication.



In order to ensure fresh lubricant to reach all rolling components of a bearing during the top up lubrication, it is necessary to use the amount of lubricant specified in the table.

Always perform top up lubrication:

- on a warmed up and rotating bearing,
- before downtime,
- before long idle periods.

11.3.1. Notes to the top up lubrication schedule

The schedule of top up lubrication depends on the degree of lubricant degradation through bearing friction, rotational speed, load and bearing’s temperature.

The presented top up lubrication schedule applies to bearing’s temperature of 75°C. In case of any deviations, adjust the top up lubrication schedule in accordance with the table.

Table 5. Change of top up lubrication schedule depending on the bearing’s temperature

Bearing’s temperature	Coefficient of top up lubrication schedule
75°C	x1.00
80°C	x0.8
85°C	x0.63
90°C	x0.5
95°C	x0.4
100°C	x0.32

Because of their diverse chemical composition, lubricants must not be mixed together.

Roller bearings used in Nyborg-Mawent SA’s fans are factory filled with adequate amount of lubricant and ready for use. The above mentioned types of lubricant are of standard type, if any other type of lubricant has been used, it is indicated on the fan’s nameplate.

For the type of lubricant used, see “Maintenance of bearings” plate located on the fan.



In general, different lubricants shall not be mixed. In case any non-compatible lubricants are mixed together, their composition may significantly change. Moreover, mixture of lubricants can possibly result in significant softening; thus, lubrication conditions may deteriorate.

In general, the applied lubricant can be stored for three years, in the following conditions:

- closed room (warehouse),
- temperature from 0°C through +40°C,
- relative air humidity below 65%,
- no exposure to chemicals (vapours, gasses, liquids),
- sealed bearings.

Lubricants are subject to aging as a result of environmental impact and operation.



Use of lubricants of any types other than recommended by Nyborg- Mawent S.A. is unacceptable in the warranty period.

11.3.2. Limit values of bearings temperature

- **warning at 80°C** – reduce the intervals between top up lubrication by applying the coefficient specified in the table "Change of top up lubrication schedule depending on the bearing's temperature"
- **tripping at 100°C.**

Temperature is a "life cycle indicator" for machine load. Overload of bearing, interrupted lubrication film, changes of rotational speed cause bearing's temperature increase. Constant bearing's temperature will be kept in constant operational conditions, if a roller bearing is used in compliance with its intended use and in accordance with design assumptions. If temperature changes without any change of rotational speed or load, it means that a bearing is improperly lubricated. Any change of load as a result of disturbed operation of loose bearing can be diagnosed based on bearing's temperature chart. Temperature control allows for early diagnosis of any bearing damage caused by interrupted lubrication film. Damages caused by ageing and fatigue cannot be detected this way.

Temperature shall be measured using electrical temperature sensor directly at the bearing's external ring.

11.3.3. Total replacement of lubricant

In general, during the installation the bearing shall be fully filled with lubricant and any free space in the housing shall be equal to amount specified in the table "Top up lubrication schedule of bearings" which corresponds to approx. 50% of free space in the housing.

The whole amount of lubricant in a bearing shall be replaced when free space in housing cannot embrace additional lubricant, which corresponds to filling of more than 75% of free space of the housing.

Excessive amount of lubricant causes quick increase of bearing's operational temperature, especially at high rotational speeds. When starting operation at maximum speed, wait until excess lubricant settles in the housing. When the process of lubricant "running-in" is finished, the bearing's temperature decreases which confirms that the lubricant has properly settled in a bearing mounting.

During the lubricant replacement after the calculated period of operation or after a defined number of top up lubrication operations, waste lubricant shall be totally removed and then replaced with a fresh lubricant.

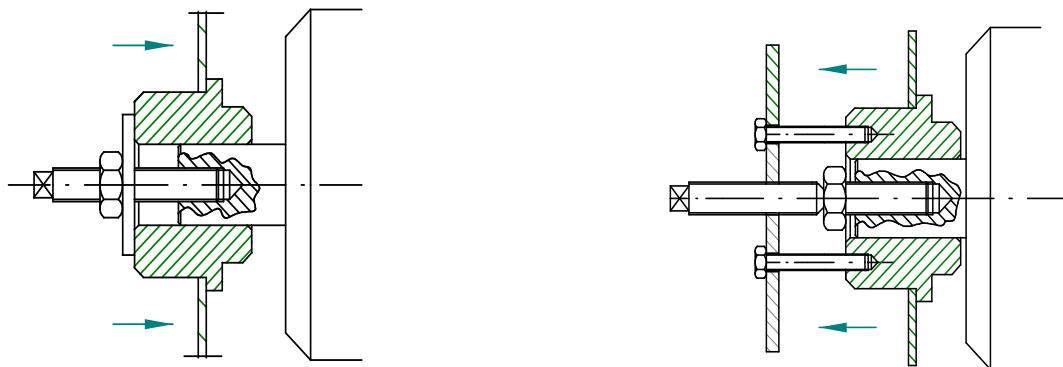
The replacement of lubricant requires easy access to the housing and its opening. Covers of split housings can be easily removed to reveal the bearing. Removable upper part of split housing which is aligned with the lower part using expansion pins facilitates installation and maintenance. Upper parts

shall not be swapped with each other. After removal of waste lubricant, fresh lubricant shall be applied between rolling elements first. Pay attention not to let any contaminations to penetrate inside the bearing and keep lubricant free of any contaminations. Use of protective gloves is recommended to avoid possible allergic skin reactions to the lubricant.

In case of planned fan's downtime shorter than 3 months, it is recommended to top up bearing lubrication during the fan's operation or during the downtime by rotating the impeller. Motors fitted with drain plugs for condensation drainage should always have these drain plugs open.

In prolonged periods of shutdown (more than 3 months), motors fitted with condensate drain plugs should have them open for the whole time. Fill 100% of spaces between covers of the housing and roller bearings with lubricant and manually turn the shaft a few times. Before re-starting, remove upper covers of bearing housing and check the lubricant level. If the inspection reveals any loss of lubricant or lubricant's contamination (ingress of condensate causes change of lubricant's consistency), the lubricant shall be replaced. In case lubricant's consistency has not changed or no contaminations were found, remove excess lubricant before starting the fan.

Fan's components shall be disassembled carefully, not to damage machined parts and surfaces. Use a puller or other auxiliary devices to disassemble an impeller, clutches, pulleys and bearings (Fig. 12). Never apply one-sided levering, impacts, etc.



Impeller's assembly using a tool

Proper impeller's disassembly using a puller

Figure 12. Assembly and disassembly of the fan's impeller.

12. HEAT-RESISTANT FANS



Precautions must be taken for fans designed for operation at elevated temperatures ($>80^{\circ}\text{C}$) to prevent contact with hot surfaces (e. g. protective covers, warning signs, symbols).

In the case of “cold” starts, power consumption may possibly exceed the design value and the electricity consumption may increase to excessive - unacceptable values. This is most often the case with motors whose power was selected for the temperature of conveyed medium higher than the temperature during starting (at operation points) as well as when centrifugal fans are not started with closed throttles. This can be prevented by lower rotational speeds, e.g. controlled by a frequency converter. Note – careful observation of fan’s start-up is necessary.

Before switching off the fan, it should operate at low temperatures ($<80^{\circ}\text{C}$) until the impeller, shaft and housing cool down. This is to protect bearings and lubricant against high temperatures during rapid stopping and downtime.

When cooling discs (heat deflectors) are used for high temperatures, remember that proper cooling can only be achieved at the rated speed. When the temperature of the conveyed medium is high and speed of the impeller is low (e. g. when operating with a frequency converter) or when the fan is stopped (e. g. due to failure or lack of power supply), external cooling of the cooling disc, e. g. by using another fan must be provided.



For heat-resistant fans (mainly exhaust gas fans) operating with a frequency converter, at low temperatures and variable rotational speed, highly corrosive compounds may condensate from the conveyed medium. The condensation of these compounds occurs when the dew point of the medium is exceeded. In the consequence, the painting coating gets damaged, various types of corrosion may appear that may result in cavities in the material of the housing and the impeller.

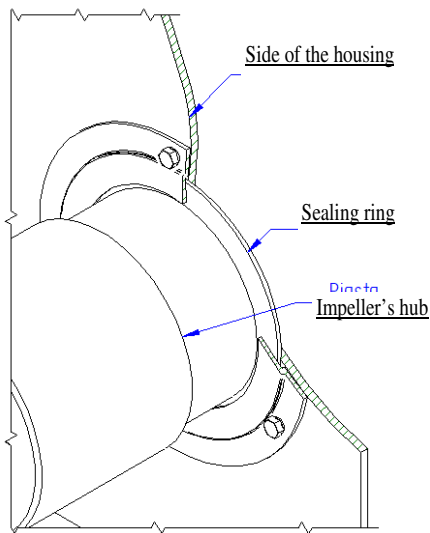
In order to prevent this type of damage, it is necessary to continuously monitor the medium temperature and maintain the medium temperature at a level preventing the dew point to be exceeded.

13. TYPES OF SHAFT SEALINGS

Fans produced by Nyborg Mawent S.A. can have various types of sealing of the shaft passage through the housing, depending on the requirements. Despite the applied seals, the fan is not gas-tight. The tightness of the entire fan can be tested by sealing the entire system, generating a specific pressure and then measuring the rate of a pressure drop in accordance with PN-EN ISO 13349:2010.

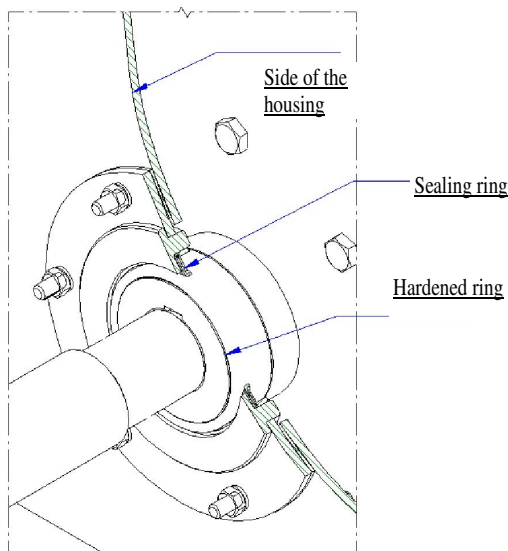
13.1. Standard sealing

The standard seal for the shaft passage through the housing is a gland seal, where the sealing element is a brass or Teflon ring. Lubrication of the seal is not possible.



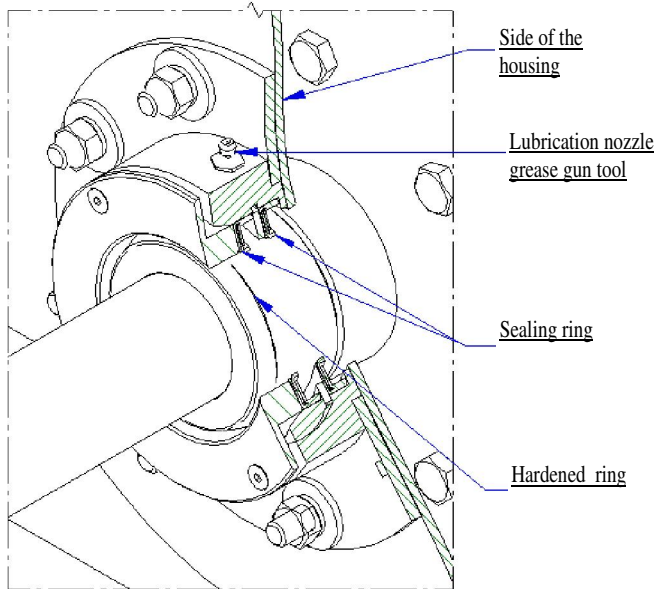
13.2. Simmering type shaft sealing

Shaft seal - single seal ring (e.g. Simmering® B2PT, Garlock PS-Seal®) with hardened ring. Lubrication of the ring is not possible.



13.3. Shaft seal with lubricant barrier

Shaft seal – double seal ring (e.g. Simmering® B2PT, Garlock PS-Seal®) with hardened ring. The increased tightness is activated by a lubricant barrier. This barrier reduces the gas leakage through the seal. Lubrication of the rings is possible via a grease nipple on top of the seal housing.



It is recommended to replace sealing rings with the hardened ring at least once a year.

In order to avoid excessive wear and heat build-up, the seals must be regularly lubricated. The grease must be suitable for the given temperature and must be compatible with the medium, e.g. Multi3 or MultiTop by FAG.

Lubrication frequency depends on the operating parameters and must be checked every 6 months. Lubrication chambers shall be then filled up with the slowly rotating impeller. The proper amount of lubricant is when the resistance to lubricant introduction increases significantly (use hand grease guns). Under no circumstances should the lubricant be forcefully pressed into the seals, since it may push apart the sealing rings. Additional lubrication should be carried out only if the seal is leaking.

Sealed fans must be regularly inspected for leakage. If the limit values are exceeded and human health is endangered, the installation must be stopped and safety measures for downtime must be taken.

The room shall be provided with general ventilation so that any unnoticed leakage does not lead to poisonous, corrosive concentrations of gases.

Be careful not to damage the shaft seals during installation and maintenance work. Do not drag them along sharp edges. Sealing rings must be placed exactly coaxially on the shaft. The shaft misalignment is shown in Figure 12, while the maximum shaft runout is shown in Figure 13.

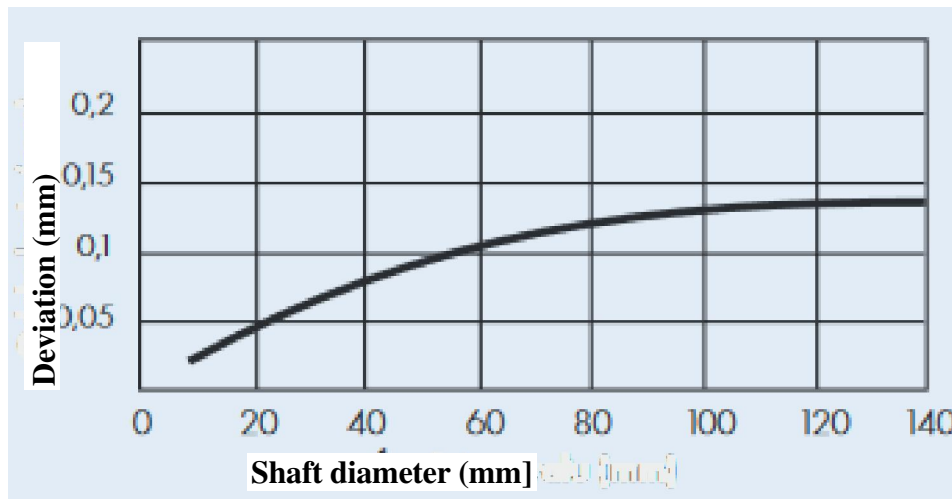


Figure 12. Maximum shaft misalignment

The shaft runout must be measured before the seal is installed. Assemble the sealing rings with a lip towards the fan impeller (opposite to the direction of the pressure exerted by the conveyed medium), keeping the distance between the rings.

Before reassembly, replace the seals with new ones and lubricate them with silicone.

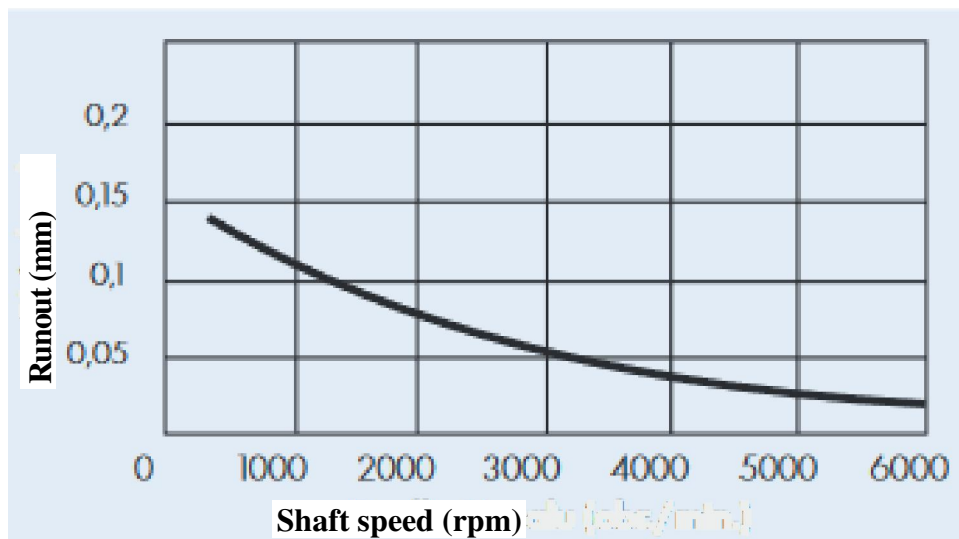


Figure 13. Maximum shaft runout

Scratches, imprints, rust or other damages to the surface of the hardened ring at the sealing ring's location may cause leakage.

The gas leakage test shall be repeated after assembly. It is essential to take additional measures in accordance with local or legal regulations, standards, guidelines or instructions.

It is essential to strictly comply with the transportation instructions.

Methods of mounting the sealing ring depending on the direction of the sealing lip's deflection:

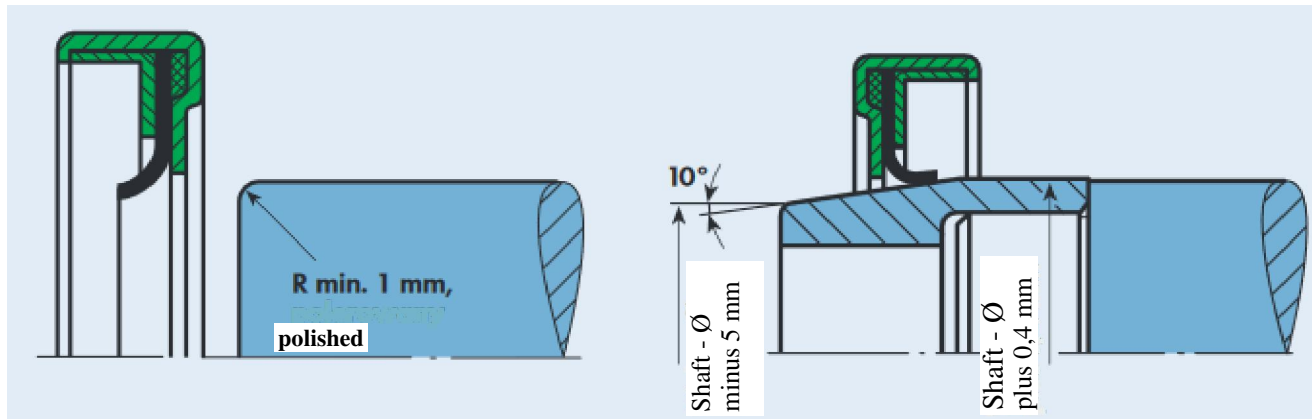


Figure 14. Methods of mounting the lip sealing

14. WORK HEALTH AND SAFETY REGULATIONS.



During the installation and use of the device, observe the provisions of this Operating Manual and all applicable local and national building, electrical and technical standards and norms.

Personnel operating the fans shall read the Operating Manual and the electric motor manual (available on the website of the motor manufacturer or contact your Nyborg-Mawent S.A. representative), know the fan's construction, proper operation and be familiar with safety regulations regarding the operation of power equipment.



Fans shall be mounted in the place ensuring free access, safe operation by the personnel and adequate lighting facilitating work during putting in use, operation, assembly, disassembly works and repairs, maintenance and cleaning. Minimum required working space around the fan shall be 0.75m.



Never power the motor on without prior inspection of electrical installation and without prior checking the tightness of screws fastening the motor and the fan. All operations related to the motor and electrical installation shall be performed by an electrician, appropriately qualified for the operation of power equipment,



Never use loose aprons, scarves and similar clothes. Operating personnel present in the vicinity of rotating parts shall wear personal protection measures, i.e. well-fitted protective clothes preventing catching and entanglement by moving parts of the fan. Never lean against an operating fan and never touch any rotating parts. If operating personnel has long hair, it must, for safety reasons, tie it up at the back or otherwise secure it. Wearing jewellery may also pose a risk of injury.



Operating personnel of the fan must wear personal protective measures, i.e. overalls, protective gloves. Due to its intended use, the fan's subassemblies and parts may have sharp edges and corners which may result in falling and related injuries.

Before starting any repair etc., stop the fan. Disconnect wires from a terminal box, provide a fan with relevant information or warning plates.

Overview of the hazards related to centrifugal fans:

Type of hazard	Place of hazard	Hazard	Additional activities
Friction and abrasion	All rotating parts	Explosion hazard due to spark formation or hot surfaces	Observe the operating instructions, use personal protective equipment
Impacts and friction	Housing, impeller, motor, pulleys, V-belts, transport damages	Explosion hazard due to spark formation or hot surfaces	Observe the operating and transport instructions
Corrosion	Housing, impeller, motor, storage or temporary storage	Corrosion spots increase the risk of ignition, explosion hazard	Observe the operating and storage instructions
Denting, shear, impact	Unloading, lifting, assembly and installation of the fan	Risk of death, risk of injury and material damage	Pay attention to secure fixing and safe foundation
Catching, winding, pulling in, faulty installation	Heat deflector, impeller, all rotating parts	Risk of death, risk of injury and material damage	Observe the operating instructions
Electrical hazard	Directly through electrically conductive parts	Risk of death	Observe the operating instructions of motor manufacturer
Electrical hazard	Indirectly through defective electrically conductive parts	Risk of death	Observe safety regulations
Thermal hazard due to contact and burns	Hot surfaces	Risk of death, risk of injury and material damage, risk of explosion due to increased ignition risk	Wearing of personal protective equipment by the personnel, if necessary, the client must define safety zones
Thermal hazard due to incorrect installation, commissioning	Hot surfaces e.g. housing, lifting lugs, condensate drain stub, fan base	Risk of death, risk of injury and material damage, risk of explosion due to increased ignition risk	Wearing of personal protective equipment by the personnel, if necessary, the client must define safety zones
Hazard posed by materials and foreign	Housing, impeller, bearings, drive elements,	Risk of material damage and risk of injury	Observe the operating instructions, provide

bodies and improper use	monitoring devices		adequate ventilation, prevent entry of foreign bodies
Noise-related hazard	During operation, sound intensity exceeds 70 dB(A)	Hearing impairment, risk of injury	Observe the operating instructions, use personal protective equipment
Combination of hazards	Risk to machinery, people and the environment if the fan is not started up by properly trained personnel;	Risk of injury, material damage, environmental damage	Observe the operating instructions

15. POSSIBLE MALFUNCTIONS AND TROUBLESHOOTING



If the main and/or auxiliary power supply fails, the fan must be put into a safe condition. The control system must be designed in such a way that an interruption of the power supply or a failure of the control system would not lead to a dangerous situation either at the time of the interruption or at the time when the power supply is restored or the control system is reactivated. Additional measures for fans with conveyed medium temperatures > 80°C: In case of power failure it is absolutely necessary to avoid air inflow (from the suction side of the fan) and backflow or accumulation of hot medium (on the pressure side of the fan). The customer is responsible for installing and maintaining appropriate shut-off devices including the suitable control system.

TYPE OF MALFUNCTION	POSSIBLE REASONS	TROUBLESHOOTING
Fan (electric motor) - cannot start	Incorrect power supply	Check whether power supply is compliant with data on the nameplate of the electric motor
	Incorrect connection to power supply	Compare the connections with the diagram delivered with electric motor
	Damaged switch	Replace the switch
	Damaged electric motor	Replace the electric motor
Fan – excessive vibration	Loosened threaded connections	Tighten and secure threaded connections
	Damaged or unbalanced impeller	Replace or balance the impeller
	Contamination of impeller	Clean the impeller
	So called ‘pumping’ phenomenon	Suppress the medium (mixture) flow in the suction line
		Select suitable fan
	Damaged bearings of electric motor	Replace the bearings of electric motor
Impeller – impacts, friction against fixed elements of a fan	Loosened threaded connections	Tighten and secure threaded connections
	Deformation of impeller	Replace the impeller
	Deformation of housing	Replace the housing
	Deformation of inlet stub	Replace the inlet stub
		Check the electrical connection in the terminal box of the electric motor
	Contaminated inlet guard	Clean the inlet guard
	Contaminated outlet guard	Clean the outlet guard

Contamination inside the fan	Clean fan's internal surfaces
Contamination of fan's electric motor	Clean the electric motor
Short-circuit between the winding of the electric motor's stator	Check the winding of the electric motor's stator
	Replace the electric motor
Damaged bearings of electric motor	Replace the bearings of electric motor
Incorrect selection of the fan type	–
Damaged bearings of electric motor	Replace the bearings of electric motor

16. TERMS AND CONDITIONS OF WARRANTY

1. Nyborg-Mawent S.A. grants the User a guarantee for the products sold on the terms and conditions provided in detail below.
2. Nyborg-Mawent S.A. guarantees the efficient operation of the product provided that the product is installed, maintained and operated in accordance with the Nyborg-Mawent S.A. guidelines set out in this document, hereinafter referred to: the "Operation Manual".
3. The warranty period is 24 (twenty four) months, starting from the date of delivery of the product – the fan - to the User.
4. The User has the option to extend the warranty, which requires individual arrangements between Nyborg-Mawent S.A. and the User and it is effected upon concluding an appropriate agreement and paying a warranty fee.
5. The warranty is applicable at the territory of the Republic of Poland.
6. Nyborg-Mawent S.A. may perform warranty service outside the territory of the Republic of Poland. The User should note the fact (possibility) of installation and operation of the product outside the territory of the Republic of Poland in the order, otherwise the possibility of using the warranty service outside the territory of the Republic of Poland in the future shall be excluded. In this case, the User shall bear the costs of, in particular, travel, accommodation and meals of the Nyborg-Mawent S.A. service technicians. Such service shall be based on separate arrangements between Nyborg-Mawent S.A. and the User, concluded in an appropriate agreement.
7. After the expiration of the warranty period, Nyborg-Mawent S.A. may perform post-warranty maintenance services for the User. In this case the provisions of clause 6, sentence 4 above shall apply accordingly.
8. Under the warranty Nyborg-Mawent S.A. shall be liable only for defects revealed in the warranty period and arising from product-related causes. The warranty does not cover the defects of the product resulting from other causes, i.e.:
 - a) installation and use of the product which is not in accordance with the intended use and/or engineering practice and the operation manual;
 - b) installation of the product by persons who are not appropriately qualified;
 - c) installation of the product not in compliance with the wiring diagram, powering the product with a voltage other than the one specified on the nameplate and/or in the operation manual;
 - d) unauthorised repairs or changes to the product's design without the consent of Nyborg-Mawent S.A.;
 - e) damage to the product caused by external factors (mechanical, thermal, chemical, water damage, etc.);
 - f) damage caused by improper transport or storage of the product;
 - g) unauthorised use involving operation of the product under conditions inconsistent with the intended use and design of the product and inconsistent with the operating conditions laid down in the operation manual;
 - h) chemical corrosion of the product's elements, e.g. as a result of condensation of aggressive compounds from the conveyed medium;
 - i) failure to carry out the mandatory inspections described in the operating instructions;
 - j) product damage resulting from vibration caused by erosion, clogging of the impeller, damage to the impeller or any other cause;
 - k) product damage caused by ingress of any object or component likely to cause such damage into the installation;
 - l) errors in the design of the installation or incorrect selection of the product;
 - m) product damage resulting from the use of non-original parts, accessories and materials not compliant with the Nyborg-Mawent S.A. recommendations;
 - n) product damage resulting from fortuitous events, force majeure (fire, flood, lightning, etc.);

- o) malfunction of other installations (e.g. electricity, heating, etc.) and/or equipment affecting the operation of the product (e.g. inverters, relays, humidifiers, coolers, heaters, etc.).
9. The warranty does not cover defects resulting from normal wear and tear of the product and consumable parts, i.e.: bearings, filters, V-belts, oils, greases, etc.
10. The User shall lose their warranty rights (loss of warranty), in case of:
- any modification of the product;
 - tampering with the product by unauthorised persons;
 - any unauthorised attempt to repair the product;
 - failure to carry out mandatory periodic inspections;
 - failure to carry out appropriate maintenance work when required;
 - the payment for the product is more than 30 days overdue from the due date.
11. Product which has been found defective should be taken out of use immediately after the defect has been found, otherwise the warranty will be invalidated.
12. Warranty claims are examined based on, in particular:
- a complaint filed by the User, which should include: the User's details, the description and serial number of the product and its year of manufacture indicated on the nameplate, a detailed description of the product defect and the date on which it was detected. The complaint should be sent by email to: reklamacje@nyborg-mawent.com - not later than within 5 days from the date the defect was detected;
 - the above mentioned complaint shall be accompanied by the invoice for the purchase of the product and the proof of timely, i.e. compliant with the operation manual, periodic inspections (a completed inspection form can be found in the operation manual).
13. Nyborg- Mawent S.A is not obliged to disassemble elements of installation inherently belonging to the product. If the aforementioned disassembly is necessary for Nyborg-Mawent S.A. to carry out service work, it should be carried out by the User.
14. After the User has carried out the activities referred to in clause 12 above, then - taking into account previous arrangements with Nyborg-Mawent S.A.:
- the User shall deliver the product personally to the registered office of Nyborg-Mawent S.A. or deliver it by express delivery to the registered office address of Nyborg-Mawent S.A., shipping at the risk of the User. Nyborg-Mawent S.A. shall not be responsible for any damage or destruction of the product during transportation, in particular resulting from improper packaging or securing the product by the User.
- or
- Nyborg-Mawent S.A. will send its service team to the place of assembly (installation) of the product in order to diagnose the problem (ascertain the defects reported) and then, if the complaint is found to be justified, undertake further activities referred to in clause 17 below. The User is obliged to ensure free access to the product and enable the Nyborg-Mawent service team to carry out maintenance activities in accordance with any and all work health and safety regulations, and in particular to ensure adequate preparation of the place where the maintenance activities will be carried out, i.e. to organise scaffolding, platform, ladders, lifting equipment, if necessary, and to provide access to power sources etc. Otherwise, the Nyborg-Mawent S.A. service team has the right to refuse to carry out the maintenance service and the User will be charged for the costs of travel by the Nyborg-Mawent S.A. service team.
15. Nyborg-Mawent S.A. is obliged to examine the warranty complaint, respond to it within 14 (fourteen) days from the date it was filed (response to the complaint).
16. In case the complaint is found justified, Nyborg-Mawent S.A. is obliged to repair (remove quality defects of the product) or replace the product with a product free from quality defects, if the repair of the product appears to be impossible or the cost of repairing the product is disproportionately high compared to the price of a new product. Nyborg-Mawent S.A. is solely responsible for deciding how to perform the warranty obligations.
17. The time limit for repairing the defect of the product or its replacement, depending on the way the warranty is being carried out, shall not exceed 90 days, starting from the day of filing the complaint. In

cases justified by technical, technological or other reasons beyond the control of Nyborg-Mawent S.A., the aforementioned time limit will be extended by the additional time needed for the removal of the defect or replacement of the product, but not longer than another 30 days in relation to the time limit specified in the first sentence above.

18. Replaced products and parts obtained during the repair of the product shall become the property of Nyborg-Mawent S.A.
19. In case the complaint is found justified, Nyborg-Mawent S.A. shall bear the costs of transport, including the costs of express delivery of the defective products, as well as the costs of travel and stay of the Nyborg-Mawent S.A. service technicians at the place of installation of the product at the User's premises.
20. In case the complaint is found unjustified, Nyborg-Mawent S.A. shall invoice the User for the costs incurred in connection with the complaint (expert opinion, travel, express delivery, etc.).
21. Nyborg-Mawent S.A. shall not be liable for any losses incurred by the User or any third party as a result of failure or malfunction of the product, both during the warranty period and after the warranty period, except for damages caused intentionally by Nyborg-Mawent S.A.
22. The liability of Nyborg-Mawent S.A. under statutory warranty for physical and legal defects is excluded.

17. DISASSEMBLY AND DISPOSAL

If the fan's repairs are technically and economically unreasonable, the fan shall be disposed of.

The unit shall be disconnected from the power mains and then dismantled in the reverse order of installation, as per the sections 6, 5 ,4.

The following information should be regarded as recommendations only and is does not apply to fan version produced to special order. The Customer must ensure that the local regulations are observed.

In general, the materials used to produce the fan are shown in Table 6.

Material	Material content
Steel	80-95%
Copper	1-2%
Cast iron	4-8%
Aluminium	<1%
Plastic	1-2%
Other	<1%

Table 6. The percentage content of materials used in a fan.

Lubricants from the lubrication system, bearing mountings are hazardous waste and must be disposed of in accordance with local regulations.

18. EQUIPMENT INSPECTION FORM

Each operating fan shall be subject to periodical inspections. The operations to be carried out are described in section 9 of this manual.

Number of inspection	Date of inspection	Description of activities	Stamp and signature of the inspector
1 [500rbg]			
2 [1000rbg]			
3 [1500rbg]			
4 [2000rbg]			
5 [2500rbg]			
6 [3000rbg]			
7 [3500rbg]			
8 [4000rbg]			
9 [4500rbg]			

10 [5000rbg]			
11 [5500rbg]			
12 [6000rbg]			
13 [6500rbg]			
14 [7000rbg]			
15 [7500rbg]			

Number of inspection	Date of inspection	Description of activities	Stamp and signature of the inspector
1 [8000rbg]			
2 [8500rbg]			
3 [9000rbg]			
4 [9500rbg]			
5 [10000rbg]			
6 [10500rbg]			
7 [11000rbg]			
8 [11500rbg]			
9 [12000rbg]			
10 [12500rbg]			

Number of inspection	Date of inspection	Description of activities	Stamp and signature of the inspector
1 [13000rbg]			
2 [13500rbg]			
3 [14000rbg]			
4 [14500rbg]			
5 [15000rbg]			
6 [15500rbg]			
7 [16000rbg]			

19. EQUIPMENT CARD
Warranty: standard/ non-standard*

Serial no. of a fan <p>.....</p>	Type of a fan <p>.....</p>
Date of first start-up <p>.....</p>	Stamp of the installation company <p>.....</p>

* delete as appropriate