TLT-Turbo GmbH

Erection- and Maintenance Manual

of

Raw Mill Fan Type 1886 ZA/ 1664

TLT-Job No.: 71260-1

2	25Jan06	Ritz	26Jan06	Labod	Customer: **Polysius AG**	Job: **IRSAB**	
Rev.	Date	Prepared	Date	Approval	Job.-No.: 71260-1	Order.-No.: **33705967**	Page
	09Dec05	Ritz	13Dec05	Labod	Fabr.: **23071694 AAT 060-14**	EQU 536093	1 / 51

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2. Description

2.1 Rating Data / Technical Data

Kind of Fan:	Raw Mill Fan
Type of fan:	1886 ZA/ 1664
Job No.:	71260-1
Built in:	2005
Factory No.:	723006976
Sense of rotation:	L (VDMA) acc. VDMA 24165

Characteristic of the fan:

Volumetric flow rate:	**263,9**	**m3/s**
Gas temperature:	**90**	**°C**
Temperature $_{max. mech.}$:	**250**	**°C**
Spec. Energy	**10538**	**J/kg**
Density at fan inlet	**0,885**	**kg/m³**
Total pressure rise:	**9670**	**Pa**
Fan speed:	**993**	**rpm**
Fan speed $_{max.}$:	**1000**	**rpm**
Power required at shaft:	**2962**	**kW**
Mass inertia moment (J = 0,25 x GD2):	**6800**	**kgm²**
Motor power:	**3617**	**kW**
Max. permissible power:		**kW**
Motor speed:	**993**	**1/min**

Kind of installation:	concrete foundation
Kind of coupling:	flex. compression sleeve coupling
Kind of bearing:	oil lubricated roller bearing

Weight of machinery (without motor and insulation): app. 56800 kg

General drawing No.: H6002313

2.1.1 Parts of delivery

Driver: (by Customer)

Motor-Fabricate / Type: ELIN / HRR 010 B	Rated output: 3617 kW
Size: IM B3	Rated speed: 993 1/min
Frequency: 50 Hz	Rated voltage: 6600V
Weight: 17000 kg	Protection: IP 54

Coupling:

Manufacture: Flender	Type: RWS 710

Bearing:

Manufacture: SNR	Type: SNOE 238
Lubricant: Oil	ISO VG 100
Set points of bearing temperature: (measured at outside bearing ring) Alarm: 95°C Disconnection: 105 °C	Set points of vibration monitoring: (measured at outside bearing ring) Alarm: 8,8 mm/s Disconnection: 11 mm/s

Inlet Damper with actuator:

manufacturer: Steinberg+Kirsch	Type: Auma Actuator SAR 07.5-B3/45-GS125.3/VZ4.3

Thermo couple:

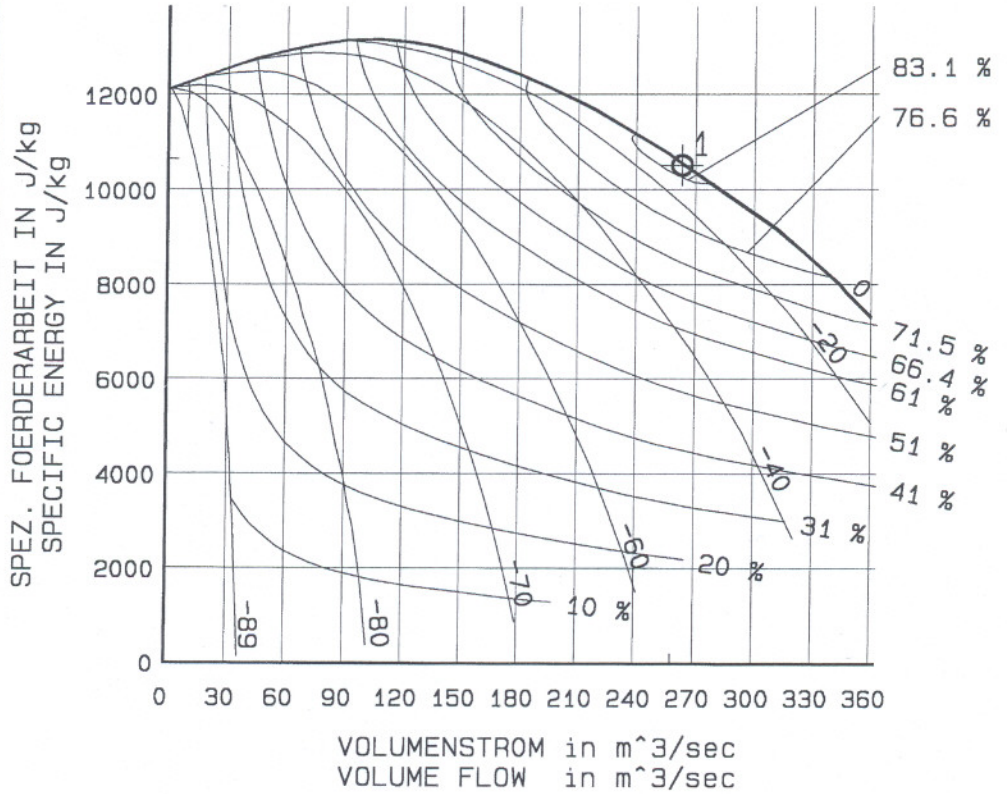
manufacturer: Dittmer	Type: Pt100 3 Wire connection

2.1.2 Characteristic curve

TLT-TURBO GMBH	KENNFELD FAN PERFORMANCE DRALLDROSSEL INLET DAMPER CONTROL	PROJ: 70.20250 KOMM: 71260 Polysius
ABT.IV 24. JUNI 2005		
Kavallar		

Rohmehl-Vent. TYPE 1886ZA/ 1664

VOLUMENSTROM	VOLUME FLOW	263.9	m^3/sec
GESAMTDRUCK	TOTAL PRESSURE	9670	Pa
TEMPERATUR	TEMPERATURE	90	Grad C
DREHZAHL	SPEED	990	1/min
WELLENLEISTG. Ohne Staub	POWER AT SHAFT without dust	2962	kW
WELLENLEISTG. Mit Staub	POWER AT SHAFT with dust	3145	kW
MOTOR-LEISTG.	MOTOR POWER	3617	kW



DATEI: (ka) 71260rmv		KNL- 50719

2.1.3 Table

TLT-Turbo GmbH		Table to the Rohmehl-Vent. Type 1886ZA/ 1664			Com.-No. 71260 Cust. Polysius	
Dpt IV	24.06.2005				TAB-No. 50719	
Name : Kavallar		Control by Inlet Damper			Sheet 1 of 1	

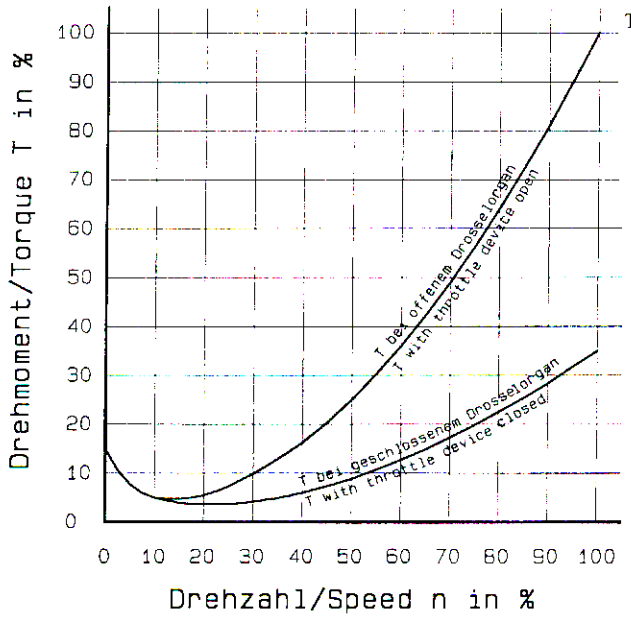
Impeller diameter	3134 mm	Cross sec. suc. box	IN	8.84	m²
Recomm. motor power	3617 kW	Cross sec. housing	IN		m²
Motor speed	990 1/min	Cross sec. housing	OUT	5.54	m²
Barometric pressure	1007 mbar	Cross sec. diffusor	OUT	13.1	m²

Load	Design					
Point	1	2	3	4	5	6
Mass flow kg/s	233.6					
Volume flow Sm3/h	646763					
Volume flow Am3/s	263.9					
Temperature ss deg C	90					
pl inquiry Pa	9000					
pl suc. box Pa	172					
pl damper Pa	160					
pl shaft Pa	184					
pl diffuser Pa	154					
Total press. Pa	9670					
pa absolute Pa	91720					
Density (std) kg/m3	1.300					
Density (act) kg/m3	0.885					
Compress-fact. -	0.964					
Density (aver) kg/m3	0.918					
Spec. energy J/kg	10538					
Efficiency %	83.0					
Power at shaft kw	2962					
Power with dust kw	3145					
Speed rpm	990					
Temperature ds deg C	103					
Datei : ka71260rmv						

2.1.4 Startup-curve

TLT-TURBO GmbH	ANLAUF-KURVE STARTUP-CURVE	PROJ: 70.20250 KOMM: 71260 Polysius
ABT.IV | 15. JUNI 2005		
Kavallar		

Rohmehl-Vent. TYPE 1886ZA/ 1664



T = 28572 (37991) Nm
Ohne Staub Without dust

= 30338 (40338) Nm
Mit Staub With dust

$$T = \frac{9550 * PW}{NG}$$

T: Drehmoment bezogen auf die Geblaese-Auslegung und NG

T: Torque referring to fan design with NG.

GEBLAESE-AUSLEGUNG:
FAN DESIGN:

V	(m3/s)	:	263.9			
PT	(Pa)	:	9670	(12857)		
T	(C)	:	90	(0)		
NG	(1/min)	:	990			
PW	(kW)	:	2962	(3938)	Ohne Staub,	Without dust
PW	(kW)	:	3145	(4182)	Mit Staub,	With dust

EMPFOHLENE MOTORDATEN:
RECOMMENDED MOTORDATA:

PM	(kW)	:	3617
NM	(1/min)	:	990

Massentraegheitsmoment
Mass moment of inertia
I = 0.25*GD2 = 6800 kgm2

Alle Klammerwerte gelten fuer das Anfahren mit kaltem Foerdermedium.
All values in brackets refer to the start-up with cold gas.

Die endgueltige Motorauslegung muss der Motorhersteller unter Beruecksichtigung des genannten Massentraegheitsmomentes und der Art des Anlaufes vornehmen.
Bei Uebersetzungen zwischen NM und NG ist I entsprechend umzurechnen.

The final motor design has to be carried out by the motor manufacturer considering the stated mass moment of inertia and kind of starting.
In case of a transmission between NM and NG the mass moment of inertia has to be converted respectively.

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2.1.5 Octave Band Analysis

TLT-Turbo GmbH		Octave Band Analysis to Rohmehl-Vent. Type 1886ZA/ 1664	Project-no 70.20250 Cust. Polysius
Dpt IV	24.06.2005		OAN-no 50720
Name : Kavallar			Sheet 1 of 1

Design data :

Volume flow	263.90	m3/s	Diameter of impeller	3134	mm
Temperature	90	°C	Tip speed	162	m/s
Total pressure	9670	Pa	Number of blades	12	-
Density suc. side	0.885	kg/m3	Blade passing frequency	198/396	Hz
Speed	990	rpm			

Frequency Hz	Measuring surface sound press.level at a distance of 1m from the fan casing re 2·10E-5 N/m²		Sound power level in the gas flow suction side re 10E-12 W		Sound power level in the gas flow discharge side re 10E-12 W	
	dB	dB(A)	dB	dB(A)	dB	dB(A)
31	103	64	123	84	124	85
63	103	77	129	103	130	104
125	102	86	131	115	132	116
250	106	97	136	127	137	128
500	103	100	134	131	135	132
1000	92	92	129	129	130	130
2000	82	83	123	124	124	125
4000	77	78	117	118	118	119
8000	74	72	108	107	109	108
Total level	111	102	140	135	141	136

Measuring area [Ls=10·lg(S/So)] 24 dB

Tolerances :
Total level : ±4 dB
Octave band : ±6 dB

All data according to DIN 45635

Datei : ka71260rmv

5.3.3 Mounting of bearing

Located bearing: SNOE 238 BF Material GG
Non located bearing: SNOE 238 AL Material GG

ATTENTION! **Due to the increased shaft expansion of approx. 14 mm, the non located bearing support is transferred installed in relation to the bearing center. The different alignment amounts to 6 mm**

After mounting of the bearings, the necessary amount of oil must be filled in, according lubricant instruction. Oil level at start-up should be set at maximum.
The max. sump dimensions are such to guarantee, via an optimum oil level, perfect lubrication of the bearing when the shaft turns it drags the oil ring with it at a lower rpm.

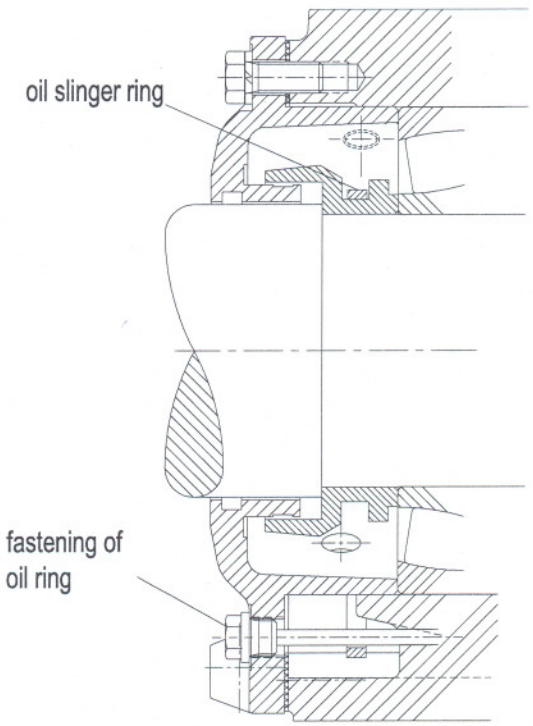
The lube oil may be introduced through the breather existing in the upper part of the housing (amounts to be introduced are indicated in the chapter "Start-up"). The oil level may be checked by means of an oil level indicator threaded into a lug which is integrally cast to the lid.
Four fixing points are available on the lid so as to ensure that the indicator may be arranged at a point which is the most favorable one for the location in each specific case. The spent lube oil may be drained after one of the three plug screws has been removed from the lugs integrally cast to the lid.

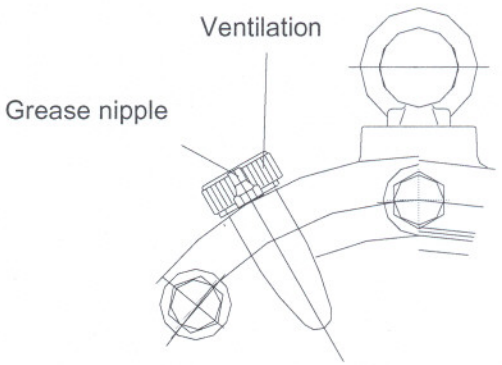
The anti-friction bearings installed in the housings are lubricated by means of an oil slinger ring consisting of St 37 steel. The drill holes in the housing lid shells, through which the oil returns into the oil sump, are arranged so that the anti-friction bearing dips into a determined oil sump.

The oil slinger ring is guided in a groove of the labyrinth ring seated on the shaft.
A bolt keeps it in the lower part of the housing so that it may not leave the groove of the labyrinth ring during operation.

The shaft passageway is sealed by means of a labyrinth and a grease chamber susceptible to relubrication.

For further information, please see the Mounting and Maintenance instruction of SNR, at chapter 11 Erection / Maintenance of Components





6.4 Service check list

Factory.- No. List No.

1.	Check before start-up:	Date	Notes:
1.1	No foreign matter in casing and suction box	[ ]	
1.2	No water in casing and suction box	[ ]	
1.3	Inspection doors tightly closed	[ ]	
1.4	Protective hoods for cooling disc, shaft coupling securely mounted	[ ]	
1.5	Throttling device moves easily and is in closed position	[ ]	
1.6	Graduated glasses are undamaged	[ ]	
1.7	No maintenance personnel on the maintenance platforms	[ ]	

2	Start-up: Time	Date	Notes:
2.1	Instruments and circuits without failure	[ ]	
2.2	Main drive motor is switched on	[ ]	
2.3	Throttling device moved from closed position (app. 1 min. after switching on the main drive motor)	[ ]	

3. Continuous Operation: Time Date

3.1 Bearing temperature (read locally)

Time	°C	°C	°C	°C	°C
non located bearing	°C	°C	°C	°C	°C
located bearing	°C	°C	°C	°C	°C

3.2 Bearing vibration

Time	mm/s	mm/s	mm/s	mm/s	mm/s
non located bearing $V_{eff.}$	mm/s	mm/s	mm/s	mm/s	mm/s
located bearing $V_{eff.}$	mm/s	mm/s	mm/s	mm/s	mm/s

3.3 Leak oil check on located and non located bearings [ ]

3.4 Anchor bolts and fixing screws of bearings and motor checked [ ]

4.	Main drive motor switched off:	Date	Cause:
	Throttling device position : closed	[ ]	

Date _____ Recorded _____

6.6 Troubles and how to eliminate them

Failure and/or indication	Cause	Remedy
Heavy vibrations see VDI 2056	Unbalance of the fan wheel caused by damage to the fan wheel, wear or dust deposit on the blades.	After a careful check of the fan wheel and its fixing to the shaft, effect local repair and/or cleaning. Rebalancing is necessary on principle. In the case of major damage, replace the fan wheel by a spare wheel. In this case, too, rebalancing is to be effected.
	Poor alignment of the coupling or wear of the Rubber buffer	Adjust coupling clearance according to installation instructions. Align coupling parts with each other. Replace worn rubber buffer.
	Loose fixing screws on the bearings and the motor	Re-tighten the screws after an alignment check.
	Damaged bearing	replacement of bearing
Bearing temperature too high irregular noises	Insufficient lubrication	Check the lubrication
	Damaged bearing	replacement of bearing

6.7 Vibration behavior

Assessment of vibration behavior
Possible set points of a vibration monitoring system

The vibration probe is radially/horizontally fixed at the bearing support plates off the bearing at the free shaft end,
in cross sense to the shaft centerline.

The vibration assessment takes place according to VDI 2056.

Machine group 'G' refers to permanent installation.

The VDI 2056 values are indicative values which do not at all take into consideration
the type of the machines whereas the size and elasticity are only conditionally considered.

According to our experience, the following values are applicable to our fans:

alarm : V_{eff} : 8,8 mm/s alarm delay 10 s

disconnection : V_{eff} :11 mm/s alarm delay 1 s

To determine the cut-off value for a specific machine taking into account the acceptable unbalance which is equivalent to a theoretical centrifugal force of 80 % of the weight of the rotating parts,
2 tare runs are necessary, namely

the 1st run with a balanced impeller

the 2nd run with an applied tare weight.

The specific reaction of the machine can be derived from the amplitude and phase differences
of the vibrations recorded during these tare runs.
Thus, the cut-off value can be fixed by comparison with the allowed unbalance.

Constant monitoring of radial vibrations is recommended especially for machines at which
unbalances must be anticipated as a result of the operating conditions.
The compensation for heath treated/annealed impellers
has to be done via fixed points and the compensation weights are to be bolted.

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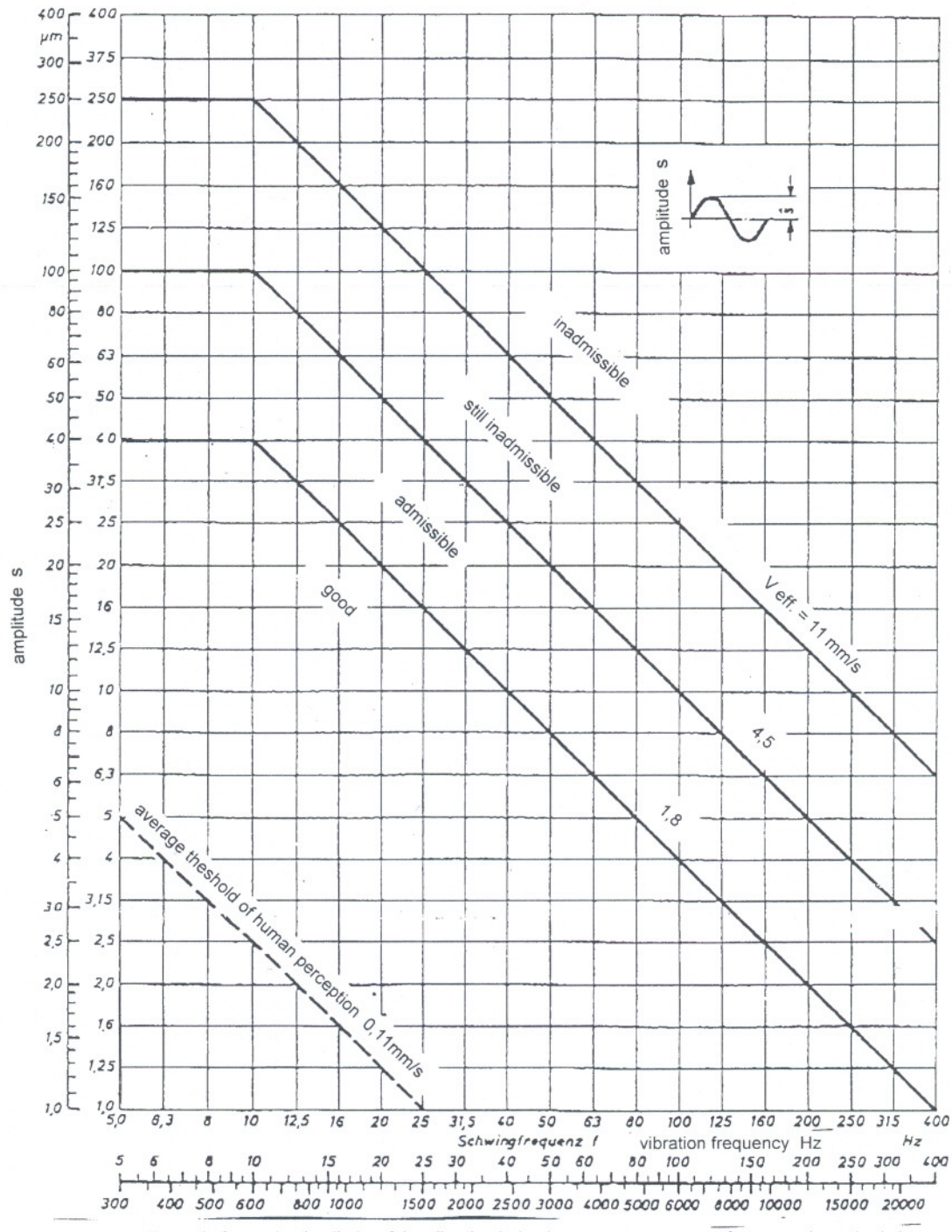
Set points

VDI 2056



Example for evaluation limits of the vibration behaviour:

machine group G

= fan on foundation (adjusted to high frequencies)

2	25Jan06	Ritz	26Jan06	Labod	Customer: **Polysius AG**	Job: **IRSAB**	
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7. Maintenance

Please observe sections 3 + 5 of this manual before carrying out any maintenance/servicing work.

7.1 General

- Inspections During Operation
  During operations, routine-like checks are to be carried out.
  Their purpose is to preserve operational readiness up to the scheduled stoppages.
  (oil-level, effectiveness of the oil seals, bearings temperature, smoothness of running)
- Inspections During Short Standstill Periods
  If stoppage of other plant parts results in an unexpected downtime for the fan,
  then this opportunity should be used for inspecting the fan.
  Fan parts subject wear (e.g. coupling compression sleeves, seals, bearings)
  are to be checked in the process.
  Clean the impeller of any impurities on hand and examine as to wear.
- Inspections During Scheduled Stoppages
  During the scheduled stoppages, work is to be undertaken
  to enable the fan to again run without any interruption to the next stoppage.

We would recommend the following work being carried out:

- Inspect the impeller for impurities and clean
- Examine the impeller as to wear
- Check the impeller for signs of damage
- Renew the bearing assembly lubricant
- Inspect the seals for wear and replace
- Check the coupling as to its functioning
- Check on the expansion joint for wear
- Clean the suction and pressure lines plus the fan casing

A trial run is to complete the inspection.

7.1.1 Important Advice for Repair and Maintenance Work

In each fan, the rotating fan wheel represents a source of danger as high-energy body of rotation.
Further dangers also result from hot, corrosive or toxic media conveyed in the corresponding fans.

It is therefore absolutely necessary to fulfill the following requirements for work on the fan wheel or within the fan casing:

- Drive motor is protected against unintentional switching on.
- Fan wheel stands still.
- The line are shut off to avoid that the fan wheel is moved by gases passing through.
- There are no dangerous media (hot, corrosive, toxic) inside the fan.

Only when these conditions have been fulfilled and checked,
the protective hoods may be removed and/or the fan be opened.

7.2 Maintenance of fan in operation and standstill

7.2.1 While running of the fan the following work shall be performed

- The bearing assembly has to be supervised permanently during the initial hours after starting.
- Oil tightness of the bearing housing

  The housings shall be mounted so as to be absolutely leak oil tight.
  In particular check the joints, the connections of the lines and instruments,
  the plug screws and the shaft passageways.

- Bearing temperature
  (Measured at outside bearing ring)

  This temperature shall gradually rise in the first hours until the steady temperature is reached.
  The steady temperature will range between 60 and 90 deg. C .

  In case of unsteady running or permanently increasing bearing temperatures exceeding
  105 deg. C the fan has to be taken out of operation and cause has to be determined and eliminated.

- Quiet running of the fans
  Fan running shall be steady and free from trouble.

7.2.2 Maintenance of fan at standstill

ATTENTION!

At least once a week the fan rotor shall be turned with several complete rotations to ensure that all parts of the bearing are wetted with oil and to vary permanently the load position of the rolling bodies. Therefore put the driver in short operation.

- Longer operational standstill periods (more than 1 month) bear the risk of condensate collecting in the bearing casing.
- The oil should be exchanged once to twice a year, since condensate forms with time, which has to be removed.
  Before starting the fan, the oil has to be removed completely and replaced according to point 8.
- Check the oil level every two weeks.
- Special maintenance of the coupling is not necessary

7.3 Maintenance of fan wheel / shaft

Wheel and shaft have been balanced at our shop in the assembled condition.
This is why the wheel should not be separated from the shaft, as far as possible.

When certain reasons make it an absolute necessity to do so, the position of the parts with respect to each other shall exactly be match marked so that the original position may be restored upon assembly.

Special maintenance of the rotor is not necessary.

But it is advisable to check the wheel at regular intervals for wear and to remove any adhering dust, because unbalances will be produced in either case.
(See also chapter 6.6 " Troubles and how to Eliminate Them ").

7.4 Maintenance of the bearing

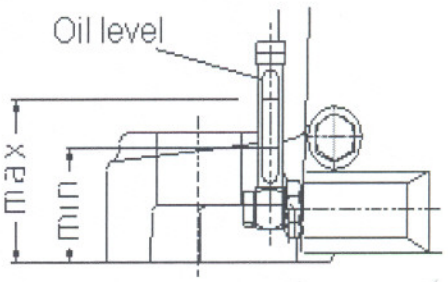
Located bearing: SNOE 238 BF Material GG
Non located bearing: SNOE 238 AL Material GG

Before start-up the pillow block must be filled with the proper volume of oil. Minimum and maximum oil levels are shown on lubricant instruction. The maximum oil level guarantees lubrication at start-up when the oil ring can not yet lubricate the bearing.

Before each start-up and after each long duration shutdown the oil level in the sump must be brought to the maximum level by adding oil if necessary.

Even after having carefully cleaned the pillow block prior to mounting it is possible that some dirt will remain in the pillow block cavity, therefore it is recommended that after two or three hours of initial running a full oil change be carried out. Oil change frequency should be based on the oil type used and on the running conditions especially running temperature. Oil change should be done at least once a year. Oil change must take place when the system is shutdown. If during trial runs no leaks were detected it is sufficient to inspect oil level once a month. During running periods the oil level can be as low as the minimum level.

SNR pillow blocks incorporate on the top of the cap a blind hole (M20) plugged with a plastic plug. If necessary, via this hole, it is possible to insert a thermometer or a temperature sensor for measuring temperature or for the control of temperature. The hole reaches down close to the bearing outer ring, so it is possible to measure temperature very close to the temperature source. Using this system faster response can be achieved than measuring the temperature of the oil sump.



ATTENTION!

Due to the increased shaft expansion of approx. 14 mm, the non located bearing support is transferred installed in relation to the bearing center. The different alignment amounts to 6 mm

For further information, please see the Mounting and Maintenance instruction of SNR, at chapter 11 Erection / Maintenance of Components

7.5 Maintenance of the coupling

If irregularities are detected during operation, the drive assembly should be set off immediately.

Check during routine control of the drive system:

- Alignment of the coupling
- Condition of the elastomer

Note! Exact alignment of the coupling increases the services life of the elastic buffer!

Caution!	**The buffers should be changed in sets.**
Note!	**Both bolts and buffers can be replaced without any axial displacement of the coupled machinery.**

For further information, please see the Mounting and Maintenance instruction
of Flender, at chapter 11 Erection / Maintenance of Components

7.6 Vibration behavior possible set points of a vibration monitoring system

The vibration probe is radially/horizontally fixed at the bearing support plates off the bearing at the free shaft end,
in cross sense to the shaft centerline.
The vibration assessment takes place according to VDI 2056.

Machine group 'G' refers to permanent installation.

The VDI 2056 values are indicative values which do not at all take into consideration the type of the machines whereas the size and elasticity are only conditionally considered.

According to our experience, the following values are applicable to our fans:

alarm : V_{eff} : 8,8 mm/s alarm delay 10 s
disconnection : V_{eff} :11 mm/s alarm delay 1 s

7.7 Maintenance intervals

The time intervals specified are based on continuous operation of the fan. Because of varying operating conditions, it is impossible to determine beforehand the exact intervals for inspections, or wear and maintenance checks. A routine maintenance schedule must be drawn up on the basis of the operating conditions prevailing at your installation.

Operating hours	**Check item/Maintenance item**
Every year	Inspect the impeller for impurities and clean
Every year	Examine the impeller as to wear
Every year	Complete check of fastening-bolts
Every year	Check the coupling as to its functioning
Every 4000 h	Check on the inlet damper for wear und function
Every 2000 h	Lubricant exchange of fan bearing
After 500 + 1000 h (only once)	Lubricant exchange
Every week	Check the temperature and oil tightness of the bearings
Every week	Quit running of the fan

8. Lubricant instruction

8.1 Fan Bearing

For lubrication of the fan bearings, we recommend Hydraulic oils acc. DIN 51524 part 1+2 of the viscosity class VG-100.

Lubrication point	Lubricant		Filling / lubricating point		Lubricant interval h	Remarks
	Grease	Oil	gr.	l		
Located bearing SNOE 238 BF		ISO VG 100		7,2	1. : 500 2. : 1000 further : 2000	Oil level: 70-100mm height
Bearing seal	Grease with dripping point of 190°C		62,5			After request
non located bearing SNOE 238 BL		ISO VG 100		7,2	1. : 500 2. : 1000 further : 2000	Oil level: 70-100mm height
Bearing seal	Grease with dripping point of 190°C		62,5			After request

Lubricant selection for fan bearing

hydraulic oil	Sealing grease Grease with dripping point of 190°C
Shell Tellus C100	Mobilux 3
Mobil DTE 27	

9. Spare parts

Spare parts and replacement parts that cannot be delivered quickly should be kept in stock.
Production down time is generally more expensive than the cost of the part in question.

We wish to point out explicitly that we do not test and issue spare parts or replacement parts not supplied by us. Any and all responsibility by the manufacturer is explicitly excluded for damage arising from the use of non-original parts and accessories.

Our Serviceadresse for Spare parts:

TLT-Turbo GmbH
Havensteinstr. 46
46045 Oberhausen
Tel.: 0049 (208) 8592 451 / Fax 0049 (208) 8592 250

Please mention the Ventilator-Data given below:

Kind of Fan:	Raw Mill Fan
Type of fan:	1886 ZA/ 1664
Job No.:	71260-1
Dimension sheet	H6002313
Factory No.:	723006976
Sense of rotation:	L (VDMA) acc. VDMA 24165

Pos	Piece	Denomination	Weight	Wear
1	1	fan wheel ∅ 3180 x 1178	5000	X
2	1	shaft ∅ 540 x 5577 long	7700	X
3	1	bearing housing type SNOE 238 BL	230	
4	1	bearing system type 22238EAB33J30	37	X
5	1	bearing housing type SNOE 238 BF	230	
6	1	bearing system type 22238EAB33J30	37	X
7	1	coupling type Rupex RWS 710	275	
8	Set	Elastic buffers	10	X
9	2	shaft seal type ∅ 750 / ∅ 305 x 10	4	X