Klübersynth® GEM 2 oils

Synthetic high-performance gear oils

Description

The Klübersynth GEM 2 oils are high-performance gear oils with a synthetic ester oil as base oil. They achieve a scuffing load capacity ≥ 13 in the FZG test acc. to DIN 51 354, pt. 2 (A/16,6/90), which is better than the CLP requirements. A micropitting test was performed acc. to FVA No. 54, which yielded a micropitting resistance > 10.
The most comprehensive tests for rolling bearing lubrication were made with Klübersynth GEM 2-320. Tests with the rolling bearing lubricant tester FE 8 resulted in a rolling element wear m_{W50} < 2 mg and a cage wear m_{K50} < 20 mg (test acc. to DIN 51819-03-D-7,5/80-80, two test runs, no failure). The oil also passed the SKF roller test (120 °C / 8 weeks).
The Klübersynth GEM 2 oils have a good viscosity-temperature behaviour and a wide operating temperature range. They offer good wear and corrosion protection as well as ageing and oxidation stability.
Biodegradability as shown in the CEC-L-33-A-93 test is > 70% after 21 days.

Fields of application

Klübersynth GEM 2 oils may be used for the lubrication of spur, bevel and worm gears as well as the associated machine elements such as sliding and rolling bearings. Furthermore, they are particularly suited for applications where leaking or dripping lubricant might pose a hazard to the environment.

Application notes

Klübersynth GEM 2 oils can be applied by immersion, immersion circulation or injection. Drip-feed lubrication and application by brush or oil is also possible, as well as use in automatic lubricating systems.

Basically, Klübersynth GEM 2 oils are miscible with conventional mineral oils and polyalfaolefin oils. It should be noted, however, that the oils may no longer be rapidly biodegradable when mixed with mineral or polyalfaolefin oil. For this reason careful cleaning of the gear or the oil circulation system is advisable before switching to Klübersynth GEM 2 oils.

Ester-based synthetic lubricants may affect the functional characteristics of rubber seals, depending on the temperature and time of exposure. For permanent oil sump temperatures of max. 80 °C, NBR seals (acrylonitrile-butadiene rubber) can be used. For higher temperatures, FKM (fluoropolymers) are suggested. It should be noted that elastomers from one or several manufacturers can behave differently. Therefore the data given in the "compatibility with elastomers" table should be used for reference purposes only. A compatibility test should always be carried out with the elastomers which are actually used.

When using Klübersynth GEM 2 oils, we recommend two-component paints (catalysed lacquers) for the coating.

We further recommend testing the suitability of design materials and paints in contact with the selected lubricants, especially for series application.

Viscosity selection for rolling bearings and gears

To select the correct oil viscosity, observe the bearing manufacturer's instructions or refer to worksheet 3 from the Society of Tribology (GfT).

For determining the correct viscosity for gears, the manufacturer's instructions take priority in all cases.

Only in cases where there are no gear manufacturer's instructions, the viscosity can be selected in accordance with the enclosed worksheet "Klübersynth GEM 2 oils – selection of oil viscosity for gears".

Klübersynth GEM 2 oils

- Synthetic high-performance gear oils
- High scuffing load capacity
- Very good wear protection
- High micropitting resistance
- Excellent rolling bearing test results
- Rapidly biodegradable
- Good viscosity-temperature behaviour
- Wide operating temperature range

Service temperature range

Service temperatures are guide values which depend on the lubricant's composition, the intended use and the application method. Lubricants change their consistency, apparent dynamic viscosity or viscosity depending on the mechano-dynamical loads, time, pressure and temperature. These changes in product characteristics may affect the function of a component.

For immersion lubrication of gears and chains:

- Klübersynth GEM 2-220/320 approx. -30 °C to approx. 130 °C

When using automatic systems, observe the manufacturer's instructions regarding the maximum viscosity that can be pumped.

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Synthetic high-performance gear oils

Minimum shelf life

The minimum shelf life is approx. 36 months if the product is stored in the original closed container in a dry place.

Pack sizes

20	l	canister
200	l	drum

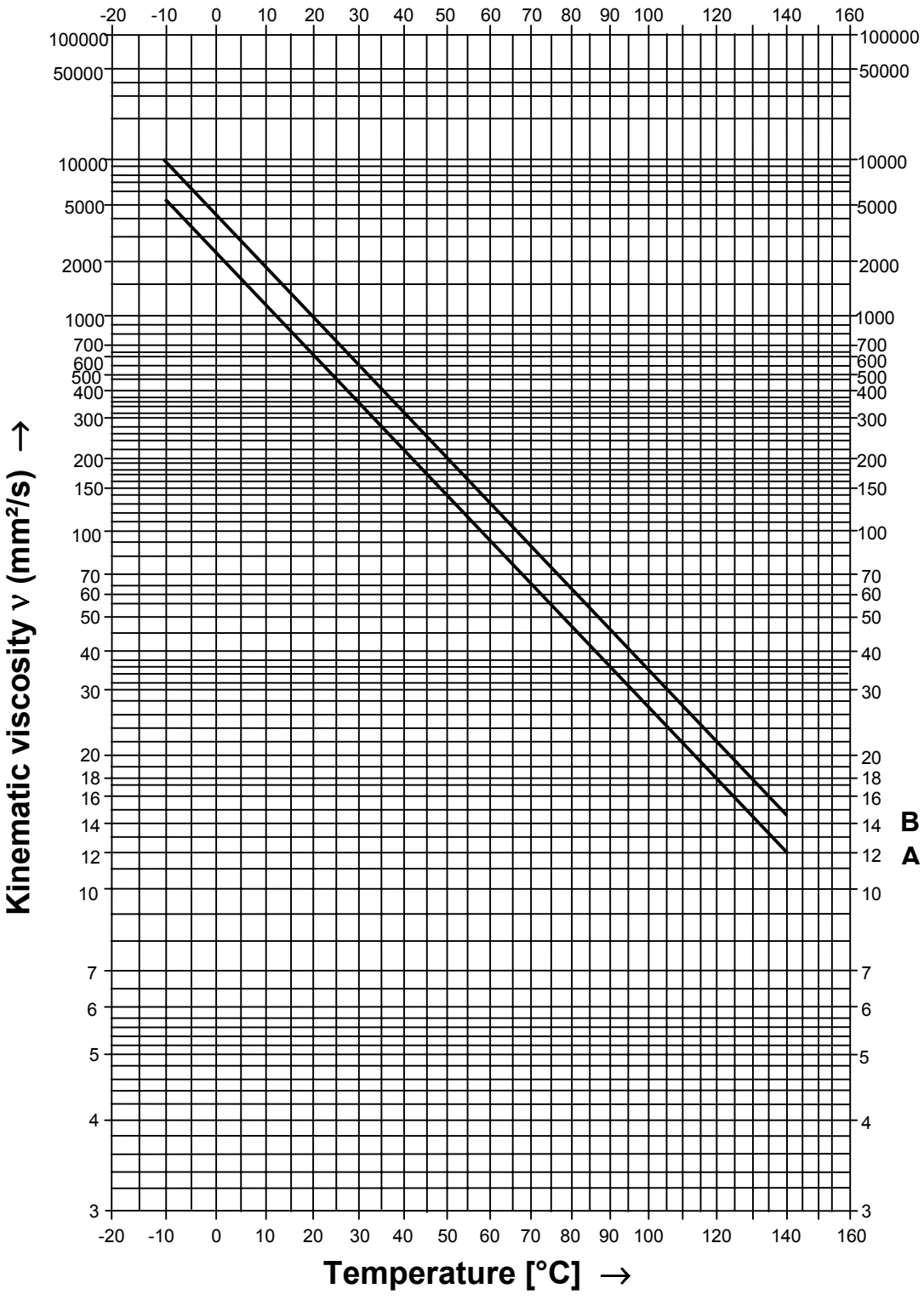
Product data

Klübersynth GEM 2-...		220	320
ISO VG DIN 51 519		220	320
Density (g/ml) at 20 °C, approx. DIN 51 757		0.95	0.95
Kinematic viscosity (mm²/s), approx. DIN 51562	40 °C	220	320
	100 °C	27	35
Viscosity index, approx. DIN ISO 2909		150	150
Flash point (°C), approx. DIN ISO 2592		270	270
Pour point (°C) DIN ISO 3016		≤ -30	≤ -30
Steel corrosion, DIN 51585 24h/60 °C – method A		0-A	0-A

Compatibility with elastomers

Klübersynth GEM 2-...		220	320
towards 72 NBR 902 at 100 °C / 168 h			
change in volume (%)	approx.	5	5
change in hardness (Shore A)	approx.	- 4	- 4
towards 75 FKM 585 at 150 °C / 168 h			
change in volume (%)	approx.	3	3
change in hardness (Shore A)	approx.	- 1	-1

Temperature-viscosity diagram



A) Klübersynth GEM 2-220
B) Klübersynth GEM 2-320

Klübersynth GEM 2 oils
Safety Data Sheet

1.1 Product name: Klübersynth a) GEM 2-220, b) GEM 2-320
Code-No.: a) 012 110, b) 012 111
31.08.2000

1.2 Klüber Lubrication München KG
Geisenhausenerstraße 7
D-81379 München
Tel. ++49 - 89 78 76 - 0 telephone exchange
Fax: ++49 - 89 78 76 - 333

Emergency telephone no.:
++49 - 89 7876 - 0

2. Composition / information on ingredients
Chemical characterization (preparation): Ester oil

3. Hazards identification
No particular hazards known

4. First aid measures
After inhalation: Not applicable
After contact with skin: Wash off with soap and plenty of water
After contact with eyes: Rinse with plenty of water
After ingestion: Do not induce vomiting. Obtain medical attention
Advice to doctor: Treat symptomatically. If swallowed or in the event of vomiting, risk of product entering the lungs

5. Fire-fighting measures
Suitable extinguishing media: Water spray, foam, dry powder, carbon dioxide (CO_2)
Unsuitable extinguishing media: High volume water jet
Special Hazards: In case of fire the following can be released: Carbon monoxide, hydrocarbons
Special protective equipment for firefighters: Standard procedure for chemical fires
Additional information: Water mist may be used to cool closed containers. In the event of fire and/or explosion do not breathe fumes

6. Accidental release measures
Personal precautions: Risk of splipping due to leakage/spillage of product
Environmental precautions: Do not flush into surface water or sanitary sewer system
Methods for cleaning up / taking up: Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Dispose of absorbed material in accordance with the regulations
Additional information: None

7. Handling and storage
Advice on safe handling: Avoid formation of aerosol
Advice on protection against fire and explosion: No special precautions required
Requirements on storage rooms and vessels: No special storage conditions required
Incompatible materials: Incompatible with oxidizing agents. Do not store together with food
Further information on storage conditions: Store at room temperature in the original container

8. Exposure controls / personal protection
Additional advice on system design: Not applicable
Ingredients and specific control parameters: None
Respiratory protection: No special protective equipment required
Hand protection: No special protective equipment required
Eye protection: No special protective equipment required
Body protection: No special protective equipment required
Other protection measures: No special protective equipment required
General protection and hygiene measures: Avoid prolonged and/or repeated contact with skin. Clean skin thoroughly after work; apply skin cream. Remove soiled or soaked clothing immediately. Do not inhale aerosol

9. Physical and chemical properties

Form	liquid
Colour	orange
Odour	characteristic
Pour point	a) < – 30, b) < – 25 °C, DIN ISO 3016
Flash point	> 270 °C, DIN ISO 2592
Ignition temperature	not applicable
Lower explosion limit	not applicable
Upper explosion limit	not applicable
Vapour pressure-first	not applicable
Density	approx. 0.95 g/cm^3, 20 °C, DIN 51 757
Water solubility	insoluble
pH value	not applicable
Kinematic viscosity,	approx.a) 220, b) 320 mm^2/s, 40 °C, DIN 51 562
Further information	none

10. Stability and reactivity
Conditions to avoid: Do not heat above flash point
Materials to avoid: Strong oxidizing agents
Hazardous decomposition products: None under normal use
Additional information: None

11. Toxicological information
The toxicological data has been taken from products of similar composition
Acute toxicity: LD_{50}/oral/rat = > 2 g/kg (literature data)
Chronic toxicity: None
Human experience: Prolonged skin contact may cause skin irritation and/or dermatitis

12. Ecological information
Information on elimination (persistence and degradability): Readily biodegradable (> 70%). Test method: CEC-L-33-A93
Behaviour in environmental compartments: Ecological injuries are not known or expected under normal use
Ecotoxic effects: Aquatic toxicity is unlikely due to low solubility
Additional information: Do not discharge product unmonitored into the environment

13. Advice on Disposal
Disposal: Dispose of in accordance with your local, state and federal regulations as used oil for incinceration
Dispose of contaminated packaging and recommended cleaning: Offer rinsed packaging material to local recycling facilities

14. Transport information

GGVS / GGVE:	not applicable
ADN / ADNR:	not applicable
IMDG-Code:	not applicable
ICAO / IATA-DGR:	not applicable

Further information: Not classified as dangerous in the meaning of transport regulations

15. Regulatory information
Labelling according to EU-guidelines: The product does not require a hazard warning label in accordance with EC-directives/German regulations on dangerous substances
National regulations

16. Other information
Issue-department of Safety Data Sheet: Chemical Documentation,
Tel.: ++49 - 89 7876 - 564

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Klübersynth® GEM 2 oils

Synthetic high-performance gear oils
Selection of oil viscosity for gears

Worksheet: selection of oil viscosity for gears

The manufacturer's instructions on oil viscosity take priority in any case. If the viscosity is not calculated e.g. on the basis of the EHD theory, it can be selected in accordance with this worksheet. Selection is based on DIN 51509, pt. 1 "Selection of lubricants for toothed gears". All information in this worksheet applies only to Klübersynth GEM 2 oils. The differing viscosity-temperature behaviour of these synthetic oils as compared to mineral oils has been taken into account.

The correct viscosity must be selected independently for every gear stage, and a compromise is required for multi-stage gears. The selection of the correct viscosity in accordance with this worksheet is based on the oil's expected operation temperature, i.e. the oil sump temperature or the temperature of the injected oil. This temperature is calculated by determining the gear's thermal economy, taking into account the produced losses, or, in the case of gears already installed, by measuring the temperature. It might be required to select a lower viscosity to ensure lubricant supply during a cold start and at low ambient temperatures. In the individual case it is necessary to check the viscosity at the existing starting temperature (especially in the case of oil circulation lubrication), or to test the components at the expected starting temperature (especially in the case of immersion lubrication).

The viscosity grade of the Klübersynth GEM 2 oils required for a gear stage is determined by means of the Klüber viscosity index and the expected oil operating temperature using the diagram of the last page.

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Synthetic high-performance gear oils
Selection of oil viscosity for gears

Determination of the Klüber viscosity index for a spur gear stage:

The required Klüber viscosity index for a spur gear stage is calculated using the force-speed factor in accordance with table 1.

Table 1:

Force-speed factor $K_S/v \left[\frac{MPa \cdot s}{m}\right]$	Klüber viscosity index KVZ
≤ 0.02	1
> 0.02 to 0.08	2
> 0.08 to 0.3	3
> 0.3 to 0.8	4
> 0.8 to 1.8	5
> 1.8 to 3.5	6
> 3.5 to 7.0	7
> 7.0	8

v = Peripheral speed at the reference circle [m/s]
K_S = Rolling pressure acc. to Stribeck [N/mm², MPa]

$$K_S = \frac{F_t}{b \cdot d_1} \cdot \frac{U+1}{U} \cdot Z_H^2 \cdot Z_\varepsilon^2 \cdot K_A \left[N/mm^2, MPa\right]$$

F_t = Nominal peripheral force [N]
b = Tooth width [mm]
d_1 = Diameter of reference circle [mm]
U = Gear ratio = Z_2/Z_1; $Z_2 > Z_1$
Z_H = Distribution factor [*1]
Z_ε = Contact ratio [*1]
K_A = Application factor [*2]

[*1] Note: Determination of Z_H and Z_ε according to DIN 3990, pt. 2. For a rough calculation: $Z_H^2 \cdot Z_\varepsilon^2 \approx 3$
[*2] Note: Guide values for K_A are listed in DIN 3990, pt. 6.

Example 1: Single-stage spur gear driving a fan

Drive:	Electric motor
Nominal peripheral force:	F_t = 3000 N
Tooth width:	b = 25 mm
Diameter of reference circle:	d_1 = 230 mm
Gear ratio:	U = 2.5
$Z_H^2 \cdot Z_\varepsilon^2$:	≈ 3
K_A:	1
Peripheral speed:	v = 4 m/s
Rolling pressure acc. to Stribeck:	K_S = 2.2 MPa
Force-speed factor:	K_S/v = 0.55 $\frac{MPa \cdot s}{m}$
Acc. to table 1, Klüber viscosity index:	KVZ = 4
Expected oil sump temperature:	≈ 90 °C

For this application we selected Klübersynth GEM 2-220 in accordance with the diagram on page 4.

Determination of the Klüber viscosity index for a worm gear stage

The required Klüber viscosity index for a worm gear stage is calculated in accordance with table 2.

Table 2:

Force-speed factor K_S/v $\left[\frac{N \cdot min}{m^2}\right]$	Klüber viscosity index
≤ 60	5
> 60 to 400	6
> 400 to 1800	7
> 1800 to 6000	8
> 6000	9

$$\text{Force-speed factor } K_S/v = \frac{T_2}{n_1 \cdot a^3} \cdot K_A \left[\frac{N \cdot min}{m^2}\right]$$

T_2 = Output torque [Nm]
n_1 = Worm speed [min^{-1}]
a = Centre distance [m]
K_A = Application factor
Note: Guide values for K_A are listed in DIN 3990, pt. 6.

Example 2:

Worm gear stage of a gear motor driving a circular conveyor

Drive:	Electric motor
Output torque:	T_2 = 300 Nm
Worm speed:	n_1 = 1500 min^{-1}
Centre distance:	a = 0.08 m
Application factor:	K_A = 1
Force-speed factor	K_S/v = 390.6 N·min·m^{-2}
Klüber viscosity index acc. to table 2:	KVZ = 6
Expected oil sump temperature:	≈ 85 °C

For this application Klübersynth GEM 2-320 was selected in accordance with the diagram on page 4.

Klübersynth® GEM 2-Öle

Synthetic high-performance gear oil
Selection of oil viscosity for gears