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Section C – Mechanics

Part 2: Proactive maintenance

The following delivery specifications of Wieland-Werke AG form part of the contract.
Any deviating specifications are to be agreed upon between the supplier/contractor and Wieland, and documented.

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1. Vibrations, balancing qualities and alignment qualities

1.1 Vibrations as a function of drive size

To assess the running quality with regard to trouble-free operation, the following limit values apply to newly commissioned machines in accordance with DIN ISO 10816.

(Limit values = Effective values (RMS values) of the vibration velocity = v_{eff} in mm/s):

Max. permissible v_{eff} in mm/s RMS	Drive size in kW	Mounting
0.71	<15	
1.12	15-75	
1.80	75-300	Rigid
2.80	75-300	Elastic
2.30	>300	Rigid
3.50	>300	Elastic
4.50	Piston pumps	

The maximum permissible values according to DIN ISO 10816 correspond to the values of VDI 2056 which was valid until 1997 and the values gained from many years of practical experience by Wieland-Werke AG in the field of vibration analysis. The limit values are defined for a “good machine” (wording in VDI 2056) or for machines in zone A (DIN ISO 10816). Zone A: “The vibration of newly commissioned machines normally falls within this zone.”

To check the limit values, an acceptance measurement is carried out in the frequency range from 5 to 2500 Hz. The measurement locations are at non-rotating components such as bearing housings or other locations that reflect the action of alternating forces. Each measurement point is measured in three directions, i.e. horizontal (H), vertical (V) and axial (A), where H and V are offset by 90° from each other in one measuring plane. The limit values apply to all operating conditions (speed ranges).

Arrangement of measurement points, see Annex 1.

Definition of rigid and elastic (soft) mounting:

If the lowest natural frequency of the overall system consisting of machine and substructure is at least 25% above the main excitation frequency (in most cases this is the rotational frequency), the substructure can be described as rigid, otherwise it is to be considered elastic.

Mounting machines on an elevated steel structure:

If machines are not placed directly on foundations at ground level, resonance problems can be expected. Therefore, the steel structure (natural frequencies) and machine (excitation frequencies) must be matched to avoid resonance (see section 2). When designing the steel structure, care must be taken to ensure that forces from the machine are dissipated as directly as possible into the foundation / steel structure. Supports must be positioned directly under the feet of the motor/machine. For vibration-isolated structures, see section 3.

Vibrations and their impact on people:

If vibrations caused by machinery and equipment can affect people, workplaces and surrounding facilities (buildings, offices, etc.), the causes must be recorded by measurement, the transmission mechanisms investigated, and the amplitude levels for both structure-borne noise and airborne noise must be limited to a non-harmful minimum. This minimum is frequency-dependent and must be assessed and individually determined according to the latest knowledge in this field. For airborne noise, low-frequency infrasound ($f < 20\text{Hz}$) must also be assessed (limit values in accordance with DIN 45680). For structure-borne noise, the German noise and vibration occupational safety ordinance (*Lärm- und Vibrations-Arbeitsschutzverordnung*, (LärmVibrationsArbSchV)), applies; ISO 2631 for whole-body vibrations; and DIN EN ISO 5349 for hand-arm vibrations. The assessment is carried out directionally (x-, y- and z-direction).

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	Hand-arm vibrations $A(8) = a_{hv,8h}$	Whole-body vibrations $A(8) = a_{wz,8h}$
Action value	2.5 m/s ²	0.50 m/s ²
Exposure limit value	5.0 m/s ²	Vertical 0.8 m/s ²
		Horizontal 1.15 m/s ²

1.2 Freedom from resonance

Any machine, group of machines or the entire plant must be free of resonance.

This means that the natural frequencies of individual parts of the plant or of the plant as a whole must not match any excitation frequencies.

Excitation frequencies include:

- Frequencies below 1x speed (e.g. belt frequencies)
- 1x speed of rotors (imbalances)
- 2x speed of rotors (misalignment)
- Blade pass frequencies or typical modes of operation (speed + number of blades, pistons, vanes etc.)
- Tooth meshing of gearboxes (tooth meshing frequency = speed x number of teeth)
- Electromagnetic frequencies (1x and 2x mains frequency or frequency during frequency converter operation, rotor bar pass frequency = speed x number of rotor bars).

Any natural frequencies must be at least $\pm 20\%$ outside of excitation frequencies. This also applies to the critical speed of rotors. The operating speed must not be in the range of the critical speed. If a natural frequency is below an excitation frequency, then no damage may occur during the idling, starting and stopping of rotating machinery when passing through the critical speed.

Resonances constitute a serious design defect and must be eliminated immediately by the manufacturer or plant supplier.

1.3 Vibration isolation

If the cause of a vibration cannot be completely eliminated, vibration isolation can be used to reduce the transmission of periodic, shock or stochastic forces from a machine into the surrounding structures or to protect people and sensitive machinery, devices and buildings from vibration.

The vibration isolation must be matched to the machine, its mass and stiffness, to prevent the system from resonating.

Defective vibration isolation shall be corrected at the expense of the manufacturer or supplier.

1.4 Balancing quality

The following applies to the balancing quality for rigid motors in accordance with DIN ISO 21940-1:

- **Quality class G 2.5** for axial fans, electric motors, spur gear units, pumps with mechanical or labyrinth seals, individual rotor components for machines of quality class G 6.3
- **Quality class G 6.3** for radial fans, pumps other than those mentioned in G 2.5

The balancing qualities apply to the entire machine.

If the individual mass of a rotor (shaft, coupling, impeller) is greater than 10% of the total mass of the machine, then the rotor component must be balanced one quality class better than the machine.

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Balancing of rotors with keyways must be carried out in accordance with DIN ISO 21940-32 (half-key convention). A half-key must be placed in the shaft keyway when the shaft is balanced without the part with which it ordinarily forms an assembly (e.g. coupling). The end face of the shaft must then be permanently marked with the letter H.

To prevent imbalances, protruding parts of keys on couplings and belt pulleys must be machined down to the diameter of the shaft. The same applies to excessively large keyways. Excess portions must be made up to the diameter of the shaft (mass balancing).

If rotating parts have to be balanced during their service life / period of operation, they must be designed in such a way that there is access to all planes where balancing is required. This applies in particular to impellers of fans conveying or circulating media containing solid particles.

1.5 Alignment quality (shaft alignment)

Permissible tolerance between two connected machines on a common axis of rotation in horizontal and vertical directions depending on the speed:

Speed in RPM	Max. parallel error in mm	Max. angular error in mm/100 mm
0 to 1000	0.13	0.10
1000 to 2000	0.10	0.08
2000 to 3000	0.07	0.07
3000 to 4000	0.05	0.06
4000 to 6000	0.03	0.05

Before each alignment operation, the “soft foot” must be checked and levelled to within < 0.10 mm. A “soft foot” means that one or more feet of the machine is not making good contact with the supporting surface, and only the force of the screw is making it sit solidly. This should always be avoided!

Units that were pre-aligned in the factory should be checked again and readjusted on site after installation. Only then should a measurement report be prepared.

1.6 Alignment quality (shaft alignment) taking the working temperature into account

In principle, the same limit values apply here as those given in the table in section 5.

If a difference of more than 20 °C occurs between the operating/working temperature of the moving machine (M-unit = the unit to be aligned, usually the motor) and that of the stationary machine (S-unit, e.g. pump), then the thermal expansion (or thermal contraction) has to be taken into account during alignment in the cold state. This also applies to machines that convey cold media, e.g. cold water.

1.7 Acceptance measurement

In order to assess the vibration situation, Wieland carries out acceptance measurements to check the limit values specified in this delivery specification. The greatest importance is attached to freedom from resonance!

1.8 Continuous vibration monitoring systems

The use of continuous vibration monitoring systems is generally desirable. The technology to be used must be agreed with Wieland.

1.9 Airborne noise at machinery and equipment

Airborne noise is vibration in the medium of air, which can be evaluated according to the same principles of physics as structure-borne noise (sections 1 to 7). To evaluate machine noises, Wieland-Werke AG performs third-octave analyses as well as Fast Fourier Transform (FFT) analyses of the airborne noise and uses them for the acceptance of the machine. Each machine/drive is evaluated individually. If a component in the frequency spectrum contributes significantly to increasing the permissible total level of 80 dB(A), the cause of these frequencies must be determined and eliminated. This also applies to low-frequency noise ($f < 20$ Hz), which can have a disturbing effect on the working environment at the machine. Noise containing sound in the sense defined in DIN 45681 must be avoided.

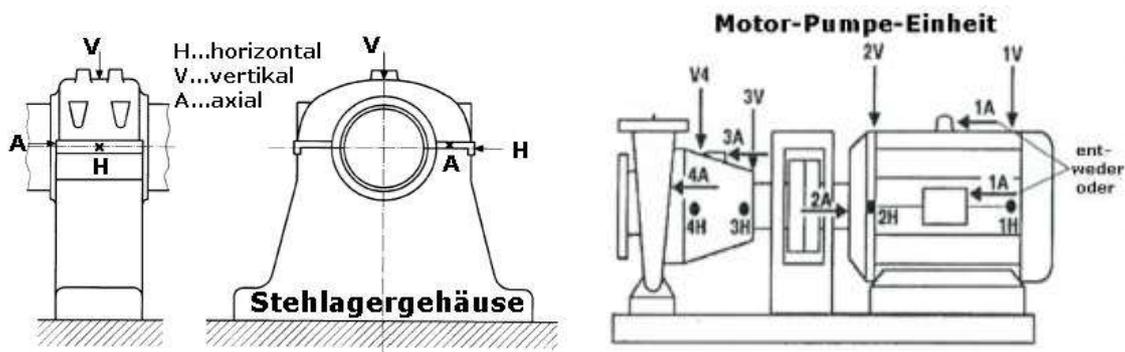
Remedial measures are to be implemented in the following order:

1. Primary measures – determination and evaluation of the source; eliminate causes.
2. Secondary measures – identify transmission paths, install decoupler systems or suchlike (use of elastomeric elements, damping elements, vibration insulation materials). Sound-insulated enclosures are possible as a final measure.

In principle, work equipment must conform to the state of the art in noise reduction technology and have low emission sound pressure level and sound power level values.

A noise data sheet must be prepared for individual machines (see www.baua.de German Federal Institute for Occupational Safety and Health (*Bundesanstalt für Arbeitsschutz und Arbeitsmedizin*)).

Annex 1: Examples of the arrangement of measuring points:



Legend:

DE	EN
H...horizontal	H...horizontal
V...vertikal	V...vertical
A...axial	A...axial
Stehlagergehäuse	Pillow block housing
Motor-Pumpe-Einheit	Motor-pump unit
entweder oder	either / or

2. Thermography

Infrared (IR) thermography is used for areawide temperature control on mechanical and electrical machinery and plant components as well as furnace systems. The main purpose is to localise overheating on mechanical components, uneven temperature distributions and loads, large temperature differences on small surfaces, loose contacts and connections, defective insulation, etc.

IR thermography should be carried out during regular production operation or during the acceptance test with everything running at full power. The respective plant components must have been in operation for some time (hours).

Furnace systems and insulated parts must be measured at maximum operating temperature. Limit value for surface temperatures see thermoprocess technology specifications.

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3. Lubricants, oil analysis and lubrication equipment**3.1 Lubricants**

The product overview of standard lubricants, see Annex 2, applies to the provision of hydraulic, gear, turbine and other operating oils as well as lubricating greases.

The standard products currently used are noted in the boxes highlighted in yellow, and are preferable to others for reasons of supplier and product limitation.

3.2 Central lubrication systems

A level-monitoring system must be provided.

Progressive distributor

- In the case of central lubrication systems with progressive distributor technology, only one progressive distributor level is to be provided. Additional requirements beyond that must be covered by additional pump elements + progressive distributors.
- It must be possible refill the reservoirs via a coupling with a pneumatic grease gun, without removing the cover of the reservoir. Refilling via this coupling must only take a few minutes.

3.3 Automatic lubricator for individual lubrication points

Wieland uses “simalube” lubricators. The grease used is “Total Ceran XM 220”.

In the case of deviating requirements, this must be agreed in advance.

Agreement on the lubrication strategy must take place in the planning phase!

Annex 2 – Product overview standard lubricants



Ansprechpartner bei Fragen: GE.MCC / Patrick Abt, Tel. 3832

Werkstoffnorm Schmierstoffe Wieland Werke AG 2021

Kennzahl	Artikelnr.	Bezeichnung nach DIN 51622	Viskosität in mm²/s bei 40°C, 100°C	VI	ILGI	Basis	Temp. Bereich	AVIA/ BANTLEON J	Castrol	TOTAL	FUCHS	EXXON ON Mobilbil	sonstige
118	5090097	Spezial (HLP, CLP, OKC)	2,2	-	-	Miranol	-75°C	Hypon Sinate Oil 2					
119	51001150	SPINDELOL 5	4,6	1,6	Miranol	-90°C	Fluid RSL 5	Hypon Sinate Oil 2					
6	5090027	HYDRAKOL HLP 10	10,0	2,5	Miranol	-60°C	Fluid RSL 10	Hypon ZZ 10					
118	5100268	HYDRAKOL HLP 22	22	4,4	Miranol	-60°C	Fluid RSL 22	Hypon ZZ 22					
19	5090081	HYDRAKOL HLP 32	32	5,5	Miranol	-60°C	Fluid RSL 32	Hypon ZZ 32					
18	5090086	HYDRAKOL HLP 46	46	6,9	Miranol	-60°C	Fluid RSL 46	Hypon ZZ 46					
114	5100358	HYDRAKOL HLP 68	68	8,9	Miranol	-60°C	Fluid RSL 68	Hypon ZZ 68					
116	5100359	HYDRAKOL HLP 100	100	11,2	Miranol	-60°C	Fluid RSL 100	Hypon ZZ 100					
118	34395	HLP 22	22	4,4	Miranol	-60°C	Fluid RSL 22	Hypon ZZ 22					
8	50901031	UMKALF-GETREBEÖL CLP 68	68	8,8	Miranol	-100°C	Gear RSK 68	Alpha SP 68					
9	50901031	UMKALF-GETREBEÖL CLP 100	100	11,2	Miranol	-100°C	Gear RSK 100	Alpha SP 100					
11	50901056	GETREBEÖL CLP 220	220	19,0	Miranol	-100°C	Gear RSK 220	Alpha SP 220					
104	50901208	GETREBEÖL CLP 320	320	24,2	Miranol	-100°C	Gear RSK 320	Alpha SP 320					
12	50901061	GETREBEÖL CLP 460	460	30	Miranol	-100°C	Gear RSK 460	Alpha SP 460					
16	5100360	GETREBEÖL CLP 680	680	39,9	Miranol	-100°C	Gear RSK 680	Alpha SP 680					
46	73943	GETREBEÖL CLP 680 mit Max	680	30,0	Miranol	-100°C	Gear RSK 680	Alpha SP 680					
64	37735	GETREBEÖL CLP PAO 320	320	35,0	Synth PAO	-100°C	Synlogear PE320						
65	50901212	GETREBEÖL CLP PAO 460	460	45,6	Synth PAO	-100°C	Synlogear PE460						
182	50901050	Getrebeö CLP PG 220	240	37	Polyglykol	-60°C	GEAR 1500 220	GEAR 1500 220					
184	50901010	Getrebeö CLP PG 460	460	73	Polyglykol	-60°C	GEAR 1500 460	GEAR 1500 460					
186	24361	Getrebeö CLP PG 680	680	111	Polyglykol	-60°C	GEAR 1500 680	GEAR 1500 680					
28	5090146	800EROL MA 10	8	-	Miranol	-	Tribol 780						
28	50901022	TURBENÖL	68	9	Miranol	-	Turbendol OS						
22	50901111	VERPÖCHTERÖL VOL 100	100	11	Miranol	-	Compara VOL 100	Avia PD 100					
8	50901041	GLEITBÄHNLÖL GOLF 68	68	9,0	Miranol	-	Avia CO 68	Magnaglide 68					
188	50901218	GLEITBÄHNLÖL GOLF 220	220	19,0	Miranol	-	Avia CO 220						
14	50901072	WÄRMELÖL ATF-A	39	7	Miranol	-	Multi HCD Extra						
24	50901130	HÖHMERSALNIEBERREICHES MOTORÖL SAE 15 IV 40	99	14	Miranol	-	Magylith SW-30 Longlife II						
26	51001071	MOTORÖL SAE 30 LOWSUFPE LOW 50WS	73	12	Miranol	-	Hypod 50 LS						
13	86669	GETREBEÖL SAE 85	170	16	Miranol	-	Hypod 90 LS						
80	5090091	METRAVEX-HOCHDRUCKFETT 85 3000 ppm	200	-	Miranol	-							
91	5090095	METRAVEX-HOCHDRUCKFETT 100 3000 ppm	>170	-	Miranol	-							
xx	51001002	GETREBEFLIESSFETT	700	36	Lithium-Seife	-30°C...+180°C							
84	5090206	GEL-FET 2 EP + M82	860	60	Get-Bentall	-30°C...+180°C							
87	5090209	GETREBEFLIESSFETT	375	24	Lithium-Seife	-10°C...+120°C							
121	5090142	ANTI-SEIFE-PASTE	-	-	Synth Öl + Al-Pulver	-70°C...+120°C Dose							
122	5090144	MONTAGEPASTE M082	-	-	Miranol + M082	-35°C...+400°C Dose							
124	51001035	MONTAGEPASTE M082	-	-	Miranol + M082	-35°C...+400°C Spray							
73705		SPANNUNTERPASTE	-	-	Synth Öl + Al-Pulver	-45°C...+110°C							
132	50902164	HAFTSCHMERTOFF + KETTENSCHMERTOFF	-	-	Synthesil	bis 250°C Spray							
138	5090236	ROSTLÖSER	-	-	Miranol	-30°C...+60°C Spray							
134	50901270	KETTENSCHMERTOFF	-	-	Miranol	-30°C...+60°C Bandrol							

Zinksehrne Schmierstoffe sind blau markiert. Diese Öle sollten nicht mit herkömmlichen Ölen gemischt werden. Bei Unsicherheiten Rücksprache.
 Synthetische Schmierstoffe mit PAO-Basis sind rot markiert. PAOs und Minerale sind miteinander verträglich.
 Synthetische Schmierstoffe auf Polyglykol-Basis sind grün markiert. Polyglykole dürfen nicht mit Mineralen, PAOs oder Esterölen vermischt werden.

Geber Hintergrund - eingekauft

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Legend:

DE	EN
Wartungsöle	Maintenance oils
Pasten	Pastes
Fette	Greases
Fahrzeug	Vehicle
Spezialitäten	Specialities
Getriebe	Gears
Hydraulik	Hydraulic system
Spindel	Spindle
Werknorm Schmierstoffe Wieland Werke AG 2021	Factory standard, lubricants, Wieland Werke AG 2021
Ansprechpartner bei Fragen; GE.MCC / Patrick Abt	Contact for questions: GE.MCC / Patrick Abt
Kennzahl W	Code W
Artikelnr.	Article no.
Bezeichnung nach DIN 51502	Designation in acc. with DIN 51502
Viskosität In mm ² /s	Viscosity [mm ² /s]
VI	VI
NLGI	NLGI
Basis	Basis
Temp. Bereich	Temp. range
Gelber Hintergrund – wird derzeit eingekauft	Yellow background – is currently purchased
Zinkaschfreie Schmierstoffe sind blau markiert. Diese Öle sollten nicht mit herkömmlichen Ölen gemischt werden. Bei Unsicherheiten Rücksprache.	Zinc ash free lubricants are listed in blue type. These oils should not be mixed with conventional oils. Consult us if there is any uncertainty.
Synthetische Schmierstoffe mit PAO-Basis sind rot markiert. PAOs und Mineralöle sind miteinander verträglich.	PAO-based synthetic lubricants are marked in red. PAOs and mineral oils are compatible with each other.
Synthetische Schmierstoffe auf Polyglykol-Basis sind grün markiert. Polyglykole dürfen nicht mit Mineralölen, PAOs oder Esterölen vermischt werden.	Polyglycol-based synthetic lubricants are marked in green. Polyglycols must not be mixed with mineral oils, PAOs or ester oils.
Mineralöl	Mineral oil
Mineralöl Z&A-frei	Mineral oil Z&A-free
PAO Z&A-frei	PAO Z&A-free
Synth. PAO	Synthetic PAO
Polyglykol	Polyglycol
Mineralöl & CaSuCo	Mineral oil & CaSuCo
Lithium-Seife	Lithium soap
Gel-Bentonit	Bentonite gel
Synth. Öl + Al-Pulver	Synthetic oil + aluminium powder
Mineralöl + MOS2	Mineral oil + MOS2
Syntheseöl	Synthetic oil
Spindelöl	Spindle oil
Hydrauliköl	Hydraulic oil
HVLP	HVLP
Umlauf-/Getriebeöl	Circulating oil / gear oil
Getriebeöl CLP 100	Gear oil CLP 100
Isolieröl	Insulating oil
Turbinenöl	Turbine oil
Verdichteröl	Compressor oil
Gleitbahnöl	Slideway oil
Wandleröl ATF-A	Automatic transmission fluid ATF-A
HD-Universal-Mehrbereichs Motorenöl	HD universal multigrade engine oil
Motornoel 5W-30 LONGLIFE, Low SAPS	Engine oil 5W-30 LONG LIFE, low SAPS
Mehrzweck-Hochdruckfett bis 3000 rpm	Multipurpose high pressure grease up to 3000 rpm
Mehrzweck-Hochdruckfett ! Kein Wälzlagerfett !	Multipurpose high-pressure grease ! Not roller bearing grease !
Getriebefliessfett	Low-viscosity grease for gears
Gel-Fett 2 EP + MOS2	Gel grease 2 EP + MOS2
Anti-Seize-Paste	Anti-seize paste

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Montagepaste MOS2	Assembly paste MOS2
Spannfutterpaste	Chuck jaw paste
Haftschmierstoff + Kettenschmiermittel	Adhesive lubricant + chain lubricant
Rostlöser + Kettenschmiermittel	Penetrating oil + chain lubricant
Dose	Tin
Spray	Spray
Kanister	Container