



TLT-Turbo GmbH

# **Erection- and Maintenance Manual**

of

## **Compound Operation Fan Type 1444 Z/ 2052**

TLT-Job No.: 72284

					Customer: <b>Polysius AG</b>	Job: <b>IRSAB</b>	
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## 2. Description

### 2.1 Rating Data / Technical Data

Kind of Fan: Compound Operation Fan  
Type of fan: 1444 Z/ 2052  
Job No.: 72284  
Built in: 2006  
Factory No.: 723006977  
Sense of rotation: L (VDMA) acc. VDMA 24165

Characteristic of the fan:	<b>Volumetric flow rate:</b>	<b>366.5</b>	<b>m<sup>3</sup>/s</b>
	<b>Gas temperature:</b>	<b>240</b>	<b>°C</b>
	<b>Temperature</b> <small>max. mech.:</small>	<b>300</b>	<b>°C</b>
	<b>Spec. Energy</b>	<b>5623</b>	<b>J/kg</b>
	<b>Density at fan inlet</b>	<b>0,673</b>	<b>kg/m<sup>3</sup></b>
	<b>Total pressure rise:</b>	<b>3783</b>	<b>Pa</b>
	<b>Fan speed:</b>	<b>745</b>	<b>rpm</b>
	<b>Fan speed</b> <small>max.:</small>	<b>750</b>	<b>rpm</b>
	<b>Power required at shaft:</b>	<b>1556</b>	<b>kW</b>
	<b>Mass inertia moment</b> ( $J = 0,25 \times GD^2$ ):	<b>5800</b>	<b>kgm<sup>2</sup></b>
	<b>Motor power:</b>	<b>1789</b>	<b>kW</b>
	<b>Max. permissible power:</b>		<b>kW</b>
	<b>Motor speed:</b>	<b>739</b>	<b>1/min</b>

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. 59000 kg  
General drawing No.: H6002314

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### 2.1.1 Parts of delivery

Driver: ( by Customer )

Motor-Fabricate / Type: ELIN / HRR 010 B06	Rated output: 1800 kW
Size: IM B3	Rated speed: 739 1/min
Frequency: 50 Hz	Rated voltage: 6600V
Weight: 13800 kg	Protection: IP 54

Coupling:

Manufacture: Flender	Type: RWN 630
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Bearing:

Manufacture: SNR	Type: SNOE 234 / SNOE 230
Lubricant: Oil	ISO VG 100
Set points of bearing temperature: ( measured at outside bearing ring )	Set points of vibration monitoring: ( measured at outside bearing ring )
Alarm: 95 °C	Alarm: 8,8 mm/s
Disconnection: 105 °C	Disconnection: 11 mm/s

Inlet Damper with actuator:

manufacturer: Hamm	Type: Auma Actuator SA 07.5- B3/16-GS125.3/VZ4.3
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Thermo couple:

manufacturer: Dittmer	Type: Pt100 3 Wire connection
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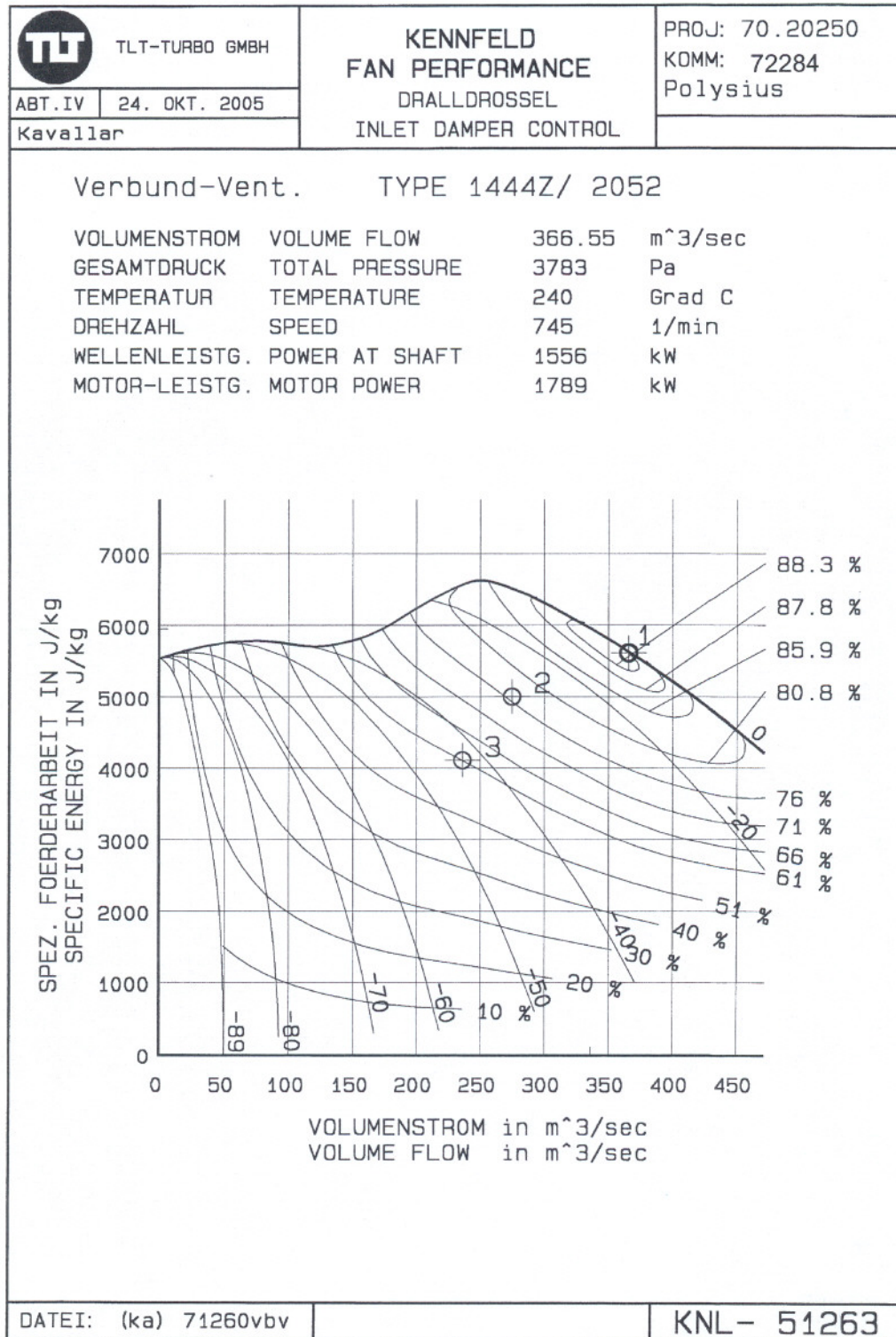
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## 2.1.2 Characteristic curve



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### 2.1.3 Table

TLT-Turbo GmbH		Tabelle zum Verbund-Vent. Typ 1444Z/ 2052		Komm.-Nr. 70.20250 Firma Polysius		
Abt IV	24.10.2005	Regelung durch Dralldrosselklappe		TAB-Nr. 51263		
Name : Kavallar				Blatt 1 von 1		
Laufrad-Durchmesser	2946 mm	Querschn. Saugkasten	EIN	13.4	m <sup>2</sup>	
empf. Motorleistung	1789 kW	Querschn. Gehäuse	EIN	0	m <sup>2</sup>	
Motordrehzahl	745 1/min	Querschn. Gehäuse	AUS	11.0	m <sup>2</sup>	
Barometerstand	1007 mbar	Querschn. Diffusor	AUS	18.3	m <sup>2</sup>	
Lastfall	Direkt	Verbund2	Verbund8			
Punkt	1	2	3	4	5	6
Massenstrom kg/s	243.3	199.3	207.3			
Volumenstrom Nm <sup>3</sup> /h	673783	551976	574032			
Volumenstrom Bm <sup>3</sup> /s	366.5	275.7	236.8			
Temperatur ss ° C	240	198	116			
pv Anlage Pa	3500	3500	3500			
pv Saugkasten Pa	84	52	46			
pv Drossel Pa	70	43	39			
pv Welle Pa	85	52	47			
pv Diffusor Pa	44	27	24			
pt total Pa	3783	3674	3656			
pal absolut Pa	97220	97220	97220			
Dichte (Norm) kg/m <sup>3</sup>	1.300	1.300	1.300			
Dichte (Betr) kg/m <sup>3</sup>	0.664	0.723	0.875			
Kompress-Fakt. -	0.986	0.987	0.987			
Dichte mittl. kg/m <sup>3</sup>	0.673	0.733	0.887			
Förderarbeit Nm/kg	5621	5014	4121			
Wirkungsgrad %	87.9	82.7	61.2			
Wellenleistung kW	1556	1209	1395			
Drehzahl min-1	745	745	745			
Temperatur ds ° C	246	204	123			
Datei : ka71260vbw						

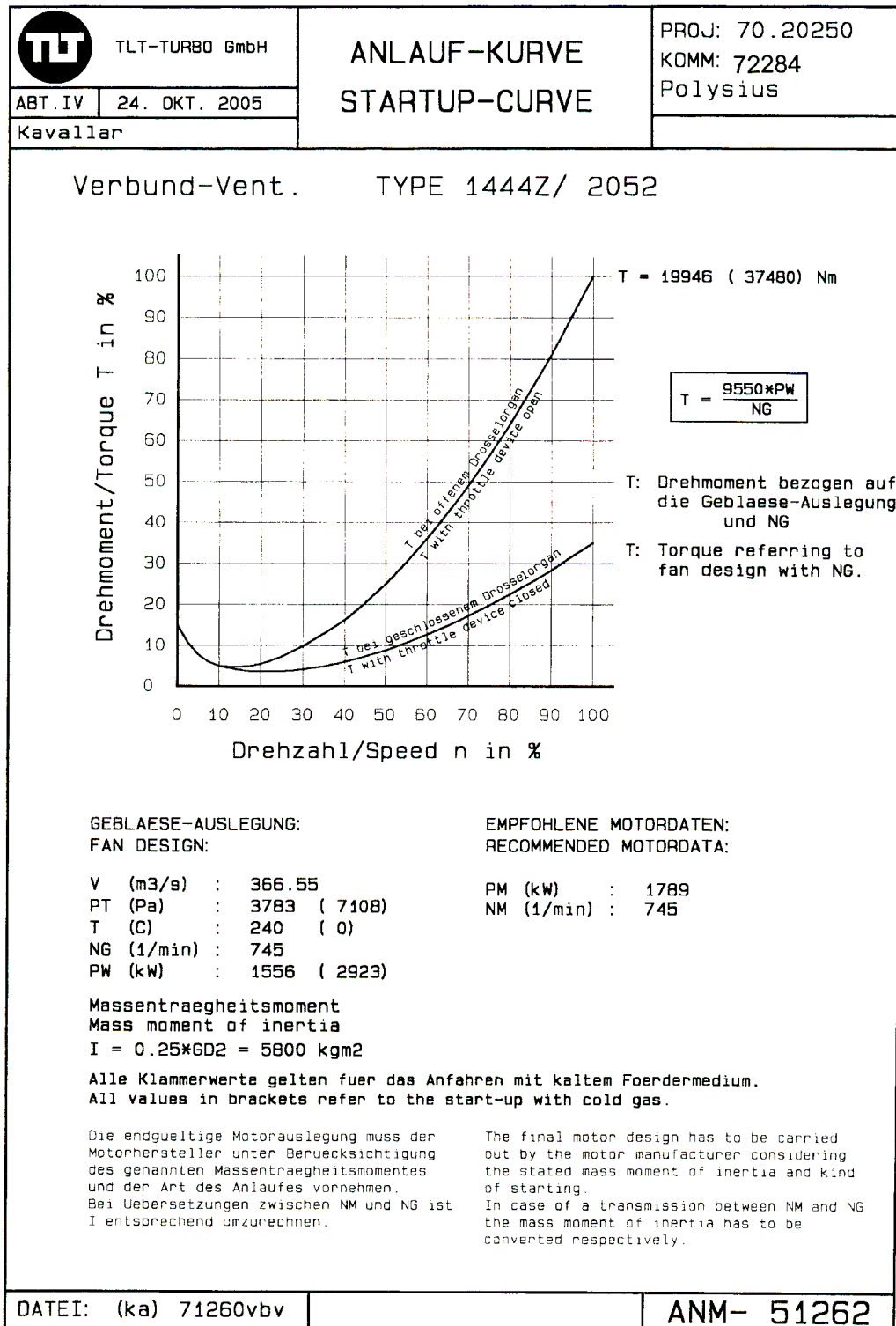
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## 2.1.4 Startup-curve



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## 2.1.5 Octave Band Analysis

TLT-Turbo GmbH		Oktavanalyse zum		Projekt-Nr. 70.20250																															
Abt IV		24.10.2005		Firma Polysius																															
Name : Kavallar		Verbund-Vent.		OAN-Nr. 51264																															
		Typ 1444Z/ 2052		Blatt 1 von 1																															
<u>Auslegungsdaten :</u> <table border="0"> <tr> <td>Volumenstrom</td> <td>366.55</td> <td>m<sup>3</sup>/s</td> <td>Schaufelenddurchmesser</td> <td>2946</td> <td>mm</td> </tr> <tr> <td>Temperatur</td> <td>240</td> <td>°C</td> <td>Umfangsgeschwindigkeit</td> <td>115</td> <td>m/s</td> </tr> <tr> <td>Totaldruckerhöhung</td> <td>3783</td> <td>Pa</td> <td>Anzahl der Schaufeln</td> <td>11</td> <td>-</td> </tr> <tr> <td>Dichte saugseitig</td> <td>0.664</td> <td>kg/m<sup>3</sup></td> <td>Hauptstörfrequenz</td> <td>137/273</td> <td>Hz</td> </tr> <tr> <td>Drehzahl</td> <td>745</td> <td>min-1</td> <td></td> <td></td> <td></td> </tr> </table>						Volumenstrom	366.55	m <sup>3</sup> /s	Schaufelenddurchmesser	2946	mm	Temperatur	240	°C	Umfangsgeschwindigkeit	115	m/s	Totaldruckerhöhung	3783	Pa	Anzahl der Schaufeln	11	-	Dichte saugseitig	0.664	kg/m <sup>3</sup>	Hauptstörfrequenz	137/273	Hz	Drehzahl	745	min-1			
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Drehzahl	745	min-1																																	
Frequenz  Hz	Meßflächen- Schalldruckpegel  in 1m Abstand vom Gebläse  re 2·10E-5 N/m <sup>2</sup>		Schalleistungs- pegel  im Gasstrom saugseitig  re 10E-12 W		Schalleistungs- pegel  im Gasstrom druckseitig  re 10E-12 W																														
	dB	dB(A)	dB	dB(A)	dB      dB(A)																														
31	94	55	122	83	123      84																														
63	92	66	125	99	126      100																														
125	96	80	128	112	129      113																														
250	93	84	127	119	128      120																														
500	83	79	125	122	126      123																														
1000	72	72	121	121	122      122																														
2000	68	69	115	116	116      117																														
4000	64	65	109	110	110      111																														
8000	60	58	100	99	101      100																														
Gesamtpegel	100	87	133	126	134      127																														
Meßflächenmaß [Ls=10·lg(S/So)]			25 dB																																
Toleranzen :			Gesamtpegel : ±4 dB Oktavband : ±6 dB																																
Alle Angaben gemäß DIN 45635			Datei : ka71260vbv																																

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## 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
non located bearing	°C	°C	°C
located bearing	°C	°C	°C
3.2	Bearing vibration		
Time	mm/s	mm/s	mm/s
non located bearing $V_{eff}$ .	mm/s	mm/s	mm/s
located bearing $V_{eff}$ .	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 \_\_\_\_\_

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## 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
	Insufficient lubrication	Check the lubrication
Bearing temperature too high irregular noises	Damaged bearing	replacement of bearing

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## 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 heat treated/annealed impellers

has to be done via fixed points and the compensation weights are to be bolted.

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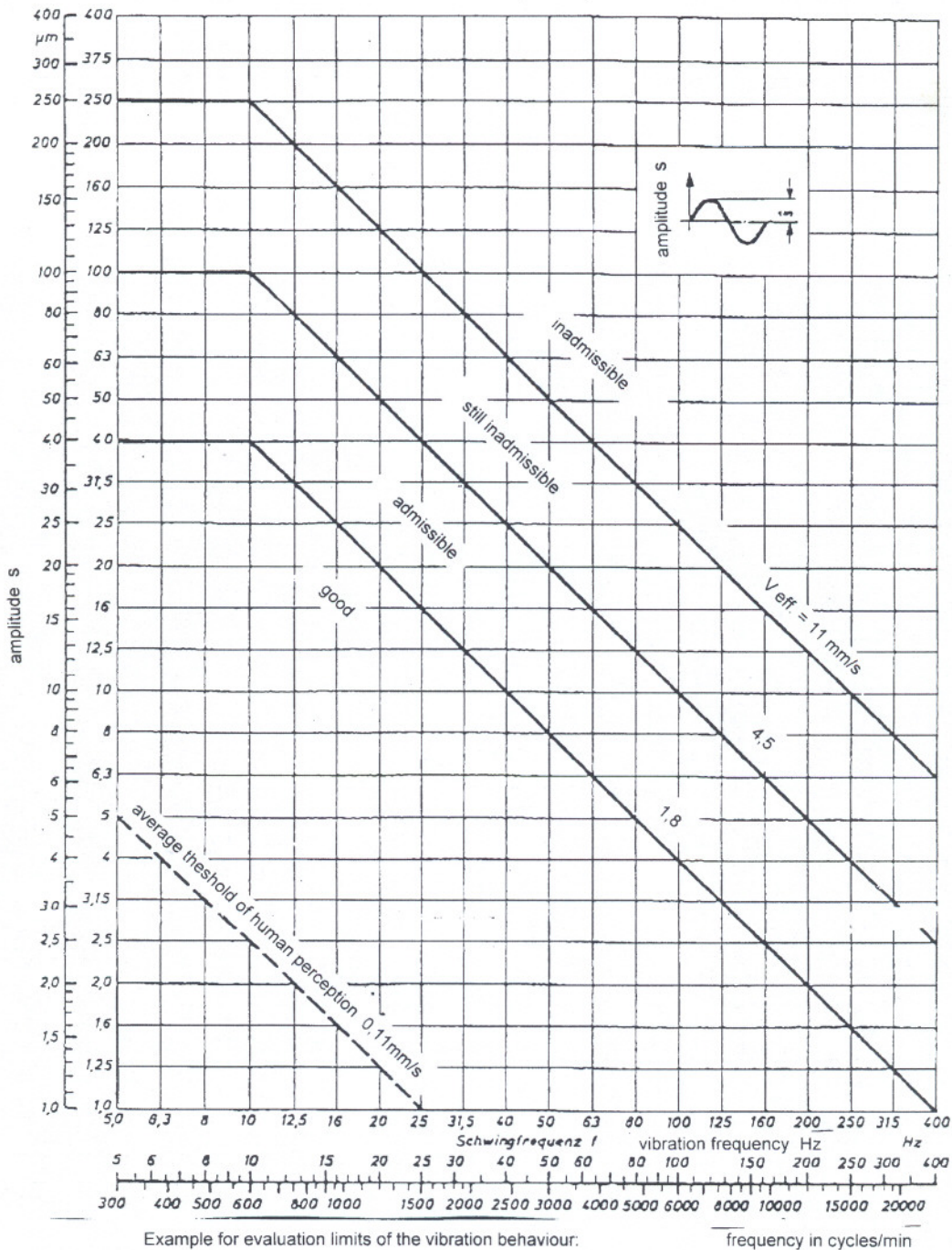
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## Set points

VDI 2056



Example for evaluation limits of the vibration behaviour:

machine group G

= fan on foundation ( adjusted to high frequencies )

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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.

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## 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 ").

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#### 7.4 Maintenance of the bearing

Located bearing: SNOE 234 BF Material GG

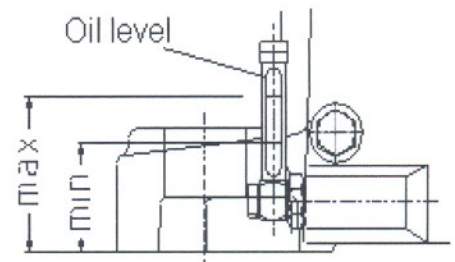
Non located bearing: SNOE 230 AL Material GG

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. 21 mm, the non located bearing support is transferred installed in relation to the bearing center.  
The different alignment amounts to 8 mm**

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

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## 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!

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

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

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## 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

					Customer: <b>Polysius AG</b>	Job: <b>IRSAB</b>	
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## 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 234 BF		ISO VG 100		6,0	1. : 500 2. : 1000 further : 2000	Oil level: 90-105mm height
Bearing seal	Grease with dripping point of 190 °C		44			After request
non located bearing SNOE 230 AL		ISO VG 100		4,2	1. : 500 2. : 1000 further : 2000	Oil level: 65-90mm height
Bearing seal	Grease with dripping point of 190 °C		33,9			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	

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## 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 Service address 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: Compound Operation Fan  
Type of fan: 1444 Z/ 2052  
Job No.: 72284  
Dimension sheet H6002314  
Factory No.: 723006977  
Sense of rotation: L (VDMA) acc. VDMA 24165

Pos	Piece	Denomination	Weight	Wear
1	1	fan wheel $\varnothing$ 2990 x 2132	4000	X
2	1	shaft $\varnothing$ 515 x 5900 long	8700	X
3	1	bearing housing type SNOE 230 AL	125	
4	1	bearing system type 22230EAB33J30	18	X
5	1	bearing housing type SNOE 234 BF	160	
6	1	bearing system type 22234EAB33J30	28,5	X
7	1	coupling type Rupex RWN 630	195	
8	Set	Elastic buffers	10	X
9	2	shaft seal type $\varnothing$ 760 / $\varnothing$ 265 x 10	4	X

					Customer: <b>Polysius AG</b>	Job: <b>IRSAB</b>	
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