TOS ZNOJMO®

INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR GEARBOXES AND VARIATORS

- MRT..A / RT..A
- MKT / KT
- MRP
- MKP
- MAT
- MTC..A / TC..A
- ATC
- TNC
- KTM
- VARIATOR

TÜV MANAGEMENT SERVICE ISO 9001

Index

1. BASIC INFORMATION

1. 1 General Information

It is necessary to make yourself familiar with this Installation, Operation and Maintenance Manual before installing any gearbox or variator. It is further necessary to observe instructions and recommendations given in this Manual. The manufacturers cannot be held responsible for any damage to human health, animals, third party goods or properties caused by ignoring instructions and recommendations contained in this Manual or incorrect operation or use of any gearbox or variator. Consumables wearing out quickly such as shaft seals etc. are not covered by manufacturers‘ warranty. For more details see Terms and Conditions of Sale.

Instruction manual applicable for electric motors must be observed when gearboxes are supplied with electric motors fitted. Gearboxes and variators are tested and run-in at the manufactures prior to despatch.

If in doubts please contact TOS ZNOJMO.

NOTE!!!
Selection of individual gearboxes and variators for intended application is carried out using the catalogues containing information about individual types, parameters (e.g. permitted radial force F_{rad} or axial force F_{ax}, output torque T_2, efficiency etc.). The person responsible for gearbox installation must include the technical information into his documentation and include Installation, Operation and Maintenance Manual for Gearboxes and Variators as well as the installation manual related to electric motors and hand over this documentation to the end-user. Failing to do that incorrect operation can occur resulting in invalidation of the warranty.

1. 2 Use of Gearboxes and Variators

Gearboxes and variators generate revolving motion and are intended for installation in industrial equipment and machines. The mechanical connection between the Gearboxes and Variators and the driven equipment is as standard through hollow shaft or solid output shaft.

Gearboxes and Variators are suitable for use in ambient temperature range -20 °C to 40 °C in chemically inert environment, which does not effect their housing (made of aluminium alloy), do not effect the shaft seals or the paint finish.

Incomplete machinery equipment must not be put into operation unless compliance with European Parliament and Commission Directive No. 2006/42/ES (NV No. 176/2008 sb) about compliance of the complete equipment to which the gearboxes are to be installed is observed.

The Manufacturers‘ Declaration of the Installation of Incomplete Machinery Equipment with regards to the EU Directive No. 2006/42/ES (NV No. 176/2008 sb) can be provided upon request.

NOTE!!!
The operation in hazardous (ATEX classified) areas is not permitted.

2. HEALTH AND SAFETY

2. 1 Requirements

All manipulations such as transportation, storage, installation, commissioning, electrical supply, general and technical maintenance as well as repairs **can be carried out by qualified personnel only**. The manufacturers‘ recommendation is to let the repairs carried out by TOS ZNOJMO appointed service partners or at the manufacturers.

All Health and Safety instructions must be observed inclusive of those contained in the individual paragraphs of this Manual. All the national and local directives concerning Health and Safety in the country of installation must be observed.

2. 2 Hazard Warning

During the installation and maintenance: Installation and maintenance must be carried out on gearboxes, which are not in operation. The driving equipment must be switched off and secured against accidental initiation.

During transportation: Only installed eye bolts provided by the manufacturers can be used for lifting and transportation whilst no additional equipment must be fitted to the gearbox. The lifting and transportation equipment must have sufficient weight capacity. In case of electric motors being fitted to the gearboxes both eye bolt on the gearbox and the one on the electric motor must be employed when lifting. The eye bolts must not be subject to slant forces. Eye bolts must be screwed-in all the way in and tightened before use.

During installation and operation: Serious damage to human health, animals, third party goods or properties can be caused by improper installation and/or application, incorrect operation or when Health and Safety instruction are ignored.

2. 2. 1 Safety Couplings and Switches

When shock load operation is envisaged or when the gearboxes and variators are likely to get jammed or blocked through the load the use of safety switches or safety couplings must be considered. This safety measure needs to be considered in all cases when jamming and blocking cannot be ruled out. Serious damage to human health, animals, third party goods or properties can be caused by ignoring this recommendation.

2. 2. 2 Radial F_{rad} and Axial F_{ax} Loads

NOTE!!!
Installed equipment on both input and output shafts must not exceed the permitted radial and axial load specified in the catalogue of the relevant gearbox or variator. (permitted radial F_{rad} and axial F_{ax} forces). Especially when belts are used correct adjustment must be observed. Additional forces caused by imbalanced hubs are not permitted. Radial forces must be applied closest to the gearbox housing. Should the radial load be still high or should the radial force be applied on the shaft further away from the gearbox housing, external support bearings must be considered.

2. 3 Gearbox Noise

Acoustic Power level A when a weight filter A is used does not exceed 70 dB.

2. 3. 1 Noise Emission at Variators

Acoustic Power level A when a weight filter A is used in the range of 75–90 dB depending on the type of variator. At no load condition the noise is depending mainly on the execution, speed, output and application. When variators are used as part of the machinery equipment or when additional machinery equipment is installed in the same area the acoustic pressure can increase.

NOTE!!!
Test acoustic power of the entire machinery equipment.

NOTE!!!
Ear defenders must be worn at all times.

2. 4 Environmental Protection

NOTE!!!
Local laws and regulations must be observed.
Lubricants must be collected and disposed off in an approved way.

At the end of their useful life the gearboxes or variators must be disposed off observing the local laws and regulations about waste and liquidation of oil based substances so no damage to human health, animals or environment occurs. The gearboxes or variators must be disassembled at the end of their life and parts separated according to materials and lubricants and disposed off through an authorised company or firm.

Parts of Gearboxes or Variators	Material Used
Gears, shafts, bearings, shaft keys, hubs, couplings, chains, discs, worms	Steel
Gearbox or variators housings, flanges, rings, housings' parts	Cast iron
Gearbox alloy housings, flanges, housings' parts	Aluminium
Worm gears	Bronze
Shaft seals, lid seals, rubber elements	Elastomer and steel
Lubricants	Synthetic and mineral lubricants

2. 5 Further Information

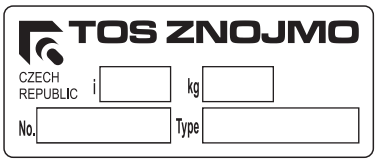
Further information can be obtained from the following documentation:
- Gearboxes and Variators catalogues
- Instruction and Operation Manual for electric motors
- Further written documentation related to special executions
- On manufacturers‘ website **www.tos-znojmo.cz**

3. TECHNICAL INFORMATION

3. 1 Gearbox Identification

Every gearbox is equipped with a nameplate with the following contents:

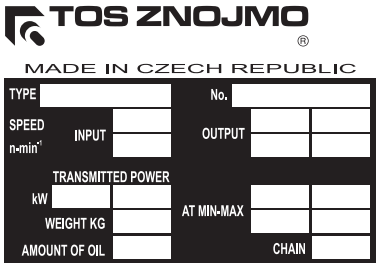
Type: gearbox type
kg: gearbox weight without electric motor
No: serial number
i: gear ratio



3.2 Variator Identification

Each variator is equipped with a nameplate with the following contents:

Type: variator type
No: serial number
Speed: input-input speed (n-min^{-1})
output speed (n-min^{-1})
Transferred power: min. max. (kW)
Torque: min. max. (Nm)
Weight: variator with motor fitted
Amount of oil: recommended quantity of oil
Chain: size of chain

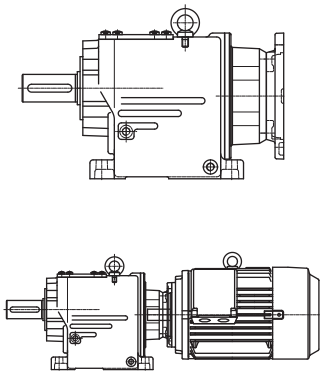


3. 3 Type Designation of Gearboxes and Variators

Worm Gearboxes	
MRT..A 28, 30, 40, 50, 60, 70, 80, 100, 120, 150, 180 **MKT 63, 75, 90**	Gearboxes with hollow input shaft in combination with a flange for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
RT..A 28, 30, 40, 50, 60, 70, 80, 100, 120, 150, 180 **KT 63, 75, 90**	Gearboxes with solid input shaft – without electric motor
MRP 28, 30, 40, 50, 60, 70, 80, 100, 120, 150, 180 **MKP 63, 75, 90**	Gearboxes with in-line step gearbox and hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
MAT	Gearboxes with ATC in-line step gearbox and hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
MRT..A × RT..A 28, 30, 40, 50, 60, 70, 80, 100, 120, 150, 180 **MKT × KT 63, 75, 90**	More gearboxes in mutual combination with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Coaxial Gearboxes (helical)	
Single-reduction **MTC..A / TC..A 11, 21, 31, 41**	Gearboxes with input and output shaft, execution with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Double-reduction **MTC..A / TC..A 02, 12, 22, 32, 43, 52, 62, 72, 82**	Gearboxes with input and output shaft, execution with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Triple-reduction **MTC..A / TC..A 23, 33, 43, 53, 63, 73, 83**	Gearboxes with input and output shaft, execution with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
ATC 40, 60	Gearboxes with solid output shaft and hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Shaft Mounted Spur Gearboxes	
Double-reduction **TNC 12, 22, 32, 42, 52, 62**	Gearboxes with input and output shaft, execution with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Triple-reduction **TNC 13, 23, 33, 43, 53, 63**	Gearboxes with input and output shaft, execution with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Triple-reduction **TNC 1B**	Gearboxes with solid output shaft and hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Right-angle Bevel Gearboxes	
Triple-reduction **KTM 33, 43, 53, 63**	Gearboxes with input and output shaft, execution with hollow input shaft for fitting flange mounted IM B14 (IM3681) electric motor or for complementing other flanged IEC equipment.
Variators	
Type: VA 0-6 B **1** – **** general purpose** **2** – **** with single gear drive** **3** – **** with double gear drive** **4** – **** with triple gear drive** **5** – **** with planetary gearbox** **6** – **** with shifting gear drive** **7** – **** with gear drive with conical gears** **8** – **** single worm gear drive** **9** – **** double worm gear drive**	Chain variators with automatic chain tensioning and speed regulation during operation in general purpose execution or equipped with input or output gear drive and other accessories. Mechanical connection with the driving and driven equipment is through solid shafts.

4. TRANSPORTATION AND STORAGE

Fig 4.1/1 Example of suspension eye bolts for manipulation



4. 1 Transportation and Manipulation

The gearboxes are as standard supplied filled with long term lubricant, without fastening screws and electrical installation material. Variators are supplied without lubricant. Gearboxes and variators are supplied in packaging securing them in position against free movement and conserved for 3 months duration when KORING conservation agent is applied. The packaging containing a gearbox or variator must not be subjected to vibration, tumbling or falls. Before unpacking the packaging needs to be examined for damage and integrity. Upon receipt of the gearbox or variator please check that they have not been damaged during transportation. Any damage must be documented and carrier advised as well as the supplier.
The suspension eye positioned at the top of gearbox housing is provided for manipulation. In case a gearbox is supplied fitted with an electric motor both gearbox and motor suspension eyes must be used for manipulation.
Local lifting and manipulation regulations must be observed when handling gearboxes and variators.

4. 2 Storage

4. 2. 1 Short-term Storage

The following points need to be observed in case of short term storage -lasting less than 3 months:

- Gearboxes must be stored in operation position (see paragraph 9.1) and must be secured against fall.
- Contacting surfaces need to be cleaned and shafts lubricated with conservation oil.
- Gearboxes must be stored in dry place.
- Temperature range -5 °C to +40 °C must be maintained.
- Relative humidity of 60 % must be maintained.
- Gearboxes must not be exposed to direct sun or UV radiation.
- Influence of aggressive or corrosive substances must be prevented (such as contaminated air, ozone, gas, solvents, acids, alkaloids, salts and nuclear radiation).
- Gearboxes must not be subject to vibration.

4. 2. 2 Long-term Storage

NOTE!!!
During a storage period longer than 3 months Long-term Storage instructions must be followed. Gearboxes or variators conserved in this way can be stored up to 12 months. The period of safe storage can be determined based on local conditions and the relevant environment (it is depending on local conditions).

Preparation of gearboxes or variators and storage area requirements for Long-term Storage up to 12 months and instructions for preparation before installation:

- Gearboxes must be stored in operation position (see paragraph 9.1) and must be secured against fall.
- Repair of damaged paint finish must be carried out. Contacting surfaces need to be cleaned and shafts lubricated with conservation oil.
- Gearboxes or variators must be filled with oil (see paragraph 11)
- Gearboxes or variators supplied without oil must be filled with recommended amount of oil. The recommended oils are listed in paragraph 9.4.
- Gearboxes equipped with a breather must have the breather replaced with a plug during the storage period.
- Gearboxes must be stored in dry place.
- Temperature range -5 °C to +40 °C must be maintained.
- Relative humidity of 60 % must be maintained.
- Gearboxes must not be exposed to direct sun or UV radiation.
- Influence of aggressive or corrosive substances must be prevented (such as contaminated air, ozon, gas, solvents, acids, alkaloids, salts and nuclear radiation).
- Gearboxes must not be subject to vibration.

NOTE!!!
The following points must be carried out before installation after a Long-term Storage period:

- **Replace the plug for a breather.**
- **Check all seals and shaft seals.**
- **Replace all damaged seals.**
- **Change the oil if the gearbox was subject to excessive ambient temperatures during storage period. The recommended amount of oil depending on gearbox positioning is summarised in paragraph 11. The recommended oils are listed in paragraph 9.4.**
- **After each Long-term Storage period and during any outage all seals must be repetitively checked for tightness. Seals can be damaged by long-term periods of inactivity and must be replaced.**

5. ADDITIONAL PAINTING

NOTE!!!
The following parts must not come in contact with paint, thinners, cleaning agents when additional painting is applied: Shaft seals, rubber parts, pressure relieve valves, nameplates, warning stickers and part of electric motor coupling. These parts can be damaged or become illegible.
Use paint, thinners and cleaning agents which will not interfere with the original paint finish.
Use of masking tape or other protection is necessary when spraying.
In case the sealing components are effected their sealing properties could be compromised.

6. GEARBOX OR VARIATOR INSTALLATION

6. 1 Preparation before installation

NOTE!!!
Installation preparation, installation and commissioning of a gearbox or variator can be carried out by qualified engineer authorised to carry out such work.

NOTE!!!
Gearboxes are supplied filled with oil as standard.

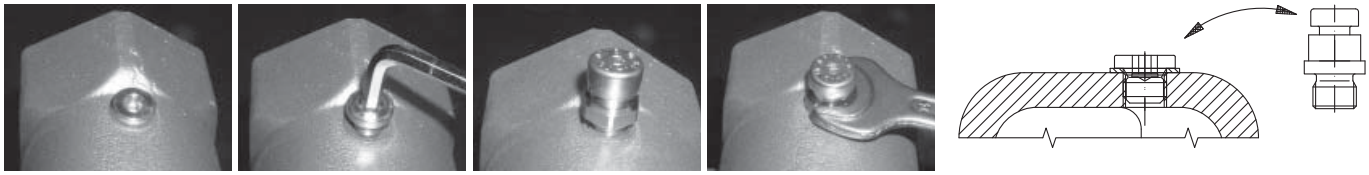
NOTE!!!
Variators are supplied without oil .

Check the gearbox or variator for damage before installation and proceed with the installation when no apparent damage can be observed. Pay special attention to shaft seals and lids. Make sure that no aggressive or corrosive agents are present at site or that they cannot develop during the operation. Interaction with substances effecting metal, aluminium alloys, lubricants and rubber must be prevented. If in doubts please contact the manufacturers for a consultation.

In case the breather is supplied separately it must be fitted to the gearbox (exchanged for the sealing plug) prior to commissioning (see Fig 6.1/1). Breather positioning depends on gearbox working position (see paragraph 9.1).

Oil level must be checked prior to commissioning at gearboxes equipped with oil gauges or dipstick.

Fig 6.1/1 Exchange of the transportation sealing plug for a breather.



NOTE!!!
Gearboxes and variators are equipped with suspension eyes for manipulation and installation.
Please observe Health and Safety instructions (see paragraph 4.1)

NOTE!!!
Gearboxes assembled in combinations consist of individual housings and have not only isolated oil compartments but also individual breathers.
Variators are supplied without oil.
Variators are supplied in lots of combinations, some of them have common oil compartment some have isolated oil compartments. For more information consult the nameplate (see paragraph 3.2)

NOTE!!!
Gearboxes and variators can get warmer during operation or due to the working environment. In these cases affixing signs “Caution – Hot Surface” is recommended. Where possible a screen or guard preventing contact with gearbox surfaces is recommended. The airflow from motor fan cooling the gearbox or variator must not be obstructed.

6. 1. 1 The following instructions must be observed before installation

1. The base or flange where the gearbox or variator will be fitted must be rigid, stable, plane and vibration free.
2. The planeliness of the contacting surface or flange must comply with DIN ISO 2768-2 class H.
3. Contacting surfaces must be free of impurities and protected against rust.
4. Holes in the driven equipment where the output shaft is fitted must be produced to ISO 8015 and tolerance H7.
5. Shafts of the driven equipment inserted in hollow output shafts must be produced to ISO 8015 and tolerance h6.

6. 2 Installation of a Gearbox or Variator

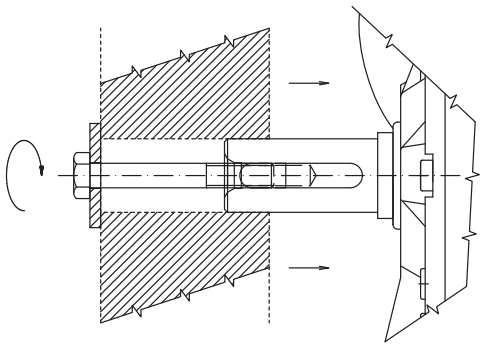
1. Gearboxes or variators must be precisely aligned with the shaft of the driven equipment without tension causing additional load to the gearbox.
2. Gearboxes or variators must be installed in the stipulated working position.
3. When the working position is changed it is necessary to re-position the breather and possibly to alter the amount of oil in the gearbox as per paragraph 9.1.
4. No welding is allowed on a gearbox or variator. Gearbox or variator must not serve as weight point for welding as bearings as well as internal parts can be damaged.
5. All holes in feet or flanges or torque reaction arms must be utilised when connecting a gearbox or variator. All screws or bolts used must be of 8.8 quality or better. All screws must be used and tightened with the recommended torque as outlined in Tab 9.2/1.
6. Good access must be maintained to reach to oil filling and oil checking plugs and breathers.
7. Gearboxes or variators must not be subject to high ambient temperatures, all heat sources affecting the gearboxes and variators must be screened or removed, no obstacles must be affecting the air stream around the gearboxes or variators.
8. Gearboxes or variators must be protected against direct sun and extreme weather conditions.
9. Rotating parts must be covered with suitable safety guard.
10. Local regulations and standards must be observed when connecting an electric motor to the mains. Operation Manual is supplied with each electric motor.

6. 3 Fitting of Hubs on the Shaft

NOTE!!!
Gearboxes must not be subject to axial forces during installation.
Special tools must be used when fitting the hubs.

Fitting of driving and output connecting hubs such as couplings and chains sprockets to input or output shafts of gearboxes or variators must be carried out using special tools so no unacceptable axial forces are applied on gearbox shafts. Do not use a hammer to force hubs to fit on the shaft. The tapped hole on the shaft is to be used for fitting hubs. In order to facilitate fitting the shaft and hub surfaces are to be lubricated and hub heated up to 100 °C.

Fig 6.3/1 Example of simple fitting tool



NOTE!!!
The parts fitted to input and/or output shafts must not develop greater radial and axial forces then the permitted radial F_{rad} and axial forces F_{ax} listed in the catalogue. Particular care must be taken when tensioning belts or chains. Additional forces caused by imbalanced hubs must be prevented. Radial forces must be applied as close as possible to the gearbox housing. Should the radial force be too great or the force be applied at the end of the shaft additional external bearing support must be considered.

6. 4 Installation of Shaft Mounted Gearbox

NOTE!!!
Incorrect installation can cause damage to bearings, gears, shafts and housings

The installation of shaft mounted gearbox must be carried out using a suitable tool so no damaging axial and radial forces develop during installation. Do not use a hammer to force a gearbox to fit on the shaft.

Mounting and dismantling of the gearbox can be facilitated by lubricating the shaft or hub prior to the installation. Such lubrication serves also as general as well as anti-corrosion protection.

For fitting of shaft mounted gearboxes please see paragraph 6.2.

7. GEARBOX OR VARIATOR COMMISSIONING

7. 1 Gearbox Commissioning

NOTE!!!
In order to achieve maximum efficiency at worm gearboxes the gearbox must run-in at 70–80 % load during 20–30 hour period.
Please note that lower efficiency will be achieved before running-in.

7. 1. 1 Gearbox Commissioning Check List

Commissioning Check List					
Inspection	**Related Paragraph**	**Yes/No**	**Checked by**	**Date**	**Signature**
Sealing plug exchanged for breather	paragraph. 6. 1				
Oil checked for quantity	paragraph 6. 1, 6. 2				
Required working position corresponds with actual working position	paragraph 6. 2				
Breather position corresponds with actual working position	paragraph 6. 2				
External forces applied on output shaft are within permitted limits (belts, chains)	paragraph 6. 3				
Torque reaction arm correctly fitted to gearbox	paragraph 6. 2				
Was the use of safety switch or coupling considered?	paragraph 2. 2. 1				
Need of safety switch or coupling established	paragraph 2. 2. 1				
Safety switch or coupling utilised	paragraph 2. 2. 1				
Safety switch or coupling checked for correct functioning	paragraph 2. 2. 1				
Rotating parts covered with safety guard	paragraph 6. 2				
Gearbox protected against direct sun and extreme weather conditions	paragraph 6. 2				
Gearbox protected against ambient heat	paragraph 6. 1				
User advised about possibility of overheating	paragraph 6. 1				

7. 2 Variator Commisisoning

NOTE!!!
The variator speed must be controlled only when the variator is running!
The variator need to be loaded progressively from min to max load when running.
The max power (kW) and torque (Nm) must not be exceeded – permitted data can be found on the nameplate.

NOTE!!!
Variators and their accessories are supplied without oil. The amount of oil needed can be found on the nameplate.

Variators are supplied after they have been run-in at the manufacturers. Should a variator be commissioned after long period of storage or inactivity or when a mechanical arrangement alters for some reason, it is necessary to check whether the pull springs pos. 25 are suspended and limit levers pos.43 are in initial position as shown on Fig 9.5.6/1.

The levers pos.43 should at this position have a movement between 2-3mm. If the movement is found to be greater than that the chain must be tensioned or adjusted as per paragraph 7.2.2.

NOTE!!!
In order to check on the chain adjustment or replacement the top lid containing the nameplate must be removed. When the lid is re-fitted both contacting surfaces must be cleaned, remains of the old seal removed, contacting surfaces de-greased and suitable sealing agent (such as LOCTITE) applied.
The lid must have all screws tightened (see Tab 9.2/1 for tightening torque).

7. 2. 1 Chain Adjustment Check

Check the movement of two limiting levers (see Fig 9.5.6/1 pos.43). Should the limiting lever pos. 43 be close to the indicator on the regulating lever and the chain be capable of further operation it must be tightened following paragraph 7.2.2. Damaged chain must be replaced (as described in paragraph 7.2.3). The wear of variator discs must be checked during chain replacement. Damaged discs must be replaced in pairs.

7. 2. 2 Chain Adjustment

Please refer to Fig 9.5.6/2. Release the screw pos.30, which is engaged with safety disc pos.13. Release the springs pos.25 from the holes in limiting levers pos.43 (see Fig 9.5.6/1). Shift the levers against the direction of the pull of the springs pos.25 until you reach the limit point. Turn with the safety disc pos.13 until the movement of limiting levers pos.43 is between 3-3mm. By simultaneous turning of the safety disc pos.13 turn the variator slowly until the chain is correctly positioned in-between the variator discs. Secure the disc pos.13 with the lock screw pos.30 and put the springs back in holes in the limiting levers pos.43. The variator is now prepared for operation.

7. 2. 3 Chain Replacement

Set the variator ration to 1:1. Release the screw pos.13 and turn the safety disc pos.13 (Fig 9.5.6/2) until the chain becomes loose. Remove the locking pin from the chain. Connect the new chain to the old chain and by pulling the old chain out introduce the new chain in the variator. Disconnect the old chain and use the locking pin to connect the new chain together. Release the springs pos.25 from the holes in limiting levers pos.43 (see Fig 9.5.6/1). Follow the Chain Adjustment procedure as described in paragraph 7.2.2.

7. 2. 4 Variator Commissioning Check List

Commissioning Check List					
Inspection	**Related Paragraph**	**Yes/No**	**Checked by**	**Date**	**Signature**
Check chain adjustment	paragraph 7. 2, 7. 2. 1				
Adjust chain tension	paragraph 7. 2, 7. 2. 2				
Variator filled with correct amount of oil. Oil level checked.	paragraph 3. 3, 6. 1, 6. 2				
Required working position corresponds with actual working position	paragraph 6. 2				
Breather position corresponds with actual working position	paragraph 6. 2				
External forces applied on output shaft are within permitted limits (belts, chains)	paragraph 6. 3				
Was the use of safety switch or coupling considered?	paragraph 2. 2. 1				
Need of safety switch or coupling established	paragraph 2. 2. 1				
Safety switch or coupling utilised	paragraph 2. 2. 1				
Safety switch or coupling checked for correct functioning	paragraph 2. 2. 1				
Rotating parts covered with safety guard	paragraph 6. 2				
Gearbox protected against direct sun and extreme weather conditions	paragraph 6. 2				
Gearbox protected against ambient heat	paragraph 6. 1				
User advised about possibility of overheating	paragraph 6. 1				

8. INSPECTION AND MAINTENANCE

8. 1 Inspection and Maintenance Intervals

Interval	Inspection and Maintenance	Paragraph
At least once a month	Visual inspection for cleanliness of the gearbox or variator surface (dust, other impurities)	paragraph 8. 2. 1
At least every 6 months	Visual inspection Check noise during operation Check oil level Check temperature rise Fill re-lubrication devices with grease (at gearboxes equipped with with re-lubrication devices)	paragraph 8. 2. 1 8. 2. 2 8. 2. 3
Every X operation hours or every 24 months	Oil change This interval is to be shortened if gearbox is operating under extreme conditions (high humidity, aggressive environment, extreme temperature changes)	paragraph 9. 4
Every 10 years	Complete overhaul This interval is to be shortened if gearbox is operating under extreme conditions (high humidity, aggressive environment, extreme temperature changes)	paragraph 8. 4

8. 2 Inspection and Maintenance Activities

NOTE!!!
The inspection and maintenance can be carried out by qualified personnel only.
Dismantling and servicing can be carried out on equipment which is not in operation.
The equipment must be isolated from electrical supply and measures must be taken preventing accidental connection to the mains during the maintenance.

8. 2. 1 Visual Inspection

Check the surface of a gearbox or variator for cleanliness. Any dust/dirt layer must not be greater than 1mm.

Check a gearbox or variator for mechanical damage. Check the resilient mounting blocks if they are utilised. Should an oil leak be detected or mechanical damage detected it is necessary to overhaul the gearbox. In this instance please contact a supplier service agent or the manufacturers.

NOTE!!!
The presence of oil around the lips of oil seals is not a sign of damage as the shafts are oiled during mounting. The shafts/oil seals must not be operated unless the surface under the seals' lips is lubricated.

8. 2. 2 Noise Inspection during Operation

Should excessive noise or excessive vibrations or excessive temperature rise of a gearbox or variator be detected there is a possibility that the gearbox or variator can be subject to damage. In this instance the gearbox or variator must be dismantled and overhauled.

8. 2. 3 Oil level Inspection

Variators unlike gearboxes are supplied without oil equipped with an oil gauge.
The gearboxes are supplied filled with oil suitable for long term operation unless it is not agreed differently (see paragraph 11). At gearboxes and variators combinations oil must be inspected in each housing. At gearboxes, which are not equipped with oil check plugs oil level does not need to be inspected.

1. Oil can be inspected only when the gearbox or variator is not in operation.
   Measures must be taken preventing accidental introduction of the gearbox into operation during maintenance.
2. At gearboxes and variators equipped with an oil gauge the oil level is to be maintained at the central position.
3. Oil used for topping up must be the same as the original oil used for filling up (see paragraph 11 and paragraph 3.2)

Re-greasing
Some gearboxes are supplied with bearings with re-greasing facility.

8. 3 Oil change

NOTE!!!
Synthetic and mineral lubricants must not be mixed. In case of change of type or make of oil the gearbox must be rinsed and cleaned.

NOTE!!!
Gearboxes are supplied filled with oil suitable for long term operation (synthetic oil) as standard so frequent oil changes are not necessary.

NOTE!!!
Variators must have the oil changed after the first 500 hours of operation and then after every 1000 hours of operation. The amount of oil can be found on the nameplate.

NOTE!!!
Gearboxes can be filled with oil requiring frequent changes if specified by the customer. See paragraph 11.

8. 3. 1 Oil Change

1. Oil can be changed only when a gearbox or variator is not in operation.
2. Measures must be taken preventing accidental introduction of the gearbox into operation during the oil change.
3. Place a suitable vessel under the drain hole.
4. Unscrew the inspection or drain plug.
5. Make sure that the entire volume of oil is drained off.
6. Rinse the gearbox with rinsing oil.
7. Put the inspection or drain plug back in and tighten it using recommended torque (see Tab 9/2/1)
8. Using the filling hole fill the required amount of oil into the gearbox.

8. 4 Overhauling

RECCOMENDATION!!!
A gearbox overhaul should be carried out at specialised service agent who have necessary tooling as well as qualified personnel available. It is recommended that the overhaul is carried out at the supplier or manufacturer who perform warranty repairs.

Before an overhaul the gearbox must be totally dismantled off the machinery equipment in order to establish the wear of individual parts.
• All bearings must always be changed
• All seals and shaft seals, covering rigs and lids must always be changed.

9. ATTACHMENTS

9. 1 Mounting (Working) Positions

9. 1. 1 Mounting Positions – Worm Gearboxes

Fig 9.1.1/1 MRT/RT Mounting positions

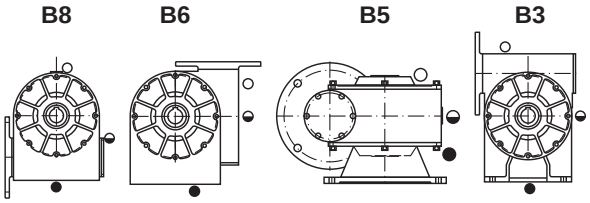
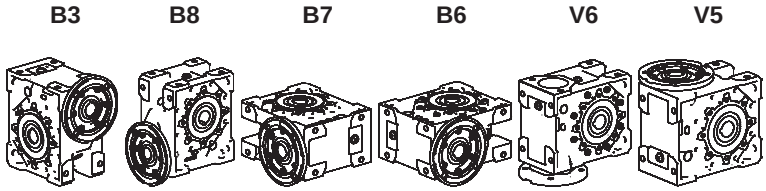


Fig 9.1.1/1 MKT/KT Mounting positions



9. 1. 2 Mounting Positions – Coaxial Gearboxes (helical)

Fig 9.1.2/1 MTC..A/TC..A Mounting positions

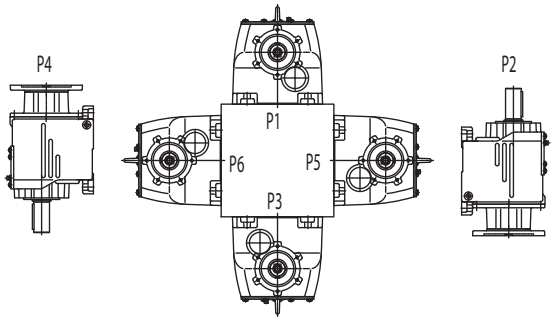
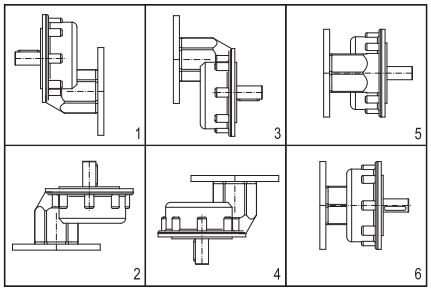
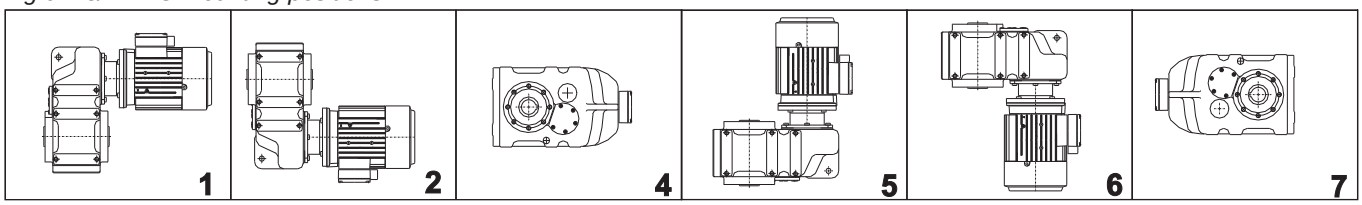


Fig 9.1.2/2 ATC Mounting positions



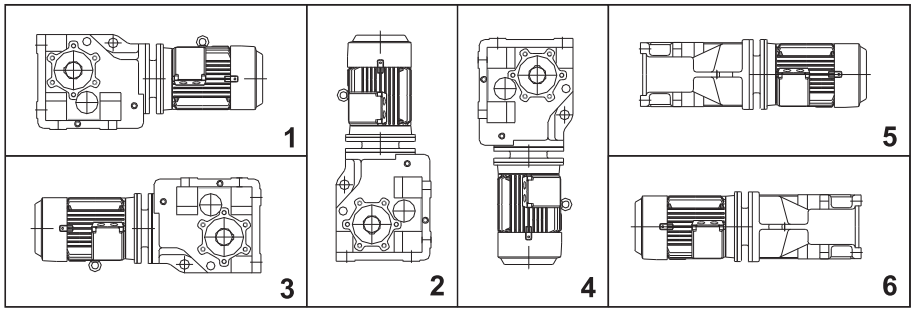
9. 1. 3 Mounting Positions – Shaft Mounted Spur Gearboxes

Fig 9.1.3/1 TNC Mounting positions



9. 1. 4 Mounting Positions – Right-angle Bevel Gearboxes

Fig 9.1.4/1 KTM Mounting positions



9. 1. 5 Mounting Positions – Variators

Working positions of variators are determined by feet. A variator can be mounted in upright, suspended and horizontal positions only.

Fig 9.1.5/1 Upright position

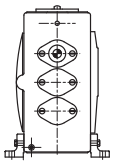


Fig 9.1.5/2 Suspended position

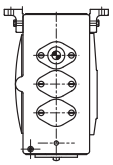
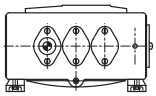


Fig 9.1.5/3 Horizontal position



9. 2 Screw Tightening Torque

Tab 9.2/1 Tightening Torque

Tightening Torque (Nm)				
Screw size ø (mm)	Strength Grades of Screws and Bolts			Sealing caps (for transport) and Breathers
	8.8	10.9	12.9	
M4	3,2	5	6	–
M5	6,4	9	11	–
M6	11,0	16	19	–
M8	27,0	39	46	–
M10	53,0	78	91	8
M12	92,0	135	155	10
M16	230,0	335	390	12
M20	460,0	660	770	–
M24	790,0	1150	1300	–
M30	1600,0	2250	2650	–
M36	2780,0	3910	4710	–
M42	4470,0	6290	7540	–

9. 3 Troubleshooting

NOTE!!!
Should a gearbox or variator get damaged it must be removed from the operation immediately.

9. 3. 1 Troubleshooting – Gearboxes

Fault	Possible cause of Fault	Troubleshooting
Excessive noise, vibration	Lack of oil, damaged bearings, damaged gears	Call your service agent or TOS Znojmo
Gearbox is overheating	Incorrect gearbox positioning, general fault, overloading	Call your service agent or TOS Znojmo
Shocks at startup, vibration	Damaged coupling, connection between motor and gearbox, gearbox mounting	Change coupling, tighten screws connecting motor and gearbox, tighten gearbox mounting screws
Oil leak	Damaged seal	Call your service agent or TOS Znojmo
Oil leak through breather	Incorrect amount of oil, incorrect oil, incorrect mounting (working) position	Change oil or breather, change working position or breather position
Output shaft does not turn whereas input shaft does	Damaged gears	Call your service agent or TOS Znojmo
Oil leak through shaft seal	Damaged shaft seal	Change the shaft seal

9. 3. 2 Troubleshooting – Variators

Fault	Possible cause of Fault	Troubleshooting
Excessive noise, vibration	Lack of oil, damaged bearings, damaged chain or disc	Call your service agent or TOS Znojmo
Gearbox is overheating	Incorrect variator positioning, general fault, overloading	Call your service agent or TOS Znojmo
Shocks at startup, vibration	Damaged coupling, connection between motor and variator, variator mounting	Change coupling, tighten screws connecting motor and variator, tighten variator mounting screws, adjust or replace chain and discs
Oil leak	Damaged seal	Call your service agent or TOS Znojmo
Oil leak through breather	Incorrect amount of oil, incorrect oil, incorrect mounting (working) position	Change oil or breather, change working position or breather position
Output shaft does not turn whereas input shaft does	Damaged gears, damaged or loose chain, damaged discs	Call your service agent or TOS Znojmo
Oil leak through shaft seal	Damaged shaft seal	Change the shaft seal

9. 4 Lubricants

Tab 9.4/1 – Oils

OIL TYPE	GEAR TYPE	To [°C]	SHELL	MOBIL	ARAL	KLÜBER	BP
Mineral oil						klüberoil	BP Energol
CLP VG100	Coaxial, Bevel	-20…+25	Shell Omala 100	Mobilgear 629	Degol BG 100	GEM 1-100	GR-XP100
CLP VG100	Worm	-20…+10	Shell Omala 100	Mobilgear 629	Degol BG 100	GEM 1-100	GR-XP100
CLP VG220	Coaxial, Bevel	-10…+40	Shell Omala 220	Mobilgear 630	Degol BG 220	GEM 1-220	GR-XP220
CLP VG680	Worm	0…+40	Shell Omala 480	Mobilgear 636	Degol BG 680	GEM 1-680	GR-XP680
Synthetic oil-PG						klübersynth	BP Enersyn
PGLP VG220	Coaxial, Bevel	-25…+80	Shell Tivela S220	Glygoyle 30	Degol GS 220	GH 6-220	SG-XP 220
PGLP VG220	Worm	-25…+20	Shell Tivela S220	Glygoyle 30	Degol GS 220	GH 6-220	SG-XP 220
PGLP VG460	Worm	-20…+60	Shell Tivela S460	Glygoyle HE460	Degol GS 460	GH 6-460	SG-XP 460
Synthetic oil-HC				Mobilgear		klübersynth	BP Enersyn
CLP HC VG220	Coaxial, Bevel	-40…+80	Shell Omala HD220	SHC XMP220	Degol PAS 220	EG 4-220	HTX 220
CLP HC VG460	Worm	-30…+80	Shell Omala HD460	SHC XMP460	Degol PAS 460	EG 4-460	HTX 460
Synthetic oil for food processing				Mobil		klüberoil	BP Energol
USDA-H1 VG220	Coaxial, Bevel	-30…+40	Shell Cassida GL220	DTE FM 220	Eural Gear 220	4 UH 1-220	GR-FG 220
USDA-H1 VG460	Worm	-30…+40	Shell Cassida GL460	DTE FM 460	Eural Gear 460	4 UH 1-460	GR-FG 460

Tab 9.4/2 – Oil Change Intervals – Mineral Oils

Operation Temperature (°C)	Operation	Oil Change Interval (hours)	Oil Change Interval (latest)
< 60	Continuous	4000	24 months
< 60	Intermittent	6000	24 months
> 60	Continuous	2000	24 months
> 60	Intermittent	4000	24 months

Tab 9.4/2 – Oil Change Intervals – Synthetic Oils

Operation Temperature (°C)	Operation	Oil Change Interval (hours)	Oil Change Interval (latest)
< 60	Continuous	10000	24 months
< 60	Intermittent	12000	24 months
> 60	Continuous	7000	24 months
> 60	Intermittent	9000	24 months

9. 4. 1 Amount of Oil in Worm Gearboxes

Tab 9.4.1/1 Amount of oil

Type	Amount of oil (L)		Type	Amount of oil (L)	Type	Amount of oil (L)
	G/box	Step G/box				
MRP 40	0,13	0,05	**MRT/RT 28A**	0,02	**MKT/KT 63**	0,4
MRP 50	0,21	0,05	**MRT/RT 30A**	0,04	**MKT/KT 75**	0,6
MRP 60	0,36	0,15	**MRT/RT 40A**	0,13	**MKT/KT 90**	1,2
MRP 70	0,46	0,20	**MRT/RT 50A**	0,21		
MRP 80	0,70	0,20	**MRT/RT 60A**	0,36		
MRP 100	1,60	0,30	**MRT/RT 70A**	0,46		
MRP 120	2,20	0,40	**MRT/RT 80A**	0,70		
MRP 150	4,00	0,30	**MRT/RT 100A**	1,60		
MRP 180	7,00	0,30	**MRT/RT 120A**	2,20		
			MRT/RT 150A	4,00		
			MRT/RT 180A	7,00		

9. 4. 2 Amount of Oil in Coaxial Gearboxes (helical)

Tab 9.4.2/1 Amount of oil related to mounting positions

OIL (L)	Mounting Positions					
Type	**Position 1**	**Position 2**	**Position 3**	**Position 4**	**Position 5**	**Position 6**
MTC/TC 0*A	0,20	0,35	0,25	0,30	0,25	0,25
MTC/TC 1*A	0,25	0,40	0,27	0,35	0,27	0,27
MTC/TC 2*A	0,35	0,60	0,30	0,70	0,40	0,40
MTC/TC 3*A	0,70	1,20	0,70	1,30	0,80	0,80
MTC/TC 4*A	1,60	2,80	2,00	2,50	1,60	1,60
MTC/TC 5*A	2,30	3,40	3,00	3,20	2,30	2,30
MTC/TC 6*A	5,00	7,50	6,50	7,00	6,50	6,50
MTC/TC 7*A	8,00	12,00	10,00	12,50	10,00	10,00
MTC/TC 8*A	10,00	12,00	12,00	13,50	12,00	12,00

Tab 9.4.2/2 Amount of oil related to mounting positions

OIL (L)	Mounting Positions					
Type	**Position 1**	**Position 2**	**Position 3**	**Position 4**	**Position 5**	**Position 6**
ATC 40	0,06	0,07	0,06	0,07	0,07	0,07
ATC 60	0,08	0,09	0,08	0,09	0,09	0,09

9. 4. 3 Amount of Oil in Shaft Mounted Spur Gearboxes

Tab 9.4.3/1 Amount of oil related to mounting positions

OIL (L)	Mounting Positions					
Type	**Position 1**	**Position 2**	**Position 3**	**Position 4**	**Position 5**	**Position 6**
TNC 1*A	0,70	0,70	0,70	0,70	0,70	0,70
TNC 2*A	1,20	1,20	1,20	1,20	1,20	1,20
TNC 3*A	2,20	2,20	2,20	2,20	2,20	2,20
TNC 4*A	3,00	3,00	3,00	3,00	3,00	3,00
TNC 5*A	7,50	7,50	7,50	7,50	7,50	7,50
TNC 6*A	17,00	17,00	17,00	17,00	17,00	17,00
TNC 1B	0,45	0,45	0,45	0,45	0,45	0,45

9. 4. 4 Amount of Oil in Right-angle Bevel Gearboxes

Tab 9.4.4/1 Amount of oil related to mounting positions

OIL (L)	Mounting Positions					
Type	**Position 1**	**Position 2**	**Position 3**	**Position 4**	**Position 5**	**Position 6**
KTM 33	1,0	1,5	1,5	1,5	1,0	1,0
KTM 43	2,0	3,0	3,0	3,0	2,0	2,0
KTM 53	1,8	3,9	3,9	3,9	3,9	3,9
KTM 63	3,0	7,5	7,5	7,5	7,5	7,5
KTM 20A	0,4	0,4	0,4	0,6	0,4	0,4
KTM 25A	0,7	0,7	0,7	1,0	0,9	0,9
KTM 30A	1,1	1,3	1,1	1,4	1,2	1,2

9. 4. 5 Amount of Oil in Variators

The amount of oil can be found on the nameplate.

9. 5 Spare Parts

9. 5. 1 Spare Parts – Worm Gearboxes

Fig 9.5.1/1 Spare parts-Worm gearboxes MRT/RT

1. Housing
2. FT Flange
3. Oil seal
4. Bearing
5. Worm gear
6. NBR Lid
7. Circlip
8. Circlip
9. Bearing
10. Worm
11. Bearing
12. Oil seal
13. Input flange
14. Bearing
15. Worm RT
16. Bearing
17. Oil seal
18. Lid RT
19. FF Flange-adapter
20. Foot-adapter
21. Torque reaction arm
22. Output shaft single-sided
23. Output shaft double-sided

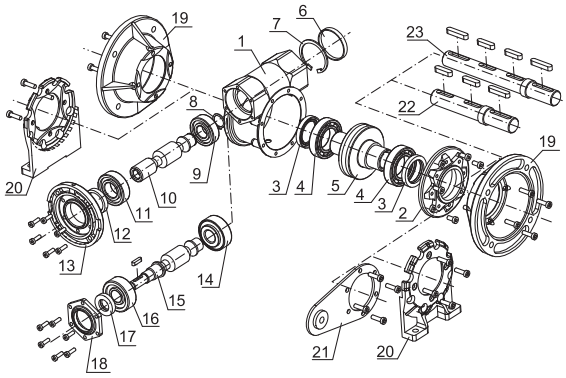


Fig 9.5.1/2 Spare parts-Worm gearboxes MRP

1. Housing
2. Bearing
3. Oil seal
4. Step-gearbox gear
5. Circlip
6. Bearing
7. Circlip
8. Step-gearbox pinion
9. Oil seal
10. Flange
11. Bearing
12. Step gearbox housing
13. Worm gear
14. Bearing
15. Circlip
16. NBR Lid
17. Circlip

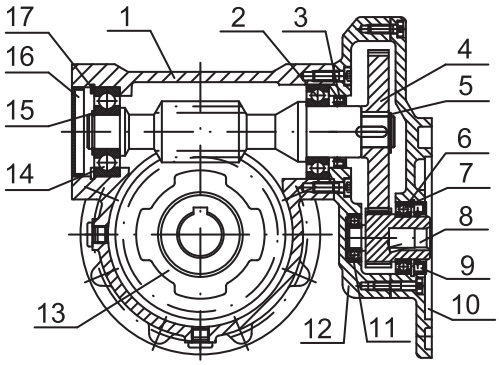
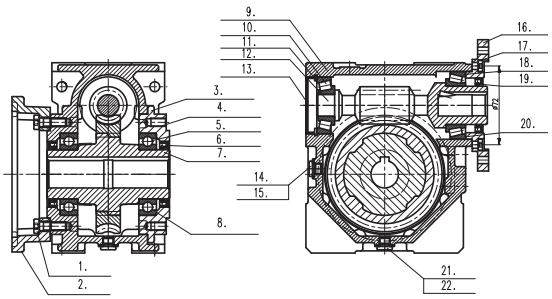


Fig 9.5.1/3 Spare parts-Worm gearboxes MKT/KT

1. Screw
2. FF Flange - Adapter
3. FT Flange - Adapter
4. Screw
5. Bearing
6. Oil seal
7. Worm gear
8. Shim
9. Housing
10. Bearing
11. Ring
12. Worm
13. Lid
14. Plug
15. Washer
16. Input flange
17. Screw
18. Bearing
19. Oil seal
20. Shim
21. Plug
22. Washer



9. 5. 2 Accessories

The hollow output shaft can accommodate single-sided or double-sided solid output shaft. These shafts are supplied fitted with shaft keys and with fastening screw and washer where appropriate. The double-sided output shaft (shaft II) is supplied with a circlip to secure the shaft in position in the gearbox hollow shaft.

Fig 9.5.2/1 – Solid single-sided output shaft (I) and solid double-sided output shaft (II) – for MRT/RT

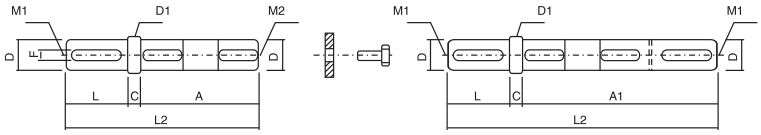
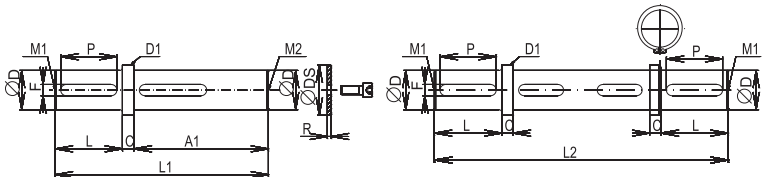


Fig 9.5.2/1 – Solid single-sided output shaft (I) and solid double-sided output shaft (II) – for MKT/KT



9. 5. 3 Spare parts – Coaxial Gearboxes (helical)

Fig 9.5.3/1 Spare parts-Coaxial Gearboxes (helical) MTC..A/TC..A

1. Housing
2. Lid II
3. Input flange
4. Top lid
5. Output shaft
6. Shaft key
7. Oil seal
8. Circlip
9. Bearing
10. Shim
11. Shaft key
12. Gear
13. Bearing
14. Circlip
15. NBR Lid
16. Circlip
17. Bearing
18. Shaft with pinion
19. Shim
20. Bearing
21. Shaft key
22. Gear II
23. Circlip
24. Circlip
25. Bearing
26. Shaft with pinion II
27. Shaft key
28. Gear I
29. Bearing
30. Circlip
31. Pinion I
32. Bearing
33. coupling
34. bearing
35. Circlip
36. Oil seal
37. Screw
38. Breather
39. Suspension eye
40. Screw
41. Screw
42. Plug DIN908
43. Output flange
44. Screw
45. Circlip

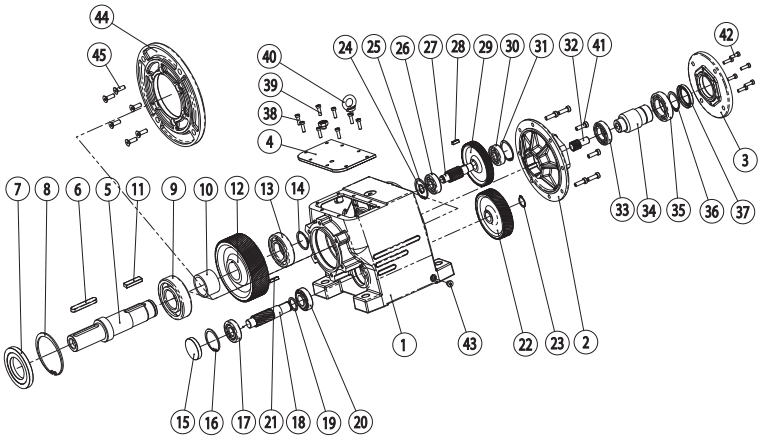
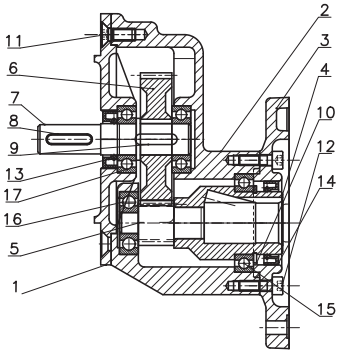


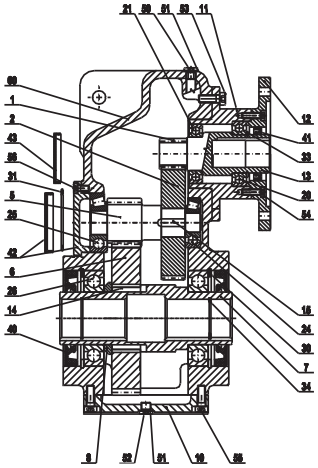
Fig 9.5.3/2 Spare parts-Spur gearboxes ATC

1. Lid
2. Housing
3. Output flange
4. Coupling
5. Pinion
6. Gear
7. Shaft
8. Shaft key
9. Shaft key
10. Circlip
11. Screw
12. Screw
13. Shaft seal
14. Shaft seal
15. Bearing
16. Bearing
17. Bearing



9. 5. 4 Spare parts – Shaft Mounted Spur Gearboxes

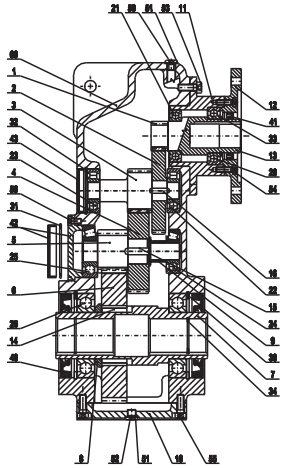
Fig 9.5.4/1
Spare parts-Shaft Mounted g/boxes TNC – double-reduction



1. Pinion
2. Gear I
3. Shaft with pinion II
4. Gear II
5. Shaft with pinion III
6. Gear III
7. Hollow output shaft
8. Shim
9. Ring
10. Housing lid
11. Reduction
12. Flange
13. Coupling
14. Shaft key
15. Shaft key
16. Shaft key
20. Bearing
21. Bearing
22. Bearing
23. Bearing

Fig 9.5.4/2
Spare parts-Shaft Mounted g/boxes TNC – triple-reduction

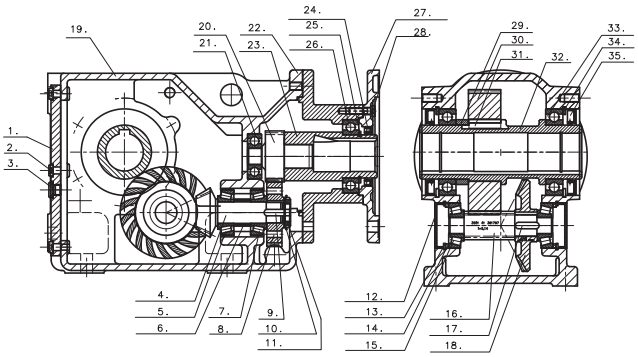
24. Bearing
25. Bearing
26. Bearing
30. Circlip
31. Circlip
32. Circlip
33. Circlip
34. Circlip
40. Shaft seal
41. Shaft seal
42. Lid
43. Lid
50. Breather
51. Plug
52. Sealing
53. Screw
54. Screw
55. Screw
56. Screw
60. Housing



9. 5. 5 Spare parts – Right-angle Bevel Gearboxes

Fig 9.5.5/1 Spare parts-Right-angle bevel gearboxes KTM

1. Screw
2. Lid
3. Plug
4. Bevel gear
5. Bearing
6. Shim
7. Bearing
8. Gear I
9. Shaft key
10. Safety washer
11. KM nut
12. NBR lid
13. Circlip
14. Shim
15. Bearing
16. Pinion
17. Shaft key
18. Bevel gear
19. Housing
20. Pinion
21. Bearing
22. Flange
23. Coupling
24. Oil seal
25. Circlip
26. Bearing
27. Input flange
28. Screw
29. Ring
30. Gear III
31. Shaft key
32. Shaft
33. Bearing
34. Circlip
35. Oil seal



9. 5. 6 Spare parts – Variators

Fig 9.5.6/1 Spare parts-Variators (and belt adjustment)

1. Disconnect
2. Shaft
3. Shaft key
4. Flange
5. Flange
6. Chain
7. Ring
8. Lever 8.1 Lever
9. Washer
10. Top pin-left tread
11. Top pin-right tread
12. Screw-central
13. Safety disc
14. Insert

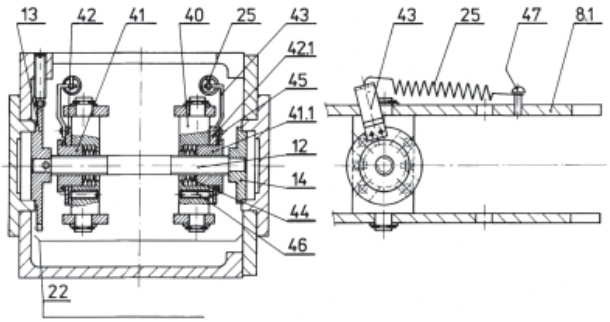
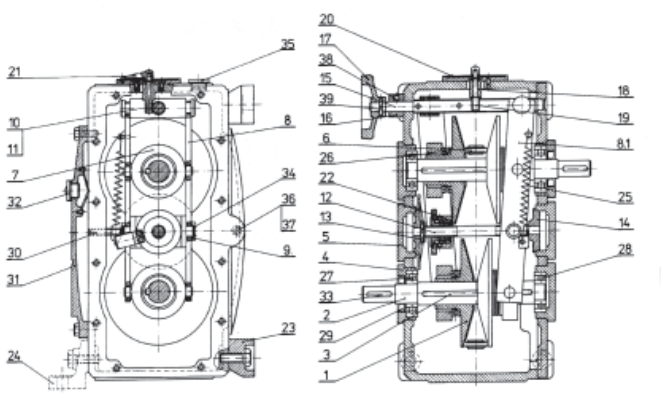


Fig 9.5.6/2 Spare parts-Variators

15. Regulation screw
16. Bearing
17. Hand wheel
18. Flange
19. Pinion
20. Indicator disc
21. Indicator hand
22. Yoke-free tensioning
23. Horizontal foot
24. Vertical foot
25. Spring
26. Bearing
27. Bearing
28. Bearing
29. Oil seal
30. Safety screw
31. Lid
32. Breather
33. Shaft key
34. Circlip
35. Oil gauge
36. Plug
37. Washer
38. Screw
39. Pin
40. Shaft
41. Nut -right
41.1 Nut -left
42. Limit I
42.1. Limit II
43. Limit lever
44. Dish spring
45. Dish spring
46. Screw
47. Rivet



10. WARRANTY

Warranty is provided in compliance with the laws and regulations of the Czech Republic (Commercial Code 513/91) as amended (see the Sales Agreement).

Invalidation of Warranty occurs when a gearbox or variator utilisation conflict with the Installation, Operation and Maintenance Manual for Gearboxes and Variators or when a gearbox or variator has been tampered with.

Manufacturing as well as the Final Release Inspection have been governed by ISO 9001:2008.

11. COMPLETION CERTIFICATE

Product Type: . . . . . .

Order Number: . . . . . .

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Serial Number: . . . . . .

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Lubricant: . . . . . .

Release Inspection Date: Inspected by: