

Voith Paper

VOITH

Operating Instructions

Thickener

EFK1335

Revision Date: 10/14

Customer: **Graphic Packaging International**

Location: **Middletown, OH**

Serial No.: **34960**

Contract Specification No.: **194157**

Revision sheet

[illegible]

3 Technical Specifications

3.1 Machine specifications

Manuf. no.	34960
Year of construction	2014

3.2 Weights

Total machine, empty	Kg	5000
Total machine operating weight	Kg	11000
Complete machine with max. filling.	Kg	16000
Cover hood	Kg	190
Inlet chamber	Kg	280
Drop chute	Kg	315
Drive unit	Kg	480
Cylinder in folded design with bearing unit	Kg	1500
Take-off device	Kg	210

3.3 Operating specifications

Cylinder diameter	mm	1330
Track length	mm	3500
Cylinder speed	rpm	2-20
Shower water pressure	bar	4
Shower water consumption	l/min	314
Stock consistency on inlet	%	2,5
Stock consistency on outlet	%	4,0
Stock temperature, on inlet	°C	Max. 70

3.4 Drive specifications

Bevel spur gear unit motor

Motor rating	hp	15
Cylinder speed	rpm	11.5
Frequency	Hz	50 / 85
Protection class	IP	55
Torque	Nm	⇒ Sec. 12, Supplier Documentation on page 12-1

Fan

Motor rating	Kw	1.5
Rated motor speed	rpm	3000
Air flow rate	m ³ /h	2220
Air pressure	Pa	1500
Frequency	Hz	60
Protection class	IP	55

Pipework



All pipework must be connected completely free of tension.

Do not join with force using the fixing bolts.

Support and suspend pipework so that it does not swivel or affect the machine during operation, e.g. through pipework expansion caused by heat.

The inlet and outlet piping can be positioned as required within a wide range. To avoid disturbing deposits, e.g. in dead corners, the flange connections between the single pieces of the pipe work must be exactly concentric.

Protective equipotential bonding

The machine must be grounded according to VDE/0100 using the included grounding plate. Follow the specifications required by the type of grounding (TN or IT systems). Machine parts which can be touched at the same time must be connected to the same grounding system.

Bevel gear motor

The motor is included in the scope of supply. For connecting observe the manufacturer's specifications (⇒ [Sec. 12, Supplier Documentation](#)).

→ Install EMERGENCY STOP switch in the vicinity of the machine.

→ Install frequency converter including electric control.

The thickener is driven by a FLENDER Motox N-helical bevel geared motor with external fan.

Connection of the three-phase motor of the thickener drive according to the regulations of the manufacturer of the frequency converter (Provided in Y-connection for mains operation; for an operation with converter please make the windings in delta-connection!).

The motor is equipped with a thermal winding protection. For this purpose, two additional terminals are provided in the junction box. It is essential to connect this overload protection. The temperature tripping device in the switchboard required for this purpose as well as the additional cable to the motor are to be supplied on-site.

There is the possibility of installing a visual or acoustical warning signal which indicates OUT OF ACTION of the thickener when the overload connection is released.

The insulation of the motor is to be done in insulation class F.

The allowed increase in temperature of the stator coil must be 80°K, i.e. ambient temperature +80 °C.



Before starting the gearmotor for the first time, make sure it is prepared according to the Subcontractor Documentation (⇒ [Sec. 12, Supplier Documentation](#)).

Frequency converter



The frequency converter has to be dimensioned for a cut-off frequency of 87 Hz (⇒ [Sec. , Bevel spur gear unit motor on page 3-2](#)).

Frequency inverter including switchboard is to be supplied completely by the customer.

Do not separate between frequency converter and motor unless the motor has stopped.

For control lines, only use shielded cables.



The accelerating time or braking time respectively for the motor of the thickener drive is to be set on the frequency converter to approx. 20 seconds, and it is to be re-adjusted, if necessary. In the event of a sudden drive breakdown (e.g. power failure, or damaged drive) use an electrical interlocking to make sure that the feed valve to the thickener is closed immediately. Otherwise the thickener will be flooded.

After start-up, when switching off the machine, always proceed as described in [Sec. 6.4, Switch off on page 6-3](#).

Never start the machine when thickened stock is still in the cylinder trough. Once the machine is stopped, the stock suspension remaining in the cylinder trough continues to dewater during the standstill. It becomes a thick stock marsh that can lead to inadmissibly high starting moments, increased wear to all drive components and even damages to the cylinder in folded design, the take-off teeth and the drive, when the machine is restarted.

Pos. No.	Qty.	Designation	Dimensions	Part No.
—	1	DRIVE K107DRE132M4	EFK1335	157875
—	1	MOTOR	15 HP, 1200 RPM, 284TC	159232
001	1	GEAR BASE PLATE	280 X 590 X 55	1243-005392
002	1	COUPLING ATRA-FLEX	T6	159234
003	1	STEEL PLATE	695 X 590 X 55	2550272
004	6	SPRING WASHER DIN128	A20	2510815
005	6	HEX. BOLT ISO4014	M20X70	01064376
006	4	HEX. BOLT ISO4017	M30X100	979330100-VT
007	4	WASHER ISO7089	30	01056973
008	1	SPRING WASHER DIN128	B30	2503318
009	2	HEX. NUT ISO4032	M8	01083771
010	1	COUPLING GUARD, SPLIT	528 X 417 X 285	1243-005393
011	10	HEX. BOLT ISO4017	M8 X 16	01045536
012	4	SPRING WASHER DIN128	A8	01083777
—	6	WASHER ISO7089	8	01056967

Tab. 10-10 Component parts list drive.

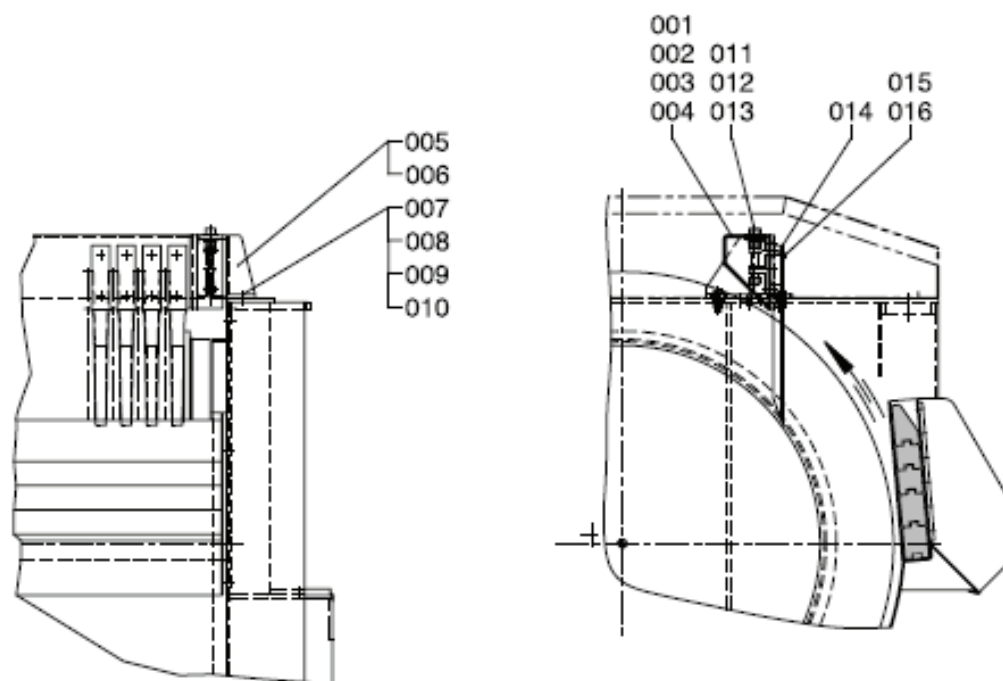
10.11 Take-off device

Fig. 10-11 Component parts take-off device

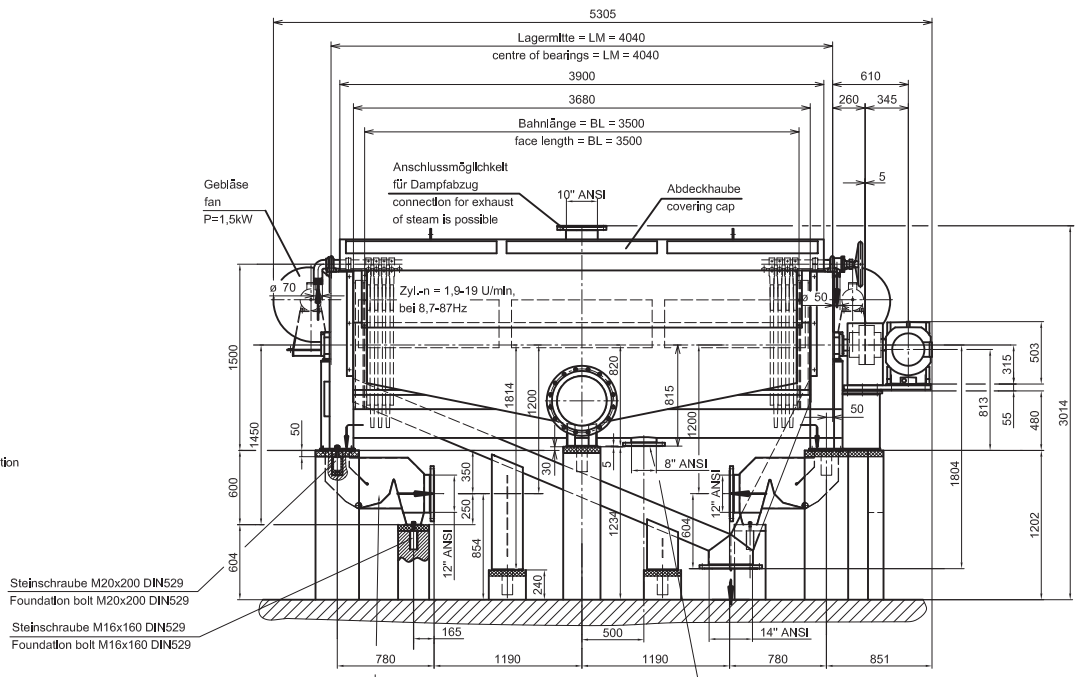
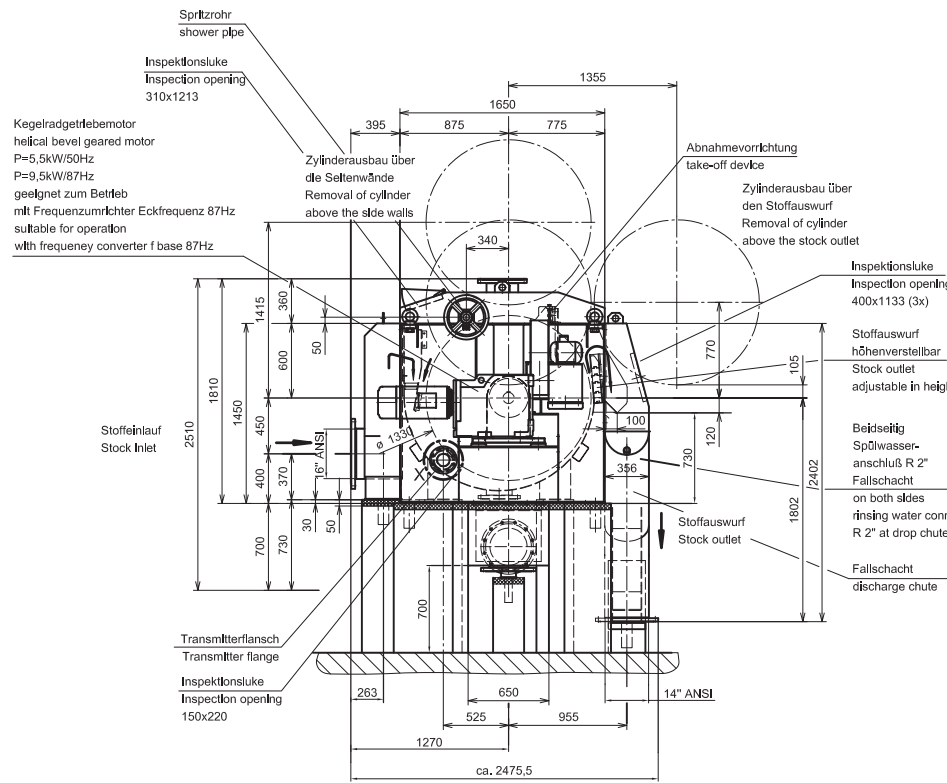
11 Appendix

This appendix contains:

- 3 Order Forms for Spare Parts
- Certification Sheet
- Foundation Drawing No. [1243-005347/Ô](#)

DRUM THICKENER Certification Sheet

IDENTIFICATION	CUSTOMER <u>Graphic Packaging</u>		EQUIPMENT TYPE <u>EFK</u>	
	ADDRESS (ORDER) <u>Middletown, OH</u>		MODEL NO. <u>EFK 1335</u>	
	ADDRESS (INSTALL) <u>Same</u>		SERIAL NO.* <u>34960</u>	
	CUSTOMER P.O. NO. <u>4504214051</u> DATED <u>10/01/2013</u>		VOITH PAPER ORDER NO. <u>194157</u>	
	CUSTOMER EQUIPMENT NO. _____		VOITH PAPER ORDER DATE <u>10/03/2013</u>	
	CERTIFIED BY <u>Michael Wiedemeier</u> Michael E. Wiedemeier		TITLE <u>Senior Product Engineer</u>	
APPLICATION	INSTALLATION DWG. <u>1243-005347/C</u>		PRODUCTION <u>182</u> BDSTPD _____ GPM	
	INLET STOCK CONSISTENCY (MIN) <u>1.3%</u>		OUTLET STOCK CONSISTENCY <u>4.5%</u>	
	FREENESS <u>325 CSF</u>			
MATERIAL	VAT <u>316</u>			
DRIVE	MAIN DRIVE BY: <u>SEW</u> <u>15 HP KW</u> <u>1200 RPM INPUT</u> <u>21 RPM OUTPUT</u>			
MOTOR	DRIVE MOTOR BY <u>Voith</u>		MFG <u>Baldor</u>	FRAME <u>284T</u> HP <u>15</u> RPM <u>1200</u>
	VOLTS <u>460</u>	PHASE <u>3</u>	HERTZ <u>60</u>	ENCLOSURE _____ MOUNTED BY _____
	FAN MOTOR BY <u>Voith</u>		MFG _____	FRAME _____ KW <u>1.5</u> RPM <u>3600</u>
	VOLTS <u>460</u>	PHASE <u>3</u>	HERTZ <u>60</u>	ENCLOSURE _____ MOUNTED BY _____
REMARKS	<p>*ALWAYS SPECIFY UNIT SERIAL NO. WHEN ORDERING SPARE PARTS.</p> <p>01/15/2014 Revision "B" - Certified Drawing. 10/8/14 revised motor information, Revision "C" - Certified Drawing</p>			

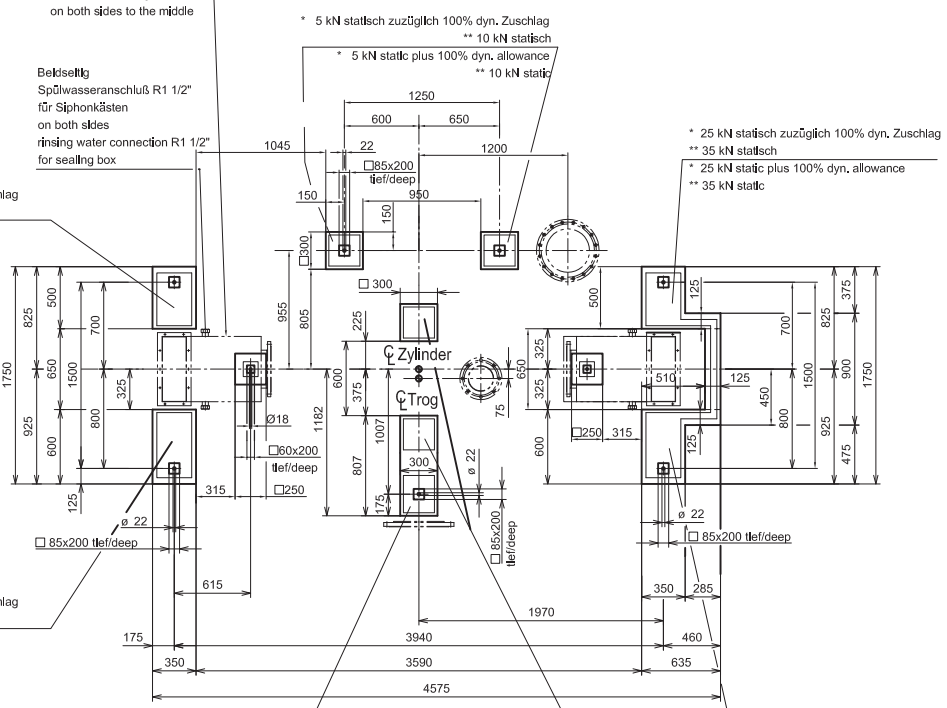


Steinschraube M20x200 DIN529
Foundation bolt M20x200 DIN529

Steinschraube M16x160 DIN529
Foundation bolt M16x160 DIN529

Variante B:
Anschluss Siphonkasten
beidseitig zur Mitte
connection sealing box
on both sides to the middle

Zylindertrogentleerung
Entleerungsschieber
und Rohrleitung
kundenseitig beigestellt
cylinder trough discharge,
discharging valve and piping
to be supplied by customer!



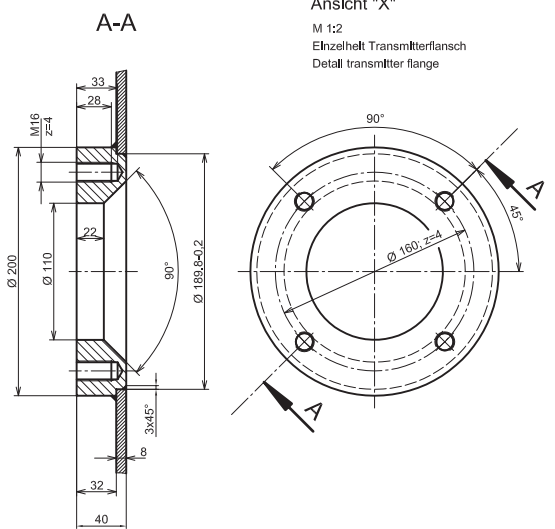
* 20 kN statisch zuzüglich 100% dyn. Zuschlag
** 30 kN statisch
* 20 kN static plus 100% dyn. allowance
** 30 kN static

* 20 kN statisch zuzüglich 100% dyn. Zuschlag
** 30 kN statisch
* 20 kN static plus 100% dyn. allowance
** 30 kN static

* 15 kN statisch zuzüglich 100% dyn. Zuschlag
** 15 kN statisch
* 15 kN static plus 100% dyn. allowance
** 15 kN static

* 15 kN statisch zuzüglich 100% dyn. Zuschlag
** 15 kN statisch
* 15 kN static plus 100% dyn. allowance
** 15 kN static

* 25 kN statisch zuzüglich 100% dyn. Zuschlag
** 35 kN statisch
* 25 kN static plus 100% dyn. allowance
** 35 kN static



Ansicht "X"
M 1:2
Einzelheit Transmitterflansch
Detail transmitter flange

Maschine mit Antrieb "rechts!"
(in Stofflaufrichtung gesehen)
Machine with drive side "right!"
(seen in stock flow direction)

Anmerkungen / Notes:

Masse ca. / Mass approx.	Kg
Gesamtmaschine leer / Total machine empty	5000
Gesamtmaschine betriebsbereit / Total machine operational	11000
Gesamtmaschine mit max. Füllung / Total machine with max. filling	16000
Zylinder mit Lagerung / Cylinder with bearings	1500
Antrieb mit Grundplatte / Drive with base plate	480
Kupplung / Coupling	66

Düsen-/Spritzrohr / Nozzle shower

Spritzwasserdruck / Shower water pressure	4 bar
Spritzwasserverbrauch / Shower water consumption	314 l/min

Lüfter / Fan

<input type="checkbox"/> Standard	
<input type="checkbox"/> auftragsbezogen gem. Motormaßblatt-Nr. order-related acc. to motor dimension sheet N°	
Motorleistung / Motor power requirement	1,5 kW
Motorendrehzahl / Rated motor speed	3000 1/min
Motorrendrehmoment	... Nm
Motorart / Type of motor	B3
Massenträgheitsmoment / Moment of inertia	... Kgm**2

Antrieb / Drive

<input type="checkbox"/> Standard	
<input type="checkbox"/> auftragsbezogen gem. Motormaßblatt-Nr. order-related acc. to motor dimension sheet N°	
Motorleistung / Motor power requirement	15 HP
Motorendrehzahl / Rated motor speed	1200 1/min
Getriebemotorenndrehmoment / Rated gearmotor torque	21800 lb-in
Getriebemotorart (Fabrikat SEW) / Type of gearmotor (manufacturer SEW)	K107AM284
Massenträgheitsmoment / Moment of inertia	... Kgm**2

Flansch-Anschlussmaße nach DIN EN 1092-1 PN10
FLANGE CONNECTING DIMENSIONS DIN EN 1092-1 PN10

Bei Ortsmontage mit schwundfreiem Verguss unterglessen
During local erection, grout with shrink-free grouting material

Kunde/Customer
VOITH

SCHUTZPOTENTIALAUSGLEICH / PROTECTIVE BONDING CONDUCTORS
Die Körper müssen unter den für jedes System nach Art der Erdverbindung (TN oder IT-System) festgelegten Bedingungen an einen Schutzleiter angeschlossen werden. Gleichzeitig berührbare Körper müssen an dem selben Erdungssystem angeschlossen sein.
THE BODIES ARE TO BE CONNECTED TO A PROTECTIVE CONDUCTOR UNDER THE CONDITIONS DETERMINED FOR EACH SYSTEM ACCORDING TO THE TYPE OF GROUND CONNECTION (TN OR IT-SYSTEMS). SIMULTANEOUSLY ACCESSIBLE BODIES ARE TO BE CONNECTED TO THE SAME EARTHING SYSTEM.

Liefergrenzen / DELIVERY LIMITS
In der Zeichnung angegebene Liefergrenzen sind Standardliefergrenzen. Der auftragsbezogene Lieferumfang von VPR ist im Vertrag verbindlich festgelegt.
THE DELIVERY LIMITS GIVEN IN THE DRAWING ARE THE STANDARD DELIVERY LIMITS. THE VPR-ORDER-SPECIFIC SCOPE OF DELIVERY IS CONTRACTUALLY STIPULATED.

Achtung / NOTE
VPR ist nicht verantwortlich fuer die Ausführung von Stahlkonstruktionen, Fundamenten, Strukturen und sonstigen Ausrustungen, die nicht im Lieferumfang von VPR sind.
VPR IS NOT RESPONSIBLE FOR THE DESIGN OF SUPPORTS, FOUNDATIONS, STRUCTURES AND OTHER EQUIPMENT WHICH ARE NOT PART OF THE VPR DELIVERY.

Maschinen Nr. machines no.	Equipment Nr. equipment no.
34960	

STATUS :
☐ Nur zur Information
Only for information
☐ Vorläufig
Preliminary
☐ Zur Genehmigung
For approval
.....
Unterzeichnet / Signed
Datum / Date
☒ Freigabe zur Fertigung
Certified for construction
☐ Endgültige Ausführung
Final design

12 Supplier Documentation

Contents:

- ATRA-FLEX® T-Flex® Coupling Installation Manual
- SEW SPIROPLAN® W Series Gear Units Assembly and Operating Instructions
- Baldor® Motor EM4100T Product Information Packet
- Stamm Showers Installation, Operating, & Maintenance Instructions
- Groste Single Stage Radial Fan Operating Manual

T-Flex® ≤ Installation Manual

1. Preparation for Mounting Hubs:

- Shaft and bore surfaces must be clean of burrs, nicks and dirt.
- Shaft and bore dimensions should be checked for required fit.

** Note Shaft-to-Hub fit required depends on the type of service in which the coupling will be used. The End User or OEM should specify the fit. **

2. Mounting the Ring Hub and Flex Hub:

- Mount the Ring Hub and Flex Hub as illustrated, flush to the shaft ends if possible. If overhang is required, maintain a minimum of 1:1 shaft contact for slip fits, or .6:1 for interference fits of .0005 per inch or greater. Tighten set screws.

3. Coupling Alignment:

- Before moving the equipment in place for alignment, the Drive Ring must be placed behind the winged section of the Flex Hub (lobe side of Drive Ring facing Ring Hub) to rest on small diameter of Flex Hub or shaft. If laser alignment is not an option, use a dial indicator to check the radial and angular offsets. Attach the dial indicator to the ring hub with the probe contacting the outside diameter of the Flex Hub. The probe should be perpendicular to shaft centerline for the radial offset alignment check. Rotate the ring hub 360° while checking the measurements of the probe at each of the 6 wings. The total indicated run out should not exceed (R). To check the angular offset, adjust the indicator probe to contact the face of the Flex Hub as near to the outside diameter as possible, and rotate the Ring Hub 360°, checking the readings at a minimum of three wings 120° apart. The difference from one wing to the other cannot exceed (A). The (E) gap should be set by using a feeler gauge between the narrowest points, ensuring a gap of (E) minimum. Note: the - axial tolerance should be reserved for thermal growth during operation.
- Note: Increase (E) as needed if anticipated thermal growth exceeds the - axial tolerance.
- If **Spacer Type Coupling** is used, (E) should be increased by the spacer body length. The Spacer Body length is adjusted by the factory to allow the proper coupling gap when spacer body is installed.

4. Installing the Insert:

Note: The insert may be 1, 2, Or 3 piece depending on size and type

Once the alignment is complete, the insert can either be wrapped into or placed inside the pockets of the Flex Hub.

5. Installing the Drive Ring:

- Pull the Drive Ring over the Flex Hub, placing the ring lobes over the insert lobes until you make contact with the Ring Hub. Insert 1 or 2 cap screws with lock washers through the Drive Ring and line up the cap screws with the threaded holes of the Ring Hub. Make sure the Drive Ring is fitted completely over the locator of the Ring Hub. Hand tighten a few to get it started, then torque down all 6 cap screws to (TT) Inch Lbs.

6. Replace Coupling Guard:

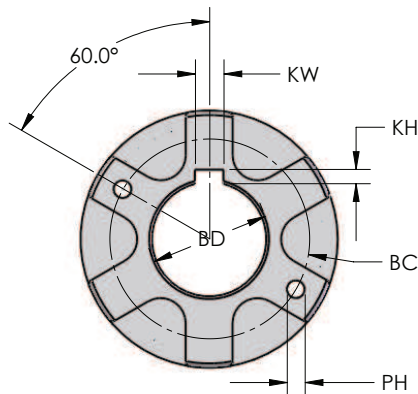
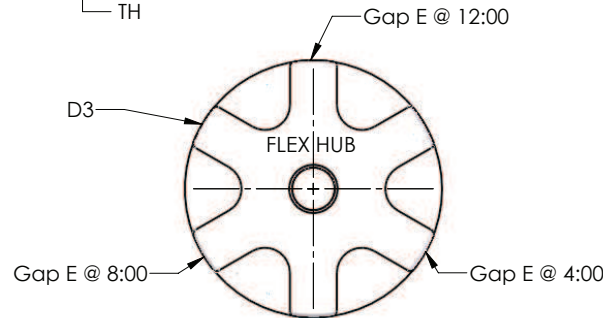
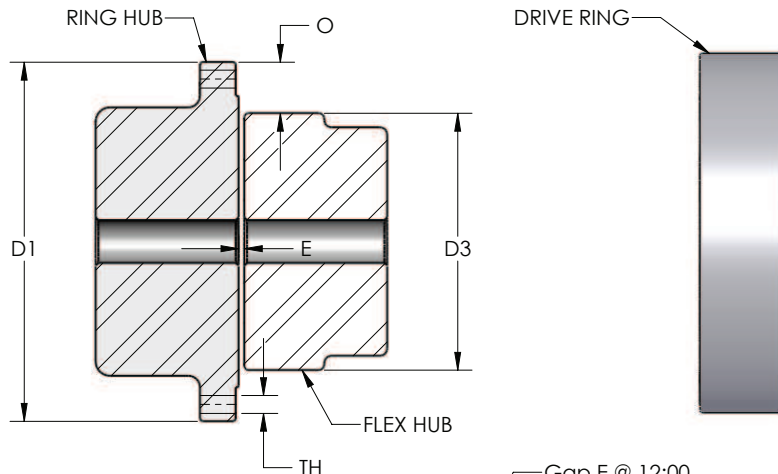
Per OSHA, all rotation al equipment must be enclosed with a guard.

T-FLEX® TECHNICAL INFO / ALIGNMENT AND MACHINING TOLERANCES

PATENT # 7,244,186

ALIGNMENT TOLERANCES

SIZE>	T-0	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	T-12
GAP E	.100	.100	.100	.100	.180	.180	.180	.200	.200	.200	.200	.250	.275
E +	.100	.125	.125	.175	.175	.225	.225	.250	.250	.250	.350	.350	.350
E -	.020	.030	.030	.040	.040	.050	.050	.070	.070	.070	.070	.070	.100
PARALLEL O	.450	.571	.650	.895	1.265	1.207	1.693	1.767	2.090	2.120	2.120	2.687	3.756
O +/-	.020	.030	.030	.030	.040	.040	.040	.040	.040	.045	.050	.075	.075
TIR	.040	.060	.060	.060	.080	.080	.080	.080	.080	.090	.100	.150	.150
ANGULAR A°	2	2	2	2	1	1	1	1	1	1	1	1	1
D1	2.950	3.840	4.800	6.290	7.800	9.765	11.900	13.600	14.625	18.020	19.950	23.250	28.500
D3	2.050	2.820	3.500	4.500	5.650	7.350	8.515	10.065	10.435	13.780	15.710	17.875	20.988
TH-UNF	6-32	10-2	1/4	5/16	1/2	1/2	5/8	5/8	3/4	7/8	1	1 1/8	1 1/2
TT IN-LBS	31	85	210	415	1900	1900	3500	3500	6200	8500	12300		46500



BORE/KEYWAY CHART

BD	KW X KH	BD	KW X KH
1/2 - 9/16	1/8 X 1/16	3 5/16 - 3 3/4	7/8 X 7/16
5/8 - 7/8	3/16 X 3/32	3 13/16 - 4 1/2	1 X 1/2
15/16 - 1 1/4	1/4 X 1/8	4 9/16 - 5 1/2	1 1/4 X 5/8
1 5/16 - 1 3/8	5/16 X 5/32	5 9/16 - 6 1/2	1 1/2 X 3/4
1 7/16 - 1 3/4	3/8 X 3/16	6 9/16 - 7 1/2	1 3/4 X 7/8
1 13/16 - 2 1/4	1/2 X 1/4	7 9/16 - 9	2 X 1
2 5/16 - 2 3/4	5/8 X 5/16	9 1/16 - 11	2 1/2 X 7/8
2 3/16 - 3 1/4	3/4 X 3/8	11 - 13	3 X 1

**SLIP FIT BORES = NOMINAL SHAFT DIAMETER +.001/+.002
SUPPLIED WITH STANDARD KEYWAY AND TWO SET SCREW (1 OVER KEYWAY & 1 @90°)**

**INTERFERENCE FIT BORES = NOMINAL SHAFT DIAMETER X .0005 = INTERFERENCE +/- .0005
SUPPLIED WITH STANDARD KEYWAY AND ONE SET SCREW OVER KEYWAY**

**ALL SPLINED AND TAPER BORES ARE AVAILABLE WITH EXTRA CHARGE & LEAD TIME
FACTORY DYNAMIC BALANCING IS AVAILABLE WITH EXTRA CHARGE & LEAD TIME**

FLEX HUB PULLER HOLES (OPTIONAL)

SIZE>	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	T-12
PH	1/4	1/4	5/16	1/2	1/2	5/8	5/8	3/4	7/8	1	1 1/8	1 1/2
BC	2.285	2.875	3.500	4.525	5.925	7.000	8.150	8.800	11.400	13.350	14.650	16.494

NOTE: THE STANDARD RING HUB BOLT PATTERN CAN BE USED AS PULLER HOLES



BALDOR® • RELIANCE®

Product Information Packet

KURZ ELECTRIC SOLUTIONS

EM4100T

15HP, 1175RPM, 3PH, 60HZ, 284T, 1046M, TEFC, F1

Part Detail

Revision:	D	Status:	PRD/A	Change #:	Proprietary:	No
Type:	AC	Prod. Type:	1046M	Elec. Spec:	CD Diagram:	
Enclosure:	TEFC	Mfg Plant:		Mech. Spec:	Layout:	
Frame:	284T	Mounting:	F1	Poles:	Created Date:	05-17-2010
Base:	RG	Rotation:	R	Insulation:	Eff. Date:	11-11-2013
Leads:	9#10				Replaced By:	

Literature:

Elec. Diagram:	
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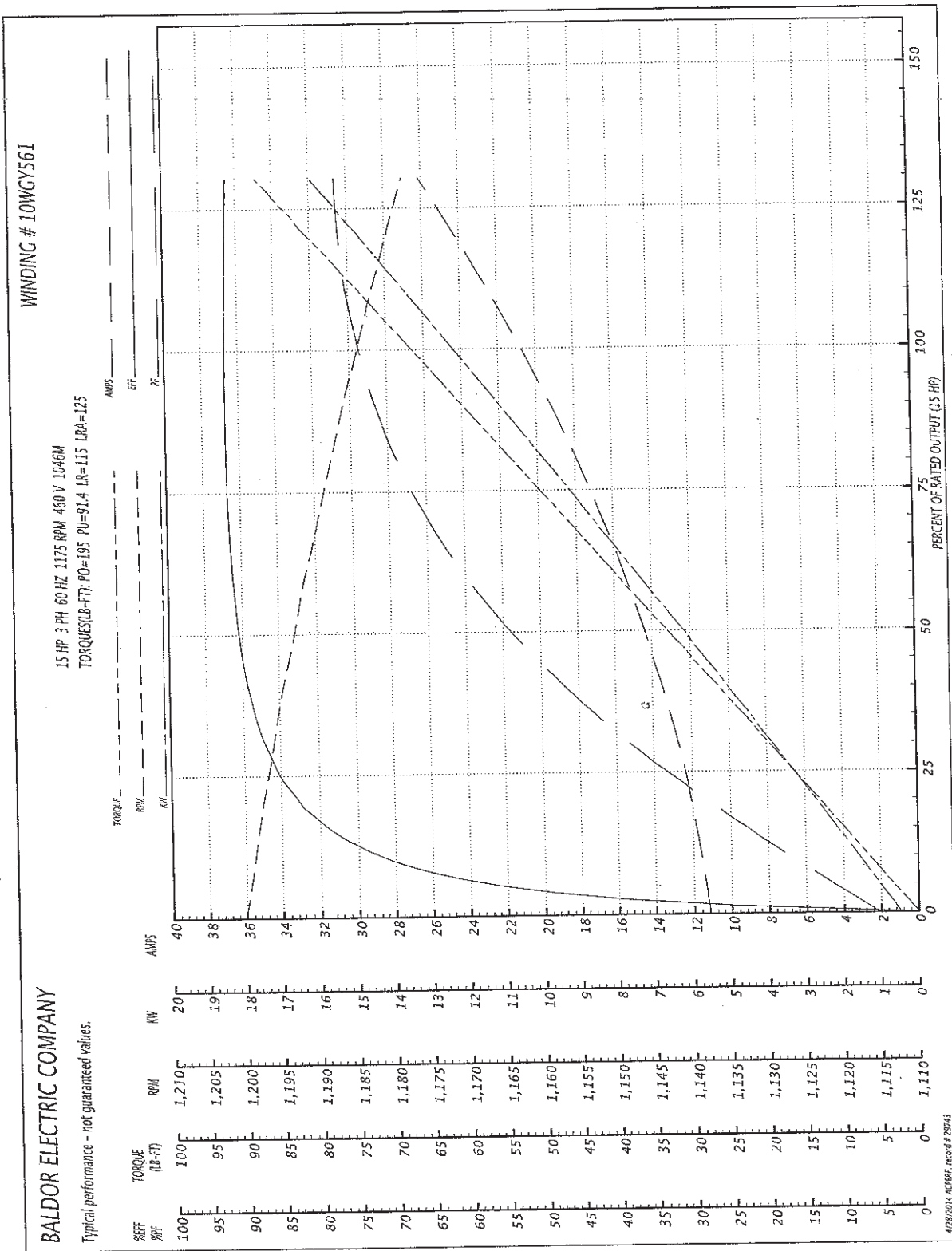
Nameplate NP2138L

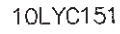
CAT.NO.	EM4100T	P/N	ENCLOSURE	TEFC:
SPEC.	10C151Y561G1	CC	FRAME	284T S/N
HP	15	CLASS	HZ	60
RPM	1175	PH	DES	A
VOLT	230/460	KVA-CODE	ODE BRG	6309 DE BRG 6311
AMP	42/21	USABLE AT 208V		
RATING	40C AMB-CONT	GREASE		
NEMA-NOM-EFF	91.7	PF	SER.F.	1.15
HTR-VOLTS		HTR-AMPS	MAX. SPACE HEATER TEMP.	

Performance Data at 460V, 60Hz, 15.0HP (Typical performance - Not guaranteed values)

General Characteristics				Start Configuration:		DOL
Full Load Torque:		66.5 LB-FT		Break-Down Torque:		195.0 LB-FT
No-Load Current:		11.3 Amps		Pull-Up Torque:		91.4 LB-FT
Line-line Res. @ 25°C.:		0.56099 Ohms A Ph / 0.0 Ohms B Ph		Locked-Rotor Torque:		115.0 LB-FT
Temp. Rise @ Rated Load:		49 C		Starting Current:		125.0 Amps
Temp. Rise @ S.F. Load:		59 C				
Load Characteristics						
% of Rated Load	25	50	75	100	125	150
Power Factor:	34.0	54.0	66.0	73.0	76.0	77.0
Efficiency:	85.0	90.6	91.8	92.0	91.5	91.3
Speed:	1197.0	1193.0	1188.7	1183.9	1179.0	1177.5
Line Amperes:	12.2	14.3	17.3	20.8	25.1	26.1
						23.4

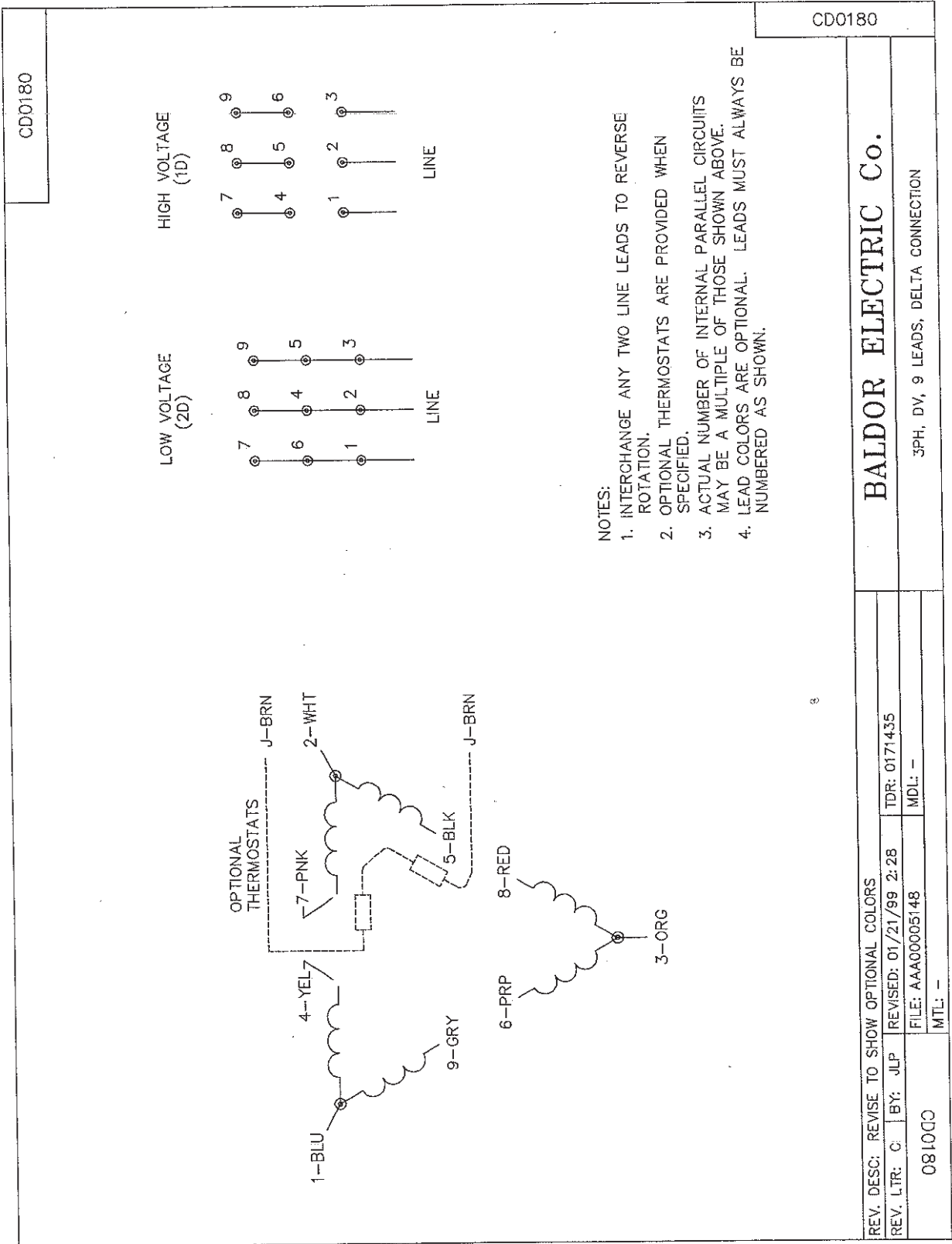
Performance Graph at 460V, 60Hz, 15.0HP Typical performance - Not guaranteed values





BALDOR

SH 1 of 1

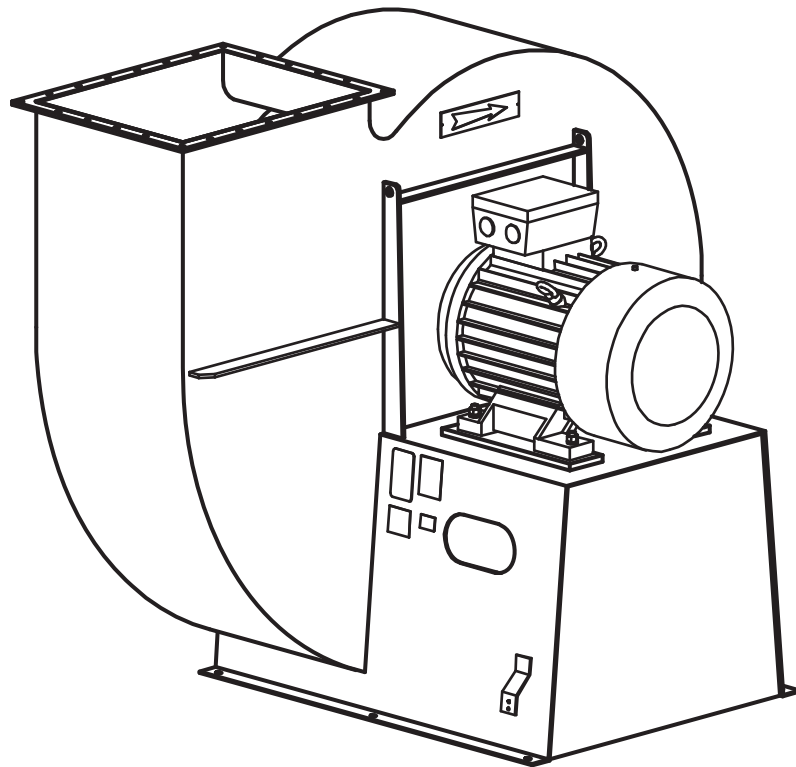


Translation of the Original Instructions

Operating manual

Single Stage Radial Fan

Design M





Please read this operating manual carefully. In case of doubts or if uncertain points occur, please clarify them with GroSte first.

The operating manual is, like spare parts lists and documentations of sub-suppliers, a separate part of the complete documentation. The complete documentation must be made available to the personnel appointed to operating and maintenance works.

OPERATING MANUAL: RADIAL FAN M

This operating manual is intended for technical personnel that performs the following work related to the fan: transport, mounting, commissioning and start-up, operation, operating, troubleshooting, maintenance, repair, shutting-down, dismantling, disposal. Instructions and drawings of technical nature must not be copied in parts or completely, distributed or used without authorization for the purpose of competition or information of third parties.

This operating manual was drawn up with the utmost care. GroSte GmbH is not liable for possible errors in this operating manual. Liabilities for indirect and / or direct damages that are related to the delivery or the usage of this operating manual are excluded, as far as legally permitted.

This document is a translation. In case of discrepancy the original and obligatory version is the German original.

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1. Introduction

This general operating manual is valid for all fans of this structural design including those that are designed in accordance to the Directive 94/9/EC on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (ATEX). All fans are designed and produced in accordance with EC Machinery Directive 2006/42/EC.

1.1 EC Declaration of conformity and EC Declaration of incorporation

Being part of the overall documentation, these declarations are attached as separate documents to this operating manual (see enclosure).

The fan design in accordance with EC directive 94/9/EC (ATEX) will be certified by correspondent declaration of conformity.-

1.2 Fan data sheet

The fan data sheet (see enclosure) is also attached as a separate document to this operating manual. All relevant technical data of the fan is clearly given in the fan data sheet. It may also be called technical data sheet and is generated for each individual fan.

The fan data sheet contains the following information:

- Serial fan number
- Fan type
- Flow data (nominal data and operating points)
- Motor data
- Acoustic data
- Material data
- Type of coating
- Fan equipment and accessories
- Customer's order number
- Customer's type designation

For fans according to EC directive 94/9/EC (ATEX), an additional part of the documentation is the completed and signed form of the questionnaire (RKU0063-... as amended from time to time) and – if applicable – the indication of the certification body where the documentation for fans of category II was lodged.

1.3 Description

The fan of M design is a welded single-stage radial fan.

The fan is directly driven by the motor shaft on which the impeller is mounted.

Further technical information that is not covered by this operating manual can be requested from the manufacturer.

The fan can be designed for use in potentially explosive atmosphere. An individual nameplate indicates the equipment group and category as per directive 94/9/EC (ATEX)

1.4 Intended use

The fan is designed, calculated, produced, tested and delivered in accordance with the design conditions stated in the order.

The values given in the fan data sheet must not be exceeded.

Any other or exceeding use is considered to be improper use. Damages resulting from improper use are excluded from the manufacturer's liability.

1.4.1 Fans according to 94/9/EG

If the fan is designed in accordance to EC directive 94/9/EC (ATEX), the intended use is restricted to

- the field of application
- the equipment group and category
- the explosion group for gases and vapours
- the gas or dust type
- the temperature class

These specifications can be found on the ATEX nameplate at the fan and in the corresponding ATEX questionnaire.

Any other use or application in installation conditions deviating from those there stipulated is prohibited.

1.4.2 Limits for use of fans acc. to 94/9/EG (ATEX)

The limiting conditions for the use of fans that are designed according to Directive 94/9/EG are:

- Maximum inlet temperature under ambient atmospheres in the temperature range from -20°C to +60°C
- Absolute pressure from 0.8 to 1.1 bar
- maximum 21% oxygen share in volume flow

If the operating conditions differ from the stated limiting conditions, a special contract of work and labour has to be concluded with GroSte. The design must be documented by a separate ignition hazard assessment.

1.5 Installations and mounting instructions to reduce noise and vibrations

Take the following measures to reduce noise and to protect the operating personnel's health:



- Connect the fan to the duct work at inlet and discharge prior to fan start-up
- Mount the sound protection cover (if included in the delivery)
- Isolate the housing on-site if the fan is prepared for insulation and this is included in the delivery
- Wear personal protective equipment (especially ear protection) → see also chapter 2.2 Danger outline

Take the following measures to reduce the vibrations and to avoid the transmission of vibrations to the duct work:

- Check the impeller according to the maintenance plan (see chapter 7.8 Maintenance schedule) with regard to sticking material, wear and tear, etc. since out-of-balance might result in an increase in fan vibrations → see chapter 9.1.2 Limiting values vibrations
- Mount the flexible connections at inlet and discharge prior to fan start-up (see also chapter 3.7.5 Use of flexible connections)
- If the fan is intended for resilient mounting: mount the fan on anti-vibration mounts (see chapter 3.6.4 Mounting and Alignment)

1.6 General remarks

This universal operating manual assists the operating company to carry out the safe and proper transport, installation, commissioning, start-up and maintenance of the fan.

This operating manual exclusively refers to the fan, but not to the electrical equipment like drive motors and other auxiliary drives. The unit “fan and motor” will not turn into electrical equipment when an electric drive is mounted. Please observe the operating and maintenance instructions of the motor manufacturer for mounting, installation and maintenance of the electric motors and auxiliary drives.

This operating manual describes and represents components that may not be included in your delivery.

In addition, our scope of delivery can include components and additional equipment that are not mentioned in these instructions. In that case, please observe the corresponding operating manuals of the relative producers. If applicable, request them from GroSte.

This operating manual is subject to modifications due to further technical development of the fan described herein.

Many images and drawings of this operating manual are simplified representations. Due to improvements and modifications the fan operated by your company might vary from the representations.

We reserve the copyright in this operating manual and the attached drawings and further documents.

The manufacturer will not undertake liability for damages that

- occur during the warranty period resulting from:
 - inadequate maintenance,
 - improper operating and another than the intended use
 - faulty mounting and installation,
 - incorrect or inexperienced connection of electric or mechanic machines and devices.
- result or originate from unauthorized modifications or from disregarding the manufacturer's recommendations and instructions.
- result from the use of accessories, equipment and/or spare parts that are not recommended by or delivered from the manufacturer.

This operating manual serves to avoid personal injury, property damage, functional failure as well as environmental damage.

Read these instructions carefully and completely before start of work. Should you have any questions or in case of doubts please do not hesitate to contact GroSte.

Keep these instructions in a safe place. They must be accessible for the operating company at any time. Protect them against harmful environmental influences and keep them in a legible and complete condition. Store them near to the fan.

The following additional instructions apply for fans according to directive 94/9/EC (ATEX):

If any technical modification at a fan that was designed and constructed in accordance with directive 94/9/EC (ATEX), that has not been agreed upon prior to the modification with GroSte, is carried out the originally issued declaration of conformity will become invalid.

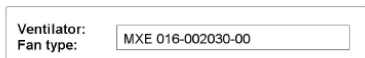
The validity of the declaration of conformity can be maintained, if a qualified person carries out applicable tests and examinations after the technical modifications and prior to re-commissioning of the fan and keeps records of the tests. In particular, these inspections are the check of the gap measure, vibration test and further checks to ensure that the formation of sparks is eliminated. The qualified person must be authorized to install and mount the components in accordance with §§ 14 and 15 of the German Health and Safety at Work Regulations („Betriebssicherheitsverordnung BetrSichV“). In addition, the qualified person must be able to recognize possible dangers for persons, property and environment and to avoid them. A written confirmation of the checks and examinations along with corresponding test reports must be sent to GroSte without further request. Please contact GroSte if any questions or uncertainties occur.

If the fan is of category II, we will inform the certification body, to which the documentation has been sent, accordingly.

1.7 Nameplate

The nameplate shows the following information:

- Manufacturer
- Address
- Designation of the machine
- Type designation
- Serial number
- Year of construction
- Technical data
- CE - sign



If technical information is or spare parts are required, all above mentioned data must be communicated.

If the fan is designed in accordance with directive 94/9/EC (ATEX), it has an additional nameplate with the following information:

- manufacturer
- address
- ATEX marking
- type designation
- serial number
- certification body

Figure 1

Figure 1: Example of an ATEX-nameplate

2. Safety instructions

2.1 General remarks

It is essential to read the operating manual prior to transport, installation, commissioning, start-up, operating, repair and maintenance. The instructions have to be observed.

2.2 Danger outline

Radial fan – single-stage, structural design M

Kind of danger	Location of danger	Danger	Additional measures
rubbing and abrasing	brake (optional), all rotating parts	explosion hazard by sparking and/or hot surfaces	observe operating manual, wear personal protective equipment
impact and rubbing	housing, impeller, motor, improper handling during transport	explosion hazard by sparking and / or hot surfaces	observe operating manual and transport instructions
corrosion	housing, impeller, motor, improper storage or intermediate storage	deposits of corrosion increase the risk of ignition and sparking, explosion hazard	observe operating manual and the storage and corrosion protection instructions
crushing, shearing, impact	unloading, lifting, mounting and installation of the fan	danger to life, risk of injury and property damage	pay attention to safe fastening and safe foundation / floor conditions
entangling, winding, drawing-in, trapping, faulty installation	heat flinger, impeller, all rotating parts, brake (optional)	danger to life, risk of injury and property damage	observe operating manual
electrical hazard	directly by alive parts	danger to life	observe motor manufacturer's operating manual
	indirectly by faulty alive parts	danger to life	observe safety regulations
thermal hazard caused by contact and burn	hot surfaces	danger to life, risk of injury and property damage, risk of explosion due to heightened ignition risk	wearing of personal protective equipment by staff, if necessary, customer must install safety areas
thermal hazard caused by improper installation, commissioning and start-up	hot surfaces e.g. housing, lifting lugs, drain, fan pedestal	danger to life, risk of injury and property damage, risk of explosion due to heightened ignition risk	wearing of personal protective equipment by staff, if necessary, customer must install safety areas
hazard generated by materials and foreign substances and improper use	housing, impeller, driving elements, monitoring devices	risk of property damages and danger of injury	observe operating manual, provide sufficient ventilation, avoid penetration and drag-in of foreign substances
high pressure ingress and ejection of fluids and gases	shaft seal with purge medium connection	danger to life, risk of injury and property damage	observe the operating manual, wearing of personal protective equipment
hazard generated by noise	during operation the sound emission exceeds 70 dB(A)	impairment of hearing ability, danger of injury	observe the operating manual, wearing of personal protective equipment

Kind of danger	Location of danger	Danger	Additional measures
combination of hazards	danger for machinery, personnel and environment if the commissioning, start-up of the fan is not carried out by sufficiently trained staff members	danger of injury, property damages, environmental damages	observe operating manual

Table 1 – danger outline

2.3 Symbols

The following symbols used in this operating manual need to be particularly observed:

Observe carefully the safety instructions that are listed next to the symbols in the following chapters. A label with these symbols and the corresponding instructions is also fixed to the fan.



DANGER!

Danger to life!

Serious physical injury with potential fatal consequences.



DANGER!

Danger of death by electrocution!

Serious physical injury with potential fatal consequences.

Working must exclusively be carried out by authorized electrician



DANGER!

Risk of fatal injury from entangling, drawing-in or trapping

Serious physical injury with potential fatal consequences.

Beware of automatic operation



DANGER!

Explosion hazard!

Spark formation or hot surfaces

Serious physical injury with potential fatal consequences.



WARNING!

Very hot surface – Do not touch!

Risk of burns. Severe personal injury



WARNING!

Risk of escaping of hot or dangerous gases.



CAUTION!

Risk related to exposure to noise!

Physical injury

Wear ear protection when fan is in operation.



WARNING!

Environmental harm!

Considerable damage caused to the environment.



NOTICE!

Read the operating manual.



NOTICE!

Refers to useful information and explanations.

2.4 Safety regulations

The following instructions and regulations that are part of the operating manual are strictly to be observed.

- safety regulations,
- regulations for the prevention of accidents,
- directives and accepted engineering standards.

Disregarding the safety regulations causes the risks of personal injury and damage to the fan.

Any work on fans that are marked according to directive 94/9/EC (ATEX) must exclusively be carried out by qualified persons that are authorised as per §§ 14 and 15 of the German Health and Safety at Work Regulations („Betriebssicherheitsverordnung BetrSichV“), unless these works are carried out by trained personnel of GroSte.

2.5 Regulations, standards

Working on the fan must comply with the valid rules for the prevention of accidents and the accepted engineering standards.

- Betriebssicherheitsverordnung (German Health and Safety at Work Regulations (BetrSichV) – “Regulations on safety and health protection for the provision of work equipment and their use for work, on the safety of the operation of plants that require special monitoring and on the organisation of health and safety protection at factory level” (translation of the full German title).
- VDMA 24165 “Ventilatoren – Sicherheitsanforderungen” (Industrial fans, safety requirements - VDMA – Verband Deutscher Maschinen- und Anlagenbau eV – German Engineering Federation)
- Regulations for the prevention of accidents (BGVs) of the “Berufsgenossenschaften (BGs)” (institutions for statutory accident insurance and prevention in Germany)
 - „Grundsätze der Prävention“ BGV A1 (General prescriptions) BGV A1
 - „Elektrische Anlagen und Betriebsmittel“ BGV A3 (Electrical installations and operating material) BGV A3
 - „Lärm“ BGV B3 (Noise) BGV B3
- Occupational Safety Regulations for safety and health at work (BG rules -BGR)
 - „Explosionsschutz-Regeln - Regeln für das Vermeiden der Gefahren durch explosionsfähige Atmosphäre“ BGR 104 (bisher ZH 1/10). (Explosion protection regulations – regulations for the prevention of dangers caused by ignitable atmospheres BGR 104 (so far ZH1/10))
 - „Vermeidung von Zündgefahren infolge elektrostatischer Aufladungen“ BGR132 (bisherige ZH 1/200) (Prevention of the ignition risk due to electro-static charging – BGR 132 (so far ZH 1/200))
 - “Betreiben von Arbeitsmitteln” BGR 500, Kap. 2.8 (Use of work equipment BRG 500 chap. 2)

- Harmonised European standards and national standards
 - EN 1127-1 „Explosive atmospheres – Explosion prevention and protection“
 - DIN 24166 „Technische Lieferbedingungen für Ventilatoren“
(German Industrial Standard - Technical delivery conditions for fans)
 - DIN EN 14986 „Konstruktion von Ventilatoren für den Einsatz in explosionsgefährdeten Bereichen“
(Design of fans working in potentially explosive atmospheres)^
- EU Directive
 - 89/686/ECC “Personal protective equipment”
 - 2009/104/EC „Use of work equipment“

2.6 Electric connection conditions

The operating company has to observe the instructions and to meet the connection conditions of the local electric supply company for the electric connection of the motor and the auxiliary drives (if any) and the system.



All electric works on the machine and its connections must exclusively be carried out by professional electricians that are authorized by the definition regarding professionals (e.g. German definition DIN VDE 0105 and IEC 364).

It has to be ensured that type of current, voltage and frequency of the electric power supply are suitable for the below enlisted components and that the electric connections are expertly made for:

- drive motor/s fan
- actuator/s damper/s
- monitoring devices
- other electric parts

If the fan is of explosion-proof design, the electric installation has to meet the requirements of DIN EN 60079-14.

2.7 Marking, danger signs

Information directly arranged on the fan, e.g. sense of rotation arrows, information signs, markings or danger signs must be observed and kept in legible condition.

See an example of nameplate, danger signs and other markings positioning at the fan in chapter 7.5 Marking, information sign.

2.8 Qualified person

Qualified persons in terms of the § 2, clause 7 German Health and Safety at Work Regulations („Betriebssicherheitsverordnung BetrSichV“) is personnel that due to professional training, work experience and their current occupational activity has the necessary expert knowledge for testing the working devices.

Qualified persons only are allowed to carry out all works at the fan, at fan components, at the fan equipment, maintenance devices and electric components. Authorised personnel must also have sufficient knowledge about

- currently valid safety regulations,
- currently valid regulations for the prevention of accidents,
- directives and accepted engineering standards.

In addition, qualified personnel must:

- be authorized to carry out the necessary works
- be able to assess the works allocated to them with regard to dangers, be able to recognize possible dangers and to avoid them.
- have read these instructions prior to working

The person who is responsible for the safety of the system authorises the personnel to carry out the works.

2.9 Personal protective equipment

The operating company and the plant engineering company are responsible for the required protective measures on site like coverage, barriers or personal protective equipment.

Operating personnel are all staff members that are in charge of installation, mounting, operation, setting, maintenance, cleaning, repair and transport of machinery.

Carrying out dangerous works and activities requires wearing personal protective equipment in terms of EU Directive 89/689/EEG in order to avoid injuries or minimise the risk of injury that might not be prevented through other measures.

The minimum equipment includes:

- helmet
- eye protection
- foot guard
- hand guard
- ear protection
- reflective jacket
- appropriate working clothes.

In dependence of the type of the works or their dangerousness, wearing of further personal protective equipment and taking further safety precautions (e.g. fall protection) may become necessary.

When working on the fan, the following "Occupational Safety Regulations for safety and health at work (BG rules -BGR) are to be observed:

- „Wearing of protective clothing “ BGR 189
- „Wearing of foot and leg guards“ BGR 191
- „Use of head protection“ BGR 193
- „Use of ear protection“ BGR 194
- „Wearing of protective gloves“ BGR 195
- „Use of protective equipment against falling“ BGR 198

2.10 Risk of slipping, tripping or falling

The operating company and the plant engineering company are responsible for necessary precautionary protective measures on site.



- Mark the transport aisles and keep them clear
- Sufficiently light the transport aisles and work-places
- Remove unevenness of floor and installation sites
- Keep the working environment tidy and clean
- Treads must be anti-slip and undamaged
- Eliminate the slip danger (e.g. remove packed snow and black ice, keep the place in a dry condition)
- Apply fall protection (e.g. safety harness) when ladders are used to access the workplace
- There is the risk of falling from heights of more than 1 metre above the floor and in case of hollows or floor openings → install safety fence (e.g. guard railing, barriers), use fast devices instead of warning tape
- Ladders cannot serve as working places. It is not allowed to carry out certain works from the ladder, when for example the ladder lacks stability, the tool's weight exceeds 10 kg, the area exposed to wind exceeds 1 m².
- Install working platforms at places that have to be maintained on a regular basis.



- Spilt working material is to be removed with suitable oil binding agent. Dispose of it in a safe manner consistent with all applicable regulations.
- Remove completely leaked grease and dispose of it properly and professionally in view of environmental protection requirements.

2.11 Measures in case of electrical power outage

In case of main and/or auxiliary electrical power failure, the fan has to be put into a safe condition. The control system must be designed so that the power breakdown or the control system itself does not result in a dangerous situation, neither at the time of the mains failure nor at the time when the energy is re-established or the control system is again ready for operation.

Additional measures for fans, whose handled gas temperature exceeds 80°C: In case the power fails, the hot handled gas must absolutely be prevented from flowing in at inlet of the fan and also from flowing back or backing up at discharge of the fan. Install proper shut-off devices including appropriate control systems on-site and keep them in an operable state.

3. Transport, Installation

3.1 General remarks

The fan and the equipment should only be transported and lifted at the provided marked lifting lugs. Load suspension devices as well as sling devices have to be in perfect condition and should only to be fastened at the provided lifting lugs.

Personnel that lifts and transports the fan must:

- have read the operating manual,
- have understood the content of the chapter transport, especially the safety regulations, the regulations for the prevention of accidents and the instructions for the transport of the fan,
- be familiar with the hoists, the required load suspension devices and the sling devices.

3.2 Safety instructions



The safety instructions for lifting and transport of the fan must be observed.

- Use hoists, load suspension devices and sling devices with sufficient load capacity only (for load / weight see fan data sheet or fan drawing)
- The angle of spread must not exceed 120° (see Figure 3).
- Do not knot steel wire ropes and chains.
- Do not tie ropes from fibres with knots.
- Do not distort the ropes.
- Untwist distorted ropes prior to lifting.
- Do not kink the ropes at wire rope clamps.
- Thimbles (cable eye stiffeners), rope eyes, suspension hooks and other lifting links must suspend freely on the lifting hook.
- Use edge guards when the slings are laid on sharp edges.
- Lift up the hook tackle when it is not used.
- Do not lift loads over people.

Observe the regulations for the prevention of accidents.

Auxiliary lifting lugs (e.g. at the motor) – if any – are suitable only for lifting the corresponding single component.



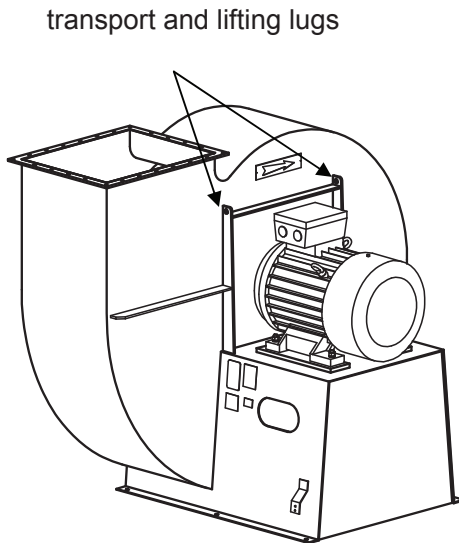
We recommend an installation performed by manufacturer's skilled staff.

3.3 Regulations, standards

The valid regulations for the prevention of accidents and the accepted engineering standards apply to the lifting and transport of the fan.

- Regulations for the prevention of accidents (e.g. German BG regulations)
 - „Allgemeine Vorschriften“ (General Instructions) BGV A1
 - „Krane“ (Cranes) BGV D6 (VBG 9)
 - „Betreiben von Arbeitsmitteln“ BGR 500, Kap. 2.8 (Use of work equipment BRG 500 chap. 2)
- National standards (e.g. Standards of the German Institute for Standardisation)
 - „Hebezeuge, Lastaufnahmeeinrichtungen“ (Hoists, load suspension devices) DIN 15003
 - „Ösenhaken, Güteklasse 5“ (Eye hooks, quality class 5) DIN 7540
 - „Schäkel“ (Shackles) DIN 82101

3.3.1 Load suspension devices



- Fans are only to be lifted and transported with the appropriate hoists and means of transport (weight indication see fan data sheet or fan drawing).
- Fasten sling devices at the especially provided lifting lugs only (see Figure 2)
- Do not damage components or fan when fastening sling devices.
- Do not fasten sling devices to the inlet, discharge, motor or base frame. This damages the fan and excludes and limits the liability of the manufacturer
- Use sling devices of appropriate length. Pay attention to an even weight distribution. Attention: Transport of fan is only permitted when the weight is evenly distributed. The fan must be kept in a nearly horizontal position throughout complete fan lifting and transport activities.

Figure 2

spread and inclination angle

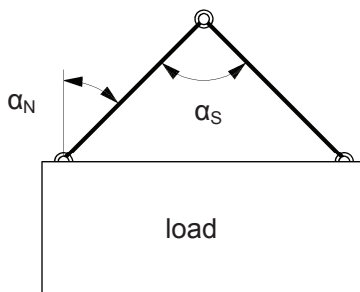


Figure 3

- Observe the spread angle and the inclination angle (see Figure 3)
The inclination angle α_N must not exceed 60° , that is to say the spread angle α_S must not exceed 120° .
- Wear personal protective equipment (see chapter 2.9)

3.4 Packing

The fan and the equipment are packed in the factory in accordance with

- the transport route,
- the storage at customer's premises
- and / or customer's requirements

Types of packing:

- Fan components mounted on wooden pallet with protection covering (welded in plastic foil).
- Fan components mounted on wooden pallet with protection covering (welded in plastic foil) and special bearing protection.
- Fan components mounted on wooden crate, protection covering (welded in plastic foil) and special bearing protection.
- Seaworthy packing in closed wooden case → Figure 4).

Fan components must only be transported with transport safety contrivances, with a protection covering (foil) and desiccants, so that no dirt and humidity can enter in the fan, in the motor bearings or in the electric components.

The protection covering must be removed prior to that installation of the fan components.

Symbol legend:

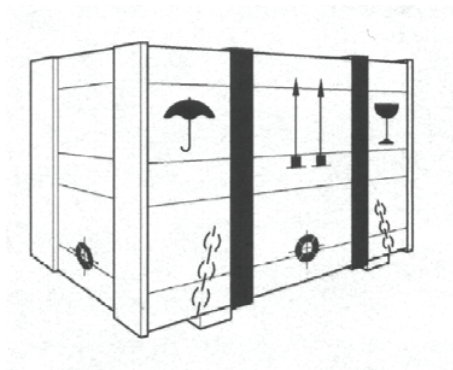
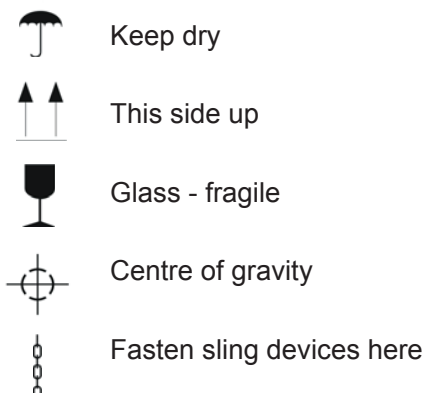


Figure 4



In case the fan or the equipment is packed and corrosion protected for an extended period of time at the factory, the separate „Instructions for Storage and Corrosion Protection of Radial Fans“ must be observed.

3.5 Transport



For lifting and transport of the fan components and the equipment observe

- 2.4 Safety regulations,
- 2.5 Regulations, standards,
- 3.3.1 Load suspension devices

- Sling devices, e.g.
 - wire ropes,
 - ropes from fibres,
 - steel cables

must be fixed at lifting lugs and suspension hooks.

- Unload the fan with suitable hoists only. Disregard of this instruction may cause the danger of crushing or shearing of parts of the body.



Cautiously place the fan onto the floor or foundation to avoid damages to the fans and other components.

- Observe permitted ground, floor, foundation or ceiling load capacities.
- After unloading of fan components and equipment
 - remove packing (depending on type of packing),
 - check fan and equipment for damages,
 - check accessories for completeness in accordance with the delivery note,
 - do not remove the cover foil and/or weather protection hood of the anti-friction bearings.
- Transport the fan components and the equipment by suitable hoists / means of transport to the installation location or storage place only.
- If the fan is transported to the installation location by vehicle:
 - lift the fan with suitable hoists onto the platform of the vehicle,
 - secure the fan against shifting and displacing by fastening belts.

3.5.1 Transport damages

Document any transport damage preferably with photographs and immediately report them to the forwarding agent, insurance company and manufacturer.

3.5.2 Intermediate storage

Please observe our separate “**Instructions for Storage and Corrosion Protection**” for proper storage of fan, shaft seal, drives, actuators, monitoring devices and other equipment.

3.6 Installation

If the fan is not delivered in a completely assembled condition, observe the separate mounting instructions for the assembly of fan which can be ordered from GroSte.

Further action to be taken if the fan has been partly pre-assembled at GroSte:



Pay particular attention to the GroSte serial number when the fans are assembled. Only assemble fan parts of the same serial number. If several pre-assembled fans of the same design are supplied, the following fan parts are clearly marked with the individual corresponding GroSte serial no.:

- lower housing parts
- upper housing parts
- rotor

In case the rotor is delivered in a transport safety contrivance, keep this transport stand for possible future rotor dismantling, rotor intermediate storage or transport on site

Fans of sectional splitting housing design:

Before the fan housing is assembled, seal the sectional splitting flanges as per the separate sealing instructions. The sealing instructions are part of the separate mounting instructions for the assembly of fans. Observe further instructions of the mounting and assembly drawing, if any.

3.6.1 General remarks

- Design conditions

The fan and the equipment are designed, tested and delivered in accordance with the design conditions specified in the order.

The specifications made in the order are documented in the fan data sheet. It is not permitted to deviate from the conditions shown in the fan data sheet (e.g. different handled gas).

Unless otherwise agreed upon, the electric components of the machine are designed for a maximum ambient temperature of 40°C and an altitude of site up to 1000 m asl in accordance with the instructions of the German standard VDE0530.. Please observe the installation instructions in the operating manual of the motor producers.

- Warranty

The warranty details refer to sing values and testing conditions in accordance with the applicable EN DIN standards and/or the valid standards and regulations. The system's specific special characteristics and local conditions must be taken into account by the system designer or the project engineer when the order data are specified.



It is essential to convert the data for the operating conditions in accordance with the existing local conditions.

3.6.2 Safety instructions

Installation works must exclusively be carried out by specialist personnel (see chapter 2.8)



It is recommended to request installation specialists of the manufacturer.

3.6.3 Preparation for installation

- Substructure of the fan like base plates, additional base frames, sole plates, steel stages or foundations must:
 - be designed in accordance with the weight and the foundation load (→ dimension sheet),
 - ensure a vibration-free installation for operation or standstill.
- Compare foundation dimensions with the fan dimension sheet and the foundation plan and ensure that:
 - there is sufficient space for installation, maintenance and repair works,
 - there is sufficient space for the intake and discharge of the cooling air for the rotary current motor.
- Carry out required corrections on the foundation and clean treated surfaces.
- Transport fan to the location of installation by suitable hoists / means of transport (see chapter 3.3.1 Load suspension devices)

3.6.4 Mounting and Alignment

3.6.4.1 General remarks



Stability of fan is at risk when the installation site is not even. This might increase the danger of crushing and shearing of parts of the body.

Prior to the start of the installation the mounting place has to be checked for evenness and dimension accuracy.



Steel foundations, foundation blocks and concrete foundations that guarantee a safe operation free from impact, vibration and distortion are appropriate sub-structures for the fan.

Assembling auxiliaries like alignment plates, fastening screws, etc. can be obtained from the manufacturer.

Request installation specialists from the manufacturer, if necessary.

After mounting on the foundation the fan must be aligned. Use appropriate measuring instruments, tools, jack screws and shims for this work.



If the fan is installed within chemically aggressive atmosphere or outdoor → use alignment sheets made of rustproof material.

3.6.4.2 Sequence of mounting

The sequence of mounting depends on the fan design. Take the appropriate fan design from the separate dimension sheet or any additional order-related drawings.

mounting on	without anti-vibration mounts	with anti-vibration mounts		
		anti-vibration mounts without mounting plate	anti-vibration mounts with mounting plate	anti-vibration mounts (spring type)
steel foundation	X	X	X	X
concrete foundation	X	-	X	X
X = possible - = not possible				

Table 2

- **Fan without anti-vibration mounts and mounting on steel foundation**

Align the fan horizontally (if necessary, use alignment plates) and fasten the fan with hexagon head screws. For tightening moments see chapter 9.1.1 Tightening moments for fastening screws

- **Fan without anti-vibration mounts and mounting on concrete foundation**

Align the fan horizontally (if necessary, use alignment plates) and screw the fan to the concrete foundation with suitable fastening devices (e.g. heavy duty anchor bolts, stone bolts).

For tightening moments see chapter 9.1.1 Tightening moments for fastening screws

- **Fan with anti-vibration mounts and mounting on steel foundation**

- Anti-vibration mounts without mounting plate
 - Screw the anti-vibration mounts to the steel foundation
 - Carefully place the fan on the anti-vibration mounts (correctly fit the set screw in the bore holes)
 - Align the fan and screw it to the steel foundation.
- Anti-vibration mounts with mounting plate
 - Carefully place the fan including the anti-vibration mounts on the steel foundation
 - Align the fan and screw it to the steel foundation.
- Anti-vibration mounts (spring type) – spring phonolators
 - Screw the anti-vibration mounts (spring type) to the steel foundation
 - Carefully place the fan on the anti-vibration mounts (spring type), correctly fit the set screw in the bore holes.
 - Align the fan and screw it to the steel foundation.
 - Observe the mounting instructions of the producer of the anti-vibration mounts (spring type), which can be obtained from GroSte

- **Fan with anti-vibration mounts and mounting on concrete foundation**
 - Anti-vibration mount with mounting plate
 - Carefully place the fan including the anti-vibration mounts on the concrete foundation
 - Align the fan and bore the foundation holes for the heavy duty anchor bolts through the bores provided on the mounting plates.
 - Screw the fan to the concrete foundation with suitable fastening devices (e.g. heavy duty anchor bolts, stone bolts). and observe the tightening moments → see chapter 9.1.1
 - Anti-vibration mounts (spring type) – spring phonolators
 - Screw the anti-vibration mounts (spring type) to the concrete foundation
 - Carefully place the fan on the anti-vibration mounts (spring type), correctly fit the set screw in the bore holes.
 - Observe the mounting instructions of the producer of the anti-vibration mounts (spring type), which can be obtained from GroSte

3.6.4.3 Screw connections

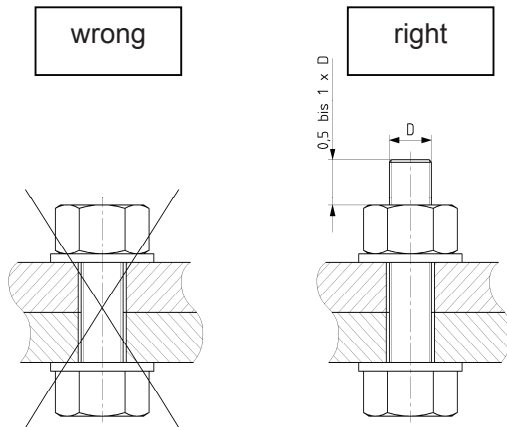


Figure 5

In principle, make sure for all screwed connections that there is sufficient excess length after the screw or nut has been tightened. The screw must project from the nut not less than the length of the screw diameter.

Always position the screw head so that a loosening or even loss of the screw can be immediately recognized. Always position the nut on top in case of vertical screwing.



Figure 6 Example motor screwing



Figure 7 Example frame screwing



Figure 8

Exception from the prescribed screw head position:

When flexible connections are screwed, the screw ends must always be turned away from the flexible connection.

Figure 8: representation of flexible connection with correct screwed connections (example)

Tighten all screw connections with the proper tightening moment, see chapter 9.1.1 Tightening moments for fastening screws

3.7 Connections

3.7.1 General remarks

The connection of the electric components of the fan must be carried out in accordance with the following regulations, as amended:

- Regulations issued by the local electric supply company (e.g. German EVU),
- national associations for electronic regulations (eg. EN DIN VDE regulations: VDE – German Association for Electrical, Electronic & Information Technologies.)
- Installation and mounting instructions in the operating manual of the motor producer.

3.7.2 Safety instructions

Works on the fan or the equipment must exclusively be carried out by specialist personnel, that due to professional training, experiences and instructions has sufficient knowledge about:

- Safety regulations,
- regulations for prevention of accidents,
- directives and accepted engineering standards (e.g. VDE directives, DIN EN standards)

The specialist personnel must:

- be able to assess the works allocated to them, to recognize possible dangers and to avoid them,
- be authorized by the person who is responsible for the safety of the system to carry out the required works and tasks.

All electric works on the components of the fan must exclusively be carried out by professional electricians that are authorized by definition regarding professionals (e.g. German definition DIN VDE 0105 and IEC 364). The electricians must observe the following regulations and instructions, as amended:

- EN DIN VDE-regulations (e.g. Germany),
- IEC-regulations (International Electrotechnical Association),
- Safety instructions,
- Transport, installation and maintenance instructions

Professional electricians are specialists, who due to professional training, experiences and instructions have knowledge about valid appropriate standards, regulations and regulations for prevention of accidents.

Furthermore they must be able to assess the works allocated to them and to recognize and to eliminate possible dangers.

The professional electricians must be authorized by the person who is responsible for the safety of the system to carry out the required works and tasks.

3.7.3 Ducting of fan



Distortions of the fan at the connections caused by the ductwork are not permitted. Distortions cause alterations, e.g. the gap at the nozzle decreases at one side which might lead to rubbing in the inlet.

- Remove the transport covers from the connections.
- Move the duct work to be connected to the inlet and discharge openings of the fan without causing offsets between the ducts and openings.
- Connect duct and conduits to the fan free-of-load.

3.7.4 Check of clearances

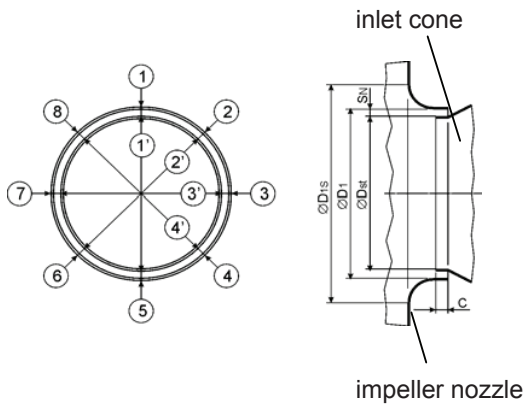


Figure 9

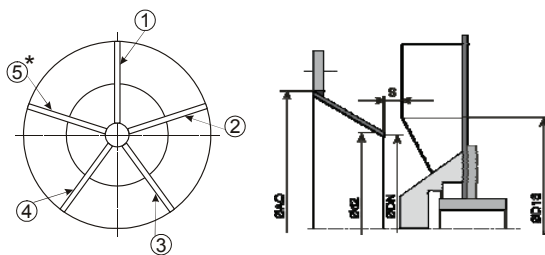


Figure 10

Prior to the first commissioning of the fan, the radial clearance between inlet cone and impeller nozzle must be checked and recorded pursuant to the following instructions. We cannot exclude possible shifts resulting from the transport between inlet cone and impeller. The fan can only be operated safely and trouble-free when the minimum clearance is observed. Any claim under guarantee void if the minimum clearance is not maintained.

There are two different impeller designs:

- impeller with shroud (Figure 9)
incl. representation of the check points ① to ⑧

- unshrouded impeller (Figure 10)
* number of check points according to the number of blades

In dependence on impeller design start to check the gap in case of:

- impeller with shroud:
check the gap at eight check points (see Figure 9)
- unshrouded impeller:
number of check points according to the number of the blades (see Figure 10)

Then turn the impeller by 90° and again check the gap at all check points. Repeat this process three times.



For fans of earlier design and for replacement deliveries of impeller or unshrouded impeller, the clearance dimensions can differ from the values given in the table.

3.7.4.1 Check of clearance for impeller with shroud

The minimum radial clearance must amount to 3 mm at least.

Take further clearance measures from Table 3 minimum clearance table.

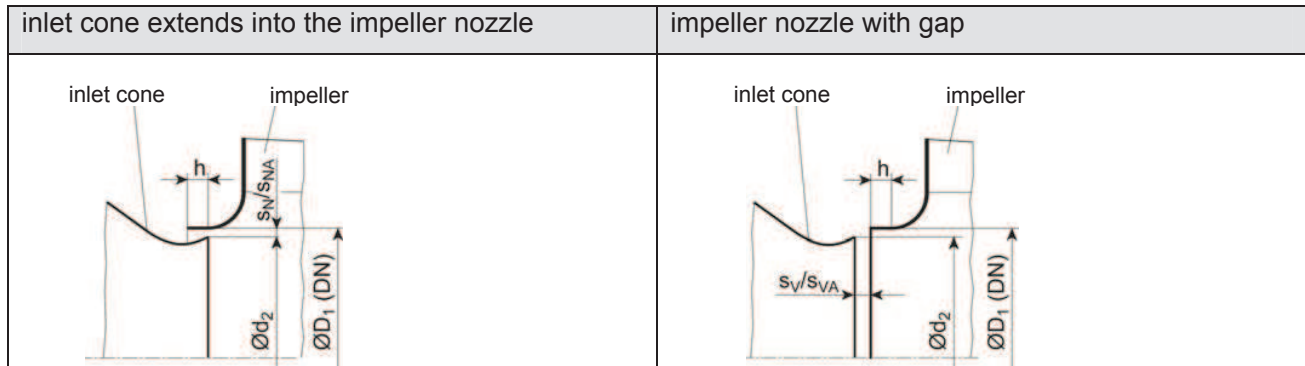


Figure 11

Figure 11 Representation of different installation situation: impeller „inlet cone extends into the impeller nozzle and „nozzle with gap“

				Standard		Atex
DN	D1	h	Tol.s _N	s _N	s _V	s _{NA} /s _{VA}
100	100	5	+/-0,5			
112	112	5				
125	126	5		3	5	5
140	141	5		3	5	5
160	158	5		3	5	5
180	178	5		3	5	5
200	199	6		3	5	5
224	224	7		3	6	6
250	251	8		3	6	6
280	282	9		3	6	6
315	316	10		3	6	6
355	355	11	+/-1	3,5	7	7
400	398	12		3,5	7	7
450	447	14		3,5	7	7
500	501	16		3,5	7	7
560	562	18		3,5	7	7
630	631	20		3,5	7	7
710	708	22		3,5	7	7
800	794	25		3,5	7	8
900	891	28		3,5	7	9
1000	1000	48		3,5	7	10
1120	1120	35		3,5	7	11,5
1250	1265	25		4	8	12,5
1400	1403	35		4	8	14
1600	1575	40		4	8	16
1800	1768	40		4	8	18
2000	1985	45		4	8	20

Table 3 minimum clearance table

Legend:

clearance measure	installation type
s _N	inlet cone extends into the impeller nozzle (standard-design)
s _V	nozzle with gap (standard-design)
s _{NA}	inlet cone extends into the impeller nozzle (ATEX-design)
s _{VA}	nozzle with gap (ATEX-design)

3.7.4.2 Check of clearance for unshrouded impeller

DN	D1	Standard	Atex
		s	s
100	100	10	10
112	112	10	10
125	126	10	10
140	141	10	10
160	158	10	10
180	178	10	10
200	199	10	10
224	224	10	10
250	251	10	10
280	282	10	10
315	316	10	10
355	355	10	10
400	398	10	10
450	447	10	10
500	501	10	10
560	562	10	10
630	631	10	10
710	708	10	10
800	794	10	10
900	891	10	10
1000	1000	10	10
1120	1120	15	15
1250	1265	15	15
1400	1403	15	15
1600	1575	20	20
1800	1768	20	20
2000	1985	20	20

The minimum axial clearance must amount to 10 at least.

Take further clearance measures from Table 4 minimum clearance table.

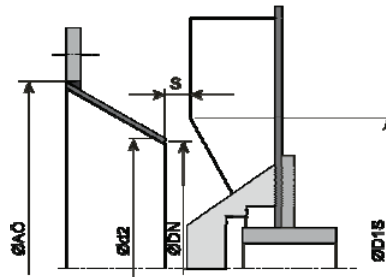


Figure 12 representation of installation situation unshrouded impeller

Table 4 minimum clearance table

3.7.5 Use of flexible connections

Flexible connections are intended to prevent the transmission of structure-borne sound and vibration forces. They are also used to reduce / prevent the transmission of forces from the duct work to the fan. Furthermore alignment errors of the ducts are reduced. The flexible connections should always be arranged directly at the fan connection flange (except when a damper is mounted on the fan).

If the fan is mounted on anti-vibration mounts, flexible connections must be provided at the inlet and discharge on principle.

3.7.5.1 Installation of flexible connections

Do not install flexible connections before completion of the duct work.

Flexible connections with hose clamps:

Pull flexible hose-type connections on the duct cautiously and fix them with hose clamps.

Flexible connection with back flanges:

Pull flanged flexible connections cautiously (inclusive back flanges) over the chute and arrange them between the fastening flanges. Apply sealing or sealing cord under the chute and fasten it by screw. All fastening screws must be tightened equally and – if possible – crosswise.

For tightening moments see annex (→ chapter 9.1.1).

3.7.6 Use of chutes

Depending on arrangement and load, chutes must be provided if:

- temperatures exceed 90 °C,
- velocities of flow exceed 30 m/s,
- pressure loads exceed 1000 daPa,
- aggressive or abrasive media are conveyed,
- the flexible connection is arranged at the inlet (as the flexible connection is supported by the chute against the existing negative pressure and does not reduce the inlet cross section of the fan),
- there are high noise level demands (the chute acts as a connected duct with corresponding attenuation values).
- Fans working with potentially explosive atmosphere should always be equipped with chutes for flexible connections. The chutes have to operate in the direction of flow.
- Always observe the flow direction when chutes are installed (see arrow in Figure 13 representation chute and direction of flow)

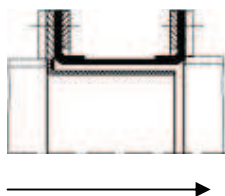


Figure 13

Figure 13 representation of chute and direction of flow

3.7.7 Electric connection conditions



Connect the power supply lead according to the valid regulations of the local electric supply company and observe in addition:

- the EN DIN VDE-regulations (e.g. Germany),
- the safety regulations,
- the regulations for the prevention of accidents.

As far as the low-voltage line is concerned, use for example

- earthing wire acc. DIN VDE 0255,
- plastic cable acc. DIN VDE 0273,
- cable lugs acc. DIN 46235
- terminal screws

and observe the instructions of the cable and sealing end manufacturers.

The cross section of the power supply lead depends on the type of cabling, rated voltage and rated power of the machine.

Cable ends with pressed-on cable lugs must be arranged and connected in accordance with the connecting plan that is to be found in the terminal box cover.

The power supply lead and the cable ends must not exert any lateral and/or torsional power on the terminal studs during or after the cable connecting work.

In case the fan is provided with electric protection devices (e.g. position switch), adhere to the instructions of DIN EN 60204-1 Safety of machinery – Electrical equipment of machines.

3.7.7.1 Earthing



Figure 14

If the fan and/or its equipment are provided with earthing clamps, connect the system's earthing to them.

Figure 14 → earthing link

3.7.7.2 Monitoring devices

The fan can be equipped with vibration monitoring, bearing condition monitoring and bearing temperature monitoring. Furthermore, the temperature probes can be installed for monitoring the temperature of the handled gas. Additional monitoring devices are described in separate operating manuals.

Connections of the monitoring devices must be connected in accordance with the detailed wiring diagram.

Please observe the instructions in the annex of this operating manual.



The annex shows the maximum warning and disconnecting values.

Chapter 9.1.2 Limiting values vibrations

Chapter 9.1.3 Limiting values bearing temperatures

3.7.8 Lubrication

The anti-friction bearings of the motor bearings are filled with proper operational grease quantities.

For type of grease see lubrication plate of motor.

For lubrication intervals see operating manual of motor manufacturer.



Lubricants must be disposed of in a safe manner consistent with all applicable regulations and in an environmentally compatible way.

4. Start-up

4.1 General remarks

Perform a start-up after installation and after each repair. Check for compliance of the finished installation and present operating conditions with the specified data of the fan data sheet (→ chapter 1.2).

The specialist personnel must be authorized by the person who is responsible for the safety of the system to carry out the required works and tasks for the start-up. (see chapter 2, Safety instructions).

4.2 Mechanical check

- Check all external fastening screws for tightness.
- Check impeller for unblocked run (rotate manually once)
Attention:
The impeller must not rub at the inlet.
- Remove possibly existing foreign substances from the fan housing.
- Check all screwed connections of the duct connections for tightness.
- Close the inspection openings properly.
- Remove transport securing devices, if any.
ATTENTION:
If the fan is provided with a transport safety device (e.g. shaft support, etc.), the provisions for transport have to be removed before the fan is start-up. In any case, it must be easy to turn the impeller.

4.2.1 Alignment

Check and document the alignment of the motor to the fan (→ chapter 3.6.4 Mounting and Alignment).

4.3 Electric check

- Check the operating voltage.
- Check for proper condition of earthing connections and equipotential bonding connections.



The electric connections inside the switching cabinet must comply with the regulations of the local power supply company and the valid regulations (e.g. German standard DIN VDE 0105) as well as the instructions of the producers of the drive motor and auxiliary motors.

4.3.1 Monitoring devices / auxiliary equipment

- Check the connections and cabling of the monitoring devices and auxiliary equipment for compliance with the detailed wiring diagram (→ switch cabinet).
- Switch on measuring systems and check connected monitoring devices for functionality.

4.3.2 Check of sense of rotation

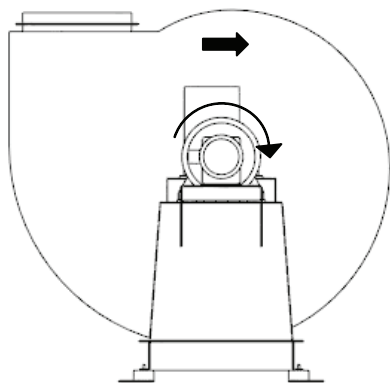


Figure 15

- Manually check the impeller for unblocked run.
- Switch on the motor and check the sense of rotation for compliance with the sense of rotation arrow arranged at the back of the fan.
- Motor sense of rotation must be the same as the fan's sense of rotation (see Figure 15)
- Disconnect the fan.
- The following motor connection results from the sense of rotation:

Connection L1, L2, L3	Sense of rotation facing the drive side (motor shaft journal)
U1 - V1 - W1	clockwise
W1 - V1 - U1	counterclockwise



When checking the sense of rotation, only the assigned inspector is permitted to be present within the danger area of the fan. Switch on motor and check sense of rotation (observe valid regulations, e.g. DIN VDE 0105).



- Ensure that the motor is switched dead.
- Secure against restart and mark with relevant information sign.
- Check for and guarantee dead condition.
- Connect to earth and short-circuit.
- Cover or secure by barrier adjacent alive parts.

Figure 15 → check of sense of rotation

4.3.3 Commutating wrong sense of rotation

If two of the existing connecting lines are interchanged, the sense of rotation is altered. In this case the connecting cables must be arranged inside the terminal box in accordance with the terminal connecting plan shown above and the sense of rotation.

4.4 Start-up of fan

4.4.1 General remarks

Check and inspect the following items prior to start-up:

- Is it possible to switch on the fan?
- Has the fan been checked mechanically and electrically and do all results show faultless conditions?
- Are all connections / ductworks installed professionally?
- Are the air intake openings of the motor free and uncovered?
- Has the clearance been checked? (see chapter 3.7.4),
- Are the safety devices in active and correct position?
- Are the power units, switchgears, monitoring devices and the cable cross sections designed and checked by the project engineer / operating company regarding the type of starting, starting time and peak load?
- If the fan is provided with a transport safety device: Has the transport safety device been removed?

4.4.2 Safety instructions



- The start-up must exclusively be carried out by specialist personnel that is appointed by the person who is responsible for the system.
- Observe the valid safety instructions (e.g. DIN VDE 0105)
- Before switching on the fan:
 - finish all works on the fan,
 - install all covers and safety devices,
 - reverse the protection measures that were carried out for the works on the fan (earthing and short-circuit of the connecting cable, securing against restart, etc).

The screws of safety devices for rotating parts are provided with retentions. The screw retentions ensure that the screws will remain on the safety devices if it is dismantled. Care must be taken when mounting and dismantling the safety devices in order to maintain the serviceability of the screw retentions.

4.4.3 Switching on of the fan



It is only permitted to start-up the fan, if a sufficient acceleration torque is available, covering the complete range of acceleration up to the nominal speed.

Start-up the fan with closed damper.

In case the fan is of gastight design, check the housing, the shaft seal and the connections at inlet and discharge for tightness.

Switch-on fan.

Monitor the following values and document them:

- During start-up
 - current consumption,
 - voltage,
 - vibrations (quiet running),
 - noises.
- After start-up
 - current / voltage,
 - vibrations,
 - noises,
 - bearing temperatures
 - temperature increase at fan housing due to compression of handled gas.

After start-up charge the fan.

Monitor the following values of the fan and document them:

- current consumption / voltage,
- vibrations (quiet running),
- noises,
- bearing temperatures.



The fan must be disconnected, when

- specified values are exceeded (see chapter 1.2 Fan data sheet)
- unacceptable vibration values or increased noise levels of the fan occur,
- limit values are exceeded (see chapter 9.1.2 Limiting values vibrations)



If the above mentioned malfunctions occur, contact the service specialists of the manufacturer.

4.4.3.1 Direct starting

Direct starting (delta starting) of the motor does not only cause a high starting torque but also a high starting current.

During starting the starting current is 6 to 8 times higher than the rated current (depending on the type of rotor).

Account for this high consumption of current when selecting the fuses.

4.4.3.2 Star-delta-starting

During star-delta starting the drive motor only provides 1/3 of the acceleration torque when star connected. From a certain speed onwards, the load moment of the fan exceeds the acceleration torque of the motor. The motor stops to accelerate. In this state, the motor must be switched to delta connection. The resulting peak load is significantly lower than that of direct fan starting.

The connecting frequency of the electric motors is limited to maximum six starting processes per hour. For this the instructions of the motor manufacturers must be observed.

4.4.3.3 Prevention of high negative torque impacts during test run

On principle, the fan is only to be restarted after the total standstill of the impeller. This prevents torque impacts which can occur when the rotor is still running (even slightly) at the time of restart. The torque impacts can cause significant damages on components (impeller).

4.4.3.4 Fan operation with variable speed control

If the fan has a variable speed control, observe the instructions in 5.6 Automatic operation of fan.

4.4.4 Disconnecting of fan

- Disconnection of fan → open power switch
- Let the fan coast brakeless.



Observe valid regulations, e.g. DIN VDE 0105.

When working on live parts, observe the following:



- Ensure that the fan is switched dead.
- Secure against restart and mark with relevant information sign.
- Check for and guarantee dead condition.
- Connect to earth and short-circuit.
- Cover or secure by barrier adjacent alive parts.

5. Operation, Operating

5.1 General remarks

Specialist personnel only is permitted to start and disconnect the fan. The specialist personnel must be appointed by the person who is responsible for the system.

Furthermore all instructions concerning the factory and the operation / operating of the operating company must be observed.

5.2 Safety instructions

Read the operating manual of the fan and the motor and observe the instructions and information.

5.3 Operational performance of the fan

During operation the fan must be checked regularly for:

- current consumption and voltage (values → rating plate),
- vibrations and noises (especially for rubbing noises) of the fan, (vibration monitoring → chapter 9.1.2 Limiting values vibrations),
- condition of the shaft sealing.

Disconnect the fan when

- the rated values for current, voltage and temperature are exceeded,
- vibrations or increased noise levels occur on the fan,
- the shaft sealing leaks.

5.4 Disconnecting of fan

Disconnect the fan by opening the power switch

Let the fan coast brakeless.



Observe the valid regulations, e.g. German DIN VDE 0105.

When working on live parts, observe the following:



- Ensure that the fan is switched dead.
- Secure against restart and mark with relevant information sign.
- Check for and guarantee dead condition.
- Connect to earth and short-circuit.
- Cover or secure by barrier adjacent live parts.

5.5 Emergency stop of fan

Automatic or semi-automatic operation

If the fan is installed in a ventilation system and is operated by automatic or semi-automatic control, it must be ensured that the fan can safely coast down to a standstill in case of an emergency shut-down. The fan itself is not provided with an emergency stop or power-off switch. The switch-off of the fan in case of emergency must be provided for in the control of the complete system. The operating company of the plant is responsible for the proper setting of the system control.

In case the fan is provided with monitoring devices, the emergency cut-off must be released as soon as the corresponding limit values have been achieved.

Possible parameter for maintenance are:

- bearing temperatures
- bearing vibrations
- speed (fan and motor)
- sense of rotation
- temperature of handled gas

We differentiate between the following limit values:

- prewarning: further operation subject to constant monitoring
- main alarm: the fan must be disconnected immediately!

Unless otherwise prescribed by the motor manufacturer, the limit values for prewarning and disconnection at main alarm, that are indicated in chapter 9.1.2 Grenzwerte Schwingungen und Kapitel 9.1.3 Grenzwerte Lagertemperaturen are to be observed.

Observe the following instructions about the monitoring devices to avoid injury to persons, property damage and environmental harm:

- ensure proper functioning of the readings recorder, of the transmission electronics and of the evaluation unit
- immediately replace damaged or components that are no longer serviceable
- properly connect the maintenance devices to the control panel and carry out a functioning test
- set the measuring value accurateness and – tolerances in accordance with the limit values for pre-warning and disconnection
- select reasonable scaling dimensions adapted to the measuring range within the measuring values transmission chain, to ensure the highest possible resolution and to avoid measuring results falsification
- pre-warning must be shown at the control panel by flash on the display or light or acoustic signal
- main alarm must be shown at the control panel by flash on the display or light or acoustic signal and the fan must immediately be disconnected.

Carry out the following measures, when the limit values for prewarning and main alarm are achieved:

- Check the facts and find out the reasons
 - Check the readings recorder, the sensor system, the evaluation units, etc.
 - Immediately replace faulty sensors, reading recorders, etc.
 - Check the impeller for sticking material, wear and tear, deformations, etc. and clean the impeller in case of stickings and replace it in case of wear and tear and deformations
 - Check the bearings for oil level (at oil-lubricated bearings) or grease quantity (at grease-lubricated bearings)
 - Check the anti-friction bearings for wear and tear and replace them if necessary
 - Do not re-set the signal until the cause of the limit exceeding has been clearly identified
- Attention:
Only the person or company responsible for the operation of the plant (operating company) may re-set the main alarm.
- Re-start the fan and check the machine's behaviour
 - If the limit values for prewarning or main alarm (disconnection) are again exceed, carry out the described measures anew and immediately inform GroSte Lüftungstechnik GmbH

The monitoring devices serve to detect deviations from normal operation at an early stage and therefore to avoid damage to machine parts (e.g. impeller, shaft sealing, motor bearings). Damages can be early determined with proper diagnostic units and replacement of parts can be easily scheduled.

5.6 Automatic operation of fan

5.6.1 Variable speed control with frequency converter

During automatic operation it must be ensured that the speed of the fan shaft does not oscillate around a preset value (periodic control behaviour) in order to avoid probable damage to the power train.

In addition, there must be enough time for the fan

- to start up until the operating or maximum speed is achieved
- to coast down from operating speed to standstill
- to change the operating point and hence the fan speed.

In order to avoid considerable loads, in particular speed accelerations and speed reductions in short periods of time, the variable speed control with frequency converter has to be set as "slow-reacting" as possible, so that symptoms of fatigue of impeller, motor shaft etc. will be minimised. The additional alternating load that is generated by the control actions will be almost avoided, if the speed change velocities indicated below are observed (ramp times of the frequency converter)

The following classification applies (recommended values). The ramp time may not fall below the given values.

fan speed:	ramp time:
[min ⁻¹]	[s]
750	38
1000	50
1200	60
1500	75
1800	90
3000	150
3600	180

table: recommended values for ramp times

Irrespective the above, always consider the existing conditions of the individual application case (mass moment inertia of the impeller and the complete rotating unit, start up and acceleration behaviour of the drive, current consumption, process-friendly control behaviour, etc.)

Table 5

5.6.2 Natural frequency of the impeller

Resonances cannot be excluded since each fan component, in particular the impeller, has a natural frequency that can be excited at certain fan speeds.

We design and construct our fans so that resonances generally do not occur in operation at constant rated speed.

If the fan is variable speed controlled, each change in speed (frequency) can result in an excitation. Additional excitations through the frequency converter control are also possible. If natural frequencies of the components lie within the speed range of the fan, these must be skipped when the variable speed control is parameterised.

5.6.3 Parameterising the variable speed control

If the fan including the variable speed control has been delivered by GroSte, the factory-provided parameterisation has to be kept. Any changes of the originally supplied parameterisation will void any claim on our guarantee. Changes in or improper parameterisation may lead to

- operation behaviour that is not free-from-vibration as per DIN IS 10816-3
- fatigue failure of impeller
- resonance vibrations on various components
- damage of drives because the fan is started-up and decelerated too quickly or due to too frequent changes in operating points.

5.6.4 Speed control range

We recommend not falling below a speed control range of 1:10 in order to maintain proper greasing of the bearing. In particular, torsional vibrations of the power train may arise in the range of 5 Hz output frequency of the variable speed control. This range is therefore to be provided.



We recommend having the parameterisation and commissioning done by a GroSte service technician.

6. Trouble, Repair

6.1 General remarks

The repair of troubles on the fan must only be carried out by specialist personnel that is appointed by the person who is responsible for the system.

When trouble shooting is carried out, the entire surroundings of the fan (equipment, motor, variable speed control, foundation, kind of installation, switchboard plant, etc.) must be taken into account.

Observe the particular instructions in the operating manuals of the motor and variable speed control producers.

If damages occur during the warranty period, contact the manufacturer.

6.2 Safety instructions



When trouble shooting or repair is carried out, observe the following:

- valid regulations, e.g. German DIN VDE 0105
- regulation for the prevention of accidents, e.g. German regulations BGV A1 and BGV A3



- Ensure that the fan is switched dead.
- Secure against restart and mark with relevant information sign.
- Check for and guarantee dead condition.
- Connect to earth and short-circuit the fan.
- Cover or secure by barrier adjacent live parts.
- Ensure that the impeller is at standstill and cannot be set unintentionally into motion.

Attention:

Stack draught or other air draught in the connected duct work may set the impeller in motion.

6.3 Troubles

Troubles	Possible cause	Remedy
unsteady run of fan	material sticking to impeller blades.	clean impeller carefully
	impeller worn out	exchange impeller
	impeller deformed by thermal effect	exchange impeller
	distortion of fan by uneven foundation	loosen foundation fastenings and level foundation, subsequently re-fasten the fan
	improper adjustment of the anti-vibration mounts or of the anti-vibration mounts (spring-type)	correct adjustment
	stress due to incorrect installation of the ductwork	use flexible connections for the ducting
handled gas leaks from the shaft sealing	seal defective or worn out	exchange sealing.
rubbing noises from the fan	impeller rubs against inlet.	loosen top part of housing and readjust, if required, check ducting and readjust it
	motor noise	check motor for bearing damages, if required, exchange bearings
the current consumption stated on the motor name plate is exceeded permanently	handled gas volume too high	reduce the flow volume by using a damper until the permitted current consumption is reached
	different speed due to 60 Hz net work	check frequency.
fan does not start up	incorrect electric connection of the motor	check electric connection
	trouble with star-delta starting, motor stops acceleration during star connection	reduce change-over time from star to delta
	start-up against too low system resistance	close dampers or install additional plate shutters
	design of motor protective system insufficient	cable cross section and motor protective system must be designed for the starting current during the complete start-up
	start-up time takes too long	close dampers, check starting torque of the motor M_A/M_N
	drive motor defective	check motor and exchange, if required
	motor too warm due to high connecting frequency	choose permanent operation of the fan and control the flow with dampers or variable speed control
	starting current too high	incorrect voltage provide for star-delta start-up, insufficient local power supply

Table 6

7. Maintenance

7.1 General remarks

- All maintenance and service works on the fan may only be carried out by specialist personnel that is appointed by the person who is responsible for the plant, see chapter 2.8 Qualified person and chapter 2.9 Personal protective equipment.
- Please observe the maintenance instructions for the electric drive as indicated in the operating manuals of the motor producers.
- Observe specified maintenance intervals and use specified lubricants and lubricant quantities only.
- Collect used oil, used grease and/or cleaning rags contaminated with oil / grease in containers correspondingly marked and take care for proper disposal.
- Check all securing components of the screwed connections and exchange them for the new securing components, if required.

7.2 Safety instructions



- Carry out maintenance works (lubrication works excepted) at standstill of the fan only, maintenance works see chapter 7.8 Maintenance schedule.
- Ensure that the fan is secured against restart and marked by a corresponding information sign.
- Observe the safety instructions and the regulations for prevention of accidents of the relevant manufacturers when oil / lubricants, detergents or spare parts are used.
- Maintenance works on the electric connections of the fan or on electric auxiliary / control connections must exclusively be carried out by professional electricians who have to observe the valid regulations (e.g. German DIN VDE 0105)



- Ensure that the fan is switched dead.
- Secure against restart and mark with corresponding information sign.
- Check for and guarantee dead condition.
- Connect to earth and short-circuit.
- Cover or secure by barrier live parts.
- Ensure that the impeller is at standstill and cannot be set unintentionally into motion.
Attention:
Stack draught or other air draught in the connected duct work may set the impeller in motion.

7.3 Motor bearings

7.3.1 Motor anti-friction bearings

Maintenance of the anti-friction bearings:
See technical documentation of the motor manufacturer.

- monitoring of the bearing temperature during operation,
- check of the bearings for running noises and vibrations
- lubrication of the motor anti-friction bearings in accordance with the instructions of the motor manufacturer,
- exchange of bearings.

If increased bearing temperatures (→ chapter 9.1.3) or running noises and / or vibrations (→ chapter 9.1.2) occur during operation, disconnect the fan immediately to avoid consequential losses.

Remove motor bearings and check them for damages.

If the bearing shows dark discoloured, dull, coarse or polished looking parts of the bearing races and / or of the rollers / balls, install a new bearing.



Motor bearing removal / installation by the service staff of the motor manufacturer.

If the removal / installation of the motor bearings are carried out by the operating company, only the bearings recommended or delivered by the bearing manufacturer must be installed. Furthermore the installation instructions of the motor manufacturer must be observed.

Only install motor bearings of the same type and clearance range, for type of bearing see nameplate.

When ordering spare parts, specify fan type and serial number (→ nameplate).

Check and document the bearing temperature and vibration velocity at the bearing regularly, but at least once a week in order to maintain the operational reliability and availability of the fan. If necessary, take measures such as maintenance at bearings, coupling, motor or impeller.

7.4 Shaft seal

Depending on the individual requirements the fan can be equipped with different seal systems.

If heightened temperatures or running noises occur at the shaft sealing during operation, immediately switch down the fan to prevent subsequent damage.

7.4.1 Standard seal

Shaft seal with soft fibre ring (eg UNITEC 300) for a temperature range up to +180°C

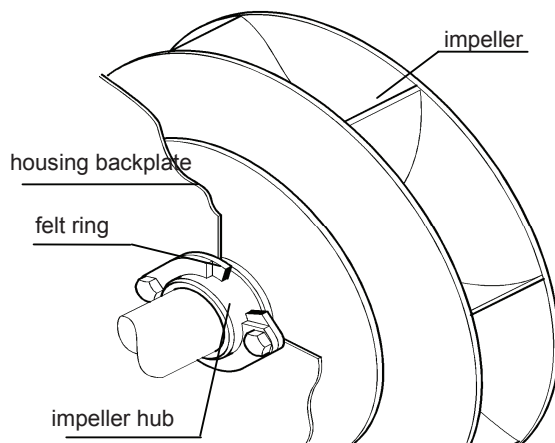


Figure 16

Figure 16 → presentation of shaft seal

7.4.2 Shaft seal with graphite ring

Shaft seal with cramped graphite-ring in sheet metal housing

The seal with cramped graphite ring must be re-lubricated monthly. Apply a small quantity of lubrication oil into the clearance between the seal and shaft by oil can.

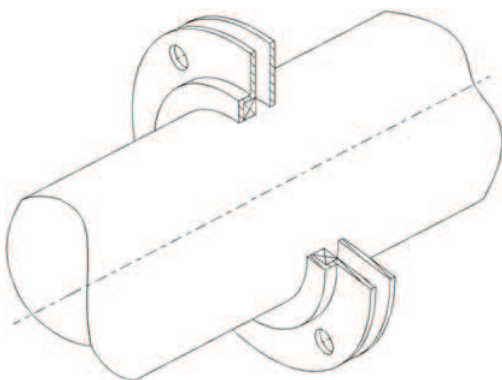


Figure 17

Figure 17 → presentation of shaft seal

7.4.3 Seal with special rings

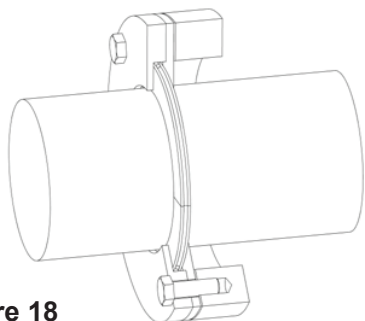


Figure 18

The shaft seal can be provided with one or two graphite rings. This type of seal is also called labyrinth seal.

Lubrication of this sealing type is not possible.

Figure 18→ Presentation of shaft seal with one graphite ring

7.4.4 Shaft seal with grease barrier

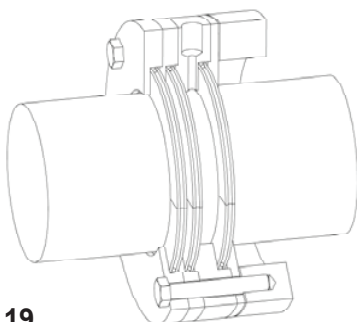


Figure 19

For improving the leak tightness a grease barrier can be used. The grease barrier reduces the gas penetration through the shaft seal.

Usage of the lubricator enables a maintenance-free operation of approximately 3 months.

Figure 19→ Presentation of shaft seal

7.4.5 Shaft seal with barrier gas

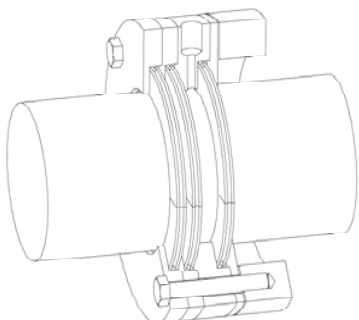


Figure 20

If barrier gas is used, it must be ensured that the pressure of the barrier gas is always higher than the pressure at the shaft seal that is created by the fan operation. Vacuum operation means higher barrier gas pressure than the maximum static pressure increase, pressure operation means higher barrier gas pressure than the total pressure increase.

It is obligatory to observe the instructions of the seal manufacturer.

Please note: Request technical data regarding minimum and maximum barrier gas pressure from the manufacturer.



Equal or lower barrier gas pressure would enable the penetration of solid matters into the sealing system and therewith an increased wear or, in the worst case, a total breakdown of the seal could be caused



Monitor the barrier gas consumption or the leakage continuously. A significant increase of the values points out wear of the sealing rings and / or repair

While carrying out inspection works, the shaft seal must be checked for damages (e.g. corrosion) and must be cleaned.

If sealing components are damaged (scratches, cracks, dents) the complete seal set must be renewed.

Figure 20→ presentation of shaft seal

7.4.6 Shaft seal of type REW6 (Ø 40 to Ø 120)

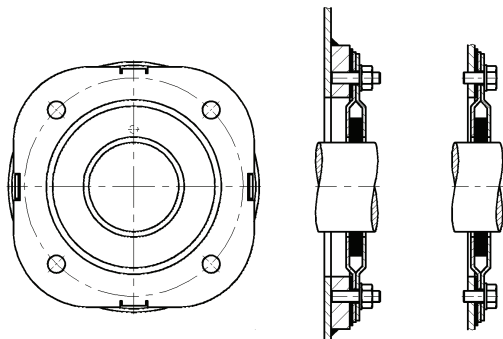


Figure 21

The shaft seal of type REW6 can be used up to a seal diameter of 120mm. It is suitable for dry running and do not require any lubrication.

The sealing rings are radially cut into several sections and held together by means of a surrounding hose spring.

If it is necessary to replace the sealing rings, please observe the separate mounting instruction of the manufacturer.

Further mounting remarks:

Seal the housing halves with non-adhesive sealing compound (e.g. Eppler Stukarit 203 or sealing grease E600N). The radial shaft centre offset of the shaft may not exceed $\pm 1.5 \text{ mm}$

7.4.7 Shaft seal of type REW6 (Ø 140 to Ø 240)

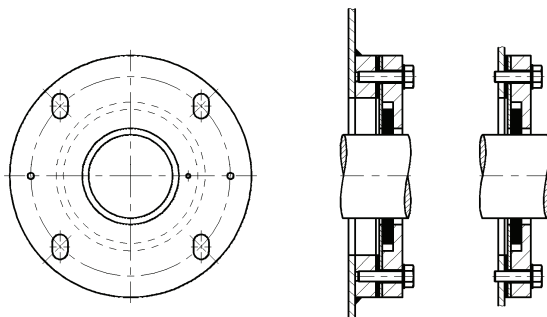


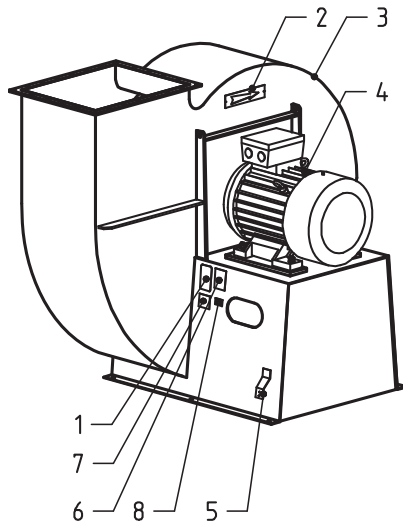
Figure 22

The shaft seal of type REW6 can be used up to a seal diameter of 120mm. It is suitable for dry running and do not require any lubrication.

The sealing rings are radially cut into several sections and held together by means of a surrounding hose spring.

If it is necessary to replace the sealing rings, please observe the separate mounting instruction of the manufacturer.

7.5 Marking, information sign



The marking / information signs must be:

- cleaned with a rag,
- checked for tight fastening and legibility.

Legend:

- 1 name plate
- 2 sense of rotation arrow
- 3 warning notice inspection opening (optional)
- 4 motor nameplate
- 5 earthing clamps (optional)
- 6 sign "danger symbols with explanations"
- 7 sign "Read operation manual"
- 8 sign "Attention – do not weld"

Figure 23

Figure 23 → Example for markings



Figure 24

Figure 24 → example of an ATEX individual nameplate

The fan can be designed for use in potentially explosive atmosphere. An individual nameplate then indicates the equipment group and category as per directive 94/9/EC (ATEX).

7.6 Waste disposal



Collect used oil, used grease or cleaning rags / wool contaminated with oil / grease in containers correspondingly marked and dispose of them in a safe manner consistent with all applicable regulations and in an environmentally compatible way.

7.7 Revision

The required examinations and maintenance of fans that are designed in accordance with directive 94/9/EC may only be carried out by qualified personnel.

In general, half-yearly up to yearly revision intervals should be sufficient under the conditions that:

- all checks in the course of the commissioning / start-up and the maintenance works were carried out properly and in due time, and
- each serious constitutional change that were recognized by the continuous operation monitoring has been systematically investigated and repaired.

7.8 Maintenance schedule

Structural component	Daily	Weekly	Quarterly	Yearly
impeller	<p>An inspection of the impeller must be carried out immediately, if</p> <ul style="list-style-type: none"> the permissible limiting values (see chapter 9.1.2 Limiting values vibrations) are exceeded, changed impeller noises occur. <p>Examine the impeller every 5,000 operating hours and check it for alteration (cracks, geometric alterations, balancing condition, wear and sticking material), but at least once a year.</p> <p>Check the impeller e.g. by non-destructive crack testing.</p> <p>Fans that are subject to high dynamical stresses are to be checked in accordance with the additional agreement (maintenance schedule) within the prescribed intervals.</p>			
shaft seal	<p>The shaft sealing rings have to be checked and exchanged if the barrier gas consumption or leakage increases. Exchange the shaft seal ring when the rings are worn or damaged. If the seal ring consists of more than one part, replace the full seal ring set.</p>			
condensate drain	<p>Drain the accumulated condense water in regular intervals or when required in a suitable drain receptacle and dispose of it in an environmentally compatible way.</p>			
motor	pay attention to running noises and quiet running, remove sticking material (e.g. dust), if required		re-tighten screws, check bearings, check motor fixation	check motor, if required, exchange bearings, observe maintenance instructions of motor manufacturer, check the motor fixation
earthing motor terminal box			clean inside, tighten screws	clean inside, tighten screws
connections for monitoring devices and auxiliary equipment	collect measuring values and analyse them	check for functionality	check for functionality	check for functionality
flexible connections and chutes	check at regular intervals and – if required – after change of the processes.		check, if required, retighten screws and if worn-out, exchange flexible connections	check, if required, retighten screws and, if worn out, exchange flexible connections
total fan		pay attention to operational noises and quiet running, remove sticking material (dust) on the fan, in particular in the area of the shaft sealing	pay attention to operational noises and quiet running, check all screwed connections for tightness and re-tighten if necessary	check impeller, motor bearings, shaft seal and flexible connections for wear and, if required, repair or exchange them

Table 7

The checks and controls in accordance with the maintenance schedule mainly contribute to the unrestricted continuous functioning of the fan and hence to the complete system and are regarded as being part of the operational company's requisite obligations.

8. Repair work

8.1 General remarks

Authorized personnel only is entitled to repair fans that are designed in accordance to the directive 94/9/EC (ATEX).

- Prior to removal / installation of spare parts, as:
 - impeller,
 - motor bearings,
 - sealing,
 - motor

prepare everything to ensure smooth and faultless working processes.

- Use appropriate removal / installation devices, tools and heating devices for the anti-friction bearings.
- The working place for the removal of the parts must be kept clean.
- Install only spare parts recommended and/or delivered by the manufacturer. The special installation instructions must be observed. These instructions are not part of this operating manual and are to be requested from GroSte as separate documents.

8.2 Fans in accordance with directive 94/9/EC ATEX

Maintenance of fans that were designed in accordance with directive 94/9/EC may only be carried out by qualified personnel (see chapter 2.8 Qualified person), see also chapter 2.4 Safety regulations.

Example for the stages of the maintenance:

stage	activity	instructions	responsible
maintenance	e.g. re-grease motor bearings	observe lubrication instructions	operating company
inspection	e.g. check impeller for wear and tear	observe the instructions of the operating manual	operating company
repair	e.g. replace impeller	observe the instructions of the operating manual	operating company

Table 8 Example for the stages of the maintenance

8.3 Safety instructions

Repair work that has been carried out during the warranty without our prior written agreement of the manufacturer, leads to the extinction of all guarantee rights.



Recommendation:

If repair works are required, request the service specialists of the manufacturer:



Carry out maintenance works at standstill of the fan only.

Ensure that the fan is secured against restart and marked by a corresponding information sign.

Observe the safety instructions and the regulations for prevention of accidents.

8.4 Spare parts

When ordering spare parts, specify

- the exact name of the structural components
- the type of machine and
- the serial number.

The spare parts list (see enclosure) is a document separately attached to this operating manual. The clearly arranged list comprises all main spare parts for the fan with exact description of the parts.



Type of machine and serial number are shown on the name plate.

If required, send the manufacturer a sample of the part to be exchanged.

9. Annex

9.1 Additional technical information

9.1.1 Tightening moments for fastening screws

Unless otherwise stated, use the following tightening moments for connections with fastening screws and fastening nuts: Data in Newton metre (Nm).

	screws property class 8.8	screws property class 10.9
M6	10	14
M8	25	35
M10	49	69
M12	86	120
M16	210	295
M20	410	580
M24	710	1000
M27	1050	1500
M30	1450	2000
M36	2400	3555

When installing the fan, reduce the tightening moments by 10% so that the screw is not tightened to its yield point.

Values for set screws with metric coarse pitch thread bases upon German Standard VDI2230 with a coefficient of frictions are

$$\mu_{\text{ges}} = \mu_{\text{K}} = \mu_{\text{G}} = 0,12.$$

The tightening moments refer to slightly oiled screws and nuts.

9.1.2 Limiting values vibrations

Table of limiting values for fans:

Machinery Class	Motor Power in kW	Substructure or System of Installation	Evaluation Zones			
			A	B	C	D
			New State	Continuous operation	Permissible for a short-time	Unacceptable
eff. velocity v_{eff} in mm/s						
2 *)	> 15 ≤ 300	rigid	≤ 1,4	1,4 - 2.8	2,8 - 4,5	> 4,5
		flexible	≤ 2,3	2,3 - 4,5	4,5 - 7,1	> 7,1
1	> 300	rigid	≤ 2,3	2,3 - 4,5	4,5 - 7,1	> 7,1
		flexible	≤ 3,5	3,7 - 7,1	7,1 - 11	> 11

*) Motors smaller than 15kW are not treated separately in the DIN ISO 10816-3 and are therefore assigned to group 2.

The values assigned to the rating zones are not intended to serve as acceptance values. The acceptance values have to be specified between the machine manufacturer and the customer. The values should serve as guidelines to avoid major errors or unrealistic requirements.

The above shown warning and disconnecting values regarding the working temperature are maximum values. They are related to an ambient temperature of 40°C and an altitude of installation of up to 1000 m asl. Under special circumstances these values can be exceeded, if the preceding agreement of the manufacturer is obtained.

Evaluation criteria regarding vibrations according to German standard DIN ISO 10816/3.

If the vibration values level out between warning and disconnecting and if the fan is carefully observed, the operating of the fan can be continued until a proper point of time is defined, so the process can be shut down in a controlled way.

Possible damages of the fan can not be excluded → if required, inform GroSte.

9.1.3 Limiting values bearing temperatures

See also operating manual of the motor manufacturer.

Temperature is a long-time indicator for the machine load. Excessive bearing load results in an increase in temperature of the bearing. Provided that the anti-friction bearing is used properly in accordance with the advised design instructions, a nearly constant working temperature of the bearing will turn up at constant working conditions after the initial operation phase. If the temperature changes without alteration of the speed or the load or without addition or reduction of warmth, this is an indication for a disturbed lubrication condition. Load changes due to malfunction of the non-located bearing can be recognised by the temperature course of the bearing. Bearing damages due to interruptions of the lubrication film or malfunction of the bearing can be recognized early by using a temperature monitoring device for the bearing. Running period damages due to fatigue and ageing can not be detected by a temperature monitoring device for the bearing.

The bearing temperature is measured by an electric temperature probe directly on the outer ring of the bearing.

9.2 Requests regarding field service staff

For any queries or to require service specialists or spare parts, we ask you to specify the following data:

- Serial number of the fan, (6-digit number, see fan data sheet or name plate).
- Exact address of the operating company.
- Name of the person in charge who is to be contacted by our service specialist.
- Describe the trouble and your observations as exact as possible. The more exact the information, the easier for us to support you efficiently and quickly. Please inform us in detail by fax or e-mail.

See chapter 13 of this operating manual for detailed addresses of all companies of the GroSte

10. Fan shutdown

10.1 General remarks

The definition – fan shutdown– means standstill of the fan for a longer period of time. It is necessary to weather-proof the fan.

In case the fans are intermediately stored for more than 3 months observe the instructions of the separate “Instructions for Storage and Corrosion Protection”. If necessary, request them from GroSte.

10.2 Safety instructions

Works required for putting the fan out of action must exclusively be carried out by specialist personnel, that due to professional training, experiences and instructions has sufficient knowledge about:

- Safety regulations,
- Regulations for prevention of accidents,
- Directives and accepted engineering standards (e.g. German VDE-directives, DIN EN Standards).
- The specialist personnel must:
 - be able to assess the works allocated to them, to recognize possible dangers and to avoid them.
 - be authorized by the person who is responsible for the safety of the plant to carry out the required works and tasks.



Works on electric systems, like disconnecting the fan from the electric supply, must exclusively be carried out by professional electricians.

- Disconnect fan from the power supply.
- If a future re-commissioning is intended, protect all structural components against corrosion.
- Cover machine parts.



Dispose properly of all lubricants, oils and any other materials dispose of them in a safe manner consistent with all applicable regulations and in an environmentally compatible way.

10.3 Measures in case of extended shutdown

When the fan is put out of operation for more than three months the following steps must be taken:

- Drive motors and actuators
If there are drains, please open them, drain the accumulated water and re-close the openings. Check the terminal box connections for tight screwing.

10.4 Measures in case of re-commissioning

Carry out the following steps:

- Check the shaft seal for tightness
- Check drives and actuators for condensate water in the terminal box and housing, if necessary, drain the water and dry the interior.
- Remove the anti-corrosion coating from all bright parts which could affect the functioning (e.g. shaft seal, shaft earthing)

It is not permitted to employ damaged or corroded parts or such parts that are unfit for operation.



Prior to a new start-up, chapter 4 Start-up must be observed.

11. Dismantling

11.1 General remarks

The definition “Dismantling” means the removal of the fan and the subsequent re-mounting at a new location or the scrapping of the fan.

Prior to a new start-up especially the chapters 1 to 5 of this operating manual must be observed.

It is recommended to request the field service staff of the manufacturer to carry out the professional dismantling of the fan.

11.2 Safety instructions

Works required for dismantling the fan may exclusively be carried out by specialist personnel, that due to professional training, experiences and instructions has sufficient knowledge about:

- safety regulations,
- regulations for prevention of accidents,
- directives and accepted engineering standards (e. g. German VDE-directives, DIN EN-standards).

The specialist personnel must:

- be able to assess the works allocated to them, to recognize possible dangers and to avoid them.
- be authorized by the person who is responsible for the safety of the plant to carry out the required works and tasks.



Works on electric systems, like disconnecting the fan from the electric supply, must exclusively be carried out by professional electricians.

The dismantling must not start before all works that are required for putting the fan out of action are finished and not before the start of the dismantling works are permitted by an authorized assigned supervisor.

- Initially all accessory parts like flexible connections and louvre dampers must be removed.
- Subsequently remove the monitoring devices and the safety hoods.



Overturning or dropping components can cause most serious injuries or even death.

Secure all components to avoid sliding and dropping of these parts during dismantling works and transport.

Staying below suspended loads means danger to life and therefore must be refrained from in any circumstance.

12. Expiry of service life, disposal

Dismantle and dispose of properly and in accordance with the national and international laws and regulations of those fan components and parts, whose service life has expired due to wear and tear, corrosion, mechanical load, fatigue and/or other effects that could not be directly discerned. The same applies to the auxiliary materials used like oil, grease or the like.

Deliberate or unintentional further application of used parts, e.g. impellers, shaft seals etc. may endanger persons, harm the environment and/or damage the machine or the complex system. The corresponding local regulations of the operating company are to be observed and applied.