Santasalo

TECHNICAL DOCUMENTS

Handler/Designer: / Eerikki Kiviniemi

Santasalo Gears Inc.
380 Business Parkway

29651 GREER
SC

Customer Ref.:
Salesperson ref.: ISD10098410 / Arja Klemola
Project:
Gear unit type: **S2BV-450PP**
Manufact. no.: FI-107426 - FI-107426
Delivering following documents:
Document data format: PDF

TECHNICAL SPECIFICATION

PART LIST

DRAWINGS
Dimension drawings
Assembly drawings

Manufacturer's warranty and buyer's responsibility	MDI-110
General product safety guide	MDI-120
Corrosion protection and storage	MDI-130
Foundation of industrial gear assemblies, standing installation	MDI-140
Installation of industrial gear assemblies, standing installation	MDI-150
Lubricants in industrial gears	MDI-170
Use and maintenance of gear units	MDI-180
Assembly report	U306

SANTASALO GEARS OY
Vesangantie 1
P.O.Box 1001
40101 Jyväskylä
FINLAND

Tel +358 293 401000
Fax +358 20 184 7101

LY 2646194-8
www.santasalo.com

Santasalo

Technical specification

		SpecificationNo.	**ISD10098410**
		Revision	
1. General data		Delivery date EXW	**17.12.2015**
Customer	**Santasalo Gears Inc.**	Issued by	**Arja Klemola**
Country	**United States**	Date	**5.8.2015**
		Revision row no.	
Customer order no.	**GP09603** Date **3.8.2015**	Date	
Customer ref.		Designed by	**Eerikki Kiviniemi**
Driven Machine / item no.		Date	

2. Product description

Gear unit type	**S2BV-450PP**	Shaft position		Manufacturing nos.	**FI-107426 - FI-107426**
Ratio i	**7,484**	Weight appr.[kg]	**3200**	Quantity	**1**
Running data	min.	norm.	max.	Service factor Fs	**3,5**
Rotation speed HSS [1/min]		**1168**		according to	
LSS [1/min]		**156**			
Running Power Pk1 [kW]		**515**		Mounting position	
Running torque Mk2 [kNm]				Anch. rod length HA	
Rot.direction of LSS				Hollow shaft nom. dia.	
Painting system	**ISO 12944-5/S3.18(EP200/3-FeSa 2½)**			Colour code	**RAL 6029**

3. Operating conditions

Driving machine	Type		Code	Duration of service[h/day]		
	Pm [kW]		/n	Max load occ./hour		
Connection diameters [mm]	Driving machine shaft			Driven machine shaft		
External loads [kN]	Fa norm	Fa max	Direction	Fr norm	Fr max	Acting point fr. shaft end[mm]
LSS						
HSS						
Electrical supply	Main[V]		[Hz]	Instr.supply[V]		[Hz]
Ambient temperature	[ºC] min.		[ºC] norm.		[ºC] max.	

4. Lubrication

Lubrication method	**Central lubrication**	Lubr. unit location	
Lubricant Oil			
Ambient temperature range	[ºC]	[ºC]	[ºC] **56**
Oil level indication		[mm]	Oil qty appr.
Grease type			Grease qty [g]

5. Documentation

Dimension drawing no.	
Assembly drawing no.	**8K028-0292**
Other documents	

6. Additional equipment/other information

Qty

1 GEAR UNIT WITH ACCESSORIES OLD VALMET/SANTASALO SERIES (S-, L-, M, C, CN, CL-, CH-SERIES)

1 GEAR UNIT S2BV-450PP

i=7,484

Painted: RAL 6029

1 INTERNAL PIPING S2BV-450PP

1 LONG CORROSION PROTECTION

1 SEAWORTHY PACKING CN450S

OSA PART	NIMITYS DESCRIPTION	AINES DIMENSIONS	RAAKA-AINE MATERIAL	PIIRUSTUSNUMERO DRAWING	KPL REQ'D	HUOMAUTUKSIA NOTES

TYOTAPAKOHTAISET TOLERANSSIT: LASTUAVA TYOSTO: RTS1730 (SFS4011) HITSATUT RAKENTEET: RTS1731(SFS 3393). VALUKAPPALEET: RTS1760 (SFS 3392)

PERMISSIBLE VARIATIONS IN DIMENSIONS WITHOUT TOLERANCE INDICATION: MACHINING: RTS 1730 (SFS 4011) WELDINGS: RTS 1731 (SFS 3393) CASTINGS: RTS 1760 (SFS 3392)

		PAIVAYS DATE	NIMI NAME
MASSA KG MASS	PIIRT DRWN	00-02-16	RNurmi
AIHIO BLANK	SUUNN DES'D	00-02-16	RNurmi
LASK. CALC. 3200	TARK. CHK'D	00-02-17	PEV
PUNN. WEIGHT	HYV. APP'D	00-02-17	PEV

MITTAK. SCALE Z (1:6)

KOK.P.PIIR. ASSEMBLY DWG

Santasalo

NIMITYS KULMAVAIHDE
TITLE RIGHT ANGLE GEAR UNIT S2BV-450PPKE

RYHMA GROUP UNC/NPT i=7.484:1

UUSI PIIR. NEW DWG

VERT.PIIR. REF.DWG 8K028-0291

TILAAJA CUSTOMER STONE UNCASVILLE

VALMISTE PRODUCT KIERTOVOITELU CONNECTION PLATE C2

8K028-0292

AATIT NATES | LUKUM. CHANGES | MERKKI KEY | VALUMALLI PATTERN | RT-TUNNUS | ENT.PIIR. SUPERSEDES DWG | OTOS M-F 1/

MANUFACTURER'S WARRANTY AND BUYER'S RESPONSIBILITY

1. MANUFACTURER'S WARRANTY AND BUYER'S RESPONSIBILITY

Santasalo Gears warrants that all products manufactured by it comply with terms to be agreed upon separately. For the warranty to be applicable, the customer shall have followed Santasalo Gears guidelines, national and international standards and norms, careful procedures and generally accepted mechanical engineering methods. This set of instructions is not exhaustive and may not always be applicable in all respects to all products and components with which it has been supplied. In special cases, instructions pertaining to specific uses shall be taken into consideration. Santasalo Gears reserves the right to modify the content of this set of instructions without separate notification.

Santasalo Gears is not liable for damage caused by transportation, storage, installation, use or other actions to the product. Santasalo Gears is not liable for damage to the product resulting from factors external to the delivery content, such as the corrosive effects of weather, leakage or welding currents or magnetism, which may damage the product, increase the risk of damage or shorten the life cycle of the product or its components.

Transport, installation, lubrication, use, maintenance and inspections shall be performed by qualified personnel to prevent accidents and damage to the machinery.

All parts of the drive system must be compatible. The overall system should never run at the critical rotational speed or exhibit torsional or other vibrations that could damage the gears. The responsibility for this lies with the main supplier of the equipment, as it is most often the only party that has comprehensive information of all factors affecting the matter.

Santasalo Gears must be informed without delay if a significant risk relating to the environment or the operating staff is about to occur due to a defect in the machine.

The warranty shall be valid only if the instructions provided by Santasalo Gears are complied with.

2. USER'S RESPONSIBILITY IN CASE OF DAMAGE

In the event of damage during the validity of the warranty, the user's responsibility is to retain the gear unit as intact as possible until such a time as Santasalo Gears has issued instructions on further measures.

The following may void the warranty:

- failure to provide maintenance
- continued use after detection of damage
- gear unit load and use in violation of the technical specifications
- failure to report any circumstance that essentially contributed to the occurrence of the damage
- refusal to provide reliable maintenance data
- failure to comply with instructions from Santasalo Gears
- failure to comply with instructions from Santasalo Gears in connection with damage

GENERAL PRODUCT SAFETY GUIDE

1 GENERAL PRODUCT SAFETY INSTRUCTIONS

The purpose of these instructions is to minimize risks and prevent accidents and injuries. Even though safety factors have been taken into account in the design of each Santasalo Gears product, the equipment may be dangerous if used carelessly or without sufficient experience. Installation, assembly and maintenance of mechanical drive units may only be carried out by qualified personnel. It is prohibited to make changes to drive units.

All parts of the drive system must be compatible. The overall system should never run at the critical rotational speed or exhibit torsional or other vibrations that could damage the gears. The responsibility for this lies with the main supplier of the equipment, as it is most often the only party that has comprehensive information of all factors affecting the matter. Santasalo Gears must be informed without delay if a significant risk relating to the environment or the operating staff is about to occur due to a defect in the machine.

Below is a list of the most typical risk factors that need to be considered when handling mechanical drive units.

- Untidy working conditions
- Poor lighting
- Noise and vibration
- Working on scaffolds or in confined places
- Lifting and moving heavy loads
- Inappropriate work methods
- Automatic functions or unexpected start-ups
- Rotating devices and other moving devices
- High-pressure hydraulic components
- High oil temperature
- Any oil leaks
- Flammable and corrosive substances as well as other chemicals that are dangerous to health and the environment

Separate instructions on mechanical use must always be followed in addition to these instructions.

1.1 Gear units

1.1.1 Rustproofing

Gear units may be equipped with VCI anti-corrosive agent for rustfree storage and transport. If so, there will be a red sticker on the side of the housing displaying the text "DINITROL VCI-UNI 0-40 Internal Corrosion Protection". Inside the gear unit, there is air tightly sealed oil that releases VCI inhibitors inside the gear unit. There are 3-4 liters of VCI oil per free cubic meter of air inside the gear unit. The VCI oil can be mixed with gear oil, so there is no need to remove it. VCI oil is irritating so avoid getting oil on your skin or in your eyes. Wear protective eyewear.

Xi Irritant

Open flame near the gear unit is strictly forbidden.

1.1.2 Other notes on using the gear unit

The gear units are equipped with either lifting holes or eyes to enable the lifting or moving of the gears. They may only be used for lifting the gear unit. Always use reliable, inspected and properly dimensioned lifting eyes, chains or ropes when lifting gear units or couplings. Disengage all pipes, tubes and cables as well as drive shafts and couplings connected to the gear unit before lifting. Lifting must be carried out in accordance with the plant's general lifting instructions.

Always ensure that the machine cannot be started before connecting the gear unit to the drive system or disengaging them. Make sure that external energy sources (electricity, hydraulics, pneumatics, spring force, masses, etc.) have been disconnected or reliably secured and locked. You should also ensure that the warning signs are in place. Do not touch any moving parts before they have come to a complete stop. You must not use any aids to stop the moving parts.

To avoid slipping accidents, block the oil filling and draining holes of the gear immediately after disengagement of joints and remove any leaked oil or grease from the work area without delay.

The oil temperature and the gear unit surface temperature are approximately 60 ºC (140 ºF) during operation. The maximum temperature may be as high as 100 ºC (212 °F) particularly in splash- and bath-lubricated gears.

The noise level of gear assemblies varies depending on the mechanical power and gear type. The noise level may exceed 85 dB, in which case you must use hearing protectors.

1.2 Safeguarding rotating parts

Appropriate safeguards must be used in accordance with safety legislation so that rotating parts cannot be touched. The safeguards must be sufficiently strong to meet the standards.

Mechanical safeguards must not be removed during the operation of the gears.

1.3 Maintenance

Installation and maintenance must be performed using skilled maintenance personnel.

All maintenance procedures shall be performed when the gears are not in operation.

During maintenance, the gear temperature must be the same as the ambient temperature.

1.4 Environmental protection

When the oil is changed, waste oil and oil filters must be collected in suitable containers and disposed of in accordance with national legislation and regulations. Any leaked oil shall be removed immediately using oil-absorbent material, which shall be disposed of as solid oil-containing waste in accordance with national legislation and regulations.

Any gears delivered to Santasalo Gears for maintenance must be drained of oil prior to transport. The gears shall be transported in such a position that any oil remaining inside the gears will not leak into the environment.

Any break pads included in a Santasalo Gears delivery do not contain asbestos, so worn-out pads may be disposed of with other industrial waste.

2. LIFTING WORK

2.1 General instructions

- When lifting, you must adhere to all international and national rules and work place instructions
- Before lifting, a person familiar with lifting equipment must examine the equipment.
- Lifting must be planned carefully: the weight, shape, lifting position, and center of gravity of the load must be determined before lifting. **Load division between lifting straps must be determined before lifting**. Lifting straps of different length and the need for lifting straps must be considered.
- **You must not walk under the load,** and the load must be lifted and moved in such a way that people do not get under the load. You must take the possible tipping or falling of the load into account.
- You must note that a slanted lifting strap lessens the permitted load. A ß - angle of over 45 degrees is never allowed. The maximum ß - angle allowed on large, heavy gears is 20 degrees. (gear units that weigh more than 5 tonnes). Lifting straps should be long enough not to exceed allowed lifting angles. (See picture 2) A separate lifting beam must be used where applicable.
- The sliding of flat webbing sling, textile sling, or other lifting loop on flat surfaces must be prevented by lifting with an almost vertical straps, ß angle max 10 degrees. (See pictures 6 and 9)
- If the strap attached to a load is a textile sling, etc., you must protect sharp edges with rounded edge protectors. The minimum allowed radius for an edge against a strap that could possibly get damaged is 13 mm.
- A starting lift where the load detaches from its platform must always be performed first. After this, the stability of the load, strap attachment, and possible deflections/openings must be checked before the lifting can continue. The lifting must be performed evenly, avoiding any jerking motions. Lateral pulling or lifting and dragging the load is forbidden.
- You cannot lift anything heavy besides the gear unit itself from the gear unit lifting points. When using only the collar eyebolts of the gear unit, there must be no large motors, parts of the customer device, etc., attached to the gear unit during lifting. When using the gear unit collar eyebolts, the maximum allowed additional load is 10% of the gear unit weight and the center of gravity may not shift substantially. (See pictures 5, 6, 7, 8, and 9)

2.2 Collar eyebolts

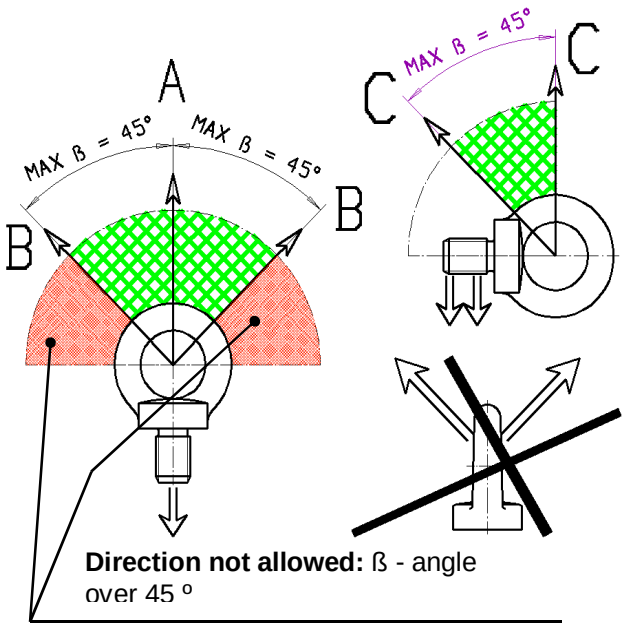
The gear unit collar eyebolts/nuts are **DIN580 (2010-09) / DIN582 (2010/09)** lifting eyebolts/nuts.

- The maximum allowed ß - angle is 45 degrees. (See picture 1)
- The lifting eyebolts must be tightened against their platform before lifting; a slanted lifting force must not open the eyebolt's thread.
- You must consider unevenly distributed loads and the angle of the lifting strap. The maximum allowed lifting weight must not be exceeded on any of the gear unit collar eyebolts.
- All the gear unit lifting points/eyebolts must be used during lifting to ensure distributing the load as evenly as possible.
- You cannot lift anything heavy besides the gear unit from the gear lifting points. There must be no large motors, parts of the customer device, etc., attached to the gear unit during lifting.

Table 1. *Maximum load per one collar eyebolt/nut. DIN580 (2010-09) / DIN582 (2010/09)*

Maximum load on one DIN 580 / DIN582 collar eyebolt/nut				
Lifting eyebolt/nut size	**Picture 1: A** Lifting force directly upwards. Per lifting eyebolt/nut		**Picture 1: B** Lifting force at an angle (max. 45 degree ß - angle). Per lifting eyebolt/nut	
	[kg]	*[lbs]*	***[kg]***	*[lbs]*
M10	230	*505*	170	*375*
M12	340	*750*	240	*530*
M16	700	*1545*	500	*1100*
M20	1200	*2645*	860	*1895*
M24	1800	*3965*	1290	*2845*
M30	3200	*7055*	2300	*5070*
M36	4600	*10140*	3300	*7275*
M42	6300	*13890*	4500	*9920*
M48	8600	*18960*	6100	*13450*
M56	11500	*25350*	8200	*18070*

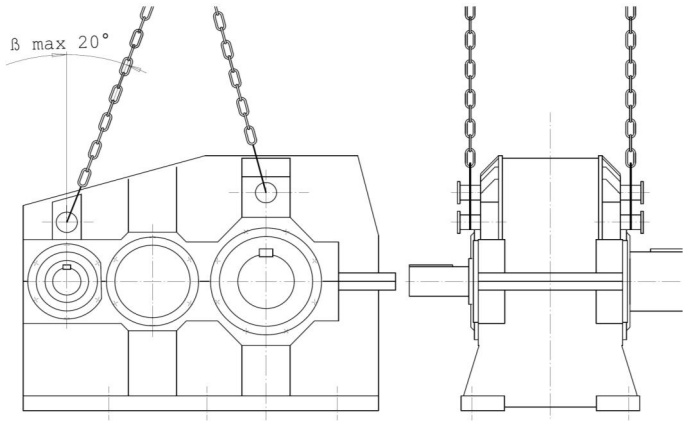
Lifting eyebolt/nut size	**Picture 1: C** Lifting force directly upwards and lifting force at an angle (max. 45 degree ß - angle). Per lifting eyebolt/nut	
	[kg]	*[lbs]*
M10	115	*250*
M12	170	*375*
M16	350	*770*
M20	600	*1320*
M24	900	*1980*
M30	1600	*3525*
M36	2300	*5070*
M42	3150	*6940*
M48	4300	*9480*
M56	5750	*12670*



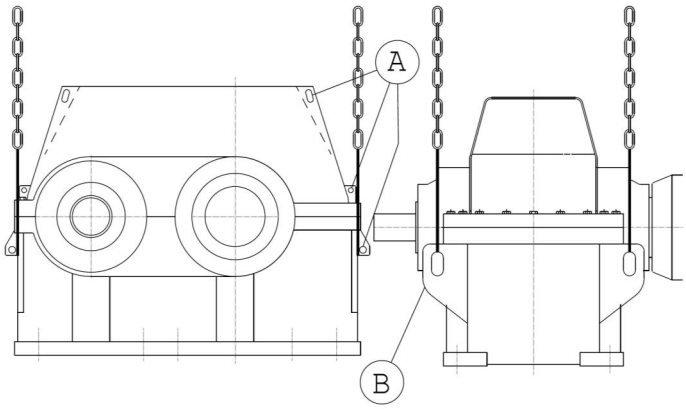
Picture 1. *Maximum allowed pulling direction for the lifting loop is ß = 45 º or less.*

2.3 Other hoist brackets

The gear unit may also be equipped with lift holes or hoist brackets. The lifting strap must usually be upright so that the hook or other attachment will not slide off the lifting bracket. The hook may not twist the lift hole or its surrounding area. (See picture 2)



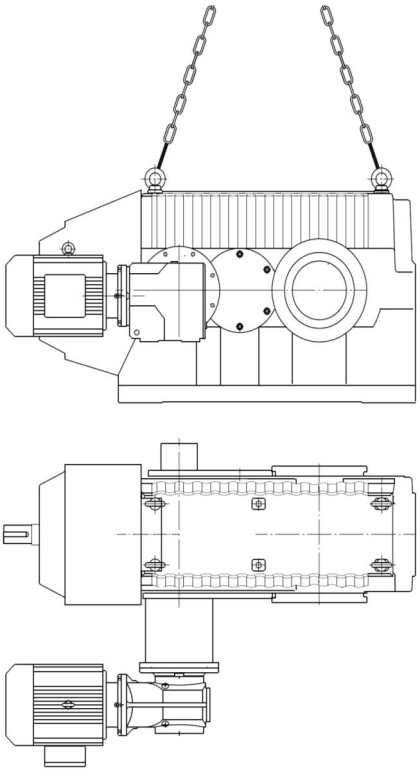
Picture 2. *The largest strap angle (ß) allowed on large gear unit (more than 5 tonnes) is 20 degrees. The strap must be upright if there is a danger of the hook moving in the lift hole or the hoist bracket. Only hooks with safety catches or self locking hooks may be used.*



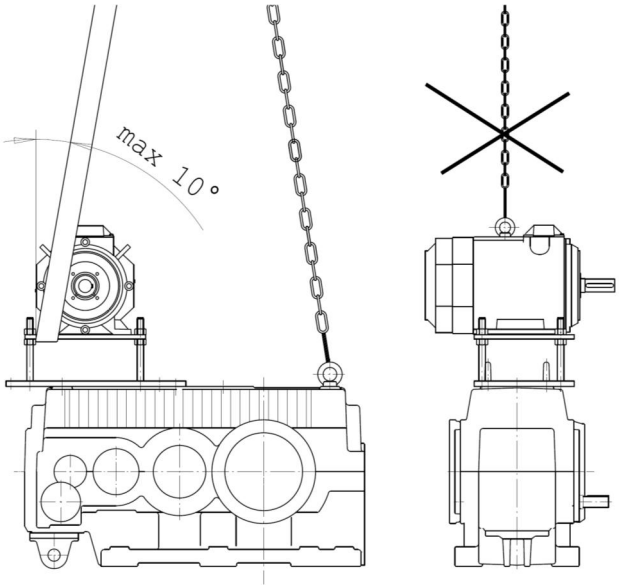
Picture 3. *The gear unit may also be equipped with small hoist brackets (A) for lifting components, e.g. housing halves. These may not be used for lifting the gear unit, instead you must choose the sturdiest lifting points (B).*
If the lift could twist the lifting point surroundings as in the picture, you must only lift by using upright straps and a lifting beam.

2.4 Other notes on lifting

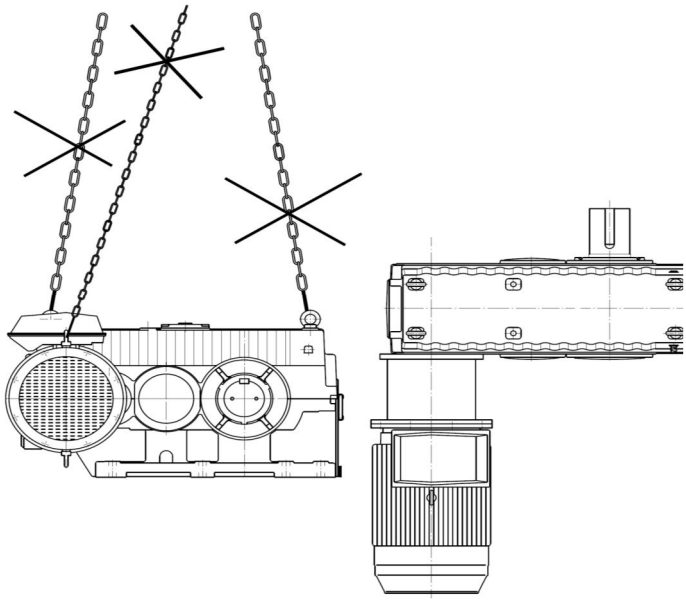
- The gear unit may never be lifted from the end of the shaft because the bearings could be damaged.
- Heavy accessories (more than 10% of the gear unit's weight) or accessories that are in the way of the lifting straps and cause steep bends in the lifting strap must be lifted in some other way than by using the gear unit lifting points.



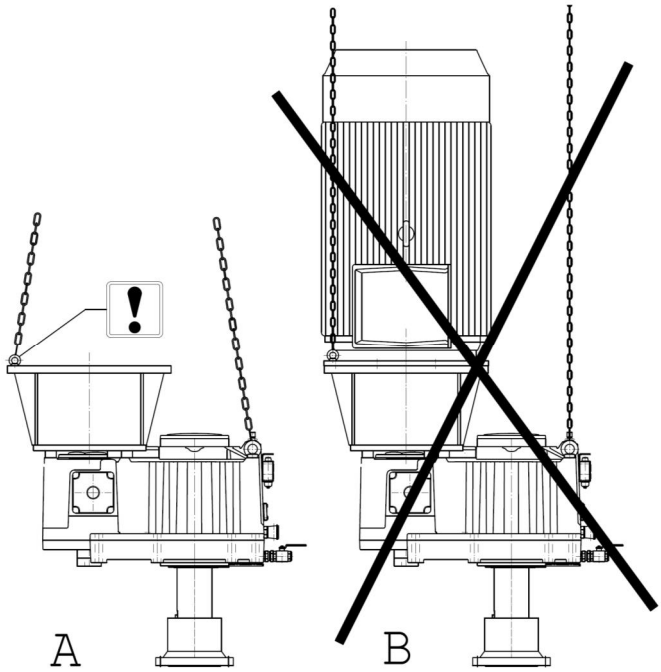
Picture 5. *Small accessories that do not alter the location of the center of gravity significantly and whose combined weight is no more than 10% of the weight of the gear unit, can be lifted with the gear unit by using the gear unit lifting eyebolts.*



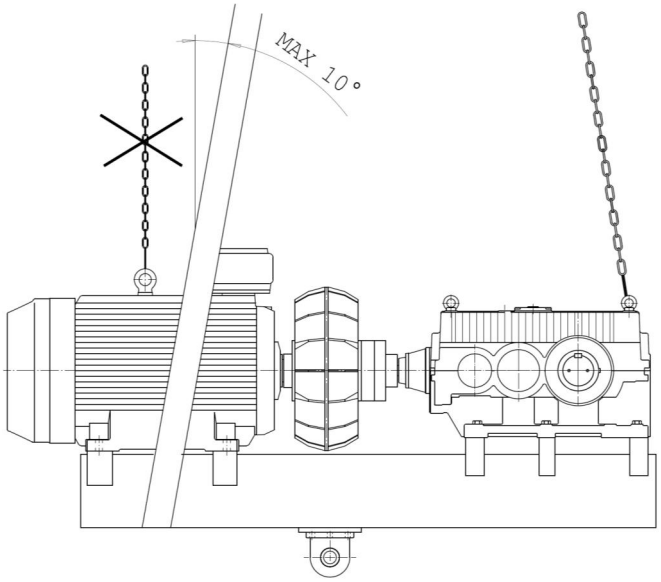
Picture 6. *A small motor can be lifted with the gear unit. The maximum angle for the textile sling is 10 degrees so that the flat webbing sling does not start to slide. Use edge protectors to protect the textile sling. The lifting eyebolt of the motor or any other component must never be used to lift the gear unit. Instead, the component's lifting eyebolt may be used to stabilize the load to prevent tipping it, when needed.*



Picture 7. *Components that are too big (that weigh more than 10% of the weight of the gear unit or impair attaching the straps) cannot be lifted with the gear unit from the gear unit's lifting points. The lifting eyebolt of the motor or any other component must never be used to lift the gear unit.*



Picture 8.A: *If the lifting eyebolts are missing, the existing holes can be used for the customer's lifting eyebolts, BUT the customer must check the capacity of their lifting eyebolts in relation to the weight of the gear unit and location of the center of gravity. You must always use at least four lifting points.*
Picture 8.B: *The motor is too big; you may not lift it with the gear unit.*



Picture 9. *Components that are too big (that weight more than 10% of the weight of the gear unit or impair attaching the straps) cannot be lifted with the gear unit from the gear unit's lifting points.*
Heavy components can be lifted with the gear unit if the lifting strap is attached somewhere else than the gear unit's lifting points and the weight of the components is distributed evenly to the lifting straps in question. Use a sturdy enough lifting strap. Check the combined mass and the location of the center of gravity. Check the gear unit weight put on the lifting eyebolts and compare it with table nr. 1.
The maximum angle for the lifting textile sling is 10 degrees so that the flat webbing sling does not start to slide. Use edge protectors on sharp edges where needed.
The lifting eyebolt of the motor or any other component must never be used to lift the gear unit. Instead, the component's lifting eyebolt may be used to stabilize the load to prevent tipping it, when needed.

THE CORROSION PROTECTION AND STORAGE OF THE INDUSTRIAL GEAR AND ITS SPARE PARTS

1. The corrosion protection and storage of the industrial gear and its spare parts

Corrosion usually refers to the unintended destruction of a metal object due to chemical or electro-chemical reactions caused by the operating environment, e.g. the rusting of steel. Air humidity, acidity, impurities and temperature have a significant effect on corrosion. Storage time and place must be known in order to design the method of protection.

In their orders, Santasalo Gears factories abide by the corrosion protection methods of industrial gears and the related accessories mentioned below. Protection carried out in the Santasalo Gears factory must not be damaged in storage. You must be especially careful not to damage the airtight packages protected with inhibitors. The supplier responsibility for the protection becomes void if the protection is broken.

These methods may also be used by the customer in storage later. If a Santasalo Gears product is protected against corrosion by the customer, the customer has full liability for the protection.

Table 1. Storage times

	Storage time guaranteed by the protection
Outside in a covered space	12 months
Indoors in a heated space	36 months

If the product is stored outside in a covered space, it must be kept in an appropriate package (e.g. original packaging). The package must also be protected with a tarpaulin or plastic sheet for added protection against mechanical dents, splashing water and dirt, for example.

The shafts must be rotated during storage approx. every 3 months to lubricate the lip seals.

1.1. Inner protection

Inner protection is established when the gear unit are road tested at the factory using protective oil (Neste protective oil 20W/30 ISO VG 100). The protective agents left behind by the oil protect the inside of the gear unit against corrosion. Gears are usually supplied without oil! Alternatively, inner protection can be carried out using the VCI method, see chapter 1.4. In this case, the gear is sprayed with approx. 1 dl per m3 of Dinitrol VCI UNI 0-40 VCI oil after the road test,after which the gear is sealed air tight.

The breather is covered with an air tight plastic bag or it must be removed and replaced with a plug. The breather is attached to the gear, and it must be installed according with the instructions before commissioning the gear.

Alternatively, inner protection for storage can be carried out by the customer by filling the gear with oil, if all of the device seals are lip seals. The gear is filled with as much of normal gear oil as possible, without exceeding the breather or oil filling connection. All moving parts, bearings included, should be covered with oil.

1.2. External protection of spare parts

When carrying out external protection, all unpainted surfaces should be treated with an easily removable protective agent (Zerust Perigol VCI230-spray) and protected with a corrosion inhibiting film (Zerust Valeno). For marine or overseas transport, the pallets or boxes containing the pieces should also be covered in plastic.

Small loose parts, such as spare parts, screws and nuts, are supplied packed in corrosion inhibiting Zerust bags.

It should be checked every six months, that the protection is intact and that the protected piece is free of corrosion.

1.3. External protection of larger gear parts

The product's external, unpainted surfaces and parts are treated by spraying the surfaces with a protective agent (Zerust Axxanol Spray G) and the shaft seal and seal surfaces are protected from outside with a special bearing grease. The product is protected with a corrosion inhibiting film (Zerust Valeno) and the packaging box lid or the product packaged onto a pallet is covered with plastic.

Any holes, such as air valve and pressure lubrication piping openings, fastening drilling and cooling circuit connections, are protected with plugs and/or VCI plastic. Drillings that may accumulate water must be protected with plugs.

1.4. The VCI method

In the VCI method (Volatile Corrosion Inhibitor), anticorrosive oil releases VCI inhibitors inside the gear, where it forms an invisible anticorrosive layer on the inside surfaces of the gear. Users must be protected from the effects of the agent. You must also ensure that there are no open flames or sparks nearby during the spraying and when the solution evaporates. In the cold, the release of VCI slows down, which means that the treated gear must not be taken out into the cold before the protective layer has formed (12-24h).

The effectiveness of the VCI additive diminishes due to the exchange of the inside air of the gear. All holes must therefore be blocked so that any fumes are trapped inside the gear. After spraying, the breather must be blocked or covered with an airtight plastic bag. During inspection, the gear may only remain open for a maximum of two hours.

The package protected with a corrosion inhibiting film or bag may not be damaged during storage. Any tears must be taped shut immediately.

The gears and packages must be marked with separate VCI warning stickers. The VCI warning sticker must be placed as a seal on the edge of the VCI film. VCI protection must be renewed every three years.

1.5. Commissioning

Any corrosion inhibiting agents and oil used for storage must be removed from the gear prior to commissioning. Please see the instructions on commissioning in the use and maintenance manual for the gear.

You must be careful not to damage the lip seals or surfaces mechanically when cleaning the ends of the shaft.

1.6. Application

The inner and external protection applies to all Santasalo products.

The level of protection may be altered if it has been specifically agreed with the customer.

FOUNDATION OF INDUSTRIAL GEAR ASSEMBLIES, STANDING INSTALLATION

1. Foundation of industrial gear assemblies, standing installation

1.1 General

The faultless operation of a gear assembly requires a sturdy and vibration-free foundation. Changes in the foundation may result in deteriorated tooth contact, which causes local increase of surface pressure in the tooth. This may cause heavy wear of the tooth and result in damage to the gear assembly.

1.2 Basic types

A prerequisite for rapid and reliable installation is the selection of a suitable foundation type and sufficient preliminary planning of installation, manifested as appropriate foundation drawings and the required structural and dimensional data.

Santasalo Gears recommends foundation on foundation bars or a foundation plate, which are presented in this guide. Installation on foundation bars is suitable for all sizes of standing gear assemblies. However, for installations in excess of 5,000 kg, we recommend a plate foundation.

The customer's own solution, if any, must be of similar technical and quality level as the basic solutions in this guide. When installing a gear assembly on a steel structure, special attention must be paid to the rigidity of the structure to prevent harmful vibration and structural swaying. The top surface of the gear assembly mounting surface must be mechanised and, in its final structure, meet the level and other quality requirements set for mechanised platforms.

For the subsequent installation of a spare gear assembly, if any, it is recommended that adaptor plates and centring collars be used in the primary installation. If necessary, apply latitudinal and longitudinal support with adjustment screws.

1.2.1 Foundation with foundation bars

The foundation dimensioning is done according to the load data (static and dynamic) provided by the hardware supplier. The dimensioning of the foundation and its reinforcement must take into account the load caused by the foundation bars (G), while the reinforcement (usually 300 kg steel / m^3) must correspond at least to the strength of the mounting screws (H) of the gear assembly. The grade of concrete of the foundation concreting (A) must be at least K30-2 (FIN), K30 (SWE), C30 (BS), B35 (DIN) or 4000PSI (ACI). The concrete surface of the foundation concreting must be roughened and cleaned (remove the so-called cement paste from the surface). Remove any oil stains.

The operating unit (K) is installed on the foundation bars (G) on top of the foundation concreting (A) (Figure 1). The reinforcement (C) of the foundation concreting must be made in such a way as to serve as good dowel-bar reinforcement for secondary concreting (B). The foundation concreting is cast high enough to position the operating unit and the attached foundation bar close to the required operating unit's shaft height. More detailed adjustment of the shaft height of the operating unit is to be done with the adjustment screws (E) in the foundation bar. Figure 1.

After fitting the operating unit in place, the secondary concreting is done. The compressive strength of the secondary concreting must be at least 30 N/mm^2. Non-shrinking concrete must be used in the secondary concreting.

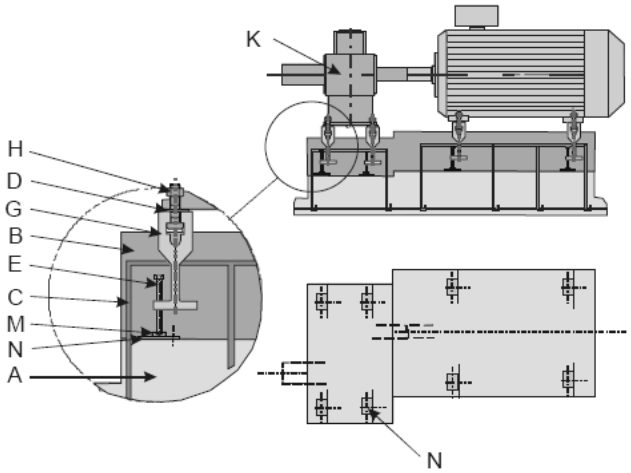


***Figure 1**: Foundation of the operating unit on foundation bars.*

The foundation concreting is part of the construction work, and therefore the constructor specifies the concreting material to be used and is responsible for carrying out the work and for its quality.

When using foundation with foundation bars, the foundation bars are selected according to the hole size of the fixing level of the device to be foundered. If the foundation bars are ordered from Santasalo Gears, our delivery will include the foundation bars, stud bolts (T bolts), T groove nuts, installation plates and adjustment screws (Figure 2). Figure 3 and Table 1 present the dimensioning of the foundation bars.

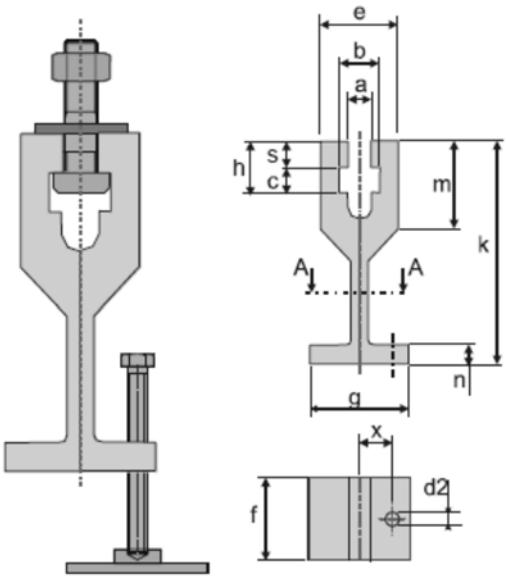


Figure 2 *Foundation bar and supplies Groove for T bolts DIN 787, ISO 299 and T nuts DIN 508*

Figure 3 *Foundation bar dimensioning*

Figures 4 and 5 and Table 2 present two different installation methods with dimension data. We recommend an installation method conformant to Figure 5

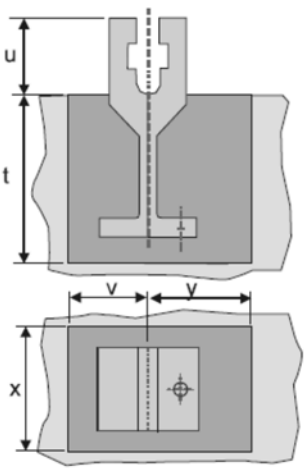


Figure 4. *There is a hole in the foundation concreting, which is filled with secondary concreting after installing the foundation bar.*

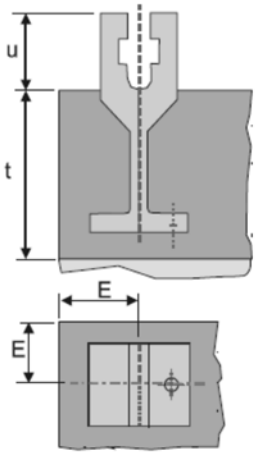


Figure 5. *Recommended installation method. A secondary concreting is done on top of the foundation concreting after installing the foundation*

Table 1*: Foundation bar dimensions*

SIZE	T- SLOT					DIMENSIONS							
	a	b	c	h	s	e	f	g	k	m	n	x	d2
P-M10	12	19	12	25	13	51	40±5	70	140	49	15	25	M10
P-M12	14	23	14	28	14	51	40±5	70	140	49	15	25	M10
P-M16	18	30	18	36	18	60	65±5	84	200	75	20	30	M12
P-M20	22	37	23	45	22	60	65±6	84	200	75	20	30	M16
P-M24	28	46	28	56	28	90	85±5	124	280	108	24	42	M16
P-M30	35	55	35	71	36	90	85±5	124	280	108	24	42	M20
P-M36	42	68	43	85	42	126	100	160	360	143	30	60	M20
P-M42	48	80	47	95	48	126	100	160	360	143	15	60	M20

***Table 2**. Installation dimensions of the foundation bar.*

SIZE	MASS	INSTALLATION				
	kg	t	u min	v min	y min	E
P-M10	1,7	150	27	60	240	85
P-M12	1,7	150	27	60	240	85
P-M16	3,7	210	35	80	260	120
P-M20	3,7	210	45	80	260	120
P-M24	10,5	280	55	100	330	150
P-M30	10,5	280	68	100	330	150
P-M36	20,3	340	82	120	410	220
P-M42	19,5	340	92	120	410	220

1.2.2 Foundation on foundation plate

The foundation dimensioning is done according to the load data (static and dynamic) provided by the hardware supplier. The dimensioning of the foundation and its reinforcement must take into account the load caused by the foundation screws (D), while the reinforcement (usually 300 kg steel / m^3) must correspond at least to the strength of the mounting screws (H) of the gear assembly. The grade of concrete of the foundation concreting (A) must be at least K30-2 (FIN), K30 (SWE), C30 (BS), B35 (DIN) or 4000PSI (ACI). The concrete surface of the foundation concreting must be roughened and cleaned (remove the so-called cement paste from the surface). Remove any oil stains. Figure 6.

The foundation screw holes are created with a corrugated steel foundation tube (C). See also Figure 8. The foundation concreting is cast high enough to position the foundation plate (G) on the adjustment screws and the attached operating unit close to the required operating unit's shaft height. More detailed adjustment of the shaft height of the operating unit is to be done with the adjustment screws (E) in the foundation plate. The distance between the foundation concreting and the bottom surface of the foundation plate is approximately 60 mm (25–70 mm). To ensure that the foundation plate remains immobile throughout the secondary concreting, all adjustment screws must support the foundation plate. The adjustment may initially be done by using three adjustment screws.

Secondary concreting is to be done in two phases. The foundation screw holes are cast (B1) up to the top surface of the foundation concreting (A) and are allowed to dry. The foundation screws are pre-tightened against the adjustment screws by 15 % of the screw's tightening torque after which secondary concreting (B2) of the space between the foundation concreting and the foundation plate is done with running special mass.

To allow for secondary tightening, the secondary concreting (B2) must not, however, cover the nuts of the foundation screws. If the surface of the secondary concreting is to be raised above the foundation screw level, a tightening hole must be made for the nuts in the concreting. The secondary concreting mass (B2) must properly fill the space beneath the plate and must not shrink. The mass (B1, B2) must not contain additives that corrode the pre-tensioned foundation screws. The secondary foundation is not reinforced. The compressive strength of the secondary concreting must be at least 30 N/mm^2. Non-shrinking concrete must be used in the secondary concreting.

The foundation concreting is part of the construction work, and therefore the constructor specifies the concreting material to be used and is responsible for carrying out the work and for its quality.

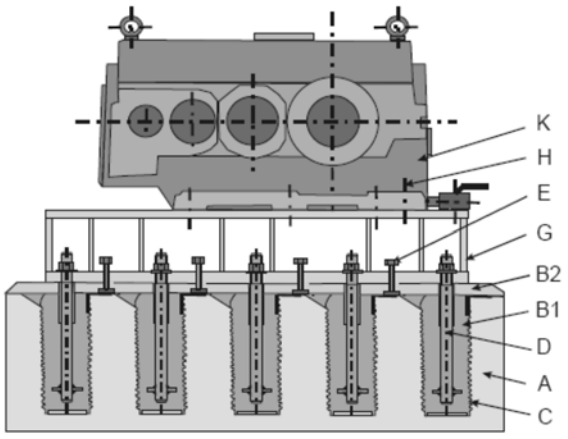


***Figure 6**. Foundation on foundation plate.*

The foundation screw (D) can be an SFS 4632 type A screw. Figures 6 and 7 and Table 3 illustrate the installation method with a foundation socket (C) and present the dimensions. Figure 8 presents a more detailed structure of the foundation socket.

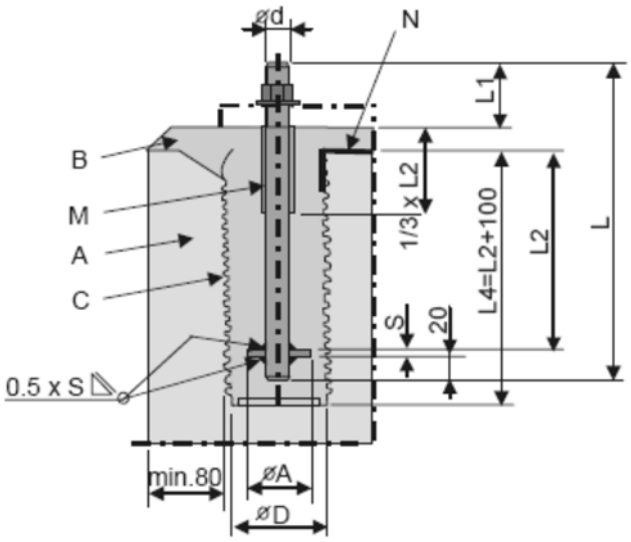


Figure 7. *Short foundation screw with flange: SFS 4632 type A foundation screw dimensioning. The foundation concreting (A), secondary concreting (B1), foundation socket (C), fixing iron (N) and anti-adhesion agent (M) are marked in the figure.*

Table 3*. Dimensions, allowed load capacity and allowed pre-tensioning of a foundation screw conformant to SFS 4632 and the foundation socket dimensions.*

BOLT						ALTERNATIVE AXIAL LOAD max		PRETENSIONING max		FOUNDATION SOCKET
Ød	L mm	L1 mm	L2 min mm	ØA mm	S mm	F_{staa} kN	F_{dyn} kN	TORQUE M_e Nm	FORCE F_e kN	ØD mm
M24	400 500 600	80	260	100	20	51,1	33,2	301,9	70,6	≥200
M30	500 600 700	120	310	120	25	81,3	52,8	559,2	112,2	≥210
M36	SHALL BE DEFINED IN DRAWING	120	400	140	30	118	76,7	1048	163,4	≥250
M42		140	450	170	35	152	98,8	1695	226,8	≥290
M48		160	550	200	35	199,1	129,4	2486	290,4	≥340
M56		180	640	220	40	274,3	178,3	3949	406,4	≥380

1.2.3 Materials

Bolt	S355J0 SFS-EN 10025, for outdoor use S355J2G3
Grip plate	S235JRG2 SFS-EN 10025, for outdoor use S235J2G3
Nut	SFS-ISO 4032 EN 24032. Grade of concrete 8 SFS-ISO 898-2
Base plate	SFS-ISO 887

If the bolt's structural material is not S355J0, the corresponding max. Fstaat, Fdyn, Fe ja Me can be obtained by multiplying the table values with the ratio of the yield limit of the steel used and that of the steel S355J0.

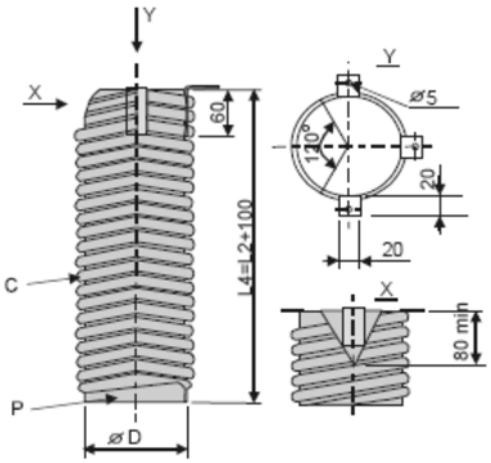


Figure 8. *SFS 4632 Corrugated steel foundation socket. The foundation socket (C) and base plate (P) are marked in the figure.*

INSTALLATION OF INDUSTRIAL GEAR ASSEMBLIES, STANDING INSTALLATION

1. INSTALLATION

1.1 Factors that affect installation

Before equipment installation, the dimensions of the foundation must be verified to the appropriate drawings. Differences between the operating and installation temperatures of the machines to be connected may cause thermal expansion and shaft offset. You need to predict these issues in the installation. Installation must be carried out so that the couplings between the machines will work faultlessly at the normal operating temperature. On the other hand, it must also be ensured that the coupling play is sufficient even under the worst possible operating circumstances

2. INSTALLATION ON FOUNDATION BARS

Couplings are installed on the gear shafts according to the installation instructions of the coupling.

A gear installed on a concrete foundation is lowered with its foundation bars (G) and installation supplies (M, E, D, H) on installation plates (N) on the foundation concreting (A) (Figure 1). The gear unit (K) is placed in such a way that it is at the required operating unit shaft level. Proper gear placement is required for successful subsequent operating unit alignment. There are adjustment screws (E) in the foundation bars for the vertical placement of the gear unit. The foundation bars are supported with the reinforced concrete (C) with welds, for example.

After gear unit placement, the grouting of the foundation is done according to the foundation instructions. When the concreting is dry, loosen the tensioning screws (H) so as to straighten the gear unit that may have been bent during concrete drying. After this, fine-tune the gear unit placement using adaptor plates (D). The tensioning screws (H) are tensioned to the instructed torque. When installing a new gear unit, adaptor plates (D) must be used between the gear base and foundation bar (G) to enable the installation of a spare gear assembly.

The foundation concreting is part of the construction work, and therefore the constructor specifies the concreting material to be used and is responsible for carrying out the work and for its quality.

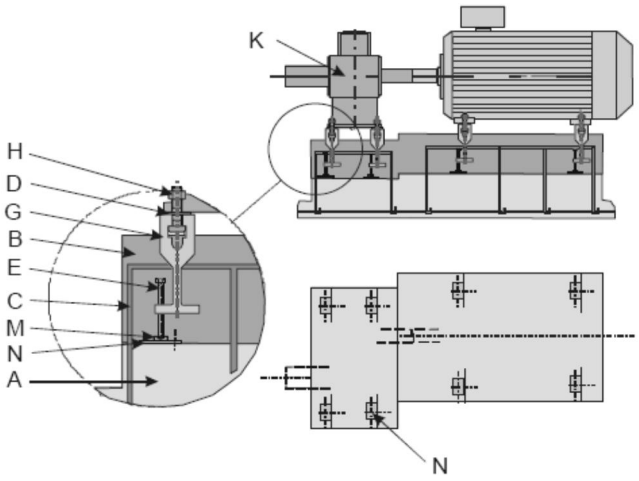


Figure 1. *Installation of an operating unit with foundation bars. Foundation concreting (A), grouting (B), foundation concreting reinforcement (C), adaptor plate (D), adjustment screw (E), foundation bar (G), fixing screw (H), gear unit (K), installation block (M), installation plate (N).*

3. INSTALLATION ON FOUNDATION PLATE

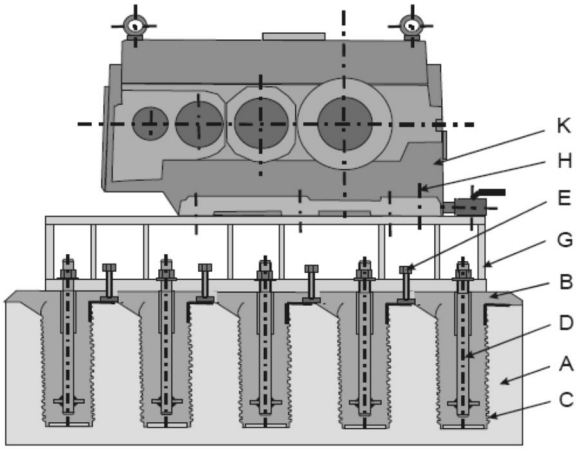


Figure 2. *Installation on foundation plate. Foundation concreting (A), grouting (B), foundation socket (C), foundation screw with supplies (D), adjustment screw (E), foundation plate (G), screw fixing (nut, centring collar, adaptor plates, screw) (H), gear unit (K).*

The operating unit is put in place according to the basic instructions, which also describe the stages of the foundation and grouting. The actual installation of the operating unit can be done after the grouting has dried. Before the final installation, remove any centring collars used in the gear unit fixing holes.

When installing a new gear unit, adaptor plates (D) must be used between the gear base and foundation plate (G) to enable the installation of a spare gear assembly.

The foundation screws are pre-tensioned against adjustment screws after the concreting has dried. The adjustment screws are loosened before the foundation screws are tensioned. The required tensioning torque is specified in Table 1. Approximate or estimated tensioning is not allowed. The foundation screws must be re-tensioned 1 month and 6 months after the installation of the gear unit.

***Table 1**. Dimensions, allowed load capacity and allowed pre-tensioning of a foundation screw conformant to SFS 4632 and the foundation socket dimensions.*

BOLT						ALTERNATIVE AXIAL LOAD max		PRETENSIONING max		FOUNDATION SOCKET
Ød mm	L mm	L1 mm	L2 min mm	ØA mm	S mm	F_{staa} kN	F_{dyn} kN	TORQUE M_e Nm	FORCE F_e kN	ØD mm
M24	400 500 600	80	260	100	20	51,1	33,2	301,9	70,6	≥200
M30	500 600 700	120	310	120	25	81,3	52,8	559,2	112,2	≥210
M36	SHALL BE DEFINED IN DRAWING	120	400	140	30	118	76,7	1048	163,4	≥250
M42		140	450	170	35	152	98,8	1695	226,8	≥290
M48		160	550	200	35	199,1	129,4	2486	290,4	≥340
M56		180	640	220	40	274,3	178,3	3949	406,4	≥380

4. INSTALLATION ACCURACY

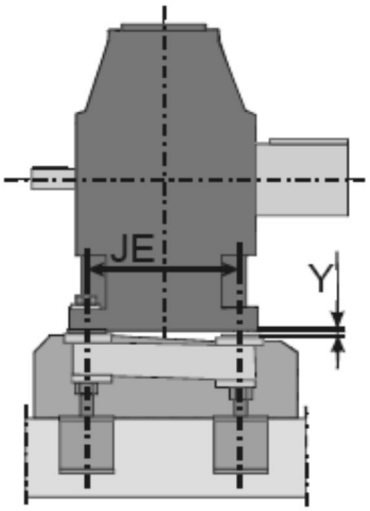
The gear unit installation accuracy is determined primarily based on the coupling and connected machine accuracy as well as on the rotation speeds. Use Santasalo Gears instructions for coupling installation accuracy.

4.1 Gear unit installation accuracy

During installation, make sure that the foundation installation accuracy deviations do not exceed the y_{max} values in Table 1. Use keys to help you straighten the foundation.

4.2 Checking the tooth contact with drum gears

After installation, particularly in demanding installations and with large gear units, check the tooth contact. You can check the tooth contact through the inspection door using inspection colour. The requirement is 80% lateral contact. If the contact is less than 80%, the gear unit may have been skewed while tightening with the foundation bolts. To correct the contact, the fine-tuning of gear placement must be redone (Figure 3).



JE [mm]	y_{max} [mm]
<400	0,035
400...799	0,060
800...1200	0,090
1200...1600	0,125
1600...2000	0,150

***Figure 3.** Gear unit installation accuracies with dimensions.*

LUBRICANTS IN INDUSTRIAL GEARS

1. SIGNIFICANCE OF LUBRICATION

To secure the appropriate lubrication of a gear assembly, it is of primary importance that its lubrication and the related observation and maintenance tasks have been properly arranged.

The main task of lubrication is to form an oil film between the working flanks of the gear teeth of a gear wheel to prevent metal contact and to lubricate the bearings and seals.

Other lubrication functions include:

- reducing friction and the resultant power loss
- transfer heat away from the tooth contact and bearings
- minimise wear and tear
- prevent the entry of impurities into the lubricated parts
- move impurities and wear-down particles away
- reduce vibration
- protect the parts from corrosion

The thickness of the oil film depends for example on the surface pressure of the gear tooth, the viscosity of the oil and the pitch line velocity. If the oil film fails repeatedly during operation, the working flank of the tooth becomes damaged.

Information pertaining to the viscosity and amount of the gear lubrication oil is presented per application either in the plate attached to the gear and/or in the dimensional drawing of the gear. Oil types approved for use in industrial gears are presented in section 5. When using oil types not presented in the above appendix, consult with the gear manufacturer first.

2. LUBRICATION METHODS

2.1 Bath lubrication

In bath lubrication, the oil surface is raised high enough to submerge the tooth contact and the rolling elements of the bearings in oil. Bath lubrication is suitable only for very slow-rotating gear wheels with a low pitch line velocity.

2.2 Splash lubrication

In splash lubrication, the gear wheels are partially submersed in oil. Tooth contact is lubricated with the oil splashing from the gear wheels or conveyed with the teeth. The bearings are lubricated with oil splashing from the gear wheels. Splash lubrication is suitable for relatively slow-rotating gear wheels.

2.3 Grease lubrication

The use of grease lubrication is limited almost solely to the lubrication of bearings and seals if the bearing structure of a gear assembly requires that.

2.4 Pressure-feed lubrication

The structure, size, use and cooling requirement of the gear may require pressure-feed lubrication. In pressure-feed lubrication, the oil pipeline of the gear is connected to a central lubrication system, or a dedicated lubrication pump is located close to the gear. The lubrication pump may be shaft-operated, which means that it gets its operating power directly from the gear shaft, or it may have a dedicated electric engine.

The equipment level in pressure-feed lubrication is determined by the demand level, supervision and gear cooling requirements of the machine being operated. It is also possible to connect a standard lubrication unit to the gear and equip it with a water or air cooling unit.

3. LUBRICATION IN EXTREME SITUATIONS

3.1 Oil heating

If a gear is located outdoors or in a non-heated location, the gear manufacturer must be notified of this and of the temperature variations. The usual problem at low temperatures is the supply of oil to the item requiring lubrication because of the high viscosity of the oil.

An oil heater is a resistor element located in the oil compartment of the gear and thread-mounted in the wall of the gear housing. If required, the resistor element can be detached for cleaning. In this case, the gear oil must be removed first.

There is a thermostat for controlling the oil heater. The thermostat must be programmed in such a way as to power on the oil heater if the temperature in the gears falls below the pour point in bath or splash lubricated gears or below the temperature listed in Table 1 for pressure-feed-ubricated gears.

Table 1. *Minimum temperatures (℃) with different oil qualities in pressure-feed-lubricated gears at or above which the oil viscosity value <2000 cSt occurs.*

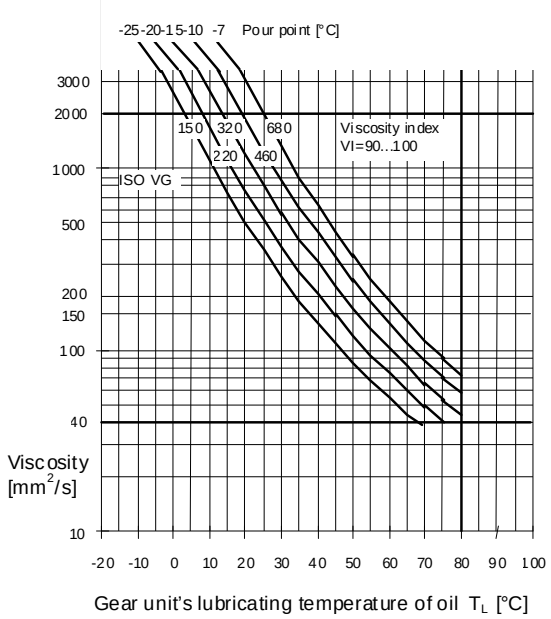
ISO VG class	**680**	**460**	**320**	**220**	**150**	**100**
Mineral oil	+25	+20	+15	+10	+5	
Synthetic oil		+15	+10	+5	0	-5

In pressure-lubricated gears, the viscosity of the lubrication oil must be <2000 cSt at the start-up temperature.

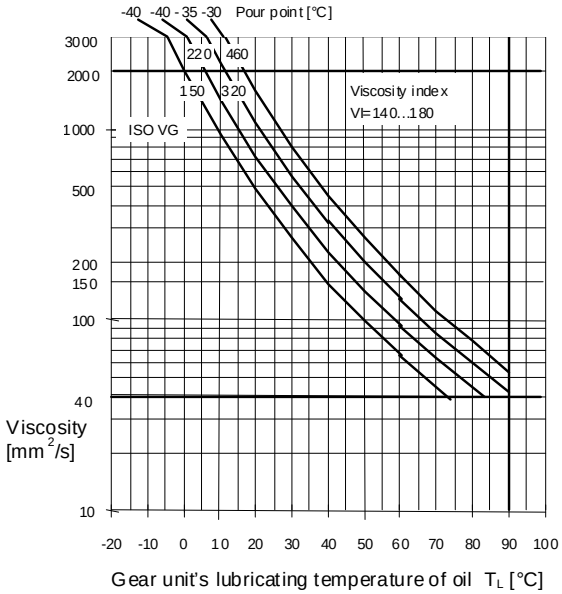
The high end of the thermostat is set to power the unit off at a temperature of +8..+10 ºC above the abovementioned power-on temperature.

Table 2. *Oil viscosity as a function of temperature.*

Mineral oils



Synthetic PAO oils



3.2 Oil cooling

The gear manufacturer must be notified of above-normal operating temperatures and temperature variations. If the operating temperature of the oil is higher than the designed temperature, the oil viscosity falls too low. This may result in decreased lubrication film thickness, potential metal contact, surface wear and damage.

3.2.1 Bath and splash lubrication

The highest allowed operating temperature of bath and splash-lubricated gears is normally +90 ºC measured at the gear's bearing housing. In special cases the highest allowable operating temperature

may be +100 ºC. If the gear's operating power exceeds the thermal power, the above normal operating temperature will be exceeded unless the gear cooling is enhanced.

Gear cooling may be enhanced as follows:

- place a water cooling coil unit in the gear's oil compartment
- place one or two fans on the input shaft of the gear

Fans are not recommended in dusty or humid environments.

The input side of the water cooling coil unit must have a thermostat-controlled water valve. The greatest allowed operating pressure of the water is 1 MPa (10 bar). The direction of flow of the water is insignificant in the water cooling coil unit.

The flow amount of the water cooling coil unit must be adjusted so that the temperature of the oil compartment in the gear does not exceed +80 ºC. There must be a thermometer in the oil compartment of the gear for monitoring the temperature.

3.2.2 Pressure-feed lubrication

The operating temperature of a gear with pressure-feed lubrication is normally at most +80 ºC measured at the gear's bearing housing.

Gear cooling may be enhanced as follows:

- use a water-cooled oil cooler
- use an air-cooled oil cooler

An air-cooled oil cooler must be located in a dust-free environment.

The input side of a water-cooled oil cooler must have a thermostat-controlled water valve. The greatest allowed operating pressure of the water is 1 MPa (10 bar). The direction of water flow marked in the oil cooler must be adhered to.

In water-cooled oil coolers, the water volume must be adjusted with a thermostat so that the temperature of the oil entering the gear is +45..+55 ºC.

If the gear has an air-cooled oil cooler, it must be thermostat-controlled and control the operation of the fan engine so that the temperature of the oil entering the gear is +45...+55 º.

3.3 Cold start

In a cold start situation, the viscosity of the lubrication oil must be <2000 cSt at the start-up temperature for the pressure-feed-lubricated gears. For bath and splash-lubricated gears, the start-up temperature must be higher than the pour point of the lubrication oil. If this is not the case, the seals, bearings and gear wheels will not be lubricated at all.

If the viscosity of the selected oil exceeds the allowed viscosity at the start-up temperature, the following measures can be performed with the gear manufacturer's permission:

- use the closest matching oil of a thinner oil group
- use different oil for winter and summer environments
- use an oil heater
- use a synthetic polyalphaolephin-based (PAO) oil

In case of a temporary start-up temperature decrease (e.g., downtime), start-up problems in pressure-feed-lubricated gear wheels can be reduced by allowing the electric engine pump to run through the downtime.

4. HANDLING AND DISPOSING OF LUBRICANTS

Lubrication oils are hazardous waste and dangerous to the environment. National laws and regulations must be adhered to in their handling and disposal.

5. APPROVED LUBRICANTS

The lubricant table below lists the lubricants approved for Santasalo Gears industrial gear wheels.

Mineral oils

ISO VG class	AGMA number	Company	Oil types	Viscosity cSt / 40 ºC	Pour point ºC
150	4EP	Aral	Degol BG 150 plus	150	-12
		BP	Energol GR-XP 150	149	-12
		Castrol	Alpha SP 150	150	-21
		Castrol	Alpha MAX 150	150	-23
		Castrol	Optigear BM 150	150	-18
		Castrol	Tribol 1100/150	146	-27
		Chevron	Meropa WM 150	150	-27
		Fuchs	Renolin CLP 150	150	-24
		Fuchs	Renolin CLP 150 PLUS	150	-24
		Fuchs Lubritech	Gearmaster CLP 150	150	-24
		Klüber	Klüberoil GEM 1-150 N	150	< -10
		Lubrication Engineers	604 ALMASOL Vari-Purpose Gear Lubricant	150	-24
		Lukoil	Steelo 150	150	-15
		Mobil	Mobilgear 600 XP 150	150	-24
		Neste	Vaihteisto 150 EP	150	-21
		Petro Canada	Ultima EP 150	150	-33
		Shell	- - - - - - -	- -	- -
		Statoil	Loadway EP 150	140	-27
		Total	- - - - - - -	- -	- -
		Total	Carter XEP 150	150	-27
220	5EP	Aral	Degol BG 220 plus	220	-15
		BP	Energol GR-XP 220	210	-9
		Castrol	Alpha SP 220	220	-21
		Castrol	Alpha MAX 220	220	-23
		Castrol	Optigear BM 220	220	-15
		Castrol	Tribol 1100/220	214	-24
		Chevron	Meropa WM 220	220	-21
		Fuchs	Renolin CLP 220	220	-24
		Fuchs	Renolin CLP 220 PLUS	220	-24
		Fuchs Lubritech	Gearmaster CLP 220	220	-21
		Klüber	Klüberoil GEM 1-220 N	220	< -10
		Lubrication Engineers	607 ALMASOL Vari-Purpose Gear Lubricant	220	-24
		Lukoil	Steelo 220	220	-15
		Mobil	Mobilgear 600 XP 220	220	-24
		Neste	Vaihteisto 220 EP	220	-24
		Petro Canada	Ultima EP 220	220	-27
		Shell	Omala F 220	220	-18
		Statoil	Loadway EP 220	225	-21
		Total	- - - - - - -	--	--
		Total	Carter XEP 220	220	-24
320	6EP	Aral	Degol BG 320 plus	320	-9
		BP	Energol GR-XP 320	311	-9
		Castrol	Alpha SP 320	320	-21
		Castrol	Alpha MAX 320	320	-23
		Castrol	Optigear BM 320	320	-15
		Castrol	Tribol 1100/320	331	-21
		Chevron	Meropa WM 320	320	-18

320	6EP	Fuchs	Renolin CLP 320	320	-14
		Fuchs	Renolin CLP 320 PLUS	320	-18
		Fuchs Lubritech	Gearmaster CLP 320	320	-15
		Klüber	Klüberoil GEM 1-320 N	320	< -10
		Lubrication Engineers	605 ALMASOL Vari-Purpose Gear Lubricant	320	-18
		Lukoil	Steelo 320	320	-15
		Mobil	Mobilgear 600 XP 320	320	-24
		Neste	Vaihteisto 320 EP	320	-12
		Petro Canada	Ultima EP 320	320	-21
		Shell	Omala F 320	320	-15
		Statoil	Loadway EP 320	337	-18
		Total	- - - - - - -	--	--
		Total	Carter XEP 320	320	-18
460	7EP	Aral	Degol BG 460 plus	460	-18
		BP	Energol GR-XP 460	432	- -
		Castrol	Alpha SP 460	460	-6
		Castrol	Alpha MAX 460	460	-9
		Castrol	Optigear BM 460	460	-12
		Castrol	Tribol 1100/460	460	-21
		Chevron	Meropa WM 460	460	-15
		Fuchs	Renolin CLP 460	460	-12
		Fuchs	Renolin CLP 460 PLUS	460	-14
		Fuchs Lubritech	Gearmaster CLP 460	460	-12
		Klüber	Klüberoil GEM 1-460 N	460	-10
		Lubrication Engineers	608 ALMASOL Vari-Purpose Gear Lubricant	460	-15
		Lukoil	Steelo 460	460	-15
		Mobil	Mobilgear 600 XP 460	460	-15
		Neste	Vaihteisto 460 EP	460	-15
		Petro Canada	Ultima EP 460	460	-15
		Shell	Omala F 460	460	-9
		Statoil	Loadway EP 460	440	-12
		Total	- - - - - - -	--	--
		Total	Carter XEP 460	460	-12
680	8EP	Aral	Degol BG 680 plus	680	-12
		BP	Energol GR-XP 680	710	- -
		Castrol	Alpha SP 680	680	-6
		Castrol	- - - - - - -	- -	- -
		Castrol	Optigear BM 680	680	-9
		Castrol	Tribol 1100/680	690	-18
		Chevron	- - - - - - -	- -	- -
		Fuchs	Renolin CLP 680	680	-10
		Fuchs	Renolin CLP 680 PLUS	680	-17
		Fuchs Lubritech	Gearmaster CLP 680	680	-12
		Klüber	Klüberoil GEM 1-680 N	680	-5
		Lubrication Engineers	609 ALMASOL Vari-Purpose Gear Lubricant	680	-15
		Lukoil	Steelo 680	680	-15
		Mobil	Mobilgear 600 XP 680	680	-9
		Neste	Vaihteisto 680 EP	680	-12
		Petro Canada	Ultima EP 680	680	-15
		Shell	- - - - -	- -	- -
		Statoil	Loadway EP 680	645	-9
		Total	- - - - - - -	--	--
		Total	Carter XEP 680	680	-9

Mineral oils for paper machine use

ISO VG class	AGMA number	Company	Oil types	Viscosity cSt / 40 ºC	Pour point ºC
220	5EP	Esso	Teresstic N 220	220	-12
		BP	Energol PM 220	220	-18
		Mobil	DTE PM	220	-6
		Neste-Exxon	Paperikone 220D	220	-12
		Petro Canada	SEPRO XL 220	218	-21
		Petro Canada	ULTIMA EP 220	220	-27
		Texaco	PMO Premium 220	220	-18
		Texaco	PMO Ashless 220	220	-18

Synthetic polyalphaolephin-based oils

ISO VG class	AGMA number	Company	Oil types	Viscosity cSt / 40 ºC	Pour point ºC
150	4EP	Aral	Degol PAS 150	150	-39
		BP	Enersyn EP-XF 150	150	-48
		Castrol	Alphasyn EP 150	150	-48
		Castrol	- - - - - - -	- -	- -
		Castrol	Optigear Synthetic X 150	146	-39
		Castrol	Tribol 1510/150	155	-45
		Fuchs	Renolin Unisyn CLP 150	150	-45
		Klüber	Klübersynth GEM 4 – 150 N	150	-40
		Mobil	Mobil SHC Gear 150	150	-54
		Mobil	Mobil SHC 629	150	-42
		Neste	Vaihteisto S 150 EP	150	-42
		Petro Canada	Enduratex Synthetic EP 150	150	-54
		Shell	Omala HD 150	150	-54
		Shell	Omala S4 GX 150	150	-45
		Statoil	Mereta 150	150	-57
		Total	Carter SH 150	148	-45
220	5EP	Aral	Degol PAS 220	220	-39
		BP	Enersyn EP-XF 220	220	-42
		Castrol	Alphasyn EP 220	220	-42
		Castrol	Optigear Synthetic A 220	210	-36
		Castrol	Optigear Synthetic X 220	218	-33
		Castrol	Tribol 1510/220	220	-42
		Fuchs	Renolin Unisyn CLP 220	220	-42
		Klüber	Klübersynth GEM 4 – 220 N	220	-40
		Mobil	Mobil SHC Gear 220	220	-45
		Mobil	Mobil SHC 630	220	-42
		Neste	Vaihteisto S 220 EP	220	-48
		Petro Canada	Enduratex Synthetic EP 220	223	-48
		Shell	Omala HD 220	220	-48
		Shell	Omala S4 GX 220	220	-45
		Statoil	Mereta 220	220	-48
		Total	Carter SH 220	220	-45
320	6EP	Aral	Degol PAS 320	320	-39
		BP	Enersyn EP-XF 320	320	-30
		Castrol	Alphasyn EP 320	320	-36
		Castrol	Optigear Synthetic A 320	330	-36
		Castrol	Optigear Synthetic X 320	325	-33
		Castrol	Tribol 1510/320	330	-39

320	6EP	Fuchs	Renolin Unisyn CLP 320	320	-42
		Klüber	Klübersynth GEM 4 – 320 N	320	-35
		Mobil	Mobil SHC Gear 320	320	-48
		Mobil	Mobil SHC 632	320	-42
		Neste	Vaihteisto S 320 EP	320	-48
		Petro Canada	Enduratex Synthetic EP 320	323	-42
		Shell	Omala HD 320	320	-45
		Shell	Omala S4 GX 320	320	-42
		Statoil	Mereta 320	320	-42
		Total	Carter SH 320	314	-42
460	7EP	Aral	Degol PAS 460	460	-39
		BP	Enersyn EP-XF 460	460	-36
		Castrol	Alphasyn EP 460	460	-36
		Castrol	Optigear Synthetic A 460	463	-30
		Castrol	Optigear Synthetic X 460	459	-27
		Castrol	Tribol 1510/460	460	-33
		Fuchs	Renolin Unisyn CLP 460	460	-39
		Klüber	Klübersynth GEM 4 – 460 N	460	-30
		Mobil	Mobil SHC Gear 460	460	-48
		Mobil	Mobil SHC 634	460	-39
		Neste	Vaihteisto S 460 EP	460	-45
		Petro Canada	Enduratex Synthetic EP 460	501	-42
		Shell	Omala HD 460	460	-42
		Shell	Omala S4 GX 460	460	-36
		Statoil	Mereta 460	460	-39
		Total	Carter SH 460	455	-30
680	8EP	ARAL	- - - - -	- -	- -
		BP	- - - - -	- -	- -
		Castrol	- - - - -	- -	- -
		Castrol	- - - - -	- -	- -
		Castrol	- - - - -	- -	- -
		Castrol	Tribol 1510/680	680	-30
		Fuchs	Renolin Unisyn CLP 680	680	-33
		Klüber	Klübersynth GEM 4 – 680 N	680	-30
		Mobil	Mobil SHC Gear 680	680	-42
		Mobil	Mobil SHC 636	680	-39
		Neste	Vaihteisto S 680 EP	680	-35
		Petro Canada	- - - - -	- -	- -
		Shell	Omala HD 680	680	-39
		Shell	Omala S4 GX 680	680	-33
		Statoil	Mereta 680	680	-39
		Total	Carter SH 680	676	-21

Synthetic polyalphaolephin-based oils for paper machine use

ISO VG class	AGMA number	Company	Oil types	Viscosity cSt / 40 ºC	Pour point ºC
220	5EP	Castrol	Optisynth HT 220	220	-39
		Mobil	SHC PM 220	225	-36
		Neste	Lamda 220 ZF	220	-45
		Texaco	Paper Machine Oil Premium		

Roller bearing greases

Operating temperature -30..+100 ºC			NLGI 2 (EP)
Company	**Grease type**	**Penetration**	**Fluency point °C**
Aral	Aralub HLP2	265/295	180
BP	Energrease LS-EP	265/295	195
Castrol	Tribol 3785/220-1,5	265/295	>180
Castrol	Longtime PD 2	265/295	260
Castrol	Tribol 4020/220-2	265/295	260
Chevron	Dura-Lith EP2	265/295	185
Elf	Epexa EP2	265/295	207
Exxon	Beacon EP2	265/295	190
Gulf	Gulfcrown EP 2	265/295	180
Klüber	CENTOPLEX 2EP	265/295	190
Mobil	Mobilux EP2	265/295	190
Neste	Allrex EP 2	265/295	198
Shell	Alvania Grease EP2	265/295	180
Statoil	Uniway EP2N	270/280	185
Teboil	Multi-purpose EP	265/295	185
Texaco	Multifak EP2	265/295	186
Total	Multis EP2	265/295	190

Lubrication of hot-running cone bearings (>80 ºC) NLGI 2 (EP)			
Company	**Grease type**	**Penetration**	**Fluency point °C**
Castrol	Tribol 3785/220-1,5	265/295	>180
Castrol	Tribol 4020/220-2	265/295	260
Castrol	Tribol 4747/220-2	265/295	>250
Klüber	Klüberplex BE 31-102	265/295	190
Shell	Albida Grease EP2	265/295	260
Teboil	Multi-purpose HT	265/295	260

Lubrication of slow-rotating, axial, spherical pressure bearings NLGI 0..1 (EP)			
Company	**Grease type**	**Penetration**	**Fluency point °C**
Castrol	Molub-Alloy 9141-1	310/340	>230
Castrol	Olista Longtime 1	310/340	>180
Castrol	Optipit	245/275	300
Castrol	Tribol 3020/1000-1	265/295	260
Klüber	STABURAGS NBU 30	245/275	220
Klüber	Klüberplex BEM 41-141	310/345	250

USE AND MAINTENANCE OF GEAR UNITS

1. DEPLOYMENT OF INDUSTRIAL GEAR UNITS

1.1 Pre-deployment measures

Before deployment, check the following items according to their separate instructions:

- Gear assembly cleaning: MDI-130
- Correctness of operating unit installation: MDI-150/MDI-160/MDI-165
- Safety: MDI-120

In addition to these, also check the following:

- Correct direction of rotation and electrical locking of the electric engine
- Safeguarding rotating parts
- Connection of any monitoring devices used
- Breather installation

Industrial gears are delivered with the breather detached. The breather is delivered with the gearbox, packed in a separate protective bag.

1.2 Gear lubrication

The operating principles for gear lubrication are presented in more detail in the guide MDI-170.

If a splash-lubricated industrial gear has been warehoused for more than ½ year prior to deployment, all rolling bearings should be lubricated through the inspection hole and all mouth gaskets should be lubricated with a suitable manual lubrication device. After this, rotate the shafts manually to spread the lubrication oil throughout the bearings.

For pressure-feed lubricated industrial gear assemblies, you need to check before starting the unit that the pressure-feed lubrication works properly using a test run. Also ensure that the electric engine of the pump has the correct direction of rotation, is properly safeguarded, that the operating engine of the gear assembly is electrically locked and any monitoring devices are connected. As the start-up is the most critical phase with respect to lubrication, you need to monitor the operation of the pressure-feed lubrication devices and ensure that the pump sucks oil and causes pressure on the pressurised side.

We recommend that you connect the electric engine of the pump in such a way that it must be started first before the operating engine of the gear assembly can be started. We also recommend that you protect the electric engine of the pump with an overcurrent relay.

1.3 Running in the gear unit

Before the actual deployment of the gear unit, it must be run in. In the run-in, the load and, if possible, the rotation speed of the gear unit is increased to the full capacity in 2–3 steps. This process takes approximately 8–10 hours. During run-in, monitor the smoothness of the gear unit's operation, any vibration, sounds of operation, temperature, possible leaks and lubrication. If something suspicious is detected, the cause of the anomaly must be determined and eliminated.

In demanding installations and particularly with large gear assemblies, tooth contact must be checked after the run-in executed at the rated capacity using a permanent colour and the inspection covers of the gear assembly. For the inspection, the gear assembly must be stopped and locked properly. The requirement is almost 100% lateral contact. If the contact is less than 100%, the gear unit may have been skewed while tightening with the foundation bolts or the alignment has been incorrectly carried out.

If the tooth shape of the stage being inspected has been corrected and if the run-in is carried out at partial capacity, the tooth contact must be compared to the contact diagram in the assembly drawing.

2. MAINTENANCE OF INDUSTRIAL GEARS

The primary task of the maintenance is to proactively prevent damage. All major events related to the gear unit must be marked in the preventive maintenance job card. The gear unit maintenance job card must start to be filled in already in the installation stage. Central issues to be entered in the maintenance job card include:

- Date of completion of the installation and measured installation accuracies
- First oil fill date, oil quality and oil quantity
- Run-in start and end time and any observations made during run-in
- Time of start of production use as well as power measurement results
- First oil change and any checks and observations made during it, such as tooth contact surface condition check
- Oil changes actualised and the next planned time of oil change
- All repair and maintenance tasks carried out as well as spare parts replaced

It is important for both the user and manufacturer of the industrial gear that an inspection carried out at the end of the warranty period is done carefully.

Maintenance and inspection measures can be divided into two groups:

- inspection during operation
- inspections and maintenance carried out during downtime

2.1 Inspection during operation

During operation, observe the following:

- heating
- sound of operation and vibration (vibration measurements)
- oil pressure and flow
- operating power and load peaks
- any oil leaks

The operating temperature of the gear unit should be +40…+80 °C measured in the oil sump. With synthetic oils, temperatures up to +90 ºC can be allowed, however, also in these cases there may be isolated areas on the surface of the casing where the temperature is higher.

If the gear temperature exceeds the allowable limit, check:

- whether the oil type used is one of the recommended types
- oil level when the gear unit is stopped
- whether the valves in the cooler's waterline are open
- whether the cooler is clogged
- the setting of the thermostatic water valve

The normal range for the oil pressure is 0.5–3 bar. Any changes in the oil pressure may indicate clogged pipelines, nozzles, filters or heat exchangers or damage to the pump.

Observing the power values helps assess the useful life of the gear unit in the operating environment.

2.2 Inspections and maintenance carried out during downtime

It is very important that also the condition of the gear wheels and, if possible, bearings is checked during the inspection and the results are marked in the preventive maintenance job card. if there is clearly increasing wear or flank damage (dents) in the teeth, you need to determine the cause immediately. Excessively short useful life may indicate a failed foundation, overload, wrong lubricant, water in the lubricant, clogged oil pipeline or wrong load assessment during the gear specification stage.

2.2.1 External gear assembly cleaning

The external surface and the fan, if any, as well as the electric engines of the gear unit must be kept clean because stain accumulation increases the operating temperature. When using an air-operated oil cooler, the cells of the cooler must also be kept clean. During pressure wash, do not aim the jet to the shaft gaskets or breather. The functionality of the breather must always be ensured during oil change.

2.2.2 Changing the lubrication oil

We recommend that a pump unit (not included in the gear assembly delivery) that also filters the refill oil be used in oil changes. When the oil refill cover is opened, make sure that impurities do not enter the oil tank.

Oil change interval

The first oil change must be carried out after 500–800 hours of operation. The used oil must be removed while it is still warm. During oil change, the oil tank must be washed with rinsing oil if necessary.

For mineral oils, the following oil changes are needed every one (1) year. The operating temperature measured at the bearing housing should not exceed +80 ºC. For large gear assemblies with large quantities of oil, the useful life of the mineral oil may be extended based on the results of the annual oil analysis results. A permission for extended use of the oil is usually granted by the oil company.

For synthetic (PAO) oils, the following oil changes are needed every three (3) years. If the operating temperature measured at the bearing housing is +90 ºC or higher, the oil change interval is 12,000 hours of operation (ca. 1.5 years). Also with synthetic oils, it is recommended that the oil quality be monitored with regular oil analyses during the oil use period.

In particular, monitor the water concentration of oil in gear units used outdoors or in damp places. The water concentration should not exceed 0.03% (300 ppm).

If a roll-back brake has a separate oil compartment, its oil must also be replaced every one (1) year.

Minimum purity level for lubrication oil

The purity of industrial gear oil is defined according to the ISO 4406 standard. The impurity level of a gear unit that has been in operation must be 20/17/14 (2/5/15 µm) or better. The oil sample is taken from the oil compartment immediately after stopping the gear unit, however not from the sump.

In pressure-feed lubricated units, the oil sample can be taken from the pressurised side before the filter through a sampling valve while the gear unit is in operation or immediately after stopping.

Significance of correct oil quantity

In spatter-lubricated industrial gear assemblies where the operating power is close to the thermal power, the correct amount of oil is of great importance. In certain cases, the operating temperature may rise +15…+20 ºC higher than normal because there is approximately 15% too much oil.

This will result in decreased lubrication capacity of the oil and, in the worst case, damage to the industrial gear assembly. If the oil surface is lower than the arrow that indicates the oil level, there is the risk that the gear wheel does not reach the oil and does not therefore splatter oil where lubrication is needed. In case of any leaks, the oil quantity and level must be carefully reviewed. Any leaks must be repaired.

Oil refill

The oil quality must be as recommended by us or identical, and the oil quantity must be correct. Each spatter-lubricated industrial gear assembly and those with a separate lubrication system are equipped with a plate that lists the oil types recommended for the assembly. These gear units also have an oil level indicator, an oil glass or a dipstick with a mark for the required oil level. The oil surface must reach to the marked level when the gear assembly is stopped and the pump, if any, and pipelines are full of oil. The oil fill must be done according to the oil level mark because the quantity marked on the plate is only a recommendation. It should be noted that it is often impossible to determine the correct level of oil while the gear assembly is in operation.

2.2.3 Secondary lubrication of grease-lubricated bearings

For grease-lubricated bearings, the free access of grease to the oil compartment has been prevented, and therefore there is little need for secondary lubrication. The first grease fill of the bearings has been carried out at our factory. The grease type we use is indicated on the grease recommendation plate in the gear unit, as are the alternative greases recommended by us.

In secondary lubrication objects, such as the bearing housing or cover, there is a grease nipple, which is marked with a plate. In most cases, it is sufficient to add grease during oil change. Beware of excessive greasing, as it will increase the operating temperature of the bearing. The secondary lubrication instructions are provided individually for each gear unit.

2.2.4 Oil heater maintenance

When the oil heater gets stained, it must be detached and cleaned during oil change. Always make sure that the heater is powered off before removing the oil. A heated resistor element may cause the gasified oil to explode. You can effectively prevent the staining of the resistor element as well as the aging and staining of the oil if the resistor element is powered off, according to instructions, at a temperature approximately +8…+10 ºC higher than the power-on temperature.

The resistor element may never be powered on when the oil temperature exceeds +40 ºC. The qualities of the additives in the oil will deteriorate at temperatures higher than this because of the surface temperature of the resistor element, accelerating the formation of an explosive gaseous mix.

2.2.5 Lubrication system maintenance

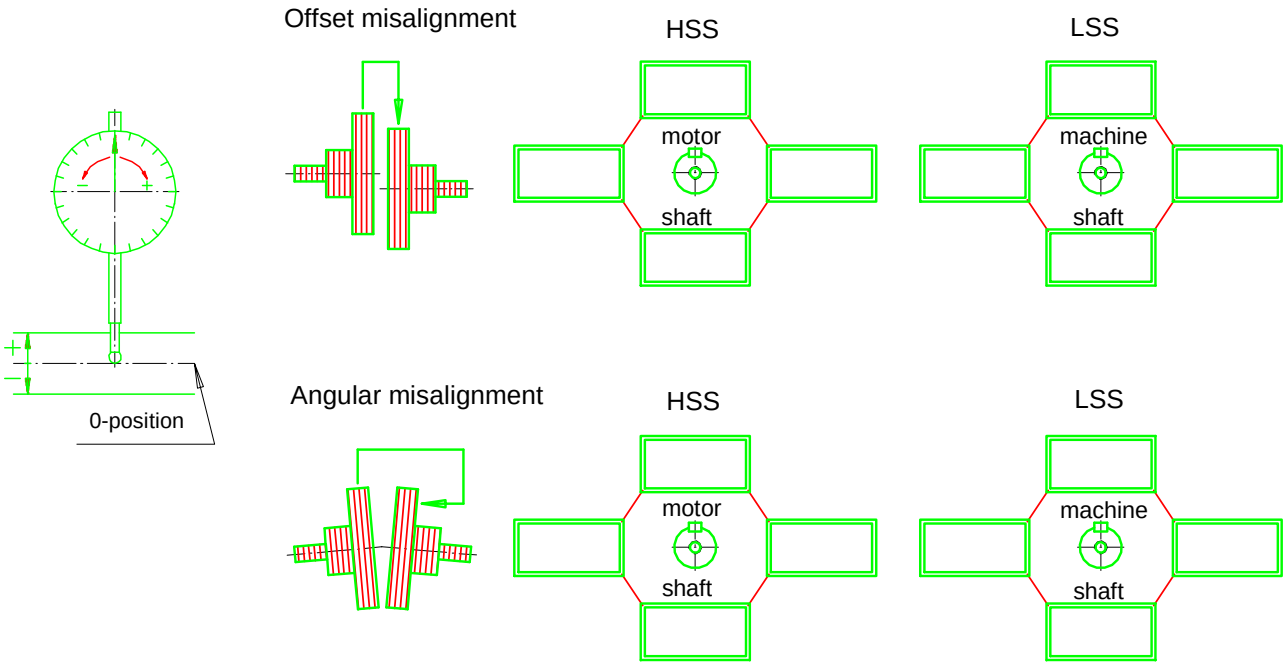
Parts that require maintenance and monitoring are the electrical lubrication pump, oil water cooler, filter and breather.

The most common maintenance task for electric pumps is external cleaning of the engine to attain thermal balance. If necessary, the fan must also be cleaned. In connection with the above, check the gear unit's breather and replace or clean it, if necessary.

During oil change, it is recommended that the oil water cooler be opened, checked and cleaned, if necessary. **A used filter element must always be replaced during oil change.**

ASSEMBLY REPORT

GEAR UNIT:	MANUF. NUMBER:
DRIVE:	



- ☐ Checked distance of coupling flanges _____ mm
- ☐ Measured assembly temperature _____ °C
- ☐ Height correction of shaft centres observed
- ☐ Grease filling completed / grease quality _____
- ☐ Gear unit fastened to foundation with pins

<u>Lubrication of gear unit</u>

Oil type:
- ☐ mineral
- ☐ synthetic
- ☐ VG class _____

- ☐ Gear unit connected to central lubrication
  flow _____ l/min
- ☐ Check of oil level height
- ☐ Operation of pressure lubrication
  _____ °C _____ bar

Date _____ Approved: _____