

INDUSTRIAL FANS

MINING

TECHNICAL MANUAL

Technical manual of industrial ventilation equipment for application in mining.

Description of the equipment, technical characteristics, installation and maintenance.

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Dear ladies and gentlemen,

The Advanced FanTR Fan is manufactured under strict specifications and control to meet the most demanding design characteristics, ensuring maximum efficiency in extreme operating conditions and continuous operation.

The descriptions of the equipment, technical characteristics, installation, and maintenance are contained in the sections and must be observed carefully to fully obtain high-performance characteristics and long durability.

Any doubts regarding the instructions presented below, as well as additional information, can be obtained from FanTR's Technical Assistance:

Telephone: +55 11 4025 1670

E-mail: fantr@fantr.com



1. WARRANTY TERM

For a period of 12 months from the start of operation or 18 months from the last shipment, whichever comes first, FanTR ensures and guarantees that the delivered products are free from manufacturing defects or defects in materials used, and are under the descriptions, requirements, and quality established in FanTR's Technical and Commercial Proposal.

The term "defects" must be interpreted as deviations from the previously mentioned definition.

Repaired or replacement parts (when supplied by FanTR) are included in the warranty set forth herein for a period of (i) twelve (12) months from the date of repair or replacement; or (ii) the remaining period of the original warranty, whichever is longer. For other parts and components of the Products, the warranty period will be extended by an equivalent period to the time during which the Products are out of operation due to defect correction.

FanTR will not be liable for defects caused by (i) alterations or repairs performed by personnel not authorized by FanTR; (ii) services provided by a third party; (iii) improper transportation, handling, or storage; or (iv) failure to install, operate, or maintain the Products following FanTR's instructions and manuals; or (v) use of the Products in ambient or operational conditions different from those specified in FanTR's Technical and Commercial Proposal or operation manuals; or (vi) Force Majeure or Acts of God; or (vii) normal wear and tear or common corrosion (under specified operating conditions).

If any defective products are identified, FanTR must receive written notice without undue delay and after reasonable steps and analysis have been conducted to identify and describe the problem.

If defects covered by the warranty are not identified, FanTR will be entitled to compensation according to the regular service fees and technical evaluation.



2. INTRODUCTION

This manual provides the necessary instructions for the operation of the FanTR Advanced Ventilator, fully developed by the FanTR Engineering department for use in industrial applications and processes, in the most adverse requests.

The design and construction of this fan foresee operation in aggressive environments, regarding humidity, abrasiveness, and continuous operation, with minimal maintenance care.

The FanTR Advanced Ventilator is rigorously balanced during the manufacturing process, following international standards for this type of equipment, thus ensuring its prompt installation, with no need for special care at the start of operation.

FanTR employs the most advanced technology in its design specification, ensuring an appropriate noise level, high aerodynamic efficiency, minimal vibration levels, and excellent overall performance for all its equipment.



ATTENTION: FAILURE TO FOLLOW THE INSTRUCTIONS PRESENTED IN THIS DOCUMENT MAY EXPOSE WORKERS TO RISK HAZARDS AND CAUSE DAMAGE TO THE EQUIPMENT, WHICH MAY RESULT IN THE LOSS OF THE WARRANTY.



3. FanTR ADVANCED FANS

3.1. Primary Fan

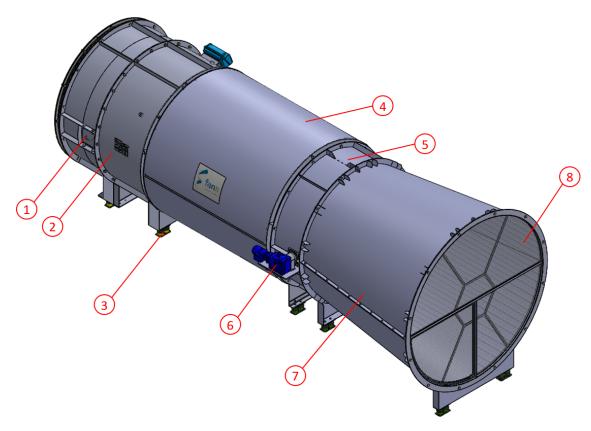


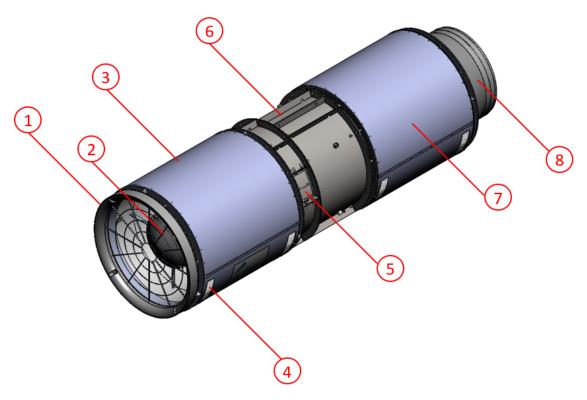
Figure 1 - Equipment: Exhaust Fan

- 1 Inspection window
- 2 Central duct
- 3 isolation damper
- 4 Attenuator

- 5 Damper
- 6 Damper control motor
- 7 Outlet cone
- 8 Protection screen



3.2. Secondary Fan



- 1 Nozzle
- 2 Inlet spinner
- 3 Inlet Attenuator
- 4 Reflective tape

- 5 Inspection window
- 6 Central duct
- 7 Outlet attenuator
- 8 Outlet cone

3.3. Components of FanTR Fans

3.3.1. Nozzles and Spinners



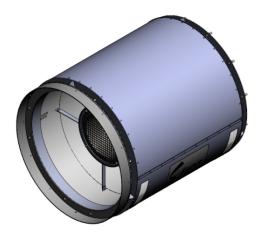
Having an important aerodynamic function, these components are attached to the fan inlet and outlet to avoid turbulence in the system.

According to simulations and bench tests, it is proven that these components, if well designed and applied, can guarantee a very expressive increase in the performance of ventilation systems.

Both the nozzle and the spinner are made entirely of structural composite material, which provides high resistance to impacts.



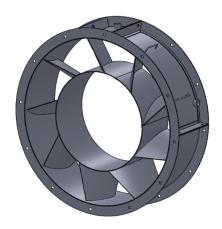
3.3.2. Noise Attenuators



Having the function of attenuating the noise generated by the motor and the high airflow inside the equipment, these accessories can be coupled both at the inlet and outlet of the fans, depending on the need.

The application of noise attenuators has the main objective of guaranteeing acoustic comfort for the environment of the ventilation system, and they should be used whenever the equipment is installed close to working fronts or places with a large circulation of people.

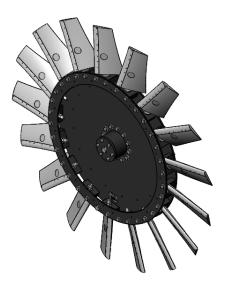
3.3.3. Flow Drivers



This component is positioned immediately after the fan rotor, aiming to reduce the turbulence of the airflow generated by the rotational movement of the rotor.

The result of its use is a real increase in air intake at the fan inlet due to the reduction of system pressure loss. As a consequence, effective gains can be observed in the flow and pressure of the equipment in which they are applied.

3.3.4. Rotors



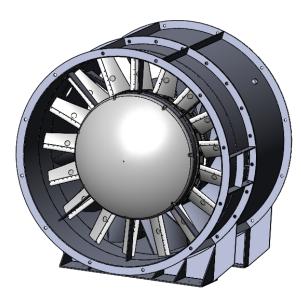
The impeller is the rotating part of the fans. It is formed by the toroid, where the blades and the spinner are attached, being directly responsible for the movement of air and the equipment's efficiency values.

In addition to the toroidal configuration, rotors can also be of the double-disc and disc-ring types.

FanTR blades are made of composite material, which allows unique solutions and ideal aerodynamic design for each application. The high efficiency of FanTR blades is the outcome of simulations and bench studies carried out by the Research and Development sector, inspired by the aeronautical industry.



3.3.5. Central Duct



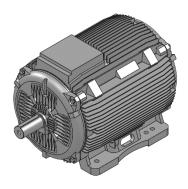
The central duct is the main part of the fan, where the motor, rotor, and flux direction fins (stator) are located.

This component is designed to meet all operating needs, and also facilitate equipment maintenance. Its main features are:

- It has an inspection window to facilitate predictive and corrective maintenance of the equipment;
- External greasing points;
- External junction boxes for easy access during installation;
- Pressure tapping points, facilitating field measurements.

NOTE: Always use a set of lifting straps anchored to the available lifting points on the top of the central duct, as shown in **Figure 2**, to move the equipment. By following this approach, the integrity of the assembly (set) will not be compromised.

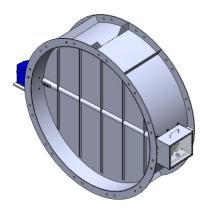
3.3.6. Engines



The motor is responsible for driving the rotor. It is installed in the central duct.

Each application requires a specific engine model. For specific engine information related to operation, maintenance, and specifications, refer to the Engine Manual shipped with this Manual.

3.3.7. Dampers



Dampers are used for opening and closing primary fan ducts.

Its main use is to close the ventilation duct when the fan is not operating, thus the other fans in the system will not have efficiency losses caused by air recirculation in nearby ventilations.



4. ASSEMBLY AND INSTALLATION

The procedures described below are merely informative. Equipment disassembly may only be started under the supervision of a FanTR technician or with FanTR permission. Failure to follow this guideline may result in loss of product warranty.



ATTENTION: THE FAN MUST BE LIFTED FOR HANDLING AND TRANSPORT USING THE 4 SPECIFIC POINTS FOR SUCH PURPOSE EXISTING IN THE CENTRAL DUCT. OTHER POINTS BESIDES THOSE, IF USED, MAY CAUSE DAMAGE TO THE EQUIPMENT, COMPROMISING ITS FULL FUNCTIONALITY.



Lifting points

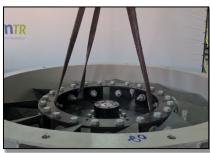
Figure 2 - Equipment lifting points



4.1. Assembly and Removal of the Motor from the Central Duct



Disassemble the rotor through the inspection window.



Remove the rotor using straps and male threaded eyes.



The engine must be removed using a lifting eyebolt or using a forklift.



Having access to the engine, remove it with the help of a forklift.



Use eyebolts on the motor to manipulate it



4.2. Mounting the Blades on the Rotor

4.2.1. Access to Rotor Blades (TLN04, CRTTN and CRTTNEM)

To access the blades, simply remove the inspection window and rotor spinner.

When the spinner rotates together with the rotor, mark the installation position of the spinner before disassembling it.

Number the blades and positions on the hub so that when removed they will be reassembled in the same positions.



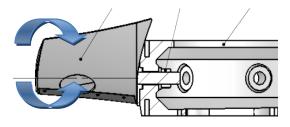
The blades can be accessed through the inspection window for checking and adjusting the angle, checked at the tip of the blade.



ATTENTION: UNDER NO CIRCUMSTANCES SHOULD THERE BE INDIVIDUAL REPLACEMENT OF THE BLADE IN THE SET WITH ANOTHER OF A MODEL OR ORIGIN THAT IS NOT SPECIFIED, AS THE MASS DISTRIBUTION AND STIFFNESS WOULD BE DIFFERENT, RESULTING IN SIGNIFICANT IMBALANCE ISSUES.

• Step Angle Adjustment

The value of this angle is determined through performance analysis to meet the needs of the project in question.



This angle is adjusted with the face of the central hub and must be within a maximum tolerance of \pm 0.3 degrees. The pitch angle must be adjusted using a digital inclinometer positioned at the tip of the blade.





It is recommended that during the first year of operation, the angles are checked and calibrated every 3 months. After the first year, it is recommended that checking and calibration be done every 6 months.

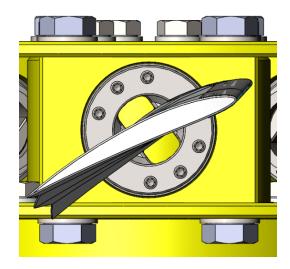
Assembly of the Blades

The blades (TLN04, CRTTN, and CRTTNEM) can be removed by unscrewing the locking nut that holds the blade. This must be completely removed from the screw so that the blade can be removed.

When replacing the blade on the rotor, the torque applied must be the same as indicated in section 4.3 Torque Tables.

4.2.2. Access to Rotor Blades (HTLN01 and FLN06)

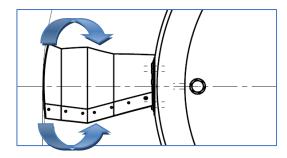
The great advantage of the HTLN01 and FLN06 blades is their accessibility to adjust the pitch angle. To do so, simply open the inspection window and unscrew the pressure screws (M8 DIN913 SEXT. INT. [Internal hexagon] headless socket set screws) that restrict the rotation of the blade.



• Step Angle Adjustment

The value of this angle is determined through performance analysis to meet the needs of the project in question.





This angle is adjusted relative to the disc/ring face and must be within a maximum tolerance of \pm 0.3 degrees. The pitch angle must be adjusted using a digital inclinometer positioned at the tip of the blade.

It is recommended that during the first year of operation, the angles are checked and calibrated every 3 months. After the first year, it is recommended that checking and calibration be done every 6 months.

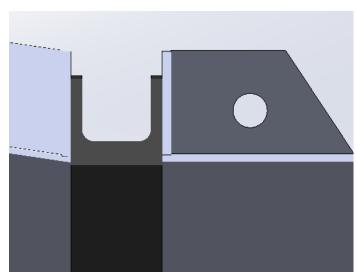
To change the angle, it is necessary to loosen the torque of the 6 screws without removing them from the blade. Upon reaching the desired angle, it is necessary to retighten the screws.

4.2.3. Flexible Gasket

In some cases, the fan is equipped with a flexible rubber joint (gasket), which serves to prevent the transmission of vibrations to other structures. The procedure below describes the correct way to install the flexible gasket

4.2.4. Drilling and Assembly Procedure

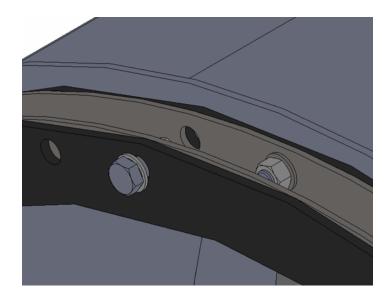
With the fan main duct already assembled, the gasket must be positioned on the circumference of the flange with the aid of sergeant-type clamps, so that the hole in the metallic flange can be marked on the rubber and guide the opening of the holes. Remember to mark the positioning between the gasket and the flange.



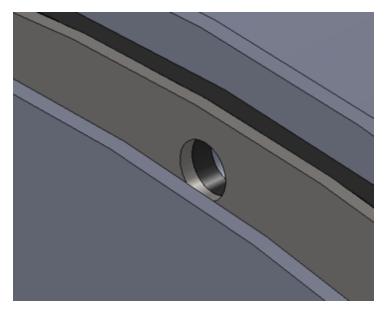
Check that there is no internal step between the gasket and the fan duct so as not to impair the flow inside the system.

After marking the hole, the clamps can be removed and with the help of a drill, holes can be opened in the rubber flange.





The drilling process must be repeated for both sides of the flange. Pay attention, as the holes of the metal flanges are interspersed, as shown in the image above. Position the metallic ring of the junction so that the holes align, as shown in the image below.



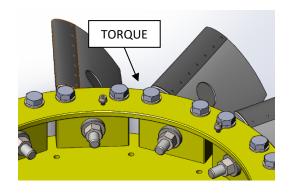
Tighten all screws according to the torque tables specified below in the flanged joints torque table.



4.3. Torque Tables

TABLE OF TORQUES ON THE STEEL DISC/RING BEARING (Kgf.m) - LUBRICATED						
		Carbon steel				
Type of blade	Observation	Class 10.9				
			M20			
CRTTN CRTTNEM	Bearing housing T-Bolt fan blades	25	40			
FLN06 HTLN1	Bearing housing Blades- Elastic Ring*	25	48			

CRTTN - CRTTNEM



FLN06-HTLN1

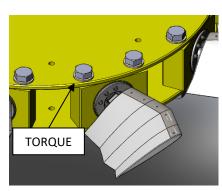
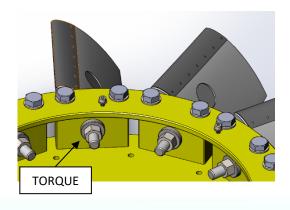


	TABLE OF TORQUES ON THE BLADES (Kgf.m) - LUBRICATE									
			Carbon s	teel		Stainle	ss steel			
Type of blade	Observation	Class 8.8		Class 10.9)	Clas	s 80			
		M14	M12	M16	M20	M12	M14			
CRTTN CRTTNEM	T-Bolt Fan Blade	-	_	15	26	-	-			
FLN08 TLN04 TLN07	CNB Bearing housings	10	-	-	-	-	14			

CRTTN - CRTTNEM



FLN08 – TLN04 – TLN07

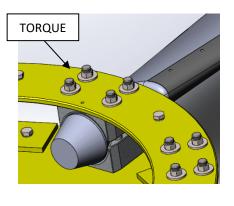
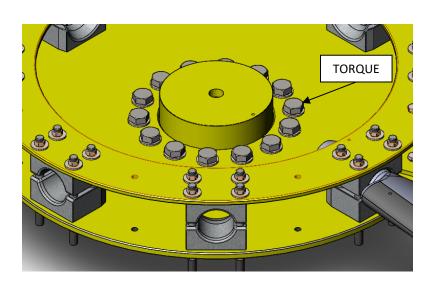




	TABLE OF TORQUES ON THE CENTRAL HUB (Kgf.m) - LUBRICATE								
				Carbo	n steel				
	Class 8.8					Class 10.9			
B420	D424		N442	M16	-	7/8"	M24	8427	M30
M20	M24	M30	M12	5/8"	M20		1"	M27	1 ¼"
34	59	114	10	25	48	65	83	119	160

	TABLE OF TORQUES ON THE CENTRAL HUB (Kgf.m) - LUBRICATE											
					Stainl	ess steel						
Clas	s 50			Clas	s 70					Class 80)	
M12 M20 M16 M20 M24 M27						M30	M33	M12	M16	M20	M24	M30
2 11 13 24 42 60 82 107 7 16 32 55 110							110					

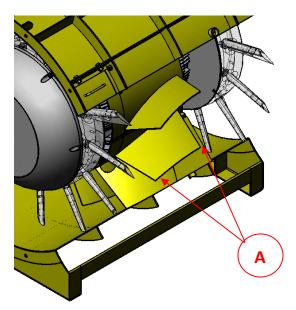


	TORQUE OF FLANGED JOINTS								
		I	DRY SCREW	(WITHOUT	LUBRICAN	TS)			
Class		8.	.8			10).9		
Gauge	M12	M16	M20	M24	M12	M16	M20	M24	
Torque (Kgf.m)	8	20	40	70	12	30	60	100	

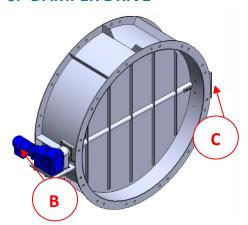


5. VIBRATION MEASUREMENT

Vibration measurement should always be performed on both sides of the fan, taking measurements at 2 points for each side, coinciding with the internal vanes of the fan flow director, as highlighted by point A.



6. DAMPER DRIVE



The Damper is activated electrically through a threephase geared motor (Point B). In an ON/OFF manner, the purpose of the damper is to keep the ductwork open or closed.

The limit switches positioned on the side opposite the geared motor (Point C) interlock the electrical part, turning off the motor at the exact moment, whether it is open or closed.

The electrical diagrams of the geared motor and magnetic brake can be found in section 9OPTIONAL SECTIONS MANUAL, which illustrates the correct use of the three-phase system. The motors used to drive the dampers have a magnetic brake attached to the back. In this way, while the motor remains electrically disconnected, in conjunction with the rectifier bridge, the brake will remain engaged. Dampers that have such a drive system cannot be operated manually.

The main shaft of the Damper rotates between two self-aligning bearing housings with grease nipples. The lubrication table for the bearings contained in these bearing housings can be found in section 9.5.



7. OPERATION, PREVENTIVE AND PREDICTIVE MAINTENANCE

7.1. Introduction

FanTR fans are supplied for a number of industrial installations. Applied in Cooling Towers, Air Coolers, Ventilation and Exhaust Systems, Mining, and Tunnels, they are subject to a wide range of working conditions. Some of these applications are critical due to the importance of the system concerning the overall process in which the FanTR ventilator is employed.

In the design and manufacturing phase, FanTR seeks to build fans that meet the critical conditions of the places where they are installed.

Achieving desired operational availability and reliability is necessary to ensure production goals. Through safe work practices and environmental respect, one should follow preventive maintenance steps and analyze predictive parameters to reduce equipment downtime impacts.



ATTENTION: THE FOLLOWING TABLE CONTAINS THE LIST OF FAN MODELS AND THEIR RESPECTIVE ROTATIONS TO BE AVOIDED. THE EQUIPMENT MUST **NOT** OPERATE CONTINUOUSLY WITHIN THIS RPM RANGE, THEREFORE, THIS INTERVAL IS RESERVED ONLY AS PASSAGE FREQUENCY. VERIFY IF YOUR FAN MODEL IS PRESENT IN THE TABLE AND, IF IT IS, WHAT ROTATION TO AVOID. FOR THE PROPER OPERATION OF THE

EQUIPMENT AND THE MAINTENANCE OF WARRANTY CONDITIONS, THE EXCLUSION OF THESE ROTATIONS FROM THE OPERATIONAL RANGE OF THE EQUIPMENT MUST BE RESPECTED.

Fan model	RPM range to	o avoid (rpm)
M-FLOW Ø1000 2 Poles	2100 to 2200	2018 to 3150

7.2. Operation

7.2.1. Pre-Match Actions

- 1 All applicable security measures must be taken;
- 2 All screws and anchor bolts must be properly tightened;
- 3 Make sure that there are no foreign bodies inside and in its accessories, such as tools, screws, shims, and dirt in general, among others;
 - 4 All sensors must be energized and working properly;
- 5 All flanged pipe joints must be sealed with Sikaflex 521 UV. It is recommended to apply it along the entire internal and external perimeter of the flanges so as not to compromise the specified flow and pressure. The surface where the product will be applied must be clean and free of moisture and the curing times of the material as described in the manufacturer's manual attached to section 9.6;
 - 6 If the equipment has a damper, it must be completely closed to keep the rotor stopped;



7.2.2. Equipment Departure

- 1 Make the electrical connection of the motor following the manufacturer's instructions;
- 2 Check the direction of rotation of the rotor through a test at low speed or using the "JOG" function, making sure that the direction of rotation is following the external indicative plates;
- 3 Turn on the fan and when it reaches approximately 5% of the nominal rotation, the damper should be opened (if the damper system has electric actuation). At nominal rotation, measure the operating current, which should not exceed the value of the nominal current indicated on the motor nameplate.
 - 4 Check the vibration levels of the equipment at nominal rotation;
- 5 The temperatures in the bearing housings of the fan will probably only stabilize after 2 hours of operation.

7.2.3. Equipment Shutdown

- 1 Cut off the electrical power to the motor and/or turn it off via the control panel;
- 2 Send a command to close the damper when the speed is around 5% of the nominal speed (if there is a damper). Wait for the rotor to stop completely;
 - 3 Before accessing any internal part, cut off the power supply and uncouple the power cables;
- 4 For evaluation conditions of operation or shutdown due to high levels of vibration, see section Maintenance on FanTR fans.

7.3. Preventive and Predictive Maintenance

The need to make equipment and systems available for as long as possible gives rise to Preventive and Predictive Maintenance tools at the service of those responsible for Maintenance and Operation activities.

Maintenance aims to define:

- Quality of operation of the equipment;
- Origin and severity of failures to be corrected;
- Analysis of performance variables;
- Analysis of component wear profile.

Advantages of Maintenance services:

- Knowledge of the real state of the equipment;
- Increased equipment reliability;
- Maintenance service planning;
- Avoid unexpected stops;
- Improves Maintenance/Operation integration;
- Increases the availability of the installation;
- Prevents further damage to equipment.

7.4. Maintenance on FanTR fans

The recommendations given below apply to FanTR Fans used in Mining, known as Jet Fans and Exhaust Fans.



Initially, turn off the equipment and separate the tools necessary for carrying out the maintenance. This maintenance must be carried out by trained personnel and observing all the parameters below.



ATTENTION: BEFORE ANY INSPECTION OF THE FAN, LOCK THE CONTROL PANEL TO ENSURE THAT IT CANNOT BE ACCIDENTALLY STARTED DURING MAINTENANCE.



ATTENTION: THE AUTOMATIC LUBRICATION SYSTEM OF FANTR FANS IS PROVIDED ACTIVATED. HOWEVER, IF THE FAN DOES NOT START OPERATING WITHIN 30 DAYS AFTER THE ISSUANCE OF THE INVOICE, THIS AUTOMATIC LUBRICATION SYSTEM MUST BE TURNED OFF, AND IT MUST BE REACTIVATED BEFORE THE FAN STARTS OPERATING.

After blocking the activation panel, remove the protection screen and the inspection window, located respectively at the entrance and on the side of the equipment, in the region of the rotor.

During Preventive maintenance, the following points will be evaluated to increase the Ventilator's useful life:

Overall Equipment Inspection

After removing the protection and inspection window cover, carry out a careful inspection of the entire Ventilator in search of cracks or marks that could indicate a collision between the rotating part and the housing.

• Removal of Debris Buildup to the Blade

The presence of debris buildup to the fan blades may occur. This material can cause variation in the mass of the rotating assembly, resulting in excessive levels of vibration, which may, in some cases, lead to equipment failure.

If there is debris buildup, wash the blade to remove it. Fine-grit sandpaper (600) can be used. Do not, under any circumstances, use spatulas or sharp objects, as these may scratch the blade and compromise its surface protection barrier. Also, do not use abrasive chemical products, as these can also remove the surface protection barrier.

Structural Integrity of the Blades

After thoroughly cleaning all the blades, proceed to a careful inspection to check for possible cracks. If there is a crack, the blade must be sent to FanTR for repair. The usage of a cracked blade in operation may cause the breakage of all rotor blades.

Overall Rotor Inspection

After checking all the blades, perform a careful analysis of the blade fixing system, checking that there are no broken screws or bearings. This can occur if the blade experiences mechanical impacts with rocks, etc.

Blade Angle

As already mentioned in this manual, the FanTR Ventilator has the manual adjustment of the blades' operating angle according to the flow and pressure conditions required for each application. Because of this, the angle of the blades must be checked and, if necessary, adjusted.

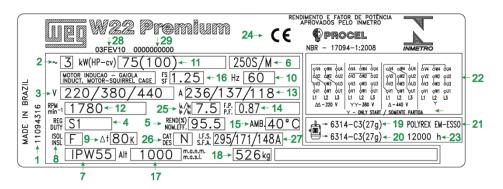


• Blade Screw Torque

After inspecting the fan rotor, the evaluation of the fan motor is performed. Check if the screws that fix the motor to the central duct are tightened.

Engine Lubrication

If it is necessary to lubricate the engine, follow the engine manual. The most important data about the lubrication interval can be found on the engine plate. This informs the interval (in hours) for lubrication, as well as the lubricant and the appropriate amounts. Failure to follow these procedures may cause the electric motor to burn out and void its warranty.



Vibration Level

After checking all the sections mentioned above, reassemble the protective screen and the inspection window cover.

Put the fan in operation for a few seconds to check for any possible operation failure, observing the presence of any strange noise in the system.

Check the current consumed by the motor. This value must not exceed the rated current value when the Fan is operating at the nominal rotation. If the operating current is greater than the rated one, turn off the equipment immediately and check the angle of the blades.

If the measured current is within the nominal current limit, measure the vibration level with the sensors positioned as described in the section VIBRATION MEASUREMENT. The global vibration level shall be 7 mm/s RMS for alarm and 10 mm/s RMS for shutdown.

If the vibration level is higher, perform the analysis of the filtered spectrum in the rotation to check the first harmonic. If possible, measure the vibration levels at the electrical motor bearing housings, as the measurement point on the central duct may influence the measurement (indirect measurement).

In case of excessive vibration and all items are in accordance with the recommendations, balance the rotor, only if there are personnel trained in this operation, or contact FanTR Technical Assistance.

Frequency of Inspection

It is recommended to perform inspections every two weeks during the initial operation phase of the equipment (first 2 months). For systems older than 6 months, inspection should be performed monthly. Whenever a new equipment installation or general maintenance occurs, this inspection must be carried out.



If the ventilator was purchased with a vibration sensor with an automatic shutdown, it features Predictive maintenance. This type of device is shipped set to trip the system if the vibration level exceeds 10 mm/s RMS for 2 seconds.

8. TROUBLESHOOTING

Below are frequently asked questions and answers related to problems that occurred in the field:

Problem:	Possible causes	Corrective action
Vibration at the	Blade angle out of specification, damaged blade (breakage).	Inspect the rotor, check all blade angles, and adjust the angle with differences above $\pm0.3^{\circ}$ tolerance. Check the torque of the blade fastening bolts.
fan rotation frequency	Imbalance.	Inspect the rotor to identify possible debris buildup on the blades. Clean up and reevaluate. If not resolved, contact FanTR Technical Assistance for arrangements for system balancing.
Peak vibration at blade passing frequency	Resonance	Decrease fan speed ± 15%. Consult FanTR Technical Support.
Harmonics in the fan rotation frequency	System rigidity	Inspect the system, check for broken screws, and retighten all system fastening bolts. If the inspection yields negative results, consult FanTR Engineering for further assistance.
Motor current above the nominal value.	Overload	Check for any obstructions or elbows in the ductwork, verify static pressure, and consult FanTR Technical Support. Lower rotation to acceptable current levels and block frequency inverter. If an inverter is not being used, decrease the blade angle.
Loss of airflow at the pipe outlet	Damaged ductwork.	Inspect the entire ductwork to identify possible air leakage.
Fan trips (shut down) during activation	Excessive Current, inverter/soft starter protection actuation	Increase the activation ramp, check soft starter/inverter parameterization
After several starts in a row, the fan does not turn on	Thermal protection of the motor/inverter/soft starter operating	Wait 30 to 40 minutes for it to cool down. This is system protection.
In an installation using a generator driven by an internal combustion engine, the fan does not turn on.	Voltage drops due to the distance between the generator and the equipment Undersized generator. Phase drop in the connection cables.	Check the incoming voltage on all phases. Check the distance between the generator and the equipment, and recalculate the voltage drop depending on the transmission cable section. Consult FanTR Technical Support. Note: Some generators require a warm-up period to reduce the voltage drop. It is important to always check the mains frequency at the generator output – 60 Hz in Brazil.
Inverted fan direction of rotation	Inverted motor/inverter/soft starter connection	If there is no equipment for phase identification, invert two power cables, or in the case of the inverter, invert the rotation in the parameterization.
Heating in the system	Lack of lubrication in motor bearings	Before relubricating, perform vibration analysis on the system (grease hides the vibration coming from the bearings). Respect system relubrication periods.
Cracks in the blades	Impact of suspended particles during operation, impacts	Photograph and urgently send to FanTR Technical Assistance for analysis and opinion. If possible, do not operate the equipment under these conditions.



Worn leading edge protector	Abrasion from particles suspended in the airflow.	Photograph and send to FanTR Technical Assistance for analysis and opinion.
Cracks in the rotor hub	Impact.	Photograph and urgently send to FanTR Technical Assistance for analysis and opinion. If possible, do not operate the equipment under these conditions.

RECOMMENDATIONS

- 1. Before accessing any rotating equipment, make sure that it is turned off, or blocked and that the motor is deenergized.
- 2. Respect all lubrication/inspection periods
- 3. Always turn off the equipment to carry out detonations in the Mine.

Whenever you need any clarification about the equipment, installation, or maintenance, consult FanTR Technical Assistance



9. OPTIONAL SECTIONS MANUAL

9.1. Automatic Lubricator

Greases up to NLGI 2

Drive - reusable

Technical data

with Battery pack STAR VARIO / Electromechanical drive with Battery pack STAR VARIO low temperature

Discharge period

STAR LC 60: + 15, 18, 21, 24 months STAR LC 500: max. 6 months 1, 2, 3 ... 12 months / 1, 2, 3 ... 26 weeks

60 cm³, 120 cm³, 250 cm³ or 500 cm³ 2.03 oz, 4.06 oz, 8.45 oz or 16.91 oz Lubricant volume

Operating temperature*

.40 °F** to +140 °F / -40 °C** to +60 °C

an integrated oil

retaining valve

Oil-filled units feature

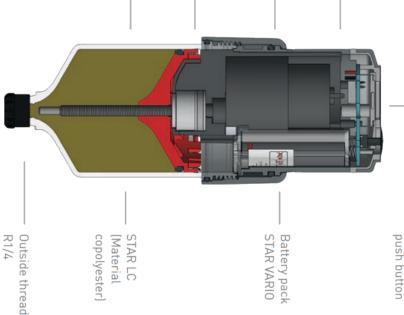
Lubricant

Continuous pressure build-up

109 psi / 7.5 bar

STAR VARIO Drive (Material PA GF)

Gearmotor



Piston

IP 67 / IP 65

Protection class

Standard & special lubricants

Dimensions

LC 60: Ø 75 x 155 mm / Ø 2.95 x 6.10 inch LC 120: Ø 75 x 178 mm / Ø 2.95 x 7.01 inch LC 250: Ø 75 x 228 mm / Ø 2.95 x 8.98 inch

LC 500: Ø 75 x 324 mm / Ø 2.95 x 12.76 inch

LCD display with

^{*}To achieve functionality below -20° C / -4° F, Battery pack / Battery housing STAR VARIO low temperature (lithium) must be used

^{**}Only to be used with suitable low temperature lubricants!



Traducción del manual de instrucciones original

= Atención, peligro

asegurarse de que Para que el sistema de lubricación no suponga ningún peligro, el operario debe

- solo se permita a personal cualificado trabajar con el sistema de lubricación o
- el personal tenga a su disposición el manual de instrucciones y lo siga
- durante el montaje y mantenimiento se cumpla la normativa vigente sobre seguridad y prevención de accidentes;
- el sistema de lubricación se use de manera profesional y adecuada y no se ajuste incorrectamente ni se modifique

Observar las hojas de datos de seguridad de los aceites y grasas

Evitar el contacto de aceite / grasa con los ojos, la piel y la vestimenta, así como ingestion de aceite / grasa.

No permitir que el aceite / la grasa llegue a la tierra ni al alcantarillado

La presencia de aceite o grasa en las vías de circulación eleva el riesgo de resbalar Limpiar el suelo inmediatamente con el producto adecuado

Pilas:



¡No las reutilice!

¡No las arroje al fuego!



¡No las abra

¡No las cargue!

i) = Nota, consejo

o a través del distribuidor local Las hojas de datos de los lubricantes se pueden obtener en nuestra página principal

El sistema de lubricación responde a la técnica más avanzada en el momento de su mente en o con el sistema de lubricación se originen por haber utilizado inapropiadamente o por haber trabajado inadecuada No se asumirá la garantía por aquellos daños y anomalías de funcionamiento que

entrega y, por tanto, en principio se considera seguro para su uso

Debido al continuo desarrollo de los productos, nos reservamos el derecho a realizar sin previo aviso cualquier modificación en los productos que no afecte a su funciona-



Proteja el medio ambiente reciclando los materiales que puedan tener valor. Tenga en cuenta las directrices de eliminación de residuos pertinentes en su pais

- Cubierta de protección Motor (reutilizable)
- Juego de pilas (no reutilizable)
- Carcasa baterías para baja temperatura (reutilizable
- Tiempo de dosificación LC llenado (no rellenable)
- Condiciones de almacenamiento
- Alcalina de manganeso lemperatura de aplicación
- Litio
- Emisión de ruido aéreo
- \$<0-000000023030-5500000 Posición de instalación Control de vibracion
- Pantalla
 - Cantidad de dosificación
 - Soltar el pulsador SET Mantener pulsado el pulsador SET

 - LC vacío
- Eliminación de baterías retención de aceite
- Pulsador SET
- En funcionamiento (parpadeante
- Residuos con grasa lapon cierre
 - Fecha de instalación / cambio
- Con aceite con válvulva
- de

1.0 Caracteristicas

3.0 Manejo 2.0 Piezas / Primer montaje

3.1 Indicadores

3.3 Estados de servicio 3.2 Configuración

6.0 Solución de problemas 5.0 Cambio LC 4.0 Instalación

Error

Solución Causa

8.0 Distintivo 7.0 Eliminación de residuos



o grasa, lubrica rodamientos, cojinetes de deslizamiento, cadenas, guías, engranajes abiertos, etc. ción automática, indicado para su uso en máquinas y equipos y que, usando aceite En el momento de recibir el pedido, compruebe inmediatamente si coincide con lo Las instrucciones sirven para trabajar con seguridad en y con el sistema de lubrica-

Si tiene alguna duda o problema, diríjase a nuestro servicio de atención al cliente posteriori. solicitado. No se aceptara ningun tipo de garantia por los defectos reclamados a

a su distribuidor local





7

Después de 3 s se acepta el cambio (sin pulsar el pulsador SET)

Tras aceptar los ajustes, el sistema se apaga

Ajustar la duración del tiempo de dosificación mediante presión corta de la tecla o larga (= función desplazar).

9

Posibilidad de ajuste en cuanto las cifras parpadean

Ajustar el tiempo de dosificación deseado









		Montaje inicial
	•	Insertar el juego de pilas (C1) en motor (B) y hacer encajar.
	•	Autoevaluación automática
ω	0	Montar motor (B) y LC (D).
	<u> </u>	Colocar el motor sobre el LC de tal manera que los elementos dentados encajon entre sí

	4	
Ajustar tamaño del LC	La dosificación del lubricante es por tiempo.	

Enroscar el anillo roscado a mano hasta que el triángulo blanco quede

13

12

		0		
veces = LC 5	3 veces = LC 250	2 veces = LC 120	1 vez = LC 60	Ajustar el tamaño del LC pulsando el pulsador SET:

9

Colocar la cubierta de protección

se produce un arranque inicial.

7

Posibilidad de ajuste en cuanto las 3 barras parpadean Mantener pulsado el pulsador SET durante 5 s.

61

	•
Ajustar el tiempo	Después de 3 s se acepta el cambio (sin pulsar el pulsador SET).

16

El LED rojo parpadeante y la visualización de "LC" en la pantalla indican que se debe cambiar el LC. Retirar el sistema de lubricación del punto de lubricación.

Cuando se instale en la parte superior, no usar la cubierta de protección

6

17

15

17 18 19 20

Retirar el juego de pilas del motor y desechar

Introducir el nuevo juego de pilas batería en el motor.

Separar el motor y el LC

Destrabar el juego de pilas

Después de 3 s se acepta el cambio (sin pulsar el pulsador SET)

6

22	Se aplica la ultima configuración existente. Al cabo de 10 s se produce un arranque inicial.
23	Atornillar el nuevo LC y el motor. El sistema de lubricación está de nuevo

Encajar el juego de pilas

			E
		Mantener pulsado el pulsador SET durante 1 s para encender.	1
_		Mantener pulsado el pulsador SET durante 1 s para apagar.	11
		Si la unidad LC está vacía, se ha de cambiar e insertar una batería nueva [C1].	1
_		Las dosificaciones vienen identificadas por "ru".	12
_		Pulsando el pulsador SET durante 10 s se activa la dosificación adicional "PU". A continuación se producen tres dosificaciones con 2,0 cm² cada una. Pulsando 12 el pulsador SET se cancela la dosificación adicional.	2
		Pulsando el pulsador SET durante 1 s se muestra el ajuste seleccionado. Después de soltar el pulsador SET durante el cambio, se muestran alternativamente durante 10 s "rd" y la cantidad de días desde el inicio del evento.	12
		Montaje	
	0	Retirar el tapón.	ed
	0	D Enroscar el sistema de lubricación en el punto de lubricación preparado.	
	0	Mantener pulsado el pulsador SET durante 1 s para encender. En la primera en marcha tras colocarse una nueva unidad LC, al cabo de aprox. 10 s	repre



17

17

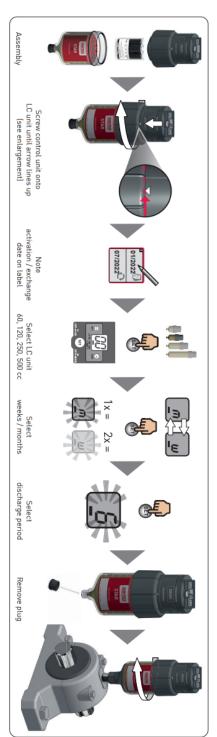
8

17

8



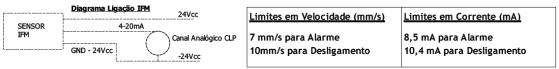




25	24									
	•	©	0	•	0	0		0	0	
Reciclar el motor una vez finalizada su vida útil	LED parpadea en rojo / se visualiza "Er"	LED parpadea en rojo / se visualiza "ut"	LED parpadea en verde aunque el LC está vacío	LED parpadea en rojo / se visualiza "LC", aun- que el LC no está vacío	LED parpadea en rojo / se visualiza "Lo"	LED parpadea en rojo / se visualiza "OL"	pilas insertado	No hay indicación en la pantalla con el juego de	No hay lubricación	Error
finalizada su vida útil.	Motor de accionamiento defectuoso	La temperatura permi- tida no se ha alcanzado durante un periodo prolongado	Se ha ajustado un tamaño del LC demasiado grande	Se ha ajustado un tamaño del LC demasiado pequeño	El juego de pilas ha sido usada varias veces	La contrapresión supera los 7,5 bar durante un periodo de tiempo prolongado	Motor defectuoso	Juego de pilas vacío	Montaje incorrecto	Causa
	Girar el anillo roscado hasta la marca (la flecha debe estar totalmente visible) Insertar un juego de pilas nuevo Sustituir el motor Eliminar obstrucciones Contrapresión < 7,5 bar, pulsar el pulsador SET Insertar un juego de pilas nuevo Seleccionar el tamaño correcto del LC y cambiar el LC Seleccionar el tamaño correcto del LC y cambiar el LC Mantener la temperatura permitida, pulsar el pulsador SET Mantener la temperatura permitida, pulsar el pulsador SET								Solución	
21		2	30				19			
	·									



9.2. Vibration Sensor with Automatic Disarm

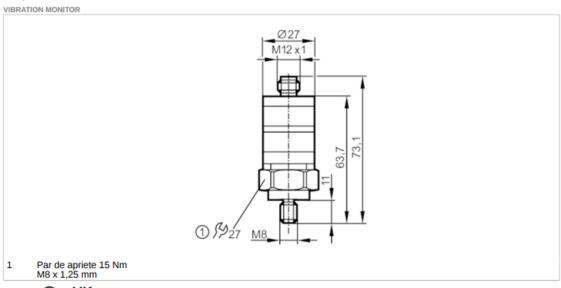


<u>Atenção:</u> O ventilador deverá ser desligado se exceder o limite de desligamento por mais de 2 segundos. Esse delay deve ser implementado na lógica de controle.

VKV021

Equipo de control de vibraciones con ajuste intuitivo del punto de conmutación







Características del produ	cto	
Rango de medición de vibraciones	[mm/s]	025; (RMS)
Rango de frecuencia	[Hz]	101000
Campo de aplicación		
Aplicación		Equipo de control de vibraciones según DIN ISO 10816
Datos eléctricos		
Tensión de alimentación	[V]	1832 DC
Consumo de corriente	[mA]	< 50
Clase de protección		III
Tipo de sensor		sistema microelectromecánico (MEMS)
Entradas/salidas		
Número total de entradas y salidas	'	2
Número de entradas y salidas		Número de salidas digitales: 1; Número de salidas analógicas: 1



Salidas					
Señal de salida		señal de conn	nutación; señal analógica		
Alimentación			PNP		
Número de salidas digitales			1		
Función de salida		norm	almente cerrado		
Caída de tensión máx. de la salida de conmutación DC	[V]		2		
Corriente máxima permanente de la salida de conmutación DC	[mA]		500		
VIBRATION MONITOR Número de salidas analógicas			1		
Salida analógica de corriente	[mA]		420		
Carga máx.	[Ω]		500		
Protección contra cortocircuitos			sí		
Tipo de protección contra cortocircuitos			pulsada		
Resistente a sobrecargas			sí		
Rango de configuración / m					
vibraciones	[mm/s])25; (RMS)		
Rango de frecuencia	[Hz]		101000		
Número de ejes de medición			1		
Precisión / variaciones					
Error de medición			<±3		
[% del valor final]					
Desvío de la linealidad	o de la linealidad 0,25 %				
Tiempos de respuesta					
Tiempo de respuesta	[s]		160		
Software / programación					
Ajuste del punto de		Anille de circle			
conmutación			nillo de ajuste		
Condiciones ambientales					
Temperatura ambiente	[°C]		-2580		
Nota sobre la temperatura ambiente		aplic	ación UL: < 80 °C		
Temperatura de almacenamiento	[°C]		-2580		
Grado de protección			IP 67		
Hamalanadanadan					
Homologaciones / pruebas	5	EN 61000-4-2 ESD	4 kV CD / 8 kV AD		
CEM		EN 61000-4-2 ESD EN 61000-4-3 radiado HF	10 V/m		
		EN 61000-4-4 Burst	2 kV		
		EN 61000-4-6 HF conducido	10 V		
Resistencia a choques			400 g		
MTTF	[años]		510		
Datos mecánicos					
Peso	[g]		113,5		
Tipo de montaje		M8 x 1,25			
Materiales		PBT; PC; FKM; inox (1.4404 / 316L)			
Par de apriete	[Nm]	15			



Indicaciones / elementos de	Indicaciones / elementos de mando				
Indicación	Disponibilidad	LED, verde			
	Estado de conmutación	LED, amarillo			
Escala disponible		sí			
Elementos de manejo	Anillo de ajuste	Anillo de ajuste			

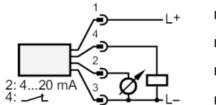
Notas	
Cantidad por pack	1 unid.

Conexión eléctrica

Conector: 1 x M12; codificación: A



Conexión



Pin 1: marrón

Pin 4: negro

Pin 2: blanco

Pin 3: azul

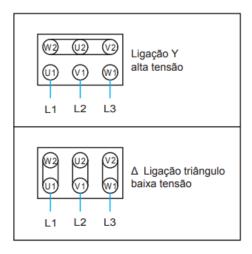
1	L+	
2	420 mA	
3	GND	
4	salida de conmutación	



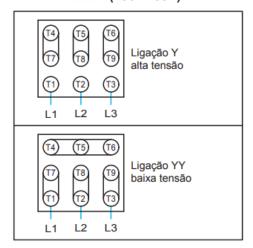
9.3. Motor Gearbox and Brake Connection Diagrams

9.3.1. Motor Reducer Diagrams

Motor trifásico

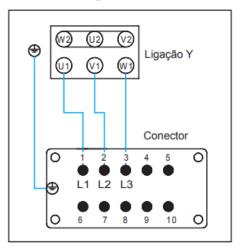


Motor trifásico NEMA (230 / 460V)

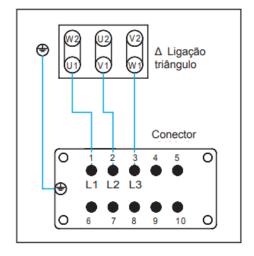


com conector do motor (MS)

400 V - Ligação estrela Y



400 V - Ligação triângulo Δ





9.3.2. Magnetic Brake Diagrams

GHE40L Part number: 19141010

Brake rectifier

Scope of delivery

1 x	Module	GHE40L
-----	--------	--------



Intended use

The brake rectifier converts AC voltage into DC voltage. It is solely intended for control and operation of an electromechanical brake with DC operation.

Safety

The brake rectifier and the components associated with it must only be installed and commissioned by a qualified electrician. A qualified electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to

- · Switching on, switching off, disconnection, earthing and labelling of electric circuits and devices,
- Correct maintenance and use of protective devices according to specified safety standards.

Please also note the following for safe installation and commissioning

- · Catalogue M7000 from NORD DRIVESYSTEMS Group,
- The operating instructions for the motor which is used (e.g. B1091 from the NORD DRIVESYSTEMS Group),
- The operating instructions for the brake which is used.

Technical Information / Datasheet	GHE40L			
Brake rectifier	TI 19141010	V 1.0	4819	en

Field of use

The brake rectifier is intended for installation in a terminal box or control cabinet. This module enables direct control of an electromechanical brake with a coil voltage of between 105 V DC and 205 V DC.

Function description

The brake rectifier converts the mains voltage into a DC voltage. An electromechanical brake is controlled and released with this DC voltage. The power supply to the brake is interrupted by switching off the mains voltage. The magnetic field of the brake reduces and the brake is applied (after a delay).

The application characteristics of the brake rectifier can be configured for normal switch-off (switching of the AC side) and for fast switch-off (DC switching).



For **normal switch-off** terminals 3 and 4 must be bridged (state as delivered). After the mains are switched off a DC current continues to flow through the brake rectifier until the magnetic field in the brake has reduced. The brake is only applied after the magnetic field has reduced to a minimum amount. The time which is required for reduction of the field depends on the inductance of the brake and the resistance of its windings.

For **fast switch-off** the bridge between contacts 3 and 4 must be removed and the terminals connected to a suitable switching contact. By switching off the DC circuit (contacts 3 and 4) the magnetic field of the brake reduces rapidly and the braking effect occurs correspondingly rapidly.

Technical Data

Permissible ambient temperature	-25 °C 75 °C
Standards and approvals	CE (in combination with motors from the NORD DRIVESYSTEMS Group)

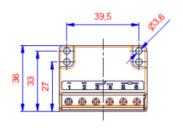
Rated voltage Permissible voltage range (U _{AC})	480 V AC 200 480 V AC ± 10 %
Output voltage (U _{DC})	216 V DC (U _{DC} = U _{AC} x 0.45)

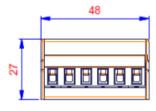
Weight	35 g
Protection class	IP20
Material	PCB in plastic housing

Braking current	2.0 A (up to 40 °C)	
	1.0 A (up to 75 °C)	
Permissible number of switching cycles	1800 switching cycles per hour	

¹⁾ Take restrictions due to the brake into account!

Dimensions





Assembly

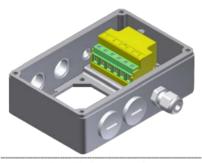
A WARNING

Electric shock

Due to an existing magnetic field, there may be a hazardous voltage at the contacts, even if the mains connection is switched off.

- · Do not work on live equipment.
- Check for absence of voltage with suitable measuring equipment before starting work.

Installation location	Within the motor terminal box, a separate terminal box or a control cabinet	
Fastening	With screw fasteners 2 x M3x8 (fastening material is not included in the scope of delivery)	



Installation example



Electrical connection

NOTICE!

Destruction of the brake rectifier through incorrect connection

Short circuits, earth faults and pulsed voltages, e.g. the output voltage of a frequency inverter result in undefined behaviour of the brake rectifier and can destroy a brake which is connected to it.

- · Take care that the wiring is correct.
- · Provide a mains supply to the brake rectifier via terminals 1 and 2.
- · Do not connect the brake rectifier to the motor terminals of a frequency inverter or motor starter.

Terminals Screw terminals		1 x terminal bar with 6 connections, spacing: 7.5 mm		
Cable cross-section 0.14 2.5 mm		AWG 14-26		

Control terminal details

Labelling, function			
1	L1	2	L2
3	Bridging contact (1) for fast switch-off	4	Bridging contact (2) for fast switch-off
5	Brake + connection	6	Brake - connection

Connection examples

The following selection shows the most common circuit versions for single-speed brake motors. Selection of the correct combination of the rectifier and the brake coil voltage must be made according to the available supply voltage by reference to Catalogue M7000. Further connection examples can be found in this catalogue.

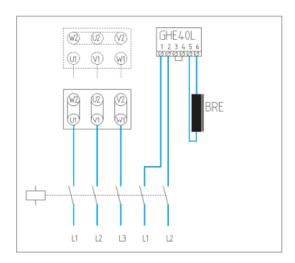
Normal switch-off

(AC switch-off)

Motor Δ circuit: 400 V AC Alternative Y circuit: 400 V AC

Rectifier supply: 400 V AC, separate

Brake coil voltage: 180 V DC





Normal switch-off

(AC switch-off)

Motor Δ circuit: 400 V AC Alternative Y circuit: 400 V AC

Rectifier supply: Via motor terminals

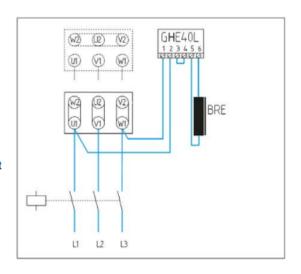
Brake coil voltage: 180 V DC

NOTICE: Connection to motor terminals is not

suitable for operation with a

frequency inverter!

Note: The brake is applied very slowly.



Fast switch-off

(DC switch-off)

Motor Δ circuit: 400 V AC Alternative Y circuit: 400 V AC

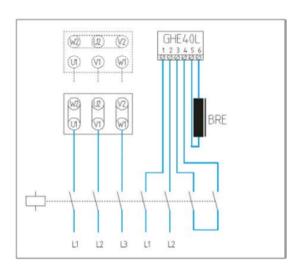
Rectifier supply: 400 V AC, separate

Brake coil voltage: 180 V DC

Note: Note the switching power for the

switch contacts in the DC circuit!

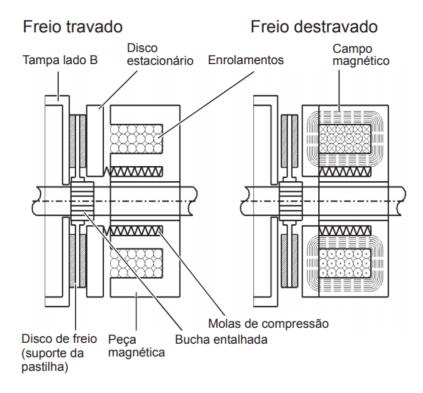
(Depends on the brake)





9.4. Reducer Motor Brake

The brake of the Gearmotor in the Damper control system is of the spring-applied pressure type, activated by direct current. The brake prevents unwanted rotational movements of the system (such as blocking) or reduces the rotation of the system until it stops (such as working brakes or in an emergency stop).



Between the engine B-side cover and the stationary disc is the brake disc. This one has the brake pad on both sides. Through the splined bushing, the brake disc transmits braking torque to the motor shaft. The brake disc can be moved axially over the slotted bushing. By the force of the spring, the stationary disc presses against the brake disc on side B. The friction between the anchor plate and the brake pad, as well as between the stationary brake disc and the brake pad, generates the braking torque. Brake release occurs via an electromagnet.

After being energized, the electromagnet pulls the stationary disc a few tenths of a millimeter against the spring force, moving it away from the brake pad so that the brake disc can rotate freely. An interruption of the current leads to a collapse of the magnetic force, causing the spring force to prevail again, breaking the system. The manual for the magnetic brake rectifier bridge of the Damper maneuvering system is available below.



9.5. Period of Lubrication for Damper Bearing Housings

	Condições de trabalho		
RPM	Temperatura em °C	Ambiente	Intervalo de relubrificação
100	Até 50	Limpo	6 a 12 meses
500	Até 70	Limpo	2 a 6 meses
1000	Até 90	Limpo	2 a 8 semanas
1500	Até 90	Limpo	1 a 4 semanas
Mais de 1500	Até 90	Limpo	Semanalmente
Mais de 1500	Mais de 90	Limpo	1 a 12 dias
Qualquer	Até 70	Sujo	1 a 10 dias
Qualquer	Mais de 70	Sujo	1 a 6 dias
Qualquer	Qualquer	Muito sujo	Diariamente

9.6. Sikaflex - 521 UV Sealant - Data Sheet

	Poliuretano híbrido monocomponente	
	Cinza (Ral 7038)	
	Umidade atmosférica	
	1,4 kg/l aproximadamente	
	Boa	
	5 - 35°C	
Temperatura de aplicação Tempo de formação de película ² (CSQP 019-1)		
	veja diagrama	
	2% aproximadamente	
	40 aproximadamente	
	1,8 N/mm ² aproximadamente	
	400% aproximadamente	
Resistência ao rasgamento contínuo (CSQP 045-1 / ISO 34)		
Temperatura de transição vítrea (CSQP 509-1 / ISO 4663)		
Resistividade elétrica (CSQP 079-2 / ASTM D 257-99)		
	10%	
permanente	-40°C a +90°C	
4 horas	140°C	
1 hora	150°C	
5-1)	9 meses	
	permanente 4 horas 1 hora	

¹⁾ CSQP = Procedimento de Qualidade - Sika 2) 23°C / 50% U.R.

Descrição:

O Sikaflex®-521 UV é um - Monocomponente adesivo selante de poliuretano- - Elástico tixotrópico e elástico, que cura envelhecimento e às condições ao entrar em contato com a umidade atmosférica, formando di atmosférica de cultura di atmosféricas - Adere perfeitamente a uma grande variedade de substituto de cultura de cultura de cultura de cultura de cultura de cult um elastômero durável, o sem necessidado de substratos Sikaflex®-521 UV é produzido - Pode ser pintado de acordo com as normas de - Pode ser lixado qualidade e meio ambiente ISO - Baixo odor 9001/14001.

Vantagens:

- monocomponente, Resistente à radiação UV, ao

 - Não é corrosivo - Elevada resistência elétrica
 - Isento de solventes
 - Isento de silicone e PVC

Áreas de Aplicação:

O Sikaflex[®]-521 UV adere bem sobre uma grande variedade de substratos e é adequado às vedações com elasticidade permanente.

Apresenta uma boa aderência em madeiras, metais, sistemas de primer e pintura (duas camadas), materiais cerâmicos, vidros e plásticos.

Consulte o fabricante antes de utilizá-lo materiais em transparentes ou pigmentados, propensos à fissura por tensões internas





Mecanismo de Cura:

O Sikaflex®-521 UV cura por com reação а umidade atmosférica. Em baixas temperaturas o teor de água no ar é geralmente menor e a reação de cura processa-se de forma mais lenta. Se o Sikaflex®-521 UV for usado em combinação com um adesivo de base poliuretano, este deve estar completamente curado antes da aplicação do Sikaflex®-521 UV.

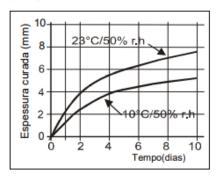


Diagrama : Velocidade cura Sikaflex®-521 UV

específicas favor contatar Serviço Técnico da Sika Industry.

Aplicação

Para unipacs: coloque o unipac na pistola de aplicação cortando uma das extremidades da embalagem, bem próximo ao lacre e colocando o adaptador de bico. Utilize o equipamento adequado (pistola de corpo tubular).

Corte a ponta do bico adaptando-o à largura desejada. Aplique o produto utilizando uma pistola manual ou pneumática.

Após abertas, as embalagens devem ser usadas num espaço de tempo relativamente curto.

Não aplique a temperaturas abaixo de 5°C ou acima de 35°C. A temperatura ideal de aplicação para o substrato e para o produto está entre 15°C e 25°C.

Para recomendação sobre aplicação utilizando balde ou tambor, favor contatar o Serviço Técnico da Sika Industry.