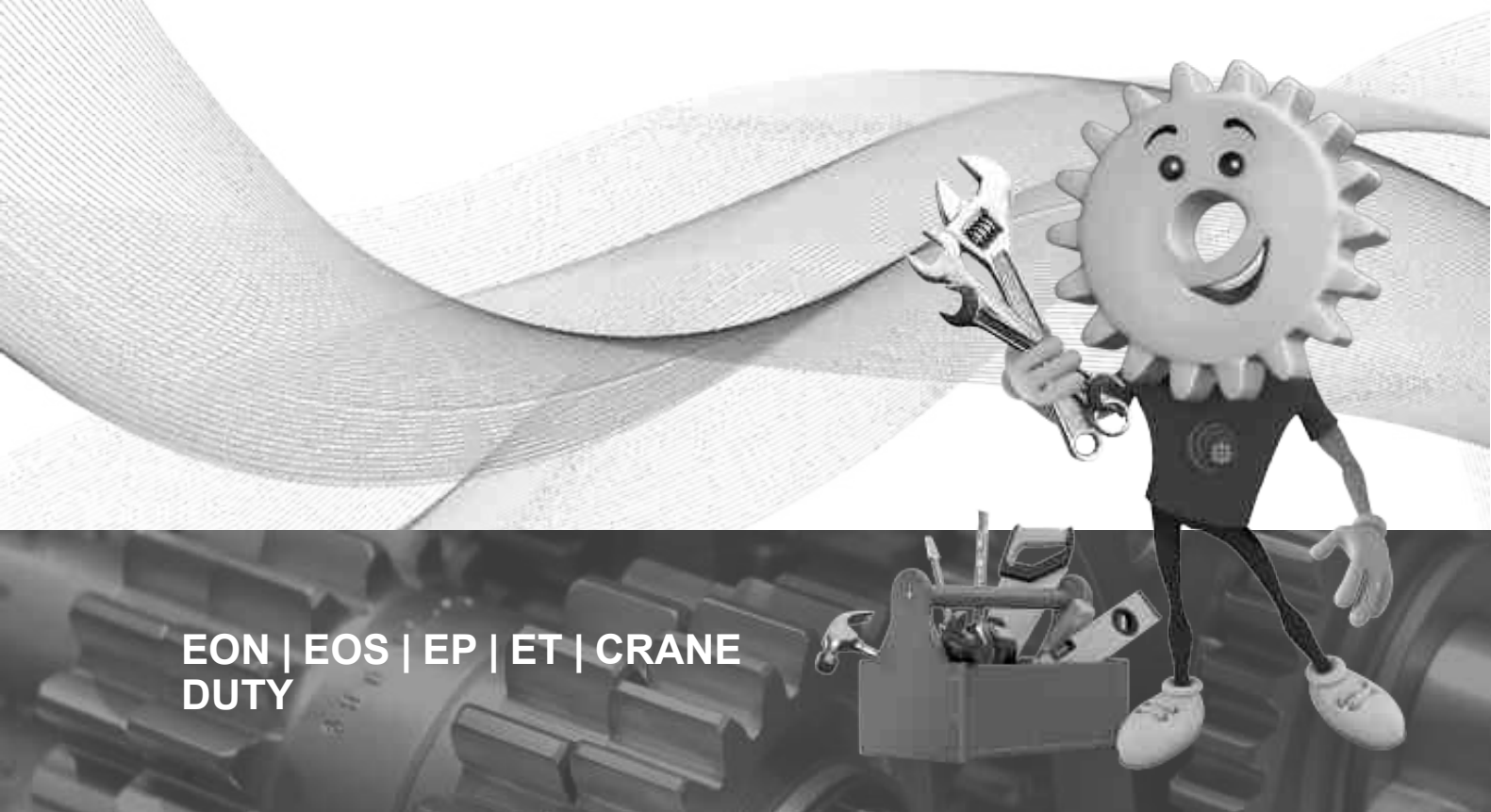


OPERATING INSTRUCTION AND MAINTENANCE MANUAL



**EON | EOS | EP | ET | CRANE
DUTY**



PRODUCT SAFETY INFORMATION

Important

General: The following information is important in ensuring safety. It must be brought to the attention of personnel involved in the selection of power transmission equipment, those responsible for design of machinery in which it is to be incorporated and those involved in its installation, use and maintenance.

ELECON equipment(s) will operate safely provided it is selected, installed, used and maintained properly. For any power transmission equipment, proper precautions must be taken as indicated in the following paragraphs, to ensure safety.

Potential hazards: These are not necessarily listed in any order of severity as the degree of danger varies in individual circumstances. It is important, therefore, that the list is studied entirely.

1. Fire or explosion

- a. Oil mists and vapor are generated within gearbox. It is, therefore, dangerous to use naked lights in the proximity of gearbox openings, due to the risk of fire or explosion.
- b. In the event of fire or serious overheating (over 150°C), certain materials (rubber, plastics, etc.) may decompose and produce fumes. Care should be taken to avoid exposure to the fumes and the remains of burned or overheated plastic or rubber materials should be handled with rubber gloves.

2. Guards

Rotating shafts and couplings must be guarded to eliminate the possibility of physical contact or entanglement of clothing. It should be of rigid construction and firmly secured.

3. Noise

The gearbox and driven machinery may produce noise levels when operated at higher speeds, which are damaging to the hearing with prolonged exposure. Ear plug should be provided to personnel in these circumstances. Department of health and safety should ensure reducing exposure to noise for employees working under such condition.

4. Lifting

Lifting points or eyebolts must be used for lifting operations (see transport and storage instructions or general arrangement drawing for lifting point positions). Failure to use the lifting points provided may result in personal injury and/or damage to the product or surrounding equipment. Keep clear of raised equipment.

5. Lubrication and lubricants

- a. Prolonged contact with lubricants can be detrimental to the skin. The manufacturer's instruction must be followed when handling lubricants.
 - b. The lubricants status of the equipment must be checked before commissioning. Follow the name plate directives and also in the installation and maintenance literature. Pay attention to all warning tags. Failure to do so could result in mechanical damage and in extreme cases risk of injury to personnel.
6. Electrical equipment
- Observe hazards warnings on electrical equipment and isolate power before working on the gearbox or associated equipment in order to prevent the machinery being started.
7. Installation, maintenance and storage
- a. In the event that equipment is to be held in storage, for a period exceeding 6 months, prior to installation or commissioning, manufacturer must be consulted regarding special preservation requirement. Unless otherwise agreed, equipment must be stored in a building protected from extremes of temperature and humidity to prevent deterioration. The rotating components (gears and shafts) must be turned a few revolutions once a month (to prevent rusting or jamming of bearings).
 - b. External gearbox components may be supplied with preservative material applied, gloves should be worn when removing these materials.
 - c. Installation must be performed in accordance with the manufacturer's instructions and be undertaken by qualified personnel.
 - d. Before working on gearbox or associate equipment, ensure that the load has been removed from the system to eliminate possibility of any movement of the machinery and isolate power supply. Where necessary, provide mechanical means to ensure the machinery cannot move or rotate. Ensure removal of such devices after work is complete.
8. Hot surfaces and lubricants
- a. During operation, the gearbox may become hot to cause skin burns. Care must be taken to avoid accidental contact.
 - b. After extended running the lubricant in gearbox and lube system may reach temperature sufficient to cause burns. Allow equipment to cool before servicing or performing adjustments.
9. Selection and design
- a. Where the gearbox provided a backstop facility, ensure that back-up systems are provided if failure of the backstop device would endanger personnel or result in damage.
 - b. The driving and driven equipment must be correctly selected to ensure that the complete machinery installation will perform satisfactorily, avoiding system critical speeds, system torsional vibration, etc.

- c. The equipment must not be operated in an environment or at speeds, powers, torques or with external loads beyond those for which it is designed.
- d. As improvements in design are being made continually, the contents of this catalogue are not to be regarded as binding in detail, and drawings and capacities are subjected to alterations without notice.

The above guidance is based on the current stage of knowledge and our best assessment of the potential hazards in the operation of the gearbox. Any further or clarification required may be obtained by contacting our Application Engineers.

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1. GENERAL NOTES

1.1. Purpose

This manual has been prepared by the manufacturer in order to provide information regarding the safe transport, handling, installation, maintenance, repair, disassembly and disposal of the gearbox. Follow good engineering practices, read the information in the manual thoroughly and apply it rigorously.



All persons carrying out work on the gearbox must have read and understood the operating instructions and must adhere to them. Failure to observe the information provided in this manual may result in risks to personal health and safety, as well as damage to equipment. Manufacturer accepts no responsibility for damage or disruption caused by disregard of these instructions.

The gearbox is designed only for the application described in the technical data sheet or product Catalogue. Other operating conditions must be contractually agreed between buyer and manufacturer. The gearbox described in this manual reflects the state of technical development at the time these instructions went to print. The manufacturer reserves the right to modify, supplement and improve this manual in future. ELECON suggest that this manual needs to be easily accessible at the machine location.



All handling, storage, installation, start-up, inspection and maintenance of the gearbox shall be done by personnel qualified in matters of industrial mechanical and where applicable, electrical equipment. Manufacturer accepts no responsibility for damage or disruption caused by disregard of these instructions.

1.2. Terms and symbols

Some of the most frequently used terms in this manual are explained below.

Scheduled maintenance: It is a set of operations required for maintaining the functionality and efficiency of the gearbox.

Unscheduled maintenance: It is a set of operations required for restoring the functionality and efficiency of the gearbox. These operations are not scheduled maintenance operations. In order to maintain the proper functioning and safety of the gearbox, we recommend that users have unscheduled maintenance performed by the manufacturer or an authorized, special service centre. Contact the manufacturer's technical assistance service for unscheduled maintenance. Failed to

comply with this requirement during the warranty period automatically invalidates the warranty.

1.3. Symbols used in manual

Particularly significant sections of the manual and important specifications are highlighted by the following symbols with their respective meaning explained along side.



Warning – imminent personal injury

This symbol indicates safety measures which must be observed to avoid personal injury.



Warning – imminent damage to the equipment

This symbol indicates safety measures which must be observed to avoid damage to the equipment and material damage.



Important note

This symbol indicates general operating instructions which are of particular importance.



Warning – This symbol indicates hot surfaces which must be observed to avoid burns.

1.4. Technical assistance

For any technical assistance, contact the manufacturer on the following address.

ELECON ENGINEERING CO. LTD.

Post Box # 6, Anand - Sojitra Road,

Vallabh Vidyanagar - 388120, Gujarat, India

Tel.: +91 91 2692 236 469 / 238701

Fax: +91 2692 227 484

E-mail id: infogear@elecon.com

Or else, contact our sales office, quoting the information indicated on the gearbox's name plate, the approximate hours of service, the duty cycle and the type of problem for the assistance is needed. Contact detail of the sales offices is given at the end of the manual.

1.5. Manufacturer's liability

The manufacturer declines all liability in the event of :

- Use of gearbox in contravention of local occupational health and safety legislation.
- Incorrect installation, disregard of incorrect application of the instructions provided in the manual.
- Electrical power supply defects.
- Modification or tempering.
- Workdone on the gearbox by unqualified or unsuitable personnel.

The functionality and safety of the gearbox also depend on the scrupulous application of the instructions given in the manual, in particular

- Detail history of modifications done on the gearbox must be maintained by the owner of gearbox.
- Always operate the gearbox within operating limits.
- Carefully observe the maintenance schedule.
- Ensure that only trained operators are authorized to inspect and service the gearbox.
- The hazardous wastes shall be sent or sold to a recycler or re-processor or re-user registered to authorized under rules [The hazardous waste (management, handling and transboundary movement) rules] or shall be disposed of in a authorized disposal facility.
- Manufacturer accepts no responsibility for damage or disruption caused by disregard of these instructions.
- Manufacture is not liable for the failures of adjacent structures of gearboxes in any circumstances.
- Do not weld gear housing or other accessories without prior approval of manufacturer. Welding without prior permission will void the warranty.
- Manufacturer recommends holding following mandatory spares in stock:
 - 1 spare set of rotating components
 - 1 spare set of bearings
 - 1 spare set of oil seals
 - 1 spare set of instruments

Keeping above spares in stock, the damaged parts can be replaced immediately, limiting any downtime to minimum. Under ideal conditions it may take long lead time for delivery of spare parts.

2. TECHNICAL INFORMATION

2.1. Name plate

The most important technical data are shown on the name plate. These data and the contractual agreements between manufacturer and the client for the gearbox determine the limits of its correct use. If gearbox is supplied with a prime mover, all the information regarding the prime mover itself is provided in its own manual.

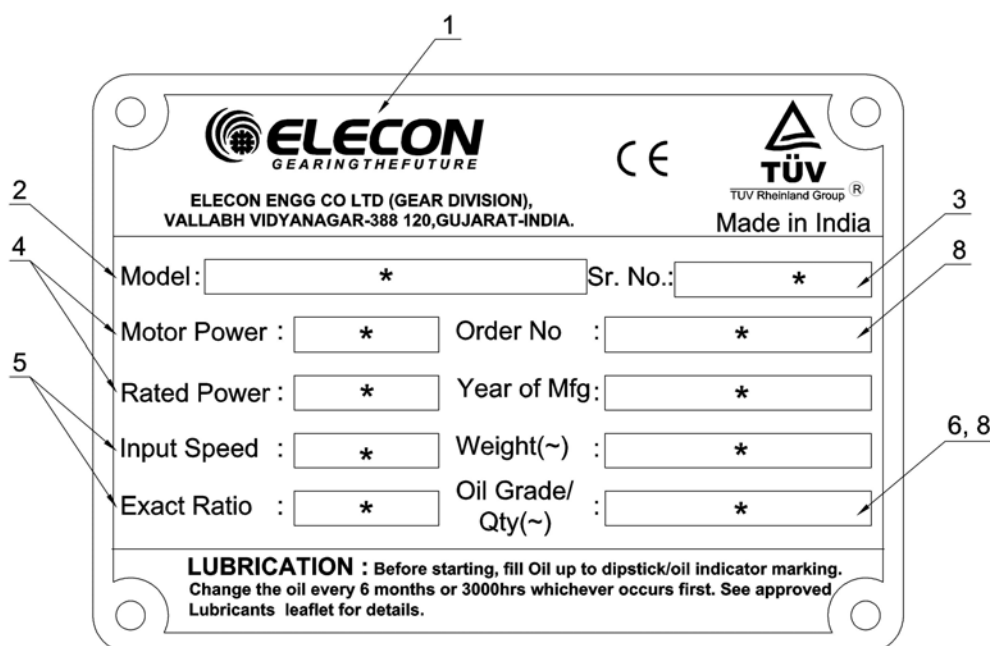


Figure 1: Name plate

Every gearbox is equipped with the name plate as shown in Figure 1: Name plate, with the following details.

1. Company logo
2. Type and size of gearbox
3. Gearbox serial number
4. Power rating (kW) (motor power & rated power)
5. Input speed (rpm) and ratio
6. Oil grade
7. Oil quantity (liters approx.)
8. Order number

9. Place of manufacturer, this information is essential to identify the gearbox is supplied by the manufacturer. Removal of name plate from gearbox will automatically relieve manufacturer from guarantee / Warrantee.



For detailed information about nomenclature of the gearbox, refer the gearbox catalogue of the manufacturer.

Removal of name plate from gearbox will automatically relive manufacturer from guarantee / warrantee.



Always quote the identifying data on the name plate in all the correspondence with the manufacturer, when ordering spare parts, requesting information or arranging technical assistance.

2.2. Understanding the type and size of gearbox

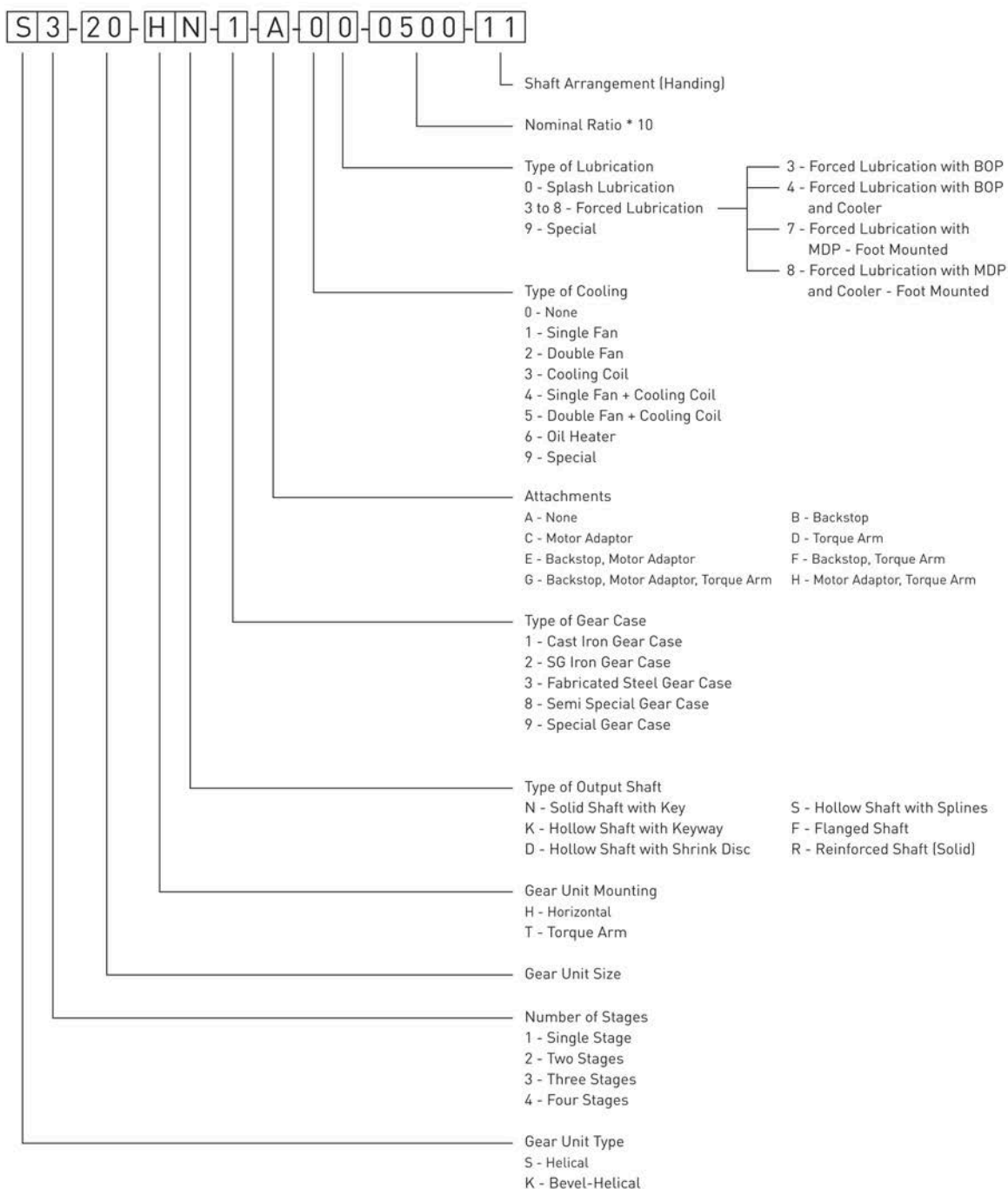


Figure 2: EON - Series

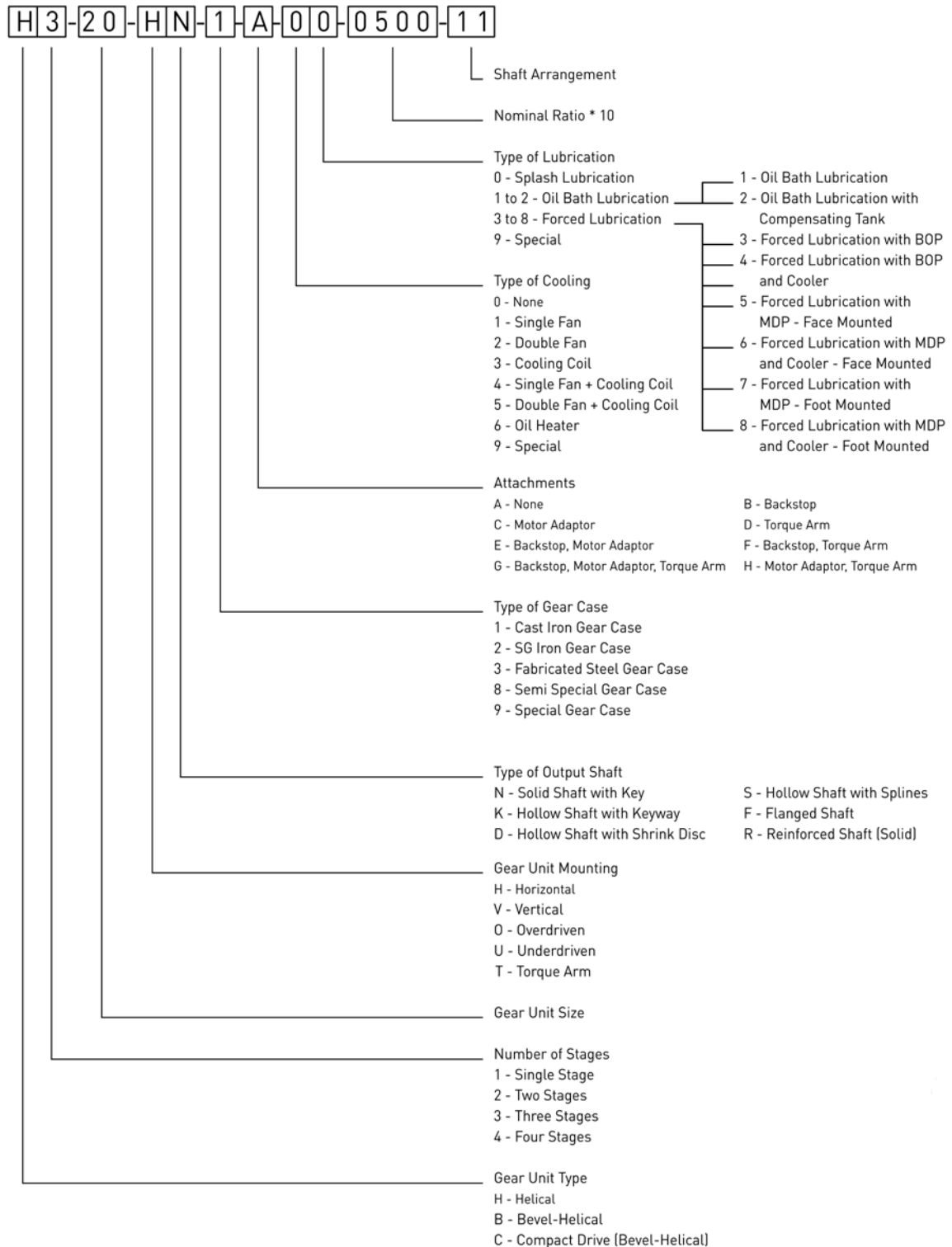


Figure 3: EOS - Series

EP - Series

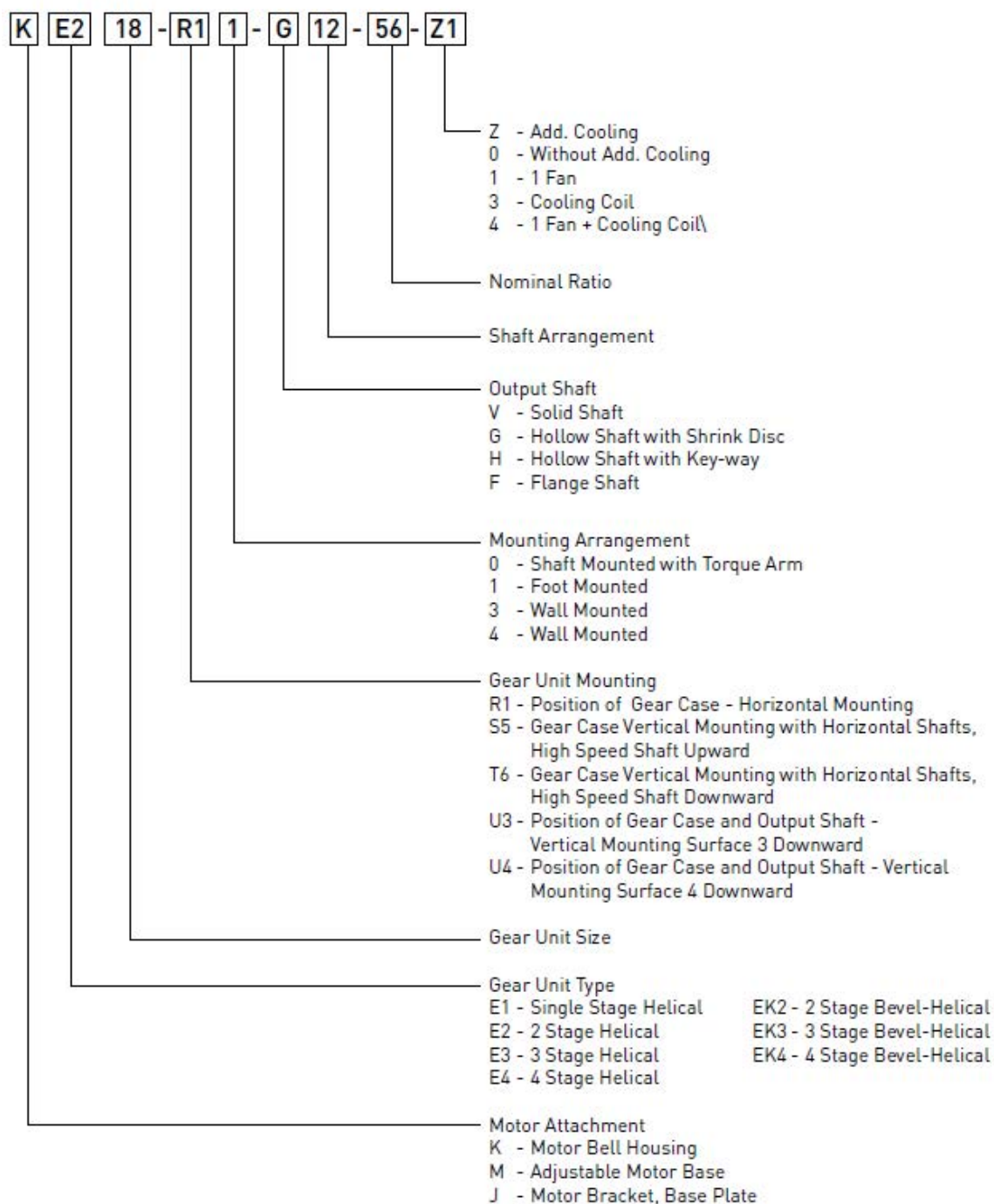


Figure 4: EP - Series

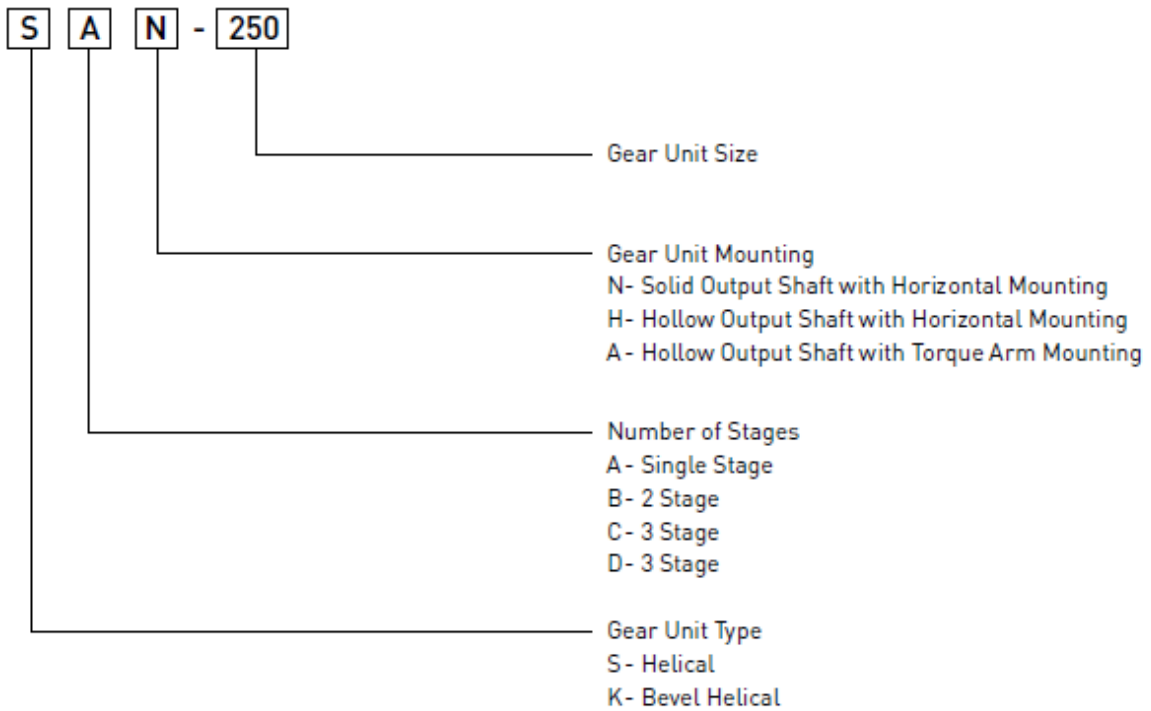
ET - Series

Figure 5: ET - Series

Crane Duty Series

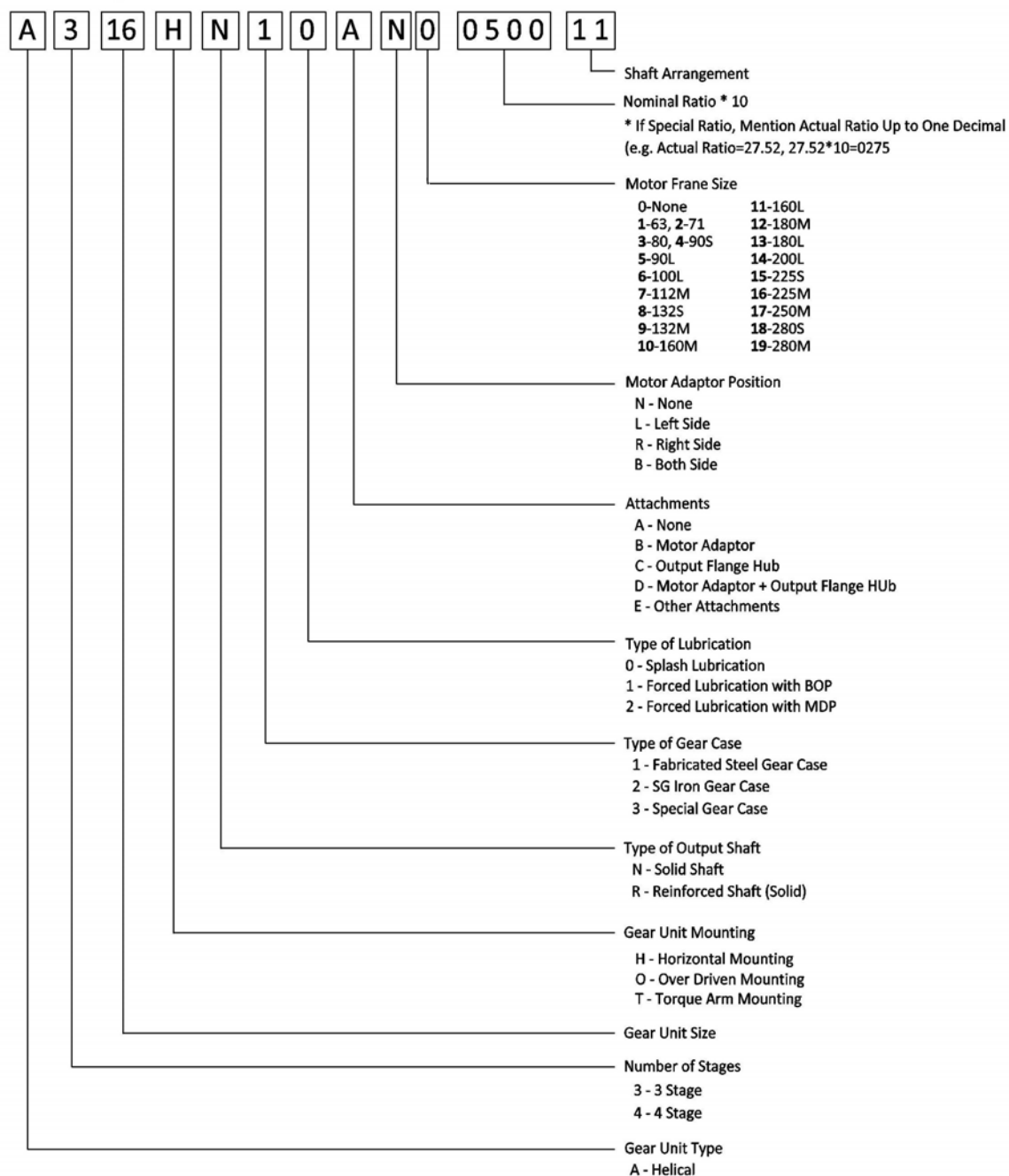


Figure 6: Crane duty - Series

3. SAFETY INSTRUCTIONS

3.1. Proper use

Following points must be kept in mind for safe operation of the gearbox.

- The gearbox must only be used for the intended purpose, and as indicated in the technical data. Use for any other purpose is deemed to be improper. The manufacturer shall not be held responsible for any damage caused by such improper use; the risk shall be borne by the user.
- Proper use also embraces adherence to the manufacturer's installation, dismantling, commissioning, operating and maintenance instructions.



Only original manufacturer's parts may be used for repairs. ELECON will not be responsible for performance of the product with usage of parts from other manufacturers.

3.2. Responsibility of the user

The user should take care of the following points to ensure safe and efficient operation of the gearbox.

- Personnel appointed to work on the gearbox at any time during its service lifetime should be trained specifically for the purpose, having the necessary skills and experience, and must be equipped with and trained to work with appropriate tools and personal protection equipment required by the local safety legislation applicable in the place where the gearbox is installed. Failure to meet these requirements constitutes a risk to personal health and safety.
- Keep the gearbox at its maximum efficiency by carefully following the maintenance schedule. Proper maintenance ensures maximum performance, extended service life and continued compliance with safety regulations.



Any work on the gearbox need to be carried out when gearbox is at a standstill. Drive system must be secured against being turn on accidentally.



If any abnormal changes are noticed during operation of gearbox, such as abnormal noises or sudden increase in temperature, the drive assembly must be switched off for investigation.

- When working on the gearbox, in the areas that are difficult to access or hazardous, ensure that adequate safety precautions have been taken for yourself and others in compliance with applicable legislation on occupational health and safety.
- All maintenance, inspection and repairs must be carried out only by an expert maintenance technician. It is essential to implement operating procedure which addresses potential hazards and their prevention for the entire machine in which the gearbox is installed. Expert maintenance technicians must always work with caution and in observation of applicable safety standards.
- When working on the gearbox, wear the clothing and personal protective equipment required by the local safety legislation applicable in the place where the gearbox is installed.
- Use only the lubricants (oil and grease) recommended by the manufacturer.
- Do not dump polluting materials into environment. Dispose all such materials as stipulated by local environmental legislation.
- After changing lubricants, clean the gearbox and the walk-on surfaces around the work area.
- If the gearbox has to be serviced in a poorly lit area, use additional lamps and ensure that the work is done in compliance with all applicable local safety legislation.
- The gearbox must not be cleaned externally using pressurized cleaning equipment.
- Any work on gearbox should be performed only when it is at standstill.
- Protect the drive assembly against accidental startup (i.e. by padlocking the main power switch or removing the power fuses from the power supply). For this purpose, also affix a notice at suitable place stating clearly that work is in progress on the gearbox.
- Do not perform welding work on the gearbox. Do not use the gearbox as an earthing point for welding operations because this could damage or destroy

parts of the gear teeth and bearings. Welding without prior permission will void the warranty.

- Rotating drive components such as coupling, gear wheels, belt drives etc. must be protected against accidental contact.
- If the gearbox is to be installed in a plant or the machine, the constructor of the said plant or machine is required to include the prescriptions, instructions, and descriptions contained in this manual in the operating manual for the plant or machine.
- Notices attached to the gearbox, i.e. name plate, directional arrows etc. must always be observed. They must be kept free from dirt and paint at all the times. Missing name plates must be replaced.
- If the gearbox is installed in situations that are particularly hazardous to personal safety, or which could cause serious damage to equipment, or involve high inertial loads, vibrations, etc. such as :
 - Suspended installations
 - Motor supported exclusively by the gearbox
 - Output shaft with shrink disc oriented downwards

Suitable safety devices, such as harnesses, safety chains, and restraining system, etc. must be installed.

- All spare parts must be obtained from the manufacturer.
- Removed safety items must be re-installed prior to starting up.
- Ensure all necessary electrical, mechanical and hydraulic connections before prior to initial startup or planned maintenance, as they may get loosened during transit / handling / operation.

3.3. Environment protection

The following points should be followed to ensure protection of the environment.

- Dispose of any packing material in accordance with local regulations or separate it for recycling.
- When changing lubricating oil, the used oil must be collected in suitable containers. Any pools of oil which may have collected should be removed at once with an oil-binding agent.
- Preservative agents should be stored separately from used oil.
- Used oil, preservative agents, oil-binding agents and oil-soaked cloths must be disposed of in accordance with the local environmental legislation.
- Disposal of the gearbox after its useful life in accordance with the local environmental legislation.

- Drain all the operating oil, preservative agent and/or cooling agent from the gearbox and dispose of in accordance with local regulations.
- Depending on national regulations, gearbox components and/or add-on parts may have to be disposed of or sent for recycling separately.
- The hazardous wastes shall be sent or sold to a recycler or re-processor or re-user registered to authorized under rules [The hazardous waste (management, handling and transboundary movement) rules] or shall be disposed of in a authorized disposal facility.

3.4. Special dangers

Some of the risks related to gearbox operation are listed below.



In case of hot surfaces ($> 50^{\circ}\text{C}$) there is a risk of burns!



In case of cold surfaces ($< 0^{\circ}\text{C}$) there is a risk of frost injury (pain, numbness, frostbite).

When draining the lubricating oil during oil change, always bear in mind that there is risk of serious burns if oil is hot.



Small foreign matter coming in contact with rotating parts may cause eye injury.



In addition to any generally prescribed personal safety equipment (such as safety shoes, safety clothing, helmet, safety glasses, earplugs, etc.) handling the gearbox requires wearing suitable safety equipment.

4. TRANSPORT AND STORAGE

4.1. Scope of supply

The products supplied are listed in the dispatch papers. Check immediately on receipt to ensure that all the products listed have actually been delivered. Damaged or missing parts must be notified to the manufacturer within seven working days.



If there is any visible damage, the gearbox must not be put into operation.

4.2. Delivery conditions

All gearboxes are manufactured with highest quality control and keeping the exact specifications in mind. The gearboxes are carefully inspected at various stages and tested on the test bed. When all the quality control tests are completed, the gearboxes are sealed and certified for dispatch. The seal on the gearbox should not be removed without our prior consent.

The user should note that if the seal is removed without prior consent from the manufacturer, it will automatically relieve the manufacturer from guarantee / warranty.

Gearboxes are packed in wooden cases having suitable battens to facilitate handling. The gearbox is delivered in the fully assembled state. Additional items such as pipes and accessories like pressure gauge, thermometers, etc. are delivered separately packaged. Different forms of packaging may be used depending on the size of the gearbox and method of transport. The symbols marked on the packaging must be observed at all times. These have the following meanings:

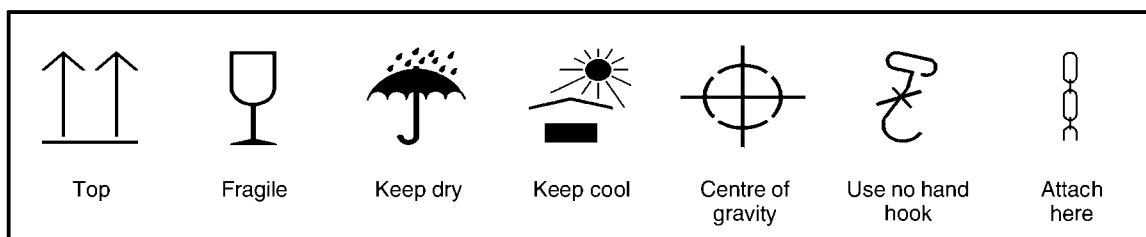


Figure 7: Symbols on packing

4.3. Handling of the gearbox



It is advisable that the client should not open the gearbox during guarantee period. In case, it is of immense importance to open the gearbox, the client should contact the manufacturer to seek the service from manufacturer.

In emergency cases, if gearbox is opened, the client should ensure that all the bearings are adjusted properly by the experienced workmen and advice for proper clearance is sought from manufacturer. Also, while assembling the gear pair in mesh, the care should be taken to ensure correct backlash as specified in technical drawings. Correct backlash and proper bearing clearance is very important for efficient working of the gearbox.

It is also necessary while refitting the gearbox, a special case-joining compound should be used and its thickness should not be higher than 0.002 mm (Loctite 573 or equivalent sealant is recommended).



The gearbox must be transported with due care to avoid danger to persons and property. Avoid bumping the ends of shafts as it may damage the gearbox. The gearbox must be transported using suitable equipment only. Never transport the gearbox filled with oil.

4.3.1. Lifting the gearbox

The following care must be taken when the gearbox is to be lifted for installation.

- Transport of the complete gearbox should be undertaken by using wire ropes or cable strips of required strength.
- The gearbox should only be lifted from the ring bolts of standard DIN 580 / ISO 3266 and/or lifting lugs provided in bottom housing for attaching lifting equipment to the gearbox.
- Do not use the front thread at the end of the shaft for attaching ring bolts for transport purposes.
- Lift the gearbox which is fitted with lubricating piping carefully to avoid any damage to the piping system. Never use shaft extensions, pipes of oil lubrication and top housing lugs for lifting of gearbox.



In circumstances where the gearbox is to be lifted along with lube system, temporary remove the instruments like thermostat, pressure gauge, temperature gauge and/or part of oil feeding piping. After removal of these elements, necessary precautions should be taken to avoid ingress of moisture or dust in lube system of the gearbox.

4.3.2. Lifting of various gearbox arrangements

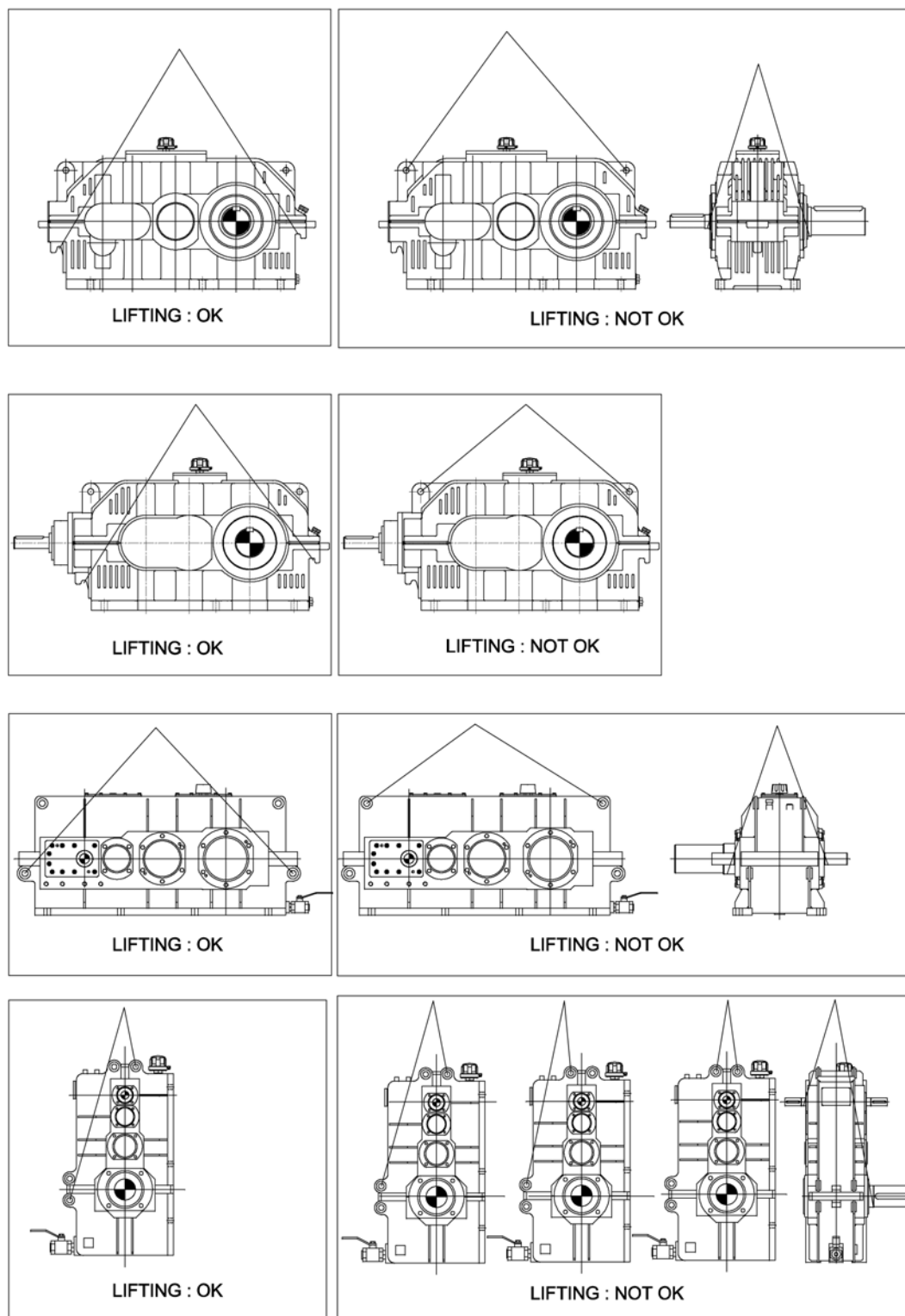
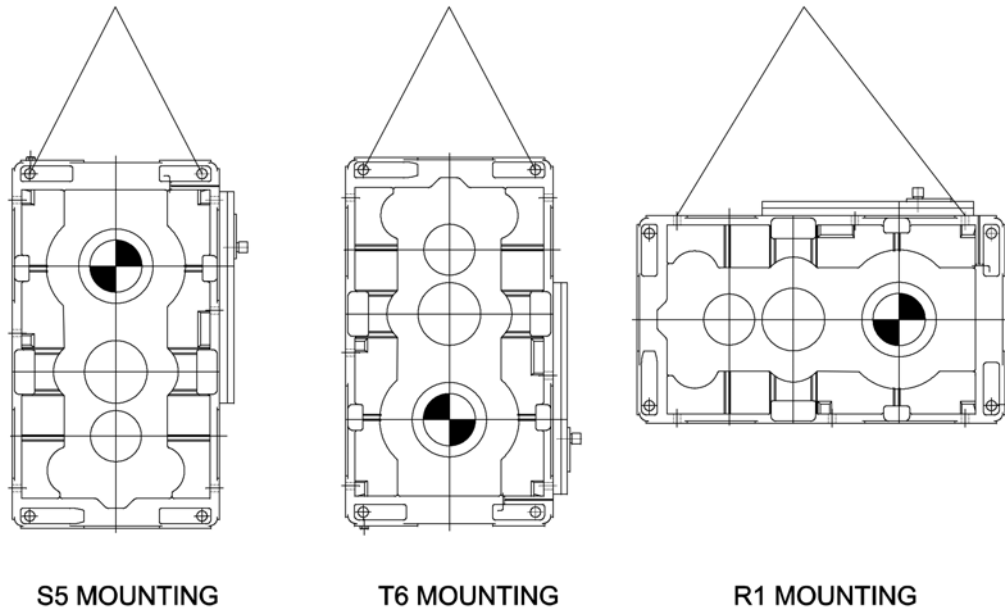


Figure 8: Correct lifting (ET, EON & Crane duty)



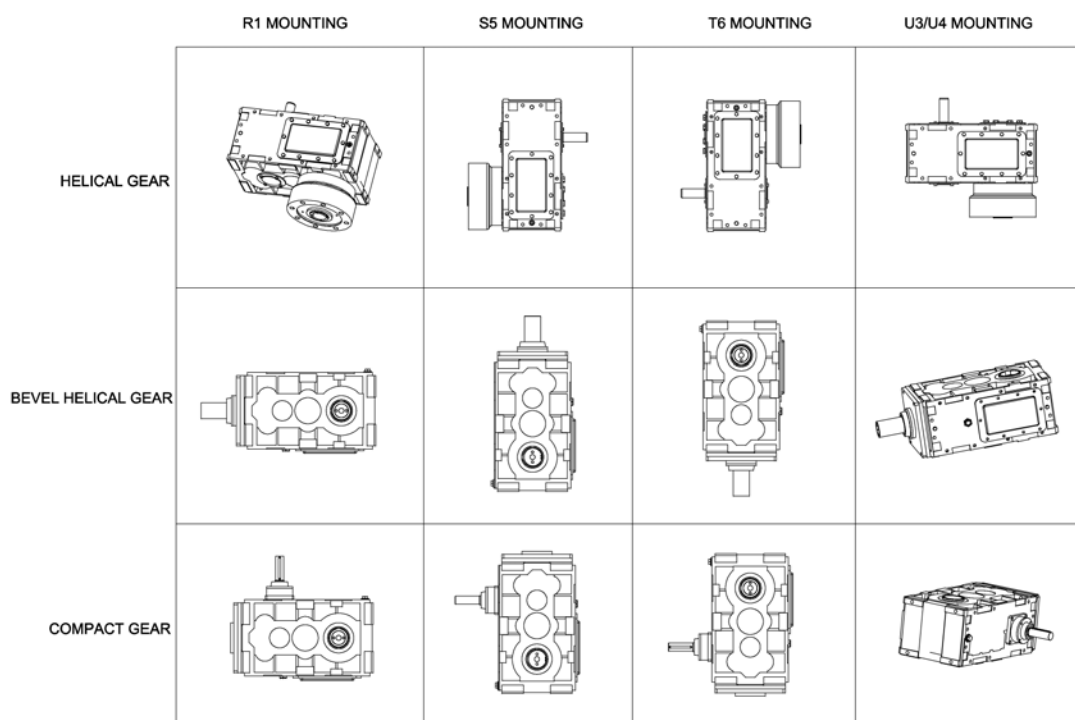
LIFTING : OK

Figure 9: Correct lifting (EP, EOS & Crane duty)

While lifting the complete gearbox ET, EON & Crane duty series, please do not use the lifting lugs provided on the top cover. Use the lifting lugs provided on bottom part of the gear housing (refer Figure 8: Correct lifting (ET & EON)).

While lifting the complete gearbox EP & EOS series, Gearbox may only be lifted using 4-lifting eyes on the Gearbox and shall be lifted with hook & chain or rope (refer Figure 9:Correct lifting (EP & EOS)).

Lift the gearbox which is fitted with lubrication piping carefully in such a way as to avoid any damage to the piping system.



4.4. Storage of gearbox

4.4.1. Instructions for short storage (less than 6 months) of gearbox

The user should take following precautions when storing the gearbox for short period of time.

- The gearbox must be stored in the position of use in a sheltered place. It must be placed on a vibration-free wooden base and covered over.
- The gearbox should not be stored in excessive humid conditions or where it is directly exposed to weather (i.e. outdoors).
- Excessive variation of temperature should be avoided where the gearbox is stored, as it can cause condensation inside the gearbox and its accessories.
- The gearbox should not be placed directly on the ground.
- If allowed, store the packaged gearbox with the instructions on the packaging itself.

Following instructions for the long time storage of the gearboxes is of extreme

importance as violating them can lead to the premature failure. Long time storage of a gearbox can be due to one of the following reasons:



Do not stack gearboxes on top of one another.



If the gearbox is being stored outdoors, it must be covered with particular care. It must be ensured that neither moisture nor foreign material can collect on the gearbox.



Unless otherwise agreed by contract, the gearboxes must not be exposed to harmful environmental factors such as chemical products, high air pollution, high air humidity, and ambient temperatures outside the range 0°C to 40°C.

Provision for special environmental conditions during transport (i. e. transport by ship) and storage (climate, termites etc.) must be contractually agreed.

4.4.2. Instructions for long storage (more than 6 months) of gearbox

Following instructions for the long time storage of the gearboxes is of extreme importance as violating them can lead to the premature failure. Long time storage of a gearbox can be due to one of the following reasons:

- Gearbox is installed, but not in action.
- Gearbox is not installed and not in action for a long time.

4.4.2.1. Gearbox is installed; but not in action.

When the gearbox is installed in the system but is out of action, following care should be taken:

- A quantity of oil must be added to exceed maximum level. Special attentions should be given to the condition of the oil. Old oil, which may form a deposit or be acidic, should be removed. The gears should be turned slowly by hand until low speed (output) shaft makes at least 1 or 2 complete revolutions, in order to ensure the oil is distributed over all parts in contact, repeat this process by every 15 days.
- Wherever grease nipples are provided, add grease through grease nipples.

- When lube system is provided to lubricate all bearings and meshing, operate lube system for 30 minutes every 15 days.
- Replace the air breather provided on the gearbox with a plug during storage.
- It is recommended to store the gearbox between -5°C to 45°C and relative humidity to 60%.
- Influence of aggressive or corrosive substances must be prevented (such as contaminated air, gas, solvents, ozone, salts, etc.)
- Avoid direct exposure to sun or UV radiation.
- Gearbox must not be subjected to vibration.

4.4.2.2. Gearbox is not installed and not in action for a long time (more than 6 months)

When the gearbox is not installed and not in action for a long time, following care should be taken:

- The gearbox can be completely filled up with lube oil up to breather plug, or,
- The gearbox should be run for 5 minutes after filling with rust protective oil. The oil level should not be higher than the normal oil level. All the parts having been thoroughly coated with oil, the protective fluid can be drained and kept for other similar operations.
- The corrosion protection of the shaft extensions has to be checked and corrected, if necessary. Apply adhesive tap at air gaps at input and output labyrinth sealing if provided.
- The inspection covers and the drain plugs should be completely sealed.
- It is recommended to store the gearbox between -5°C to 45°C and relative humidity to 60%.
- Influence of aggressive or corrosive substances must be prevented (such as contaminated air, gas, solvents, ozone, salts, etc.) To prevent corrosion during storage, silica gel bags should be kept in the vicinity of the gearbox but not inside gear housing. Silica Gel should be periodically checked for moisture absorption and should be changed from time to time.
- Avoid direct exposure to sun or UV radiation.
- Gearbox must not be subjected to vibration.

4.5. Corrosion protection

The inner parts of new gearboxes leaving works are sprayed with rust protective oil which keeps them free from rust for 6 months, provided they are sheltered from atmospheric elements, preferably in a closed ventilated place. When putting into operation, proceed as per instructions of this manual.

When storing the gearboxes leave them in the cases through which they have been transported. Do not put them near vibrating machines, such as reciprocating engines, compressors and pumps in order to avoid wear of bearings by vibration.

For a gearbox that has to be stored for more than 6 months the gear should be treated as per procedure as described in previous section. For internal preservation, Valvoline Tectyl 502C or Fuchs Anticorit VCI type or Castrol Rustilo VCI type or Suprabha VCI 412 or equivalent can be used. For external preservation, Shell Ensio Fluid TX or Valvoline Tectyl 506 / 846, Fuchs Anticorit BW 366 or Castrol Rustilo 181 or Esso Rust BAN 397 or equivalent can be used.



Ensure that the coat is not damaged!

Any damage may cause failure of the external protective coating and corrosion.

Unless otherwise contractually agreed, the interior preservation is guaranteed for 6 months, and the preservation of the free shaft ends for 6 months, provided that storage is in dry, frost-free sheds. The period of validity of the guarantee starts on the date of delivery of the gearbox.

4.6. Painting and preservation

The outside surface of gear housing is painted by us to have resistance against weak acids, alkalis, solvents and similar liquids and temperature up to 140° C (Approx.)

All bright parts such as shaft ends are given a coat of anti rust compound. Anti rust compound is easily removable by applying mineral turpentine oil or nitro-thinners or suitable solvents.



Please do not use files or sand papers for removal of anti rust coating.

4.7. Preparing the gearbox for service after storage

Following care should be taken before putting the gearbox into service after storage.

- Thoroughly clean the extensions of shafts and external surface to remove all rust proofing products, contaminants and other impurities (using standard commercial solvent). The user should perform this activity outside any hazardous area.
- Replace the screw plug by the breather plug.
- Check all seals and shaft seals. Replace the oil seals if gearbox was stored more than 6 months.
- Replace the damaged seals. Fill the grease between two oil seals.
- Oil should be changed if the gearbox was subjected to excessive ambient temperatures during storage. The recommended amount of oil should be filled before putting gearbox into service.
- If the oil or protective oil used during storage is not compatible with the lubricating oil to be used in service, the gearbox should be cleaned from inside thoroughly before filling it with the service oil.



Handle any lubricant or oil with care as according to handling and safety instructions supplied by lubricant's supplier. These instructions have to be handed over to any personnel performing installation, maintenance or repair of the gearbox.



Do not open the gearbox near flames, sparks or hot objects and take preventive measures to protect people against the volatile corrosion protective substance.

4.8. Precautions to be taken

Upon receipt and during storage

Take care of...	Possible damage... (if neglected)
• Damaged Packing. • Check the protection of machined surfaces and shaft ends. • Provide the entire drive group with an adequate protection for the planned storage period.	• Corrosion of machined surfaces and shaft ends. • Corrosion of gearbox parts and components. • Damage to shafts, gears and bearings.
• Store the gearbox in its original packing. • Long term storage.	• Corrosion of gearbox parts and components.
• Do not store the gearbox near vibrating machines.	• Damage to gears and bearings.

5. TECHNICAL DESCRIPTION

Follow the instructions given in: Chapter 3.SAFETY INSTRUCTIONS

5.1. General description

The good temperature characteristics of the gearbox is achieved by its high degree of efficiency, large housing surface and performance related cooling system.



The gearbox can be operated in both directions of rotation when holdback / backstop is not provided.

5.2. Basic type

The gearbox is supplied as a single, two, three or four stage helical or bevel-helical gearbox. It is designed for selected position as specified in respective catalogues.

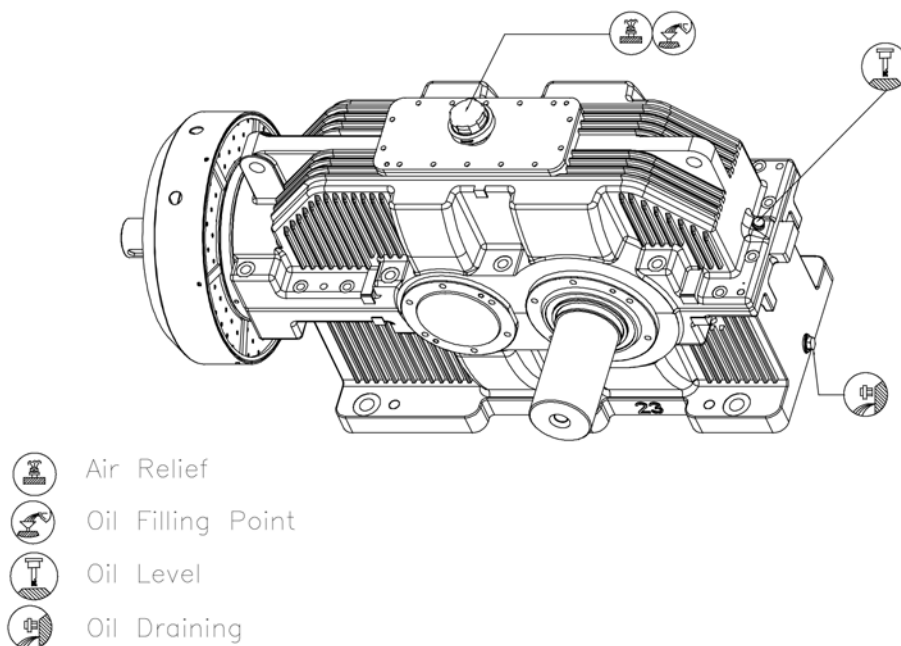


Figure 10: Gearbox features on gearbox type K2-HN (EON series) (gearbox model shown in image is for reference only)

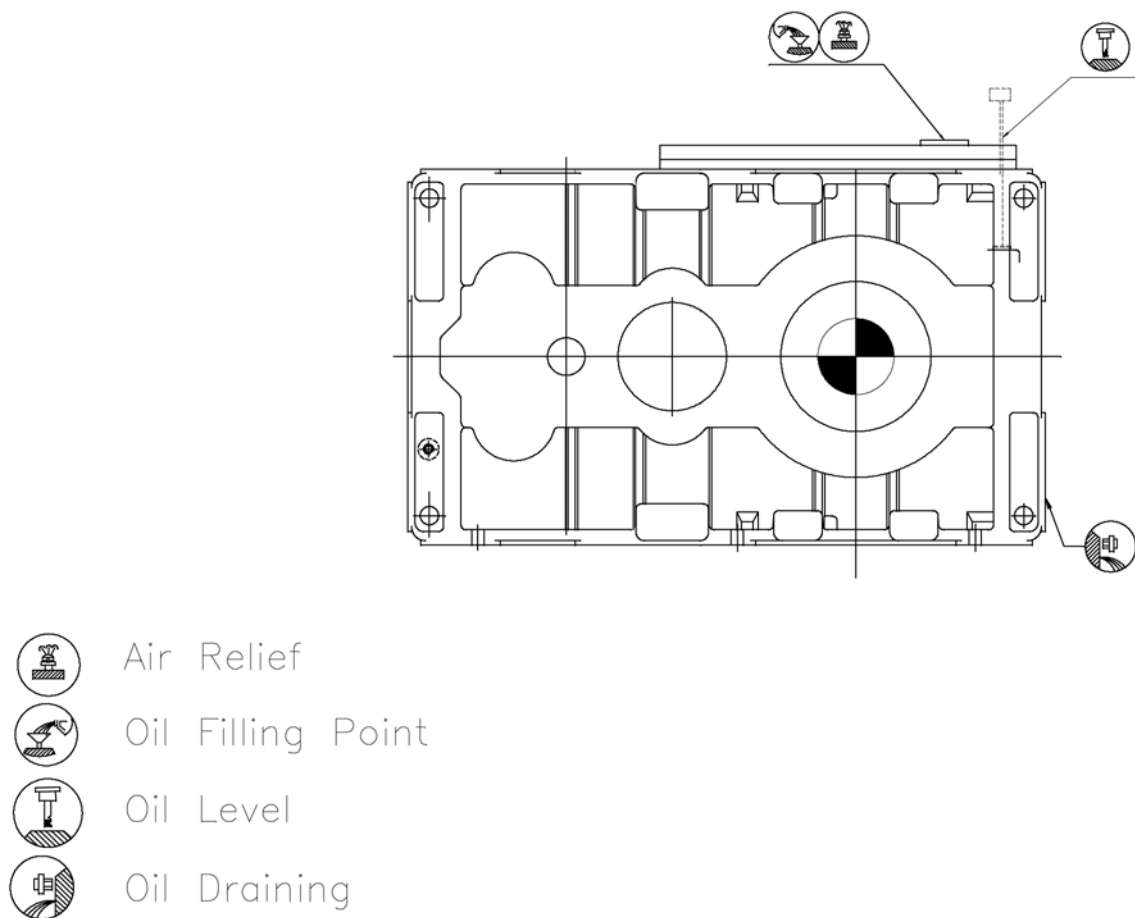


Figure 11: Gearbox features on gearbox type H1HN (EOS series) (gearbox model shown in image is for reference only)

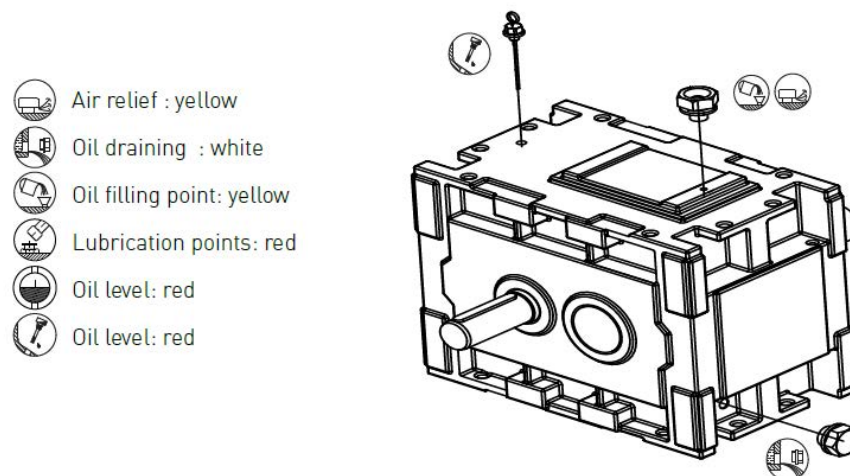


Figure 12: Gearbox features on gearbox type PB (EP series) (gearbox model shown in image is for reference only)

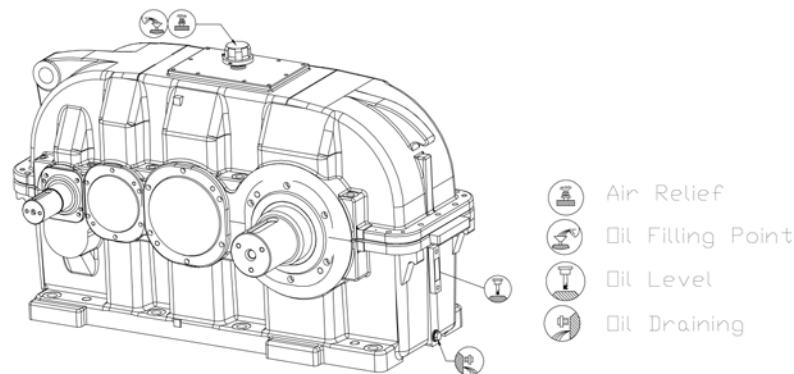


Figure 13: Gearbox features on gearbox type SBH (ET series) (gearbox model shown in image is for reference only)

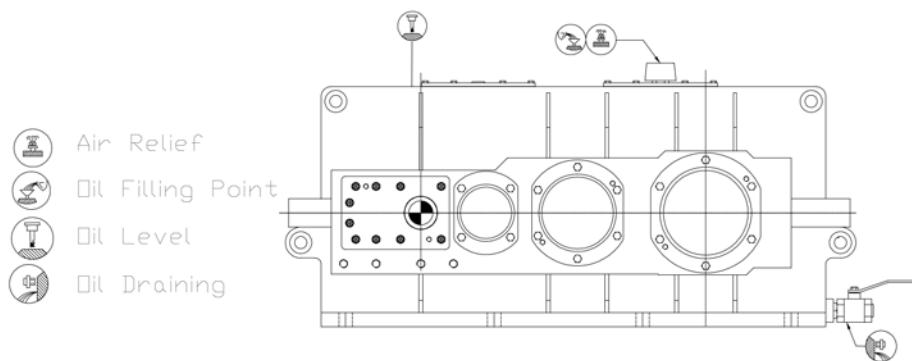


Figure 14: Gearbox features on gearbox, Crane duty series (gearbox model shown in image is for reference only)

A detailed view of the gearbox can be obtained from the drawings in the gearbox documentation.

A number of shaft configurations (types and rotation directions) are possible. These are shown in the next page as solid shafts.

5.3. Housing

The housing is made of grey cast iron or mild steel. It is of two piece design, parting line separates top housing and bottom housing that support the bearings.

The gearbox housing comes with the following equipment:

- Inspection and/or assembly cover (for oil filling and/or inspection)
- Oil sight glass or oil dipstick (for checking the oil level)
- Oil drain plug (for oil drain)
- Air filter or venting screw (for aeration and ventilation)

5.4. Toothed components

The externally toothed components of the gearbox are case hardened and ground.

The gears are connected with the shafts by interference fits and parallel keys or by shrink fits. These types of joints transmit with adequate reliability the torques generated.

5.5. Lubrication

5.5.1. General instructions

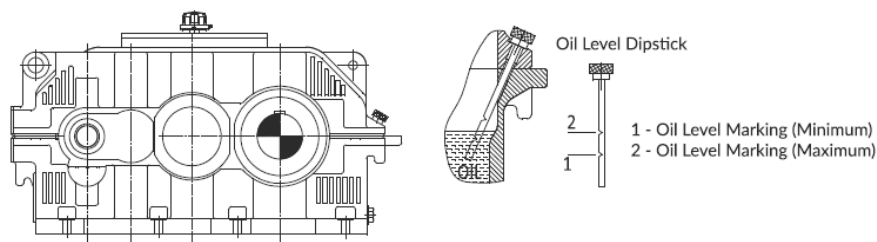


Figure 15: General components (gearbox model shown in image is for reference only)

- Quantity of lubricating oil given in the technical data or drawing is only for guidance.
- Too much oil causes heating of the gearbox and too little oil causes wear.

The oil quantity varies with different input speeds, consult Elecon if operating speed is different than specified in drawing or name plate.

Actual oil quantity is mentioned in name plate, and the same is to be ensured by oil level height from oil level gauge or dipstick marking.

The oil level in gearbox sump or tank must be checked from time to time and maintained strictly as per the given oil level mark or dipstick marking.

The bearings are generally lubricated with the oil used for gears.

If lube system is given, check oil level after lube system pipeline gets filled with oil.

If lube system is not given, check oil level on stand still condition.

5.6. Selection of lubricants

The class of lubricants is enclosed herewith. The class of lubricants states which oil or grease should be used under specific operating conditions.

In case of extreme temperature fluctuations from 0 to -30° C, special type of oil is necessary. Client should obtain the exact operating temperature to determine the correct lubricant.

In case of low ambient temperature, oil heating is necessary and where the ambient temperature is too high, oil cooling has to be provided. Hence, client should inform the ambient temperature at the time of placing order.

Temperature limitations:

The standard lubricant is suitable for operation in ambient temperatures of 0°C to 35°C (0°F to 95°F). Outside of this range consult oil grades table 1 or our application engineers.

Table 1. Oil grades

Lubricant	Ambient temperature range		
	-5°C to 20°C (E) -30°C to 20°C (H)	0°C to 35°C	20°C to 50°C
EP mineral oil (type E)	5E (VG 220)	6E (VG 320)	7E (VG 460)
Polyalphaolefin based synthetic (type H)	5H (VG 220)	6H (VG 220)	7E (VG 320)

Table 2. Lubricants chart

	Viscosity class ISO 3348 at 40°C				
Brand name	ISO VG 150	ISO VG 220	ISO VG 320	ISO VG 460	ISO VG 680
	Omala S2 GX 150	Omala S2 GX 220	Omala S2 GX 320	Omala S2 GX 460	Omala S2 GX 680
Mobil	Mobilgear 600 XP 150	Mobilgear 600 XP 220	Mobilgear 600 XP 320	Mobilgear 600 XP 460	Mobilgear 600 XP 680
	Carter XEP 150	Carter XEP 220	Carter XEP 320	Carter XEP 460	Carter XEP 680
	Alpha SP 150 Optigear BM 150	Alpha SP 220 Optigear BM 220	Alpha SP 320 Optigear BM 320	Alpha SP 460 Optigear BM 460	Alpha SP 680
	Mak Amocam Plus 150	Mak Amocam Plus 220	Mak Amocam Plus 320	Mak Amocam Plus 460	
	Parthan EP 150 MA	Parthan EP 220 MA	Parthan EP 320 MA	Parthan EP 460 MA	Parthan EP 680 MA
		Gulf Gear WT 220	Gulf Gear WT 320	Gulf Gear WT 460	
	Renolin CLP 150 / Renolin CLP Plus 150	Renolin CLP 220 / Renolin Highgear 220 / Renolin CLP Plus 220	Renolin CLP 320 / Renolin Highgear 320 / Renolin CLP Plus 320	Renolin CLP 460 / Renolin Highgear 460 / Renolin CLP Plus 460	Renolin CLP 680 / Renolin Highgear 680 / Renolin CLP Plus 680
	Gear Compound EP 150	Gear Compound EP 220	Gear Compound EP 320	Gear Compound EP 460	

5.7. Lube oil system

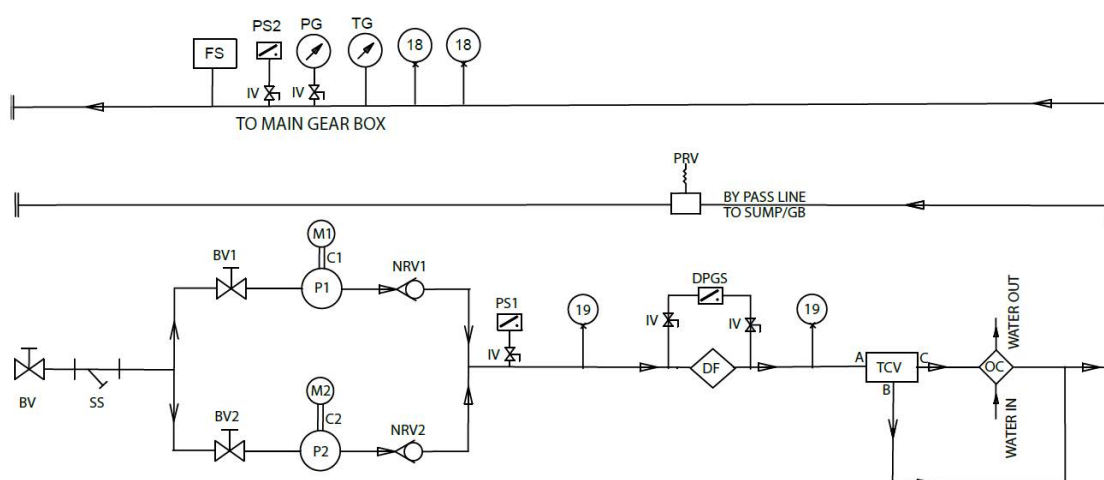
The type of lube system provided is based on order specification.

The lube system is employed to lubricate the gear meshing and bearings when splash lubrication is not sufficient as well as to enhance the thermal rating of the gearbox.

The lube system can have different configuration based on application and customer requirements. Simple lube system comprises of one pump-motor set or built-on pump without filter and cooler can be employed when only to lubricate any or all gear meshing and/or bearings when splashing lubrication is not adequate. Here, if thermal rating of gearbox is inadequate, oil cooler is also employed along with filter. In above both cases, the lube system is mostly mounted on gearbox, means lube system components are placed on gearbox suitably based on space available.

The separate lube system can also be provided based on customer requirement, which consists of one or dual pump-motor set, simplex or duplex filter, single or double oil cooler and necessary valves and instruments.

Following line diagram is shown for reference only. The actual lube system diagram is normally shown in gearbox drawing or enclosed in separate lube system maintenance manual.



Notes:

In below table, lube system components are described as per the schematic circuit diagram shown previously.

For example, for two pump lube system, one pump acts as main pump and other as standby pump. In case of failure of main pump, standby pump shall start automatically and shall stop motor of main pump and vice versa. In case of chocking

of filter or failure of pump, the delivery pressure will get reduced, so audio-visual warning and stop signals will be observed.

Symbol	Description	Setting of various switches	
SS	Suction strainer	PS1	Common pressure switch for PM-1 & PM-2 to change over at set pressure as per drawing (decreasing)
GV	Gate valve		
BV	Ball valve	PS2	Pressure switch after cooler just before gearbox oil inlet, to give signal to main motor to trip at set pressure as per drawing (decreasing)
IV	Isolation valve		
P	Pump	FS	Flow switch to give warning signal at set flow rate as per drawing (decreasing)
M	Motor		
NRV	Non return valve	DPGS	Differential pressure switch across the filter to give warning signal at set pressure as per drawing (increasing)
PS	Pressure switch		
PG	Pressure gauge		
DPGS	Differential pressure gauge with switch		
F	Filter		
TCV	Temperature control valve		
TG	Temperature gauge	TCV	Temperature control valve for by-passing oil cooler at low temperature than ambient temperature.
FS	Flow switch		

5.7.1. Oil analysis / water contamination in oil analysis

For examining the oil for water content in used oil needs to undergo laboratory test from lubrication supplier or customer service.

For oil analysis, oil sample from gearbox to be collected from bottom of gearbox through drain valve. Fresh bottle (transport worthy packing as per lubrication supplier) to be used to collect oil sample with specified quantity.

5.8. Shaft bearings

All shafts are mounted in anti friction bearings.

5.9. Shaft seals

Normally, radial shaft seals (oil seals) are provided at input and output shafts to prevent oil from escaping into gearbox and not allowing any foreign material entering into gearbox. For few applications and based on customer requirement, labyrinth type or special sealing can also be provided.

5.10. Heating

At low temperatures (-5°C to -30°C) it may be necessary to heat the gear oil before switching on the drive system or even during operation. In such cases the use of heating elements is possible. These heating elements convert electrical energy into heat which is conducted to the surrounding oil. The heating elements are located in protective tubes inside the housing, thus making it possible to replace them without draining off the oil.

Complete immersion of the heating elements in the oil bath must be guaranteed.

The heating elements can be controlled by a temperature monitor who emits a signal when maximum and minimum temperatures are reached, the signal requires amplification.

5.11. Oil temperature monitoring

Depending on the order specification, the gearbox may be fitted with resistance thermometer for monitoring the oil temperature in the sump. In order to measure the temperatures or temperature differences, the PT 100 resistance thermometer should be connected to a suitable instrument provided by the customer.

6. INSTALLATION

Follow the instructions given in: Chapter 3.SAFETY INSTRUCTIONS

6.1. General information on fitting

During the planning phase sufficient space must be allowed around the gearbox for later care and maintenance work.



Free convection through the surface of the housing must be ensured by suitable measures.

Adequate lifting equipment must be available before beginning the fitting work.



During operation, the gearbox must not be allowed to heat up through exposure to heat from external sources such as sunlight, and suitable measures must be taken to prevent this! Do avoid a heat concentration!. If a temperature-monitoring device is fitted, a warning signal must be emitted when the maximum permitted oil-sump temperature is reached. If the maximum permitted oil-sump temperature is exceeded, the drive must be shut off. Such shutting off may cause the operator's system to Stop!



The operator should ensure that no foreign bodies affect the proper function of the gearbox (i.e. falling objects or heaping over)

No welding work must be done at all on the drive. The drives must not be used as an earthing point for welding operations. Gear teeth and bearings may be irreparably damaged by welding. For finding the information given in the dimensioned drawing and foundation plan must be observed (see drawings in the gearbox documentation). All the fastening points provided by the design of the gearbox must be used. Screws which have been damaged during assembly or disassembly work must be replaced with new ones of the same strength class and type specified on the drawings.

6.2. Unpacking

The products supplied are listed in the dispatch papers. Check immediately on receipt to ensure that all the products listed have actually been delivered. Parts damaged and/or missing parts must be reported in writing immediately.

The packaging must not be opened or damaged, when this is a part of the preservation method. Remove packaging material and transporting equipment and dispose of in accordance with regulations. Perform a visual check for any damage and contamination.



If there is any visible damage, the gearbox must not be put into operation. The instructions in Chapter 4. TRANSPORT AND STORAGE, must be observed.

6.3. Installation of gearbox on housing base

6.3.1. Foundation

The foundation should be designed in such a way that no resonance vibrations are created and that no vibrations are transmitted from adjacent foundations. The structure on which the gearbox is to be mounted must be rigid. It must be designed according to the weight and torque, taking into account the forces acting on the gearbox.

Careful alignment with the gearbox on the input and output sides must be ensured by proper adequate shimming at foundation if required. Any elastic deformation through operating forces must be taken into consideration.



Fastening bolts or nuts must be tightened to the prescribed torque.

If external forces are acting upon the gearbox, it is advisable to prevent the gearbox from displacement by means of lateral stops.

For dimensions, space requirement, arrangement of supply connections (i. e. with separate oil cooling system), refer to the drawings in the gearbox documentation.

The gearbox must be mounted on leveled foundation using the correct size and type of foundation bolts. The foundation must have sufficient load carrying

capacity. A civil engineer, expert in foundation technology should be consulted for checking suitability of foundation.

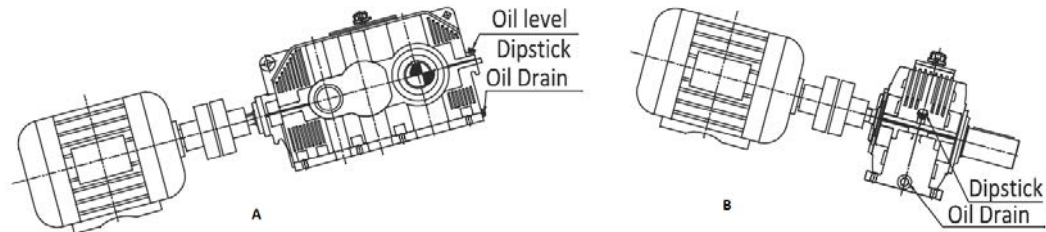


Figure 16: Installation of gearbox on housing base

The gearbox can be mounted in an inclined position, refer Figure 16: Installation of gearbox on housing base (A) and (B), only if this requirement is specified while ordering out the gearbox.

While mounting overhung pinions, gear or chain sprockets, care should be taken that as far as possible the reaction due to circumferential forces is directed downward i.e. towards foundation, see below figures (gearbox model shown in image is for reference only), the correct way of mounting overhung pinion and sprocket. Avoid installation as shown in Figure 17: Correct way of mounting overhung pinion and sprocket.

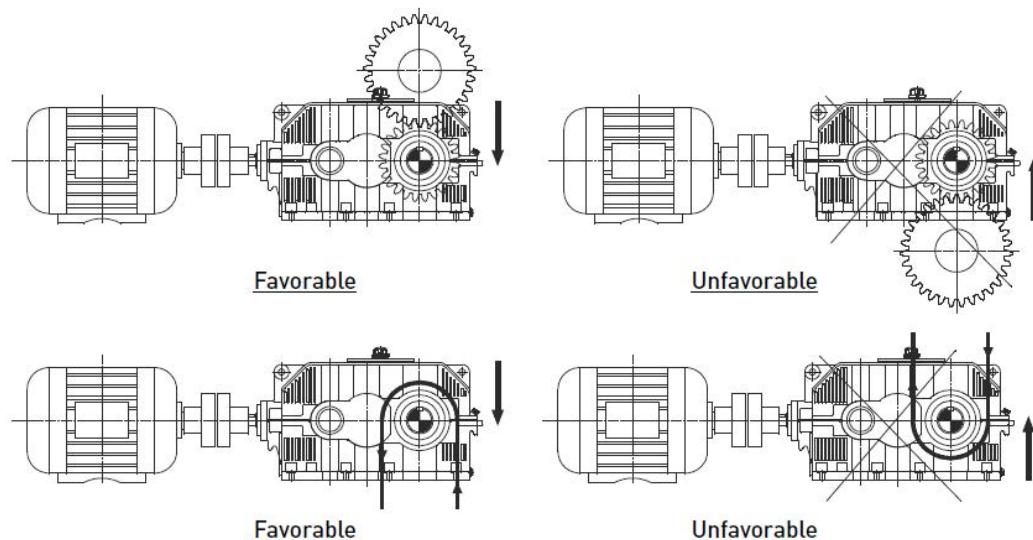


Figure 17: Correct way of mounting overhung pinion and sprocket

For shaft mounted gears (gearbox model shown in image is for reference only), provision must be made for the torque arm of adequate strength and elasticity

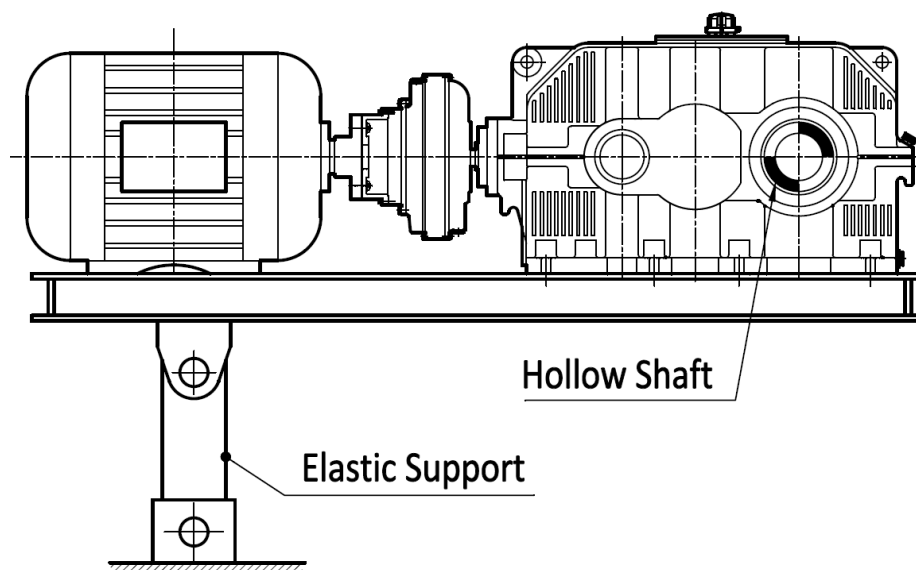


Table 3. Tightening torque

Tightening torque			
Size	8.8 (Nm)	10.9 (Nm)	12.9 (Nm)
M4	2.7	3.8	4.6
M5	5.4	7.6	9.1
M6	9.3	13	15.7
M8	22.5	32	38
M10	45	63	76
M12	78	110	132
M14	125	175	210
M16	190	267	320
M18	260	365	440
M20	370	520	620
M22	500	700	840
M24	640	900	1080
M27	940	1320	1580
M30	1280	1800	2160
M33	1730	2430	2920
M36	2220	3120	3750
M39	2880	4050	4860
M42	3560	5000	6000
M45	4430	6230	7470
M48	4970	6950	8340
M56	6750	9450	11340
M64	8850	12390	14860
M72	18100	25340	30400

Where the gearbox is used in outdoor installations, they should be protected from direct sun, wind and rain. During operation, the free air flow along the surface of gearbox should not be obstructed. Wherever the lower parts of the gear housing are provided with an integrally cast and machined leveling seat, while aligning the gearbox with the prime mover and driven equipment, check the horizontal level by means of leveling seats. Correct leveling ensures proper lubrication of bearings.

After proper alignment, tighten the foundation bolts, preferably with the torque wrench to prevent over tightening. Check the level after tightening of the bolts. If the gearbox is mounted on base frame or steel structure, provide the stops to prevent axial and lateral movement of gear due to external forces.

6.3.2. Description of installation work

Remove the corrosion-preventive agent on the shafts using a suitable cleaning agent.



Do not allow the cleaning agent (i.e. benzene) to contact the shaft sealing rings. Observe the manufacturer's instructions for handling cleaning agents!

Ensure adequate ventilation near gearbox. Do not smoke near gearbox.

Fit and secure input and output drive elements (i.e. coupling components) on the shafts. If these are to be heated before fitting, refer to the dimension drawings in the coupling documentation for the correct joining temperatures.

Unless otherwise specified, the components may be heated inductively.



Protect shaft sealing rings from damage and heating to over 100°C (use heat protective screens to protect against radiant heat)

The components must be pushed smartly onto the shaft up to the position specified in the order specific dimension drawing.



Fit the coupling with the aid of suitable fitting equipment. The parts must not be driven on by abrupt force, as this may damage the gearbox. The shaft sealing rings and running surfaces of the shaft must not be damaged when pulling in the coupling parts.

When installing the drives, make absolutely certain that the individual components are accurately aligned in relation to each other. Inadmissibly large errors in the alignment of the shaft end to be connected due to angular and/or axial misalignments result in premature wear and/or material damage. Insufficiently rigid base frames or sub-structures can also during operation cause a radial and/or axial misalignment, which cannot be measured when the gearbox is at a standstill.

Gearbox whose weight requires the use of lifting, the gearbox must be attached at the points shown in section 4, "Transport and storage". If the gearbox is to be transported with add-on parts, additional attachment points may be required. The position of these attachments points is shown in the order related dimension drawing.

6.3.2.1. Fitting on a foundation frame



The foundation frame must be horizontal and plain. The gearbox must not be excessively stressed when tensioning the fastening bolts. The levelness of the gearbox standing surface is especially important, as the contact pattern of the teeth and the load of the bearings depend on it and the service life of the gearbox is affected by it.

All points on the gearbox standing surface must lie between two Imaginary parallel planes 0.1 mm per 1 m apart. Clean the under surface of the gearbox base and the foundation frame. Using suitable lifting bolt, place the gearbox on the foundation frame.



Use only the eyes provided to attach lifting equipment to the gearbox. Do not use the front threads at the shaft ends to attach slinging and lifting the gearbox for transport.

Tighten the foundation bolts to the specified torque if necessary, use stops to prevent displacement. Align the gearbox exactly with the input and output systems.

Record alignment dimensions. The report must be kept with these instructions.

6.4. Hollow shaft with parallel keyway

The end of the driven machine shaft must be provided with a parallel key to DIN 6885 Part 1 Form A. Furthermore, a centring hole to DIN 332 Form DS (tapped) should be provided (for the connection dimensions of the driven machine shaft, see dimension drawing in the gearbox documentation)

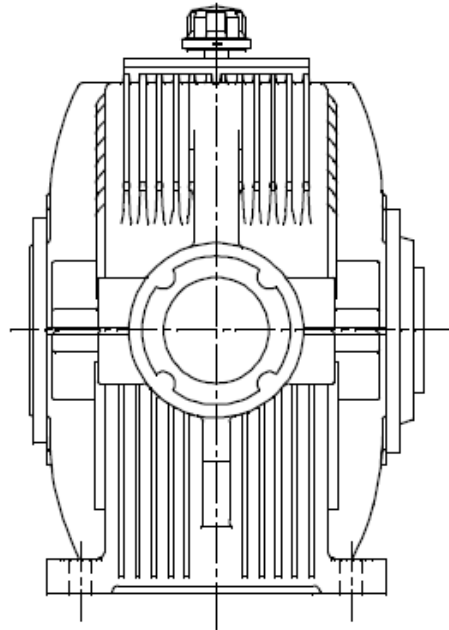


Figure 18: Hollow shaft with parallel keyway (gearbox model shown in image is for reference only)

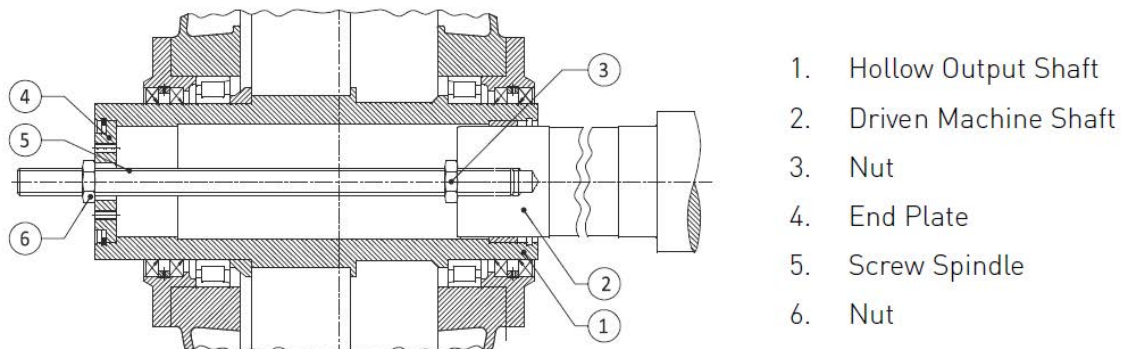


Figure 19: Procedure of mounting the gearbox with hollow shaft

Fit the gearbox by means of nut and threaded spindle support is provided by the hollow shaft.

Note:

The hollow shaft should be in alignment with the machine shaft so that no canting will take place.

Clean the rust coating from hollow shaft.

Clean the machine shaft.

Apply molykote / graphite on machine shaft for easy fitting and avoid rusting after fitting.

Fit the machine shaft.

Instead of using the shown nut and threaded spindle, i. e. hydraulic lifting device may alternatively be used.

Axial locking:

Depending on the design, secure hollow shaft axially on the machine shaft (circlip, end plate, screw and other)

Dismantling:

For disassembly of gearbox, please contact Sales / Service representative / Head office.

Remove axial safety device of hollow shaft.

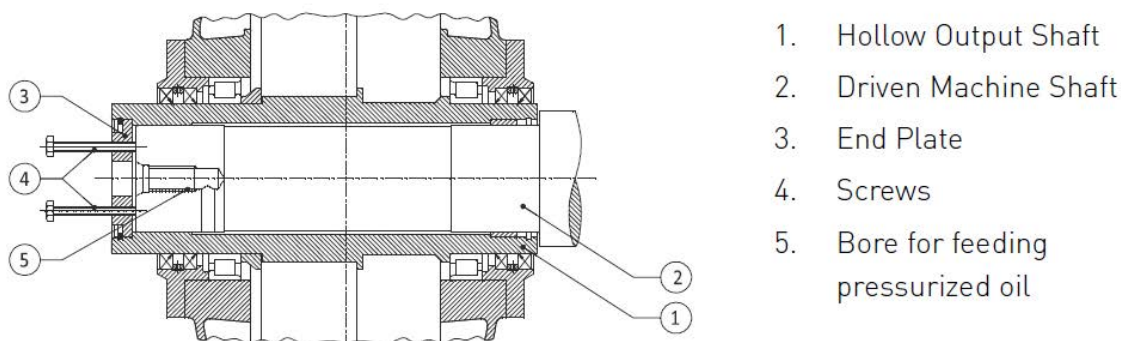
In case of formation of the rust at the seat surfaces, press penetrating oil into the void of the bore and thus against the seats by means of a pump or similar so that the gearbox can be pulled off more easily. Feeding the penetrating oil is carried out via bores in the machine shaft, refer figure or in the end plate.

Pull off the gearbox by means of the device according to figure after sufficient reaction time of the penetrating oil.

Note:

Make sure that there is no canting during pulling off.

Dirty solvents and cleaning rags are unsuitable for de-greasing.



6.5. Hollow shaft mounting with shrink disc

6.5.1. The shrink disc is delivered ready for installation



Do not disassemble shrink disc before first clamping.

In the area of the shrink disc seat, the bore of the hollow shaft as well as the machine shaft should be absolutely free of grease, as it will have negative effect on torque transmission. The safety of the torque transmission depends on it to a great extent.

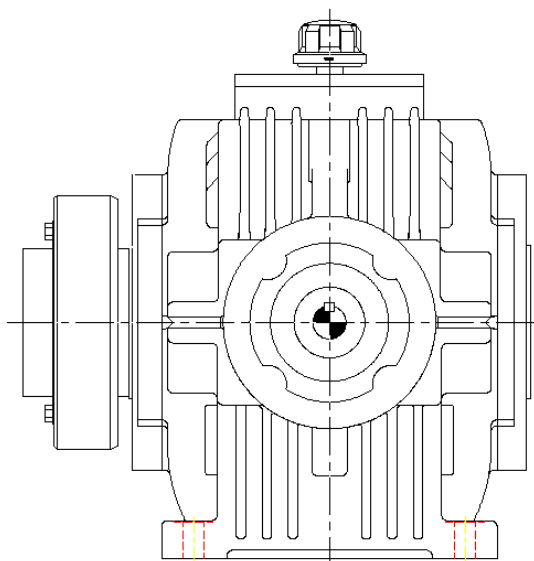


Figure 20: Hollow shaft mounting with shrink disc

6.5.2. Procedure of mounting the shrink disc

The exact mounting distance (W) of the shrink disc can be taken from the dimension drawing.

Note:

In the area of the shrink disc seat, the outer surface of the hollow shaft may be greased.

Never tighten the clamping screws before the machine shaft is installed, too.

The clamping screws are to be tightened in several turns one after the other.

Note:

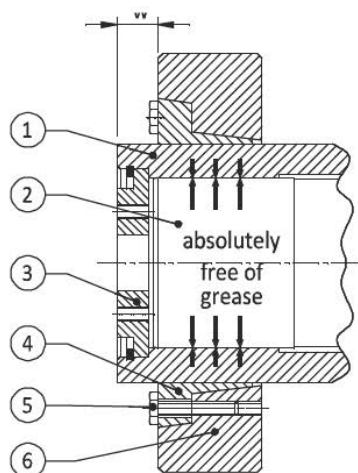
Never tighten screws crosswise.

Tighten all clamping screws until the front surfaces of the outer and inner race are flush.

Note:

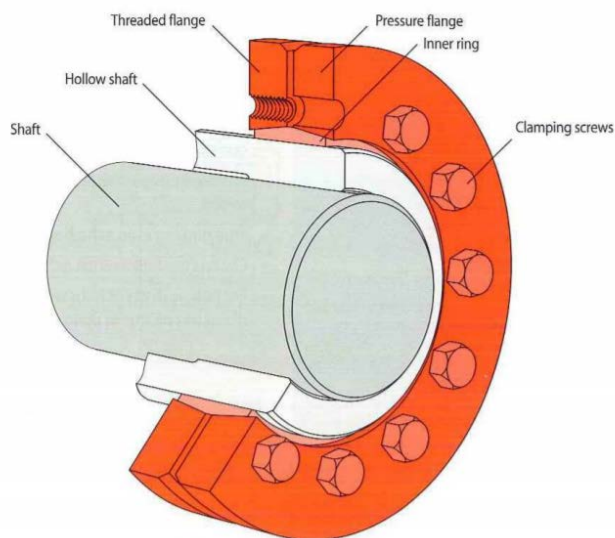
The correct clamping state can thus be checked visually.

To avoid overloading the individual screws, the maximum tightening torque. Table 3. Tightening torque must not be exceeded, what is more important is that the faces are flush. If this flushness cannot be reached during clamping, consultation is necessary



1. Hollow Output Shaft
2. Driven Machine Shaft
3. End Plate
4. Shrink Disc Inner Race
5. Clamping Screws
6. Shrink Disc Outer Race

6.5.3. Dismantling of the shrink disc



The loosening procedure is similar to that of clamping.

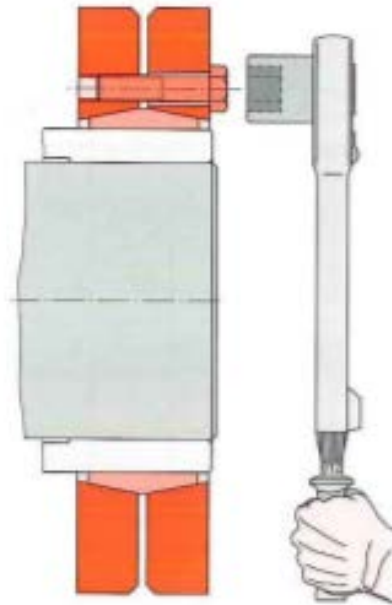
The clamping screws are to be loosed in several turns one after the other.

If the outer race does not come off the inner race by itself, some clamping screws can be unscrewed and screwed in into the neighboring forcing threads.

Un-clamping is then possible without any problem.

Pull of the shrink disc of the hollow shaft.

Clean and lubricate the shrink disc.



Loosened shrink disc do not have to be taken apart and lubricated again before being re-clamped. The shrink disc is only to be disassembled and cleaned when it is dirty.

Note:

Only the inner sliding surfaces of the shrink disc are to be lubricated again in the connection.

Refer separately provided operation and maintenance manual of the shrink disc along with gearbox documentation for more details.

6.6. Cooling coil

Cooling coil assembly consists of cooling coil, cooling coil cover, coil cup (welded with cooling coil inlet and outlet pipes), washer, hexagonal nut, o-ring, nipple, etc.

Check the leakages by passing the water through the coil outside itself before fitment to ensure any welding leakages or any other defect.

Insert the cooling coil in the cooling coil cover and ensure that the coil cup resetting on the faces of the cooling coil cover.

Insert the o-ring in another side of the cooling coil cover on the coil cup. Insert the washer and ensure that, the o-ring properly rests inside the chamfer given in the washer and tighten the hex nut fully. Fix the nipples at the end of the coil cups in inlet and outlets of cooling coil assembly.

Finally mount the cooling coil cover with cooling coil assembly in the gear housing. Pour the oil up to the recommended oil level (as per the oil level dipstick markings)

Ensure that, there is no leakage around the cooling coil cover and inlet or outlet coil cup assembly. Pass the water through the cooling coil at a pressure 5 kg/cm^2 for hydrostatic testing to ensure no leakages.

Drain the oil, clamp the cooling coil inside the sump suitably.

Note:

The lock nut (hexagonal nut) should not be loosened, once the cooling coil is fitted and tested as above.

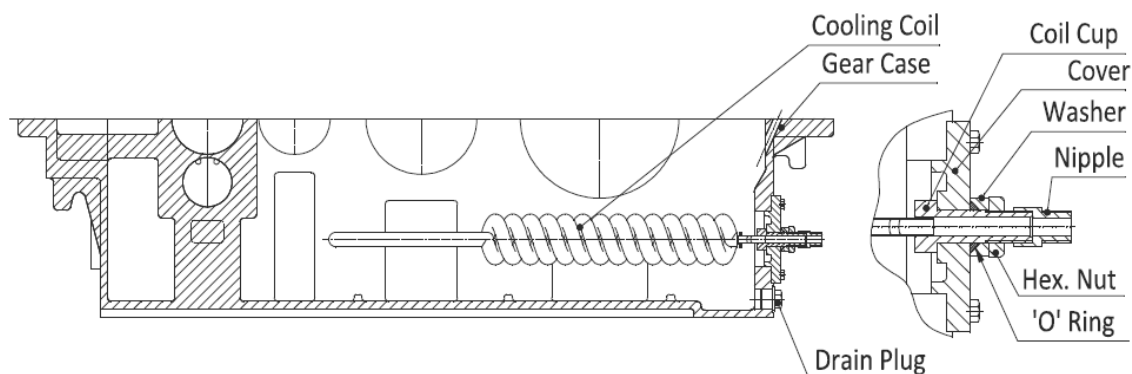


Figure 21: Procedure of mounting the gearbox with hollow shaft

6.7. Heater

For heating of lube oil due to cold ambient condition, the heater shall be used at the oil sump. Normally, the heater is used in connection with temperature sensors. The oil temperature set points are to be decided, and based on that heater can be switched-on and switched-off. When the heater is to be used, ensure that heater is completely submerged in oil sump.

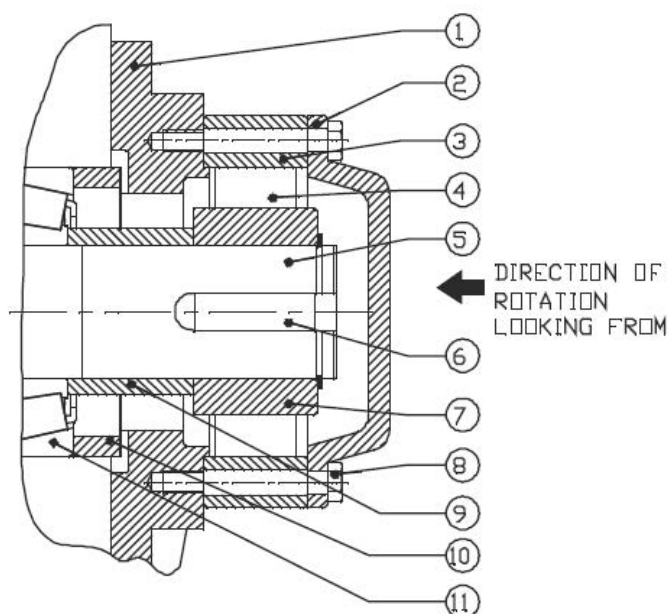
Refer separately provided operation and maintenance manual of the heater along with gearbox documentation for more details.

6.8. Holdback (backstop)

The function of the holdback is to prevent rotation in reverse direction at any time and to permit rotation of gearbox in one direction only. Holdback consists of outer race, inner race and cage assembly with sprags. At operating speed, sprags lift-off due to centrifugal action, so gets disengaged.

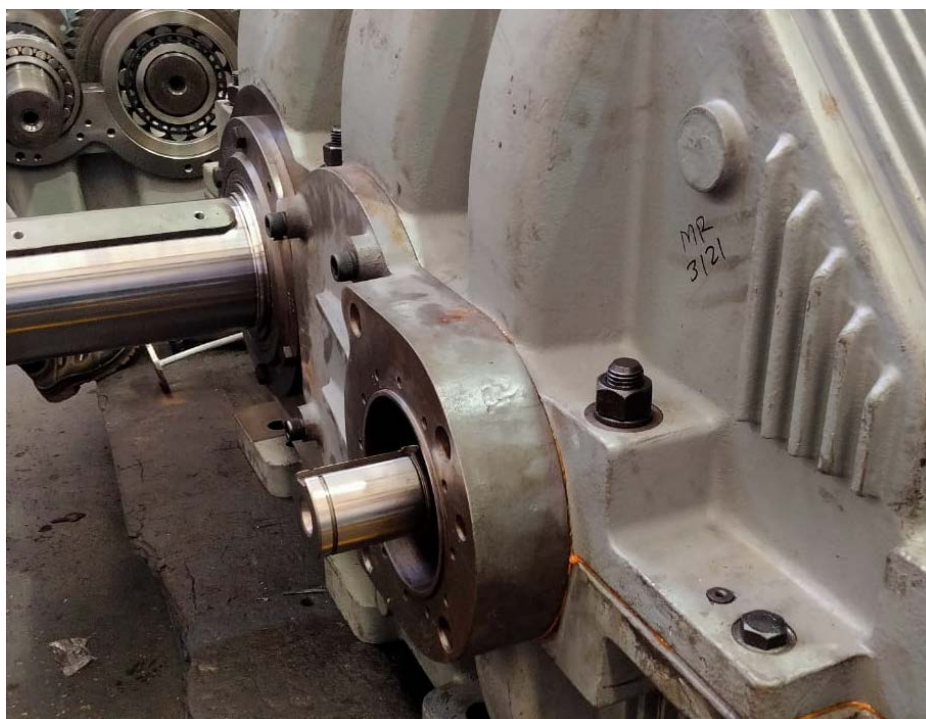
Following is the procedure for fitting of holdback at site (please also refer separate manual of holdback enclosed)

Procedure for fitting of holdback at site



1. Adapter Plate
2. End Cover
3. Outer Ring
4. Sprag Elements
5. Pinion Shaft
6. Key
7. Inner race
8. Screws
9. Distance Piece
10. Distance Piece
11. Bearing

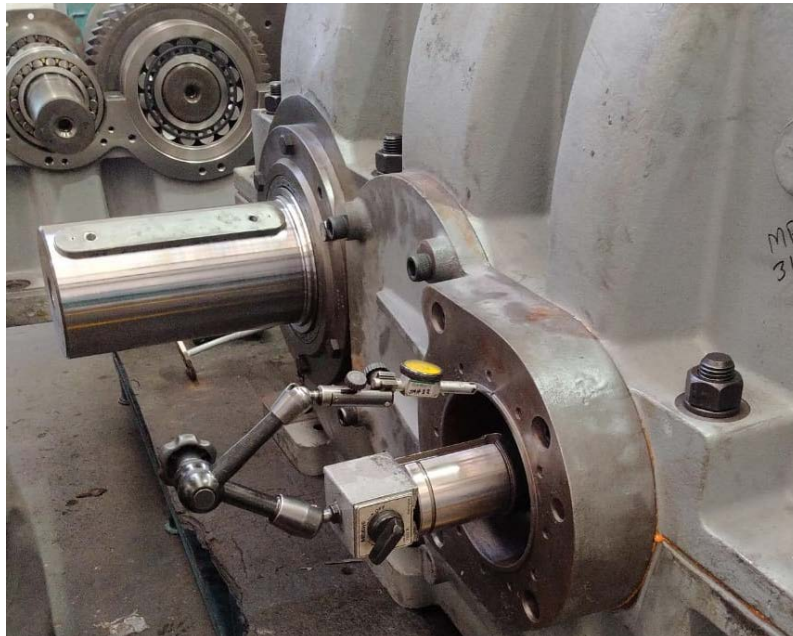
Clean shaft surface.



Check the length of the seating diameter of shaft and width of the inner race which should be equal so that circlip should seat properly in the groove after fitting the inner race in position.



Check the concentricity of the adaptor plate spigot, on which outer ring of the holdback fits, with reference to pinion shaft extension, on which inner race of holdback fits, with help of a dial gauge which should be within 0.05 mm.



Fit the key in position on shaft extension after removing the burrs.

Fit the inner race on the shaft with a slight hammer fit according to the direction of rotation required.



See the inner race is not fouling with adaptor plate when inner race is fully resting on the shaft step. If distance piece is coming in between inner race and bearing, same is to be adjusted before fitting by checking the dimensions from bearing and circlip groove and total width of the inner race.

Fill the grease EP2 in the inner race sprags, slide the outer ring of the holdback on to the inner race in such a way that all the sprags of inner race should be in its inner most position which can be achieved either by slightly rotating the outer ring on inner race while pushing inside or by wrapping and tightening a thin wire on inner race periphery.

Slide outer ring on to the spigot of adaptor plate, fill the grease once again and fit the end cover and all the screws by matching the holes of end cover, outer ring and adaptor plate.



Confirm for the free rotation of holdback by rotating the input shaft according to the direction of rotation required.

6.9. Fan

The fan is mounted on the high speed shaft of the gearbox and protected by a fan cowl.



The fan draws air through the protective grille of the fan cowl and causes it to flow through its lateral air ducts along the gearbox housing, thus dissipating a certain amount of the housing heat.



In the case of gearbox, which are fitted with a fan, adequate clearance for the cooling in the form of intake cross-section must be provided when fitting the guard for the coupling.

6.10. Couplings and clutches

As a rule, flexible couplings or safety slip clutches are provided for the drive of the gearbox. If rigid couplings or other input and/or output elements, which create additional radial and/or axial forces (i.e. gear wheels, belt pulleys, disk flywheels, hydraulic couplings) are to be used, this must be agreed by contract. The input and output shafts of gearbox are provided with a tapped hole at the end faces. This

facilitates fitting various items like couplings, belt pulleys, sprockets, overhung pinions etc.

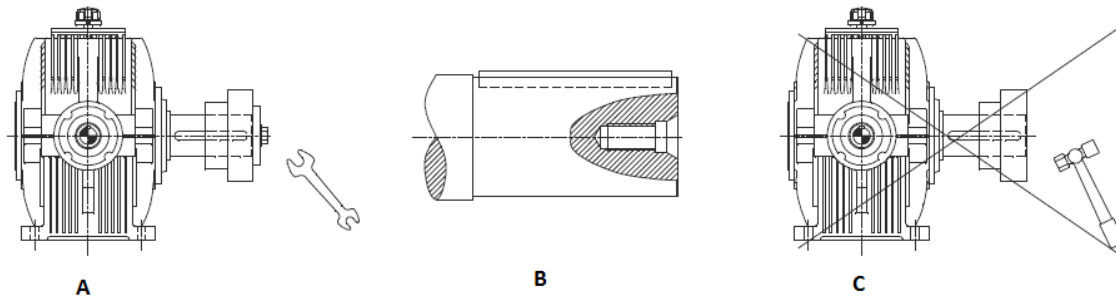


Figure 22: Gearbox model

Wherever it is decided to fit the above items by shrinking or by heating, follow the specifications given by the manufacturer. The care should be taken to protect the oil seals for any damage. Under no circumstances, couplings or similar items should be mounted by giving heavy blows or impacts. This may cause damage to shafts, bearings, oil seals, etc. (refer *Figure 22: Gearbox model*).



Couplings must be balanced in accordance with the specifications in the pertinent instructions manual! For maintenance and operation of the couplings, refer to the specific operating instructions for the couplings.

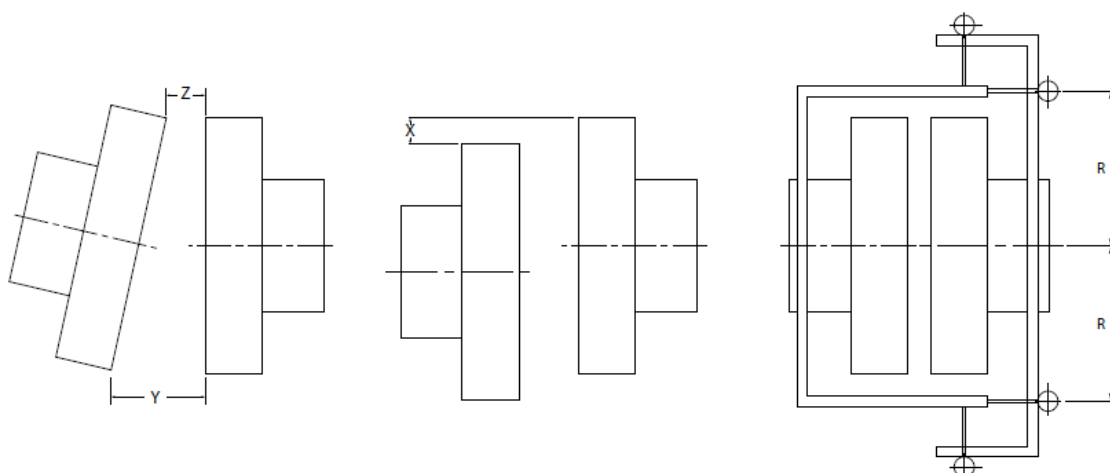


When installing the drives, make absolutely certain that the individual components are accurately aligned in relation to each other. Inadmissibly large errors in the alignment of the shaft end to be connected due to angular and/or axial misalignments result in premature wear and/or material damage.

Insufficiently rigid base frames or sub-structures can also during operation cause a radial and/or axial misalignment, which cannot be measured when the gearbox is at a standstill. For permissible alignment errors, in case of couplings supplied by ELECON, please refer to the operating instruction manuals for the couplings. If you use couplings manufactured by other manufacturers, ask these manufacturers which alignment errors are permissible, stating the radial loads occurring. Increased system service life and reliability and reduced running noise can be achieved through the least possible radial and angular misalignment.

The coupling parts may get out of alignment due to imprecise alignment during assembly or installation or during operation of the system due to:

- Heat expansion, shaft flexure.
- Too weak machine frames, etc.

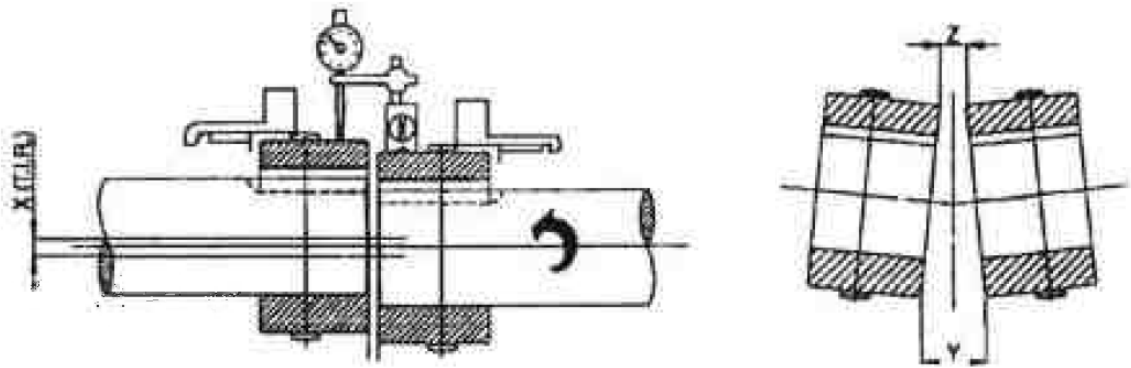


Check the eccentricity by means of a dial indicator as shown in above figure. The reading should be within 0.10 mm. It is important to keep the dial indicator support rigid, otherwise the weight of dial indicator will cause deflection and consequently inaccurate reading will be obtained.

Table 4. Permissible values of misalignment

Rigid coupling		
Outer diameter range	Parallel misalignment	Recommended installation
mm	mm	mm
upto 315	0.052	0.052
315-500	0.063	0.063
500-800	0.080	0.080
800-1000	0.090	0.090

When 'R' is larger or smaller than 200 mm (8"), the dial gauge readings shall vary and must be recalculated in proportion to specified angular misalignment values.


Table 5. Flexible coupling

Flexible coupling				
Coupling size in mm	Gap	Angularity	Eccentricity	
	F	Recommend- ed difference in gap F	Recommend- ed parallel misalignment (X)	Maximum parallel misalignment (X)
	mm	mm	mm	mm
85-180	3	0.20	0.03	0.15
181-320	5	0.35	0.04	0.20
321-500	6	0.55	0.05	0.25
501-900	12	1.00	0.05	0.25
901-1250	14	1.50	0.05	0.25
1251-1600	14	2.00	0.05	0.25

Table 6. Gear coupling

Gear coupling				
Coupling size in mm	Gap	Angularity	Eccentricity	
	F	Recommend- ed difference in gap F	Recommend- ed parallel misalignment (X)	Maximum parallel misalignment (X)
	mm	mm	mm	mm
85-180	3	0.20	0.03	0.15
181-320	5	0.35	0.04	0.20
321-500	6	0.55	0.05	0.25

Gear coupling				
Coupling size in mm	Gap	Angularity	Eccentricity	
	F	Recommend- ed difference in gap F	Recommend- ed parallel misalignment (X)	Maximum parallel misalignment (X)
	mm	mm	mm	mm
501-900	12	1.00	0.05	0.25
901-1250	14	1.50	0.05	0.25
1251-1600	14	2.00	0.05	0.25

Gear coupling										
Type- s ED, ET, ER	Speed (rpm)									
	0-250		250-500		500-1000		1000-2000		2000-4000	
	X max	(Y-Z)	X max	(Y-Z)	X max	(Y-Z)	X max	(Y-Z)	X max	(Y-Z)
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
130- 1000	0.25	0.25	0.25	0.25	0.25	0.25	0.15	0.15	0.15	0.10
1600- 6200	0.50	0.60	0.50	0.60	0.25	0.35	0.15	0.20	0.08	0.10
8400- 1740- 0	0.90	1.00	0.50	0.75	0.25	0.35	0.15	0.20	—	—

Gear coupling									
Types ED, ET, ER	Speed (rpm)								
	0-250		250-500		500-1000		1000-2000		
	X max	(Y-Z)	X max	(Y-Z)	X max	(Y-Z)	X max	(Y-Z)	(Y-Z)
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
25200 to 56000	0.90	1.00	0.50	0.75	0.25	0.35	0.15	0.20	
75000 to 110000	1.50	1.50	1.00	1.00	0.50	0.50	—	—	

6.10.1. Over-running clutch

When the driven shaft rotates faster than drive shaft, the over-running clutch will mechanically disconnect the two shafts. So the over-running clutch overruns the process, allowing the driven shaft to spin freely without the drive shaft controlling it. Technically the over-running clutch transmits torque in one direction only.

Refer separately provided operation and maintenance manual of the over-running clutch along with gearbox documentation for more details.

6.10.2. Spiral jaw clutch

Spiral jaw clutch is used for moderate speeds and where disengagements are not too frequent. Normally, it is used in-between auxiliary drive and main drive. Due to high inertia, auxiliary drive is used to start the main drive at very slow speed. When entire drive is in operation, main motor can be started. Due to difference in the relative speeds of the two coupling halves, the sliding half slides back moving away on its shaft, means fixed half over-rides the sliding half. Spiral jaws transmit power in one direction only.

Refer separately provided operation and maintenance manual of the spiral jaw clutch along with gearbox documentation for more details.

6.10.3. Thruster brake

Thruster brake is normally installed at input side of the gearbox. Normally, when there is no supply to thruster, brake is in applied condition. When supply given to thruster, brake gets released.

Refer separately provided operation and maintenance manual of the thruster brake along with gearbox documentation for more details.

6.11. Installation

Quiet running and long service life of the gearbox largely depend upon correct installation.

Installation should be carried out in such a way that inspection cover and drain plugs are readily accessible. Clients are requested to make provision for suitable draining pan below the oil outlet.

6.11.1. Special instruction for the installation of gearbox on structures

The best practice is to install the gearbox on rigid concrete foundations; however, in some applications the gearbox is required to be mounted on machinery structures especially in cement plants, chemical plants, etc.

While the gearbox is installed on structural foundation, care should be taken that gearbox is mounted on a combined base frame with driving motor and sufficient access should be there to properly align the input and output couplings.

The most important point is that the supporting structure should be sufficiently strong so that no undue vibrations are generated.

Note that excess vibrations are dangerous to the gearbox and may cause premature failure of the gearbox.

6.11.2. Flushing procedure

It is always desirable to undertake a schedule of flushing the gearbox and internal piping of the gearbox which is connected to the lube system. The flushing is nothing but circulating in and out the flushing oil in the gearbox and piping under recommended pressure, which is normally minimum 1 Kg/cm². For flushing, the light low viscosity oil such as “Lubrex Flushing 22” of Indian oil or equivalent (dynamic viscosity = 19-22 cst at 40°C) can be used.

For flushing purpose, the lube system can be used for pumping the flushing oil through the pipes and the housing. If no lube system is supplied along with gearbox, separate pump filter lube system shall be arranged by customer to perform the flushing operation.

After flushing, which normally takes 6 to 8 hours, there should not be any accumulation dirt in the filter, which can be observed every 2 to 3 hours of flushing.

6.11.3. Procedure for adjustment of spiral-bevel pair in assembly when the gearbox is opened for any spare replacement

Prepare the sub-assemblies as per the drawing with bearings, distance pieces and gear internals.

Debur and clean the gear housing, sub-assemblies thoroughly.

Normally, sub-assemblies are with taper roller bearings, instead of covers side clamps are to be fitted on sides of input and spiral bevel wheel assembly bore during adjustment.

Put the bevel pinion and spiral bevel wheel sub-assemblies as per the handing required and match the face width of both the pinion and wheel by moving the subassemblies with screws provided on side clamps during which dummy spacer ring is to be inserted between locating ring and pair bearing outer race of the bevel pinion assembly.

Ensure that there will be sufficient backlash so that both the assemblies rotate smoothly.

Now apply mechanical blue on bevel pinion teeth on profile of 4 to 5 teeth and rotate to get the contact on mating spiral bevel wheel if the contact pattern is not as per the lapping and hardcut contact (i.e. minimum 60% of tooth flank starting from the 'toe' side of spiral bevel pairs), move the bevel pinion axially, by removing or adding dummy spacer ring till proper contact is achieved.

Then adjust the backlash by moving spiral bevel wheel assembly in or out as per the standard (use enclosed recommended values) and also take the dimension of the dummy spacer ring. After making a new ring insert this in position in two pieces. Under this condition, take the spigot dimensions for input and spiral bevel wheel assembly with 'zero' clearance.

After machining the cover spigots for the covers and once again check, contact, backlash and axial clearance.

Table 7. Guidelines for backlash relative to normal module of spiral bevel

Normal module (Mn)	Backlash (mm)
0.3 - 1.0	0.03 - 0.06
1	0.06 - 0.08
2	0.08 - 0.11
3	0.10 - 0.13
4	0.12 - 0.14
5	0.14 - 0.17
6	0.15 - 0.18
7	0.16 - 0.19
8	0.18 - 0.20
8 - 10	0.20 - 0.25
10 - 12	0.25 - 0.30
12 - 14	0.30 - 0.35
14 - 16	0.35 - 0.40
16 - 18	0.40 - 0.45
18 - 21	0.45 - 0.50

7. START-UP

Follow the instructions given in: *Chapter 3.SAFETY INSTRUCTIONS*



The gearbox must not be started up, if the required instructions are not available.

7.1. Procedure before start-up

7.1.1. Removal of preservative agent



Before restarting the gearbox the screw plug (if fitted) must be replaced with the breather plug. Remove adhesive tape from the labyrinths (if present)

Oil draining point:

Place suitable containers under the oil draining points.

Unscrew the screw plug and open the oil drain cock. Remove the remaining preservative agent and/or running-in oil from the gearbox using a suitable container. Dispose of remaining preservative agent and/or running-in oil in accordance with regulations.



Remove any oil spillage immediately with an oil binding agent. The oil must not come into contact with the skin (i.e. the operator's hands). The safety notes on the data sheets for the oil used must be observed here!

Close the oil drain cock. Screw in screw plugs into the oil drain cocks again.

A detailed view of the gearbox can be obtained from the drawings in the gearbox documentation.

7.1.2. Filling with lubricant

Remove the fastening screws on inspection and/or assembly cover. Remove

cover with seal from housing (seal will be used again). Visual check of the interior parts for corrosion.



If corrosion is found, contact the ELECON customer service. Using a filter, fill the gearbox with fresh oil up to the upper mark on the oil-sight glass or dipstick .

Information on the type, quantity and viscosity of the oil is given on the name plate on the gearbox. The oil quantity shown on the name plate is to be understood as an approximate quantity. The marks on the oil sight glass or dipstick indicate the prescribed oil quantity to be put in.

In case of gearbox fitted with lube system, the oil circuit must also be charged with oil.

7.1.3. Checking after starting

Check vibration, unusual noise, oil leakage and record temperature every 15 minutes (wherever applicable) during commissioning.

Check operation of oil pressure relief valve. Normal oil pressure range is 0.8 to 2 kg/cm². Check tightness of all parts after load running. Maximum oil operating temperature is 93° C, when using specific lubricants. If the oil operating temperature is observed above 93°C, contact Sales / Service representative / Head office.

7.1.4. Trial running

After installation and checking, please keep following points in mind :

During the trial run of the gearbox, put it into no-load operation by connecting the motor and the gearbox. To ensure smooth operation and long life, continue no-load operation for more than 3 hours. During this period, the gearbox and driven machine should be disconnected, if possible.

Connect the gearbox with driven machine. Based on application, it is advisable to start the operation at reduced load, and gradually increasing the load under constant monitoring till the full load is reached. Pay attention to noise, vibration, temperature and current consumption, if these operating parameters are in normal range, the gearbox can be run for continuous operation at full load.

7.1.5. Oil-level monitoring system

This monitoring is designed as a standstill monitoring (gearbox stop) and check the level of the oil visually before the gearbox is started up. Ensure the lube system is charged with oil.

8. OPERATION

Follow the instructions given in:

Chapter 3.SAFETY INSTRUCTIONS

Chapter 9.FAULTS, CAUSES AND REMEDY

Chapter 10.MAINTENANCE AND REPAIR

8.1. General

To achieve a satisfactory and trouble-free operation of the equipment, be certain to observe the operating values specified in chapter 1 (technical data) as well as the information given in the operating instructions of the oil-supply system, if applicable.

8.2. Irregularities



If irregularities are found during the operation or if the monitoring device in the oil lube system, triggers alarm.

Determine the cause of the fault, using chapter 10 (faults, causes and remedy). If the cause cannot be found, a Service Engineer from one of our customer service centers should be called in.

8.3. Auxiliary drive

Auxiliary drive can be installed for any maintenance work at lower output speed at main gearbox and for few applications, to rotate driven equipment by quarter or half revolution if jamming happened.

8.3.1. Auxiliary drive with spiral type jaw clutch coupling (or over-running clutch)

Normally, auxiliary drive consists of electric motor that is connected to auxiliary gearbox by input coupling. Thrust brake (or disk brake) is also installed at input side, means between auxiliary gearbox and electric motor. At the output shaft of gearbox, spiral type jaw clutch coupling (or over-running type clutch) is installed, which would connect the auxiliary drive with main motor's rear end or auxiliary shaft from main gearbox.

The main motor at other end is connected with main gearbox by coupling. The main gearbox is connected with driven machine (kiln, ball mill etc)

In normal operation of main drive, the auxiliary drive is disconnected. Thruster brake is applied that will not allow auxiliary input to rotate. The spiral type jaw clutch is not in engaged condition.

When main drive is to be started for maintenance purpose or to run at lower speed, the spiral type jaw clutch needs to be engaged manually. After that, give power supply to thruster to disengage the brake as well as give power supply to auxiliary motor to run the auxiliary gearbox. After auxiliary drive is in operation and smooth running of main drive at lower speed, the main motor can be started, and when speed is gradually increased, the spiral jaw clutch will get disengaged by sliding of hub on output shaft of auxiliary gearbox.

With automated over-running clutch, when auxiliary drive is started, it connects to main drive as clutch engages due to lower speed. When main motor is started and gradually speed is increased at full speed, over-running clutch sprag will lift-off, and this makes auxiliary drive and main drive separated.

For spiral type jaw clutch having manual operation, limit switch needs to be installed to have signal to stop the electric motor of auxiliary drive as well as apply the brake at input of auxiliary gearbox to stop. This limit switch also shows status of engagement or disengagement of auxiliary drive to main drive.

Never ever try to engage the spiral jaw clutch when the main drive is in operation. Ensure the disengagement of auxiliary drive when main motor speeds up. If spiral jaw clutch does not disengage, it would severely damage the auxiliary drive and would result into major accident at site.

8.3.2. Auxiliary drive with chain sprocket arrangement

When chain sprocket arrangement is used to connect the auxiliary drive to main gearbox, ensure that chain is only assembled when both drives are at standstill by ensuring no power supply to main as well as auxiliary motor, and brakes are in applied condition. After installing chain, give power supply to auxiliary motor and run the auxiliary drive, which in turn would run the main drive at slow speed. Once the maintenance work is over, stop the auxiliary motor supply and apply brake on auxiliary drive.

Disengage the chain from sprockets and enclosed the guard that give signal that no chain and disconnection of auxiliary drive to main drive. After having this signal only, main motor can be started.

9. FAULTS, CAUSES AND REMEDY

Follow the instructions given in: Chapter 3.SAFETY INSTRUCTIONS and Chapter 10. MAINTENANCE AND REPAIR Guidelines.

1. General information on trouble / fault and malfunctions.
2. Possible faults.

Table 8. Faults, causes and remedy

Sr. No.	Problem	Problem description	Remedy
1	Oil leakage	Oil seal damaged	Replace oil seal
		Looseness in cover joint bolts	Tighten bolts uniformly with specified torque
		Broken indicator glass	Replace with new one
		Breather plug jamming	Clean or replace
		Excessive oil level	Maintain oil level as per indicator or dipstick marking
		Misalignment	Correct the alignment
		Wrong position of breather plug	Correct the breather plug position
		Improper use of sealant at joints	Refit joints by applying proper sealant, loctite or equivalent make
		Axial play / run-out of shaft	Remove axial play / run-out
		Rough surface at oil seal seat area	Change the position of oil seal seating / replace shaft
2	Abnormal sound	Foreign material into the gearbox	Remove material / check damage / replace part / replace oil
		Misalignment of shafts	Align shaft centres
		Loose fasteners / components	Tighten by specified torque / replace or tighten the component

Sr. No.	Problem	Problem description	Remedy
		Less oil / contaminated oil	Replace the oil
		Internal damaged	Check / correct / if required replace / call Service Engineer
		Bearing damaged / axial play	Replace defective bearing / remove axial play
		Rust on gear internals	Flush / overhaul gearbox
		Noise occurs due to driven machine or prime mover	Suggest client to take corrective action
		Dry oil seal	Put grease / oil at oil seal leap area
		High spot on gear teeth	Remove the high spot
		Damaged coupling	Replace the coupling
		Improper backlash / contact	Correct it
3	Over heating	Excessive lubricant / low oil level	Fill lubricant to specified level
		Misalignment	Make proper alignment
		Over load	Decrease the load to the specified value
		Improper ventilation	Provide air circulation
		Breather plug choked	Clean the breather plug
		Improper preloaded bearing	Correct it
		Damaged bearing / oil seals	Replace bearing / oil seals
		Abnormal tooth wear	Replace worn out components

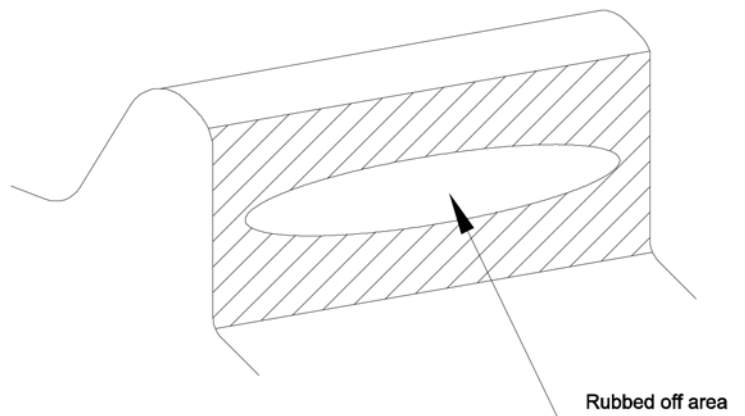
Sr. No.	Problem	Problem description	Remedy
		Lubricant incorrect / over aged	Replace with proper lubricant
		Defective oil pump	Check / correct or replace the pump
		Non-working of heat exchanger	Rectify it or replace
4	Input / output shaft not rotate	Damaged bearing / gear parts	Replace the damaged component
		Due to problem in driven machine	Inform the manufacturer
		Foreign material into the gearbox	Remove material and replace oil
		Defective back stop	Correct / replace back stop
5	Vibration	Misalignment	Correct the alignment
		Unbalanced / loose coupling / pulley	Correct it
		Improper foundation	Rectify foundation
		Looseness of fasteners of housing joints / foundation	Tight the loose bolts / fasteners
		Run out / play in shafts	Correct the same
		Damaged gear internals	Replace the same

10. MAINTENANCE AND REPAIR

10.1. Contact pattern checking

Refer following procedure for checking of tooth contact when gearbox is dismantled and new spare replacement.

- Clean the teeth of all pinions, apply uniform layer of mechanical blue or equivalent paint lacquer on complete length of gear tooth profile for two consecutive teeth at 3 or 4 places equidistant from each other. Rotate the pinion and apply some force on the gear wheel, verify the contact on the gear wheel teeth. The acceptable contact area shall be more than 35% for profile and lead corrected gears (Not applicable for planetary stage).



10.2. General maintenance

Note:

Keep record of all below activities.

Trouble	Period	Actions / remark
Oil temperature	Daily	
Oil level	Daily	
Noise	Daily	
Oil leakage from gearbox	Daily	
Oil condition for any contamination	Approx. 500 hours or quarterly	
First oil change	After 500 hours	
Oil change Intervals	8000 hours or every 18 months	
Clean the breather plug	Quarterly	
Clean filters	Every 2 months	
Change grease in labyrinth seal	3000 hours or every 6 months	
Check condition of heat exchanger	3000 hours or every 6 months	
Check pipeline, joints, flanges, bolts	Every 6 months	
Check pressure gauges and switches	Every 6 months	
Check tightness of case joining bolts	Every 3 months	Depend on application / site conditions
Check gear internals	Every 8000 hours or in 1 year	At the time of oil change
Check shaft alignments	Every 8000 hours or in 1 year	When gearbox dismantled and reassembled
Check vibration level	Every 6 months	

11. SPARE PARTS, CUSTOMER-SERVICE ADDRESSES

11.1. Stocking spare parts

By stocking the most important spare and wearing parts on site, you can ensure that the gearbox is ready for use at any time. To order spare parts, refer to the spare part list.

We guarantee only the original spare parts supplied by us. Non-original spare parts have not been tested or approved by us. Non-original parts may alter technical characteristics of the gearbox, thereby posing an active or passive risk of safety. ELECON will assume no liability or guarantee for damage caused by spare parts not supplied by ELECON. The same applies to any accessories not supplied by ELECON.

When ordering the spare parts, always state the following:

Serial number, Gearbox type and size, Part number.

11.2. Spare parts and customer service addresses

When ordering spare parts or requesting a service specialist, please contact ELECON.

ELECON recommends holding following key components in stock.

1 set of Pinions / Wheels

1 set of Bearings

1 set of Oil seals

1 set of Instruments

12. ARRANGEMENT DRAWING

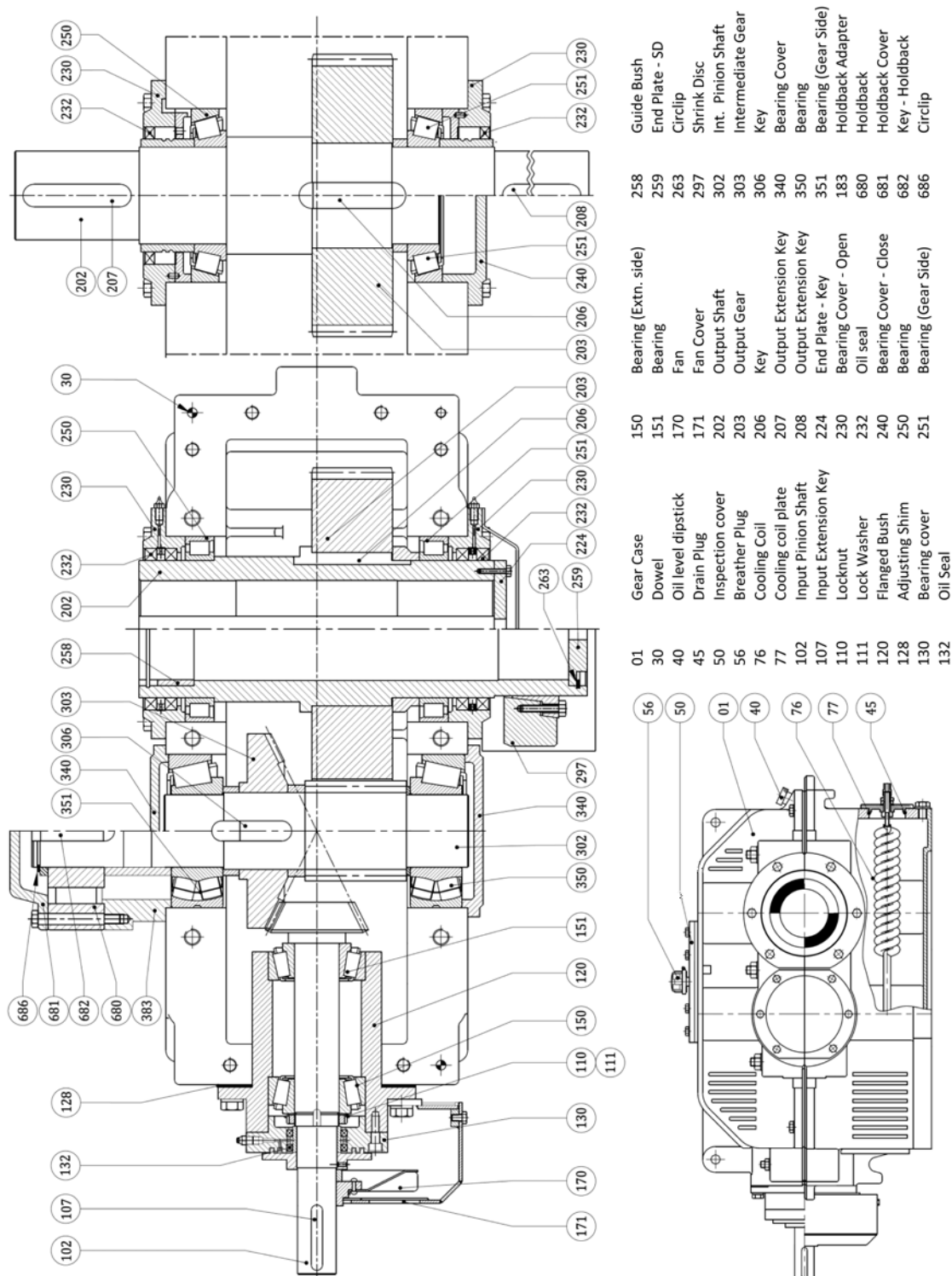
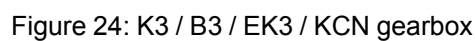


Figure 23: K2 / B2 / EK2 / KBN gearbox



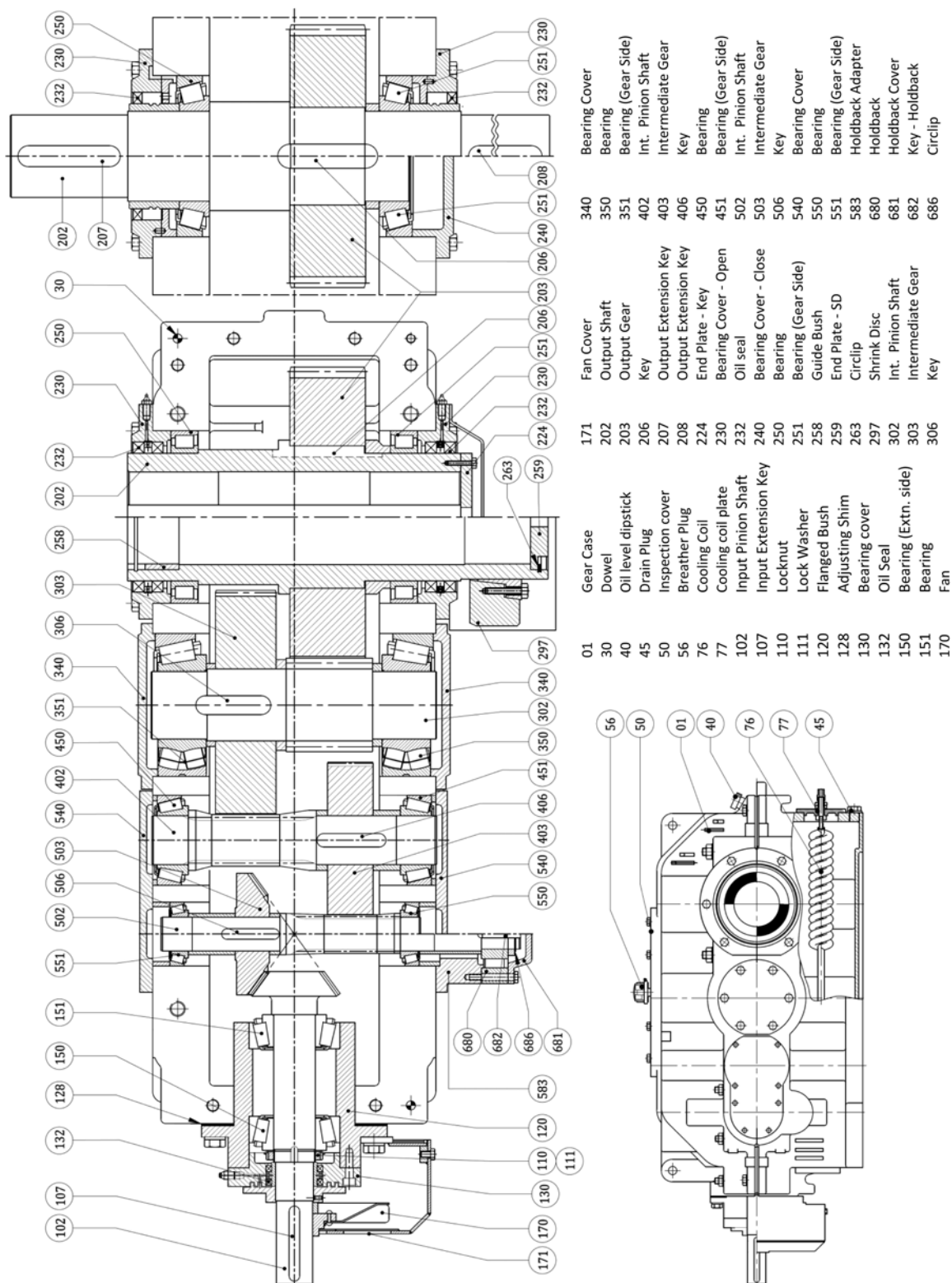


Figure 25: K4 / B4 / EK4 / KDN gearbox

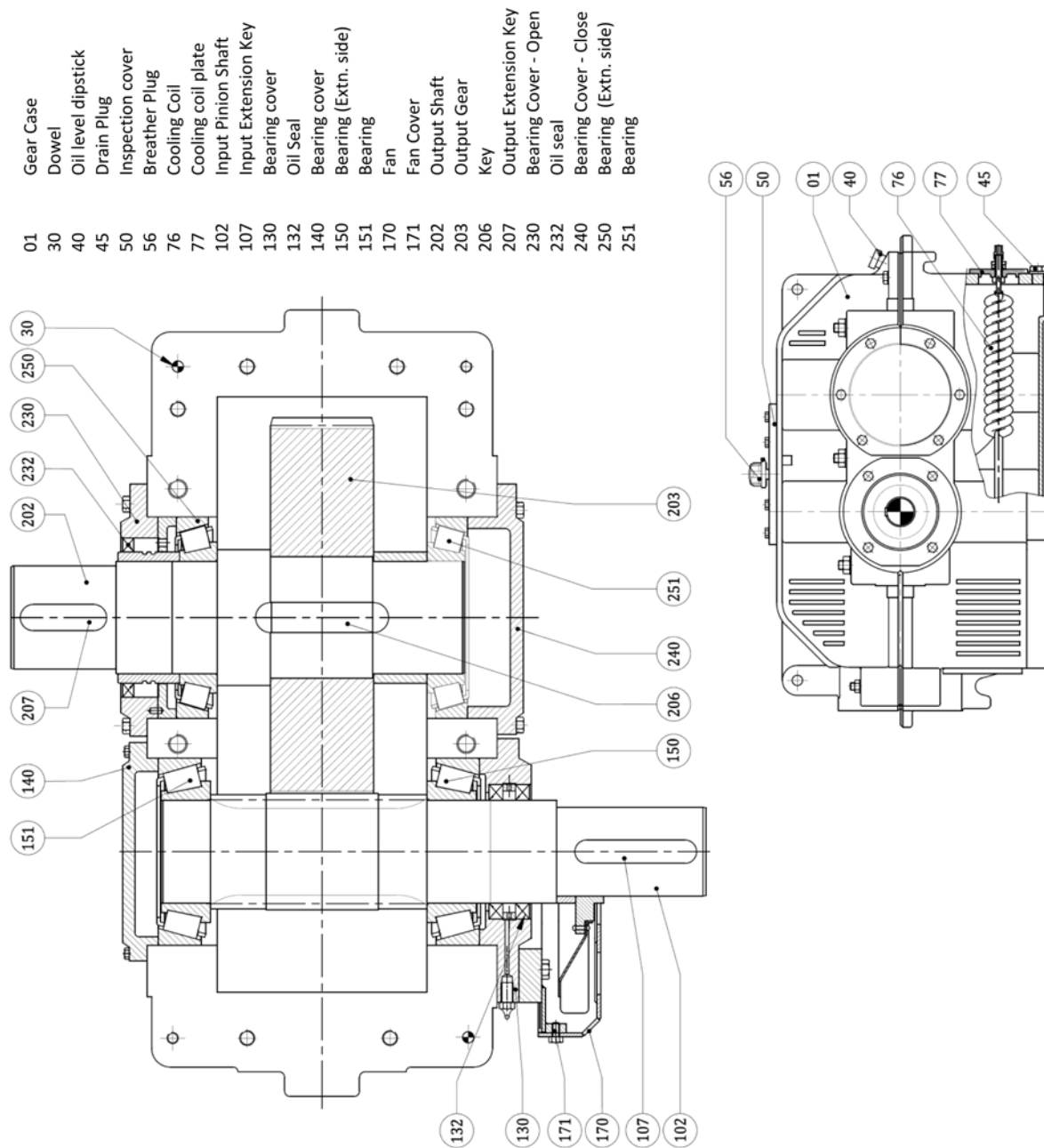


Figure 26: S1 / H1 / E1 / SAN gearbox

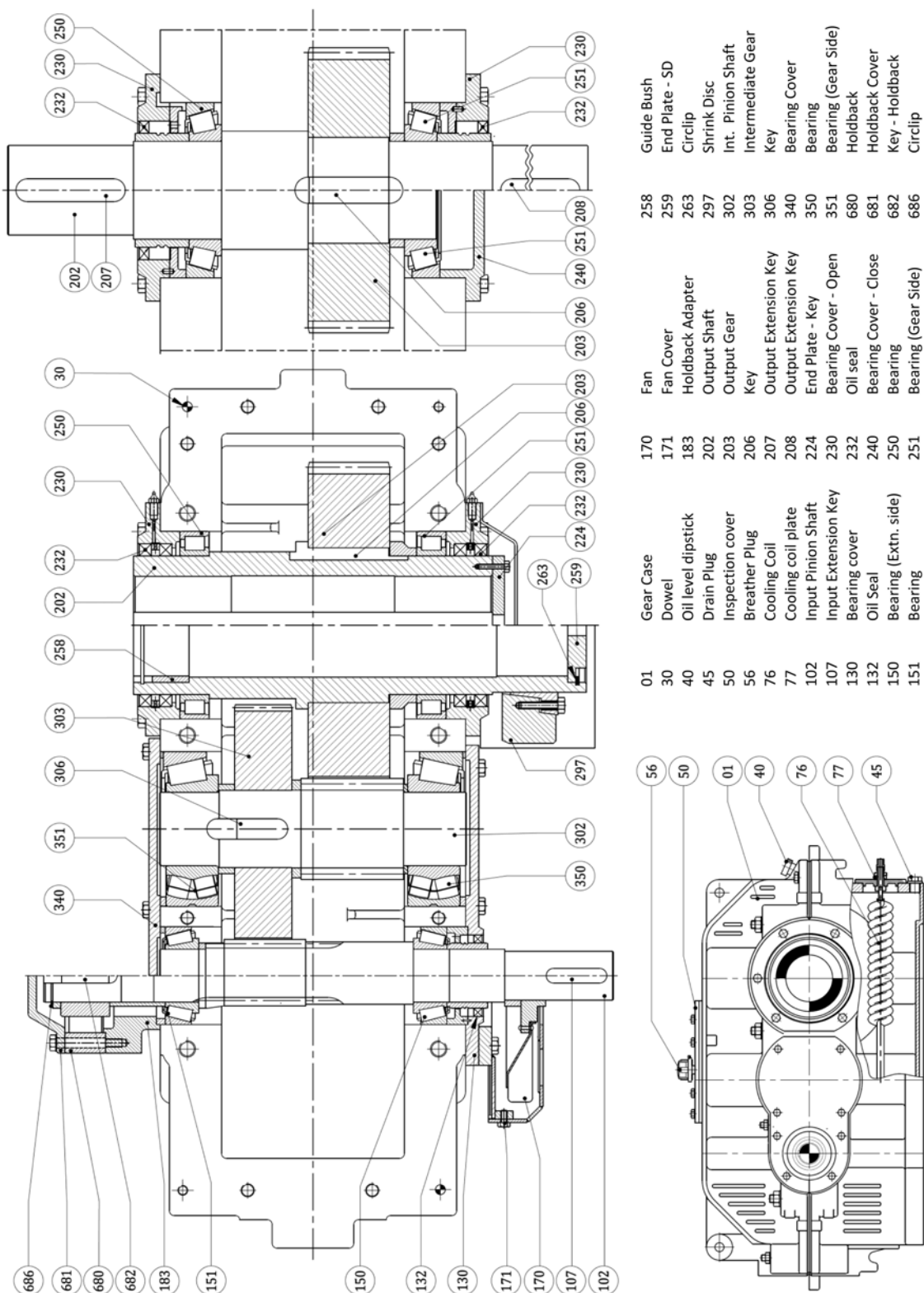
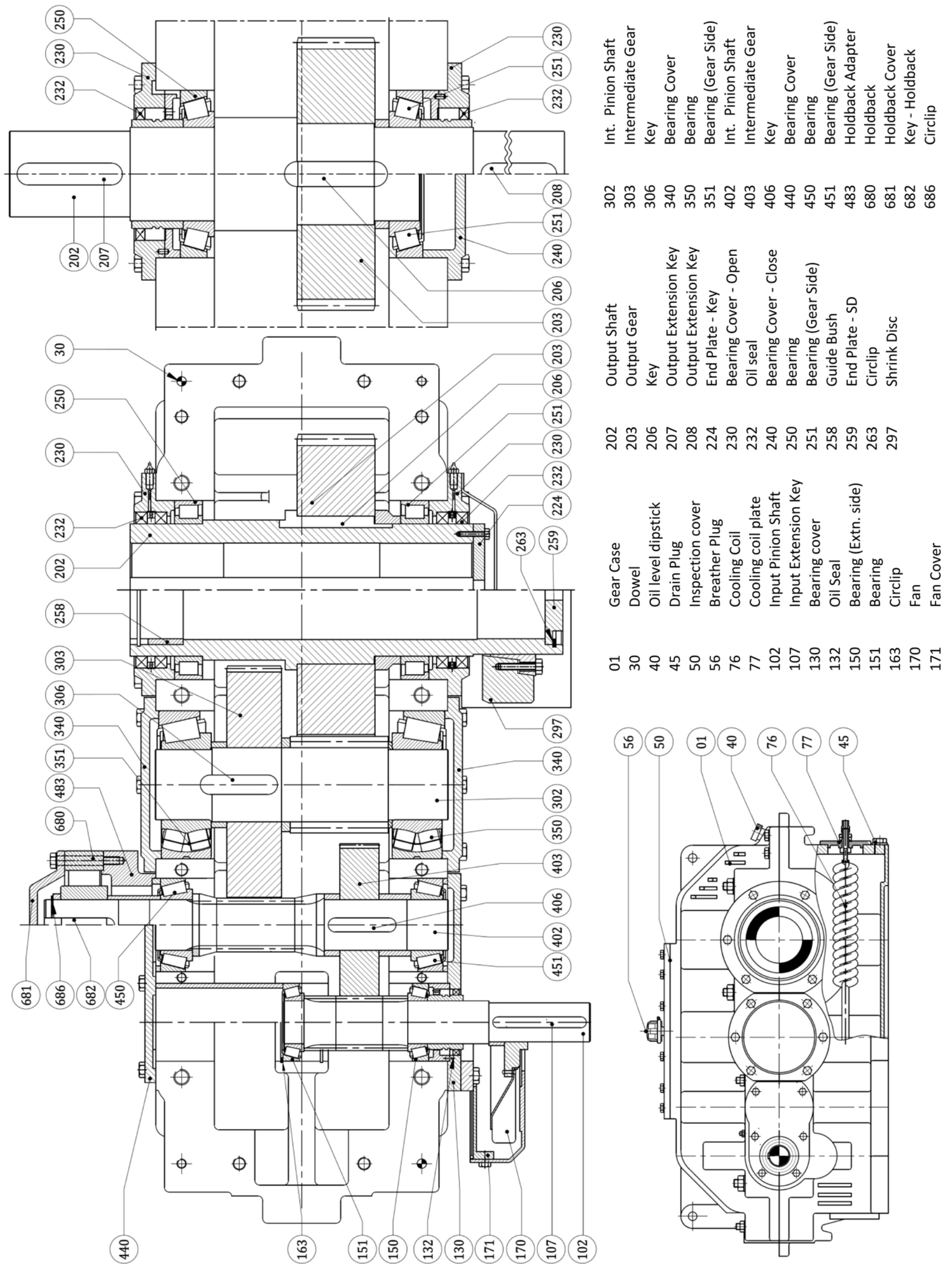


Figure 27: S2 / H2 / E2 / SBN gearbox



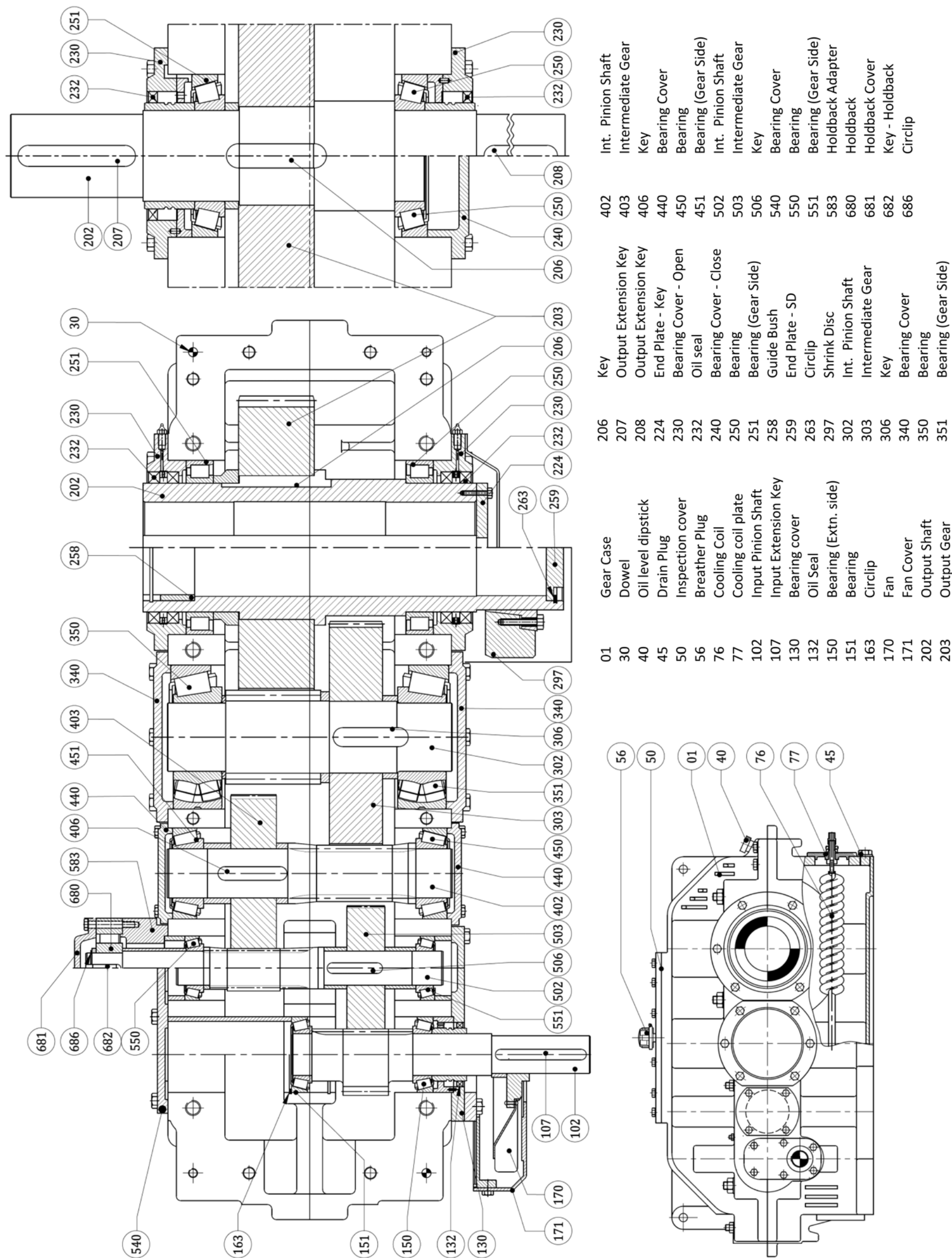


Figure 29: S4 / H4 / E4 / SDN gearbox

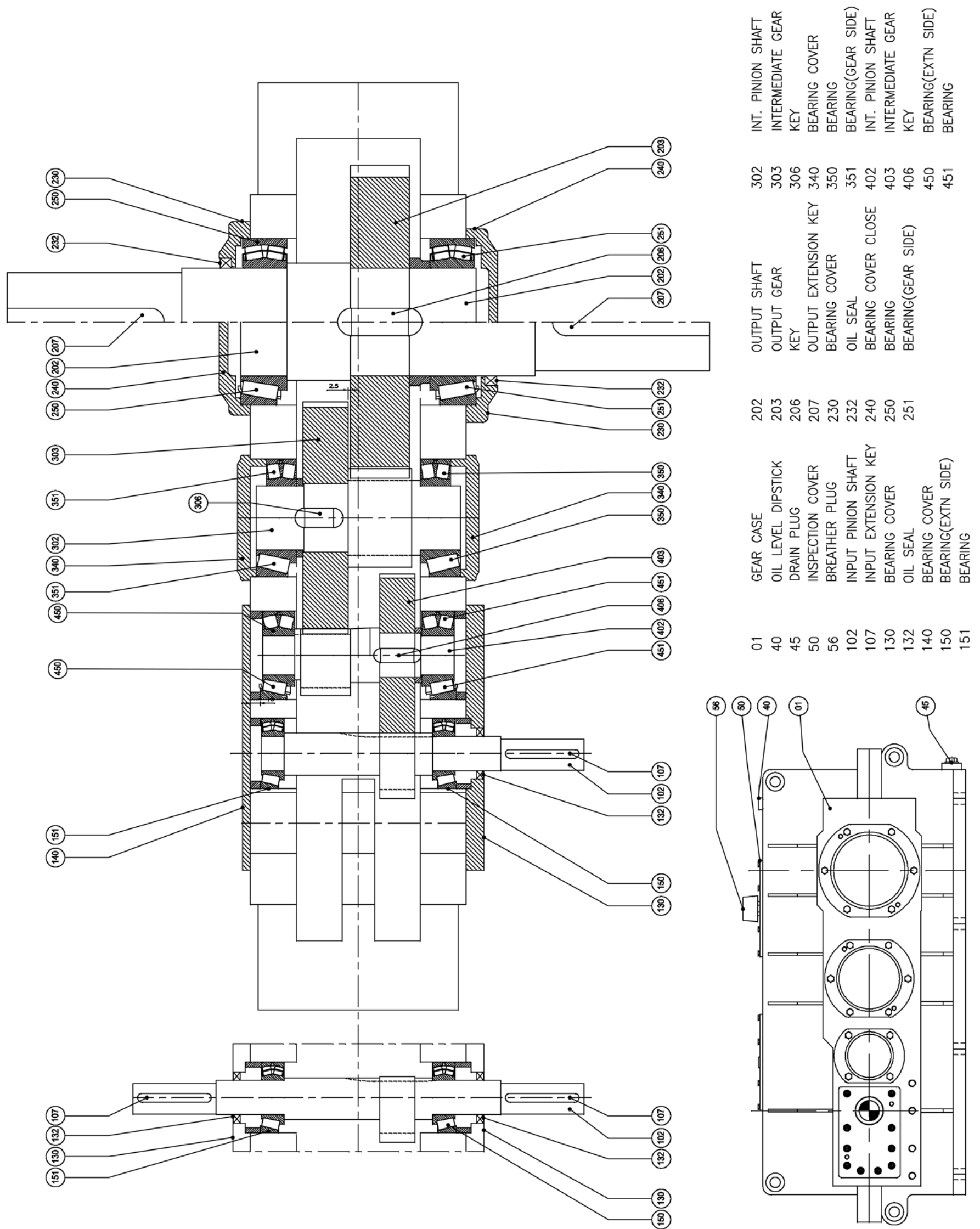


Figure 30: A3 horizontal gearbox

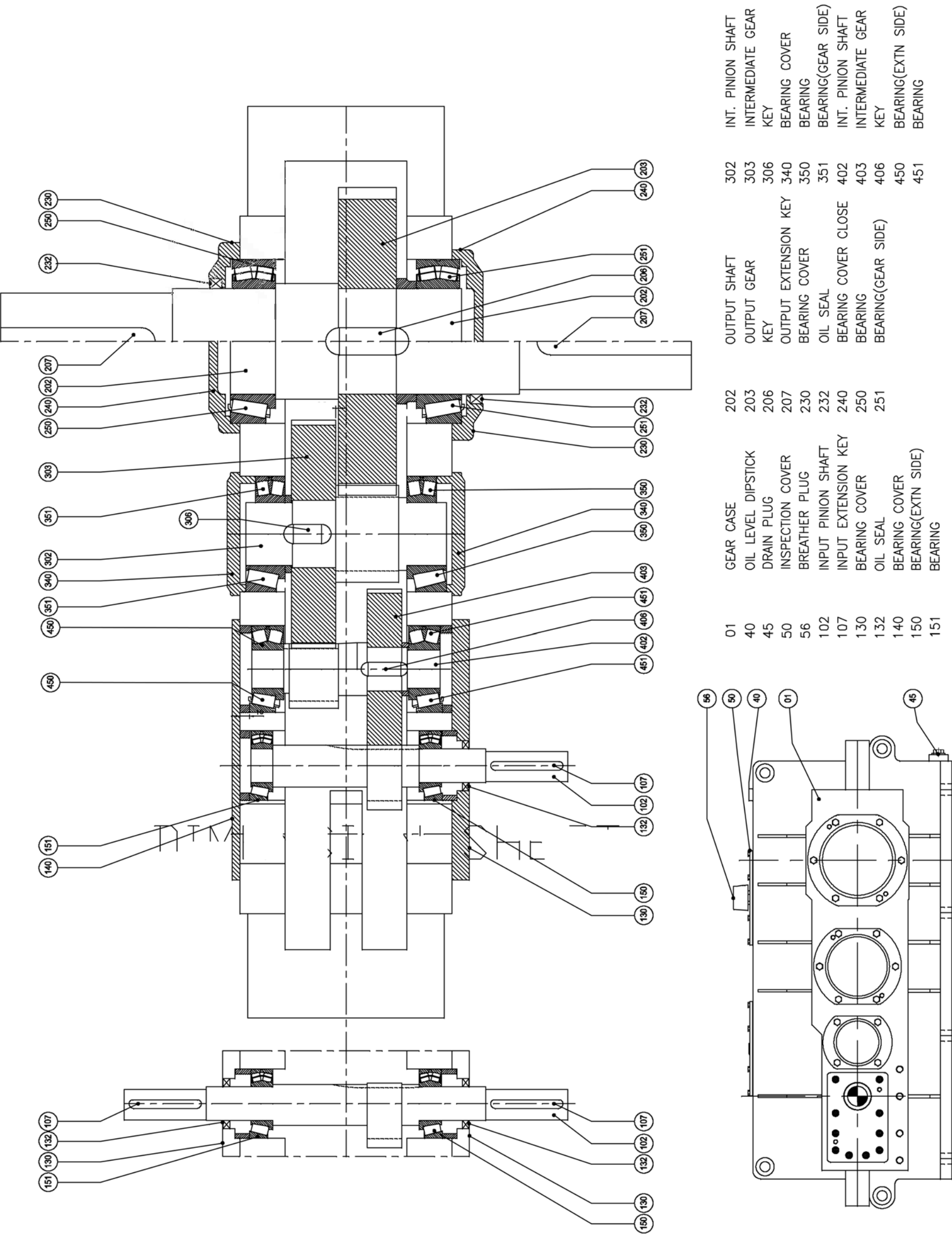
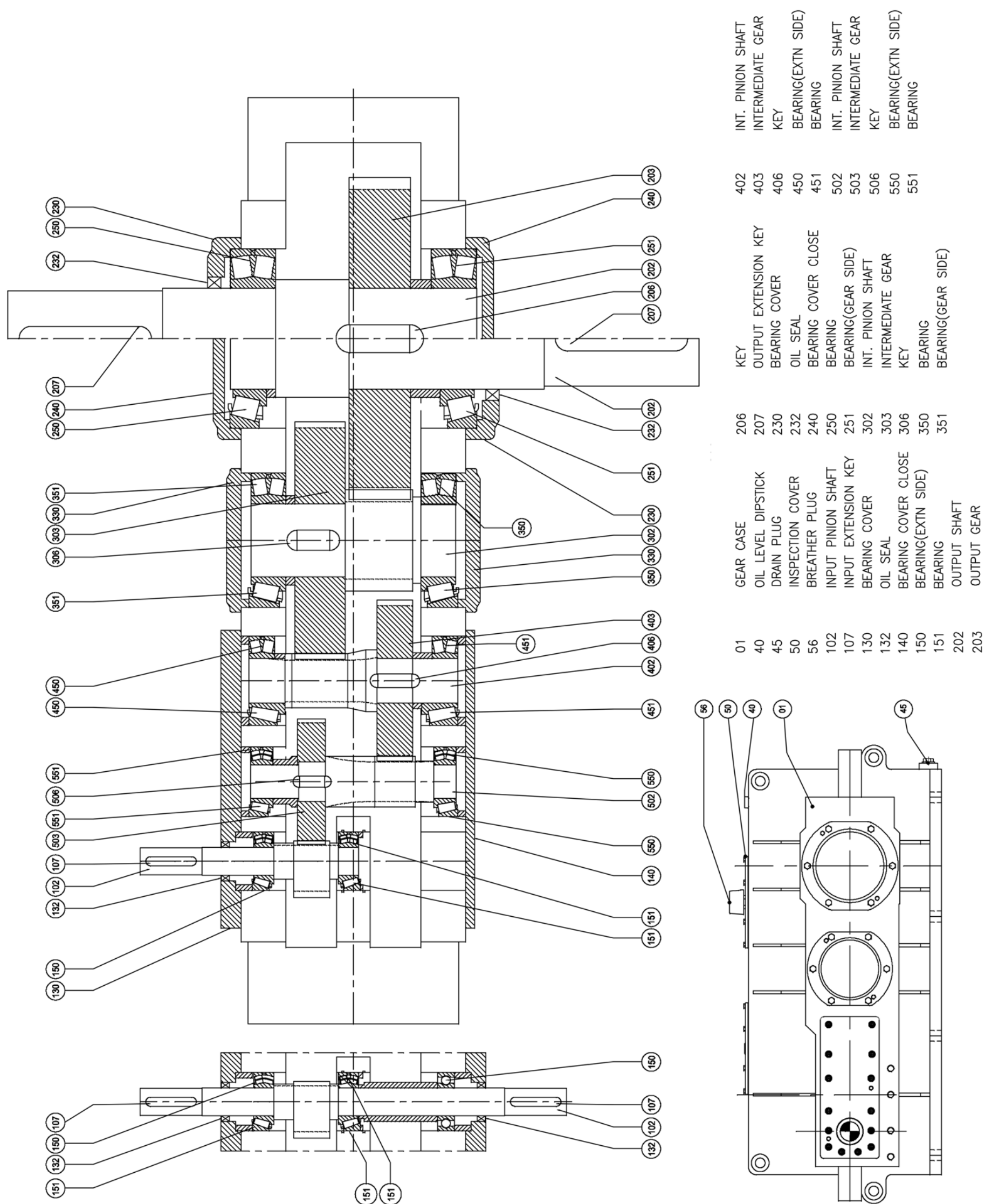


Figure 31: A3 over driven gearbox



13. CUSTOMER DATA SHEET

Company:

Name and designation:

Address:

City:

State:

Pin code:

Phone:

Fax:

Yes!!! We want more information

Please check for more information on the following

A. Power transmission products

- WORM GEARBOXES
- WORM DOUBLE REDUCTION G/B
- HELICAL GEARBOXES
- HELI-WORM GEARBOXES
- SHAFT MOUNTED GEARBOXES
- SPECIAL GEARBOXES
- GEAR ACCESSORIES
- PLANETARY GEARBOXES
- SLEWING GEARBOXES
- GEARED MOTORS
- FLUID COUPLING
- GEARED COUPLING
- FLEXIBLE COUPLING

B. Service

- GENUINE SPARES
- TESTING ON LOAD
- INSTALLATION
- REPAIRING & OVERHAULING
- DAILY SERVICE CONTRACT
- ANNUAL SERVICE CONTRACT

Detail of requirements (Please indicate with sketches or drawings as applicable)

Response expected

- SEND INFORMATION & BROCHURES ONLY
- VISIT OF REPRESENTATIVE REQUIRED
- CALL ON PHONE IMMEDIATELY
- OTHER

For faster response fax this sheet on 02692-227484 or Email: infogear@elecon.com

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