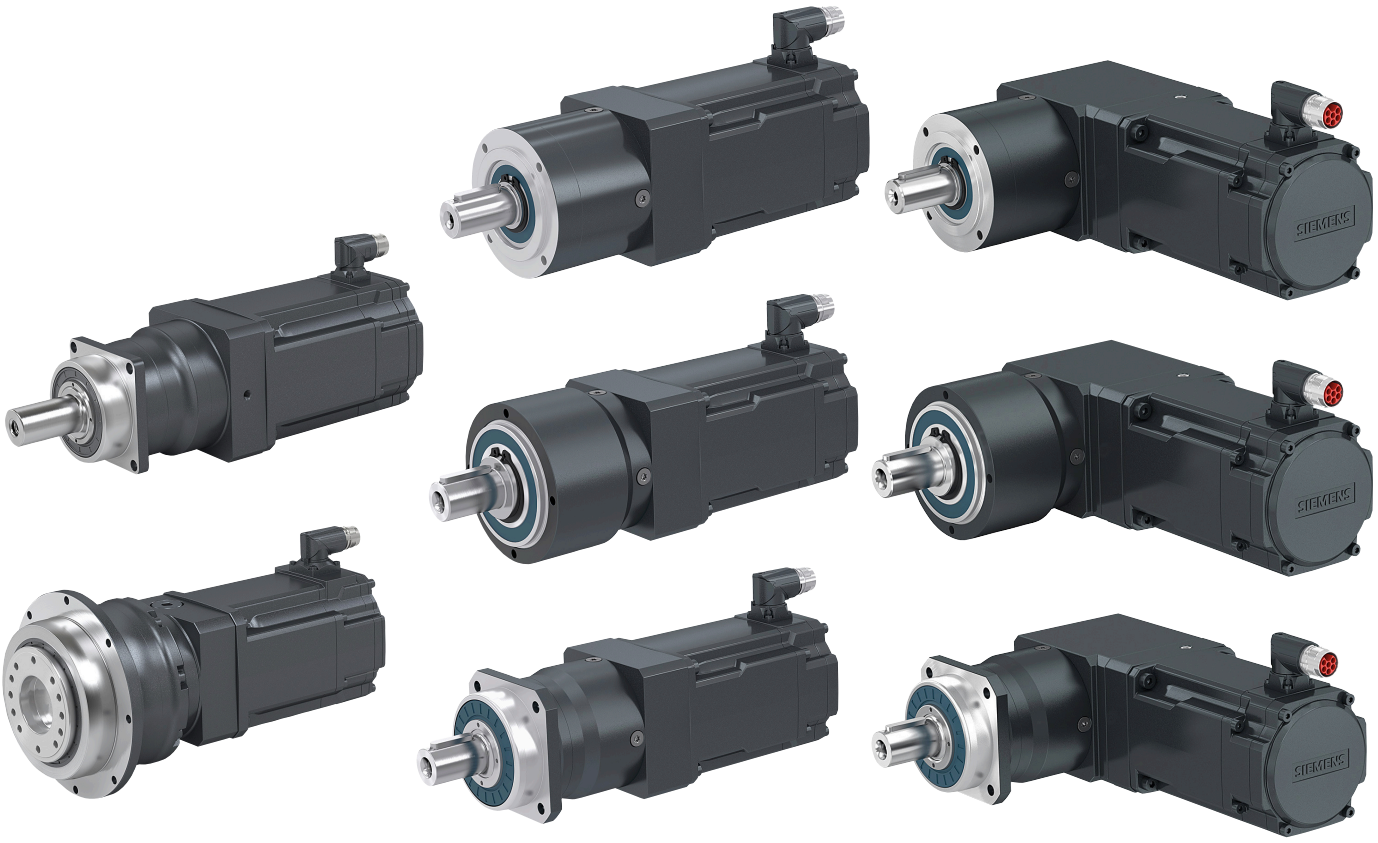

Edition 04/2025

EQUIPMENT MANUAL

SIMOTICS

Planetary gearboxes for 1FK2 and 1FT2 servomotors

www.siemens.com

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SIMOTICS

Drive technology
Planetary gearboxes for 1FK2 and 1FT2 servomotors

Equipment Manual

04/2025
A5E54515894B AA

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens Aktiengesellschaft. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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GERMANY

A5E54515894B AA
Ⓟ 06/2025 Subject to change

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Introduction

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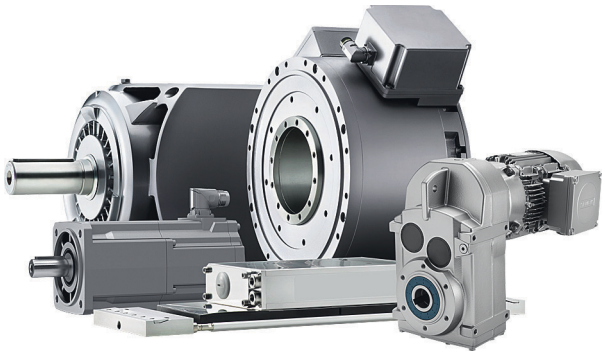
1.1 About SIMOTICS

SIMOTICS electric motors encompass a wide range of electric motors to address different applications.

- Synchronous and induction motors
- Servo motors für motion control applications with and without gearbox
- Torque motors
- Linear motors

Motors for motion control



The range also includes built-in motors and motor spindles. Every motor for motion control is perfectly harmonized to operate with a frequency converter belonging to our SINAMICS family.

1.2 About this usage information

1.2.1 Content

This Equipment Manual provides information about the motor and its components. You will learn how to correctly and safely handle the motor from delivery to disposal:

- Transport and storage
- Setup and mounting
- Connecting
- Commissioning

- Testing
- Operating
- Searching for and eliminating faults
- Disassembly
- Disposal

This documentation should be kept in a location where it can be easily accessed and made available to the personnel responsible.

1.2.2 Sales law

To illustrate possible application areas for our products, typical use cases are listed in this product documentation and in the online help. These are purely exemplary and do not constitute a statement on the suitability of the respective product for applications in specific individual cases. Unless explicitly contractually agreed, Siemens assumes no liability for such suitability. Suitability for a particular application in specific individual cases must be assessed by the user, taking into account all technical, legal, and other requirements on a case-by-case basis. Always observe the descriptions of the technical properties and the relevant constraints of the respective product contained in the product documentation.

1.2.3 Target group

This Equipment Manual is intended for:

- Planning engineers
- Design engineers
- Mechanical design engineers
- Installation personnel
- Commissioning engineers
- Machine operators
- Service and maintenance personnel
- Warehouse personnel
- Personnel that decommission the motor
- Personnel that dispose of the motor

1.2.4 Avoiding dangers

Avoid dangers. Ensure safe, problem-free operation and a maximum service life:

- Read this Equipment Manual before handling the motor.
- Always follow the safety instructions and notices in these operating instructions.

The warning notice system is explained at the beginning of this document.

1.2.5 Standard scope

The functions of the system as delivered can only be found in the order documents.

Further functions may be executable in the system, which are not explained in this documentation. However, there is no entitlement to these functions in the case of a new delivery or service.

This documentation does not contain all detailed information on all types of the product. Furthermore, this documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

The machine manufacturer must document any additions or modifications they make to the product themselves.

Information regarding third-party products

Note

Recommendation relating to third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

1.2.6 Websites of third-party companies

This document may contain hyperlinks to third-party websites. Siemens is not responsible for and shall not be liable for these websites and their content. Siemens has no control over the information which appears on these websites and is not responsible for the content and information provided there. The user bears the risk for their use.

1.3 SIMOTICS documentation Equipment Manual

Description

Comprehensive documentation on SIMOTICS and the SINAMICS converter family is provided on the Internet (https://support.industry.siemens.com/cs/ww/en/ps/13204/man).

You can display documents or download them in PDF and HTML5 format.

The documentation is divided into the following categories:

Table 1-1 SIMOTICS / SINAMICS documentation

Information	Documentation class[1)]	Content	Target group
General information	Equipment Manual	Rules, guidelines, and tools for configuring products, systems, and plants. Also contains information on the operating and ambient conditions for hardware and software, the use of functions, as well as on circuit diagrams and terminal diagrams and the installation of software insofar as this is necessary for commissioning.	Planners, configuration engineers
Device information	Installation Instructions	All relevant information on setting up, installing and cabling, as well as the required dimensional drawings and circuit diagrams	Installation personnel, commissioning engineers, service and maintenance personnel
Basic information	Equipment Manual	Comprehensive collection of all information necessary for the safe operation of products, plant/system parts and complete plants (IEC 82079)	Machine operators, plant operators
	Compact instructions	Essential contents of the operating instructions in a reduced and condensed form	Machine operators, plant operators
	Product Information	Information that only becomes known shortly before or even after start of delivery and is therefore not included in the associated user documentation	Planners, configuration engineers, technologists, installation personnel, constructors; commissioning engineers, machine operators, programmers, service and maintenance personnel
	Online help	Instructions for configuring, programming, and commissioning	Configuration engineers, programmers, commissioning engineers

1) Not all documentation classes are available for every SIMOTICS / SINAMICS product.

1.4 Service and support

1.4.1 ID link and Siemens Online Support

You can find additional information about the product:

- via ID link
- using the Siemens Industry Online Support
  - Website: SIOS (https://support.industry.siemens.com/cs/ww/en/)
  - App Industry Online Support (for Apple iOS and Android)

Product-specific information via ID link

The QR code on your product and on the product packaging contains the ID link.

ID link is a globally unique identifier according to IEC 61406-1.

You can use the ID link to access product data, manuals, Declarations of Conformity, certificates and other information about your product.

Figure 1-1 QR code with ID link included

The ID link is characterized by a frame with a black corner at the bottom right.

Content of Siemens Online Support

- Product support
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via the contact person database (→ Contact)
- Product information
- FAQs (frequently asked questions)
- Application examples
- Manuals
- Downloads
- Compatibility tool
- Newsletter with product selection
- Catalogs/brochures
- Certificates

1.4.2 Spare parts services

The online spare part service "Spares on Web (https://www.sow.siemens.com)" offers spare parts for the product.

1.5 Proper and intended use

Intended use

⚠ WARNING

Non-proper usage

If you do not use the motors correctly, there is a risk of death, severe injury and/or material damage.

- Only use the motors for their intended purpose.
- Do not use the motors in hazardous areas (where there is a risk of explosion) if the motors are not expressly released and authorized for this purpose. Comply with the separately added supplementary notes.
- Make sure that the conditions at the location of use comply with all the rating plate data.
- Make sure that the conditions at the location of use comply with the conditions specified in this documentation. Take into consideration deviations regarding approvals or country-specific regulations.

The motor is intended for industrial or commercial plants.

The motor is designed for operation in sheltered areas under normal climatic conditions, such as those found on shop floors.

More detailed information is provided in Chapter Ambient conditions (Page 41).

Operating the motor in a hazardous zone is prohibited unless the motor is approved for this purpose.

The motor is only approved for converter operation.

Any other application of the motor is considered to be not as intended.

Correct and intended use includes compliance with all of the specifications in the product documentation.

Observe the data on the rating plate.

Contact your sales partner if you have questions regarding proper and intended use, or if you wish to use special versions and design variants.

WARNING

Danger to life and material damage when not used as intended

There is a risk of death, serious injury and/or material damage when direct drives or their components are used for a purpose for which they were not intended.

- Only use the motors for industrial or commercial plants and systems.
- Do not install the motors in hazardous zones if the motors have not been expressly and explicitly designed and authorized for this purpose. Carefully observe any special additional notes provided.
- Only use direct drives and their components for applications that Siemens has explicitly specified.
- Protect the motors against dirt and contact with corrosive substances.
- Ensure that the installation conditions comply with the rating plate specifications and the condition specifications contained in this documentation. Where relevant, take into account deviations regarding approvals or country-specific regulations.
- If you have any questions regarding intended use, please contact your local sales partner.
- If you wish to use special versions and design versions whose technical details vary from the motors described in this document, then you must contact your local sales partner.

WARNING

Danger to life for wearers of active implants due to magnetic and electrical fields

Electric motors pose a danger to people with active medical implants, e.g. cardiac stimulators, who come close to the motors.

- If you are affected, stay a minimum distance of 300 mm from the motors (tripping threshold for static magnetic fields of 0.5 mT according to the Directive 2013/35/EU).

Fundamental safety instructions

2

2.1 General safety instructions

⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠ WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

⚠ WARNING

Electric shock due to damaged motors or devices

Improper handling of motors or devices can damage them.

Hazardous voltages can be present at the enclosure or at exposed components on damaged motors or devices.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged motors or devices.

⚠ WARNING

Electric shock due to unconnected cable shield

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

⚠ WARNING

Electric shock if there is no ground connection

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

⚠ WARNING

Arcing when a plug connection is opened during operation

Opening a plug connection when a system is in operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

NOTICE

Property damage due to loose power connections

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

NOTICE

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

WARNING

Unexpected machine movement caused by radio devices or cellphones

Radio devices, cell phones or mobile WLAN devices in the immediate vicinity of a component can impair the function of the component or damage the component. The malfunction may impair the functional safety of machines and can therefore endanger persons or result in material damage.

- Avoid operating radio devices, cellphones and mobile WLAN devices in the direct vicinity of converters and operating units.
- Scan the machine readable code, e.g. a QR code at least 0.4 m away from the component or switch off the converter power supply before scanning.
- Only operate built-in devices with the control cabinet doors closed.
- When control cabinet doors are open, only qualified electrical personnel are allowed to carry out service and maintenance work.

WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

⚠ WARNING

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important Safety instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors. People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.

- If this applies to you, maintain the minimum distances to the respective motors as specified in the Information for use.

⚠ WARNING

Active implant malfunctions due to permanent-magnet fields

Even when switched off, electric motors with permanent magnets represent a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.

- If this affects you, maintain the minimum distances specified in the Information for use.
- When transporting or storing permanent-magnet motors, always use the original packing materials.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.

⚠ WARNING

Improper lifting and transportation operations

Improper lifting and transportation of the motor may cause death, severe bodily injury, or damage to property.

- When disassembling the motor, watch out for imminent movements when the motor is released.
- Use all lifting equipment, industrial trucks, and load handling devices in accordance with the regulations.
- Only use lifting equipment and load handling devices with maximum capacities which match the weight of the motor.
- Do not attach any additional loads to the lifting equipment.
- To hoist the motor, use suitable cable-guidance or spreading equipment, particularly if the motor is equipped with built-on assemblies.
- Do not attach lifting equipment to the power connector or signal connector of the motor.
- Do not stand in the slewing range of hoisting gear or under suspended loads.
- When placing down the motor, ensure that it cannot roll away.
- If anything is unclear, please contact the machine manufacturer, stating the machine type and serial number.

NOTICE

Shaft sealing rings damaged by solvent

Solvents can damage the shaft sealing rings of the motor.

- When removing preservation agents or when carrying out cleaning work, avoid that any solvent comes into contact with the shaft sealing rings.

⚠ WARNING

Injury caused by moving or ejected parts

Contact with moving motor parts or drive output elements and the ejection of loose motor parts (e.g. feather keys) out of the motor enclosure can result in severe injury or death.

- Remove any loose parts or secure them so that they cannot be flung out.
- Do not touch any moving parts.
- Safeguard all moving parts using the appropriate safety guards.

⚠ WARNING

Danger to life caused by machine movement and loose objects

Machine movement and loose objects that can fall out or be ejected can cause death or severe bodily injury.

- Be sure to complete all assembly and adjustment work on the machine.
- Ensure that there are no people in the danger zone of the machine before it is switched on.
- Before switching on, check that there are no loose objects in or on the motor that can fall or be flung off.
- Before switching on, check that all safety guard covers for touch protection are installed and all safety equipment functions correctly.

⚠ WARNING

Uncovered rotating or live parts

Covers over rotating or live parts and covers that ensure the motor degree of protection or are required for air guidance, and thus for cooling, must be closed during operation.

Death, serious bodily injury, or material damage may result if the required covers are removed.

- Do not remove covers while the motor is running.

⚠ WARNING

Danger to life due to a changed operating behavior of the machine

Changes in the operating behavior of the machine compared with normal operation indicate that the function of the machine is impaired. Changes in the operating behavior of the machine can be seen, for example, in one or more of the following effects:

- An increased power consumption
- Higher temperatures
- Vibration
- Unusual noises
- Unusual smells
- The monitoring devices respond

Impaired machine functioning can cause faults that may result directly or indirectly in death, serious bodily injury, or property damage.

- Immediately inform the maintenance personnel.
- If in doubt, shut down the motor immediately, taking into account the plant-specific safety regulations.

NOTICE

Motor damage in the event of uneven running or abnormal noises

Improper handling during transportation, storage, or assembly can damage the motor. A damaged motor may run unevenly or make abnormal noises during operation. If you operate a damaged motor, this may result in damage to the winding or bearings, or even total destruction of the system.

- Switch the motor off in case of uneven running or abnormal noises.
- Identify the cause.

NOTICE

Motor damage when the maximum speed is exceeded

The maximum speed n_{max} is the highest permissible motor operating speed. The maximum speed is specified on the rating plate (nameplate).

Impermissible speeds can cause damage to the motor.

- Enable speed setpoint monitoring in the control unit or drive so as not to exceed the maximum speed n_{max}.

WARNING

Fire due to incorrect operation of the motor

When incorrectly operated and in the case of a fault, the motor can overheat resulting in fire and smoke. This can result in severe injury or death. Further, excessively high temperatures destroy motor components and result in increased failures as well as shorter service lives of motors.

- Operate the motor according to the relevant specifications.
- Only operate the motors in conjunction with effective temperature monitoring.
- Immediately switch off the motor if excessively high temperatures occur.

NOTICE

Wear of the holding brake due to impermissible voltage supply

Operating the holding brake outside the permissible voltage range at the motor connection will damage the brake.

- Only operate the holding brake within its permissible voltage range.

⚠ CAUTION

Burns and thermal damage caused by hot surfaces

Temperatures above 100 °C may occur on the surfaces of motors, converters, and other drive components.

Touching hot surfaces may result in burns. Hot surfaces may damage or destroy temperature sensitive parts.

- Ensure that temperature-sensitive parts do not come into contact with hot surfaces.
- Mount drive components so that they are not accessible during operation.

Measures when maintenance is required:

- Allow drive components to cool off before starting any work.
- Use appropriate personnel protection equipment, e.g. gloves.

2.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

NOTICE

Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g conductive foam rubber of aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

2.3 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial

cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/cert.

Further information is provided on the Internet:

Configuration Manual Industrial Cybersecurity (https://support.industry.siemens.com/cs/ww/en/view/109975311)

⚠ WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a state-of-the-art, integrated industrial cybersecurity concept for the installation or machine.
- Make sure that you include all installed products in the integrated industrial cybersecurity concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- Carefully check all cybersecurity-related settings once commissioning has been completed.

2.4 Residual risks of power drive systems

When assessing the machine or system-related risk in accordance with the respective local regulations (e.g. EC Machinery Directive), the machine manufacturer or system integrator must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware faults and/or software errors in the sensors, control system, actuators, and connections
   - Response times of the control system and of the drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influences/damage
   - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures inside and outside the components, including open flames, as well as emissions of light, noise, particles, gases, etc. due to fault conditions, e.g.:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influences/damage
   - Short circuits or ground faults in the intermediate DC circuit of the converter
3. Hazardous shock voltages caused by, for example:
   - Component failure
   - Influence during electrostatic charging
   - Induction of voltages in moving motors
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly

6. Influence of network-connected and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:
   When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

Description of the geared motors

3

3.1 Product overview

Overview of the planetary gearboxes for S-1FK2 and S-1FT2 servomotors

SIMOTICS S-1FK2 or S-1FT2 servomotors, collectively called "1F□2" in the following, can be combined with various planetary gearboxes to form compact servo planetary geared motors.

Coaxial and angled economy planetary gearboxes as well as coaxial precision gearboxes are available.

Economy gearboxes have straight gearing with grease lubrication and have a low torsional backlash. The angled version is implemented using a preliminary bevel gear stage; a "W" is added to the end of the gearbox designation.

Precision gearboxes have helical gearing, are oil lubricated and have a further reduced torsional backlash when compared to economy gearboxes.

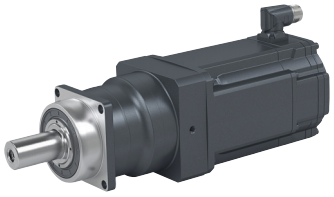
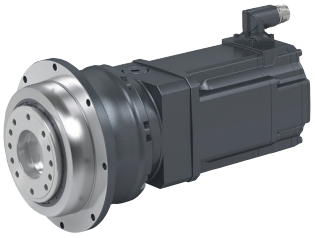
1F□2 geared motors are specified and delivered as complete units. All outstanding performance data are matched to the motor-gearbox combination. An S1 characteristic is available for thermal dimensioning, which already takes into account the thermal interaction between the motor and gearbox. This means that it is not necessary to reduce the power of the motor or gearbox any further depending on the operating point.

All planetary gearboxes are maintenance-free due to their lifetime lubrication and can be mounted in any mounting position without restriction.

The following table lists the options when combining planetary gearboxes with 1F□2 servomotors.

ECO coaxial gearbox for 1FK2 and 1FT2	**NRB**	**NRK**	**NLC**
			

ECO gearboxes only angled for 1FT2	**NRBW**	**NRKW**	**NLCW**
			

Coaxial precision gearbox only for 1FT2	SP+	TP+
		

Motor versions

2 motor versions are available for 1F□2 geared motors.

High Dynamic (Article Nos. 1FT21... and 1FK21...)

S-1FT2 servomotors with low intrinsic inertia are the perfect choice wherever small masses have to be moved with maximum dynamic response and precision. The lightweight and low-friction gearboxes in conjunction with inertia-optimized clamping systems allow the highest cycle rates in the application.

Compact (Article Nos. 1FT22... and 1FK22...)

If larger loads need to be moved with precision and dynamically, a motor version with higher inertia is absolutely necessary so that the closed-loop control can be adequately handled. 1FT2 Compact servomotors with medium inertia and planetary gearboxes with higher transmission ratios enable even difficult inertia conditions to be mastered in terms of the closed-loop control technology.

More information on the motors is provided in the Configuration Manuals for the specific motor series.

More information on the motors is provided in Chapter "AUTOHOTSPOT".

Planetary gearbox: Economy, coaxial

NRB

NRB is the lightest gearbox with the highest power density. Due to its low friction bearing design, it is suitable for high speeds and generates very little heat.

The gearboxes are suitable for the following applications:

- Packaging
- Food industry
- Pharmaceutical and medical technology
- Auxiliary axes in machine tools

NRK

The NRK series gearbox is suitable for higher radial and axial forces due to the large output bearing. This gearbox is also suitable for higher speeds thanks to low internal friction.

The gearboxes are suitable for the following applications:

- Automation and assembly technology
- Packaging
- Auxiliary axes in machine tools

NLC

Thanks to the preloaded tapered roller bearing, the NLC gearbox has a high degree of stiffness and is perfectly suited for high radial and axial loads. The IP65 seal provides protection against dust and water.

The gearboxes are suitable for the following applications:

- Automation and assembly technology
- Packaging
- Food industry
- Pressure
- Auxiliary axes in machine tools

Planetary gearbox: Economy, angle

As a result of the preliminary bevel gear stage, NRB, NRK and NLC planetary gearboxes are also available as NRBW, NRKW or NLCW angled gearboxes.

The angled versions are ideal when space is restricted. Due to the additional angle stage, the losses in the angled gearboxes are somewhat higher and the rated specifications are reduced in comparison to the corresponding coaxial version.

Precision gearbox: Precision gearboxes, coaxial

SP+

The low backlash SP+ precision gearbox sets itself apart as a result of the high positioning precision and is suitable for high dynamic cyclic operation. Thanks to the preloaded tapered roller bearing, it is suitable for high radial and axial loads. The IP65 seal provides protection against dust and water.

The gearboxes are suitable for the following applications:

- Automation and assembly technology
- Packaging
- Pharmaceutical and medical technology
- Food industry
- Auxiliary axes in machine tools
- Woodworking

- Plastics processing machines
- Pulp and paper industry

TP+

The low backlash TP+ precision gearbox sets itself apart as a result of its extremely compact design with output flange. It offers a low torsional backlash with the highest torsional rigidity and is designed to address demanding applications with high torques and large external loads.

The gearboxes are suitable for the following applications:

- Main axes in machine tools
- Packaging
- Pressure
- Robotics

Table 3-1 Design and technical features of planetary gearboxes

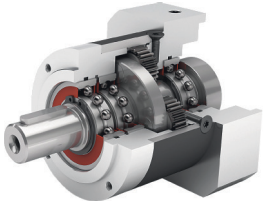
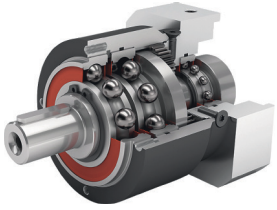
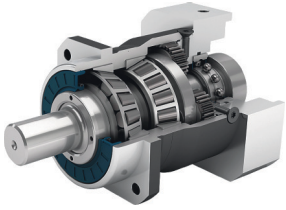
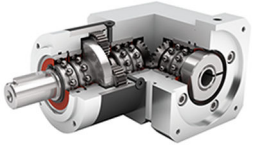
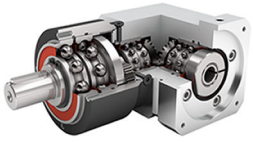
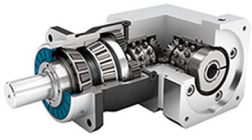
Planetary gearboxes	**NRB, NRBW**	**NRK, NRKW**	**NLC, NLCW**
Diagrams showing NRB, NRK and NLC coaxial planetary gearboxes			
Diagrams showing NRBW, NRKW and NLCW angled planetary gearboxes			
Transmission ratio *i*	3 ... 512	3 ... 100	3 ... 100
Gearbox stages *z*	1-, 2- and 3-stage, NRB160 only 2 stage	1 and 2-stage	1 and 2-stage
Torsional backlash φ_2 of the planetary gearbox in arcmin	6 ... 22 for NRB	6 ... 19 for NRK	7 ... 12 for NLC
	11 ... 28 for NRBW	11 ... 25 for NRKW	11 ... 18 for NLCW
Type of construction	IMB14 / IMV18 / IMV19	IMB14 / IMV18 / IMV19	IMB5 / IMV1 / IMV3
Degree of protection	IP64	IP64	IP65
Power density	+++	++	++
Bearing loading capacity	+	++	+++
Suitable for high speeds	++	++	+
Options	• Plain shaft or solid shaft with feather key • Standard lubrication or food-safe lubricant (grease)		

Table 3-2 Design and technical features of precision gearboxes

Precision gearbox	**SP+**	**TP+**
Transmission ratio *i*	3 ... 100	4 ... 100
Gearbox stages *z*	1-, 2-stage	1 and 2-stage
Torsional backlash φ_2 of the planetary gearbox in arcmin	3 ... 6	3 ... 4
Reduced torsional backlash φ2 of the planetary gearbox in arcmin	1 ... 4	1 ... 2
Type of construction	IMB5 / IMV1 / IMV3	IMB5 / IMV1 / IMV3
Degree of protection	IP65	IP65
Power density	+++	++++
Bearing loading capacity	+++	++++
Suitable for high speeds	+++	+++
Options	• Plain shaft or solid shaft with feather key • Standard lubrication or food-safe lubricant (oil) • Splined shaft and reduced backlash	• Standard and food-safe lubrication (oil) and reduced backlash

See also

Configuring (Page 63)

3.2 Options

3.2.1 Shaft extension

The output shaft of the planetary gearbox is available in the following versions:

- With a plain shaft for a friction-locked connection
- With a feather key for a positive locking connection
- With splined shaft for a positive locking force connection, preferably for pinion mounting

Shaft end as "plain shaft"

For dynamic loads, particularly with reversals in operation, it is preferable to select a friction-locked and zero-backlash connection with a plain shaft on the gearbox.

Shaft end as "shaft with feather key"

Alternatively, a positive locking connection with feather key is also suitable for pulsating loads without reversals. The feather key connection must be implemented according to DIN6885-1/DIN 6880 (keyway P9, feather key h9).

If you nevertheless would like to configure changing application loads with a feather key connection, then limit the application torque depending on the expected load change according to the following tables:

NRB gearboxes for 1F□2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
NRB040	9 Nm	7 Nm
NRB060	31 Nm	25 Nm
NRB080	68 Nm	54 Nm
NRB120	132 Nm	105 Nm
NRB160	401 Nm	319 Nm

NRBW gearboxes for 1FT2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
NRBW040	9 Nm	7 Nm
NRBW060	31 Nm	25 Nm
NRBW080	68 Nm	54 Nm
NRBW120	132 Nm	105 Nm

NRK gearboxes for 1F□2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
NRK050	12 Nm	9 Nm
NRK070	No restriction	29 Nm
NRK090	84 Nm	67 Nm
NRK120	No restriction	190 Nm
NRK155	389 Nm	309 Nm

NRKW gearboxes for 1FT2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
NRKW050	12 Nm	9 Nm
NRKW070	No restriction	29 Nm
NRKW090	84 Nm	67 Nm
NRKW120	No restriction	190 Nm

NLC gearboxes for 1F□2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
NLC060	37 Nm	29 Nm
NLC080	76 Nm	60 Nm
NLC120	239 Nm	190 Nm

NLCW gearboxes for 1FT2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
NLCW060	37 Nm	29 Nm
NLCW080	76 Nm	60 Nm
NLCW120	239 Nm	190 Nm

SP+ gearbox for 1FT2

Gearbox	Max. application torques M_2 for feather key design	
	Up to 10^7 load change	Up to 10^8 load change
SP060	36 Nm	28 Nm
SP075	86 Nm	68 Nm
SP100	279 Nm	220 Nm
SP140	450 Nm	355 Nm
SP180	850 Nm	680 Nm
SP210	1200 Nm	960 Nm
SP240	2400 Nm	1900 Nm

Shaft end as splined shaft according to DIN 5480 for SP+ gearboxes

For dynamic applications with fluctuating loads, which require a precise positive locking connection, a connection that can be axially shifted or a connection that can be easily released, then an SP+ gearbox as output option offers a splined shaft with involute flanks and reference diameter according to DIN 5480.

For this solution, it is not necessary to reduce the output torque depending on the load change.

See also

Structure of the article number (Page 45)

3.2.2 Reduced-backlash version

SP+ and TP+ gearboxes are optionally available in a backlash-reduced version. More information on this topic is provided in Chapters "Torsional backlash of SP+ planetary gearboxes (Page 147)" and "Torsional backlash of TP+ planetary gearboxes (Page 167)".

3.2.3 Lubricant for use in the food industry

Planetary gearboxes are available with a food-safe lubricant.

The lubricant is registered in accordance with NSF H1 and is therefore in conformance with FDA 21 CFR § 178.3570.

The lubricant was developed for unforeseeable contact with products and packaging in the food, cosmetics, pharmaceutical or animal food industry.

In product contact areas of food processing / pharmaceuticals / cosmetics, the gearbox may only be used next to or below the product area.
When using directly in the food area, encapsulate the gearbox and perform a hygiene risk assessment (in accordance with DIN EN 1672-2).

Ordering example for the option "food-safe lubricant"

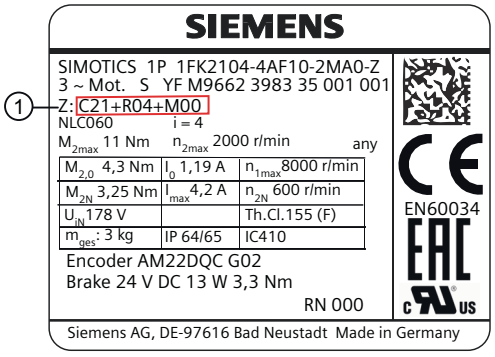
The 2nd digit of the 3rd short block of brief gearbox information defines the type of lubricant in the gearbox.

- 0 = standard lubricant
- 1 = food-safe lubricant

Example:

- 1F□2□□□-□□□□□□-□□□□-**Z** □□□ □□□ M**0**□ ⇒ gearbox with standard lubricant
- 1F□2□□□-□□□□□□-□□□□-**Z** □□□ □□□ M**1**□ ⇒ gearbox with lubricant that is suitable for food stuff environments

3.2.4 Ordering example for selecting the gearbox shaft end



① Information in short blocks for geared motors

Figure 3-1 Rating plate with display of short blocks

The last positions of the 3rd short block of brief gearbox information define lubricant, shaft end and torsional backlash options as follows:

M			
		0	plain shaft / flange output
		1	Feather key (not TP+)
		2	Splined shaft (not TP+)
		5	plain shaft / flange output, backlash reduced
		6	Feather key, backlash reduced (not TP+)
		7	Splined shaft, reduced backlash (not TP+)
	0	Standard	
	1	Food-safe lubricants	

Example:

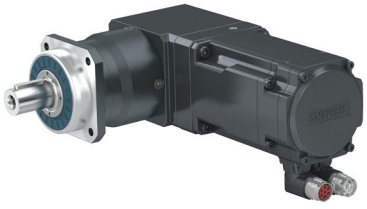
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M□**0** → plain shaft end (standard)
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M□**1** → shaft end with feather key (standard)
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M□**2** → splined shaft (standard)
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M□**5** → plain shaft end (backlash reduced)
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M□**6** → shaft end with feather key (backlash reduced)
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M□**7** → splined shaft (backlash reduced)
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M**0**□ → standard lubricant
- 1F□2□□□-□□□□□-□□□□-**Z** □□□ □□□ M**1**□ → food-safe lubricant

More information is provided in Chapter "Structure of the article number (Page 45)".

3.2.5 Orientation of the output for angled gearboxes

For angled geared motors, the motor connector is oriented to the gearbox output as standard at the top (when viewing the gearbox output and motor orientation to the right)

A different mounting can be optionally implemented in accordance with the following table.

Orientation of the gearbox output		Order code
	Standard orientation	-
	Connector on the output side	Q91
	Connector offset through 180° with respect to the standard	Q92
	Connector opposite to the output side	Q93

Independent of the connector orientation, geared motors can be mounted in any spatial position.

3.3 Technical characteristics and ambient conditions

3.3.1 Directives and standards

Relevant directives

The following directives are relevant for the 1F□2 equipped with planetary gearbox.

European Low-Voltage Directive

SIMOTICS motors comply with the Low-Voltage Directive 2014/35/EU.

European Machinery Directive

SIMOTICS motors do not fall within the scope covered by the Machinery Directive.

However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

European EMC Directive

SIMOTICS motors do not fall within the scope covered by the EMC Directive. The products are not considered as devices in the sense of the directive. Installed and operated with a converter, the motor - together with the Power Drive System - must comply with the requirements laid down in the applicable EMC Directive.

European RoHS Directive

The SIMOTICS motor series complies with the Directive 2011/65/EU regarding limiting the use of certain hazardous substances.

European Directive on Waste Electrical and Electronic Equipment (WEEE)

The SIMOTICS motor series complies with the 2012/19/EU directive on taking back and recycling waste electrical and electronic equipment.

European Directive 2005/32/EC defining requirements for environmentally friendly design of electric motors

The SIMOTICS motor series is not subject to (EC) Regulation No. 640/2009 for implementation of this directive.

European Directive 2009/125/EC defining ecodesign requirements of electric motors and speed controls

The SIMOTICS motor series is not subject to (EU) Regulation 2019/1781 for implementation of this directive.

Eurasian conformity

SIMOTICS motors comply with the requirements of the Russia/Belarus/Kazakhstan (EAC) customs union.

China Compulsory Certification

The SIMOTICS motor series does not fall in the application range of the China Compulsory Certification (CCC) (CCC negative clearance certificate).

Chinese national standard GB 30253 (CEL)

SIMOTICS S-1F□2 servo planetary geared motors do not fall in the application range of the national standard GB 30253.

China RoHS

SIMOTICS motors comply with the China RoHS.

You can find additional information at:

China RoHS (https://support.industry.siemens.com/cs/ww/en/view/109772626)

Underwriters Laboratories

SIMOTICS motors are generally in compliance with UL and cUL as components of motor applications, and are appropriately listed.

Specifically developed motors and functions are the exceptions in this case. Here, it is crucial that you carefully observe the content of the quotation and that there is a UL or cUL mark on the rating plate!

Quality systems

Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

Certificates for SIMOTICS motors can be downloaded from the Internet at the following link:

Certificates for SIMOTICS motors (https://support.industry.siemens.com/cs/ww/de/ps/13347/cert)

3.3.2 Technical features

This chapter describes the assignment and features of the individual planetary gearboxes.

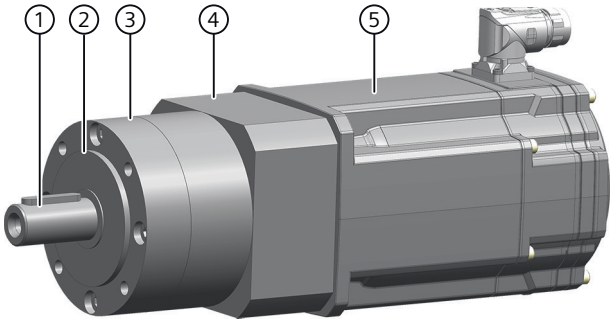
Note

Dates are not specified for the standards listed in this manual.

The current relevant and valid dates can be found in the Declaration of Conformity.

Principle design of the geared motor

The geared motor design is in principle also applicable for geared motors with flanged-on angled gearbox.



1 Output shaft
2 Mounting flange
3 Gearbox housing (gearing area)
4 Gearbox flange
5 Motor

Figure 3-2 Geared motor design

Technical features of NRB, NRBW, NRK, NRKW, NLC, NLCW planetary gearboxes

	NRB / NRBW	NRK / NRKW	NLC / NLCW
Permissible temperature during transport	- 15 ... 55 °C		
Permissible temperatures during storage	- 15 ... 55 °C		
Permissible ambient temperatures in operation without derating[1]	- 15 ... 40 °C		
Max. permissible gearbox operating temperature	90 °C		
Mounting flange (acc. to IEC 60034-7)	IMB14 / IMV18 / IMV19	IMB14 / IMV18 / IMV19	IMB5 / IMV1 / IMV3
Type of output shaft	Solid shaft with or without fitted key		

[1] Depending on the temperature, the starting torque may be increased. This must be taken into account when selecting the power unit.

Technical features of TP+ and SP+ planetary gearboxes

	SP+	TP+
Permissible temperature during transport	- 15 ... 55 °C	
Permissible temperatures during storage	- 15 ... 55 °C	
Permissible ambient temperatures in operation without derating[1]	- 15 ... 40 °C	
Maximum permissible operating temperature of the gearbox	90 °C	

	SP+	TP+
Mounting flange	IMB5 / IMV1 / IMV3	
Type of output shaft	Solid shaft with or without feather key, splined shaft	Flanged shaft

[1] Depending on the temperature, the starting torque may be increased. This must be taken into account when selecting the power unit.

3.3.3 Overview of torques and speeds

The geared motor data apply to coaxial planetary gearboxes with a screwed-on 1F□2. The geared motor data apply to angled planetary gearboxes with a screwed-on 1FT2

Overview of torques and speeds for planetary gearboxes

	NRB	NRK	NLC
Geared motor data for 1 AC 200 ... 240 V, 3 AC 200 ... 240 V motors			
Maximum torque $M_{2\,max}$ in Nm	1.51 ... 416	1.4 ... 275	3.05 ... 285
Rated torque $M_{2\,N}$ in Nm	0.194 ... 260	0.107 ... 119	0.143 ... 120
Rated speed $n_{2\,N}$ in r/min	6 ... 1000	25 ... 1000	25 ... 500
Geared motor data for 3 AC 380 ... 480 V motors			
Maximum torque $M_{2\,max}$ in Nm	4.85 ... 1280	4.65 ... 736	4.65 ... 416
Rated torque $M_{2\,N}$ in Nm	0.79 ... 690	0.54 ... 460	0.35 ... 260
Rated speed $n_{2\,N}$ in r/min	6 ... 1000	15 ... 750	20 ... 500

	SP+	TP+
Geared motor data for 1 AC 200 ... 240 V, 3 AC 200 ... 240 V motors		
Maximum torque $M_{2\,max}$ in Nm	1.5 ... 5700	2.1 ... 5500
Rated torque $M_{2\,N}$ in Nm	0.197 ... 2550	0.12 ... 2500
Rated speed $n_{2\,N}$ in r/min	5 ... 750	5 ... 600
Geared motor data for 3 AC 380 ... 480 V motors		
Maximum torque $M_{2\,max}$ in Nm	4.55 ... 5700	6.6 ... 5500
Rated torque $M_{2\,N}$ in Nm	0.54 ... 2050	0.405 ... 1980
Rated speed $n_{2\,N}$ in r/min	5 ... 750	5 ... 600

Overview of torques and speeds for angled planetary gearboxes

	NRBW	NRKW	NLCW
Geared motor data for 1 AC 200 ... 240 V, 3 AC 200 ... 240 V motors			
Maximum torque $M_{2\,max}$ in Nm	1.4 ... 416	1.37 ... 275	3.45 ... 280
Rated torque $M_{2\,N}$ in Nm	0.107 ... 260	0.098 ... 120	0.119 ... 118
Rated speed $n_{2\,N}$ in r/min	5 ... 1000	15 ... 1000	10 ... 375

	NRBW	NRKW	NLCW
Geared motor data for 3 AC 380 ... 480 V motors			
Maximum torque $M_{2\,max}$ in Nm	4.55 ... 416	4.35 ... 312	4.55 ... 416
Rated torque $M_{2\,N}$ in Nm	0.425 ... 260	0.34 ... 195	0.255 ... 255
Rated speed $n_{2\,N}$ in r/min	5 ... 1000	15 ... 750	15 ... 375

3.3.4 Ambient conditions

With the exception of environmental factors "Low air temperature", "Low air pressure", and "Condensation", the motor in the basic version complies with climate class 3K4 according to DIN EN 60721-3-3:1995-09 (historical) for fixed installation in weather-protected areas.

Table 3-3 **Permissible ambient conditions for the motor based on climate class 3K4**

Environmental parameter		Unit	Value
a)	Low air temperature	°C	- 15
b)	High air temperature	°C	+ 40
c)	Low relative humidity	%	5
d)	High relative humidity	%	95
e)	Low absolute humidity	g/m³	1
f)	High absolute humidity	g/m³	29
g)	Rate of temperature change [1)]	°C/min	0.5
h)	Low air pressure [4)]	kPa	89
i)	High air pressure [2)]	kPa	106
j)	Solar radiation	W/m²	700
k)	Thermal radiation	-	-
l)	Air movement [3)]	m/s	1.0
m)	Condensation	-	Not permissible
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-
o)	Water (other than rain)	-	See protection class
p)	Formation of ice	-	-

1) *Averaged over a period of 5 min*

2) *Conditions in mines are not considered.*

3) *A cooling system based on natural convection can be disturbed by unforeseen air movements.*

4) *The limit value of 89 kPa covers applications at altitudes up to 1000 m.*

Note

Installation instructions

The basic version of the motor is not suitable for operation

- In salt-laden or aggressive atmospheres
- Outdoors
- In a vacuum
- In hazardous areas with a danger of explosion

You will find additional data on the ambient conditions, such as for transport and storage of the motor, in Chapter "Application planning (Page 197)".

Note

When dimensioning the screwed connection, ensure that these can handle the forces that occur (radial forces, torques, possibly breakdown torque, etc.).

More information is provided in Chapter "Flange mounting and tightening torques for servomotors with planetary gearbox (Page 203)".

3.3.5 Flange mounting and tightening torques

Description

This chapter shows the designs and dimensions for flange mounting to a machine and the associated tightening torques.

Note

Siemens recommends an anaerobic adhesive to increase the friction locking between flange and mounting surface.

The tightening torque specified in this table are theoretical values.

They are based on the following:

- Calculated according to VDI 2230
- The friction coefficient for screws and mounting surfaces is μ = 0.10
- The yield strength reaches 90 %
- The tools used correspond to type II, Classes A and D according to ISO 6789

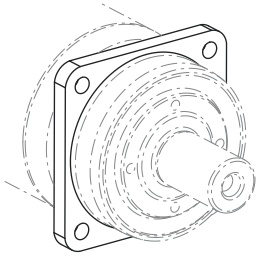
Set values of the torque tools

The set values are rounded off values that correspond to a generally applicable scale division or setting options.

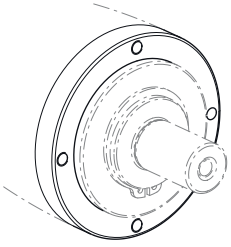
- Set these values precisely

Strength class of screws/nuts	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
8.8/8	1.15	2.64	5.2	9.0	21.5	42.5	73.5	118	180	258	362	495	625
10.9/10	1.68	3.88	7.6	13.2	32	62.5	108	173	264	368	520	700	890
12.9/12	1.97	4.55	9.0	15.4	37.5	73.5	126	202	310	430	605	820	1040

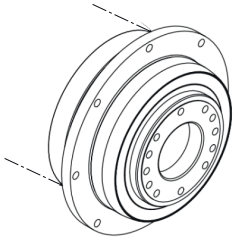
Flange designs at the gearbox output



Flange IMB5, e.g. NLC, SP+



Flange IMB14, e.g. NRB, NRK, NP



Flange IMB5, e.g. TP+

Flange mounting of the planetary gearbox

NRB/NRBW	**For gearboxes with aluminum output flange, use screws with a maximum property class of 10.9, assuming that you use 90 % of the screw yield strength.**					
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
040	IMB14	34	4	M4	6	10.9
060		52		M5	8	
080		70		M6	10	
120		100		M10	16	
160		145		M12	20	

NRK/NRKW						
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
050	IMB14	44	4	M4	8	12.9
070		62		M5	8	
090		80		M6	9	
120		108		M8	20	
155		140		M10	20	

NP						
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
005	IMB14	44	4	M4	8	12.9
015		62		M5	10	
025		80		M6	12	
035		108		M8	16	
045		140		M10	20	

NLC/NLCW						
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of through holes**	**Bore diameter in mm**	**Flange thick-ness in mm**	**Property class of the screws**
050	IMB5	68-75	4	5.5	7	12.9
070		85		6.5	8	
090		120		9	10	

SP+						
Gear unit	**Mounting flange**	**Ø circle of holes in mm**	**Number of through holes**	**Bore diameter in mm**	**Flange thick-ness in mm**	**Property class of the screws**
060	IMB5	68	4	5.5	6	12.9
075		85		6.6	7	
100		120		9	10	
140		165		11	12	
180		215		13.5	15	
210		250		17	17	
240		290		17	20	

TP+						
Gear unit	**Mounting flange**	**Ø circle of holes in mm**	**Number of through holes**	**Bore diameter in mm**	**Flange thick-ness in mm**	**Property class of the screws**
004	IMB5	79	8	4.5	6	12.9
010		109		5.5	7	
025		135			8	
050		168	12	6.6	10	
110		233		9	12	
300		280	16	13.5	18	
500		310			20	

Shaft flange

TP+					
Gear unit	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
TP004	31.5	8	M5	7	12.9
TP010	50		M6	10	
TP025	63	12		12	
TP050	80		M8	15	
TP110	125		M10	20	
TP300	140		M16	22	
TP500	160		M20	31	

3.4 Structure of the article number

Note

Selection options based on the article number

Note that not every codable combination is permissible.

An overview of the 1F□2 planetary gearbox motors currently available is provided in the respective catalog.

Description		Position of the Article No.								Short blocks in addition to the article number															
		11	12	-	13	14	15	16	-Z	A	☐	☐	+	R	☐	☐	+	M	☐	☐	+	Q	☐	☐
Basis motor 1F□2□□□-□□□, Selected according to the catalog																								
Holding brake	without	0																						
	with	1																						
Motor protection class	IP64		0																					
	IP65		1																					
Motor shaft end	See "Motor shaft" table				☐																			
Encoder	Singleturn 22 bit					S																		
	Singleturn 26 bit (only for 1FT2)					B																		
	Multiturn 22 bit					M																		
	Multiturn 26 bit (only for 1FT2)					C																		
Connection system [1]	OCC for SINAMICS S210						A																	
	2CC for SINAMICS S120 and S220						B																	
Revision number	Start							0																
Z for additional short blocks to extend the article number [2]									-Z															
1st short block [3]	Gearbox type	NRB, NRBW								A														
		NRK, NRKW								B														
		NLC, NLCW								C														
		SP+								J														
		TP+								H														
	Gearbox size	1 ... 8									☐													
	Number of gearbox stages	1 ... 3 for coaxial planetary gearboxes										☐												
		6 ... 8 for angled planetary gearboxes (1 ... 3-stage)										☐												

[1] More detailed information for S210 is provided in Catalog D32, for S120 and S220, in Catalog D21.4

[2] You can see the position of the short blocks on the following rating plate.

Description		Position of the Article No.								Short blocks in addition to the article number														
		11	12	-	13	14	15	16	-Z	A	☐	☐	+	R	☐	☐	+	M	☐	☐	+	Q	☐	☐
2nd short block [3]	Gearbox ratio, see table below	00 ... 80												R	☐	☐								
3rd short block	Lubricant	Standard lubricant																M	0					
		Lubricant for the food industry																	1					
	Shaft end and torsional backlash	Solid shaft without feather key																		0				
		Solid shaft with feather key																		1				
		Splined shaft																		2				
		Solid shaft without feather key, reduced backlash																		5				
		Solid shaft with feather key, reduced backlash																		6				
		Splined shaft, reduced backlash																		7				
4th short block (optional)	Orientation of the connector for angled gearboxes	Standard orientation																				-	-	-
		Connector on the output side																				Q	9	1
		Connector offset through 180° with respect to the standard																				Q	9	2
		Connector opposite the drive output																				Q	9	3

[3] More information is provided in the following tables.

Selecting the motor shaft extension depending on the gearbox size

Select the motor shaft extension suitable for the gearbox size.

Possible numbers for the 13th position of the Article No. are listed in the following table.

With this number, you select the shaft end that is available for the combination of planetary gearbox and motor that you require.

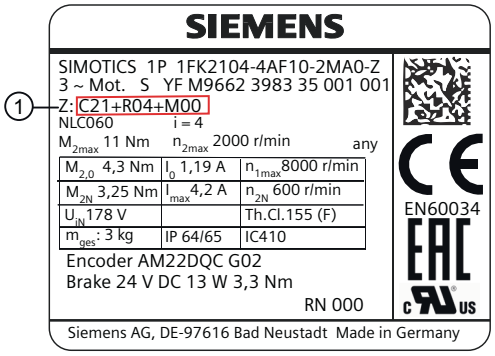
Combination options according to shaft extension for planetary gearbox and motor

Motor size	NRB040 NRK050 NBRW040 NRKW050	NRB060 NRK070 NLC060 NRBW060 NRKW070 NLCW060 SP060 TP004	NRB060 NRK070 NLC060 NRBW060 NRKW070 NLCW060 SP075 TP010	NRB120 NRB160 NRK120 NRK155 NLC120 NBRW120 NRKW120 NLCW120	SP100 SP140 SP180 TP025 TP050 TP110	SP210 SP240 TP300 TP500
1F☐2102	0	0	0	-	-	-
1F☐2☐03	2	2	0	0	0	-
1F☐2☐04	-	2	2	0	0	-
1F☐2☐05	-	0	0	0	0	-
1F☐2☐06	-	-	0	0	0	0
1F☐2☐08	-	-	0	0	0	0
1F☐2☐10	-	-	-	-	0	0

0 = plain shaft

2 = shaft extension with feather key

Position of the short blocks on the rating plate



① Specification of short blocks

Figure 3-3 Rating plate with display of short blocks

Possible motor-planetary gearbox combinations (1st short block)

The upper part of the table shows the information in the 1st short block for selecting the gearbox.

The center and lower parts of the table list the possible motor-gearbox combinations.

Note

Not every theoretically possible motor-gearbox combination is available.

For NRB/NRBW planetary gearboxes

		NRB040 / NRBW040	NRB060 / NRBW060	NRB080 / NRBW080	NRB120 / NRBW120	NRB160
1st short block: Type of gearbox	1-stage	A11/A16	A21/A26	A31/A36	A41/A46	A51
	2-stage	A12/A17	A22/A27	A32/A37	A42/A47	A52
	3-stage	A13/A18	A23/A28	A33/A38	A43/A48	A53
For converters at 200 ... 240 V	1F□2102	⇓	⇓	-	-	-
For converters at 200 ... 240 V and 400 ... 480 V	1F□2□03	⇓	⇓	⇓	⇓	-
	1F□2□04	-	⇓	⇓	⇓	-
	1F□2□05	-	⇓	⇓	⇓	⇓
	1F□2□06[1)]	-	-	⇓	⇓	⇓
	1F□2□08[1)]	-	-	-	⇓	⇓

1) Only for coaxial planetary gearboxes

For NRK/NRKW planetary gearboxes

		NRK050 / NRKW050	NRK070 / NRKW070	NRK090 / NRKW090	NRK120 / NRKW120	NRK155
1st short block: Type of gearbox	1-stage	B11/B16	B21/B26	B31/B36	B41/B46	B51
	2-stage	B12/B17	B22/B27	B32/B37	B42/B47	B52
For converters at 200 ... 240 V	1F□2102	⇓	⇓	-	-	-
For converters at 200 ... 240 V and 400 ... 480 V	1F□2□03	⇓	⇓	⇓	⇓	-
	1F□2□04	-	⇓	⇓	⇓	-
	1F□2□05	-	⇓	⇓	⇓	⇓
	1F□2□06	-	-	⇓	⇓	⇓
	1F□2□08[1)]	-	-	-	⇓	⇓
	1F□2210[1)]	-	-	-	-	-✓

1) Only for coaxial planetary gearboxes

For NLC/NLCW planetary gearboxes

		NLC060 / NLCW060	NLC080 / NLCW080	NLC120
1st short block: Type of gearbox	1-stage	C21/C26	C31/C36	C41/C46
	2-stage	C22/C27	C32/C37	C42/C47
For converters at 200 ... 240 V	1F□2102	⇓	-	-
For converters at 200 ... 240 V and 400 ... 480 V	1F□2□03	⇓	⇓	⇓
	1F□2□04	⇓	⇓	⇓
	1F□2□05	⇓	⇓	⇓
	1F□2□06	-	⇓	⇓
	1F□2□08[1)]	-	-	⇓

1) Only for coaxial planetary gearboxes

Order code for the gearbox ratio (2nd short block)

The following table shows the order codes required to select various gearbox ratios in the 2nd short block.

Number of gearbox stages *z*	Transmission ratio of gearbox *i*	Gearbox ratio order code
1	3	R03
	4	R04
	5	R05
	7	R07
	8	R08
	10	R10
2	9	R09
	12	R12
	15	R15
	16	R16
	20	R20
	25	R25
	32	R32
	40	R40
	50	R50
	64	R64
	100	R00
3	60	R60
	80	R80
	100	R01
	120	R21
	160	R61
	200	R02
	256	R52
	320	R23
	512	R51

See also

Technical features (Page 38)

3.5 Rating plate data

The rating plate contains the technical data applicable to the delivered motor. A second rating plate is supplied unattached with the motor for documentation purposes.

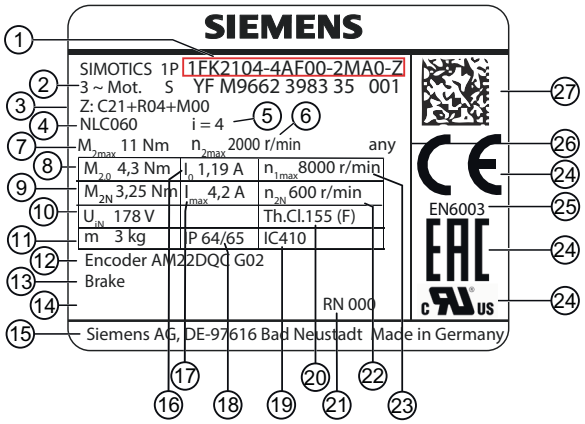


Figure 3-4 Rating plate

Table 3-4 Description of the rating plate data

Position	Description / technical data	Characteristic value
1	Article number	
2	ID No., serial number	
3	Order codes as a supplement to the article number	
4	Type and size of the planetary gearbox	
5	Transmission ratio of the planetary gearbox	i
6	Maximum permissible output speed of the geared motor	n_{2max}
7	Maximum permissible output torque of the geared motor	M_{2max}
8	Geared motor static torque (gear output side)	$M_{2.0}$
9	Geared motor rated torque (gear output side)	M_{2N}
10	Induced voltage at rated speed	U_{iN}
11	Geared motor weight	m
12	Encoder type identifier	
13	Holding brake data: Type, voltage, power consumption, holding torque (when installed)	
14	Space for customized labeling	
15	Manufacturer's address	
16	Stall current	I_0
17	Short-time permissible maximum motor current	I_{max}
18	Degree of protection	
19	Cooling method according to EN 60034-6	
20	Temperature class of the insulation system	
21	Revision version	
22	Rated speed of geared motor at output	n_{2N}

Position	Description / technical data	Characteristic value
23	Maximum motor speed at output (matched to gearbox)	n_{1max}
24	Certifications	
25	Standard for all rotating electrical machines	
26	Permissible mounting position	
27	Data matrix code	

Mechanical properties

4

4.1 Cooling

The geared motor is naturally cooled.

To ensure adequate cooling when installed, the motor and the mounted planetary gearbox must have a minimum clearance of 100 mm to adjacent components on three lateral surfaces.

Maintain theses clearances irrespective of the following mounting variants.

Description

Note

Thermal interaction between the motor and gearbox

Take into account the thermal interaction between the motor and gearbox. Reduced characteristics for the geared motors apply. You can download these by entering the article number in the "SIEMENS Product Configurator (Page 195)".

NOTICE
Gearbox damage caused by excessively high housing temperatures Housing temperatures above 90 °C may cause damage to the gearbox. • Make sure that the gearbox housing temperature remains below 90 °C.

Mounting conditions for this specification

The data specified for the geared motors is applicable, taking into account the following mounting conditions:

- Ambient temperature of 40 °C (104 °F)
- Installation altitude up to 1000 m above sea level
- The geared motor is mounted on the machine thermally coupled via a flange plate with the following dimensions:

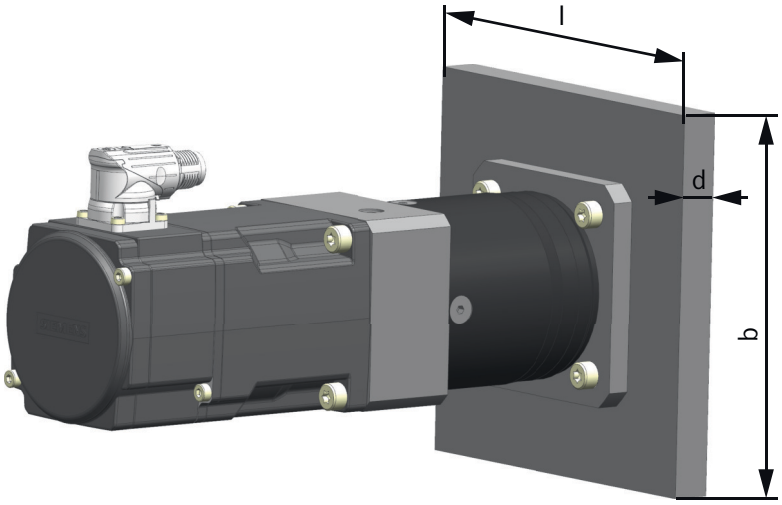


Figure 4-1 Geared motor with flange plate

Gearbox size: NRB / NRBW / NRK / NRKW / NLC / NLCW	Steel plate[1]: l x w x d (in mm)
040 / 050	200 x 200 x 6
060 / 070	250 x 250 x 6
080 / 090	300 x 300 x 12
120 / 155 /160	450 x 370 x 30

l = length, b = width, d = thickness

[1] no stainless steel or tempered steel (as a result of thermal conductivity)

Gearbox size: SP+ / TP+	Steel plate[1] : l x w x d (in mm)
SP60	250 x 250 x 6
SP75 / TP004	300 x 300 x 12
SP100 / SP140 / SP180 / SP210 / TP010 / TP025 / TP050 / TP110	450 x 370 x 30
SP240 / TP300 / TP500	550 x 380 x 35

l = length, b = width, d = thickness

[1] no stainless steel or tempered steel (as a result of thermal conductivity)

Influence of mounting conditions

Higher ambient temperatures, higher installation altitudes or smaller mounting surfaces have a negative impact on the amount of heat dissipated from the geared motor, thus necessitating power reductions.

Geared motor cooling improves at lower ambient temperatures and with larger mounting surfaces. An increase in performance within the scope of the basic motor specification is possible.

At low temperatures, the friction torque may increase when starting. Take this into account when dimensioning the converter.

The following diagram shows examples of the behavior of geared motors depending on the ambient temperature and mounting conditions:

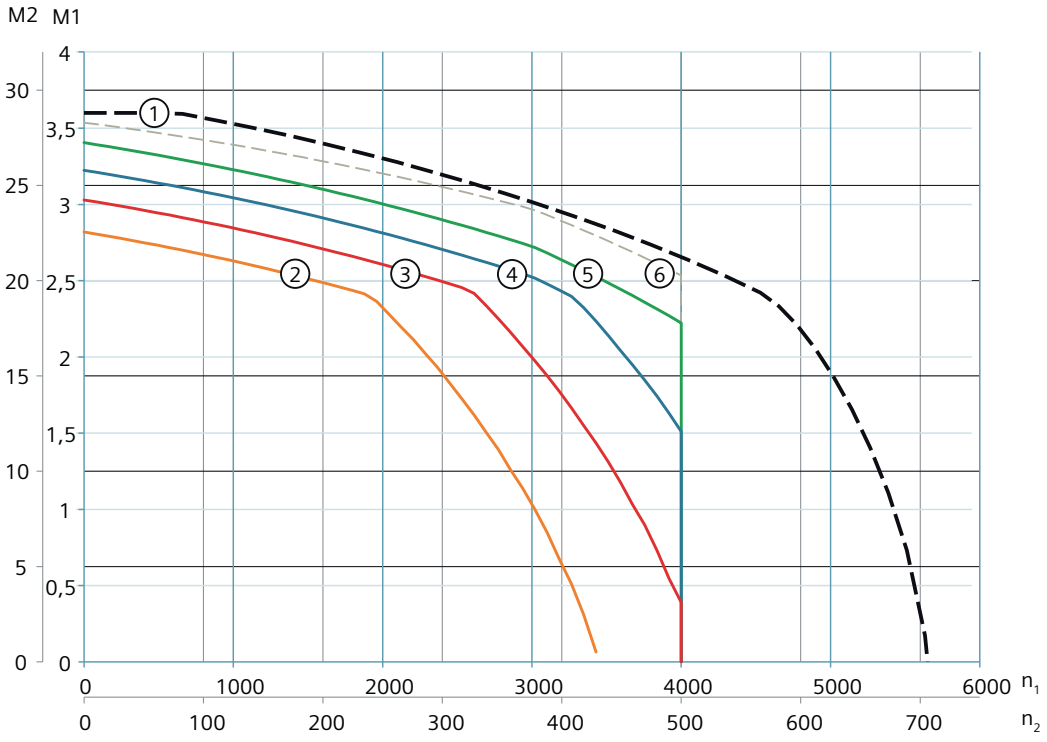


Figure 4-2 Diagram of ambient temperature. Example: 1FK2205-2AF... with NRB 080 gearbox, i = 8

①	S1 characteristic of the basic motor without gearbox at ambient temperature of 40 °C (as documented in the configuration manuals of the respective motors)	
② to ⑤	S1 characteristics of geared motor under typical mounting conditions (defined above); however, at different ambient temperatures:	
	②	For ambient temperature of 50 °C
	③	For ambient temperature of 40 °C: specification data and characteristics are specified for this ambient temperature.
	④	For ambient temperature of 30 °C
	⑤	For ambient temperature of 20 °C
⑥	S1 characteristic for optimal conditions: Ambient temperature of 20 °C On one side, the mounting surface is kept at a constant 20 °C.	

4.2 Thermal motor protection

Description

Note

The motor thermal overload protection applies to the motor without gearbox. The capacity utilization indicated in parameter r0034 is not significant for geared motors.

The geared motor is designed for operation within the specified ambient conditions and characteristics.

If you operate the geared motor outside of the specified ambient conditions and characteristics, there is a risk that the geared motor will be overloaded.
In this case, the drive system stops the motor without prior warning with the fault message: "F31405: Encoder 1: Temperature in the encoder evaluation exceeded" (OFF2).

NOTICE

Gearbox damage caused by excessively high housing temperature

In operation, the maximum permissible surface temperature of the gearbox is 90 °C.
When thermally overloaded frequently or for longer periods of time, then the lubricant life and therefore the gearbox service life can be significantly reduced.

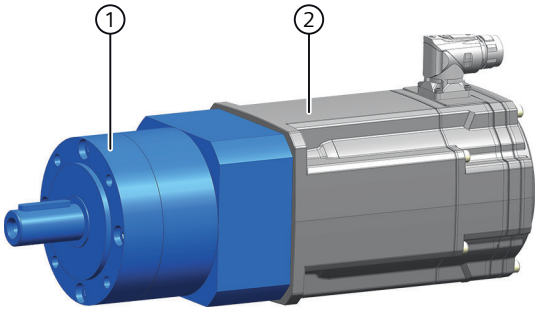
- Avoid gearbox housing temperatures > 90 °C.
- Operate the geared motor within the specified ambient conditions and characteristics.

4.3 Degree of protection

Description

The planetary gearboxes and connected servomotors are designed according to EN 60034-5 (IEC 60034-5) and are available in various degrees of protection.

Parts relevant for the degree of protection



① Gearbox
② Motor including parting plane to gearbox adapter flange

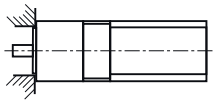
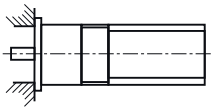
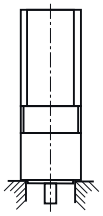
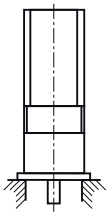
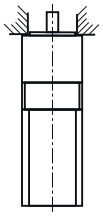
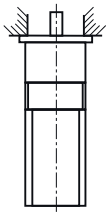
Overview of degrees of protection available acc. to IEC 60034-5

Gearbox	NRB / NRBW		NRK / NRKW		NLC / NLCW / SP+ / TP+	
Selected gearbox degree of protection (Pos. 1)	IP64				IP65	
Selected motor degree of protection (Pos. 2)	IP64	IP65	IP64	IP65	IP64	IP65
Marking on the rating plate	IP64	IP64/IP65	IP64	IP64/IP65	IP64/IP65	IP65

4.4 Types of construction

You can install and operate the geared motors in all mounting positions.

Permissible mounting positions according to IEC 60034-7

NRB, NRK	NLC / SP+ / TP+
 IM B14	 IM B5
 IM V18	 IM V1
 IM V19	 IM V3

Note

When selecting the installation, take into account the following points.

- Observe the permissible motor shaft loads, e.g. the weight force of the output elements.
- Observe the degree of protection in particular for mounting positions IM V19 and IM V3 (risk of liquid entering the motor if it accumulates on the flange).

4.5 Bearing versions

Overview

Coaxial and angled planetary gearboxes have the following bearing versions:

Gearbox type	NRB / NRBW	NRK / NRKW	NLC / NLCW	SP+	TP+
Output bearing type	Deep-groove ball bearing		Tapered roller bearing to accept high axial and radial forces		
Bearing seal	Sealed bearing		Shaft sealing ring		
Bearing lubrication type	Lubricated for life in the factory				

4.6 Radial and axial forces

4.6.1 Example of belt pretension

Description

Note

- When designing a belt drive, observe the belt manufacturer's specifications and guidelines.
- Check the belt tension with a suitable measuring instrument or test procedure.

$F_V = M_{2L,\,max} \cdot 2 / d_R \cdot 1.1$

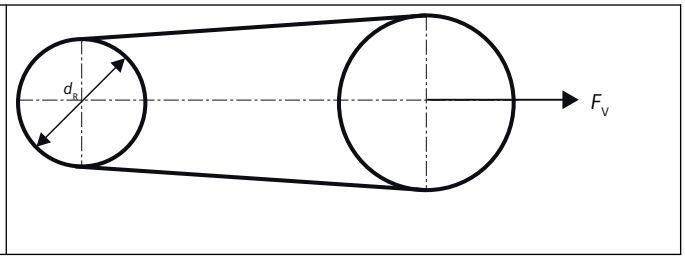


Table 4-1 Explanation of the formula abbreviations

Formula abbreviations	Unit	Description
F_V	N	Belt pretension
$M_{2L,\,max}$	Nm	Maximum transmittable torque
d_R	m	Effective diameter of the belt pulley

When using other configurations, you must take into account the actual forces generated from the torque being transferred.

More information about the permissible radial and axial forces is provided under "Service life of the output bearing depending on radial forces (Page 75)" and "Service life of the output bearing depending on the shaft load (Page 75)".

4.7 Vibrational behavior

Vibration severity

The vibration response of the drive system at the location of use is influenced by the following factors:

- Output elements
- Mounting conditions

- Alignment
- Installation
- External vibrations

The geared motors fulfill vibration severity grade A according to EN 60034-14 (IEC 60034-14).

The vibration values specified refer only to the geared motor.

The vibration severity grade is maintained up to the rated speed (n_N).

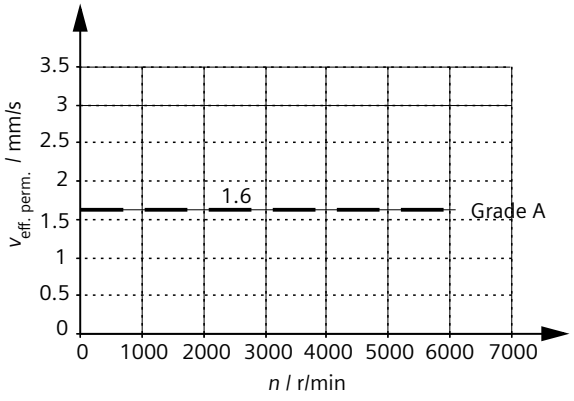


Figure 4-3 Vibration severity

Vibration stress

Comply with the vibration values in the following table to ensure perfect functioning of the geared motor and a long bearing lifetime.

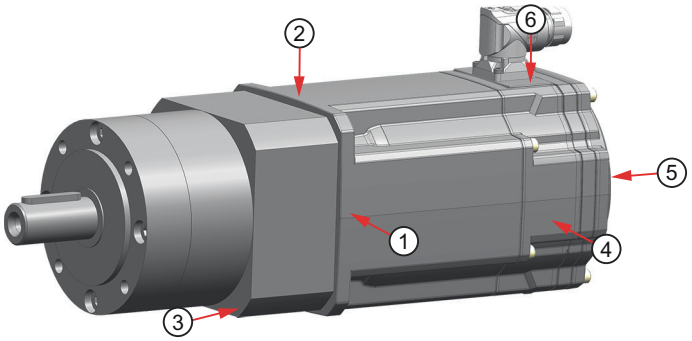
Table 4-2 Vibration values

Vibration velocity V_{rms} to ISO 10816	max. 4.5 mm/s
Vibration acceleration a_{peak} axial	25 m/s^2
Vibration acceleration a_{peak} radial	25 m/s^2

To evaluate the vibration velocity, the measuring equipment must meet the requirements of ISO 2954.

Select the measuring points according to ISO 10816-1, Section 3.2.

The vibration acceleration is evaluated in the frequency range from 10 Hz to 2000 Hz. The maximum peak value in the measurement time range is considered. The vibration values must not exceed the specified limit values at any measuring point.



1	End shield DE radial	4	End shield NDE radial
2	End shield DE radial	5	End shield NDE axial
3	End shield DE axial	6	End shield NDE radial

Figure 4-4 Points of measurement on geared motors

4.8 Noise emission

WARNING

Hearing damage caused by unsuitable environmental conditions

Hearing damage may occur if the motor exceeds a sound pressure level of 70 dB (A) due to the type of mounting or pulse frequency.

- Reduce the sound pressure level by implementing sound damping and/or soundproofing measures.

Description

The servomotors with planetary gearbox are certified for a wide range of installation and operating conditions. Under certain conditions such as a rigid or vibration-isolated foundation design, the noise emission is in some instances strongly influenced.

Note

External noise

The following noises are not taken into account for noise emission:

- Noises not generated by the gearbox but emitted from it
- Noises emitted by the driving and driven machines or by the base

The circumferential velocity of the sun wheel and the sun wheel pinion significantly influence planetary gearbox noise levels. At other speeds or transmission ratios, the sound pressure level generated may deviate from the specified value.

Maximum sound pressure level for NRB(W), NRK(W), NLC(W) gearboxes in dB(A)

Gearbox size	040 / 050	060 / 070	080 / 090	120	155 / 160
1F□2102, 1F□2□03, 1F□2□04	60	60	61	65	
1F□2□05, 1F□2□06		66	66	68	71
1F□2□08				71	73
Tolerance	+3				
General condition	Sound pressure level measured at a distance of 1 m away for an input speed of n1 = 3000 r/min without load; i = 5				

Maximum sound pressure level for SP+ gearboxes in dB(A)

Gearbox size	SP060		SP075		SP100		SP140		SP180		SP210		SP240	
z	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1FT2102, 1FT2□03, 1FT2□04	60	59	60	58	60	59	60	60		60				
1FT2□05, 1FT2□06	66		66	65	66	66	66	66	67	66		66		66
1FT2□08, 1FT2□10					70		70	70	71	70	71	70	71	70
Tolerance	+3													
General condition	Sound pressure level at a distance of 1 m Measured without load, with i = 10 for z = 1 or i = 100 for z = 2 and an input speed of n1 = 3000 r/min										Sound pressure level at a distance of 1 m Measured without load, with i = 10 for z = 1 or i = 100 for z = 2 and an input speed of n1 = 2000 r/min			

Maximum sound pressure level for TP+ gearboxes in dB(A)

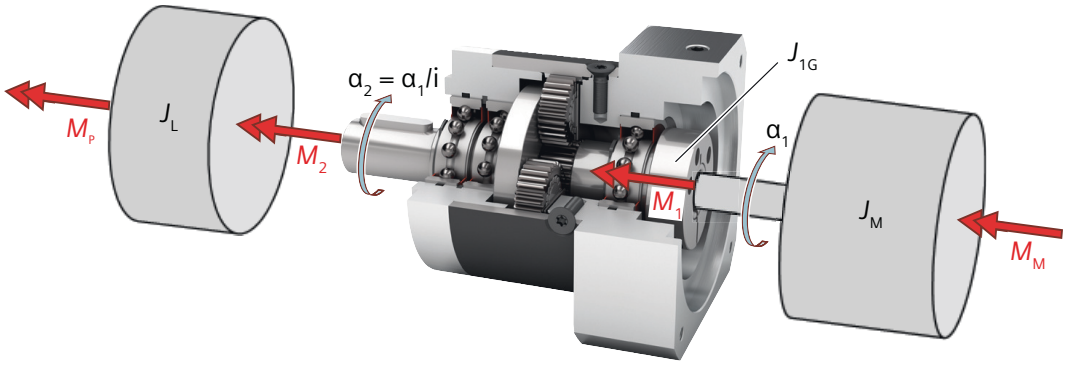
Gearbox size	TP004		TP010		TP025		TP050		TP110		TP300		TP500	
z	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1FT2102, 1FT2□03, 1FT2□04	58	58	59	58	62	60	65	60		62				
1FT2□05, 1FT2□06	65		66	65	66	66	68	66	70	66		66		66
1FT2□08, 1FT2□10					71		71	70	72	71	71	71	71	70
Tolerance	+3													
General condition	Sound pressure level at a distance of 1 m Measured without load, with i = 10 for z = 1 or i = 100 for z = 2 and an input speed of n1 = 3000 r/min										Sound pressure level at a distance of 1 m Measured without load, with i = 10 for z = 1 or i = 100 for z = 2 and an input speed of n1 = 2000 r/min			

Configuring

5

5.1 Important sizes and formulas for geared motors

Overview



J_L	Load moment of inertia (referred to the output)
J_M	Motor moment of inertia
M_M	Electromagnetically-generated motor torque
M_1	Input torque applied to gearing of gearbox
M_2	Output torque on gearbox shaft
M_P	Optional process torque
α_1	Angular acceleration at gearbox input
α_2	Angular acceleration at gearbox output

Figure 5-1 Overview of important sizes

$$M_1 = M_M - \overbrace{(J_M + J_G) \cdot \alpha_1}^{①} \qquad M_2 = \overbrace{J_L \cdot \alpha_2}^{②} + M_P$$

① Torque for accelerating the rotor and gearbox inertia

② Torque for accelerating the load

For 1F□2 geared motors, the friction torque of the gearbox has already been subtracted from the torque characteristics $M_{S1,\,M}$ and $M_{max,\,M}$ as well as from motor parameters $M_{0,\,M}$ and $M_{max,\,M}$ and the efficiency η_G has therefore been taken into account.

The following applies when calculating with these characteristic curves and characteristics:

$M_2 = M_1 \cdot i$

The following applies to the speed and acceleration:

$\alpha_2 = \alpha_1 / i$ and $n_2 = n_1 / i$

5.2 Important selection data and performance characteristics of the 1FK2 and 1FT2 geared motors

Example of characteristics

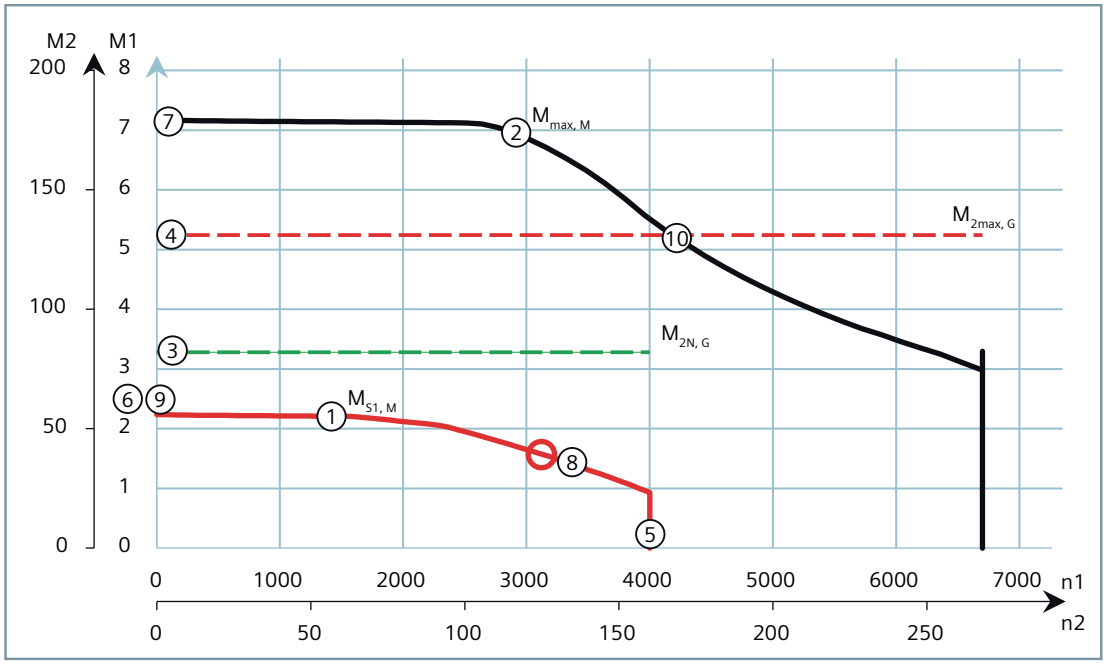


Figure 5-2 Example for geared motor with $M_{2N, G} > M_{S1, M}$

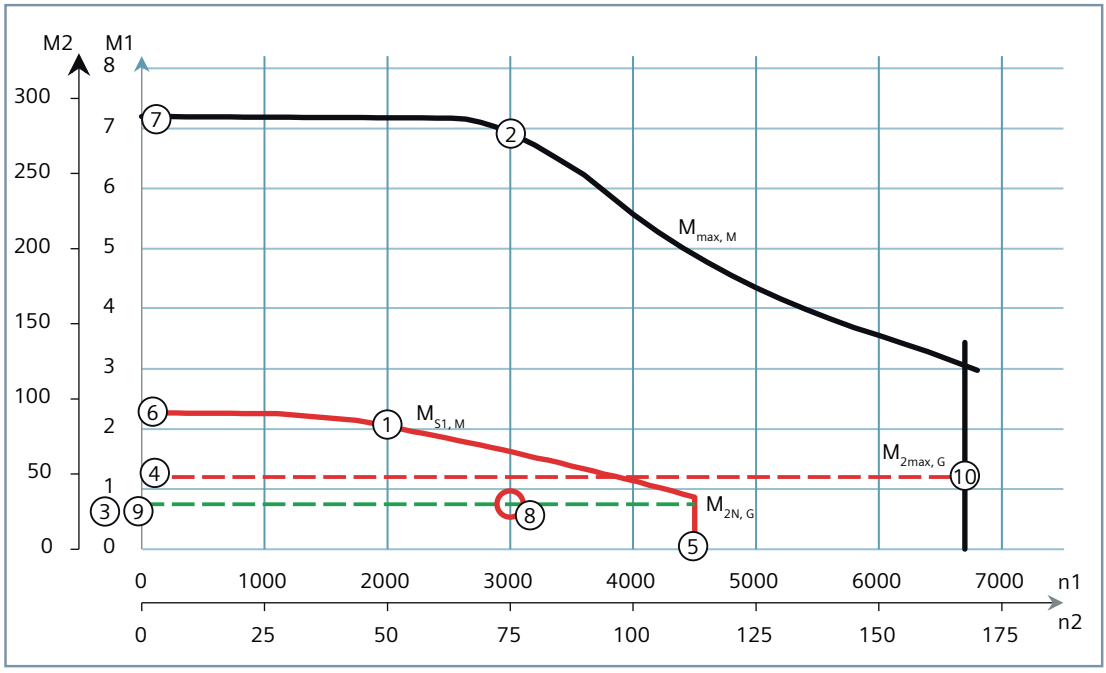


Figure 5-3 Example for geared motor with $M_{2N, G} < M_{S1, M}$

You can obtain the characteristics of the geared motor via the SIEMENS Product Configurator (Page 195).

①	$M_{S1,\,M}$	Characteristic of the largest thermally permissible effective torque of the motor component minus the gearbox friction and with consideration of the thermal interactions of the gearbox attachment. The effective operating point must be below this line to avoid thermal overload of the geared motor.
②	$M_{max,\,M}$	Characteristic of the largest torque that can be generated by the motor component for a short time minus the gear friction. $M_{S1,M}$ and $M_{max,M}$ may exceed the mechanically permissible limits of the gearbox, depending on the selection of the motor-gearbox combination[1)].

1) In this case, it must be ensured that the torque effective at the gearbox output does not exceed the permissible limits (taking into consideration load-to-motor inertia ratio when accelerating).

Table 5-1 **Important gearbox component data in these operating instructions**

③	$M_{2N,\,G}$	Rated torque of the gearbox component at the output. This represents the fatigue strength limit of the gearbox (independently of the motor). If this limit is exceeded, the gearbox will be partially damaged and a service life calculation will be required.
④	$M_{2max,\,G}$	Maximum torque of the gearbox component. This is the limit of the fatigue strength range. There is a risk of breakage if the limit is exceeded.
⑤	$n_{1av,\,G}$	Largest average input speed. In each time window of 15 minutes, for NRB(W), NRK(W), NLC(W) the average input speed must be below $n_{1av,\,G}$. In each time window of 10 minutes, for SP+, TP+ the average input speed must be below $n_{1av,\,G}$.

Table 5-2 **Important motor component data in these operating instructions**

⑥	$M_{0,\,M}$	The motor component can deliver this torque thermally on a sustained basis at standstill and near standstill. It may exceed the mechanical limits of the gearbox component[1)].
⑦	$M_{max,\,M}$	The motor component can deliver this torque for a short time. It may exceed the mechanical limits of the gearbox component[1)].

1) In this case, it must be ensured that the torque effective at the gearbox output does not exceed the permissible limits (taking into consideration load-to-motor inertia ratio when accelerating).

Table 5-3 **Important geared motor system data in these operating instructions**

⑧	Rated point	
	M_{2N}	Rated torque
	n_{2N}	Rated speed
	This rated point can be driven thermally and mechanically on a sustained basis. If the S1 characteristic $M_{S1,\,M}$ at n_{2N} is greater than $M_{2N,\,G}$, M_{2N} is reduced accordingly. At the rated point, the geared motor has approximately its maximum power.	
⑨	$M_{2,\,0}$	The geared motor can deliver this torque thermally on a sustained basis at standstill and near standstill. It can be reduced to $M_{2N,\,G}$.
⑩	M_{2max}	The geared motor can deliver this torque for a short time. It may be within the fatigue strength range of the gearbox.

You can obtain data sheets with the complete component and system data of 1F□2 geared motors SIEMENS Product Configurator (Page 195) by specifying the article number or through your sales partner. For an overview of the available motor-gearing combinations, refer to the catalog.

5.3 Configuring procedure

Procedure

Check whether the following configuration steps are required depending on the selected motor-gearbox combination.

1. **Thermal design of the geared motor:** (Page 67)
   - The effective motor torque at the average motor speed must be below the M_{S1} characteristic curve of the geared motor.
     You can obtain the characteristics of the geared motor by specifying the article number via the SIEMENS Product Configurator or through your sales partner.
   - The maximum speed n_{2max} and the highest permissible average input speed $n_{1av,G}$ must not be exceeded.
2. **Check of gearing strength** (Page 69):
   Check the gearing strength only if the application torque exceeds the rated torque of the gearbox component $M_{2N,\,G}$.
3. **Service life of the internal gearbox bearings** (Page 72)**:**
   Check the service life of the internal gearbox bearings only if one of the following points applies:
   - The application torque exceeds the rated torque of the gearbox component $M_{2N,\,G}$
   - The average application speed exceeds the reference speed of the gearbox $n_{2B,\,G}$.
     (For the reference speeds, refer to the chapter Technical specifications of planetary gearboxes (Page 81)).
   - A service life must be calculated explicitly.
4. **Max. load and service life of the output bearings** (Page 75)**:**
   At any point in time, never exceed the maximum axial, radial and breakdown loads. Calculate the service life of the output bearings only if the radial forces occurring at the gearbox shaft extension are not below the values specified for $F_{R,\,eq}$ in the radial force diagrams and the axial forces can be neglected.
5. **Emergency Off torque** (Page 78)**:**
   Check the Emergency Off torque only if high torques caused by operating faults could damage the gearbox.
6. **Maximum acceleration of the geared motor** (Page 79)
   Check the maximum acceleration of the geared motor only if the geared motor is subjected to accelerations perpendicular to its axis.

❒

5.3.1 Thermal design of the geared motor

Description

The characteristics provided for the geared motor already take thermal interactions between the motor and the gearbox and the gearbox friction into account.
By applying the following measures, avoid thermally overloading the geared motor.

- At the average speed $n_{M,\,av}$, the effective electrically generated motor torque $M_{M,eff}$ does not exceed the thermal S1 characteristic of the geared motor $M_{S1,\,M}$.
- The average speed $n_{M,av}$ of the motor in each time window of 10 minutes (for SP+ and TP+) or 15 minutes (for NRB, NRBW, NRK, NRKW, NLC, NLCW) must remain below the maximum permissible average input speed $n_{1av,\,G}$.

Carefully maintain the maximum permissible speed of the motor and gearbox components.

Precondition for thermal inspection

- You are familiar with the application data for the output side of the gearbox:
  - Torque curve over time: $M_{2L}(t)$
  - Speed curve over time: $n_{2L}(t)$
  - Acceleration over time: $\alpha_{2L}(t)$
  - Total duration of the cycle: T_C
- You have already preselected a planetary gearbox and a motor and are familiar with the data:
  - Transmission ratio of the planetary gearbox: i
  - Moment of inertia of geared motor:
    - Motor without brake: $J_1 = J_{1G} + J_M$
    - Motor with brake: $J_1 = J_{1G} + J_{M,Br}$
  - S1 characteristic of geared motor $M_{S1,\,M}$

Procedure

1. Determine the torque curve M_M (t) effective for the motor:

$$M_M(t) = \frac{M_{2L}(t)}{i} + J_1 \cdot \frac{\alpha_2(t)}{i}$$

M_{2L} (t)	= time-dependent load torque at output
α_2	= angular acceleration at output
J_1	= moment of inertia of geared motor

2. Divide the load cycle into *i* partial cycles with an almost constant torque and calculate the effective motor torque:

$$M_{M,eff} = \sqrt{\frac{\sum_i M_{M,eff}^2 \cdot \Delta t_i}{T}}$$

3. Calculate the average motor speed $n_{M,av}$:

$$n_{M,m} = \frac{\sum_i |n_{2,i}| \cdot \Delta t_i}{T}$$

❒

Evaluation and remedy

If the effective operating point from $M_{M,eff}$ and $n_{M,av}$ lies above the S1 characteristic of the geared motor, the latter is thermally overloaded.

In this case, you have the following options.

- Select a more powerful motor.
- Select a motor with a lower motor moment of inertia.
- Select a planetary gearbox with a higher transmission ratio.

If the average input speed in any section of the cycle exceeds the limiting value $n_{1av,G}$ or the maximum permissible speed at the output of the geared motor n_{2max} is exceeded at any time, then the geared motor is overloaded. For SP+ and TP+, this section is 10 minutes, for NRB, NRBW, NRK, NRKW, NLC, NLCW 15 minutes.

In this case, you have the following options.

- Select a lower transmission ratio. This requires a more powerful motor.
- Select a motor or a gearbox with higher permissible speeds (smaller frame sizes).

Note

The maximum speed of the geared motor n_{2max} is the minimum from
$n_{1max,M} / i$ (maximum speed of the motor component) and
$n_{1max,G} / i$ (maximum speed of the gearbox component).
This value is listed in the data sheet of the geared motor.

More information

The characteristics of the geared motors can be obtained on the internet via the SPC or from your sales partner. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

5.3.2 Gearing strength for 1FK2 and 1FT2 with planetary gearbox

Influence of output torque M_2 on the service life of the planetary gearbox

If the effective application torque at the output does not exceed the rated torque of the planetary gearbox $M_{2N,\,G}$ at any time, the gearing is fatigue endurable and no further calculation is required.

All output torques occurring in the application that exceed the gearbox rated torque $M_{2N,\,G}$ will result in partial damage to the planetary gearbox.

This partial damage is dependent on the magnitude of the overload and the number of revolutions performed by the output shaft with this overload.

The gearbox maximum torque $M_{2max,\,G}$ must not be exceeded at any time in normal operation.

Procedure for determining the service life

Note

When calculating the service life, take any existing application-specific torque peaks into account (e.g. shock factors). Reduce any peaks that occur by using the torque rounding function.

1. Divide the relevant load cycle into *i* partial cycles with an almost constant output torque $M_{2L,\,i}$ and a linear speed curve.
   Consider only partial cycles for which the following applies:

   $$|M_{2L,\,i}| > M_{2N,\,G}$$

2. Form the overload S_i for each partial cycle:

   $$S_i = \frac{|M_{2L,\,i}|}{M_{2N,\,G}}$$

3. Determine the following values for each partial cycle:
   - The number of actual revolutions $N_{R2,\,i}$
   - The number of permissible revolutions $N_{R2\,max,\,i}$ with the respective overload S_i

$$N_{R2,\,i} = \frac{|n_{2L\,start,\,i} + n_{2L\,end,\,i}|}{2} \cdot \Delta t_i$$

$n_{2L\,start,\,i}$ = speed at the beginning of the partial cycle *i*
$n_{2L\,end,\,i}$ = speed at the end of the partial cycle *i*
Δt_i = period of the partial cycle *i*

$$N_{R2\,max,\,i} = e^{a-b \cdot S_i}$$

Gearbox type	Transmission ratio i	a	b
SP+ / TP+	3	20.74	4.8
	4	20.33	
	5	20.04	
	7	19.64	
	10	19.23	
	16	20.33	
	20	20.33	
	25	20.04	
	28	20.33	
	35	20.04	
	40	20.33	
	50	20.04	
	70	19.64	
	100	19.23	
NRB(W) / NRK(W) / NLC(W)	All	26.93	10.36

The damage for each partial cycle results from the ratio of the number of actual revolutions to the number of permissible revolutions for the respective load S_i.

4. Calculate the partial damage D_C of the planetary gearbox for a cycle from the sum of the ratios from the number of actual revolutions $N_{R2,\,i}$ and the number of permissible revolutions $N_{R2\,max,\,i}$ of all partial cycles for the respective load S_i:

$$D_C = \sum_i \frac{N_{R2,\,i}}{N_{R2\,max,\,i}}$$

5. Calculate the number of permissible cycles Z:

$$Z = \frac{1}{D_C}$$

6. and calculate the service life *L* of the gear teeth:

$$L = \frac{T_C}{D_C}$$

T_C = period of the partial cycle

Example

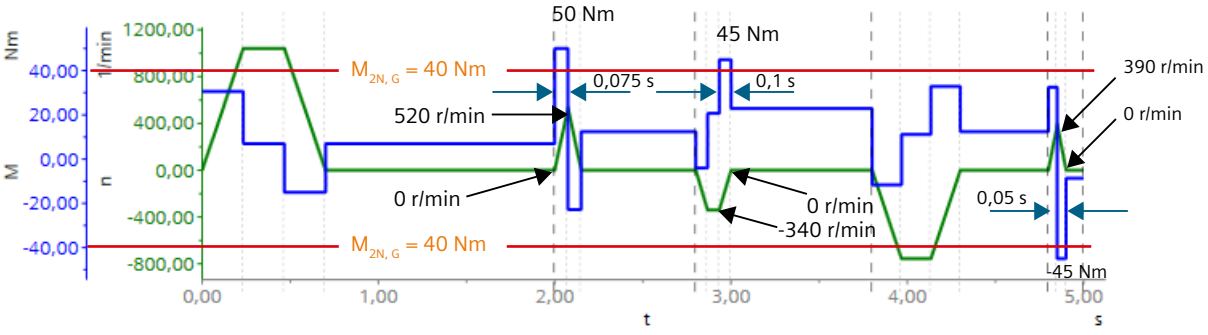


Figure 5-4 Example of a load cycle with an NRB060 coaxial planetary gearbox, i = 5 with $M_{2N,\,G}$ = 40 Nm

If rated torque $M_{2N,\,G}$ of the planetary gearbox is partially exceeded, then the fatigue strength must be recalculated.

Relevant partial cycles with
$|M_{2L,\,i}| > M_{2N,\,G}$

Partial cycle 1:

$$S_1 = \frac{|M_{2L,\,i}|}{M_{2N,\,G}} = \frac{50\ \text{Nm}}{40\ \text{Nm}} = 1{,}25$$

$$N_{R2,1} = \frac{|n_{2L\,start,\,i} + n_{2L\,end,\,i}|}{2} \cdot \Delta t = \frac{|0 + 520\ \text{r/min}|}{2} \cdot 0{,}075\ \text{s} = 0{,}325\ \text{r}$$

$$N_{R2\,max,\,1} = e^{26{,}93 - 10{,}36 \cdot 1{,}125} = 4.303.762\ \text{r}$$

Partial cycle 2:

$$S_2 = \frac{45\ \text{Nm}}{40\ \text{Nm}} = 1{,}125$$

$$N_{R2,\,2} = \frac{|-340\ \text{r/min} + 0|}{2} \cdot 0{,}1\ \text{s} = 0{,}2833\ \text{r}$$

$$N_{R2\,max,\,2} = e^{26{,}93 - 10{,}36 \cdot 1{,}125} = 4.303.762\ \text{r}$$

Partial cycle 3:

$S_3 = \frac{45\ \text{Nm}}{40\ \text{Nm}} = 1{,}215$

$N_{R2,\,3} = 0{,}1625\ \text{r}$

$N_{R2\,max,\,3} = 1.693.995\ \text{r}$

$$D_C = \sum_i \frac{N_i}{N_{R2\,max,\,i}} = \frac{0{,}325\ \text{r}}{1.178.791\ \text{r}} + \frac{0{,}2833\ \text{r}}{4.303.762\ \text{r}} + \frac{0{,}1625\ \text{r}}{1.693.995\ \text{r}} = 0{,}0000437\ \%$$

Number of permissible cycles:

$$Z = \frac{1}{D_C} = 2{,}29 \cdot 10^6$$

Service life:

$$L = \frac{T_C}{D_C} = 2{,}29 \cdot 10^6 \cdot 5\ \text{s} = 3175\ \text{h}$$

5.3.3 Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox

Description

Calculate the service life of the internal gearbox bearings only if one of the following points applies:

- The output torque exceeds the rated torque of the planetary gearbox $M_{2N,\,G}$ at any time.
- The average output speed exceeds the reference speed $n_{2B,\,G}$ of the planetary gearbox.
- You would like to configure the planetary gearbox for a nominal service life other than 20,000 hours.

To configure the service life, proceed as described below.

Determining the equivalent load torque of the application

Determine the equivalent load torque of the application $M_{2L,\,eq}$.
In its effect, it corresponds to the torque curve of the complete load cycle. For this purpose, divide the load cycle into *i* partial cycles with an almost constant torque and use the following formula:

$$M_{2L,eq} = \left(\frac{\sum_i |M_{2L,i}|^{3,33} \cdot |n_{2L,i}| \cdot \Delta t_i}{\sum_i |n_{2L,i}| \cdot \Delta t_i} \right)^{0,3}$$

$M_{2L,\,i}$	Application torque in time interval *i*
$n_{2L,\,i}$	Output speed in time interval *i*
Δt_i	Duration of time interval *i*

Determining the arithmetic mean of the output speed

1. Divide the load cycle into *i* partial cycles with an almost constant speed.
2. Calculate the average application speed with the following formula:

$$n_{2L,av} = \sum \frac{|n_{2L,i}| \cdot \Delta t_i}{T_C}$$

n_{2i}	Output speed in time interval *i*
Δt_i	Period of time interval *i*
T_C	Duration of cycle

Calculating the service life

Calculate the nominal service life $L_{10\,h}$ of the internal gearbox bearings with the following formula:

$$L_{10\,h} = 20.000\ \text{h} \cdot \frac{n_{2B,G}}{n_{2L,\,av}} \cdot \left(\frac{M_{2N,G}}{M_{2L,eq}} \right)^{3,33}$$

$n_{2B,\,G}$	Gearbox reference speed
$M_{2N,\,G}$	Rated torque of gearbox component
$M_{2L,\,eq}$	Equivalent load torque of the application
$n_{2L,\,av}$	Average application speed

If the calculated service life is not sufficient, select a larger gearbox size or reduce the loads.

See also

Technical specifications of planetary gearboxes (Page 81)

5.3.4 Check the output bearing with respect to the maximum load

Core statement

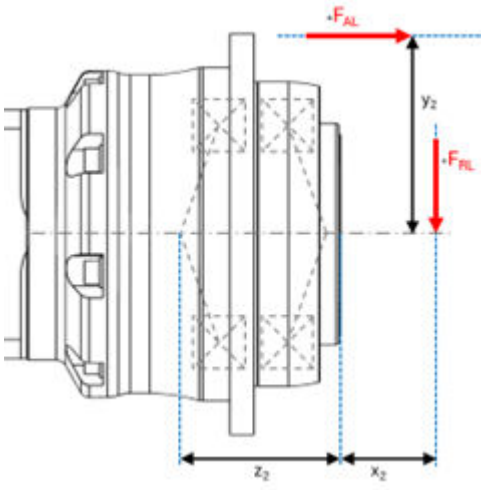
At any point in time, never exceed the maximum axial forces $F_{A, max}$ and maximum radial forces $F_{R,max}$ specified in Chapters "Technical data of planetary gearboxes".

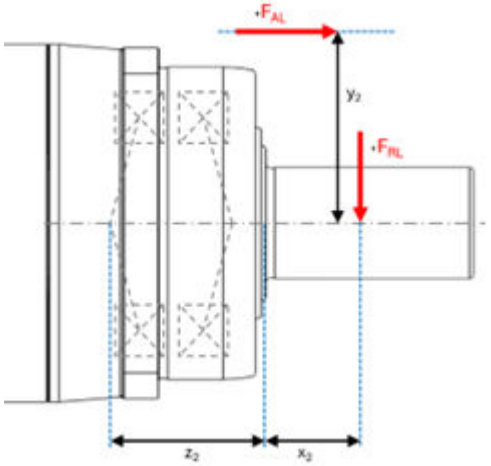
The following applies:

- $F_{AL} \leq F_{A, max}$
- $F_{AL} \leq F_{A,max}$

At no point in time may the max. breakdown torque $M_{2K, max}$ be exceeded:

- $M_{2K, max} \geq F_{RL} \cdot (z_2+x2)+F_{AL} \cdot y_2$





5.3.5 Service life of the output bearing depending on the shaft load

The service life of gearbox output bearings is dependent on the loads placed on the gearbox shaft.

Description

Pure axial forces are permissible up to the values specified in the technical specifications.

A superimposition of axial and radial forces is permissible as follows:

- The radial force application point is in the area of the output shaft.
- Axial forces of up to max. $F_{AL} = 0.24 \cdot F_{RL}$ are permissible for NRB, NBRW, NRK and NRKW gearboxes.
- For NLC, NLCW and SP+ gearboxes, axial forces up to max. $F_{AL} = 0.4 \cdot F_{RL}$ are permissible.
- For TP+ gearboxes, sizes TP004, TP010 and TP025, axial forces up to max. $F_{AL} = 1.1 \cdot F_{RL}$ are permissible.
- For TP+ gearboxes, sizes TP050, TP110, TP300 and TP500, axial forces up to max. $F_{AL} = 0.37 \cdot F_{RL}$ are permissible.

Contact your sales partner for other force relationships or force application points.

See also

Technical specifications of planetary gearboxes (Page 81)

5.3.6 Service life of the output bearing depending on radial forces

Description

Note

If the specified maximum radial forces at the maximum torque (application) are utilized by more than 10%, then the screwed connection between the geared motor and the customer's machine must be carefully checked.

The radial force diagrams assigned to the planetary gearboxes show the average permissible radial force $F_{R\,eq}$ referred to a nominal bearing lifetime. It is dependent on position x of the force application point at the gearbox shaft and on the arithmetically averaged output speed $n_{2L,\,av}$.

If the equivalent radial shaft load $F_{RL,\,eq}$ of your application is less than the permissible shaft load $F_{R\,eq}$ from the diagram, then the output bearing has the specified nominal service life L_{10h}.

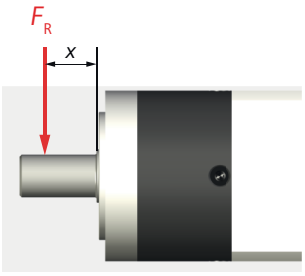


Figure 5-5 Radial force application point for planetary gearboxes

If required, calculate the nominal service life L_{10h}.

Procedure for calculating the nominal service life

1. Determine distance x from the point of application of the radial force F_{RL} to the shoulder of the gearbox shaft.
2. Calculate the arithmetic mean of the output speed $n_{2L,\,av}$:

$$n_{2L,av} = \sum \frac{|n_{2L,i}| \cdot \Delta t_i}{T_C}$$

$n_{2L,i}$	Output speed in time interval *i*
Δt_i	Period of time interval *i*
T_C	Duration of cycle

3. Determine the average permissible radial force $F_{R,\,eq}$ from the radial force diagram of the respective planetary gearbox from "x" and "$n_{2L,\,av}$". Example:

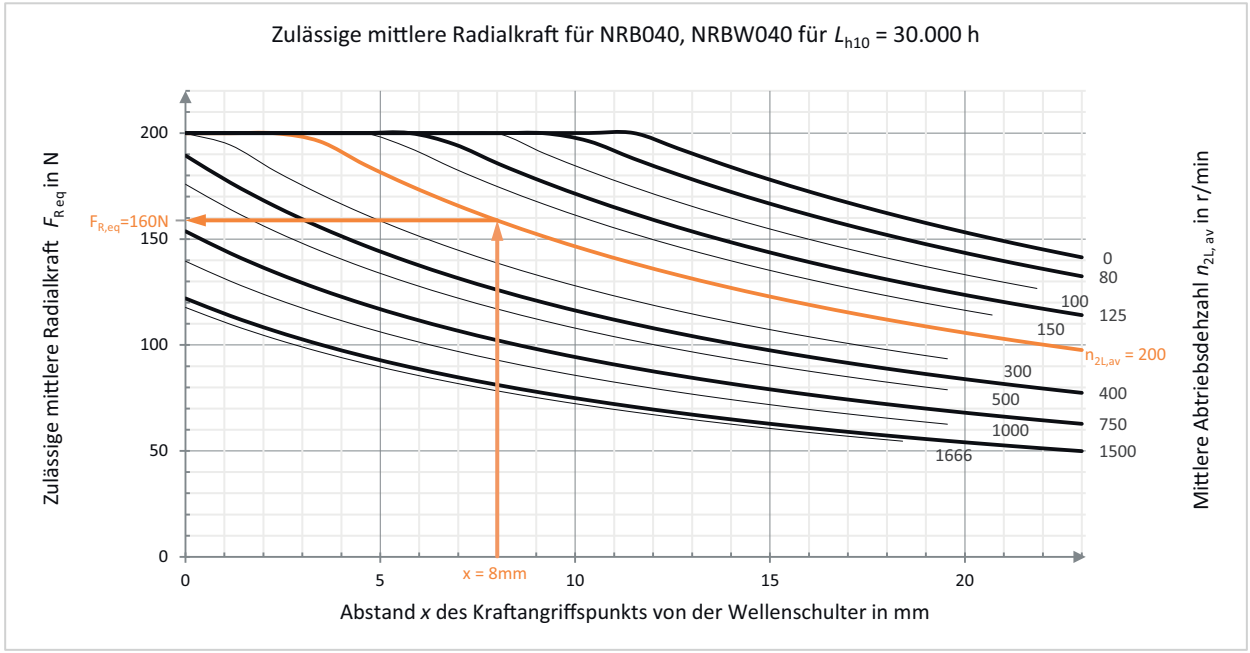


Figure 5-6 Example for determining $F_{R,\,eq}$ for $L_{10\,h}$= 30,000 h for an NRB040/NRBW040 planetary gearbox with x = 8 mm and $n_{2L,\,av}$ = 200 r/min.

If the radial force in your cycle does not exceed $F_{R,\,eq}$ at any time, then the nominal service life $L_{10\,h}$ of the output bearing is more than 30,000 h specified in the radial force diagram so that no additional calculation is required.

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If you would like to determine the nominal bearing lifetime or radial loads above $F_{R,eq}$ occur, then proceed as follows:

- Determine the average radial force equivalent to the load $F_{R\,L,eq}$ above the load curve. To do this, divide the load cycle into *i* partial cycles with an almost constant radial force and calculate the average radial force $F_{RL,\,eq}$ using the following formula:

$$F_{RL,\,eq} = \sqrt[p]{\frac{\sum_i (n_{2L,\,i} \cdot \Delta t_i \cdot F_{RL,\,i}^{p})}{\sum_i (n_{2L,\,i} \cdot \Delta t_i)}}$$

  p = 3 for NRB, NRBW, NRK and NRKW
  = 3.33 for NLC, NLCW, SP+ and TP+

  $n_{2L,i}$ Output speed in time interval *i*

  Δt_i Duration of time interval *i*

  $F_{RL,\,i}$ Radial force in time interval *i*

  If the average radial shaft load $F_{RL,eq}$ of your application is less than the permissible shaft load $F_{R\,eq}$ from the diagram, then the output bearing has the nominal service life L_{10h} of at least 30,000 h.

- If you require the nominal service life $L_{10\,h}$ of the output bearing, calculate it using the following formula:
  Economy-gearbox:

$$L_{10h} = 30\,000\ h \cdot \left(\frac{F_{R,\,eq}}{F_{RL,\,eq}}\right)^{p}$$

  p = 3 for NRB, NRBW, NRK and NRKW
  = 3.33 for NLC, NLCW, SP+ and TP+

  TP+ and SP+:

$$L_{10h} = 20\,000\ h \cdot \left(\frac{F_{R,\,eq}}{F_{RL,\,eq}}\right)^{3,33}$$

  If the achieved service life does not meet your requirements, then select either the next gearbox size or a different gearbox series with a stronger output bearing.

5.3.7 Check for excessively high torques in case of operating faults: EMERGENCY OFF torque

Description

The EMERGENCY OFF torque $M_{2Em.Off}$ can be tolerated a maximum of 1000 times during the planetary gearbox service life without causing unacceptable damage to the gearbox. You can use this data to check whether high torques, caused by very rare operating faults, can damage the planetary gearbox.

Example

The holding brake of the 1FK2208-3AC1... motor is applied during operation. The NRB120/ NRBW120 planetary gearbox, i = 10 must not be damaged by the forces generated.

Information required		Example
$M_{2Em.Off}$	= EMERGENCY OFF torque of the planetary gearbox	500 Nm
J_1	= inertia of the geared motor = $J_{M, Br}$ (motor inertia) + $J_{1,G}$ (planetary gearbox inertia)	35.36 kg cm² + 2.29 kg cm² = 37.65 kg cm²
i	Planetary gearbox transmission ratio	10
M_P	Process torque	50 Nm
J_L	Load inertia (downstream from planetary gearbox)	25000 kg cm²
$M_{Br, max}$	Maximum effective dynamic deceleration torque of the brake	37 Nm

Total moment of inertia to be braked (at output): $J_{2, sum} = J_1 \cdot i^2 + J_L = 28765$ kg cm²

Deceleration occurring at gearbox output:

$$\alpha_2 = \frac{i \cdot M_{Br, max} - M_P}{J_{2, sum}} = 0{,}0111 \text{ s}^{-2}$$

Torque occurring at gearbox output: $M_2 = i \cdot M_{Br, max} - J_1 \cdot i^2 \cdot \alpha_2 = 328$ Nm

Condition to avoid damage to the planetary gearbox: $M_2 \leq M_{2Em.Off}$

328 Nm ≤ 500 ⇒ OK

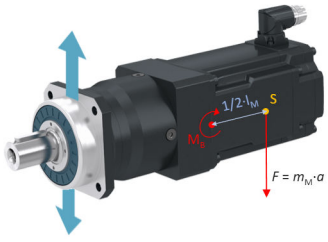
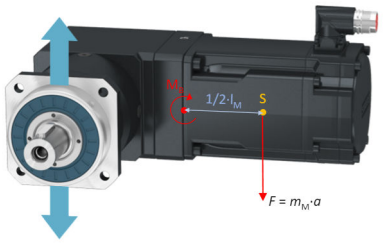
5.3.8 Check against excessively high bending moments when the geared motor accelerates for NRB(W), NRK(W) and NLC(W)

Description

If you accelerate the NRB(W), NRK(W) or NLC(W) geared motor perpendicular to the motor axis, the permissible bending moment may be exceeded at the interface between the motor and the gearbox.

Note

All motor-gearbox combinations offered are suitable for a horizontal suspension.

Coaxial planetary gearbox bending moment	Angled planetary gearbox bending moment
	

Check the occurring bending moment and limit it to the permissible bending moment $M_{B,G}$.

$$M_B = l_M \cdot \frac{1}{2} \cdot m_M \cdot \alpha$$

l_M	= overall length of motor component
m_M	= mass of motor component
a	= effective acceleration perpendicular to motor axis (incl. gravitational acceleration)
M_B	= effective bending moment during acceleration a
$M_{B,G}$	= gearbox characteristic for maximum permissible bending moment on motor flange

Note

For vertical acceleration, take the gravitational acceleration of 9.81 m/s² into account.

Technical specifications of planetary gearboxes

6

6.1 General technical data of NRB, NRBW, NRK, NRKW, NLC and NLCW planetary gearboxes, SP+ and TP+

Gearbox size	Motor frame size	$n_{1av,\,G}$ [1]	$n_{1max,\,G}$ [2]
		in r/min	in r/min
NRB040, NRBW040 NRK050, NRKW050	1F□2102	5000	18000
NRB040 NRK050	1F□2□03	4500	
NRB060, NRBW060 NRK070, NRKW070 NLC060, NLCW060	1F□2□02 ... 1F□2□04	4500	13000
NRB060 NRK070 NLC060	1F□2□05	4000	
NRB080, NRBW080 NRK090, NRKW090 NLC080, NLCW080	1F□2□03 ... 1F□2□05	4000	7000
NRB080 NRK090 NLC080	1F□2□06	3500	
NRB120, NRBW120 NRK120, NRKW120 NLC120, NLCW120	1F□2□03 ... 1F□2□06	3500	6500
NRB120 NRK120 NLC120	1F□2□08 ... 1F□2□10	3000	
NRB160	1F□2□05 ... 1F□2□10	3000	6500
NRK155			5500

[1] Largest average input speed. In each time window of 10 minutes, the average input speed must be below $n_{1av,\,G}$.

[2] Maximum input speed. It must never be exceeded.

Gearbox size	Stage	Transmission ratio	$n_{1av,\,G}$ [1]	$n_{1max,\,G}$ [2]
			in r/min	in r/min
SP060	1	3-5	3300	7500
		7-10	4000	7500
	2	16-40	4400	8500
		50	4800	8500
		70-100	5500	8500
SP075	1	3-5	2900	7500
		7-10	3100	7500
	2	16-40	3500	8500
		50	3800	8500
		70-100	4500	8500
SP100	1	3-5	2500	5500
		7-10	2800	5500
	2	16-40	3100	6500
		50	3500	6500
		70-100	4200	6500
SP140	1	3-5	2100	5000
		7-10	2600	5000
	2	16-40	2900	6000
		50-70	3200	6000
		100	3900	6000
SP180	1	3-5	1500	4500
		7-10	2300	4500
	2	16-40	2700	5000
		50	2900	5000
		70	3200	5000
		100	3400	5000
SP210	1	4	1200	3000
		5	1500	3000
		7	1700	3000
		10	2000	3000
	2	16-50	2500	4500
		70-100	3000	4500
SP240	1	4	1000	3000
		5	1200	3000
		7	1500	3000
		10	1700	3000
	2	16	2300	4500
		20-50	2500	4500
		70-100	2800	4500

[1] Largest average input speed. In each time window of 10 minutes, the average input speed must be below $n_{1av,\,G}$.

[2] Maximum input speed. It must never be exceeded.

Gearbox size	Stage	Transmission ratio	$n_{1av,G}$ [1]	$n_{1max,G}$ [2]
			in r/min	in r/min
TP004	1	3-5	3300	7500
		7-10	4000	7500
	2	16-40	4400	7500
		50	4800	7500
		70-100	5500	7500
TP010	1	4	2600	7500
		5	2900	7500
		7-10	3100	7500
	2	16-40	3500	7500
		50	3800	7500
		70-100	4500	7500
TP025	1	4	2300	5500
		5-10	2500	5500
	2	16-40	2800	7500
		50	3100	7500
		70	3500	7500
		100	4200	7500
TP050	1	4	1900	5000
		5	2000	5000
		7-10	2500	5000
	2	16-40	2900	6250
		50-70	3200	6250
		100	3900	6250
TP110	1	4	1400	4500
		5	1500	4500
		7-10	2000	4500
	2	16-40	2500	5625
		50	2900	5625
		70	3200	5625
		100	3400	5625
TP300	1	5	1000	3000
		7	1400	3000
		10	1700	3000
	2	20-35	2000	4375
		50	2300	4375
		70	2400	4375
		100	2500	4375

Gearbox size	Stage	Transmission ratio	$n_{1av,\,G}$ [1]	$n_{1max,\,G}$ [2]
			in r/min	in r/min
TP500	1	5	900	3000
		7	1300	3000
		10	1500	3000
	2	20-35	1500	4375
		50	2000	4375
		70	2100	4375
		100	2200	4375

[1] Largest average input speed. In each time window of 10 minutes, the average input speed must be below $n_{1av,\,G}$.

[2] Maximum input speed. It must never be exceeded.

6.2 Technical data of NRB and NRBW planetary gearboxes

6.2.1 Rated torque at the output shaft of NRB and NRBW planetary gearboxes

Description

This table lists the rated torque $M_{2N,\,G}$ in Nm at the output shaft of NRB and NRBW planetary gearboxes.

If the specified rated torque is exceeded, then the service life of the gearing and the service life of the internal bearings of the planetary gearbox must be calculated.
For more information, see the chapters "Gearing strength for 1FK2 and 1FT2 with planetary gearbox (Page 69)" and "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the rated planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

You will find more detailed information in the chapter "Options (Page 31)".

Table 6-1 Rated torque $M_{2N,\,G}$ in Nm at the output shaft of NRB and NRBW planetary gearboxes

Number of gearbox stages	Transmission ratio	NRB040 / NRBW040	NRB060 / NRBW060	NRB080 / NRBW080	NRB120 / NRBW120	NRB160
z	*i*					
1	3	11 / 4.5	28 / 14	85 / 40	115/ 80	400
	4	15 / 6	38 / 19	115 / 53	155 / 105	450
	5	14 / 7.5	40 / 24	110 / 67	195 / 130	450
	7	8.5	25	65	135	-
	8	6	18	50	120	450
	10	5	15	38	95	-

Number of gearbox stages	Transmission ratio	NRB040 / NRBW040	NRB060 / NRBW060	NRB080 / NRBW080	NRB120 / NRBW120	NRB160
z	*i*					
2	9	16.5	44	130	210	-
	12	20	44	120	260	800
	15	18	44	110	230	700
	16	20	44	120	260	800
	20	20	44	120	260	800
	25	18	40	110	230	700
	32	20	44	120	260	800
	40	18	40	110	230	700
	64	7.5	18	50	120	450
3	60	20	44	110	260	-
	80	20	44	120	260	-
	100	20	44	120	260	-
	120	18	44	110	230	-
	160	20	44	120	260	-
	200	18	40	110	230	-
	256	20	44	120	260	-
	320	18	40	110	230	-
	512	7.5	18	50	120	-

6.2.2 Maximum torque at the output shaft of NRB and NRBW gearboxes

Description

The maximum permissible output torque $M_{2max, G}$ must not be exceeded in operation. It is permissible for a maximum of 30,000 revolutions of the output shaft. The fatigue strength of the planetary gearbox must be calculated if output torques of up to $M_{2max, G}$ are utilized. More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the maximum permissible planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes. You will find more detailed information in the chapter "Options (Page 31)".

Table 6-2 Maximum permissible torque $M_{2max,\,G}$ in Nm at the output shaft of NRB and NRBW planetary gearboxes.

Number of gearbox stages	Transmission ratio	NRB040 / NRBW040	NRB060 / NRBW060	NRB080 / NRBW080	NRB120 / NRBW120	NRB160
z	*i*					
1	3	17.5 / 7	45 / 22	136 / 64	184 / 128	640
	4	24 / 10	61 / 30	184 / 85	248 / 168	720
	5	22 / 12	64 / 38	176 / 107	312 / 208	720
	7	13.5	40	104	216	-
	8	10	29	80	192	720
	10	8	24	61	152	-
2	9	26	70	208	336	-
	12	32	70	192	416	1280
	15	29	70	176	368	1120
	16	32	70	192	416	1280
	20	32	70	192	416	1280
	25	29	64	176	368	1120
	32	32	70	192	416	1280
	40	29	64	176	368	1120
	64	12	29	80	192	720
3	60	32	70	176	416	-
	80	32	70	192	416	-
	100	32	70	192	416	-
	120	29	70	176	368	-
	160	32	70	192	416	-
	200	29	64	176	368	-
	256	32	70	192	416	-
	320	29	64	176	368	-
	512	12	29	80	192	-

6.2.3 EMERGENCY OFF torque at the output shaft of NRB and NRBW planetary gearboxes

Description

As a maximum, the planetary gearbox can withstand the EMERGENCY OFF torque 1000 x during the gearbox service life without restricting the functionality.

Based on this data, check whether high torques, caused by very seldom operating faults, can damage the planetary gearbox. You can find more information in the chapter "Check for excessively high torques in case of operating faults: EMERGENCY OFF torque (Page 78)".

Table 6-3 EMERGENCY OFF torque in Nm of NRB and NRBW planetary gearboxes

Number of gearbox stages	Transmission ratio	NRB040 / NRBW040	NRB060 / NRBW060	NRB080 / NRBW080	NRB120 / NRBW120	NRB160
z	*i*					
1	3	22.5	66	180	390 / 360	800
	4	30 / 28	88 / 86	240	520 / 474	900
	5	36 / 35	80	220	500	900
	7	26	80	178	340	-
	8	27	80	190	380	900
	10	27 / 25	80 / 70	200 / 170	480 / 430	-
2	9	33	88	260	500	-
	12	40	88	240	520	1600
	15	36	88	220	500	1400
	16	40	88	240	520	1600
	20	40	88	240	520	1600
	25	36	80	220	500	1400
	32	40	88	240	520	1600
	40	36	80	220	500	1400
	64	27	80	190	380	900
3	60	40	88	220	520	-
	80	40	88	240	520	-
	100	40	88	240	520	-
	120	36	88	220	500	-
	160	40	88	240	520	-
	200	36	80	220	500	-
	256	40	88	240	520	-
	320	36	80	220	500	-
	512	27	80	190	380	-

6.2.4 Efficiency of NRB and NRBW planetary gearboxes under full load

Description

The gearbox losses are already taken into account in the characteristic curves and in the following characteristics of the geared motor or its components: $M_{2,0}$, $M_{2,max}$, $M_{0,M}$, $M_{max,M}$.

A reduction of these characteristic curves and characteristics via efficiency is not necessary. In the partial load range, especially when the gearbox is cold, the efficiency of the gearbox is always lower than at operating speed.

Table 6-4 Efficiency η_G of NRB coaxial planetary gearboxes

Gearbox size		**NRB040**		**NRB060**			**NRB0800**		**NRB120**		**NRB160**
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**
z	***i***										
1	3	0.98		0.98			0.98		0.98		0.98
	4	0.98		0.98			0.98		0.98		0.98
	5	0.98	0.97	0.98			0.98		0.98		0.98
	7	0.97	0.96	0.97		0.96	0.97		0.97		-
	8	0.96	0.94	0.97		0.95	0.97	0.96	0.97		0.97
	10	0.95	0.92	0.96		-	0.96	0.94	0.97	0.96	-
2	9	0.97	0.96	0.97		0.96	0.97	0.96	0.97	0.96	-
	12	0.96	0.95	0.96		0.95	0.97	0.96	0.96		0.96
	15	0.96	0.95	0.96		0.95	0.96	0.95	0.96		0.96
	16	0.96	0.95	0.96		0.95	0.96	0.95	0.96		0.96
	20	0.96	0.94	0.96		0.94	0.96	0.95	0.96	0.95	0.96
	25	0.95	0.93	0.95		-	0.95	0.94	0.95		0.95
	32	0.95	0.92	0.95		-	0.95	0.93	0.95	-	0.95
	40	0.94	0.91	0.94		-	0.94	-	0.94	-	0.94
	64	0.86	-	0.87	-	-	0.89	-	0.89	-	0.9
3	60	0.92	0.88	0.92		-	0.92	-	0.92	-	-
	80	0.9	-	0.91	-	-	0.91	-	0.91	-	-
	100	0.89	-	0.89	-	-	0.90	-	0.90	-	-
	120	0.87	-	0.88	-	-	0.89	-	0.88	-	-
	160	0.86	-	0.86	-	-	0.88	-	0.87	-	-
	200	0.82	-	0.83	-	-	0.85	-	0.84	-	-
	256	-	-	0.81	-	-	0.84	-	0.83	-	-
	320	-	-	0.77	-	-	0.80	-	0.79	-	-
	512	-	-	-	-	-	-		-	-	-

z = number of gearbox stages

i = transmission ratio

Table 6-5 Efficiency η_G of NRBW angled planetary gearboxes

Gearbox size		**NRBW040**	**NRBW060**	**NRBW080**			**NRBW120**
Motor frame size 1FT2...		**...□02**	**...□02** **...□03** **...□04**	**...□03** **...□04**	**...205**	**...105**	**...□03** **...□04** **...□05** **...□06**
z	***i***						
1	3	0.94	0.95	0.95	0.95	0.95	0.95
	4	0.94	0.95	0.95	0.95	0.95	0.95
	5	0.94	0.95	0.95	0.95	0.95	0.95
	7	0.94	0.94	0.95	0.95	0.95	0.95
	8	0.92	0.93	0.94	0.94	0.95	0.95
	10	0.9	0.92	0.93	0.93	0.94	0.94
2	9	0.94	0.94	0.94	0.94	0.94	0.94
	12	0.94	0.94	0.94	0.94	0.94	0.94
	15	0.93	0.93	0.93	0.93	0.94	0.94
	16	0.93	0.93	0.93	0.93	0.94	0.94
	20	0.92	0.92	0.93	0.93	0.93	0.93
	25	0.91	0.91	0.92	0.92	0.92	0.92
	32	0.91	0.91	0.92	0.92	0.92	0.92
	40	0.89	0.89	0.9	0.9	0.91	0.91
	64	0.75	0.77	0.8	0.8	0.84	0.84
3	60	0.86	0.86	0.87	0.87	0.88	0.88
	80	0.84	0.84	0.86	0.86	0.87	0.87
	100	0.82	0.82	0.84	0.84	0.85	0.85
	120	0.78	0.8	0.81	0.81	0.82	0.82
	160	0.76	0.76	0.79	0.79	0.81	0.81
	200	0.7	0.71	0.74	0.74	-	0.77
	256	0.68	0.68	0.72	0.72	-	0.75
	320	0.61	0.62	0.66	-	-	0.7
	512	0.31	-	0.38	-	-	-

z = number of gearbox stages

i = transmission ratio

6.2.5 Torsional stiffness of NRB and NRBW planetary gearboxes

The table lists the torsional stiffness C_{T2} of the planetary gearboxes referred the output in Nm/arcmin.

Table 6-6 Torsional stiffness C_{T2} of NRB coaxial planetary gearboxes in Nm/arcmin

Gearbox size		**NRB040**		**NRB060**			**NRB080**		**NRB120**		**NRB160**
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**
z	***i***										
1	3	0.7	0.75	2.5	2.4	2.6	7.5	7.9	18.5	18.5	59.5
	4	0.9	0.95	2.7	2.6	2.8	9.8	10.1	20.5	20.5	68
	5	0.95	0.95	2.8	2.7	2.8	10	10.2	21	21	69
	7	0.85	0.85	2.5	2.5	2.5	8.6	8.7	18.5	18	-
	8	0.85	0.85	2.4	2.4	2.5	8.4	8.4	18	18	62
	10	0.75	0.75	2.2	2.2	-	7.8	7.9	16.4	16.4	-
2	9	0.8	0.8	2.6	2.6	2.7	8.3	8.4	20	20	-
	12	1	1	2.8	2.8	2.8	10.2	10.3	22	22	73
	15	1	1	2.7	2.7	2.7	10.2	10.2	21.5	21.5	73
	16	1	1	2.8	2.8	2.8	10.4	10.5	22	22	75
	20	1	1	2.8	2.8	2.8	10.4	10.4	22	22	75
	25	1	1	2.8	2.8	-	10.3	10.3	21.5	21.5	74
	32	1	1	2.8	2.8	-	10.3	10.3	22	-	75
	40	1	1	2.8	2.8	-	10.2	-	21.5	-	73
	64	0.85	-	2.5	-	-	8.3	-	18.5	-	63
3	60	1	1	2.8	2.8	-	10.3	-	22	-	-
	80	1	-	2.8	-	-	10.5	-	22	-	-
	100	1	-	2.8	-	-	10.4	-	22	-	-
	120	1	-	2.7	-	-	10.2	-	21.5	-	-
	160	1	-	2.8	-	-	10.4	-	22	-	-
	200	1	-	2.8	-	-	10.3	-	21.5	-	-
	256	-	-	2.8	-	-	10.3	-	22	-	-
	320	-	-	2.8	-	-	10.2	-	21.5	-	-

z = number of gearbox stages

i = transmission ratio

Table 6-7 Torsional stiffness C_{T2} of NRBW angled planetary gearboxes in Nm/arcmin

Gearbox size		NRBW040	NRBW060	NRBW080	NRBW120
z	*i*				
1	3	0.45	1.6	4.1	10
	4	0.63	2.0	6.0	14
	5	0.73	2.2	7.0	15
	7	0.78	2.2	7.5	17
	8	0.78	2.2	7.5	17
	10	0.73	2.2	7.8	16
2	9	0.73	2.4	7.4	18
	12	0.93	2.6	9.3	20
	15	0.93	2.5	9.5	20
	16	0.95	2.6	9.7	21
	20	0.98	2.6	9.9	21
	25	0.95	2.7	9.8	20
	32	0.98	2.7	10.0	21
	40	0.98	2.7	9.9	21
	64	0.83	2.4	8.1	18
3	60	0.98	2.7	10	21
	80	0.98	2.7	10	21
	100	0.98	2.7	10	21
	120	0.98	2.6	9.9	21
	160	0.98	2.7	10	21
	200	0.98	2.7	10	21
	256	0.98	2.7	10	21
	320	0.98	2.7	9.9	21
	512	0.83	2.4	8.1	18

z = number of gearbox stages

i = transmission ratio

6.2.6 Torsional backlash of NRB and NRBW planetary gearboxes

Description

The table lists the gearbox characteristics φ_2 at the output shaft of the planetary gearboxes in arcmin.

Table 6-8 Gearbox characteristics φ_2 at the output shaft of NRB coaxial planetary gearboxes in arcmin

Number of gearbox stages	Transmission ratio	NRB040	NRB060	NRB080	NRB120	NRB160
z	*i*					
1	3	15	10	7	7	6
2	9	19	12	9	9	-
3	60	22	15	11	11	-

Table 6-9 Gearbox characteristics φ_2 at the output shaft of NRBW angled planetary gearboxes in arcmin

Number of gearbox stages	Transmission ratio	NRBW040	NRBW060	NRBW080	NRBW120
z	*i*				
1	3	21	16	13	11
2	9	25	18	15	13
3	60	28	21	17	15

6.2.7 Moments of inertia of NRB and NRBW planetary gearboxes

Description

The following table shows the moment of inertia $J_{1,G}$ of the gearbox component in relation to the input in kg cm².

Table 6-10 Moment of inertia $J_{1,G}$ of NRB gearbox components in kg cm²

Gearbox size		**NRB040**		**NRB060**			**NRB080**		**NRB120**		**NRB160**
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**
z	***i***										
1	3	0.027	0.073	0.128	0.149	0.396	0.654	1.52	2.36	4.72	12
	4	0.021	0.067	0.092	0.112	0.36	0.455	1.33	1.84	4.2	6.91
	5	0.019	0.065	0.08	0.1	0.347	0.423	1.29	1.63	4	5.19
	7	0.015	0.063	0.069	0.09	0.349	0.379	1.27	1.46	3.83	-
	8	0.015	0.063	0.067	0.088	0.347	0.37	1.26	1.43	3.8	3.73
	10	0.014	0.062	0.065	0.085	-	0.359	1.25	1.38	3.74	-
2	9	0.026	0.072	0.121	0.142	0.389	0.613	1.48	2.29	4.65	-
	12	0.025	0.072	0.118	0.138	0.386	0.589	1.46	2.22	4.59	10.1
	15	0.025	0.071	0.076	0.097	0.344	0.586	1.45	2.2	4.56	9.91
	16	0.02	0.066	0.085	0.106	0.353	0.446	1.32	1.75	4.11	6.06
	20	0.018	0.064	0.075	0.096	0.343	0.406	1.27	1.57	3.94	4.7
	25	0.018	0.064	0.075	0.095	-	0.404	1.27	1.57	3.93	4.63
	32	0.015	0.062	0.066	0.087	-	0.366	1.25	1.42	-	3.55
	40	0.015	0.062	0.066	0.087	-	0.365	-	1.42	-	3.52
	64	0.015	-	0.066	-	-	0.366	-	1.41	-	3.5
3	60	0.025	0.071	0.076	0.096	-	0.584	-	2.2	-	-
	80	0.018	-	0.075	-	-	0.405	-	1.57	-	-
	100	0.018	-	0.074	-	-	0.404	-	1.56	-	-
	120	0.025	-	0.066	-	-	0.59	-	2.18	-	-
	160	0.015	-	0.066	-	-	0.365	-	1.42	-	-
	200	0.015	-	0.066	-	-	0.365	-	1.42	-	-
	256	-	-	0.066	-	-	0.366	-	1.41	-	-
	320	-	-	0.066	-	-	0.366	-	1.41	-	-

z = number of gearbox stages

i = transmission ratio

Table 6-11 Moment of inertia $J_{1,G}$ of NRBW gearbox components in kg cm²

Gearbox size		**NRBW040**	**NRBW060**		**NRBW080**	**NRBW120**
Motor frame size 1F□2...		**...□02**	**...□02** **...□03**	**...□04**	**...□03** **...□04** **...□05**	**...□03** **...□04** **...□05** **...□06**
z	***i***					
1	3	0.049	0.36	0.38	1.3	2.8
	4	0.041	0.25	0.27	1.0	2.3
	5	0.035	0.24	0.25	0.97	2.1
	7	0.033	0.23	0.24	0.93	1.9
	8	0.032	0.22	0.24	0.92	1.9
	10	0.032	0.22	0.24	0.91	1.8
2	9	0.048	0.35	0.37	1.2	2.8
	12	0.048	0.35	0.37	1.2	2.7
	15	0.048	0.23	0.25	1.2	2.7
	16	0.038	0.24	0.26	1.0	2.2
	20	0.034	0.23	0.25	0.95	2.0
	25	0.033	0.23	0.25	0.95	2.0
	32	0.032	0.22	0.24	0.92	1.9
	40	0.032	0.22	0.24	0.92	1.9
	64	0.032	0.22	0.24	0.92	1.9
3	60	0.047	0.23	0.25	1.2	2.7
	80	0.033	0.23	0.25	0.95	2.0
	100	0.033	0.23	0.25	0.95	2.0
	120	0.047	0.22	0.24	1.2	2.7
	160	0.032	0.22	0.24	0.92	1.9
	200	0.032	0.22	0.24	0.92	1.9
	256	0.032	0.22	0.24	0.92	1.9
	320	0.032	0.22	0.24	0.92	1.9
	512	0.032	0.22	0.24	0.92	1.9

z = number of gearbox stages

i = transmission ratio

6.2.8 Mass of NRB and NRBW planetary gearboxes

Description

The following table shows the mass m_G of planetary gearboxes in kg.

Table 6-12 Mass m_G of NRB coaxial planetary gearboxes in kg

Gearbox size		**NRB040**		**NRB060**		**NRB080**		**NRB120**		**NRB160**
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03 ...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**
z	***i***									
1	3	0.34	0.60	0.87	1.7	2.1	3.2	5.7	7.4	17
	4	0.35	0.60	0.88	1.4	2.1	3.2	5.7	7.8	17
	5	0.35	0.60	0.89	1.4	2.2	3.2	5.8	7.8	17
	7	0.35	0.60	0.88	1.4	2.1	3.2	5.7	7.8	-
	8	0.35	0.68	0.88	1.4	2.1	3.2	5.7	7.0	17
	10	0.35	0.58	0.89	-	2.16	3.3	5.89	7.79	-
2	9	0.43	0.69	1.1	1.9	2.6	3.7	7.4	9.2	
	12	0.43	0.69	1.1	1.9	2.6	3.7	7.4	9.2	23
	15	0.43	0.69	1.1	1.6	2.6	3.7	7.5	9.3	23
	16	0.44	0.69	1.1	1.6	2.6	3.7	7.5	9.5	23
	20	0.44	0.69	1.1	1.6	2.6	3.7	7.5	9.6	23
	25	0.44	0.69	1.1	1.6	2.7	3.7	7.5	9.6	23
	32	0.44	0.77	1.1	1.6	2.7	3.7	7.5	8.9	23
	40	0.44	0.77	1.1	1.6	2.7	3.7	7.6	8.9	23
	64	0.44	0.78	1.1	1.6	2.7	3.7	7.6	8.9	23
3	60	0.52	0.78	1.3	1.8	3.1	4.2	9.2	11	-
	80	0.53	0.78	1.3	1.8	3.1	4.2	9.2	11	-
	100	0.53	0.78	1.3	1.8	3.1	4.2	9.3	11	-
	120	0.53	0.78	1.3	1.8	3.2	4.2	9.3	11	-
	160	0.53	0.86	1.3	1.8	3.1	4.2	9.3	11	-
	200	0.53	0.86	1.3	1.8	3.2	4.2	9.4	11	-
	256	0.54	0.87	1.3	1.8	3.2	4.2	9.4	11	-
	320	0.53	0.87	1.3	1.8	3.2	4.3	9.4	11	-
	512	0.54	0.87	1.3	1.8	3.2	4.3	9.4	11	

z = number of gearbox stages

i = transmission ratio

Table 6-13 Mass m_G of NRBW angled planetary gearboxes in kg

Gearbox size		**NRBW040**	**NRBW060**		**NRBW080**			**NRBW120**	
Motor frame size 1F□2...		**...□02**	**...□02 ...□03**	**...□04**	**...□03 ...□04 ...□05**	**...205**	**...105**	**...□03 ...□04 ...□05**	**...□06**
z	***i***								
1	3	0.55	1.6	1.8	3.6	3.8	4.0	9.6	10
	4	0.56	1.6	1.8	3.6	3.8	4.0	9.7	10
	5	0.56	1.6	1.8	3.6	3.8	4.0	9.7	10
	7	0.56	1.6	1.8	3.6	3.8	4.0	9.7	10
	8	0.56	1.6	1.8	3.6	3.8	4.0	9.7	10
	10	0.56	1.6	1.8	3.6	3.8	4.0	9.7	10
2	9	0.64	1.8	2.0	4.1	4.3	4.5	11	12
	12	0.64	1.8	2.0	4.1	4.3	4.5	11	12
	15	0.64	1.8	2.0	4.1	4.3	4.5	11	12
	16	0.64	1.8	2.0	4	4.2	4.5	11	12
	20	0.65	1.8	2.0	4.1	4.3	4.5	11	12
	25	0.64	1.8	2.0	4.1	4.3	4.5	12	12
	32	0.65	1.8	2.0	4.1	4.3	4.5	12	12
	40	0.65	1.8	2.0	4.1	4.3	4.5	12	12
	64	0.65	1.8	2.0	4.1	4.3	4.5	12	12
3	60	0.74	2	2.2	4.5	4.7	5	13	14
	80	0.74	2	2.2	4.5	4.7	5	13	14
	100	0.74	2	2.2	4.6	4.8	5	13	14
	120	0.74	2	2.2	4.6	4.8	5	13	14
	160	0.74	2	2.2	4.6	4.8	5	13	14
	200	0.74	2	2.2	4.6	4.8	5	13	14
	256	0.74	2	2.2	4.6	4.8	5	13	14
	320	0.74	2	2.2	4.6	4.8	5.1	13	14
	512	0.75	2	2.2	4.6	4.8	5.1	13	14

z = number of gearbox stages

i = transmission ratio

6.2.9 Maximum permissible number of axial and radial forces of NRB and NRBW planetary gearboxes

Description

The following values apply to radial forces with a force application point located at the midpoint of the shaft and to centrally applied axial forces, as well as to an output speed of 100 r/min.

You can obtain the permissible radial forces for other force application points and speeds from the radial force diagrams below.

Note

With simultaneous axial and radial force, an axial force of $F_A \leq 0.24 \cdot F_R$ *is* still permissible. Furthermore, the values apply only to purely axial or purely radial loads.

Table 6-14 Permissible radial forces for NRB and NRBW gearboxes in N

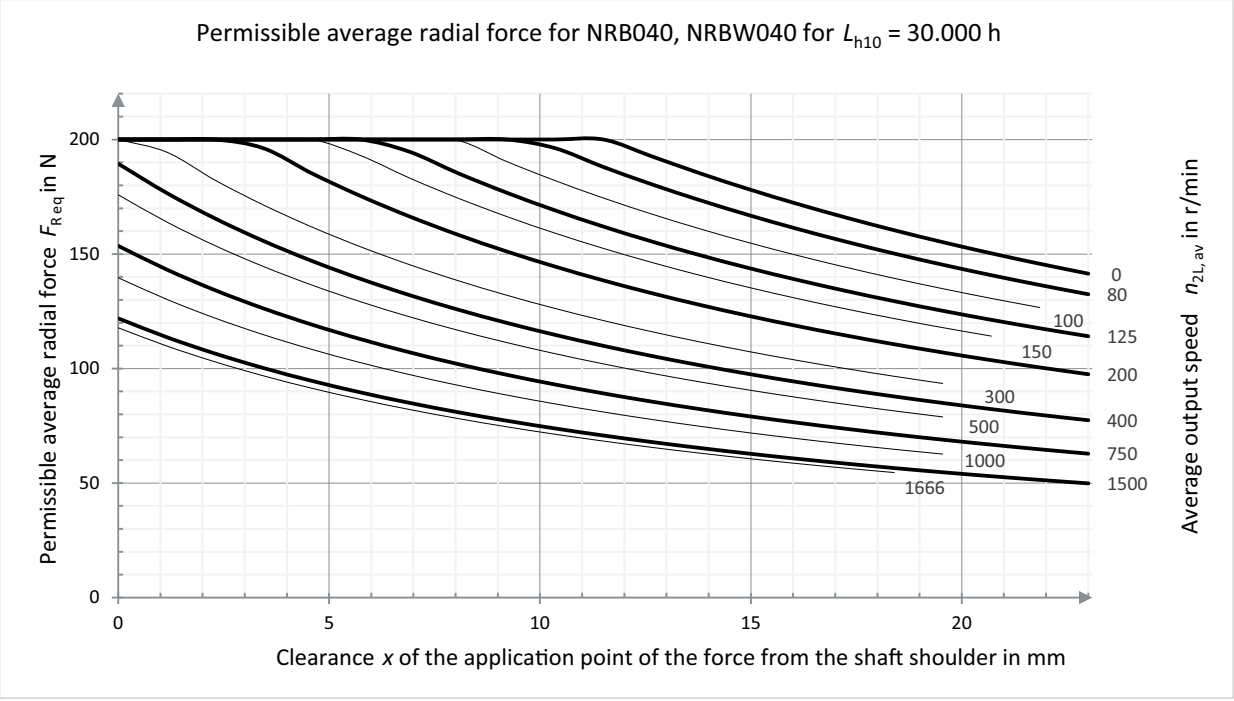
Size	Average radial force	Average axial force	Average radial force	Average axial force	Speed for average forces	Maximum permissible radial force	Maximum permissible axial force	maximum breakdown torque	Support reference
	for $L_{10\,h}$ = 20000 h		for $L_{10\,h}$ = 30000 h						
	$F_{R,eq,\ 20k}$	$F_{A,eq,\ 20k}$	$F_{R,eq,\ 30k}$	$F_{A,eq,\ 30k}$	$n_{2,\ F,av}$	$F_{R,max}$	$F_{A,max}$	$M_{2K,\ max}$	z2
NRB040 / NRBW040	200	200	160	160	100	240	200	5.5	15.9
NRB060 / NRBW060	400	500	340	450	100	800	700	24.9	20.5
NRB080 / NRBW080	750	1000	650	900	100	1600	1250	41.1	23.1
NRB120 / NRBW120	1750	2500	1500	2100	100	3800	2000	115.0	32.5
NRB160	5000	7000	4200	6000	100	11000	5000	473.5	54.7

Description

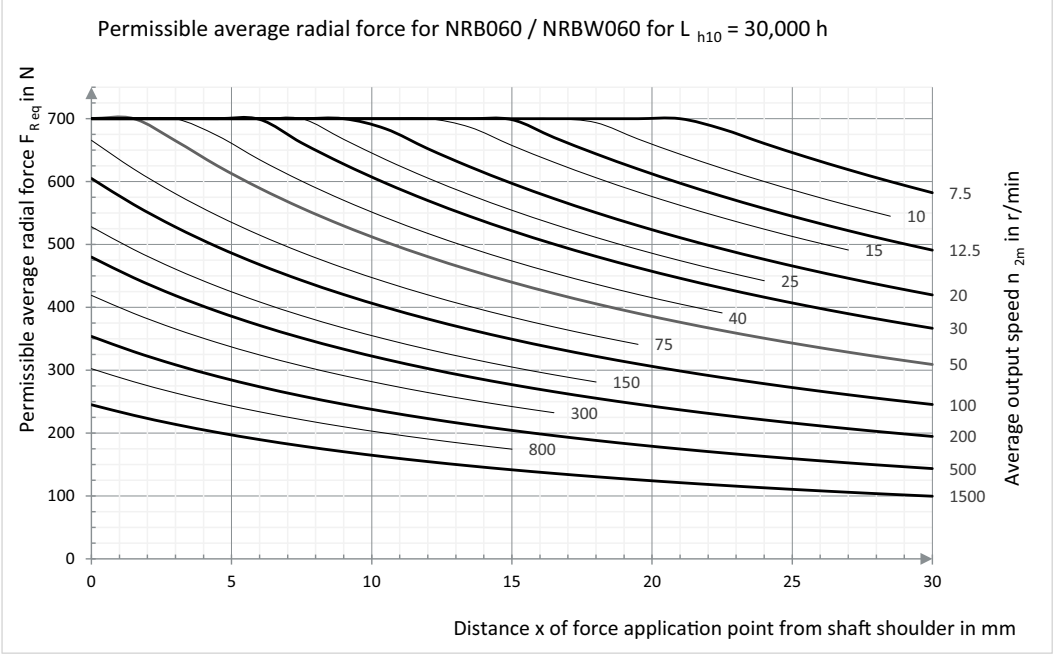
The following diagrams display the largest permissible average radial force capacity $F_{R,\,eq}$ of NRB and NRBW planetary gearboxes for output bearings with a service life of $L_{10\,h}$ = 30000 h.
The average radial force capacity $F_{R,\,eq}$ is dependent on the force application point on the gearbox shaft and on the average output speed.
If these values are exceeded in your application, calculate the service life of the output bearings.

You can find more detailed information in the chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

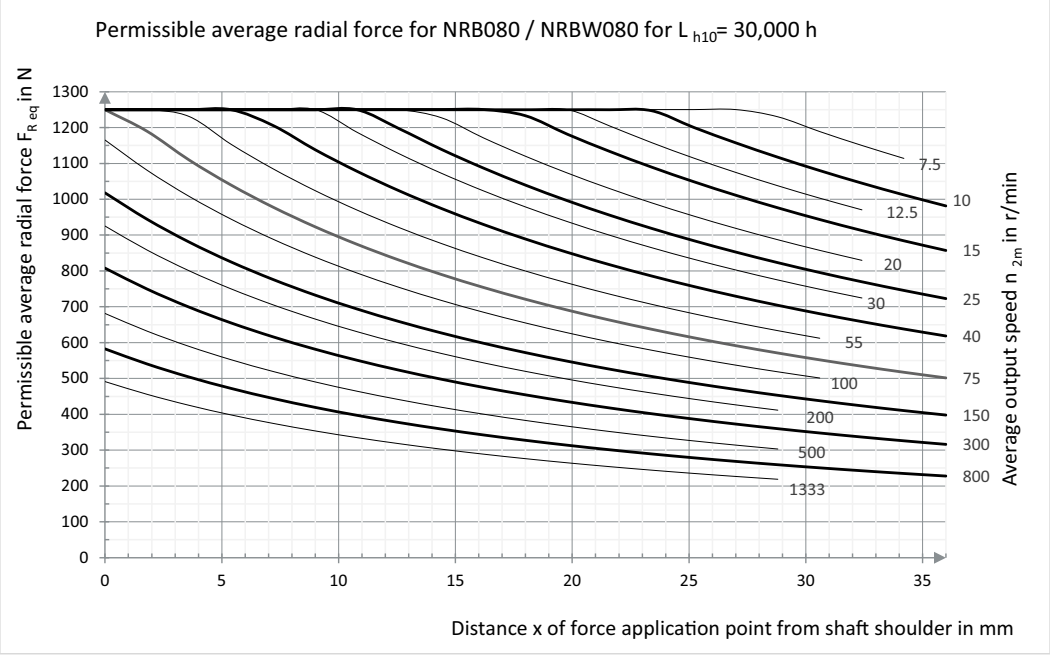
Radial force diagram for NRB040 and NRBW040



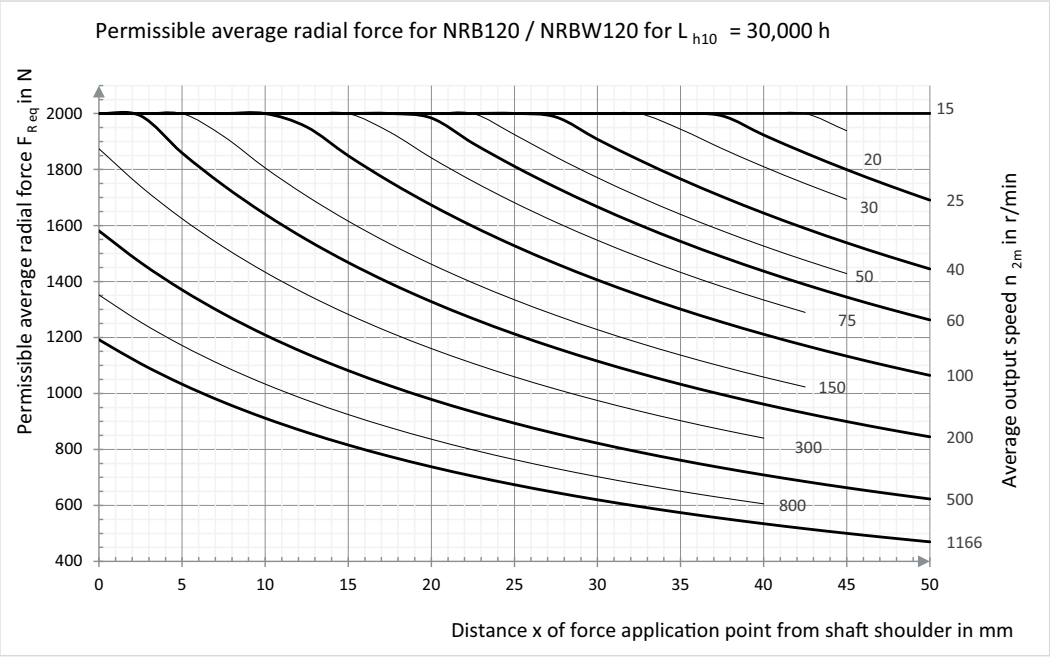
Radial force diagram for NRB060 and NRBW060



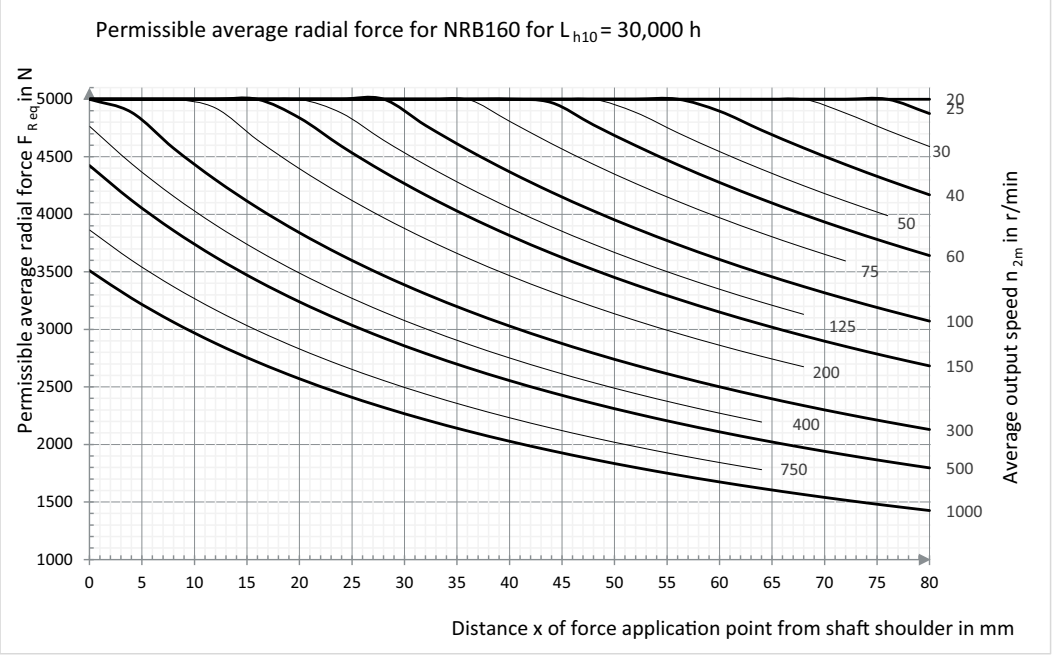
Radial force diagram for NRB080 and NRBW080



Radial force diagram for NRB120 and NRBW120



Radial force diagram for NRB160



6.2.10 Reference speeds for NRB and NRBW planetary gearboxes

Description

The reference speed *at the output of the planetary gearbox* $n_{2B,\,G}$ is required to calculate the service life of internal gearbox bearings.

Calculate the service life of the internal gearbox bearings only if one of the following points applies:

- The application torque exceeds the rated torque of the planetary gearbox $M_{2n,\,G}$.
- The average application speed at the output exceeds the reference speed.

More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

Table 6-15 Reference speed of the output to the rated torque of the coaxial planetary gearbox NRB in r/min

Number of gearbox stages	Transmission ratio	NRB040	NRB060	NRB080	NRB120	NRB160
z	*i*					
1	3	56.4	684	94.1	1120	125
	4	1310	226	330	1960	1010
	5	1520	175	353	805	912
	7	2750	286	695	950	-
	8	8370	821	1600	1370	800
	10	12600	1290	3370	2430	-
2	9	147	152	125	150	-
	12	501	139	286	350	148
	15	656	152	353	465	209
	16	501	139	286	350	148
	20	501	139	286	350	148
	25	656	175	353	465	209
	32	501	139	286	350	148
	40	656	175	353	465	209
	50	-	-	-	-	-
	64	3980	821	1600	1370	800
	100	-	-	-	-	-
3	60	501	139	383	350	-
	80	501	139	286	350	-
	100	501	139	286	350	-
	120	656	152	353	465	-
	160	501	139	286	350	-
	200	656	175	353	465	-
	256	501	139	286	350	-
	320	656	175	353	465	-
	512	3980	821	1600	1370	-

Table 6-16 Reference speed of the output to the rated torque of the NRBW angled planetary gearbox in r/min

Number of gearbox stages	Transmission ratio	NRBW040	NRBW060	NRBW080	NRBW120
z	*i*				
1	3	56.4	227	86.4	124
	4	89	161	66.1	97.5
	5	71.2	125	51.1	80.3
	7	95.9	217	110	141
	8	356	759	315	261
	10	961	1290	1120	823
2	9	21.7	65.7	22.7	61.7
	12	21.6	117	51.2	57.8
	15	46.4	152	104	130
	16	38.5	139	91.1	103
	20	60.1	139	142	161
	25	129	175	289	362
	32	154	139	286	350
	40	330	175	353	465
	64	3980	821	1600	1370
3	60	501	139	383	350
	80	501	139	286	350
	100	501	139	286	350
	120	656	152	353	465
	160	501	139	286	350
	200	656	175	353	465
	256	501	139	286	350
	320	656	175	353	465
	512	3980	821	1600	1370

6.2.11 Maximum bending moment for NRB and NRBW planetary gearboxes

Description

The tables list the maximum permissible bending moment $M_{B,G}$ at the flange between the gearbox and the motor in Nm.

Table 6-17 Maximum permissible bending moment at the flange between the coaxial planetary gearbox and the motor

Gearbox size	NRB040	NRB060	NRB080	NRB120	NRB160
Bending moment					
$M_{B,G}$ / Nm	4.5	12	16	40	140

Table 6-18 Maximum permissible bending moment at the flange between the angled planetary gearbox and the motor

Gearbox size	NRBW040	NRBW060	NRBW080	NRBW120
Bending moment				
$M_{B,\,G}$ / Nm	2	5	10.5	26

6.3 Technical data of NRK and NRKW planetary gearboxes

6.3.1 Rated torque at the output shaft of NRK and NRKW planetary gearboxes

Description

This table contains the rated torque $M_{2N,\,G}$ at the output shaft of the NRK and NRKW planetary gearboxes in Nm.
If the specified rated torque is exceeded, the service life of the gearing and the service life of the internal bearings of the planetary gearbox must be calculated.
For more information, see the chapters "Gearing strength for 1FK2 and 1FT2 with planetary gearbox (Page 69)" and "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the rated planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

More detailed information is provided in Chapter "Options (Page 31)".

Table 6-19 Rated torque $M_{2N,\,G}$ at the output shaft of NRK coaxial planetary gearboxes in Nm

Number of gearbox stages	Transmission ratio	NRK050	NRK070	NRK090	NRK120	NRK155
z	*i*					
1	3	11	28	85	115	-
	4	15	33	90	155	460
	5	13	30	82	172	445
	7	8.5	25	65	135	-
	8	6	18	50	120	-
	10	5	15	38	95	210

Number of gearbox stages	Transmission ratio	NRK050	NRK070	NRK090	NRK120	NRK155
z	*i*					
2	9	12	33	97	157	-
	12	15	33	90	195	-
	15	13	33	82	172	-
	16	15	33	90	195	460
	20	15	33	90	195	460
	25	13	30	82	172	445
	32	15	33	90	195	-
	40	13	30	82	172	460
	50	-	-	-	-	445
	64	7.5	18	50	120	-
	100	5	15	38	95	210

Table 6-20 Rated torque $M_{2N,\,G}$ at the output shaft of NRK angled planetary gearboxes in Nm

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
1	3	4.5	14	40	80
	4	6	19	53	105
	5	7.5	24	67	130
	7	8.5	25	65	135
	8	6	18	50	120
	10	5	15	38	95
2	9	12	33	97	157
	12	15	33	90	195
	15	13	33	82	172
	16	15	33	90	195
	20	15	33	90	195
	25	13	30	82	172
	32	15	33	90	195
	40	13	30	82	172
	64	7.5	18	50	120
	100	5	15	38	95

6.3.2 Maximum torque at the output shaft of NRK and NRKW planetary gearboxes

Description

The maximum permissible output torque $M_{2max, G}$ must not be exceeded in operation. It is permissible for a maximum of 30,000 revolutions of the output shaft. The fatigue strength of the planetary gearbox must be calculated if output torques of up to $M_{2max, G}$ are utilized.
You will find more detailed information in the chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the maximum permissible planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

You will find more detailed information in the chapter "Options (Page 31)".

Table 6-21 Maximum permissible torque $M_{2max, G}$ in Nm at the output shaft of NRK coaxial planetary gearboxes.

Number of gearbox stages	Transmission ratio	NRK050	NRK070	NRK090	NRK120	NRK155
z	*i*					
1	3	17.5	45	136	184	-
	4	24	53	144	248	736
	5	21	48	131	275	712
	7	13.5	40	104	216	-
	8	9.5	29	80	192	-
	10	8	24	61	152	336
2	9	19	53	155	251	-
	12	24	53	144	312	-
	15	21	53	131	275	-
	16	24	53	144	312	736
	20	24	53	144	312	736
	25	21	48	131	275	712
	32	24	53	144	312	-
	40	21	48	131	275	736
	50	-	-	-	-	712
	64	12	29	80	192	-
	100	8	24	61	152	336

Table 6-22 Maximum permissible torque $M_{2max, G}$ in Nm at the output shaft of NRKW angled planetary gearboxes.

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
1	3	7	22	64	128
	4	10	30	85	168
	5	12	38	107	208
	7	13.5	40	104	216
	8	10	29	80	192
	10	8	24	61	152
2	9	19	53	155	251
	12	24	53	144	312
	15	21	53	131	275
	16	24	53	144	312
	20	24	53	144	312
	25	21	48	131	275
	32	24	53	144	312
	40	21	48	131	275
	64	12	29	80	192
	100	8	24	61	152

6.3.3 EMERGENCY OFF torque at the output shaft of NRK and NRKW planetary gearboxes

Description

As a maximum, the planetary gearbox can withstand the EMERGENCY OFF torque 1000 x during the gearbox service life without restricting the functionality.

Based on this data, check whether high torques, caused by very seldom operating faults, can damage the planetary gearbox.

You can find more information in the chapter "Check for excessively high torques in case of operating faults: EMERGENCY OFF torque (Page 78)".

Table 6-23 EMERGENCY OFF torque of NRK coaxial planetary gearbox in Nm

Number of gearbox stages	Transmission ratio	NRK050	NRK070	NRK090	NRK120	NRK155
z	*i*					
1	3	22.5	66	180	390	-
	4	30	88	240	520	920
	5	36	80	220	500	890
	7	26	80	178	340	-
	8	27	80	190	380	-
	10	27	80	200	480	420
2	9	33	88	260	500	-
	12	40	88	240	520	-
	15	36	88	220	500	-
	16	40	88	240	520	920
	20	40	88	240	520	920
	25	36	80	220	500	890
	32	40	88	240	520	-
	40	36	80	220	500	920
	50	-	-	-	-	890
	64	27	80	190	380	-
	100	27	80	200	480	420

Table 6-24 EMERGENCY OFF torque in Nm of NRKW angled planetary gearboxes

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
1	3	22.5	66	180	360
	4	28	86	240	474
	5	35	80	220	500
	7	26	80	178	340
	8	27	80	190	380
	10	25	70	170	430

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
2	9	33	88	260	500
	12	40	88	240	520
	15	36	88	220	500
	16	40	88	240	520
	20	40	88	240	520
	25	36	80	220	500
	32	40	88	240	520
	40	36	80	220	500
	64	27	80	190	380
	100	27	80	170	430

6.3.4 Efficiency of NRK and NRKW planetary gearboxes under full load

Description

The gearbox losses are already taken into account in the characteristic curves and in the following characteristics of the geared motor or its components: $M_{2.0}$, $M_{2,\,max}$, $M_{0,\,M}$, $M_{max,\,M}$.

A reduction of these characteristic curves and characteristics via efficiency is not necessary. In the partial load range, especially when the gearbox is cold, the efficiency of the gearbox is always lower than at operating speed.

Table 6-25 Efficiency η_G of NRK coaxial planetary gearboxes

Gearbox size		NRK050		NRK070			NRK090		NRK120		NRK155	
Motor frame size 1F□2...		...□02	...□03	...□02 ...□03	...□04	...□05	...□03 ...□04 ...□05	...□06	...□03 ...□04 ...□05 ...□06	...□08	...□05 ...□06 ...□08	...210
z	*i*											
1	3	0.98	0.97	0.98	0.98	0.97	0.98	0.98	0.98	0.98	-	-
	4	0.98	0.97	0.98	0.98	0.97	0.98	0.98	0.98	0.98	0.98	0.98
	5	0.98	0.97	0.97	0.97	0.97	0.98	0.97	0.98	0.98	0.98	0.98
	7	0.97	0.95	0.97	0.97	0.96	0.97	0.96	0.97	0.97	-	-
	8	0.96	0.94	0.96	0.96	0.95	0.97	0.96	0.97	0.97	-	-
	10	0.95	0.92	0.95	0.95	-	0.96	0.94	0.96	0.96	0.97	0.97

Gearbox size		**NRK050**		**NRK070**			**NRK090**		**NRK120**		**NRK155**	
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02** **...□03**	**...□04**	**...□05**	**...□03** **...□04** **...□05**	**...□06**	**...□03** **...□04** **...□05** **...□06**	**...□08**	**...□05** **...□06** **...□08**	**...210**
z	***i***											
2	9	0.96	0.95	0.96	0.96	0.95	0.97	0.96	0.96	0.96	-	-
	12	0.96	0.95	0.96	0.96	0.95	0.96	0.95	0.96	0.96	-	-
	15	0.95	0.94	0.95	0.95	0.94	0.96	0.94	0.96	0.95	-	-
	16	0.95	0.94	0.95	0.95	0.94	0.96	0.94	0.96	0.95	0.96	0.96
	20	0.95	0.93	0.95	0.95	-	0.95	0.94	0.95	0.95	0.96	0.96
	25	0.94	0.91	0.94	0.94	-	0.95	0.92	0.95	-	0.96	0.95
	32	0.94	0.91	0.94	0.94	-	0.94	-	0.94	-	-	-
	40	0.92	0.88	0.93	0.93	-	0.94	-	0.93	-	0.95	-
	50	-	-	-	-	-	-	-	-	-	0.95	-
	64	0.86	-	0.86	-	-	0.89	-	0.89	-	-	-
	100	-	-	0.8	-	-	0.82	-	0.83	-	0.88	-

z = number of gearbox stages

i = transmission ratio

Table 6-26 Efficiency η_G of NRKW angled planetary gearboxes

Gearbox size		**NRKW050**	**NRKW070**	**NRKW090**		**NRKW120**
Motor frame size 1FT2...		***i***	**...□02** **...□03** **...□04**	**...□03** **...□04**	**...□05**	**...□03** **...□04** **...□05** **...□06**
z	***i***					
1	3	0.94	0.94	0.95		0.95
	4	0.94	0.94	0.95		0.95
	5	0.94	0.95	0.95		0.95
	7	0.94	0.94	0.95		0.95
	8	0.92	0.93	0.94		0.94
	10	0.9	0.91	0.92		0.94

Gearbox size		NRKW050	NRKW070	NRKW090		NRKW120
Motor frame size 1FT2...		*i*	...☐02 ...☐03 ...☐04	...☐03 ...☐04	...☐05	...☐03 ...☐04 ...☐05 ...☐06
z	*i*					
2	9	0.93	0.93	0.94		0.94
	12	0.93	0.93	0.93		0.94
	15	0.92	0.92	0.93		0.93
	16	0.92	0.92	0.93		0.93
	20	0.91	0.91	0.92		0.93
	25	0.9	0.9	0.91		0.91
	32	0.89	0.89	0.9		0.91
	40	0.87	0.87	0.89		0.9
	64	0.75	0.76	0.8		0.84
	100	0.59	0.65	0.69	-	0.75

z = number of gearbox stages

i = transmission ratio

6.3.5 Torsional stiffness of NRK and NRKW planetary gearboxes

Description

The table lists the torsional stiffness C_{T2} of the planetary gearboxes referred the output in Nm/arcmin.

Table 6-27 Torsional stiffness C_{T2} of NRK coaxial planetary gearboxes in Nm/arcmin

Gearbox size		NRK050		NRK070			NRK090		NRK120		NRK155	
Motor frame size 1F☐2...		...☐02	...☐03	...☐02 ...☐03	...☐04	...☐05	...☐03 ...☐04 ...☐05	...☐06	...☐03 ...☐04 ...☐05 ...☐06	...☐08	...☐05 ...☐06 ...☐08	...210
z	*i*											
1	3	0.75	0.75	4.5	4.3	5.1	10.1	10.8	31.5	31	-	-
	4	0.95	1	5.3	5.2	5.7	14.5	15.3	38.5	38	68	70
	5	1	1	5.6	5.5	5.9	15	15.5	39.5	39	71	72
	7	0.85	0.85	4.6	4.5	4.6	12	12.2	31	30.5	-	-
	8	0.85	0.85	4.4	4.4	4.5	11.6	11.8	30.5	30	-	-
	10	0.8	0.8	3.8	3.7	-	10.6	10.6	25.5	25.5	56.5	56.5

Gearbox size		**NRK050**		**NRK070**			**NRK090**		**NRK120**		**NRK155**	
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**	**...210**
2	9	0.8	0.85	5.2	5.1	5.2	11.6	11.7	36.5	36.5	-	-
	12	1.05	1.05	5.6	5.6	5.7	15.6	15.7	43	43	-	-
	15	1	1.05	5.3	5.3	5.3	15.4	15.5	40.5	40.5	-	-
	16	1.05	1.05	5.8	5.7	5.8	16.1	16.1	43.5	43.5	73	73
	20	1.05	1.05	5.7	5.7	-	16.1	16.1	43.5	43.5	73	73
	25	1.05	1.05	5.8	5.8	-	15.7	15.8	41	-	73	73
	32	1.05	1.05	5.6	5.6	-	15.8	-	43	-	-	-
	40	1.05	1.05	5.8	5.8	-	15.6	-	40.5	-	72	-
	50	-	-	-	-	-	-	-	-	-	73	-
	64	0.9	-	4.6	-	-	11.5	-	31.5	-	-	-
	100	-	-	3.6	-	-	10.1	-	22	-	57	-

z = number of gearbox stages

i = transmission ratio

Table 6-28 Torsional stiffness C_{T2} of NRKW angled planetary gearboxes in Nm/arcmin

Gearbox size		**NRKW050**	**NRKW070**	**NRKW090**	**NRKW120**
z	***i***				
1	3	0.45	2.3	4.8	13
	4	0.65	3.2	7.5	20
	5	0.75	3.8	9.2	24
	7	0.80	4.0	10	27
	8	0.80	4.0	10	27
	10	0.78	3.7	11	25
2	9	0.75	4.4	10	31
	12	0.98	5.0	14	37
	15	0.98	4.8	14	37
	16	1.0	5.3	15	39
	20	1.0	5.3	15	40
	25	1.0	5.5	15	39
	32	1.0	5.4	15	41
	40	1.0	5.5	15	39
	64	0.88	4.4	11	31
	100	0.70	3.5	9.9	22

z = number of gearbox stages

i = transmission ratio

6.3.6 Torsional backlash of NRK and NRKW planetary gearboxes

Description

The table lists the gearbox characteristics φ_2 at the output shaft of the planetary gearboxes in arcmin.

Table 6-29 Gearbox characteristics φ_2 at the output shaft of NRK coaxial planetary gearboxes in arcmin

Number of gearbox stages	Transmission ratio	NRK050	NRK070	NRK090	NRK120	NRK155
z	*i*					
1	3	15	10	7	7	6
2	9	19	12	9	9	9

Table 6-30 Gearbox characteristics φ_2 at the output shaft of NRKW angled planetary gearboxes in arcmin

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
1	3	21	16	13	11
2	9	25	18	15	13

6.3.7 Moment of inertia of NRK and NRKW planetary gearboxes

Description

The following table shows the moment of inertia $J_{1,G}$ of the gearbox component in relation to the input in kg cm².

Table 6-31 Moment of inertia $J_{1,G}$ of NRK gearbox components in kg cm²

Gearbox size		**NRK050**		**NRK070**			**NRK090**		**NRK120**		**NRK155**	
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**	**...210**
z	***i***											
1	3	0.03	0.076	0.174	0.195	0.442	0.789	1.66	2.76	5.13	-	-
	4	0.022	0.068	0.117	0.138	0.385	0.557	1.43	2.05	4.41	7.61	12.6
	5	0.02	0.066	0.095	0.116	0.363	0.476	1.34	1.77	4.13	6.48	11.5
	7	0.016	0.063	0.078	0.099	0.358	0.409	1.3	1.55	3.91	-	-
	8	0.015	0.063	0.074	0.095	0.354	0.394	1.28	1.5	3.86	-	-
	10	0.015	0.062	0.069	0.09	-	0.374	1.26	1.42	3.79	4.93	9.91
2	9	0.026	0.073	0.126	0.147	0.394	0.625	1.49	2.33	4.7	-	-
	12	0.026	0.072	0.121	0.141	0.388	0.601	1.47	2.25	4.61	-	-
	15	0.025	0.072	0.078	0.099	0.346	0.592	1.46	2.22	4.58	-	-
	16	0.02	0.066	0.087	0.107	0.354	0.453	1.32	1.76	4.12	7.11	12.1
	20	0.018	0.064	0.076	0.097	-	0.41	1.28	1.58	3.94	6.17	11.2
	25	0.018	0.064	0.075	0.096	-	0.406	1.27	1.57	-	6.12	11.1
	32	0.015	0.062	0.067	0.087	-	0.368	-	1.42	-	-	-
	40	0.015	0.062	0.066	0.087	-	0.366	-	1.42	-	5.11	-
	50	-	-	-	-	-	-	-	-	-	-	-
	64	0.015	-	0.066	-	-	0.367	-	1.42	-	-	-
	100	-	-	0.064	-	-	0.356	-	1.38	-	4.76	-

z = number of gearbox stages

i = transmission ratio

Table 6-32 Moment of inertia $J_{1,G}$ of NRKW gearbox components in kg cm²

Gearbox size		**NRKW050**	**NRKW070**		**NRKW090**	**NRKW120**
Motor frame size 1F□2...		**...□02**	**...□02 ...□03**	**...□04**	**...□03 ...□04 ...□05**	**...□03 ...□04 ...□05 ...□06**
z	***i***					
1	3	0.052	0.33	0.35	1.4	3.2
	4	0.04	0.23	0.25	1.1	2.5
	5	0.035	0.22	0.24	1.0	2.2
	7	0.033	0.22	0.24	0.96	2.0
	8	0.033	0.22	0.24	0.94	1.9
	10	0.032	0.22	0.24	0.92	1.9
2	9	0.049	0.33	0.34	1.2	2.8
	12	0.048	0.33	0.34	1.2	2.7
	15	0.048	0.22	0.24	1.2	2.7
	16	0.038	0.23	0.25	1.0	2.2
	20	0.034	0.22	0.24	0.96	2.0
	25	0.033	0.22	0.24	0.96	2.0
	32	0.032	0.22	0.24	0.92	1.9
	40	0.032	0.22	0.24	0.92	1.9
	64	0.032	0.22	0.24	0.92	1.9
	100	0.031	0.22	0.24	0.91	1.8

z = number of gearbox stages

i = transmission ratio

6.3.8 Mass of NRK and NRKW planetary gearboxes

Description

The following table shows the mass m_G of planetary gearboxes in kg.

Table 6-33 Mass m_G of NRK coaxial planetary gearboxes in kg

Gearbox size		**NRK050**		**NRK070**		**NRK090**		**NRK120**		**NRK155**	
Motor frame size 1F□2...		**...□02**	**...□03**	**...□02 ...□03 ...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**	**...□05 ...□06 ...□08**	**...□10**
z	***i***										
1	3	0.61	0.86	1.4	2.2	3.3	4.3	7.5	9.2	-	-
	4	0.61	0.87	1.4	1.9	3.3	4.3	7.5	9.6	17	22
	5	0.61	0.87	1.4	2	3.3	4.3	7.5	9.6	17	22
	7	0.62	0.87	1.4	2	3.3	4.3	7.5	9.6	-	-
	8	0.61	0.95	1.4	2	3.3	4.4	7.5	8.9	-	-
	10	0.63	0.88	1.4	2	3.3	4.4	7.6	9.7	17	22
2	9	0.77	1.0	1.7	2.5	3.9	5.0	9.4	11	-	-
	12	0.77	1.0	1.7	2.5	3.9	5.0	9.4	11	-	-
	15	0.77	1.0	1.7	2.2	3.9	5.0	9.4	11	-	-
	16	0.77	1.0	1.7	2.2	3.9	5.0	9.4	11	22	28
	20	0.77	1.0	1.7	2.2	3.9	5.0	9.4	12	22	28
	25	0.77	1.0	1.7	2.3	4.0	5.0	9.5	12	22	28
	32	0.77	1.1	1.7	2.3	4.0	5.0	9.5	11	-	-
	40	0.78	1.1	1.7	2.3	4.0	5.0	9.5	11	22	28
	50	-	-	-	-	-	-	-	-	22	28
	64	0.78	1.1	1.7	2.3	4.0	5.1	9.6	11	-	-
	100	0.81	1.1	1.9	2.4	4.1	5.1	9.7	12	22	28

z = number of gearbox stages

i = transmission ratio

Table 6-34 Mass m_G of NRKW angled planetary gearboxes in kg

Gearbox size		**NRKW050**	**NRKW070**		**NRKW090**			**NRKW120**	
Motor frame size 1F□2...		**...□02**	**...□02 ...□03**	**...□04**	**...□03 ...□04**	**...205**	**...105**	**...□03 ...□04 ...□05**	**...□06**
z	***i***								
1	3	0.82	2.1	2.3	4.7	4.9	5.1	11	12
	4	0.82	2.1	2.3	4.7	4.9	5.1	11	12
	5	0.82	2.1	2.3	4.7	4.9	5.2	11	12
	7	0.83	2.1	2.3	4.7	4.9	5.1	12	12
	8	0.82	2.1	2.3	4.7	4.9	5.2	12	12
	10	0.84	2.1	2.3	4.8	5	5.2	12	12
2	9	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	12	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	15	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	16	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	20	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	25	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	32	0.98	2.4	2.6	5.4	5.6	5.8	13	14
	40	0.99	2.4	2.6	5.4	5.6	5.8	13	14
	64	0.99	2.4	2.6	5.4	5.6	5.9	14	14
	100	1.0	2.6	2.8	5.5	5.7	5.9	14	14

z = number of gearbox stages

i = transmission ratio

6.3.9 Maximum permissible number of axial and radial forces of NRK and NRKW planetary gearboxes

Description

The following values apply to radial forces with a force application point located at the midpoint of the shaft and to centrally applied axial forces, as well as to an output speed of 100 r/min.

You can obtain the permissible radial forces for other force application points and speeds from the radial force diagrams below.

Note

With simultaneous axial and radial force, an axial force of $F_A \leq 0.24 \cdot F_R$ is still permissible. Furthermore, the values apply only to purely axial or purely radial loads.

Table 6-35 Permissible radial forces in N for NRK and NRKW planetary gearboxes

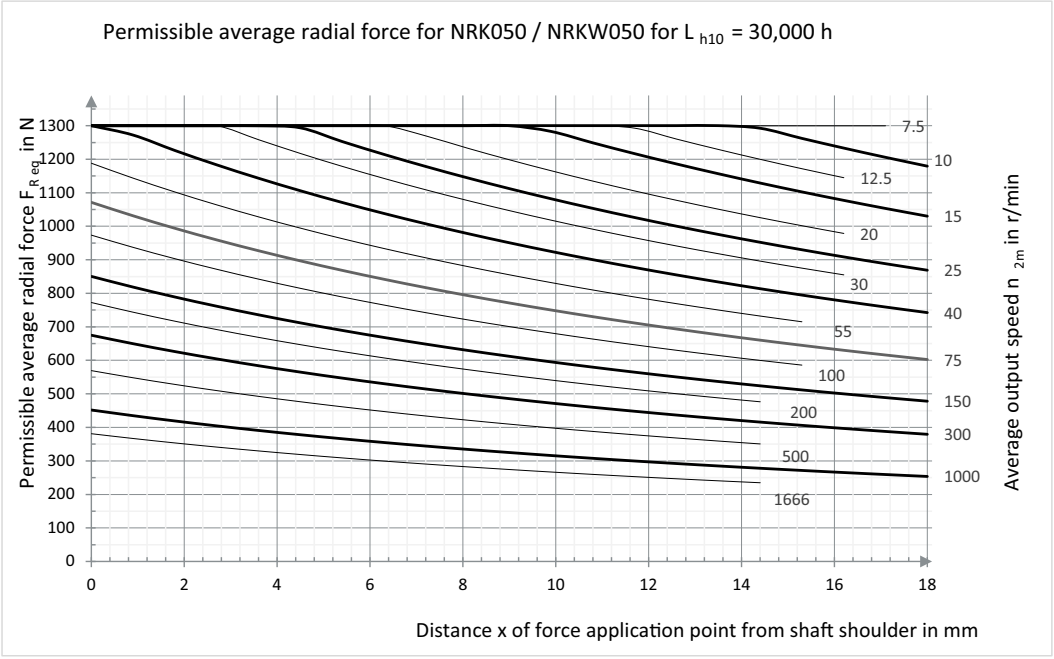
Size	Average radial force	Average axial force	Average radial force	Average axial force	Speed for average forces	Maximum permissible radial force	Maximum permissible axial force	maximum breakdown torque	Support reference
	for $L_{10\,h}$ = 20000 h		for $L_{10\,h}$ = 30000 h						
	$F_{R,eq,\ 20k}$	$F_{A,eq,\ 20k}$	$F_{R,eq,\ 30k}$	$F_{A,eq,\ 30k}$	$n_{2,\ F,av}$	$F_{R,max}$	$F_{A,max}$	$M_{2K,\ max}$	z2
NRK050 / NRKW050	800	1000	700	800	100	1000	1300	41.70	23.10
NRK070 / NRKW070	1050	1350	900	1000	100	2100	1650	60.70	26.45
NRK090 / NRKW090	1900	2000	1700	1500	100	3800	3100	161.50	34.10
NRK120 / NRKW120	2500	4000	2150	3000	100	5900	4000	268.00	38.00
NRK155	5200	7000	4600	6000	100	11000	8400	802.60	54.55

Description

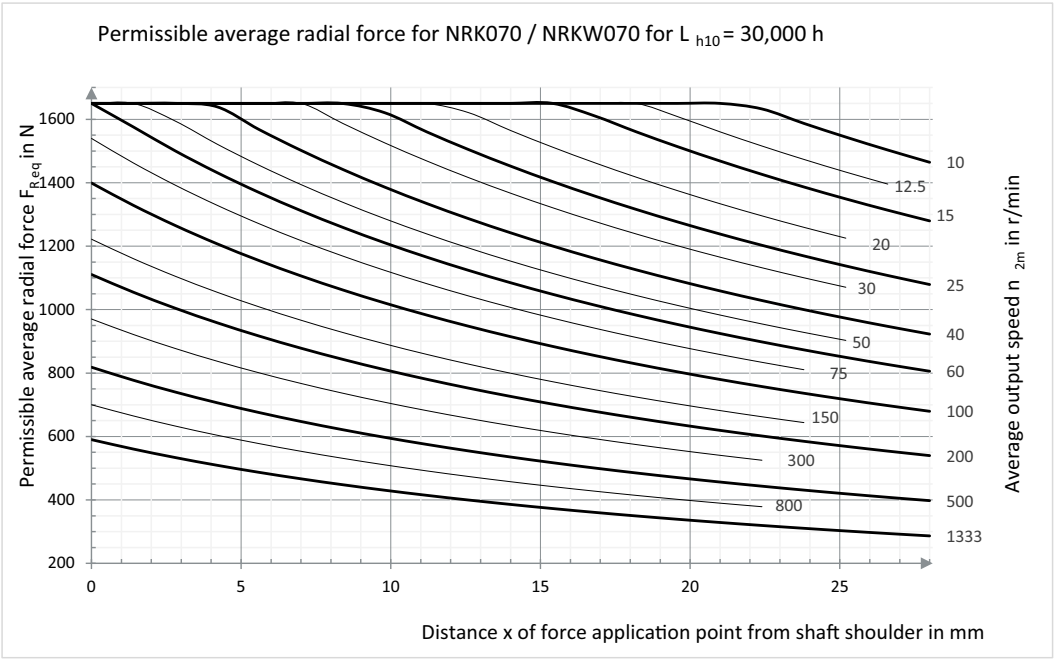
The following diagrams display the highest permissible average radial force capacity $F_{R,\,eq}$ of NRK and NRKW gearboxes for output bearings with a service life of $L_{10\,h}$ = 30000 h.
The average radial force capacity $F_{R,\,eq}$ is dependent on the force application point on the gearbox shaft and on the average output speed. If these values are exceeded in your application, calculate the service life of the output bearings.

You can find more detailed information in the chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

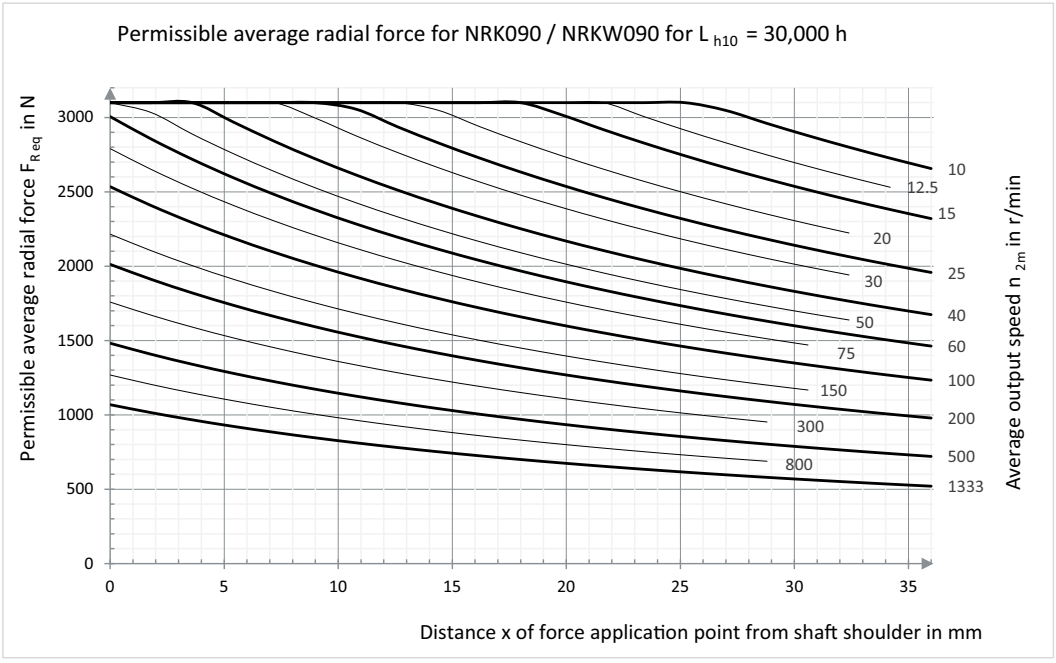
Radial force diagram for NRK050 and NRKW050



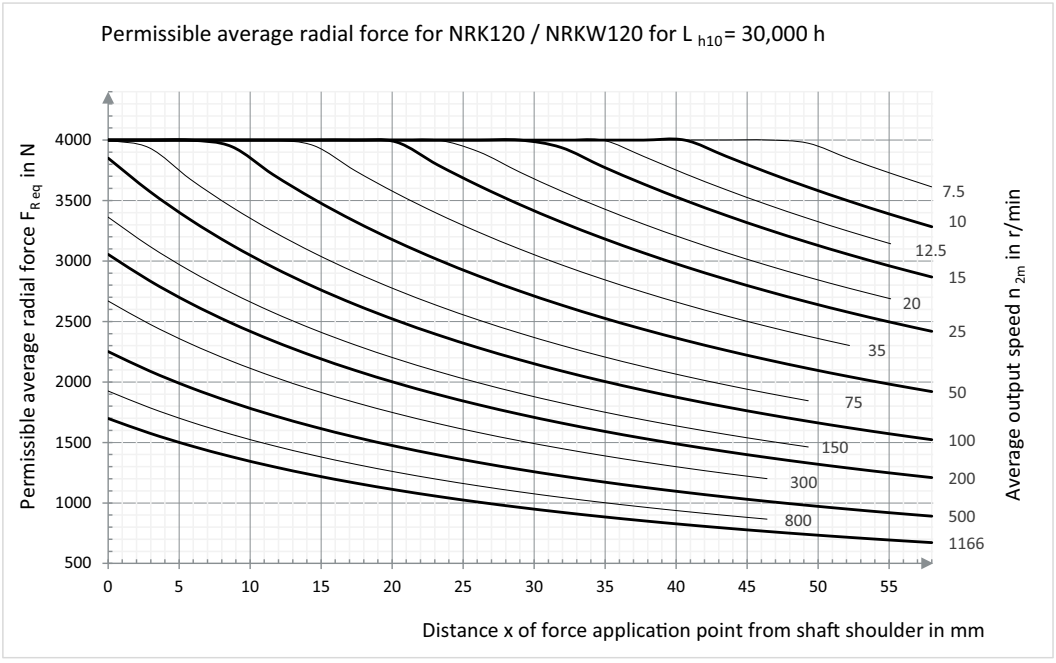
Radial force diagram for NRK070 and NRKW070



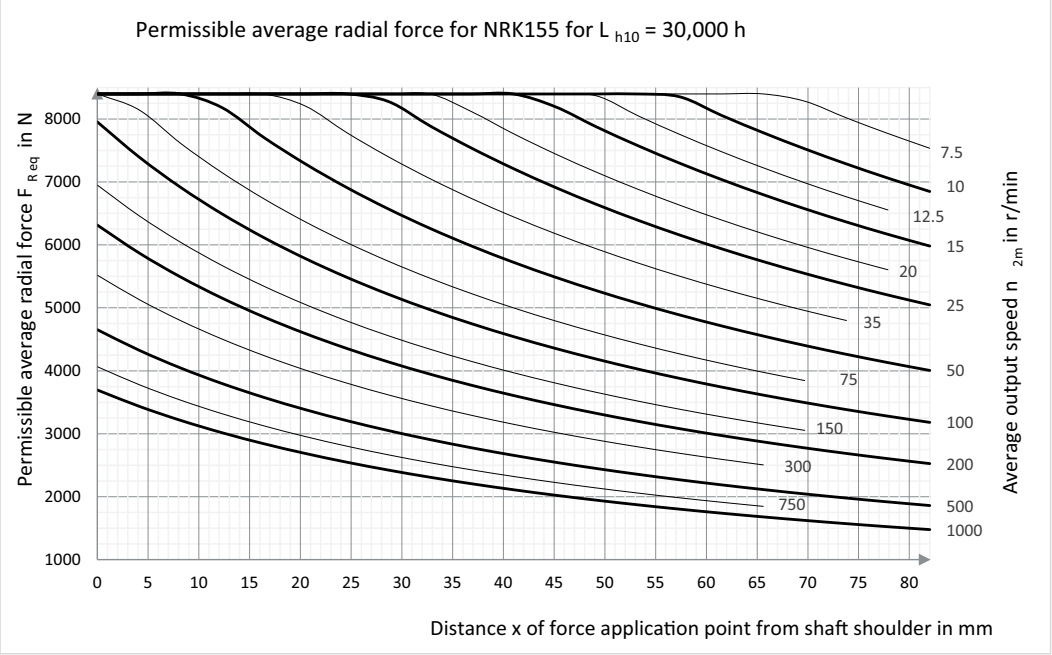
Radial force diagram for NRK090 and NRKW090



Radial force diagram for NRK120 and NRKW120



Radial force diagram for NRK155



6.3.10 Reference speeds for NRK and NRKW planetary gearboxes

Description

The reference speed *of the output of the planetary gearbox* $n_{2B,\,G}$ is required to calculate the service life of internal gearbox bearings.

Calculate the service life of the internal gearbox bearings only if one of the following points applies:

- The application torque exceeds the rated torque of the planetary gearbox $M_{2n,\,G}$.
- The average application speed at the output exceeds the reference speed.

More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

Table 6-36 Reference speed of the output to the rated torque of the coaxial planetary gearbox NRK in r/min

Number of gearbox stages	Transmission ratio	NRK050	NRK070	NRK090	NRK120	NRK155
z	*i*					
1	3	56.4	262	94.1	429	-
	4	501	139	286	752	426
	5	744	175	360	469	437
	7	2750	286	695	950	-
	8	8370	821	1600	1370	-
	10	12600	1290	3370	2430	1660
2	9	42.2	152	60.6	152	-
	12	501	139	286	350	-
	15	744	152	360	469	-
	16	501	139	286	350	426
	20	501	139	286	350	426
	25	744	175	360	469	437
	32	501	139	286	350	-
	40	744	175	360	469	426
	50	-	-	-	-	437
	64	3980	821	1600	1370	-
	100	12600	1290	3370	2430	1660

Table 6-37 Reference speed of the output to the rated torque of the angled planetary gearbox NRKW in r/min

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
1	3	119	227	86.4	124
	4	89	161	66.1	97.5
	5	71.2	125	51.1	80.3
	7	95.9	217	110	141
	8	356	759	315	261
	10	961	1290	1120	823

Number of gearbox stages	Transmission ratio	NRKW050	NRKW070	NRKW090	NRKW120
z	*i*				
2	9	42.2	152	54.5	148
	12	51.3	139	121	137
	15	123	152	251	312
	16	91.1	139	216	244
	20	142	139	286	350
	25	342	175	360	469
	32	365	139	286	350
	40	744	175	360	469
	64	3980	821	1600	1370
	100	12600	1290	3370	2430

6.3.11 Maximum permissible bending moments for NRK and NRKW planetary gearboxes

Description

The tables list the maximum permissible bending moment $M_{B,G}$ at the flange between the gearbox and the motor in Nm.

Table 6-38 Maximum permissible bending moment at the flange between the coaxial planetary gearbox and the motor

Gearbox size	NRK050	NRK070	NRK090	NRK120	NRK155
Bending moment					
$M_{B,G}$ / Nm	4.5	12	16	40	180

Table 6-39 Maximum permissible bending moment at the flange between the angled planetary gearbox and the motor

Gearbox size	NRKW050	NRKW070	NRKW090	NRKW120
Bending moment				
$M_{B,G}$ / Nm	2	5	10.5	26

6.4 Technical data of NLC and NLCW planetary gearboxes

6.4.1 Rated torque at the output shaft of NLC and NLCW planetary gearboxes

Description

This table lists the rated torque $M_{2N,\,G}$ in Nm at the output shaft of NLC and NLCW planetary gearboxes.

If the specified rated torque is exceeded, then the service life of the gearing and the service life of the internal bearings of the planetary gearbox must be calculated.

For more information, see the chapters "Gearing strength for 1FK2 and 1FT2 with planetary gearbox (Page 69)" and "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the rated planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes. You will find more detailed information in the chapter "Options (Page 31)".

Table 6-40 Rated torque $M_{2N,\,G}$ at the output shaft of NLC coaxial planetary gearboxes in Nm

Number of gearbox stages	Transmission ratio	NLC060	NLC080	NLC120
z	*i*			
1	3	28	85	115
	4	38	115	155
	5	40	110	195
	7	25	65	135
	8	18	50	120
	10	15	38	95
2	9	44	130	210
	12	44	120	260
	15	44	110	230
	16	44	120	260
	20	44	120	260
	25	40	110	230
	32	44	120	260
	40	40	110	230
	50	-	-	-
	64	18	50	120
	100	15	38	95

Table 6-41 Rated torque $M_{2N,\,G}$ at the output shaft of NLCW angled planetary gearboxes in Nm

Number of gearbox stages	Transmission ratio	NLCW060	NLCW080	NLCW120
z	*i*			
1	3	14	40	80
	4	19	53	105
	5	24	67	130
	7	25	65	135
	8	18	50	120
	10	15	38	95
2	9	44	130	210
	12	44	120	260
	15	44	110	230
	16	44	120	260
	20	44	120	260
	25	40	110	230
	32	44	120	260
	40	40	110	230
	64	18	50	120
	100	15	38	95

6.4.2 Maximum torque at the output shaft of NLC and NLCW gearboxes

Description

The maximum permissible output torque $M_{2max,\,G}$ must not be exceeded in operation. It is permissible for a maximum of 30,000 revolutions of the output shaft. The fatigue strength of the planetary gearbox must be calculated if output torques of up to $M_{2max,\,G}$ are utilized.
You will find more detailed information in the chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the maximum permissible planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

You will find more detailed information in the chapter "Options (Page 31)".

Table 6-42 Maximum permissible torque $M_{2max, G}$ in Nm at the output shaft of NLC coaxial planetary gearboxes.

Number of gearbox stages	Transmission ratio	NLC060	NLC080	NLC120
z	*i*			
1	3	45	136	184
	4	61	184	248
	5	64	176	312
	7	40	104	216
	8	29	80	192
	10	24	61	152
2	9	70	208	336
	12	70	192	416
	15	70	176	368
	16	70	192	416
	20	70	192	416
	25	64	176	368
	32	70	192	416
	40	64	176	368
	64	29	80	192
	100	24	61	152

Table 6-43 Maximum permissible torque $M_{2max, G}$ in Nm at the output shaft of NLCW angled planetary gearboxes.

Number of gearbox stages	Transmission ratio	NLCW060	NLCW080	NLCW120
z	*i*			
1	3	22	64	128
	4	30	85	168
	5	38	107	208
	7	40	104	216
	8	29	80	192
	10	24	61	152

Number of gearbox stages	Transmission ratio	NLCW060	NLCW080	NLCW120
z	*i*			
2	9	70	208	336
	12	70	192	416
	15	70	176	368
	16	70	192	416
	20	70	192	416
	25	64	176	368
	32	70	192	416
	40	64	176	368
	64	29	80	192
	100	24	61	152

6.4.3 EMERGENCY OFF torque at the output shaft of NLC and NLCW planetary gearboxes

Description

As a maximum, the planetary gearbox can withstand the EMERGENCY OFF torque 1000 x during the gearbox service life without restricting the functionality.

Based on this data, check whether high torques, caused by very seldom operating faults, can damage the planetary gearbox.
You can find more information in the chapter "Check for excessively high torques in case of operating faults: EMERGENCY OFF torque (Page 78)".

Table 6-44 EMERGENCY OFF torque in Nm of NLC coaxial planetary gearboxes

Number of gearbox stages	Transmission ratio	NLC060	NLC080	NLC120
z	*i*			
1	3	66	180	390
	4	88	240	520
	5	80	220	500
	7	80	178	340
	8	80	190	380
	10	80	200	480

Number of gearbox stages	Transmission ratio	NLC060	NLC080	NLC120
z	***i***			
2	9	88	260	500
	12	88	240	520
	15	88	220	500
	16	88	240	520
	20	88	240	520
	25	80	220	500
	32	88	240	520
	40	80	220	500
	50	-	-	-
	64	80	190	380
	100	80	200	480

Table 6-45 EMERGENCY OFF torque in Nm of NLCW angled planetary gearboxes

Number of gearbox stages	Transmission ratio	NLCW060	NLCW080	NLCW120
z	***i***			
1	3	66	180	360
	4	86	240	474
	5	80	220	500
	7	80	178	340
	8	80	190	380
	10	70	170	430
2	9	88	260	500
	12	88	240	520
	15	88	220	500
	16	88	240	520
	20	88	240	520
	25	80	220	500
	32	88	240	520
	40	80	220	500
	64	80	190	380
	100	80	200	430

6.4.4 Efficiency of NLC and NLCW planetary gearboxes under full load

Description

The gearbox losses are already taken into account in the characteristic curves and in the following characteristics of the geared motor or its components: $M_{2,0}$, $M_{2,max}$, $M_{0,M}$, $M_{max,M}$.

A reduction of these characteristic curves and characteristics via efficiency is not necessary. In the partial load range, especially when the gearbox is cold, the efficiency of the gearbox is always lower than at operating speed.

Table 6-46 Efficiency η_G of NLC coaxial planetary gearboxes

Gearbox size		**NLC060**			**NLC080**		**NLC120**	
Motor frame size 1F□2...		**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**
z	***i***							
1	3	0.96	0.96	0.96	0.97	0.97	0.97	0.97
	4	0.97	0.97	0.96	0.97	0.97	0.97	0.97
	5	0.97	0.97	0.96	0.97	0.97	0.97	0.97
	7	0.95	0.95	0.94	0.96	0.95	0.97	0.96
	8	0.94	0.94	0.93	0.96	0.94	0.96	0.96
	10	0.93	0.93	-	0.94	0.92	0.96	0.95
2	9	0.96	0.96	0.95	0.96	0.96	0.96	0.96
	12	0.95	0.95	0.94	0.96	0.95	0.96	0.96
	15	0.95	0.95	0.94	0.95	0.94	0.96	0.95
	16	0.95	0.95	0.94	0.96	0.94	0.96	0.95
	20	0.95	0.95	0.93	0.95	0.94	0.95	0.95
	25	0.94	0.94	-	0.95	0.93	0.95	0.94
	32	0.94	0.94	-	0.95	0.93	0.95	-
	40	0.93	0.93	-	0.94	-	0.94	-
	64	0.85	-	-	0.88	-	0.89	-
	100	0.78	-	-	0.81	-	0.83	-

z = number of gearbox stages

i = transmission ratio

Table 6-47 Efficiency η_G of NLCW angled planetary gearboxes

Gearbox size		NLCW060		NLCW080			NRKW120
Motor frame size 1FT2...		...□02	...□03 ...□04	...□03 ...□04	...205	...105	...□03 ...□04 ...□05 ...□06
z	*i*						
1	3	-	0.91	0.93	0.93	0.94	0.94
	4	0.92	0.92	0.93	0.93	0.94	0.94
	5	0.92	0.92	0.94	0.94	0.94	0.94
	7	0.92	0.92	0.93	0.93	0.94	0.94
	8	0.90	0.90	0.92	0.92	0.93	0.93
	10	0.88	0.88	0.90	0.90	0.92	0.92
2	9	0.93	0.93	0.94	0.94	0.94	0.94
	12	0.93	0.93	0.94	0.94	0.94	0.94
	15	0.93	0.93	0.93	0.93	0.94	0.94
	16	0.92	0.92	0.93	0.93	0.94	0.94
	20	0.92	0.92	0.93	0.93	0.93	0.93
	25	0.91	0.91	0.92	0.92	0.92	0.92
	32	0.90	0.90	0.91	0.91	0.92	0.92
	40	0.88	0.88	0.90	0.90	0.91	0.91
	64	0.75	0.75	0.78	0.78	0.83	0.83
	100	0.64	0.64	0.67	0.67	-	0.74

z = number of gearbox stages

i = transmission ratio

6.4.5 Torsional stiffness of NLC and NLCW planetary gearboxes

The table lists the torsional stiffness C_{T2} of the planetary gearboxes referred the output in Nm/arcmin.

Table 6-48 Torsional stiffness C_{T2} of NLC coaxial planetary gearboxes in Nm/arcmin

Gearbox size		NLC060			NLC080		NLC120	
Motor frame size 1F□2...		...□02 ...□03	...□04	...□05	...□03 ...□04 ...□05	...□06	...□03 ...□04 ...□05 ...□06	...□08
z	*i*							
1	3	3.7	3.6	4.1	8.5	8.9	22	22
	4	4.3	4.2	4.5	11.4	11.8	25.5	25.5
	5	4.4	4.4	4.6	11.6	11.9	26	26
	7	3.8	3.7	3.8	9.8	9.9	22	22
	8	3.7	3.6	3.7	9.5	9.6	22	21.5
	10	3.2	3.2	-	8.8	8.9	19.5	19.5

Gearbox size		**NLC060**			**NLC080**		**NLC120**	
Motor frame size 1F□2...		**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**
z	***i***							
2	9	4.2	4.1	4.2	9.5	9.6	24.5	24.5
	12	4.5	4.4	4.5	12	12.1	27.5	27.5
	15	4.2	4.2	4.2	11.9	12	26.5	26.5
	16	4.5	4.5	4.6	12.3	12.3	27.5	27.5
	20	4.5	4.5	4.5	12.3	12.3	27.5	27.5
	25	4.6	4.6	-	12.1	12.1	26.5	26.5
	32	4.5	4.5	-	12.2	12.2	27.5	-
	40	4.5	4.5	-	12	-	26.5	-
	64	3.8	-	-	9.5	-	22.5	-
	100	3.1	-	-	8.5	-	17	-

z = number of gearbox stages

i = transmission ratio

Table 6-49 Torsional stiffness C_{T2} of NLCW angled planetary gearboxes in Nm/arcmin

Gearbox size		**NLCW060**	**NLCW080**	**NLCW120**
z	***i***			
1	3	2.1	4.4	11
	4	2.8	6.6	16
	5	3.2	7.9	18
	7	3.3	8.5	20
	8	3.3	8.6	20
	10	3.1	8.9	19
2	9	3.7	8.4	22
	12	4.1	11	25
	15	4.0	11	25
	16	4.2	11	26
	20	4.3	12	26
	25	4.4	12	26
	32	4.3	12	27
	40	4.4	12	26
	64	3.7	9.3	22
	100	3.0	8.4	17

z = number of gearbox stages

i = transmission ratio

6.4.6 Torsional backlash of NLC and NLCW planetary gearboxes

Description

The table lists the gearbox characteristics φ_2 at the output shaft of the planetary gearboxes in arcmin.

Table 6-50 Gearbox characteristics φ_2 at the output shaft of NLC coaxial planetary gearboxes in arcmin

Number of gearbox stages	Transmission ratio	NLC060	NLC080	NLC120
z	i			
1	3	10	7	7
2	9	12	9	9

Table 6-51 Gearbox characteristics φ_2 at the output shaft of NLCW angled planetary gearboxes in arcmin

Number of gearbox stages	Transmission ratio	NLCW060	NLCW080	NLCW120
z	i			
1	3	16	13	11
2	9	18	15	13

6.4.7 Moment of inertia of NLC and NLCW planetary gearboxes

Description

The following table shows the moment of inertia $J_{1,G}$ of the gearbox component in relation to the input in kg cm².

Table 6-52 Moment of inertia $J_{1,G}$ of NLC gearbox components in kg cm²

Gearbox size		**NLC060**			**NLC080**		**NLC120**	
Motor frame size 1F□2...		**...□02 ...□03**	**...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**
z	***i***							
1	3	0.178	0.198	0.445	0.775	1.64	2.49	4.85
	4	0.12	0.14	0.387	0.54	1.41	1.91	4.27
	5	0.097	0.118	0.365	0.466	1.33	1.76	4.04
	7	0.078	0.099	0.358	0.401	1.29	1.49	3.85
	8	0.074	0.095	0.354	0.387	1.27	1.43	3.8
	10	0.069	0.09	-	0.37	1.26	1.39	3.76
2	9	0.135	0.155	0.402	0.641	1.51	2.33	4.69
	12	0.129	0.15	0.397	0.615	1.48	2.26	4.62
	15	0.081	0.102	0.349	0.607	1.47	2.23	4.6
	16	0.091	0.112	0.359	0.46	1.33	1.77	4.13
	20	0.079	0.1	0.347	0.415	1.28	1.59	3.95
	25	0.078	0.099	-	0.412	1.28	1.58	3.94
	32	0.068	0.088	-	0.37	1.26	1.42	-
	40	0.067	0.088	-	0.368	-	1.42	-
	64	0.067	-	-	0.369	-	1.42	-
	100	0.064	-	-	0.357	-	1.38	-

z = number of gearbox stages

i = transmission ratio

Table 6-53 Moment of inertia $J_{1,G}$ of NLCW gearbox components in kg cm²

Gearbox size		**NLCW060**		**NLCW080**	**NLCW120**
Motor frame size 1F□2...		**...□02 ...□03**	**...□04**	**...□03 ...□04 ...□05**	**...□03 ...□04 ...□05 ...□06**
z	***i***				
1	3	0.41	0.42	1.4	3.0
	4	0.28	0.29	1.1	2.3
	5	0.25	0.27	1.0	2.1
	7	0.23	0.25	0.95	1.9
	8	0.23	0.25	0.94	1.9
	10	0.23	0.24	0.92	1.8
2	9	0.36	0.37	1.2	2.8
	12	0.35	0.37	1.2	2.7
	15	0.23	0.25	1.2	2.7
	16	0.24	0.26	1.0	2.2
	20	0.23	0.25	0.96	2.0
	25	0.23	0.25	0.96	2.0
	32	0.22	0.24	0.92	1.9
	40	0.22	0.24	0.92	1.9
	64	0.22	0.24	0.92	1.9
	100	0.22	0.24	0.91	1.8

z = number of gearbox stages

i = transmission ratio

6.4.8 Mass of NLC and NLCW planetary gearboxes

Description

The following table shows the mass m_G of planetary gearboxes in kg.

Table 6-54 Mass m_G of NLC coaxial planetary gearboxes in kg

Gearbox size		**NLC060**		**NLC080**		**NLC120**	
Motor frame size 1F□2...		**...□02 ...□03 ...□04**	**...□05**	**...□03 ...□04 ...□05**	**...□06**	**...□03 ...□04 ...□05 ...□06**	**...□08**
z	***i***						
1	3	1.6	2.4	3.0	4.1	6.9	8.7
	4	1.6	2.1	3.0	4.1	6.9	9.0
	5	1.6	2.1	3.1	4.1	7.0	9.1
	7	1.6	2.1	3.0	4.1	7.0	9.1
	8	1.6	2.1	3.0	4.1	6.9	8.2
	10	1.6	2.1	3.1	4.1	7	9.1
2	9	1.7	2.6	3.6	4.6	8.6	10
	12	1.8	2.6	3.5	4.6	8.6	10
	15	1.7	2.3	3.5	4.6	8.7	10
	16	1.8	2.3	3.5	4.6	8.6	11
	20	1.8	2.3	3.5	4.6	8.7	11
	25	1.8	2.3	3.6	4.6	8.7	11
	32	1.8	2.3	3.6	4.6	8.7	10
	40	1.8	2.3	3.6	4.6	8.8	10
	64	1.8	2.3	3.6	4.6	8.7	10
	100	1.8	2.3	3.6	4.7	8.9	11

z = number of gearbox stages

i = transmission ratio

Table 6-55 Mass m_G of NLCW angled planetary gearboxes in kg

Gearbox size		**NLCW060**		**NLCW080**			**NLCW120**	
Motor frame size 1F□2...		**...□02 ...□03**	**...□04**	**...□03 ...□04**	**...205**	**...105**	**...□03 ...□04 ...□05**	**...□06**
z	***i***							
1	3	2.3	2.5	4.5	4.7	4.9	11	11
	4	2.3	2.5	4.5	4.7	4.9	11	11
	5	2.3	2.5	4.5	4.7	4.9	11	11
	7	2.3	2.5	4.5	4.7	4.9	11	11
	8	2.3	2.5	4.5	4.7	4.9	11	11
	10	2.3	2.5	4.5	4.7	4.9	11	11

Gearbox size		NLCW060		NLCW080			NLCW120	
Motor frame size 1F□2...		...□02 ...□03	...□04	...□03 ...□04	...205	...105	...□03 ...□04 ...□05	...□06
z	*i*							
2	9	2.4	2.6	5.0	5.2	5.4	12	13
	12	2.5	2.7	5.0	5.2	5.4	13	13
	15	2.4	2.6	5.0	5.2	5.4	13	13
	16	2.5	2.7	5.0	5.2	5.4	13	13
	20	2.5	2.7	5.0	5.2	5.4	13	13
	25	2.5	2.7	5.0	5.2	5.4	13	13
	32	2.5	2.7	5.0	5.2	5.4	13	13
	40	2.5	2.7	5.0	5.2	5.4	13	13
	64	2.5	2.7	5.0	5.2	5.4	13	13
	100	2.5	2.7	5.0	5.2	5.5	13	13

z = number of gearbox stages

i = transmission ratio

6.4.9 Maximum permissible axial and radial forces of NLC and NLCW gearboxes

Description

The following values apply to radial forces with a force application point located at the midpoint of the shaft and to centrally applied axial forces, as well as to an output speed of 100 r/min.

You can obtain the permissible radial forces for other force application points and speeds from the radial force diagrams below.

Note

With simultaneous axial and radial force, an axial force of $F_A \leq 0.4 \cdot F_R$ is still permissible. Furthermore, the values apply only to purely axial or purely radial loads.

Table 6-56 Maximum permissible radial forces for NLC and NLCW gearboxes in N

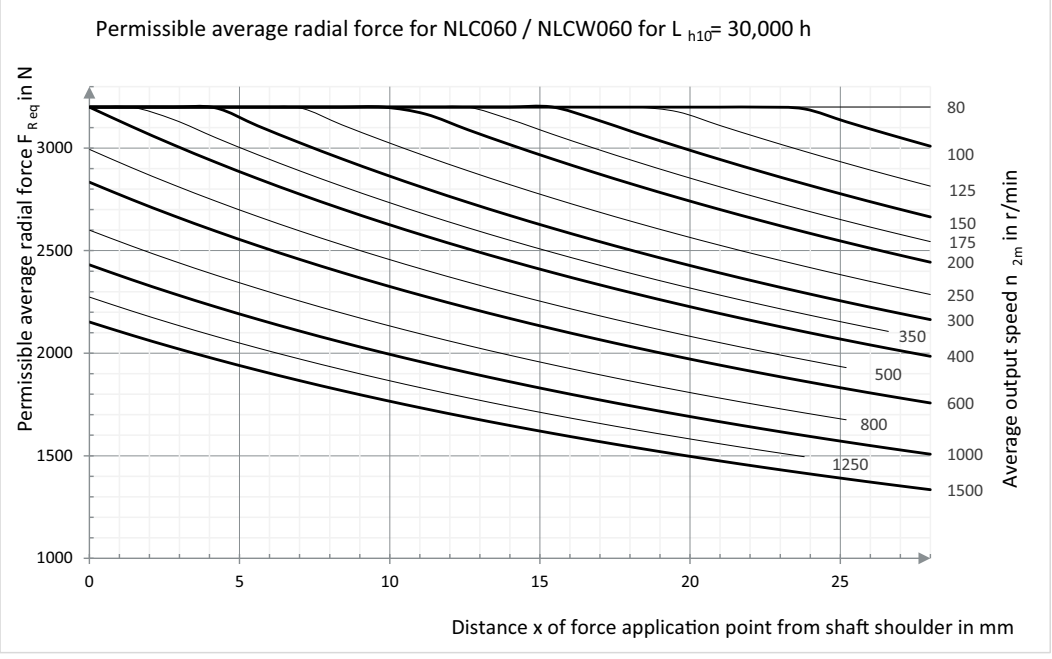
Size	Average radial force	Average axial force	Average radial force	Average axial force	Speed for average forces	Maximum permissible radial force	Maximum permissible axial force	maximum breakdown torque	Support reference
	for $L_{10\,h}$ = 20000 h		for $L_{10\,h}$ = 30000 h						
	$F_{R,eq,\ 20k}$	$F_{A,eq,\ 20k}$	$F_{R,eq,\ 30k}$	$F_{A,eq,\ 30k}$	$n_{2,\ F,av}$	$F_{R,max}$	$F_{A,max}$	$M_{2K,\ max}$	z2
NLC060 / NLCW060	3200	4400	3200	3900	100	4400	3200	191.0	45.7
NLC080 / NLCW080	5500	6400	4800	5700	100	6400	5500	383.4	51.7
NLC120 / NLCW120	6000	8000	5400	7000	100	8000	6000	487.8	52.3

Description

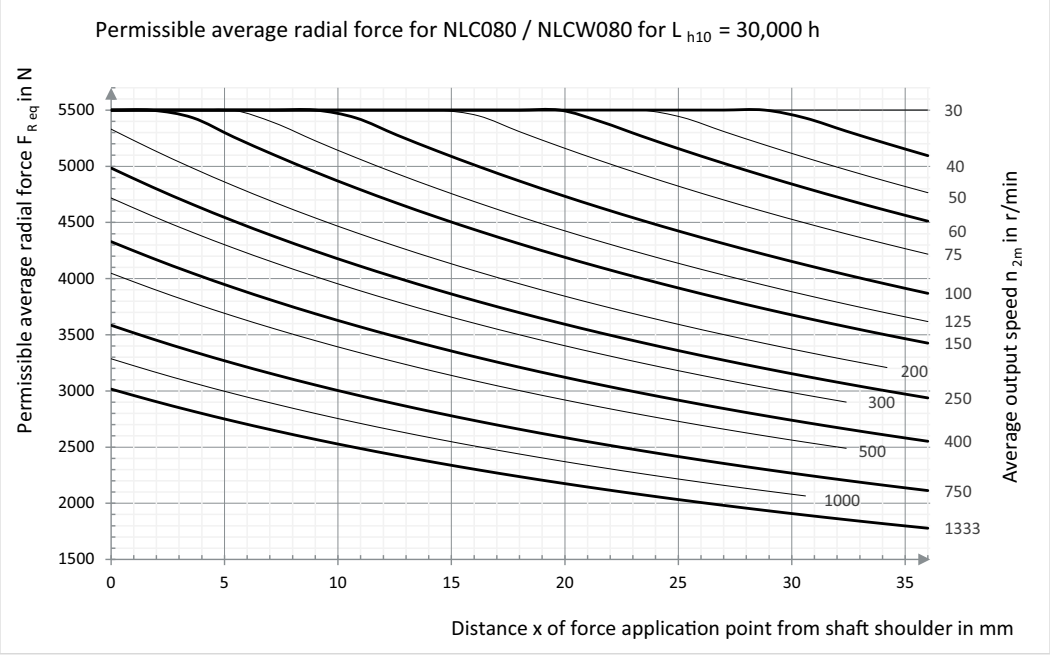
The following diagrams display the highest permissible average radial force capacity $F_{R,\ eq}$ of NLC and NLCW planetary gearboxes for output bearings with a service life of $L_{10\,h}$ = 30000 h. It is dependent on the force application point on the gearbox shaft and on the average output speed. If these values are exceeded in your application, calculate the service life of the output bearings.

You can find more detailed information in the chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

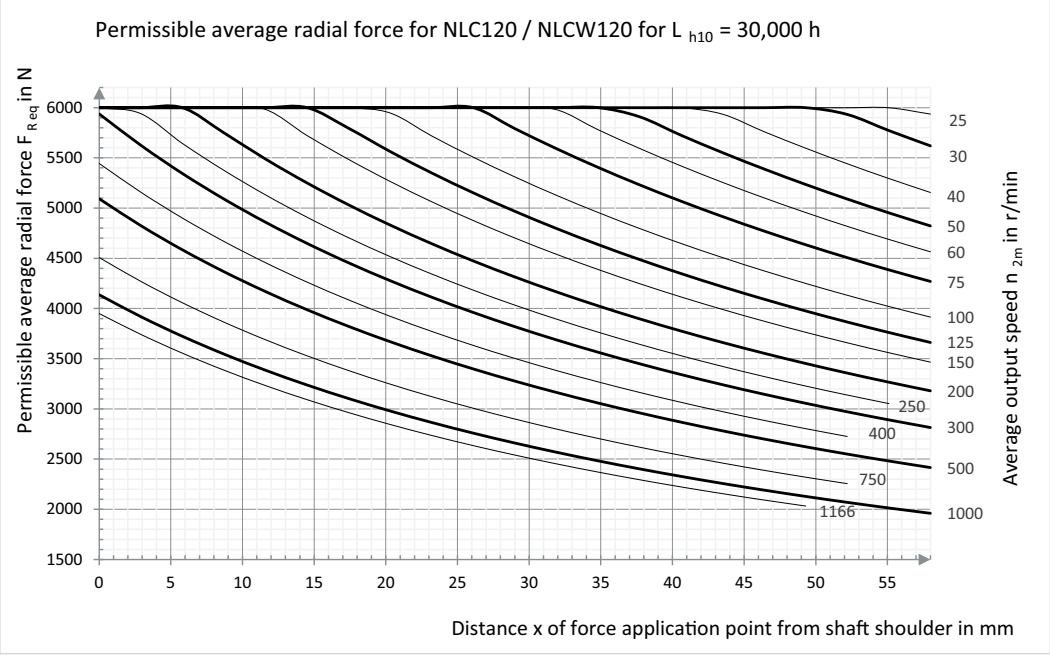
Radial force diagram for NLC060 and NLCW060



Radial force diagram for NLC080 and NLCW080



Radial force diagram for NLC120 and NLCW120



6.4.10 Reference speeds for NLC and NLCW planetary gearboxes

Description

The planetary gearbox reference speed $n_{2B, G}$ is required to calculate the service life of internal gearbox bearings.

Calculate the service life of the internal gearbox bearings only if one of the following points applies:

- The application torque exceeds the rated torque of the planetary gearbox $M_{2n, G}$.
- The average application speed at the output exceeds the reference speed.

You can find more detailed information in the chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

Table 6-57 Reference speed to the rated torque of the coaxial planetary gearbox NLC in r/min

Number of gearbox stages	Transmission ratio	NLC060	NLC080	NLC120
z	*i*			
1	3	684	94.1	1120
	4	226	330	1960
	5	175	353	805
	7	286	695	950
	8	821	1600	1370
	10	1290	3370	2430
2	9	152	125	150
	12	139	286	350
	15	152	353	465
	16	139	286	350
	20	139	286	350
	25	175	353	465
	32	139	286	350
	40	175	353	465
	64	821	1600	1370
	100	1290	3370	2430

Table 6-58 Reference speed to the rated torque of the angled planetary gearbox NLCW in r/min

Number of gearbox stages	Transmission ratio	NLCW060	NLCW080	NLCW120
z	*i*			
1	3	227	86.4	124
	4	161	66.1	97.5
	5	125	51.1	80.3
	7	217	110	141
	8	759	315	261
	10	1290	1120	823
2	9	65.7	22.7	61.7
	12	117	51.2	57.8
	15	152	104	130
	16	139	91.1	103
	20	139	142	161
	25	175	289	362
	32	139	286	350
	40	175	353	465
	64	821	1600	1370
	100	1290	3370	2430

6.4.11 Maximum bending torque for NLC and NLCW planetary gearboxes

Description

The tables list the maximum permissible bending moment $M_{B,G}$ at the flange between the planetary gearbox and the motor in Nm.

Table 6-59 Maximum permissible bending moment at the flange between the coaxial planetary gearbox and the motor

Gearbox size	NLC680	NLC080	NLC120
Bending moment			
$M_{B,G}$ / Nm	8	16	40

Table 6-60 Maximum permissible bending moment at the flange between the angled planetary gearbox and the motor

Gearbox size	NLCW060	NLCW080	NLCW120
Bending moment			
$M_{B,G}$ / Nm	5	10.5	26

6.5 Technical data of SP+ planetary gearboxes

6.5.1 Rated torque at the output shaft of SP+ gearboxes

Description

This table lists the rated torque $M_{2N,\,G}$ at the output shaft of the SP+ planetary gearbox in Nm.

If the specified rated torque is exceeded, then the service life of the gearing and the service life of the internal bearings of the planetary gearbox must be calculated.
For more information, see the chapters "Gearing strength for 1FK2 and 1FT2 with planetary gearbox (Page 69)" and "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the rated planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

More detailed information is provided in Chapter "Options (Page 31)".

Table 6-61 Rated torque $M_{2N,\,G}$ in Nm at the output shaft of SP+ planetary gearboxes with standard lubrication

Gearbox size		**SP060**		**SP075**		**SP100**		**SP140**		**SP180**	**SP210**	**SP240**
Motor frame size 1FT2...		**...102 ...☐03**	**...☐04 ...☐05**	**...☐03 ...☐04**	**...☐05 ...☐06**	**...☐03 ...☐04 ...☐05**	**...☐06 ...☐08 ...☐10**	**...☐04 ...☐05 ...☐06**	**...☐08 ...☐10**	**...☐06 ...☐08 ...☐10**	**...☐08 ...☐10**	**...☐10**
Stages	**Transmission ratio**											
1	3	29	36	96	102	139	282	454	468	1164	-	-
	4	38	50	113	132	185	378	605	792	1452	3000	5400
	5	48	50	132		232	378	681	792	1452	3000	5400
	7	50		132		292	378	792		1452	2880	5160
	10	38		114		282		636		1164	2280	4000

Gearbox size		**SP060**	**SP075**		**SP100**		**SP140**		**SP180**	**SP210**	**SP240**
Motor frame size 1FT2...		**...102 ...☐03**	**...102 ...☐03**	**...105**	**...☐03**	**...☐04 ...☐05**	**...☐04 ...☐05**	**...☐06 ...☐08**	**...☐04 ...☐05**	**...☐06 ...☐08**	**...☐06 ...☐08**
Stages	**Transmission ratio**	**...☐04**	**...☐04 ...205**			**...☐06**		**...☐10**	**...☐06 ...☐08 ...☐10**	**...☐10**	**...☐10**
2	16	50	126		232	347	536	726	1452	2880	5400
	20	50	126		232	347	536	726	1452	3000	5400
	25	50	132		290	347	670		1452	3000	5400
	28	50	126		232	347	536	726	1452	2880	5400
	35	50	132		290	347	670		1452	2880	5400
	40	50	126		232	347	536	726	1452	2840	4400
	50	50	132		290	347	670		1452	2880	5160
	70	50	113		181	347	367	726	1356	2457	4730
	100	38	105	-	193	259	376	583	1164	2043	3642

Table 6-62 Rated torque $M_{2N,\,G}$ in Nm at the output shaft of SP+ planetary gearboxes with food-safe lubrication

Gearbox size		**SP060**		**SP070**	**SP100**		**SP140**	**SP180**	**SP210**	**SP240**
Motor frame size 1FT2...		**...102**	**...☐04**	**...☐03**	**...☐03**	**...☐06**	**...☐04**	**...☐06**	**...☐08**	**...210**
Stages	**Transmission ratio**	**...☐03**	**...☐05**	**...☐04 ...☐05 ...☐06**	**...☐04 ...☐05**	**...☐08 ...210**	**...☐05 ...☐06 ...☐08 ...210**	**...☐08 ...210**	**...210**	
1	3	29		82	139	226	374	931	-	-
	4	38	40	106	185	302	605	1162	2400	4320
	5	40		106	232	302	634	1162	2400	4320
	7	40		106	292	302	634	1162	2304	4128
	10	30		91	226		509	931	1824	3200

Gearbox size		SP060	SP070		SP100		SP140			SP180	SP210	SP240
Motor frame size 1FT2...		...102 ...□03 ...□04	...102 ...□03 ...□04	...□05	...□03	...□04 ...□05 ...□06	...□04 ...□05	...□06 ...□08	...210	...□04 ...□05 ...□06 ...□08 ...210	...□06 ...□08 ...210	...□06 ...□08 ...210
Stages	Transmission ratio											
2	16	40	101		232	278	536	581		1162	2304	4320
	20	40	101		232	278	536	581		1162	2400	4320
	25	40	106		278		536			1162	2400	4320
	28	40	101		232	278	536	581		1162	2304	4320
	35	40	106		278		536			1162	2304	4320
	40	40	101		232	278	536	581		1162	2272	3520
	50	40	106		278		536			1162	2304	4128
	70	40	90		181	278	367	581		1085	1966	3784
	100	30	84	-	193	207	376	466		931	1634	2914

6.5.2 Maximum torque at the output shaft of SP+ gearboxes

Description

The maximum permissible output torque $M_{2max, G}$ must not be exceeded in operation. It is permissible for a maximum of 30,000 revolutions of the output shaft. The fatigue strength of the planetary gearbox must be calculated if output torques of up to $M_{2max, G}$ are utilized.
More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the maximum permissible planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

More detailed information is provided in Chapter "Options (Page 31)".

Gearbox size		SP060			SP075			
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08
Stages	Transmis-sion ratio							
1	3	29	38	38	-	96	109	109
	4	38	54	54	-	113	141	141
	5	48	54	54	-	141	141	141
	7	54	54	54	-	141	141	141
	10	41	41	41	-	122	122	122

Gearbox size		SP060			SP075			
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08
Stages	Transmission ratio							
2	16	46	46	-	101	101	101	-
	20	46	46	-	101	101	101	-
	25	54	54	-	126	126	126	-
	28	46	46	-	101	101	101	-
	35	54	54	-	126	126	126	-
	40	46	46	-	101	101	101	-
	50	54	54	-	126	126	126	-
	70	45	45	-	90	90	90	-
	100	38	38	-	84	84	105	-

Gearbox size		SP100			SP140			
Motor frame size 1FT2...		...□03	...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210
Stages	Transmission ratio							
1	3	139	139	301	301	454	454	499
	4	185	185	396	396	605	605	845
	5	232	232	396	396	681	681	845
	7	292	292	342	342	660	660	660
	10	301	301	301	301	576	576	576
2	16	232	278	278	-	536	581	581
	20	232	278	278	-	536	581	581
	25	278	278	278	-	536	536	536
	28	232	278	278	-	536	581	581
	35	278	278	278	-	536	536	536
	40	232	278	278	-	536	581	581
	50	278	278	278	-	536	536	536
	70	181	278	278	-	367	581	581
	100	193	207	207	-	376	466	583

Gearbox size		SP180		SP210		SP240	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08 ...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio						
1	3	-	1242	-	-	-	-
	4	-	1549	-	3200	-	4560
	5	-	1549	-	3200	-	4560
	7	-	1549	-	3072	-	4560
	10	-	1242	-	2240	-	3200

Gearbox size		SP180		SP210		SP240	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08 ...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio						
2	16	1188	1188	2527	2527	4357	4357
	20	1188	1188	2527	2527	4357	4357
	25	1486	1486	3159	3159	4560	4560
	28	1188	1188	2527	2527	4357	4357
	35	1486	1486	3072	3072	4560	4560
	40	1188	1188	2304	2304	4357	4357
	50	1486	1486	2880	2880	4560	4560
	70	1085	1085	1966	1966	4560	4560
	100	990	990	1634	1634	2914	2914

6.5.3 EMERGENCY OFF torque at the output shaft of SP+ planetary gearboxes

Description

As a maximum, the planetary gearbox can withstand the EMERGENCY OFF torque 1000 x during the gearbox service life without restricting the functionality.

Based on this data, check whether high torques, caused by very seldom operating faults, can damage the planetary gearbox.
More information is provided in Chapter "Check for excessively high torques in case of operating faults: EMERGENCY OFF torque (Page 78)".

Table 6-63 EMERGENCY OFF torque in Nm of SP+ planetary gearboxes

Gearbox size:		SP060			SP075			
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08
Stages	Transmission ratio							
1	3	40	96	100	-	100	139	250
	4	50	109	109	-	125	185	250
	5	50	109	109	-	160	250	250
	7	67	109	109	-	213	250	250
	10	95	100	100	-	213	250	250

Gearbox size:		SP060			SP075			
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08
Stages	Transmission ratio							
2	16	109	109	-	152	250	250	-
	20	109	109	-	190	250	250	-
	25	109	109	-	213	250	250	-
	28	109	109	-	213	250	250	-
	35	109	109	-	213	250	250	-
	40	109	109	-	250	250	250	-
	50	109	109	-	250	250	250	-
	70	109	109	-	250	250	250	-
	100	100	100	-	250	250	250	-

Table 6-64 EMERGENCY OFF torque in Nm of SP+ planetary gearboxes

Gearbox size:		SP100				SP140		
Motor frame size 1FT2...		...□03	...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210
Stages	Transmission ratio							
1	3	40	96	-	100	500	500	1250
	4	250	250	500	625	625	625	1350
	5	313	313	625	625	756	756	1350
	7	313	313	625	625	1059	1059	1350
	10	324	324	625	625	1250	1250	1250
2	16	463	463	625	625	741	1350	1350
	20	512	625	625	-	926	1350	1350
	25	599	625	625	-	1158	1350	1350
	28	599	625	625	-	1297	1350	1350
	35	599	625	625	-	1350	1350	1350
	40	625	625	625	-	1350	1350	1350
	50	625	625	625	-	1350	1350	1350
	70	625	625	625	-	1350	1350	1350
	100	625	625	625	-	1250	1250	1250

Table 6-65 EMERGENCY OFF torque in Nm of SP+ planetary gearboxes

Gearbox size		**SP180**			**SP210**		**SP240**	
Motor frame size 1FT2...		**...□04**	**...□06**	**...210**	**...□06**	**...□08**	**...□06**	**...210**
Stages	**Transmis-sion ratio**	**...□05**	**...□08**			**...210**	**...□08**	
1	3	-	2400	2400	-	-	-	-
	4	-	2750	2750	-	5900	-	8500
	5	-	2750	2750	-	5900	-	8500
	7	-	2750	2750	-	5900	-	8500
	10	-	2750	2750	-	5900	-	6850
2	16	2420	2420	2750	5900	5900	8500	8500
	20	2750	2750	2750	5900	5900	8500	8500
	25	2750	2750	2750	5900	5900	8500	8500
	28	2750	2750	2750	5900	5900	8500	8500
	35	2750	2750	2750	5900	5900	8500	8500
	40	2750	2750	2750	5900	5900	8500	8500
	50	2750	2750	2750	5900	5900	8500	8500
	70	2750	2750	2750	5900	5900	8500	8500
	100	2750	2750	2750	5900	5900	6850	6850

6.5.4 Efficiency of SP+ planetary gearboxes under full load

Description

The gearbox losses are already taken into account in the characteristic curves and in the following characteristics of the geared motor or its components: $M_{2.0}$, $M_{2,\,max}$, $M_{0,\,M}$, $M_{max,\,M}$.

A reduction of these characteristic curves and characteristics via efficiency is not necessary. In the partial load range, especially when the gearbox is cold, the efficiency of the gearbox is always lower than at operating speed.

Table 6-66 Efficiency η_G of SP+ coaxial planetary gearboxes

Gearbox size	**SP060**	**SP075**	**SP100**	**SP140**	**SP180**	**SP210**	**SP240**
z							
1	0.97					-	
2	0.94						

z = number of gearbox stages

i = transmission ratio

6.5.5 Torsional stiffness of SP+ planetary gearboxes

The table lists the torsional stiffness C_{T2} of the planetary gearboxes referred the output in Nm/ arcmin.

SP060	SP075	SP100	SP140	SP180	SP210	SP240
3.5	10	31	53	175	400	550

6.5.6 Torsional backlash of SP+ planetary gearboxes

Description

The table lists the gearbox characteristics φ_2 at the output shaft of the planetary gearboxes in arcmin.

Table 6-67 Standard torsional backlash φ_2 at the output shaft of SP+ coaxial planetary gearboxes in arcmin

Number of gearbox stages *z*	SP060 SP075	SP100 SP140 SP180 SP210 SP240
1	4	3
2	6	5

Table 6-68 Reduced torsional backlash φ_2 at the output shaft of SP+ coaxial planetary gearboxes in arcmin

Number of gearbox stages *z*	SP060 SP075	SP100 SP140 SP180 SP210 SP240
1	2	1
2	4	3

6.5.7 Moments of inertia of SP+ planetary gearboxes

Description

The following table shows the moment of inertia $J_{1,G}$ of the gearbox component in relation to the input in kg m².

Table 6-69 Moment of inertia $J_{1,G}$ of SP+ gearbox components in kg cm²

Gearbox size		**SP060**			**SP075**			
Motor frame size 1FT2...		**...102**	**...□04**	**...□05**	**...102**	**...□03**	**...□05**	**...□06**
Stages	**Transmission ratio**	**...□03**				**...□04**		**...□08**
1	3	0.21	0.28	0.61	-	0.86	1.03	2.4
	4	0.15	0.22	0.55	-	0.61	0.78	2.15
	5	0.12	0.2	0.52	-	0.51	0.68	2.05
	7	0.1	0.18	0.5	-	0.42	0.59	1.96
	10	0.09	0.16	0.49	-	0.38	0.54	1.91
2	16	0.08	0.17	-	0.16	0.23	0.55	-
	20	0.07	0.16	-	0.13	0.2	0.53	-
	25	0.07	0.16	-	0.13	0.2	0.52	-
	28	0.06	0.16	-	0.1	0.18	0.5	-
	35	0.06	0.16	-	0.1	0.18	0.5	-
	40	0.06	0.15	-	0.09	0.16	0.49	-
	50	0.06	0.15	-	0.09	0.16	0.49	-
	70	0.06	0.15	-	0.09	0.16	0.49	-
	100	0.06	0.15	-	0.09	0.16	0.49	-

Table 6-70 Moment of inertia $J_{1,G}$ of SP+ gearbox components in kg cm²

Gearbox size		**SP100**				**SP140**		
Motor frame size 1FT2...		**...□03**	**...□04**	**...□06**	**...210**	**...□04**	**...□06**	**...210**
Stages	**Transmission ratio**		**...□05**	**...□08**		**...□05**	**...□08**	
1	3	3.29	3.29	3.99	11.05	10.68	10.68	14.92
	4	2.35	2.35	3.04	10.11	7.82	7.82	12.06
	5	1.92	1.92	2.61	9.68	6.79	6.79	11.02
	7	1.6	1.6	2.29	9.36	5.84	5.84	10.08
	10	1.38	1.38	2.07	9.14	5.28	5.28	9.51
2	16	0.64	0.81	2.18	-	2.5	3.19	10.25
	20	0.54	0.7	2.07	-	2.01	2.71	9.77
	25	0.52	0.68	2.05	-	1.97	2.67	9.73
	28	0.43	0.6	1.97	-	1.65	2.34	9.41
	35	0.43	0.59	1.96	-	1.63	2.32	9.39
	40	0.38	0.55	1.92	-	1.4	2.1	9.16
	50	0.38	0.54	1.91	-	1.39	2.08	9.15
	70	0.37	0.54	1.91	-	1.38	2.08	9.14
	100	0.37	0.54	1.91	-	1.38	2.07	9.14

Table 6-71 Moment of inertia $J_{1,G}$ of SP+ gearbox components in kg cm²

Gearbox size		**SP180**			**SP210**		**SP240**	
Motor frame size 1FT2...		**...□04**	**...□06**	**...210**	**...□06**	**...□08**	**...□06**	**...210**
Stages	**Transmission ratio**	**...□05**	**...□08**			**...210**	**...□08**	
1	3	-	50.84	50.84	-	-	-	-
	4	-	33.91	33.91	-	94.3	-	198.2
	5	-	27.93	27.93	-	76.9	-	163
	7	-	22.23	22.23	-	61.5	-	138.3
	10	-	19.16	19.16	-	53.1	-	124.7
2	16	9.27	9.27	13.51	34.5	34.5	39.2	39.2
	20	7.72	7.72	11.95	31.5	31.5	34.6	34.6
	25	7.48	7.48	11.72	30.8	30.8	33.2	33.2
	28	6.32	6.32	10.55	30	30	30.5	30.5
	35	6.2	6.2	10.43	29.7	29.7	29.7	29.7
	40	5.51	5.51	9.74	28.5	28.5	28.2	28.2
	50	5.45	5.45	9.68	28.3	28.3	27.9	27.9
	70	5.39	5.39	9.63	28.1	28.1	27.6	27.6
	100	5.36	5.36	9.6	28	28	27.5	27.5

6.5.8 Mass of SP+ planetary gearboxes

Description

The following table shows the mass m_G of planetary gearboxes in kg.

Table 6-72 Mass m_G of SP+ coaxial planetary gearboxes in kg

Gear-box size	**SP060**				**SP075**						**SP100**					
Motor frame size 1FT2	**□02 □03**	**□04**	**205**	**105**	**□02**	**□03**	**□04**	**205**	**105**	**□06**	**□03 □04**	**205**	**105**	**□06**	**□08**	**□10**
z																
1	1.7	1.8	2.2	2.4	-	3.3	3.2	3.3	3.4	5	7	6.9	6.8	7.5	7.9	9.5
2	1.8	2.1	-	-	3.4	3.4	3.5	3.9	4.1	-	7.1	7.2	7.3	9	-	-

Gear-box size	SP140					SP180					SP210			SP240	
Motor frame size 1FT2	□04 205	105	□06	□08	□10	□04	I□05	□06	□08	□10	□06	□08	□10	□06 □08	□10
z															
1	15.2	15.1	15	-	16.9	-	-	33.2	33	32.6	-	53.6	54.3	-	79
2	16.5	16.4	17.1	18.6	20.2	35.5	35.4	35.2	-	37.1	55.4	55.4	54.5	75.9	75

6.5.9 Maximum permissible axial and radial forces of SP+ gearboxes

Description

The following values apply to radial forces with a force application point located at the midpoint of the shaft and to centrally applied axial forces, as well as to an output speed of 100 r/min.

You can obtain the permissible radial forces for other force application points and speeds from the radial force diagrams below.

Note

With simultaneous axial and radial force, an axial force of $F_A \leq 0.4 \cdot F_R$ is still permissible. Furthermore, the values apply only to purely axial or purely radial loads.

Table 6-73 Maximum permissible radial forces for SP+ gearboxes in N

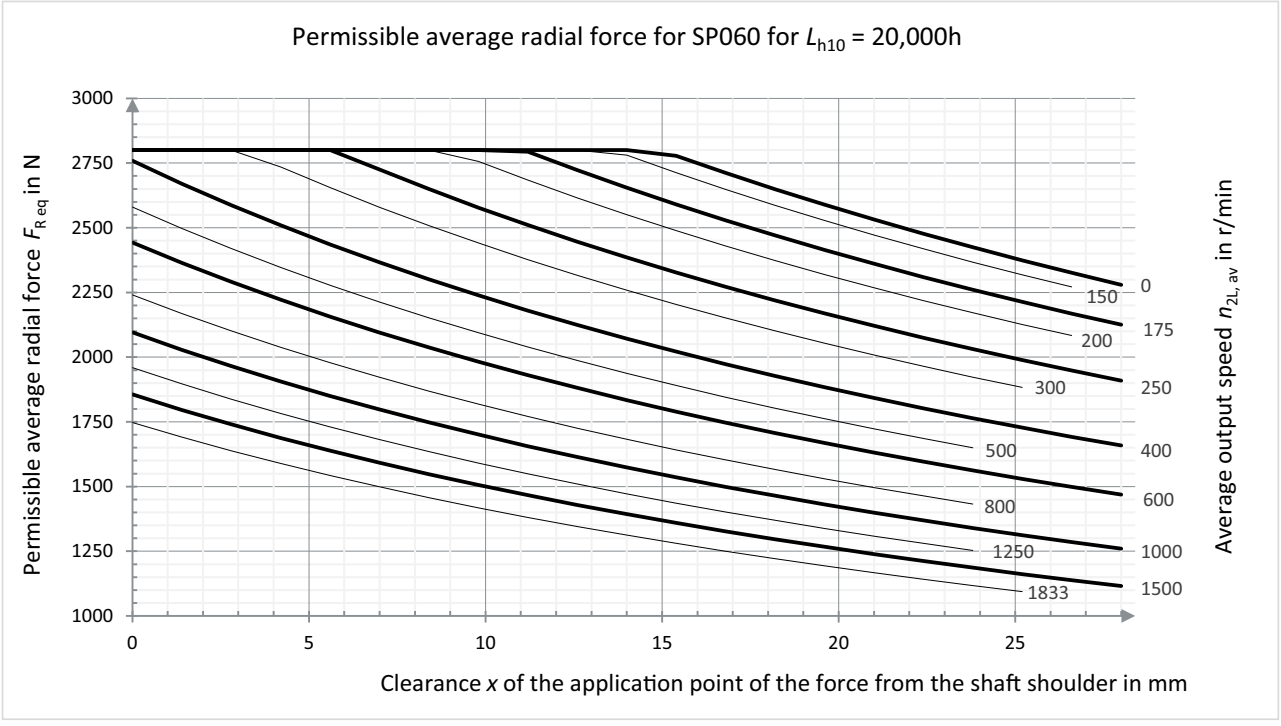
Size	Average radial force	Average axial force	Average radial force	Average axial force	Speed for average forces	Maximum permissible radial force	Maximum permissible axial force	maximum breakdown torque	Support reference
	for $L_{10h=20,000\ h}$		for $L_{10h=30,000\ h}$						
	$F_{R,eq,\ 20k}$	$F_{A,eq,\ 20k}$	$F_{R,eq,\ 30k}$	$F_{A,eq,\ 30k}$	$n_{2\ F,av}$	$F_{R,max}$	$F_{A,max}$	$M_{2K,\ max}$	z_2
SP060	1700	2400	1500	2100	833	2800	2400	160	42
SP075	2400	3350	2100	3000	506	4200	3350	260	45
SP100	3800	5650	3400	5000	318	6300	5650	500	51
SP140	6300	9870	5500	8700	323	9600	9870	1000	63
SP180	11,300	15,570	10,000	13,800	373	15,000	15,570	1800	79
SP210	20,700	30,000	18,400	26.600	174	21,000	30,000	3100	94
SP240	22,100	33,000	19,600	29,200	188	30,000	33,000	5000	99

Description

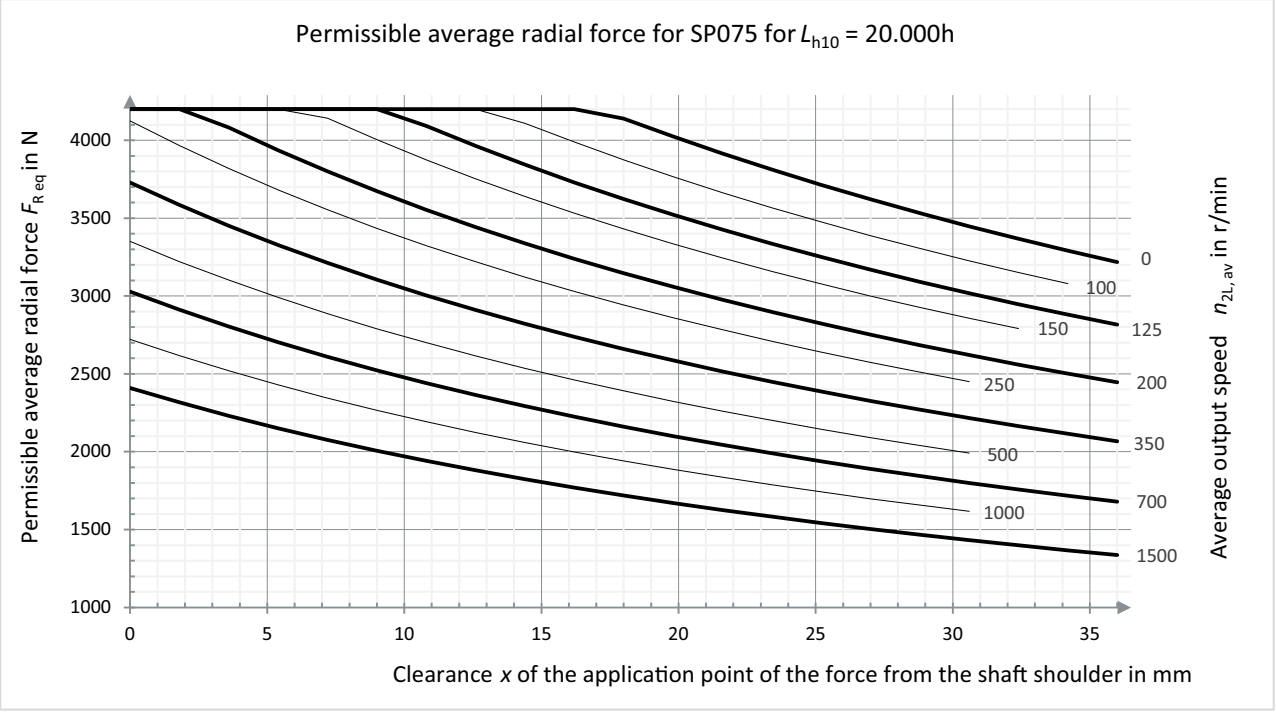
The following diagrams display the largest permissible average radial force capacity $F_{R,\,eq}$ of SP+ planetary gearboxes for output bearings with a service life of $L_{10\,h}$ = 20000 h. It is dependent on the force application point on the gearbox shaft and on the average output speed. If these values are exceeded in your application, calculate the service life of the output bearings.

More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

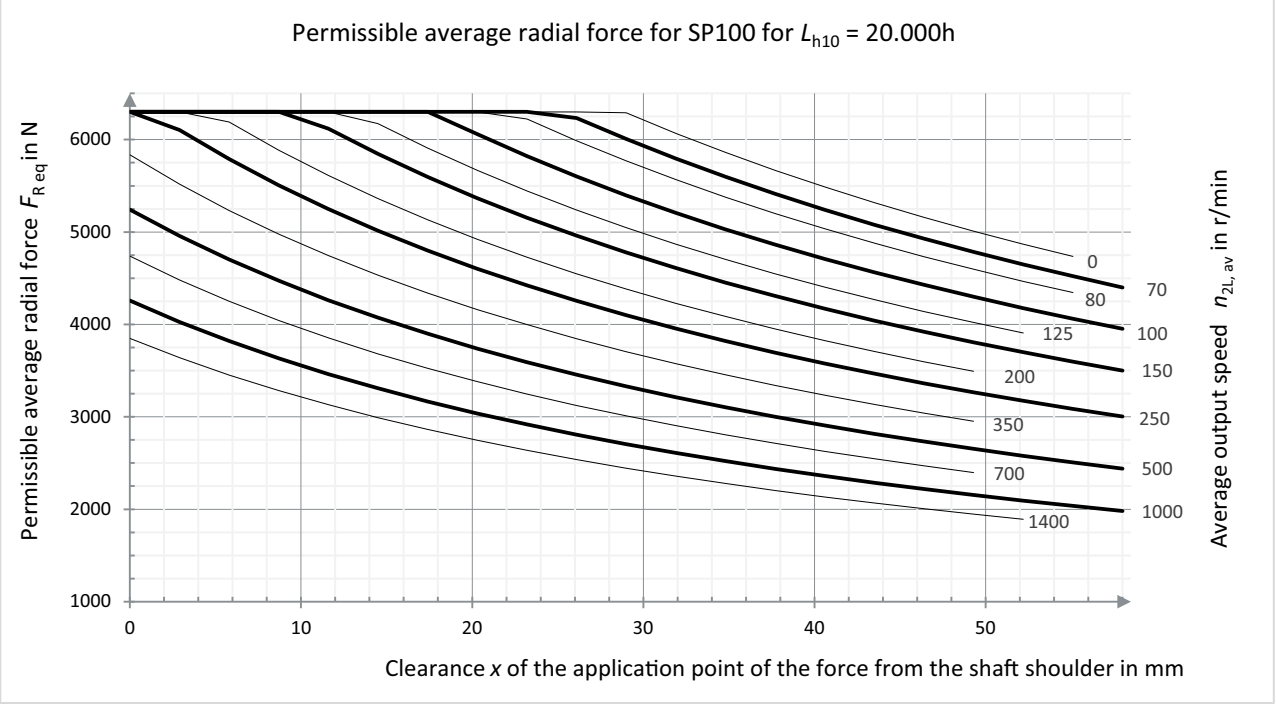
Radial force diagram for SP060



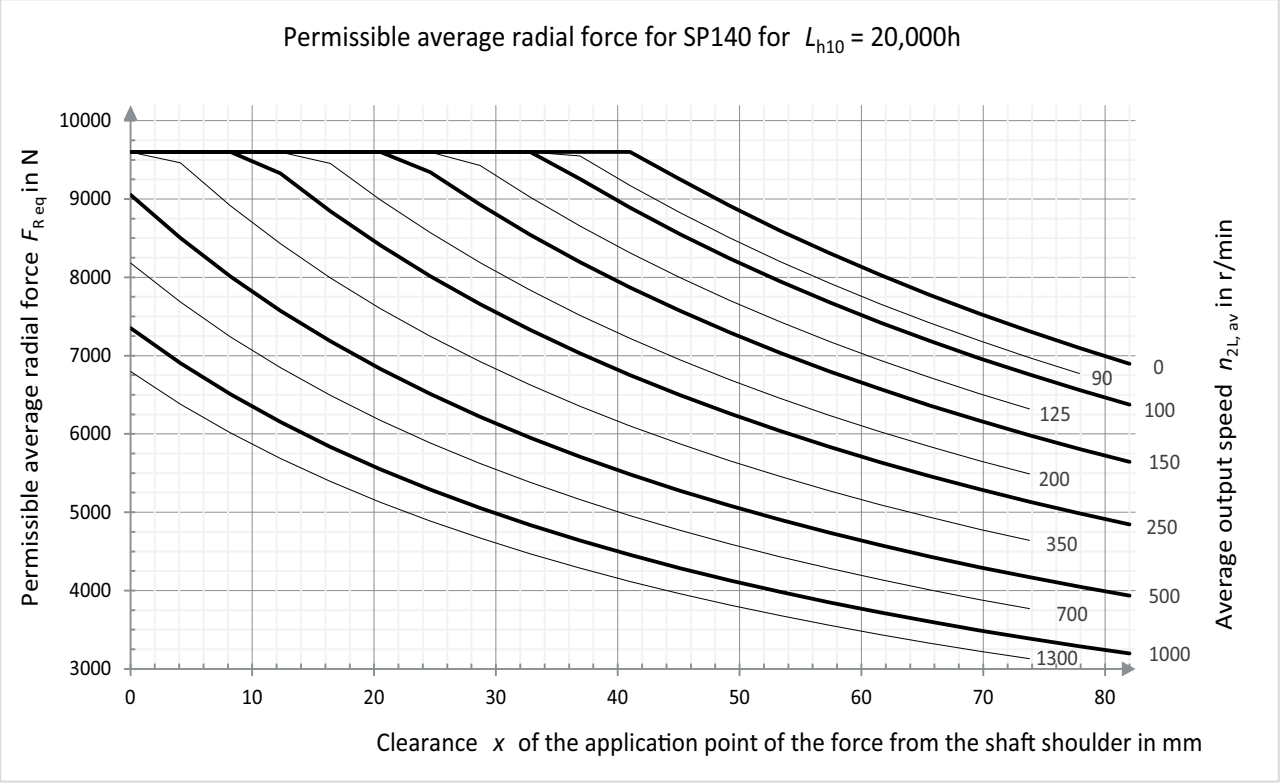
Radial force diagram for SP075



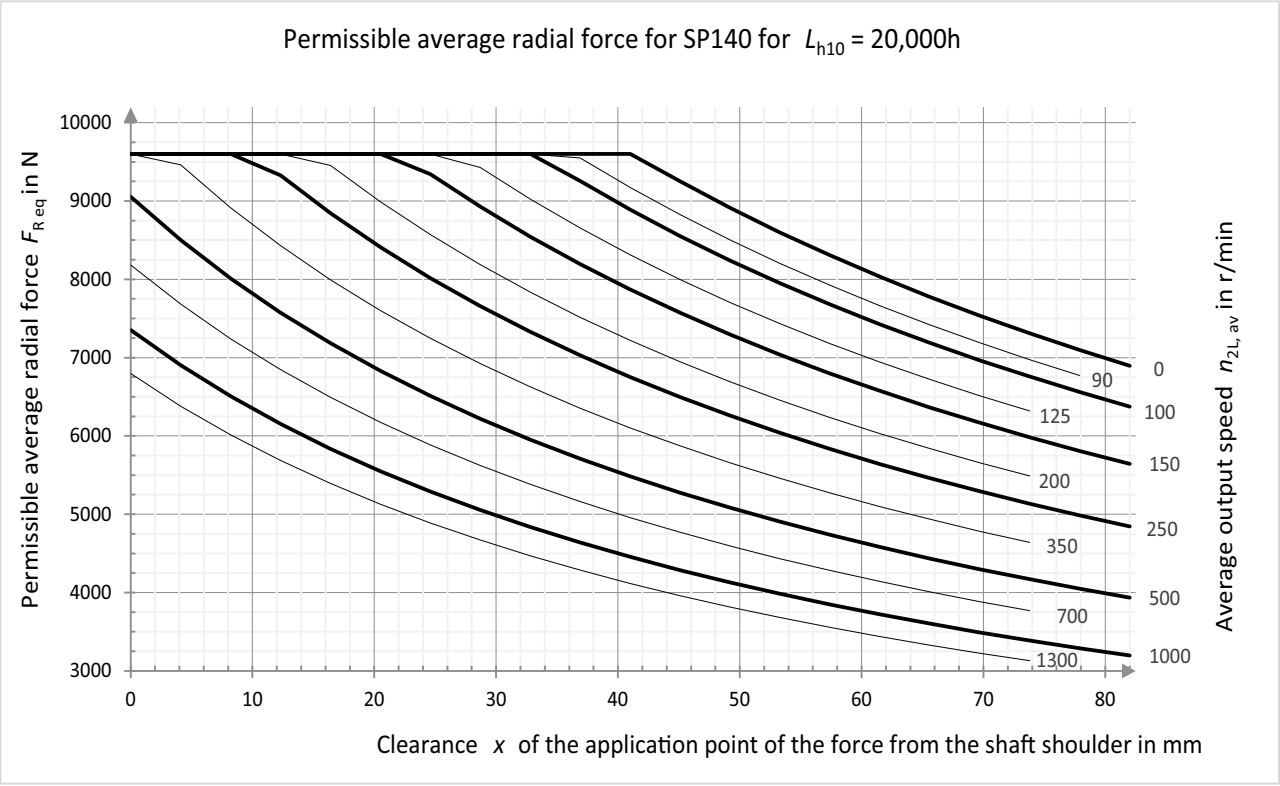
Radial force diagram for SP100



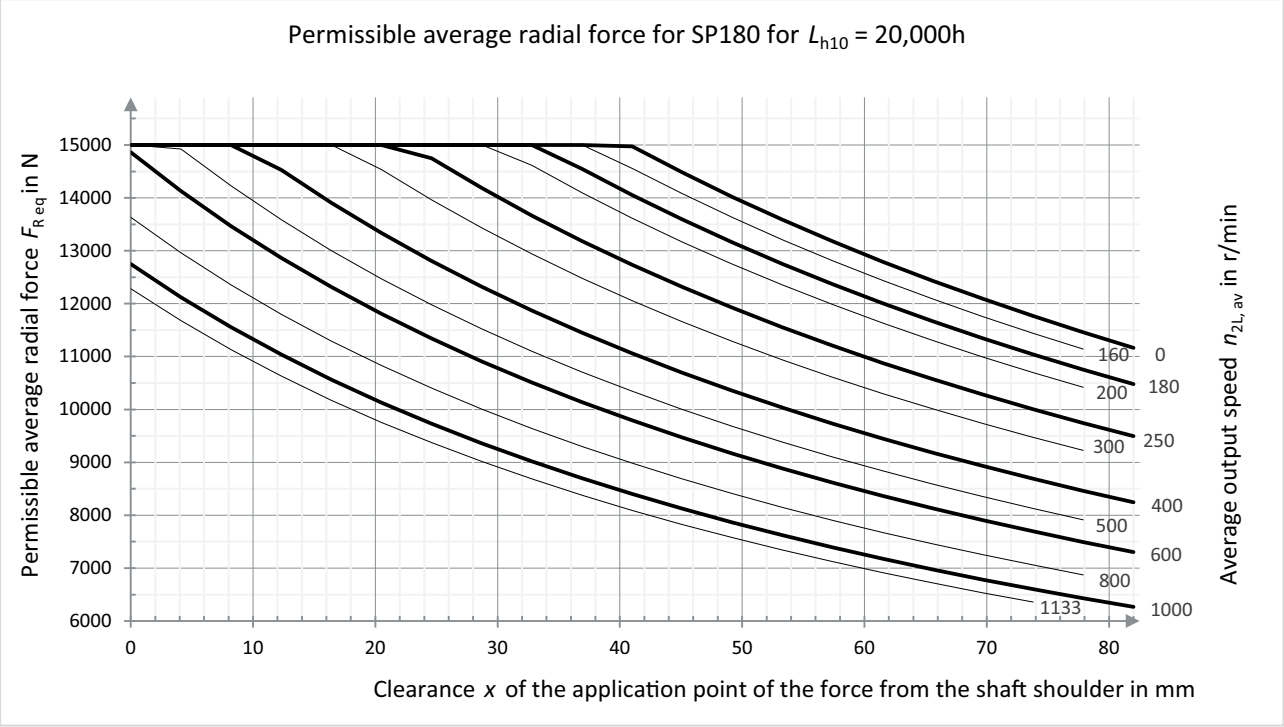
Radial force diagram for SP140



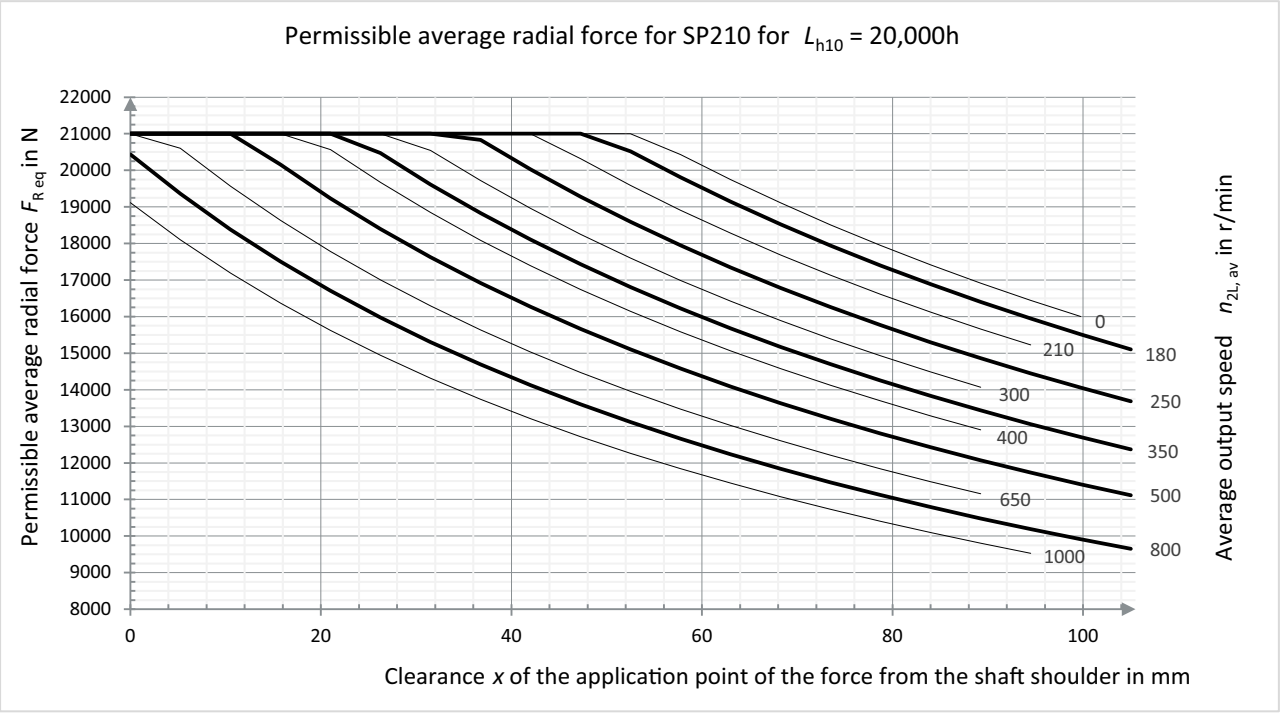
Radial force diagram for SP140



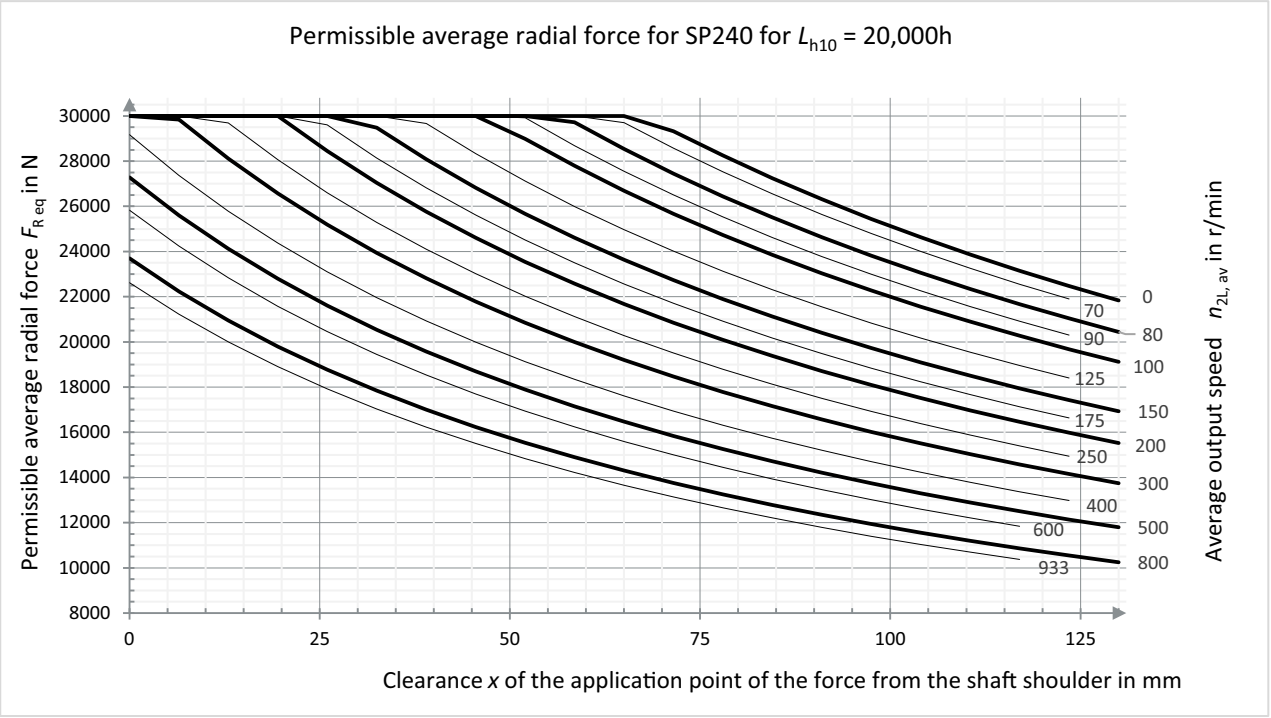
Radial force diagram for SP180



Radial force diagram for SP210



Radial force diagram for SP240



6.5.10 Reference speeds for SP+ planetary gearboxes

Description

The reference speed *at the output of the planetary gearbox* $n_{2B,\,G}$ is required to calculate the service life of internal gearbox bearings.

Calculate the service life of the internal gearbox bearings only if one of the following points applies:

- The application torque exceeds the rated torque of the planetary gearbox $M_{2n,\,G}$.
- The average application speed at the output exceeds the reference speed.

More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

Table 6-74 Reference speed in r/min of the output to the rated torque of SP+ planetary gearboxes with standard lubricant

Number of gearbox stages	**Transmission ratio**	**SP060**			**SP075**			
z	***i***	**Motor frame size**						
		...102 ...□03	**...□04**	**...□05**	**...102**	**...□03 ...□04**	**...□05**	**...□06 ...□08**
1	3	405	197	197	-	238	195	195
	4	263	106	106	-	242	144	144
	5	93	81	81	-	114	114	114
	7	61	61	61	-	88	88	88
	10	125	125	125	-	101	101	101
2	16	106	106	-	122	122	122	-
	20	105	105	-	96	96	96	-
	25	81	81	-	114	114	114	-
	28	104	104	-	72	72	72	-
	35	81	81	-	97	97	97	-
	40	176	176	-	58	58	58	-
	50	81	81	-	81	81	81	-
	70	61	61	-	148	148	148	-
	100	125	125	-	60	60	60	-

Number of gearbox stages	**Transmission ratio**	**SP100**				**SP140**		
z	***i***	**Motor frame size**						
		...□03	**...□04 ...□05**	**...□06 ...□08**	**...210**	**...□04 ...□05**	**...□06 ...□08**	**...210**
1	3	682	682	65	65	47	47	43
	4	477	477	44	44	73	73	30
	5	175	175	34	34	39	39	23
	7	62	62	26	26	17.9	17.9	17.9
	10	56	56	56	56	28	28	28

Number of gearbox stages	Transmission ratio	SP100				SP140		
z	*i*	Motor frame size						
		...□03	...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210
2	16	225	59	59	-	110	40	40
	20	225	59	59	-	110	40	40
	25	83	46	46	-	41	41	41
	28	225	59	59	-	110	40	40
	35	83	46	46	-	41	41	41
	40	225	59	59	-	110	40	40
	50	83	46	46	-	41	41	41
	70	301	34	34	-	232	24	24
	100	197	74	-	-	100	23	23

Number of gearbox stages	Transmission ratio	SP180		SP210		S240	
z	*i*	Motor frame size					
		...□04 ...□05	...□06 ...□08 ...210	...□06	...□08 ...210	...□06 ...□08	...210
1	3	-	33	-	-	-	-
	4	-	84	66	66	-	37
	5	-	66	51	51	-	29
	7	-	50	45	45	-	26
	10	-	85	77	77	-	48
2	16	84	84	10.3	10.3	13.6	13.6
	20	74	74	7.1	7.1	10.9	10.9
	25	66	66	11.5	11.5	17.5	17.5
	28	55	55	6.2	6.2	8.5	8.5
	35	65	65	10.1	10.1	13.6	13.6
	40	45	45	5.4	5.4	13.9	13.9
	50	66	66	8.3	8.3	13.2	13.2
	70	53	53	29	29	35	35
	100	84	84	120	120	81	81

Table 6-75 Reference speed in r/min of the output to the rated torque of SP+ planetary gearboxes with food-safe lubricant

Number of gearbox stages	**Transmission ratio**	**SP060**			**SP075**		
z	***i***	**Motor frame size**					
		...102 ...□03	**...□04**	**...□05**	**...102**	**...□03 ...□04 ...□05**	**...□06 ...□08**
1	3	405	405	405	-	402	402
	4	263	222	222	-	299	299
	5	171	171	171	-	236	236
	7	128	128	128	-	183	183
	10	274	274	274	-	213	213
2	16	222	222	-	254	254	-
	20	221	221	-	199	199	-
	25	171	171	-	236	236	-
	28	219	219	-	150	150	-
	35	170	170	-	201	201	-
	40	370	370	-	122	122	-
	50	171	171	-	168	168	-
	70	128	128	-	316	316	-
	100	274	274	-	126	126	-

Number of gearbox stages	**Transmission ratio**	**SP100**				**SP140**		
z	***i***	**Motor frame size**						
		...□03	**...□04 ...□05**	**...□06 ...□08**	**...210**	**...□04 ...□05**	**...□06 ...□08**	**...210**
1	3	682	682	135	135	90	90	90
	4	477	477	93	93	73	73	63
	5	175	175	73	73	49	49	49
	7	62	62	55	55	38	38	38
	10	117	117	117	117	60	60	60

Number of gearbox stages	Transmission ratio	SP100				SP140		
z	*i*	Motor frame size						
		...□03	...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210
2	16	225	123	123	-	110	84	84
	20	225	123	123	-	110	84	84
	25	96	96	96	-	86	86	86
	28	225	123	123	-	110	84	84
	35	96	96	96	-	86	86	86
	40	225	123	123	-	110	84	84
	50	96	96	96	-	86	86	86
	70	301	72	72	-	232	50	50
	100	197	156	156	-	100	49	-

Number of gearbox stages	Transmission ratio	SP180		SP210		S240	
z	*i*	Motor frame size					
		...□04 ...□05	...□06 ...□08 ...210	...□06	...□08 ...210	...□06 ...□08	...210
1	3	-	69	-	-	-	-
	4	-	176	-	139	-	78
	5	-	138	-	106	-	61
	7	-	105	-	95	-	55
	10	-	180	-	161	-	101
2	16	176	176	22	22	29	29
	20	155	155	14.9	14.9	23	23
	25	138	138	24	24	37	37
	28	116	116	13.1	13.1	18	18
	35	137	137	21	21	29	29
	40	94	94	11.3	11.3	29	29
	50	138	138	17.4	17.4	28	28
	70	112	112	61	61	74	74
	100	176	176	253	253	171	171

6.5.11 Maximum bending moment for SP+ planetary gearboxes

Description

The tables list the maximum permissible bending moment $M_{B,G}$ at the flange between the planetary gearbox and the motor in Nm.

Table 6-76 Maximum permissible bending moment $M_{B,G}$ / Nm at the flange between the coaxial planetary gearbox and the motor

Gearbox size	**SP060**			**SP075**			**SP100**		
Motor frame size 1FT2									
z	**...102 ...□03**	**...□04**	**...□05**	**...102 ...□03 ...□04**	**...□05**	**...□06 ...□08**	**...□03 ...□04 ...205 ...105**	**...□06 ...□08**	**...□10**
1	7	7	101	44	44	300	81	81	550
2	24	51	-	43	83	-	100	268	-

Gearbox size	**SP140**		**SP180**		**SP210**	**SP240**	
Motor frame size 1FT2							
z	**...□04 ...□05 ...□06 ...□08**	**...□10**	**...□04 ...□05**	**...□06 ...□08 ...□10**	**...□06 ...□08 ...□10**	**...□06**	**...□08 ...□10**
1	457	457	-	325	325	-	2200
2	255	570	595	595	595	1450	1450

6.6 Technical data of TP+ planetary gearboxes

6.6.1 Rated torque at the output shaft of TP+ gearboxes

Description

This table lists the rated torque $M_{2N,G}$ at the output shaft of the TP+ planetary gearbox in Nm.

If the specified rated torque is exceeded, then the service life of the gearing and the service life of the internal bearings of the planetary gearbox must be calculated.
For more information, see the chapters "Gearing strength for 1FK2 and 1FT2 with planetary gearbox (Page 69)" and "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the rated planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

More detailed information is provided in Chapter "Options (Page 31)".

Table 6-77 Rated torque $M_{2N,\,G}$ in Nm at the output shaft of TP+ planetary gearboxes with standard lubrication

Gearbox size		**TP004**		**TP010**		**TP025**		**TP050**		**TP110**	**TP300**	**TP500**
Motor frame size 1FT2...		**...102** **...□03**	**...□04** **...□05**	**...□03** **...□04**	**...□05** **...□06**	**...□03** **...□04** **...□05**	**...□06** **...□08** **...□10**	**...□04** **...□05** **...□06**	**...□08** **...□10**	**...□06** **...□08** **...□10**	**...□08** **...□10**	**...□10**
Stages	**Transmission ratio**											
1	4	38	66	115	172	185	352	605	840	1920	-	-
	5	48	66	144	172	232	380	681	840	1920	4200	7200
	7	60	66	172		292	352	840		1920	3960	6000
	10	42		126		318		648		1680	2280	4000

Gearbox size		**TP004**	**TP010**			**TP025**	**TP050**		**TP110**	**TP300**	**TP500**
Motor frame size 1FT2...		**...102** **...□03** **...□04**	**..102**	**...□03** **...□04** **...205**	**...105**	**...□03** **...□04** **...□05** **...□06**	**...□04** **...□05**	**...□06** **...□08** **...□10**	**...□04** **...□05** **...□06** **...□08** **...□10**	**...□06** **...□08** **...□10**	**...□06** **...□08** **...□10**
Stages	**Transmission ratio**										
2	16	57	137	157		352	667	825	1760	-	-
	20	57	126			352	825		1760	3850	5446
	25	66	158			380	825		1760	3949	6808
	28	57	157			352	825		1760	-	-
	35	66	158			380	825		1760	3949	6808
	40	57	154			352	825		1760	-	-
	50	66	158			380	825		1760	3600	4975
	70	56	157			352	770		1760	3630	5500
	100	42	105		-	292	594		1540	2800	4800

Table 6-78 Rated torque $M_{2N,\,G}$ in Nm at the output shaft of TP+ planetary gearboxes with food-safe lubrication

Gearbox size		TP004		TP010		TP025		TP050		TP110	TP300	TP500
Motor frame size 1FT2...		...102 ...□03	...□04 ...□05	...□03 ...□04	...□05 ...□06	...□03 ...□04 ...□05	...□06 ...□08 ...□10	...□04 ...□05 ...□06	...□08 ...□10	...□06 ...□08 ...□10	...□08 ...□10	...□10
Stages	Transmission ratio											
1	4	38	53	115	138	185	282	605	672	1536	-	-
	5	48	53	138		232	304	672		1536	3360	5760
	7	53		138		282		672		1536	3168	4800
	10	34		101		254		518		1344	1824	3200

Gearbox size		TP004	TP010		TP025	TP050	TP110	TP300	TP500
Motor frame size 1FT2...		...102 ...□03	...102 ...□03	...□05	...□03 ...□04	...□04 ...□05	...□04 ...□05	...□06 ...□08	...□06 ...□08
Stages	Transmission ratio	...□04	...□04		...□05 ...□06	...□06 ...□08 ...□10	...□06 ...□08 ...□10	...□10	...□10
2	16	46	126		282	660	1408	-	-
	20	46	101		282	660	1408	3080	4357
	25	53	126		304	660	1408	3159	5446
	28	46	126		282	660	1408	-	-
	35	53	126		304	660	1408	3159	5446
	40	46	123		282	660	1408	-	-
	50	53	126		304	660	1408	2880	3980
	70	45	126		282	616	1408	2904	4400
	100	34	84	-	234	475	1232	2240	3840

6.6.2 Maximum torque at the output shaft of TP+ gearboxes

Description

The maximum permissible output torque $M_{2max,\,G}$ must not be exceeded in operation. It is permissible for a maximum of 30,000 revolutions of the output shaft. The fatigue strength of the planetary gearbox must be calculated if output torques of up to $M_{2max,\,G}$ are utilized.
More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

For the feather key version, the maximum permissible planetary gearbox torque is only permissible as a pulsating load or the torque must be reduced depending on the number of load changes.

More detailed information is provided in Chapter "Options (Page 31)".

Table 6-79 Maximum permissible torque $M_{2max, G}$ in Nm at the output shaft of TP+ planetary gearboxes.

Gearbox size		**TP004**			**TP010**				**TP025**		
Motor frame size 1FT2...		**...102 ...□03**	**...□04**	**...□05**	**...102**	**...□03 ...□04**	**...□05**	**...□06 ...□08**	**...□03 ...□04 ...□05**	**...□06 ...□08**	**...210**
Stages	**Transmission ratio**										
1	4	38	66	66	-	115	148	168	185	282	282
	5	48	66	66	-	144	168	168	232	304	304
	7	60	66	66	-	168	168	168	282	282	282
	10	45	45	45	-	134	134	134	282	282	282
2	16	46	46	-	126	126	126	-	282	282	-
	20	46	46	-	101	101	101	-	282	282	-
	25	58	58	-	126	126	126	-	304	304	-
	28	46	46	-	126	126	126	-	282	282	-
	35	58	58	-	126	126	126	-	304	304	-
	40	46	46	-	123	123	123	-	282	282	-
	50	58	58	-	126	126	126	-	304	304	-
	70	45	45	-	126	126	126	-	282	282	-
	100	38	38	-	84	84	105	-	282	282	-

Table 6-80 Maximum permissible torque $M_{2max, G}$ in Nm at the output shaft of TP+ planetary gearboxes.

Gearbox size		**TP050**		**TP110**		**TP300**		**TP500**	
Motor frame size 1FT2...		**...□04 ...□05 ...□06 ...□08**	**...210**	**...□04 ...□05**	**...□06 ...□08 ...210**	**...□06**	**...□08 ...210**	**...□06 ...□08**	**...210**
Stages	**Transmission ratio**								
1	4	605	794	-	2048	-	-	-	-
	5	681	794	-	2048	-	4480	-	7680
	7	694	694	-	2048	-	4200	-	5432
	10	576	576	-	1792	-	2240	-	3200
2	16	660	660	1408	1408	-	-	-	-
	20	660	660	1408	1408	3080	3080	4357	4357
	25	660	660	1408	1408	3159	3159	5446	5446
	28	660	660	1408	1408	-	-	-	-
	35	660	660	1408	1408	3159	3159	5446	5446
	40	660	660	1408	1408	-	-	-	-
	50	660	660	1408	1408	2880	2880	3980	3980
	70	616	616	1408	1408	2904	2904	4400	4400
	100	475	475	1232	1232	2240	2240	3840	3840

6.6.3 EMERGENCY OFF torque at the output shaft of TP+ planetary gearboxes

Description

As a maximum, the planetary gearbox can withstand the EMERGENCY OFF torque 1000 x during the gearbox service life without restricting the functionality.

Based on this data, check whether high torques, caused by very seldom operating faults, can damage the planetary gearbox.
More information is provided in Chapter "Check for excessively high torques in case of operating faults: EMERGENCY OFF torque (Page 78)".

Gearbox size		TP004			TP010				TP025			
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08	...□03	...□04 ...□05	...□06 ...□08	...210
Stages	Transmission ratio											
1	4	50	100	100	-	128	250	251	313	313	625	625
	5	50	100	100	-	160	250	251	313	313	625	625
	7	67	100	100	-	224	251	251	324	324	625	625
	10	95	100	100	-	251	251	251	424	424	625	625
2	16	100	100	-	152	251	251	-	512	625	625	-
	20	100	100	-	190	251	251	-	625	625	625	-
	25	100	100	-	238	251	251	-	625	625	625	-
	28	100	100	-	251	251	251	-	625	625	625	-
	35	100	100	-	251	251	251	-	625	625	625	-
	40	100	100	-	251	251	251	-	625	625	625	-
	50	100	100	-	251	251	251	-	625	625	625	-
	70	100	100	-	251	251	251	-	625	625	625	-
	100	100	100	-	251	251	251	-	625	625	625	-

Gearbox size		TP050			TP110			TP300		TP500	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio										
1	4	625	625	1250	-	3075	3075	-	-	-	-
	5	756	756	1250	-	3075	3075	-	9900	-	15000
	7	1059	1059	1250	-	3075	3075	-	9900	-	15000
	10	1190	1190	1250	-	3075	3075	-	8750	-	15000

Gearbox size		TP050			TP110			TP300		TP500	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio										
2	16	741	1250	1250	2420	2420	3075	-	-	-	-
	20	926	1250	1250	3025	3025	3075	9900	9900	15000	15000
	25	1158	1250	1250	3075	3075	3075	9900	9900	15000	15000
	28	1250	1250	1250	3075	3075	3075	-	-	-	-
	35	1250	1250	1250	3075	3075	3075	9900	9900	15000	15000
	40	1250	1250	1250	3075	3075	3075	-	-	-	-
	50	1250	1250	1250	3075	3075	3075	9900	9900	15000	15000
	70	1250	1250	1250	3075	3075	3075	9900	9900	15000	15000
	100	1250	1250	1250	3075	3075	3075	8750	8750	15000	15000

6.6.4 Efficiency of TP+ planetary gearboxes under full load

Description

The gearbox losses are already taken into account in the characteristic curves and in the following characteristics of the geared motor or its components: $M_{2.0}$, $M_{2,\,max}$, $M_{0,\,M}$, $M_{max,\,M}$.

A reduction of these characteristic curves and characteristics via efficiency is not necessary. In the partial load range, especially when the gearbox is cold, the efficiency of the gearbox is always lower than at operating speed.

Table 6-81 Efficiency η_G of TP+ coaxial planetary gearboxes

Gearbox size	TP010 TP025 TP050 TP110	TP300 TP500
z		
1	0.97	0.95
2	0.94	0.93

z = number of gearbox stages

i = transmission ratio

6.6.5 Torsional stiffness of TP+ planetary gearboxes

The table lists the torsional stiffness C_{T2} of the planetary gearboxes referred the output in Nm/arcmin.

Stages	Transmission ratio	TP004	TP010	TP025	TP050	TP110	TP300	TP500
1	4	12	32	80	190	610	-	-
	5	12	33	86	187	610	1000	1450
	7	11	30	76	159	550	900	1300
	10	8	23	62	123	445	700	1100
2	16	12	32	81	180	585	-	-
	20	12	32	81	185	580	850	1400
	25	12	32	83	180	570	950	1450
	28	12	31	80	180	560	-	-
	35	12	32	82	175	560	900	1400
	40	11	30	76	175	520	-	-
	50	12	30	80	175	525	800	1300
	70	11	28	71	145	480	800	1250
	100	8	22	60	115	395	650	1050

6.6.6 Torsional backlash of TP+ planetary gearboxes

Description

The table lists the gearbox characteristics φ_2 at the output shaft of the planetary gearboxes in arcmin.

Table 6-82 Standard torsional backlash φ_2 at the output shaft of TP+ coaxial planetary gearboxes in arcmin

Number of gearbox stages *z*	TP004	TP010 TP025 TP050 TP110 TP300 TP500
1	4	3
2	4	3

Table 6-83 Reduced torsional backlash φ_2 at the output shaft of TP+ coaxial planetary gearboxes in arcmin

Number of gearbox stages *z*	TP004	TP010 TP025 TP050 TP110	TP300 TP500
1	2	1	1
2	2	1	2

6.6.7 Moments of inertia of TP+ planetary gearboxes

Description

The following table shows the moment of inertia $J_{1,G}$ of the gearbox component in relation to the input in kg m².

Table 6-84 Moment of inertia $J_{1,G}$ of TP+ gearbox components in kg cm²

Gearbox size		TP004			TP010				TP025			
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08	...□03	...□04 ...□05	...□06 ...□08	...210
Stages	Transmission ratio											
1	4	0.172	0.245	0.569	-	0.779	0.945	2.315	2.589	2.589	3.282	10.347
	5	0.139	0.213	0.537	-	0.622	0.788	2.158	2.111	2.111	2.804	9.869
	7	0.11	0.184	0.508	-	0.478	0.645	2.015	1.69	1.69	2.382	9.449
	10	0.095	0.168	0.492	-	0.402	0.568	1.94	1.448	1.448	2.14	9.208
2	16	0.078	0.174	-	0.167	0.24	0.564	-	0.661	0.828	2.198	-
	20	0.07	0.165	-	0.136	0.21	0.533	-	0.548	0.714	2.084	-
	25	0.068	0.164	-	0.13	0.204	0.527	-	0.529	0.695	2.065	-
	28	0.062	0.157	-	0.108	0.181	0.506	-	0.44	0.607	1.977	-
	35	0.061	0.157	-	0.104	0.178	0.502	-	0.431	0.597	1.968	-
	40	0.057	0.153	-	0.093	0.167	0.491	-	0.383	0.549	1.922	-
	50	0.057	0.153	-	0.091	0.165	0.489	-	0.378	0.545	1.917	-
	70	0.056	0.152	-	0.09	0.164	0.488	-	0.374	0.54	1.913	-
	100	0.056	0.152	-	0.089	0.163	0.487	-	0.372	0.538	1.91	-

Table 6-85 Moment of inertia $J_{1,G}$ of TP+ gearbox components in kg cm²

Gearbox size		TP050			TP110			TP300		TP500	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio										
1	4	9.471	9.471	13.708	-	44.452	44.452	-	-	-	-
	5	7.852	7.852	12.089	-	34.631	34.631	-	82.6	-	181.9
	7	6.391	6.391	10.625	-	25.494	25.494	-	61.2	-	142
	10	5.544	5.544	9.778	-	20.59	20.59	-	49.5	-	119.8

Gearbox size		TP050			TP110			TP300		TP500	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08	...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio										
2	16	2.531	3.224	10.289	8.51	8.51	12.747	-	-	-	-
	20	2.075	2.768	9.833	8.214	8.214	12.451	27.5	27.5	35.9	35.9
	25	2.01	2.703	9.768	7.821	7.821	12.058	25.9	25.9	33.7	33.7
	28	1.672	2.365	9.432	6.57	6.57	10.803	-	-	-	-
	35	1.639	2.332	9.399	6.374	6.374	10.607	22.4	22.4	27.4	27.4
	40	1.439	2.132	9.199	5.634	5.634	9.868	-	-	-	-
	50	1.423	2.115	9.183	5.536	5.536	9.769	21.5	21.5	25.4	25.4
	70	1.408	2.101	9.168	5.444	5.444	9.678	21.3	21.3	25	25
	100	1.4	2.093	9.16	5.395	5.395	9.629	21.2	21.2	24.8	24.8

6.6.8 Mass of TP+ planetary gearboxes

Description

The following table shows the mass m_G of planetary gearboxes in kg.

Gearbox size	TP004				TP010					
Motor frame size 1FT2	...102 ...□03	...□04	...205	...105	...102	...□03	...□04	...205	...105	...□06
z										
1	1.2	1.4	1.8	1.9	-	3.2	3.2	3.2	3.3	4.9
2	1.3	1.7	-	-	3.3	3.3	3.5	3.9	4	-

Gearbox size	TP025							TP050				
Motor frame size 1FT2	...□03	...□04	...205	...105	...□06	...□08	...210	...□04 ...205	...105	...□06	...□08	...210
z												
1	5.7	5.6	5.6	5.5	6.2	6.6	8.2	11.7	11.6	11.5	-	13.4
2	5.8	5.9	5.8	6	7.7	-	-	13	12.9	13.6	15.1	16.7

Gearbox size	TP110				TP300			TP500		
Motor frame size 1FT2	...□04 ...□05	...□06	...□08	...210	...□06	...□08	...210	...□06	...□08	...210
z										
1	-	28.4	28.2	27.8	-	56.6	57.3	-	-	79.2
2	30.7	30.5	-	32.4	58.2	58.1	57.3	76.7	76.6	75.8

6.6.9 Maximum permissible axial and radial forces of TP+ gearboxes

Description

The following values apply to radial forces with a force application point located at the midpoint of the shaft and to centrally applied axial forces, as well as to an output speed of 100 r/min.

You can obtain the permissible radial forces for other force application points and speeds from the radial force diagrams below.

Note

For simultaneous axial and radial forces, for TP004, TP010, TP025 an axial force of $F_A \leq 1.1 \cdot F_R$ is still permissible and for TP050, TP110, TP300, TP500 an axial force of $F_A \leq 0.37 \cdot F_R$ is still permissible. Furthermore, the values apply only to purely axial or purely radial loads.

Table 6-86 Maximum permissible radial forces for TP+ gearboxes in N

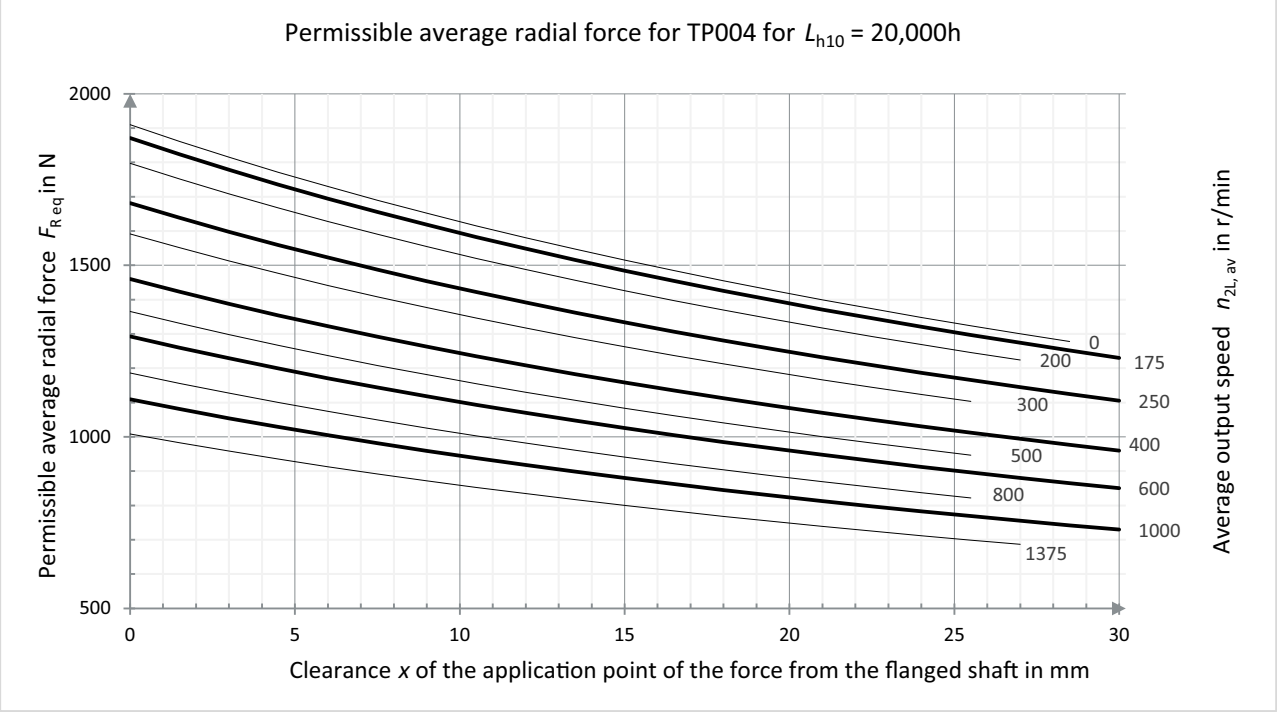
Size	Average axial force for $L_{10h=20,000\ h}$	Average axial force for $L_{10h=30,000\ h}$	Speed for average forces	Maximum permissible radial force	Maximum permissible axial force	maximum breakdown torque	Support reference
	$F_{A,eq,\ 20k}$	$F_{A,eq,\ 30k}$	$n_{2\ F,av}$	$F_{R,max}$	$F_{A,max}$	$M_{2K,\ max}$	z_2
TP004	1630	1400	5682	Calculation via the max. Breakdown torque	1630	110	58
TP010	2795	2500	7620		2795	270	83
TP025	4800	4300	2287		4800	440	95
TP050	6130	5400	338		6130	1335	81
TP110	10,050	8900	510		10,050	3280	107
TP300	33,000	29,200	39		33,000	5900	141
TP500	50,000	44,300	26		50,000	8800	157

Description

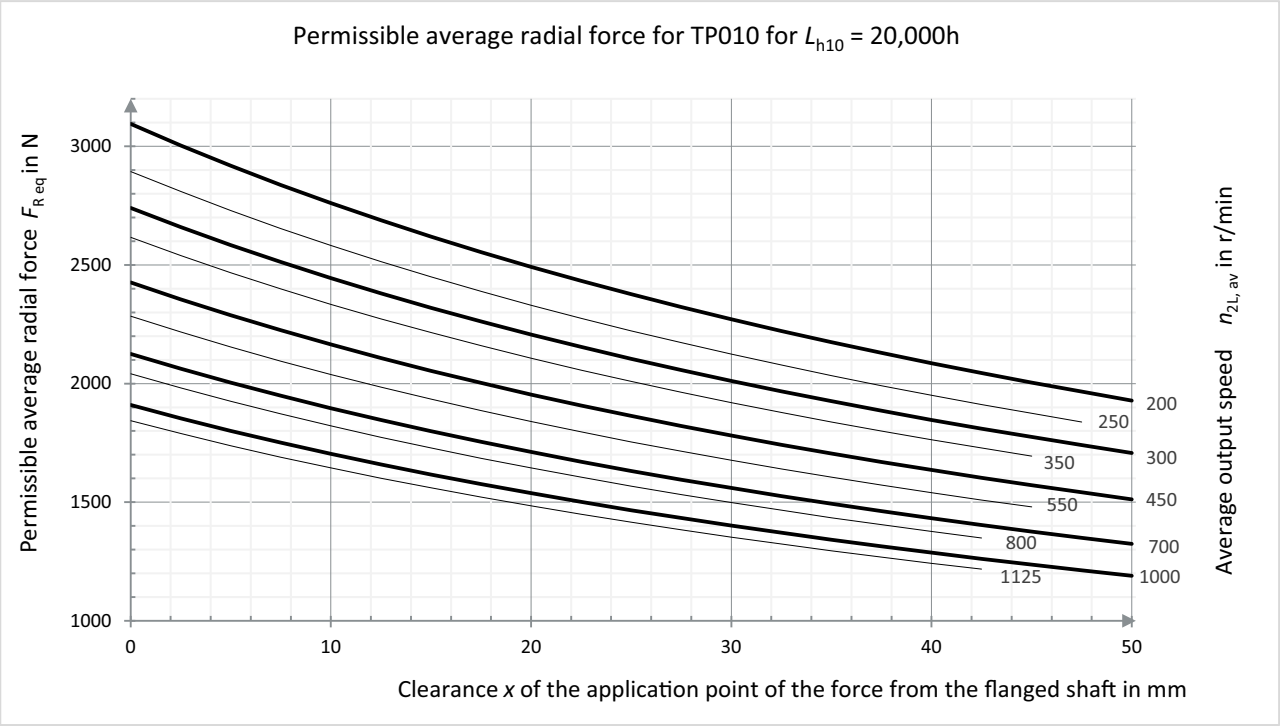
The following diagrams display the largest permissible average radial force capacity $F_{R,\,eq}$ of TP+ planetary gearboxes for output bearings with a service life of $L_{10\,h}$ = 20000 h. It is dependent on the force application point on the gearbox shaft and on the average output speed. If these values are exceeded in your application, calculate the service life of the output bearings.

More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

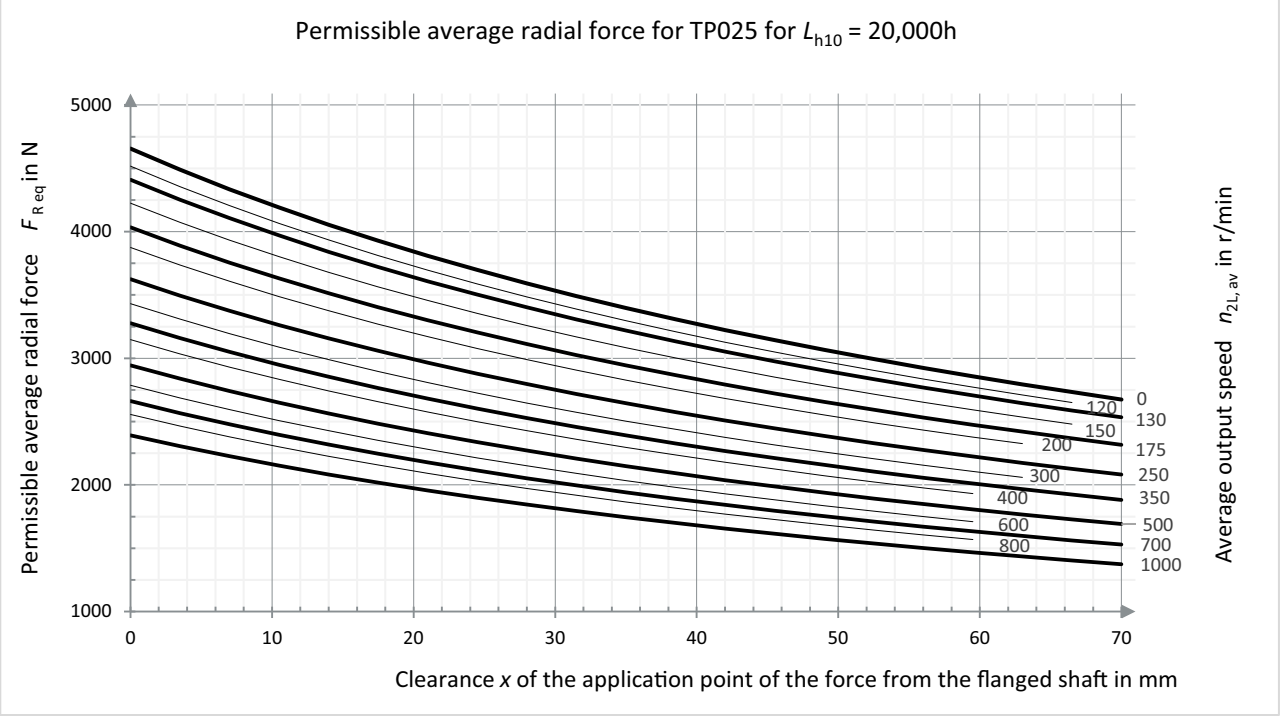
Radial force diagram for TP004



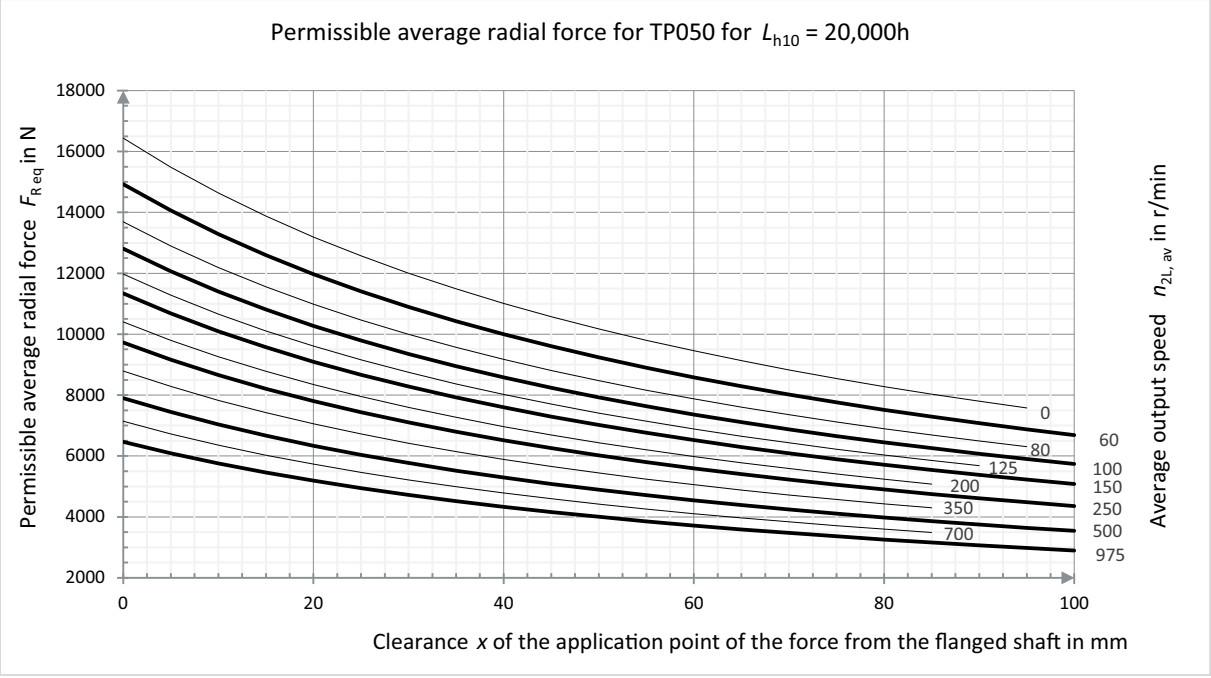
Radial force diagram for TP010



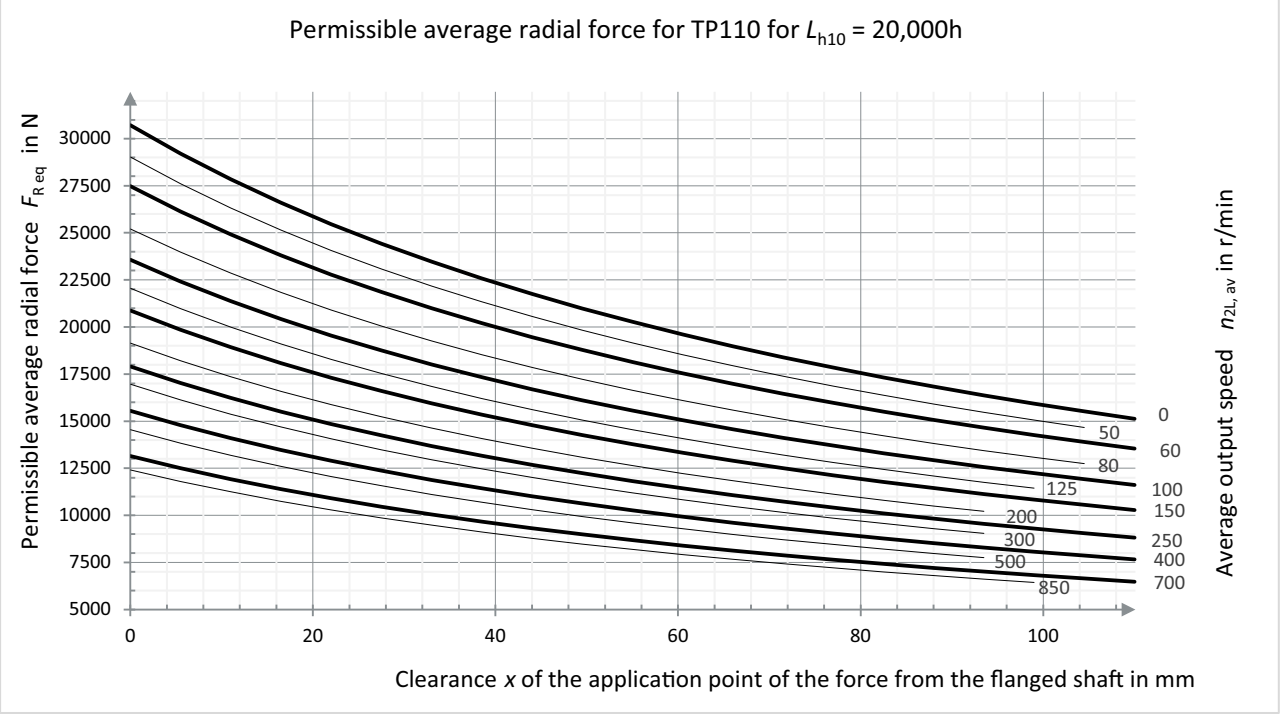
Radial force diagram for TP025



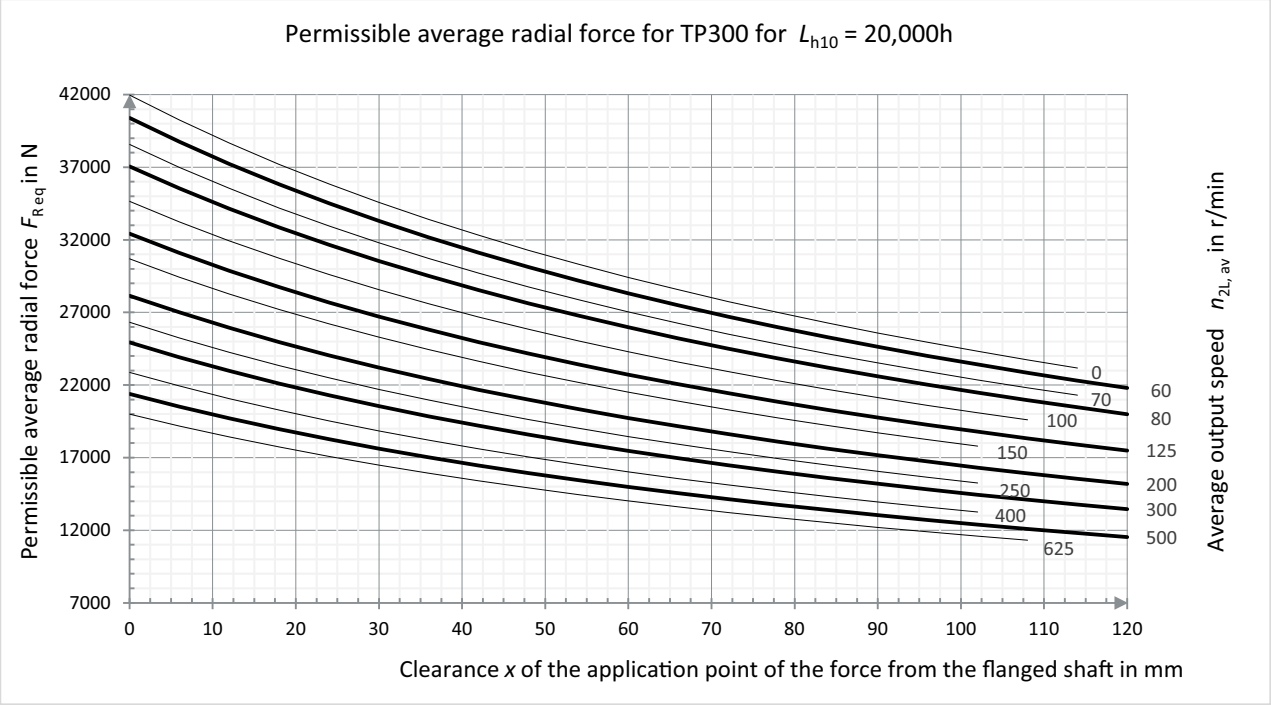
Radial force diagram for TP050



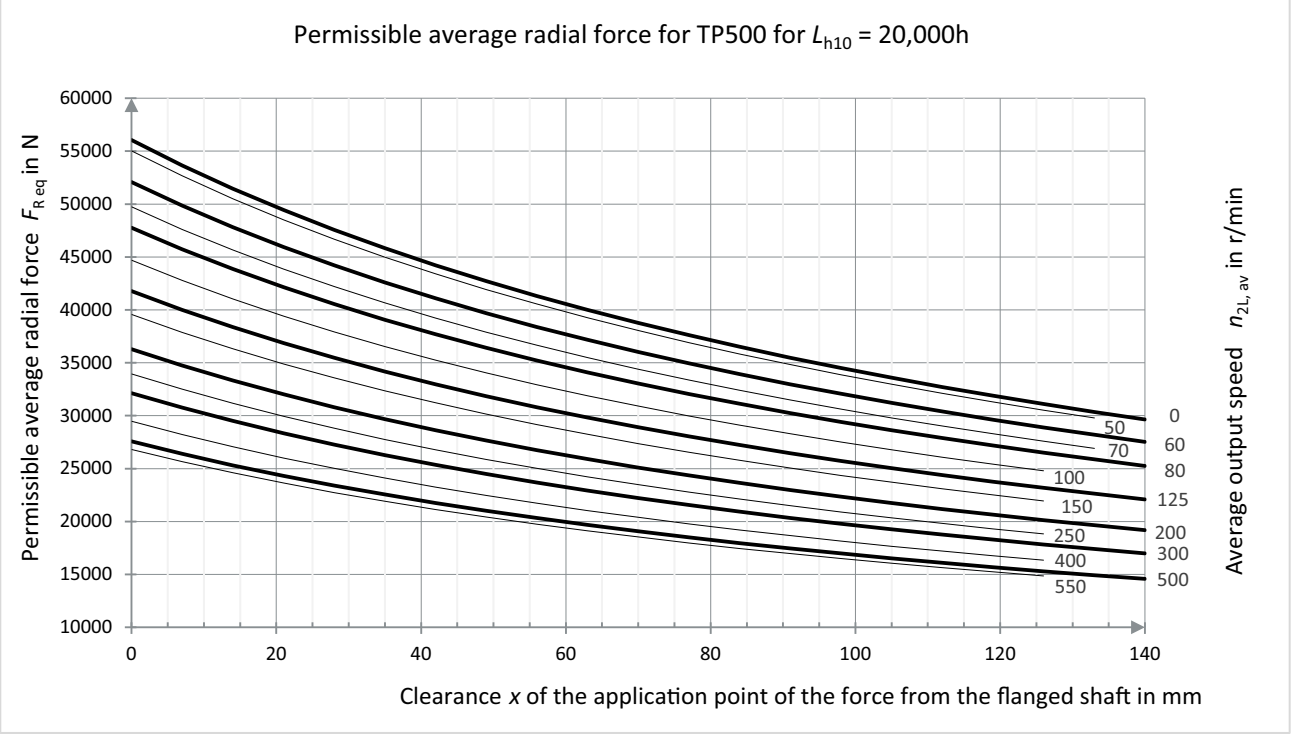
Radial force diagram for TP110



Radial force diagram for TP300



Radial force diagram for TP500



6.6.10 Reference speeds for TP+ planetary gearboxes

Description

The reference speed *at the output of the planetary gearbox* $n_{2B,\,G}$ is required to calculate the service life of internal gearbox bearings.

Calculate the service life of the internal gearbox bearings only if one of the following points applies:

- The application torque exceeds the rated torque of the planetary gearbox $M_{2n,\,G}$.
- The average application speed at the output exceeds the reference speed.

More detailed information is provided in Chapter "Service life of the planet wheel bearing for 1FK2 and 1FT2 with planetary gearbox (Page 72)".

Table 6-87 Reference speed in r/min of the output to the rated torque of TP+ planetary gearboxes with standard lubricant

Gearbox size		**TP004**			**TP010**				**TP025**		
Motor frame size 1FT2...		**...102 ...□03**	**...□04**	**...□05**	**...102**	**...□03 ...□04**	**...□05**	**...□06 ...□08**	**...□03 ...□04 ...□05**	**...□06 ...□08**	**...210**
Stages	**Transmission ratio**										
1	4	264	42	42	-	228	60	60	477	56	56
	5	93	32	32	-	85	47	47	175	34	34
	7	33	24	24	-	36	36	36	61	33	33
	10	90	90	90	-	72	72	72	37	37	37
2	16	68	68	-	92	59	59	-	56	56	-
	20	68	68	-	96	96	96	-	56	56	-
	25	32	32	-	62	62	62	-	34	34	-
	28	67	67	-	35	35	35	-	56	56	-
	35	32	32	-	53	53	53	-	34	34	-
	40	114	114	-	30	30	30	-	56	56	-
	50	32	32	-	44	44	44	-	34	34	-
	70	42	42	-	49	49	49	-	33	33	-
	100	90	90	-	60	60	60	-	50	50	-

Gearbox size		TP050			TP110		TP300		TP500	
Motor frame size 1FT2...		...□04 ...□05	...□06 ...□08	...210	...□04 ...□05	...□06 ...□08 ...210	...□06	...□08 ...210	...□06 ... □08	...210
Stages	Transmission ratio									
1	4	73	73	25	-	33	-	-	-	-
	5	39	39	19.2	-	26	-	16.8	-	11.2
	7	14.7	14.7	14.7	-	19.7	-	15.4	-	15.7
	10	27	27	27	-	25	-	77	-	48
2	16	53	26	26	44	44	-	-	-	-
	20	26	26	26	39	39	3.1	3.1	10.6	10.6
	25	20	20	20	35	35	4.6	4.6	8.1	8.1
	28	26	26	26	29	29	-	-	-	-
	35	20	20	20	35	35	3.5	3.5	6.3	6.3
	40	26	26	26	24	24	-	-	-	-
	50	20	20	20	35	35	3.9	3.9	14.9	14.9
	70	19.7	19.7	19.7	22	22	7.9	7.9	21	21
	100	22	22	22	33	33	42	42	32	32

Table 6-88 Reference speed in r/min of the output to the rated torque of TP+ planetary gearboxes with food-safe lubricant

Gearbox size		TP004			TP010				TP025		
Motor frame size 1FT2...		...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08	...□03 ...□04 ...□05	...□06 ...□08	...210
Stages	Transmission ratio										
1	4	264	87	87	-	228	124	124	477	117	117
	5	93	67	67	-	98	98	98	175	71	71
	7	50	50	50	-	76	76	76	69	69	69
	10	181	181	181	-	151	151	151	79	79	79
2	16	139	139	-	122	122	122	-	117	117	-
	20	139	139	-	200	200	200	-	117	117	-
	25	67	67	-	133	133	133	-	71	71	-
	28	138	138	-	72	72	72	-	117	117	-
	35	67	67	-	113	113	113	-	71	71	-
	40	232	232	-	63	63	63	-	117	117	-
	50	67	67	-	94	94	94	-	71	71	-
	70	87	87	-	103	103	103	-	69	69	-
	100	181	181	-	126	126	-	-	104	104	-

Gearbox size		TP050		TP110		TP300		TP500	
Motor frame size 1FT2...		...□04 ...□05 ...□06 ...□08	...210	...□04 ...□05	...□06 ...□08 ...210	...□06	...□08 ...210	...□06 ...□08	...210
Stages	Transmission ratio								
1	4	73	52	-	70	-	-	-	-
	5	40	40	-	54	-	35	-	24
	7	31	31	-	42	-	32	-	33
	10	56	56	-	53	-	161	-	101
2	16	55	55	93	93	-	-	-	-
	20	55	55	82	82	6.5	6.5	22	22
	25	43	43	72	72	9.7	9.7	17	17
	28	55	55	61	61	-	-	-	-
	35	43	43	73	73	7.4	7.4	13.3	13.3
	40	55	55	50	50	-	-	-	-
	50	43	43	73	73	8.3	8.3	31	31
	70	41	41	47	47	16.7	16.7	45	45
	100	46	46	70	70	89	89	68	68

6.6.11 Maximum bending moment for TP+ planetary gearboxes

Description

The tables list the maximum permissible bending moment $M_{B,G}$ at the flange between the planetary gearbox and the motor in Nm.

Table 6-89 Maximum permissible bending moment $M_{B,G}$ / Nm at the flange between the coaxial planetary gearbox and the motor

Gearbox size	TP004			TP010				TP025		
Motor frame size 1FT2...	...102 ...□03	...□04	...□05	...102	...□03 ...□04	...□05	...□06 ...□08	...□03 ...□04 ...□05	...□06 ...□08	...210
Stages										
1	7	7	101		44	44	300	81	81	550
2	24	51		43	43	83		100	268	

Gearbox size	**TP050**		**TP110**		**TP300**		**TP500**	
Motor frame size 1FT2...	**...☐04** **...☐05**	**...210**	**...☐04** **...☐05**	**...☐06** **...☐08**	**...☐06**	**...☐08** **...210**	**...☐06** **...☐08**	**...210**
Stages	**...☐06** **...☐08**			**...210**				
1	457	457	-	325	-	1000	-	1400
2	255	570	595	595	700	700	950	950

Assembly drawings/dimension sheets

7

Recency of dimensional drawings

Note

Changing motor dimensions

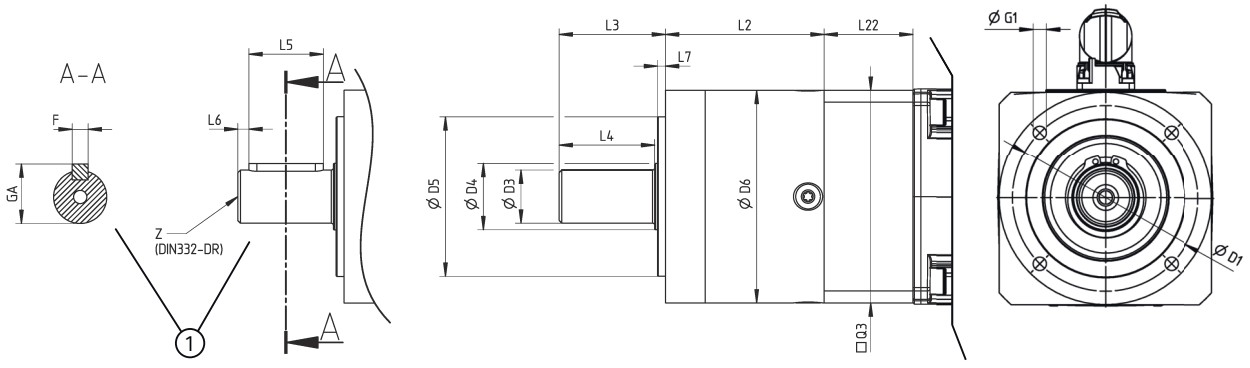
Siemens reserves the right to change the dimensions of the motors as part of mechanical design improvements without prior notice. This means that dimensional drawings can become out of date.

You can request free of charge current dimension drawings from Technical Support or your local sales partner.

You can find the detailed dimensions, including all tolerances, in the SIEMENS Product Configurator (Page 195).

7.1 NRB planetary gearboxes

The motor has the following dimensions in the different frame sizes:



① Shaft extension with feather key

Figure 7-1 NRB planetary gearboxes

Dimensions dependent on the gearbox size

Designation of dimensions		NRB040	NRB060	NRB080	NRB120	NRB160
Gearbox diameter	Ø D6	40	60	80	115	160
Shaft diameter	Ø D3	10 (h7)	14 (h7)	20 (h7)	25 (h7)	40 (h7)
Gearbox length - single-stage	L2 (z = 1)	39	47	60	74	104

Designation of dimensions		NRB040	NRB060	NRB080	NRB120	NRB160
Gearbox length - two-stage	L2 (z = 2)	52	60	78	102	154
Gearbox length - three-stage	L2 (z = 3)	65	72	95	129	-
Shaft length up to flange	L3	26	35	40	55	87
Shaft length up to output	L4	23	30	36	50	80
Diameter of shaft shoulder	Ø D4	12	17	25	35	55
Diameter of centering edge	Ø D5	26 (h7)	40 (h7)	60 (h7)	80 (h7)	130 (h7)
Depth of centering edge	L7	2	3	3	4	5
Hole circle diameter	Ø D1	34	52	70	100	145
Mounting thread / depth	Ø G1 x T	M4 x 6	M5 x 8	M6 x 10	M10 x 16	M12 x 20
Deviating dimensions for shaft extension with feather key						
Feather key width (fixed seat according to DIN 6885-1)	F	3 (h9)	5 (h9)	6 (h9)	8 (h9)	12 (h9)
Shaft height including feather key	GA	11.2	16	22.5	28	43
Length of feather key	L5	18	25	28	40	65
Distance from shaft end	L6	2.5	2.5	4	5	8
Centering bore DIN 332-DR	Z	M3 x 9	M5 x 12.5	M6 x 16	M10 x 22	M16 x 36

Dimensions dependent on the motor attached

Adapter flange dimensions	NRB040		NRB060		NRB080		NRB120		NRB160	
Edge dimension	**Q3**		**Q3**		**Q3**		**Q3**		**Q3**	
Length		**L22**		**L22**		**L22**		**L22**		**L22**
1F□2102	40	28.5	60	24	-	-	-	-	-	-
1F□2□03	60	27.5	60	24	80	33.5	115	47.5	-	-
1F□2□04	-	-	80	31	80	33.5	115	47.5	-	-
1F□2205	-	-	90	41.5	90	43.5	115	47.5	140	64.5
1F□2105	-	-	100	41.5	100	43.5	125	47.5	140	64.5
1F□2□06	-	-	-	-	115	53.5	125	57.5	140	64.5
1F□2□08	-	-	-	-	-	-	140	73	140	72.5

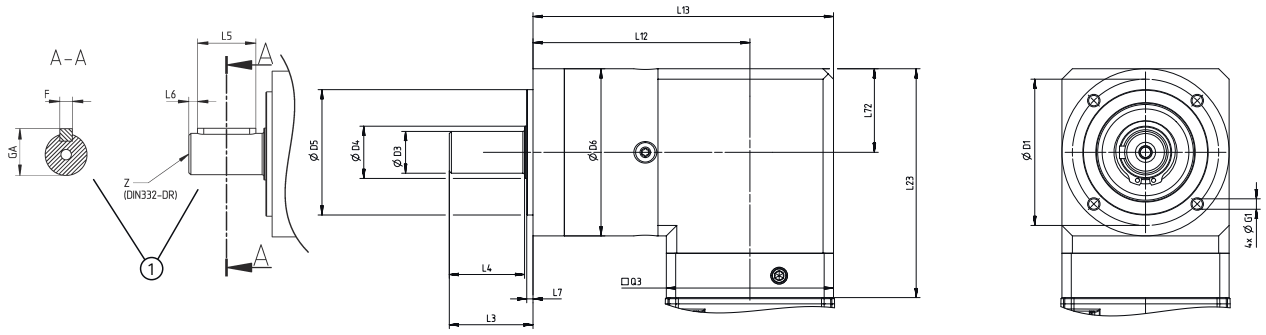
Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.2 NRBW angled planetary gearboxes

The motor has the following dimensions in the different frame sizes:



① Shaft extension with feather key

Figure 7-2 NRBW angled planetary gearboxes

Dimensions dependent on the gearbox size

Designation of dimensions		NRB0W40	NRBW060	NRBW080	NRBW120
Gearbox diameter	Ø D6	40	60	80	115
Shaft diameter	Ø D3	10 (h7)	14 (h7)	20 (h7)	25 (h7)
Gearbox axle length - single stage	L12 (z = 1)	64	82	104	137
Gearbox axle length - two stage	L12 (z = 2)	77	94.5	121.5	164.5
Gearbox axle length - three stage	L12 (z = 3)	89.5	107	139	192
Gearbox length - single-stage	L13 (z = 1)	84	112	144	194.5
Gearbox length - two-stage	L13 (z = 2)	97	124.5	161.5	222
Gearbox length - three-stage	L13 (z = 3)	109.5	137	179	249.5
Shaft length up to flange	L3	26	35	40	55
Shaft length up to output	L4	23	30	36	50
Diameter of shaft shoulder	Ø D4	12	17	25	35
Diameter of centering edge	Ø D5	26 (h7)	40 (h7)	60 (h7)	80 (h7)
Depth of centering edge	L7	2	3	3	4
Hole circle diameter	Ø D1	34	52	70	100
Mounting thread / depth	Ø G1 x T	M4 x 6	M5 x 8	M6 x 10	M10 x 16
	L72	20	30	40	57.5
Deviating dimensions for shaft extension with feather key					
Feather key width (fixed seat according to DIN 6885-1)	F	3 (h9)	5 (h9)	6 (h9)	8 (h9)
Shaft height including feather key	GA	11.2	16	22.5	28
Length of feather key	L5	18	25	28	40
Distance from shaft end	L6	2.5	2.5	4	5
Centering bore DIN 332-DR	Z	M3 x 9	M5 x 12.5	M6 x 16	M10 x 22

Dimensions dependent on the motor attached

Adapter flange dimensions	NRB0W40		NRBW060		NRBW080		NRBW120	
Edge dimension	Q3		Q3		Q3		Q3	
Length		L23		L23		L23		L23
1F□2102	40	67	60	85.6	-	-	-	-
1F□2□03	-	-	60	85.6	80	109.2	115	145.3
1F□2□04	-	-	80	92.6	80	109.2	115	145.3
1F□2205	-	-	-	-	90	119.2	115	145.3
1F□2105	-	-	-	-	105	119.2	125	145.3
1F□2□06	-	-	-	-	-	-	125	155.3

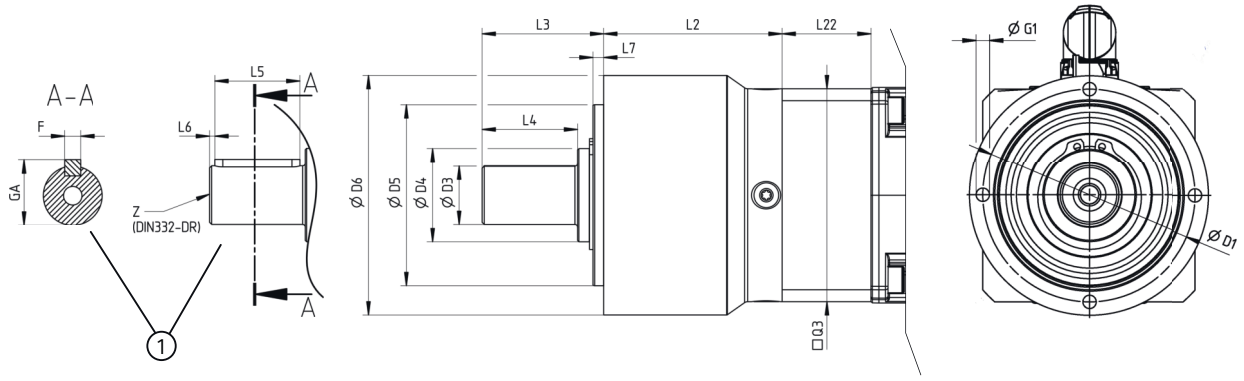
Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.3 NRK planetary gearboxes

The motor has the following dimensions in the different frame sizes:



① Shaft extension with feather key

Figure 7-3 NRK planetary gearboxes

Dimensions dependent on the gearbox size

Designation of dimensions		NRK050	NRK070	NRK090	NRK120	NRK155
Gearbox diameter	Ø D6	50	70	90	120	155
Shaft diameter	Ø D3	12 (k7)	16 (k7)	22 (k7)	32 (k7)	40 (k7)
Gearbox length - single-stage	L2 (z = 1)	46	51	67.5	76.5	100
Gearbox length - two-stage	L2 (z = 2)	58.5	64	85.5	104	144.5

Designation of dimensions		NRK050	NRK070	NRK090	NRK120	NRK155
Shaft length up to flange	L3	24.5	36	46	68	97
Shaft length up to output	L4	18	28	36	58	82
Diameter of shaft shoulder	Ø D4	15	30	35	50	55
Diameter of centering edge	Ø D5	35 (h7)	52 (h7)	68 (h7)	90 (h7)	120 (h7)
Depth of centering edge	L7	3	3	4	5	8
Hole circle diameter	Ø D1	44	62	80	108	140
Mounting thread / depth	Ø G1 x T	M4 x 8	M5 x 8	M6 x 9	M8 x 20	M10 x 20
Deviating dimensions for shaft extension with feather key						
Feather key width (fixed seat according to DIN 6885-1)	F	4 (h9)	5 (h9)	6 (h9)	10 (h9)	12 (h9)
Shaft height incl. feather key	GA	13.5	18	24.5	35	43
Length of feather key	L5	14	25	32	50	70
Distance from shaft end	L6	2	2	2	4	6
Centering bore DIN 332-DR	Z	M4 x 10	M5 x 12.5	M8 x 19	M12 x 28	M16 x 36

Dimensions dependent on the motor attached

Adapter flange dimensions	NRB040		NRB060		NRB080		NRB120		NRB160	
Edge dimension	**Q3**		**Q3**		**Q3**		**Q3**		**Q3**	
Length		**L22**		**L22**		**L22**		**L22**		**L22**
1F□2102	40	28.5	60	24	-	-	-	-	-	-
1F□2□03	60	27.5	60	24	80	33.5	115	47.5	-	-
1F□2□04	-	-	80	31	80	33.5	115	47.5	-	-
1F□2205	-	-	90	41.5	90	43.5	115	47.5	142	78.5
1F□2105	-	-	100	41.5	100	43.5	125	47.5	142	78.5
1F□2□06	-	-	-	-	115	53.5	125	57.5	142	78.5
1F□2□08	-	-	-	-	-	-	140	73	142	88.5
1F□2210	-	-	-	-	-	-			190	108.5

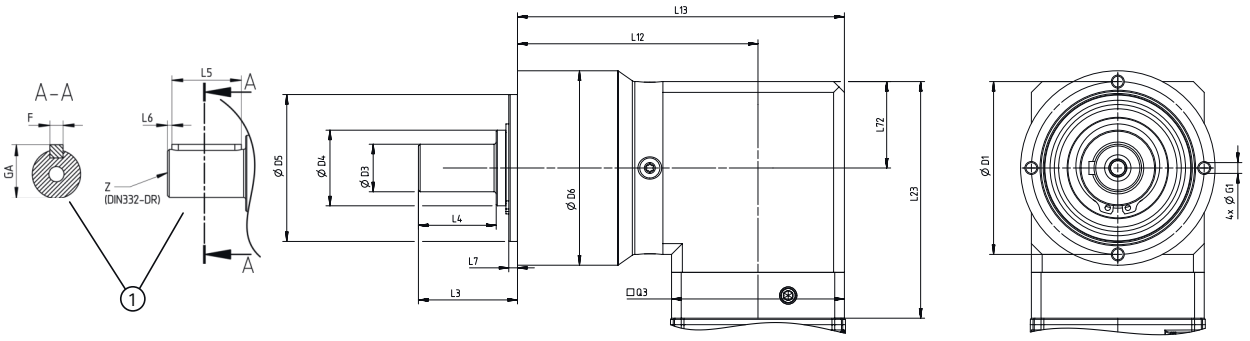
Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.4 NRKW angled planetary gearboxes

The motor has the following dimensions in the different frame sizes:



① Shaft extension with feather key

Figure 7-4 NRKW angled planetary gearboxes

Dimensions dependent on the gearbox size

Designation of dimensions		NRKW050	NRKW070	NRKW090	NRKW120
Gearbox diameter	Ø D6	50	70	90	120
Shaft diameter	Ø D3	12 (k7)	16 (k7)	22 (k7)	32 (k7)
Gearbox axle length - single stage	L12 (z = 1)	71	86.5	111.5	139.5
Gearbox axle length - two stage	L12 (z = 2)	83.5	99.5	129.5	167
Gearbox length - single-stage	L13 (z = 1)	91	116.5	151.5	197
Gearbox length - two-stage	L13 (z = 2)	103.5	129.5	169.5	224.5
Shaft length up to flange	L3	24.5	36	46	68
Shaft length up to output	L4	18	28	36	58
Diameter of shaft shoulder	Ø D4	15	30	35	50
Diameter of centering edge	Ø D5	35 (h7)	52 (h7)	68 (h7)	90 (h7)
Depth of centering edge	L7	3	3	4	5
Hole circle diameter	Ø D1	44	62	80	108
Mounting thread / depth	Ø G1 x T	M4 x 8	M5 x 8	M6 x 9	M8 x 20
	L72	20	30	40	57.5
Deviating dimensions for shaft extension with feather key					
Feather key width (fixed seat according to DIN 6885-1)	F	4 (h9)	5 (h9)	6 (h9)	10 (h9)
Shaft height incl. feather key	GA	13.5	18	24.5	35
Length of feather key	L5	14	25	32	50
Distance from shaft end	L6	2	2	2	4
Centering bore DIN 332-DR	Z	M4 x 10	M5 x 12.5	M8 x 19	M12 x 28

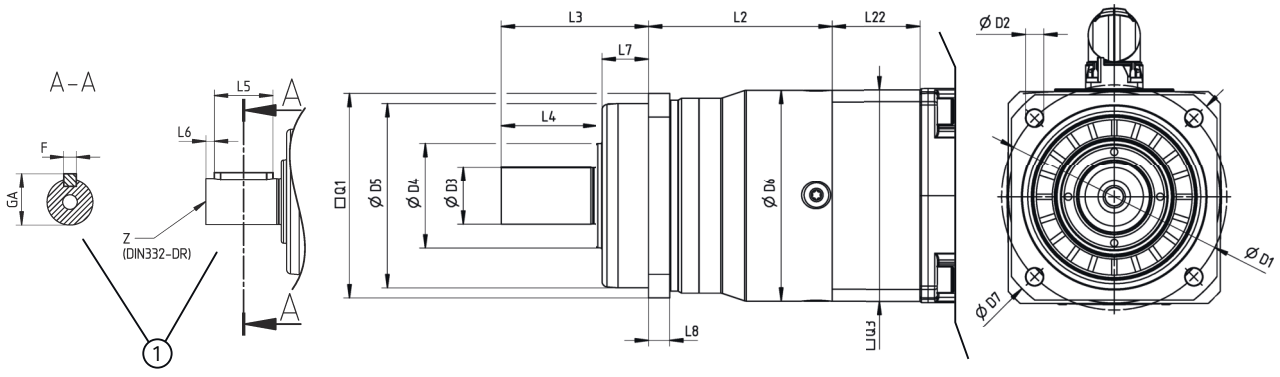
Dimensions dependent on the motor attached

Adapter flange dimensions	NRKW040		NRKW060		NRKW080		NRKW120	
Edge dimension	Q3		Q3		Q3		Q3	
Length		L23		L23		L23		L23
1F□2102	40	67	60	85.6	-	-	-	-
1F□2□03	-	-	60	85.6	80	109.2	115	145.3
1F□2□04	-	-	80	92.6	80	109.2	115	145.3
1F□2205	-	-	-	-	90	119.2	115	145.3
1F□2105	-	-	-	-	105	119.2	125	145.3
1F□2□06	-	-	-	-	-	-	125	155.3

Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "SIEMENS Product Configurator (Page 195)".

7.5 NLC planetary gearboxes

The motor has the following dimensions in the different frame sizes:



① Shaft extension with feather key

Figure 7-5 NLC planetary gearboxes

Dimensions dependent on the gearbox size

Designation of dimensions		NLC060	NLC080	NLC120
Flange edge dimension	□ Q1	70	80	110
Gearbox diameter	Ø D6	60	80	115
Flange diagonals	D7	92	100	140
Shaft diameter	Ø D3	16 (k6)	22 (k6)	32 (k6)
Gearbox length - single-stage	L2 (z = 1)	55	69.5	64
Gearbox length - two-stage	L2 (z = 2)	67.5	87.5	91.5
Shaft length up to flange	L3	48	56	88
Shaft length up to output	L4	28	36	58

Designation of dimensions		NLC060	NLC080	NLC120
Diameter of shaft shoulder	Ø D4	35	40	45
Diameter of centering edge	Ø D5	60 (g7)	70 (g7)	90 (g7)
Depth of centering edge	L7	19	17.5	28
Flange thickness	L8	7	8	10
Hole circle diameter	Ø D1	68 - 75	85	120
Screw hole	Ø D2	5.5	6.5	9
Deviating dimensions for shaft extension with feather key				
Feather key width (fixed seat according to DIN 6885-1)	F	5 (h9)	6 (h9)	10 (h9)
Shaft height incl. feather key	GA	18	24.5	35
Length of feather key	L5	25	28	50
Distance from shaft end	L6	2	4	4
Centering bore DIN 332-DR	Z	M5 x 12.5	M8 x 19	M12 x 28

Dimensions dependent on the motor attached

Adapter flange dimensions	NLC060		NLC080		NLC120	
Edge dimension	**Q3**		**Q3**		**Q3**	
Length		**L22**		**L22**		**L22**
1F□2102	60	24	-	-	-	-
1F□2□03	60	24	80	33.5	115	47.5
1F□2□04	80	31	80	33.5	115	47.5
1F□2205	90	41.5	90	43.5	115	47.5
1F□2105	100	41.5	100	43.5	125	47.5
1F□2□06	-	-	115	53.5	125	57.5
1F□2□08	-	-	-	-	140	73

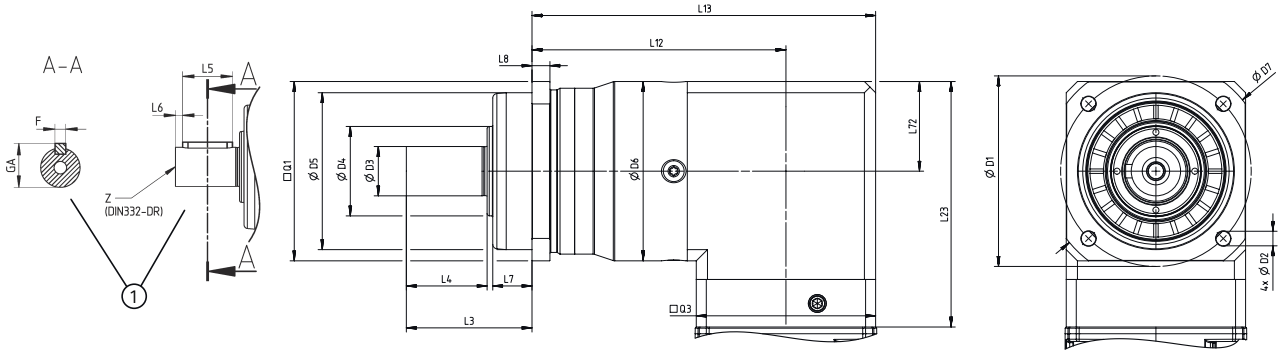
Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.6 NLCW angled planetary gearboxes

The motor has the following dimensions in the different frame sizes:



① Shaft extension with feather key

Figure 7-6 NLCW angled planetary gearboxes

Dimensions dependent on the gearbox size

Designation of dimensions		NLC0W60	NLCW080	NLCW120
Flange edge dimension	□ Q1	70	80	110
Gearbox diameter	Ø D6	60	80	115
Flange diagonals	D7	92	100	140
Shaft diameter	Ø D3	16 (k6)	22 (k6)	32 (k6)
Gearbox axle length - single stage	L12 (z = 1)	90	113.5	127
Gearbox axle length - two stage	L12 (z = 2)	102.5	131.5	154.5
Gearbox length - single-stage	L13 (z = 1)	120	153.5	184.5
Gearbox length - two-stage	L13 (z = 2)	132.5	171.5	212
Shaft length up to flange	L3	48	56	88
Shaft length up to output	L4	28	36	58
Diameter of shaft shoulder	Ø D4	35	40	45
Diameter of centering edge	Ø D5	60 (g7)	70 (g7)	90 (g7)
Depth of centering edge	L7	19	17.5	28
Flange thickness	L8	7	8	10
Hole circle diameter	Ø D1	68 ... 75	85	120
Screw hole	Ø D2	5.5	6.5	9
	L72	30	40	57.5
Deviating dimensions for shaft extension with feather key				
Feather key width (fixed seat according to DIN 6885-1)	F	5 (h9)	6 (h9)	10 (h9)
Shaft height incl. feather key	GA	18	24.5	35
Length of feather key	L5	25	28	50
Distance from shaft end	L6	2	4	4
Centering bore DIN 332-DR	Z	M5 x 12.5	M8 x 19	M12 x 28

Dimensions dependent on the motor attached

Adapter flange dimensions	**NLCW060**		**NLCW080**		**NLCW120**	
Edge dimension	**Q3**		**Q3**		**Q3**	
Length		**L23**		**L23**		**L23**
1F□2102	60	85.6	-	-	-	-
1F□2□03	60	85.6	80	109.2	115	145.3
1F□2□04	80	92.6	80	109.2	115	145.3
1F□2205	-	-	90	119.2	115	145.3
1F□2105	-	-	105	119.2	125	145.3
1F□2□06	-	-	-	-	125	155.3

Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.7 SP+ planetary gearbox

The motor has the following dimensions in the different frame sizes:

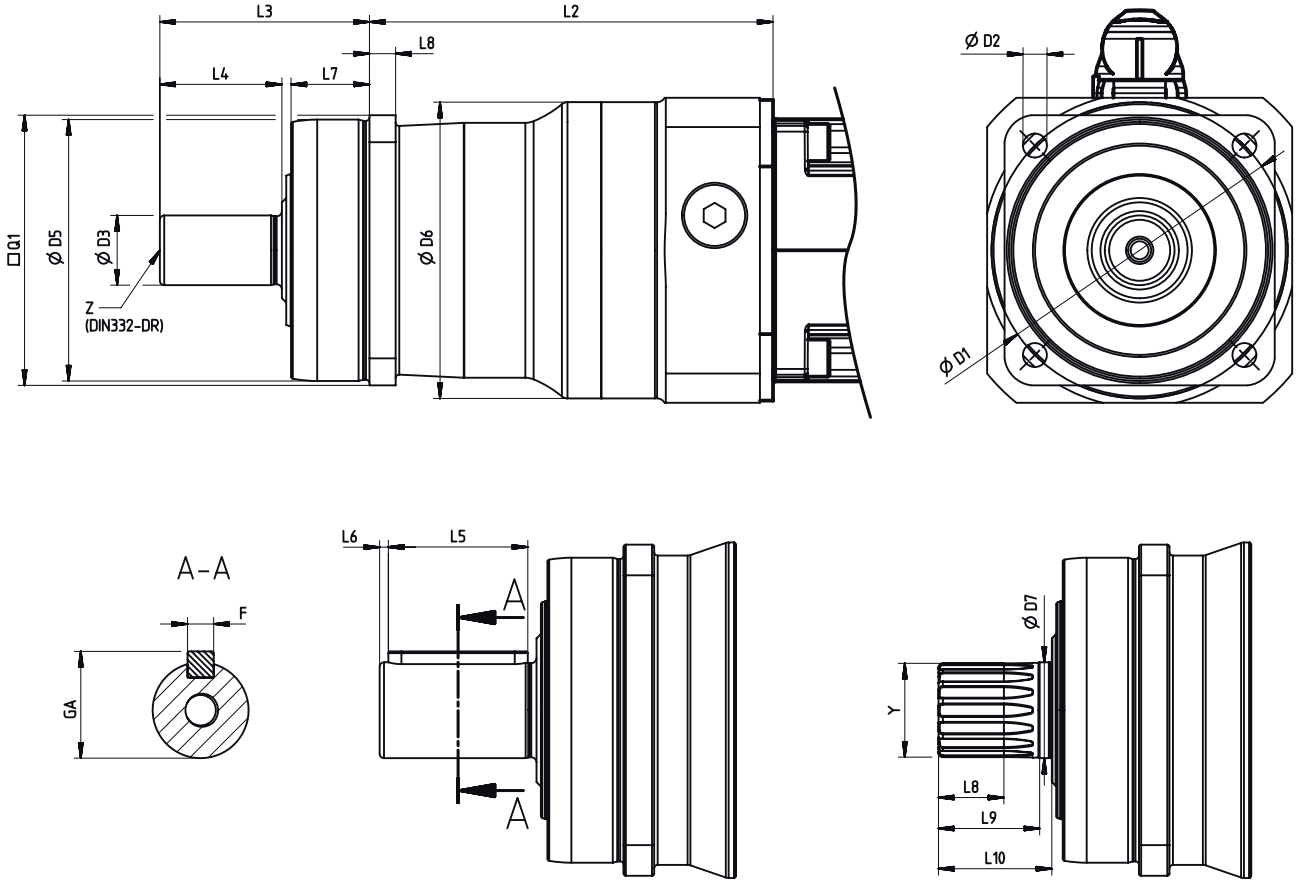


Figure 7-7 SP+ planetary gearbox

Dimensions dependent on the gearbox size

Designation of dimensions		SP060	SP075	SP100	SP140
Flange edge dimension	□ Q1	62	76	101	141
Diameter of centering edge	Ø D5	60 (g7)	70 (g7)	90 (g7)	130 (g7)
Depth of centering edge	L7	18	17.5	27	27
Flange thickness	L8	6	7	10	12
Hole circle diameter	Ø D1	68	85	120	165
Screw hole	Ø D2	5.5	6.6	9	11
Dimensions for the plain shaft end					
Shaft diameter	Ø D3	16 (k6)	22 (k6)	32 (k6)	40 (k6)

Designation of dimensions		**SP060**	**SP075**	**SP100**	**SP140**
Shaft length up to flange	L3	48	56	88	112
Shaft length up to output	L4	28	36	58	82
Centering bore DIN 332-DR	Z	M5x12.5	M8x19	M12x28	M16x36
Dimensions for the shaft end with feather key					
Shaft diameter	Ø D3	16 (k6)	22 (k6)	32 (k6)	40 (k6)
Shaft length up to flange	L3	46	46	56	70
Shaft length up to output	L4	28	36	58	82
Width of feather key	F	5 (h9)	6 (h9)	10 (h9)	12 (h9)
Shaft height including feather key	GA	18	24.5	35	43
Length of feather key	L5	25	32	50	70
Distance from shaft end	L6	2	2	4	5
Centering bore DIN 332-DR	Z	M5x12.5	M8x19	M12x28	M16x36
Dimensions for the shaft end with splined shaft					
Usable spline length	L8	15	15	15	20
Start of the seat	L9	21	22.5	23	33.5
Shaft length up to output	L10	26	26	26	40
Involute DIN 5480	Y	W16x0.8x18x6m	W22x1.25x16x6m	W32x1.25x24x6m	W40x2x18x6m
Diameter of the seat	Ø D7	16 (k6)	22 (k6)	32 (k6)	40 (k6)

Designation of dimensions		**SP180**	**SP210**	**SP240**
Flange edge dimension	□ Q1	182	215	245
Diameter of centering edge	Ø D5	160 (g7)	180 (g7)	200 (g7)
Depth of centering edge	L7	27	34.7	37
Flange thickness	L8	15	17	20
Hole circle diameter	Ø D1	215	250	290
Screw hole	Ø D2	13.5	17	17
Dimensions for the plain shaft end				
Shaft diameter	Ø D3	55 (k6)	75 (k6)	85(k6)

Designation of dimensions		SP180	SP210	SP240
Shaft length up to flange	L3	112	143	170
Shaft length up to output	L4	82	105	130
Centering bore DIN 332-DR	Z	M20x42	M20x42	M20x42
Dimensions for the shaft end with feather key				
Shaft diameter	Ø D3	55 (k6)	75 (k6)	85(k6)
Shaft length up to flange	L3	71.5	90	100
Shaft length up to output	L4	82	105	130
Width of feather key	F	16 (h9)	20 (h9)	22 (h9)
Shaft height including feather key	GA	59	79.5	90
Length of feather key	L5	70	90	125
Distance from shaft end	L6	6	7	3
Centering bore DIN 332-DR	Z	M20x42	M20x42	M20x42
Dimensions for the shaft end with splined shaft				
Usable spline length	L8	21.5	28	36
Start of the seat	L9	33.5	45	53
Shaft length up to output	L10	41.5	52	60
Involute DIN 5480	Y	W55x2x26x6m	W70x2x34x6m	W80x2x38x6m
Diameter of the seat	Ø D7	55 (k6)	75 (k6)	85 (k6)

Dimensions dependent on the motor attached

<table>
<tr><th colspan="15">Gearbox diameter D6</th></tr>
<tr><th>Adapter flange dimensions</th><th colspan="2">SP060</th><th colspan="2">SP075</th><th colspan="2">SP100</th><th colspan="2">SP140</th><th colspan="2">SP180</th><th colspan="2">SP210</th><th colspan="2">SP240</th></tr>
<tr><th>z</th><th>1</th><th>2</th><th>1</th><th>2</th><th>1</th><th>2</th><th>1</th><th>2</th><th>1</th><th>2</th><th>1</th><th>2</th><th>1</th><th>2</th></tr>
<tr><td>1FT2102</td><td colspan="2" rowspan="2">68</td><td></td><td rowspan="2">94.5</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1FT2□03</td><td rowspan="3">91</td><td rowspan="3">115</td><td rowspan="3">118</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1FT2□04</td><td rowspan="3">91</td><td rowspan="3">-</td><td rowspan="3">151.5</td><td rowspan="4">211.5</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1FT2205</td><td rowspan="2">-</td><td rowspan="2">-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1FT2105</td><td>91</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1FT2□06</td><td>-</td><td>-</td><td>115</td><td>-</td><td>115</td><td rowspan="3">146</td><td rowspan="2">207</td><td>-</td><td rowspan="3">215</td><td>-</td><td rowspan="3">245</td></tr>
<tr><td>1FT2□08</td><td>-</td><td>-</td><td>-</td><td>-</td><td>146</td><td></td><td rowspan="2">146</td><td>-</td></tr>
<tr><td>1FT2□10</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td></td><td>215</td><td>245</td></tr>
</table>

Gearbox length L2														
Adapter flange dimensions	**SP060**		**SP075**		**SP100**		**SP140**		**SP180**		**SP210**		**SP240**	
z	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
1FT2102	89.6		-	119	-	-	-	-	-	-	-	-	-	-
1FT2□03	91.6	108	107.8	125.4		142.3	-	-	-	-	-	-	-	-
1FT2□04	94	116	109.8	123.4	122	148		-	-		-	-	-	-
1FT2205		-						186.3	-		-	-	-	-
1FT2105	106	-	111.5	136	124	146	162.3	188.3	-	234	-	-	-	-
1FT2□06	-	-	129.5	-	129	164		193.3	-		-		-	
1FT2□08	-	-	-	-	156	-			198		242	272	-	297
1FT2□10	-	-	-	-		-	171.3	220	206	243	245	275	276	300

Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.8 TP+ planetary gearbox

The motor has the following dimensions in the different frame sizes:

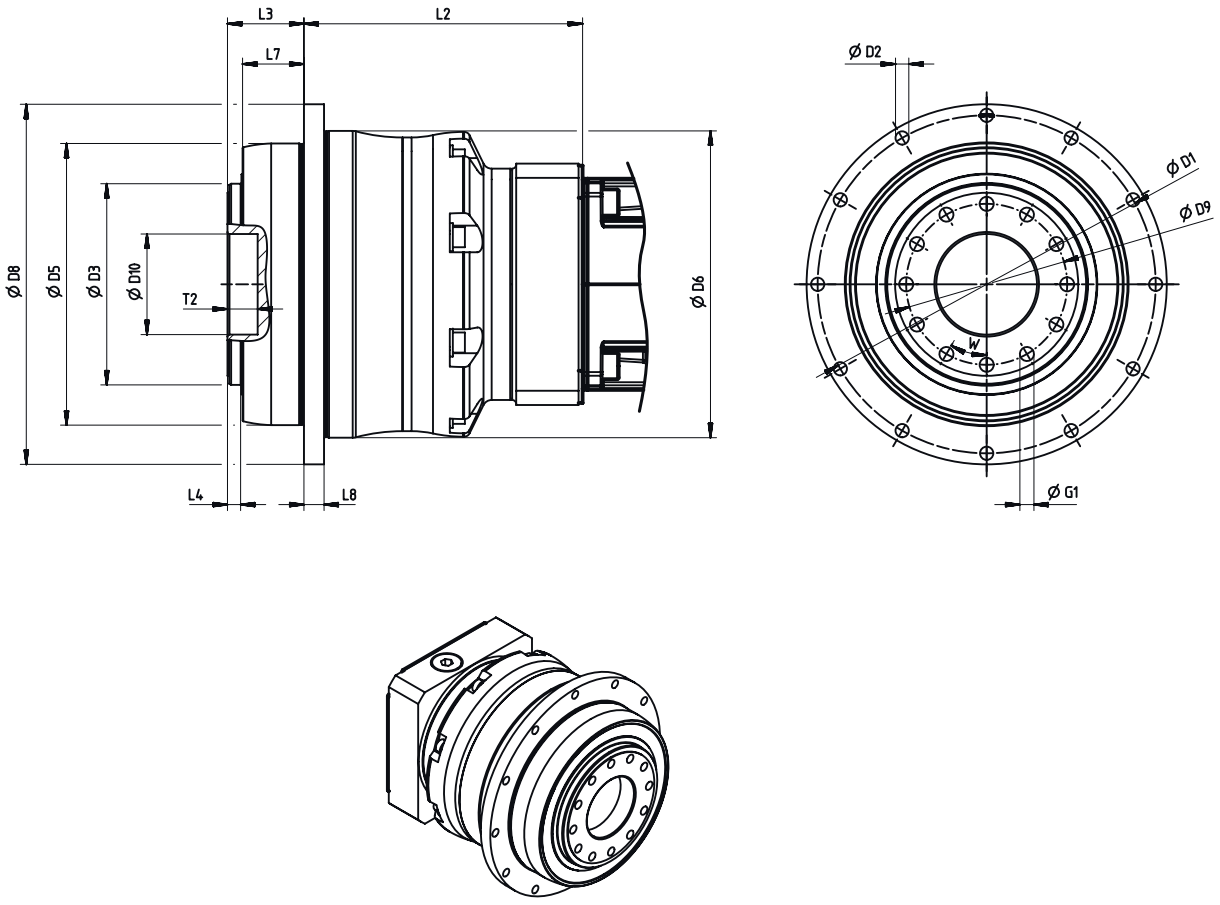


Figure 7-8 TP+ planetary gearbox

Dimensions dependent on the gearbox size

Designation of dimensions		TP004	TP010	TP025	TP050
Flange diameter	Ø D8	86	118	145	179
Diameter of centering edge	Ø D5	64 (h7)	90 (h7)	110 (h7)	140 (h7)
Depth of centering edge	L7	15.5	23	22	30.5
Flange thickness	L8	4	7	8	10
Hole circle diameter	Ø D1	79	109	135	168
Number of screw holes / diameter	U x Ø D2	8 x 4.5	8 x 5.5	8 x 5.5	12 x 6.6
Flanged shaft diameter	Ø D3	64	90	110	140

Designation of dimensions		**TP004**	**TP010**	**TP025**	**TP050**
Shaft length up to flange	L3	19.5	30	29	38
Shaft length up to output	L4	3	6	6	6
Hole circle diameter flanged shaft	Ø D9	31.5	50	63	80
Mounting thread / depth	Ø G1 x T	M5 x 7	M6 x 10	M6 x 12	M8 x 15
Bracket	W	45	45	22.5	30
No. of threaded holes	V	8	8	12	12
Shaft bore/depth	Ø D10 x min. T2	20 (H7) x 4	31.5 (H7) x 7	40 (H7) x 6	50 (H7) x 6

Designation of dimensions		**TP110**	**TP300**	**TP500**
Flange diameter	Ø D8	247	300	330
Diameter of centering edge	Ø D5	200 (h7)	255 (h7)	285 (h7)
Depth of centering edge	L7	41.5	52.5	58.5
Flange thickness	L8	12	18	20
Hole circle diameter	Ø D1	233	280	310
Number of screw holes / diameter	U x Ø D2	12 x 9	16 x 13.5	16 x 13.5
Flanged shaft diameter	Ø D3	200	255	285
Shaft length up to flange	L3	50	66	75
Shaft length up to output	L4	8	12	15
Hole circle diameter flanged shaft	Ø D9	125	140	160
Mounting thread / depth	Ø G1 x T	M10 x 20	M16 x 22	M20 x 31
Bracket	W	30	24	24
No. of threaded holes	V	12	12	12
Shaft bore/depth	Ø D10 x min. T2	80 (H7) x 8	-	-

Dimensions dependent on the motor attached

Gearbox diameter D6														
Adapter flange dimensions	**TP004**		**TP010**		**TP025**		**TP050**		**TP110**		**TP300**		**TP500**	
z	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
1FT2102	70.5			95.5	-	-	-	-	-	-	-	-	-	-
1FT2□03			95.5		120.5		-	-	-	-	-	-	-	-
1FT2□04							152.5		-	212.5	-	255	-	285
1FT2205		-							-		-		-	
1FT2105	91	-							-		-		-	
1FT2□06	-	-	115	-							-		-	
1FT2□08	-	-	-	-					212.5				-	
1FT2□10	-	-	-	-	146						225		285	

Gearbox length L2														
Adapter flange dimensions	**TP004**		**TP010**		**TP025**		**TP050**		**TP110**		**TP300**		**TP500**	
z	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
1FT2102	56.4		-	83.8	-	-	-	-	-	-	-	-	-	-
1FT2□03	58.4	75	72.5	90.2		105.3	-	-	-	-	-	-	-	-
1FT2□04	60.8	82.5	74.5	88.2	85	111		-	-		-	-	-	-
1FT2205		-		100.4				136.5	-		-	-	-	-
1FT2105	73	-	76.2		87	109	112.5	138.5	-	163.4	-	-	-	-
1FT2□06	-	-	94.2	-	92	127		143.5	-		-		-	
1FT2□08	-	-	-	-		-			127.5		164.8	194.7	-	211.6
1FT2□10	-	-	-	-	119	-	121.5	170.5	135.5	172.4	167.8	197.7	190.1	214.6

Additional motor dimensions are provided in the dimension drawings in the configuration manual or equipment manual of the motor, in the catalog and in the SPC. More information on SPC is provided in Chapter "AUTOHOTSPOT".

See also

SIEMENS Product Configurator (Page 195)

7.9 SIEMENS Product Configurator

Description

The SIEMENS Product Configurator supports you when configuring your drive.

You will find the following quickly and easily in the SIEMENS Product Configurator

- Technical data
- Characteristics
- dimension drawings
- 2D/3D CAD data

The SIEMENS Product Configurator supports you when creating system documentation regarding project-specific information.

Note

The 3D model in the SIEMENS Product Configurator is a simplified representation that does not show every detail.

You can find further information on the Internet at SIEMENS Product Configurator (www.siemens.com/SPC):

Application planning

8

8.1 Transporting

Note

Comply with the relevant national regulations for the transportation of loads.

This chapter provides instructions on how to lift and transport the geared motor.

- Always use suitable load suspension devices when lifting and transporting.
- Transport the geared motor carefully.
- Do not lift and transport the geared motor using the motor connectors.

Precondition

- Clarify in advance the equipment to be used for transport, the transport route and the conditions at the storage location.
- Provide suitable load suspension devices, e.g. eyebolts, lifting slings etc.

Lifting and transporting the geared motor without packaging

Depending on the size and weight, you can lift and transport a geared motor without any additional equipment.

Use lifting slings or lifting eyes with a crossbar for lifting and transporting.

Procedure when using lifting slings

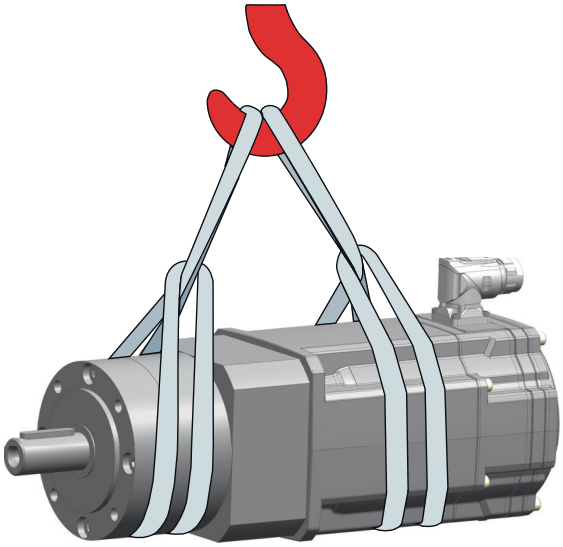


Figure 8-1 Example of lifting and transporting using lifting slings

Note

Carefully ensure that the lifting slings do not come into contact with the motor connector.

Carefully ensure a stable position when lifting and transporting.

Lifting using lifting eyebolts or lifting eyes

Use a crossbar for lifting and transporting the geared motor.

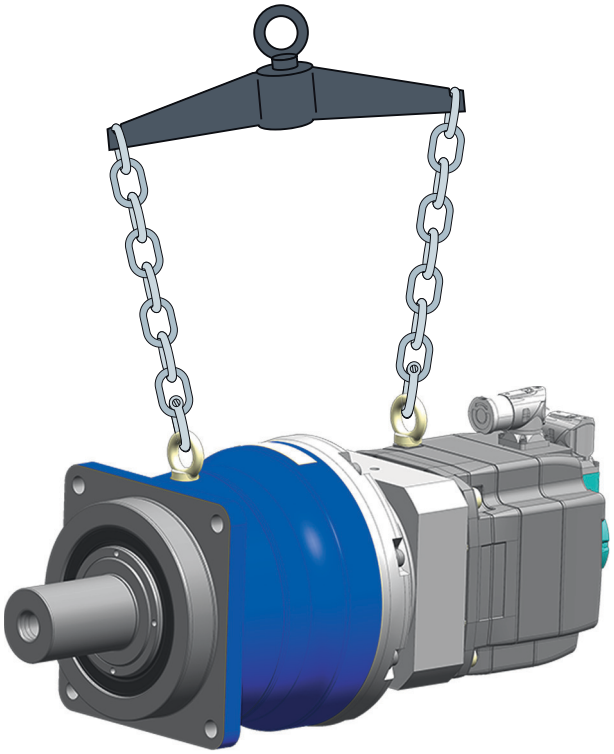


Figure 8-2 Transporting using a crossbar (example)

Carefully comply with the maximum load of the lifting eyebolt as listed in the table below.

Thread size	m in kg	d_3 in mm	Thread size	m in kg	d_3 in mm
M8	140	36	M20	1 200	72
M10	230	45	M24	1 800	90
M12	340	54	M30	3 200	108
M16	700	63	-	-	-

❒

Setting the geared motor down

Procedure

1. Set the geared motor down on a firm, level surface.
2. Secure the servo geared motor against unintentional movement.

❒

8.2 Storage

Protection against corrosion

Protect the free shaft extensions, sealing elements and flange surfaces of the geared motor against corrosion when placing it in storage. These elements are protected against corrosion by applying a protective coating ex works.
Renew this corrosion protection in case it has already been removed.

Storage conditions

Please observe the warning instructions on the packaging and labels.

Store the geared motor in a dry, dust-free, and vibration-free indoor area.

Adhere to the following values:

- $v_{rms} < 0.2$ mm/s
- Max. temperatures: -15 °C to 55 °C
- Mean relative humidity < 75 %

NOTICE
Bearing damage due to improper storage If stored incorrectly, bearing damage can occur at standstill, e.g. brinelling, as a result of vibration or shock. • Observe the instructions for storing the motor.

Long-term storage

Note

In the case of storage in transit over 6 months, special arrangements must be made for preservation.

If you store the geared motor for longer than six months, the storage room/area must satisfy the following conditions:

- The motor must be protected against extreme weather conditions.
- The ambient air is free from aggressive gases.
- The room must be free of any vibration ($v_{rms} < 0.2$ mm/s)
- According to EN 60034-1, the temperature must be within the range of -15 °C bis 55 °C.
- The relative air humidity is less than 60 %.

Mounting

9

9.1 Safety instructions

NOTICE
Damage to shaft sealing rings caused by solvent If shaft sealing rings come into contact with solvents when preservation coating is removed, the shaft sealing rings can be damaged. • Avoid contact between solvents and shaft sealing rings.

NOTICE
Thermal damage to temperature-sensitive parts Some parts of the electrical motor enclosure can reach temperatures that exceed 100 °C. If temperature-sensitive parts, for instance electric cables or electronic components, come into contact with hot surfaces then these parts can be damaged. • Ensure that no temperature-sensitive parts come into contact with hot surfaces.

9.2 Checklist before installation

Note

Required checks

The checklists below do not purport to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

Install the geared motor as described in the following chapters of the Operating Instructions.

Thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Are the environmental conditions in the permissible range?	

Checklist (2) - checks regarding the mechanical system

Check	OK
Is the geared motor free of any visible damage?	
Have the mounting surfaces (e.g. flange, shaft) on the customer's machine and on the geared motor been cleaned?	
Are the mounting surfaces free of corrosion?	
Do the mounting dimensions (e.g. shaft diameter, shaft length, true run) on the customer machine meet the specification?	

Motor-specific information

Motor-specific information about installation is provided in the Operating Instructions of the connected motors.

9.3 Mounting instructions

9.3.1 Installation instructions for geared motors

Description

Note

Observe the technical data on the rating plate attached to the gearbox housing and the motor

- Observe the data on the rating plate, as well as the warning and information plates on the motor.
- Check the permissible ambient conditions (e.g. temperature, installation altitude) at the installation location.
  Their use is prohibited in hazardous zones.
- Thoroughly clean the shaft extension of corrosion protection. Use commercially available solvents.
- Ensure sufficient dissipation of heat. Information on this topic can be found in the Operating Instructions of the motor.
- If the motor is installed vertically with the end of the shaft facing up, ensure that no liquid can enter the upper bearing.
- Ensure that the flange is in even contact with the mounting surface.
- Do not use cylinder head screws.
- When tightening the fastening bolts avoid any uneven stressing.
- Observe the tightening torques of the fastening bolts. See table "Tightening torques for fastening bolts".

9.3.2 Flange mounting and tightening torques for servomotors with planetary gearbox

Description

This chapter shows the designs and dimensions for flange mounting to a machine and the associated tightening torques.

Note

Siemens recommends an anaerobic adhesive to increase the friction locking between flange and mounting surface.

The tightening torque specified in this table are theoretical values.

They are based on the following:

- Calculated according to VDI 2230
- The friction coefficient for screws and mounting surfaces is μ = 0.10
- The yield strength reaches 90 %
- The tools used correspond to type II, Classes A and D according to ISO 6789

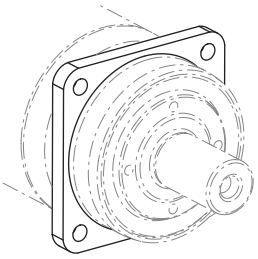
Set values of the torque tools

The set values are rounded off values that correspond to a generally applicable scale division or setting options.

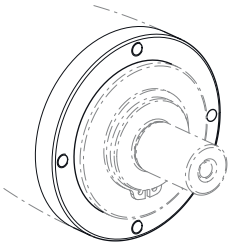
- Set these values precisely

Strength class of screws/nuts	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
8.8/8	1.15	2.64	5.2	9.0	21.5	42.5	73.5	118	180	258	362	495	625
10.9/10	1.68	3.88	7.6	13.2	32	62.5	108	173	264	368	520	700	890
12.9/12	1.97	4.55	9.0	15.4	37.5	73.5	126	202	310	430	605	820	1040

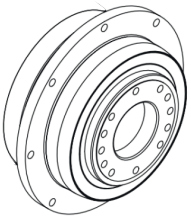
Flange designs at the gearbox output



Flange IMB5, e.g. NLC, SP+



Flange IMB14, e.g. NRB, NRK, NP



Flange IMB5, e.g. TP+

Flange mounting of the planetary gearbox

NRB/NRBW	**For gearboxes with aluminum output flange, use screws with a maximum property class of 10.9, assuming that you use 90 % of the screw yield strength.**					
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
040	IMB14	34	4	M4	6	10.9
060		52		M5	8	
080		70		M6	10	
120		100		M10	16	
160		145		M12	20	

NRK/NRKW						
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
050	IMB14	44	4	M4	8	12.9
070		62		M5	8	
090		80		M6	9	
120		108		M8	20	
155		140		M10	20	

NP						
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
005	IMB14	44	4	M4	8	12.9
015		62		M5	10	
025		80		M6	12	
035		108		M8	16	
045		140		M10	20	

NLC/NLCW						
Gearbox size	**Mounting flange**	**Ø circle of holes in mm**	**Number of through holes**	**Bore diameter in mm**	**Flange thickness in mm**	**Property class of the screws**
050	IMB5	68-75	4	5.5	7	12.9
070		85		6.5	8	
090		120		9	10	

SP+						
Gear unit	**Mounting flange**	**Ø circle of holes in mm**	**Number of through holes**	**Bore diameter in mm**	**Flange thickness in mm**	**Property class of the screws**
060	IMB5	68	4	5.5	6	12.9
075		85		6.6	7	
100		120		9	10	
140		165		11	12	
180		215		13.5	15	
210		250		17	17	
240		290		17	20	

TP+						
Gear unit	**Mounting flange**	**Ø circle of holes in mm**	**Number of through holes**	**Bore diameter in mm**	**Flange thickness in mm**	**Property class of the screws**
004	IMB5	79	8	4.5	6	12.9
010		109		5.5	7	
025		135			8	
050		168	12	6.6	10	
110		233		9	12	
300		280	16	13.5	18	
500		310			20	

Shaft flange

TP+					
Gear unit	**Ø circle of holes in mm**	**Number of threads**	**Thread size**	**Thread depth in mm**	**Property class of the screws**
TP004	31.5	8	M5	7	12.9
TP010	50		M6	10	
TP025	63	12		12	
TP050	80		M8	15	
TP110	125		M10	20	
TP300	140		M16	22	
TP500	160		M20	31	

9.4 Mounting conditions

Note

To ensure enough heat is dissipated, a minimum clearance to adjacent components of 100 mm must be kept free on three side surfaces.

Note

Thermal interaction between the motor and gearbox

Take into account the thermal interaction between the motor and gearbox. Reduced characteristics for the geared motors apply.

For more information, see the Configuration Manual for the specific motor.

- Maintain the clearances, independent of the subsequent mounting variants.

Mounting conditions for this specification

The data specified for the geared motors is applicable under the following mounting conditions:

The mounting conditions also apply to the angled gearbox versions.

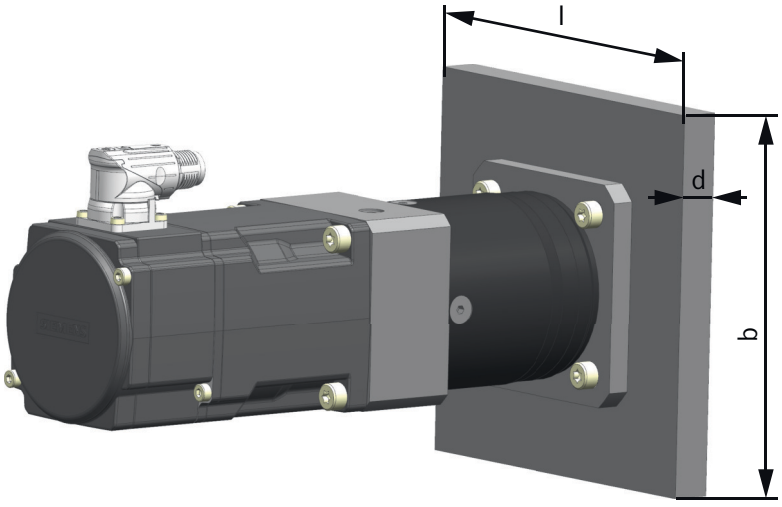


Figure 9-1 Geared motor with mounting flange

Gearbox size: NRB / NRBW /NRK / NRKW / NLC / NLCW	Steel plate: l x w x d (in mm)
040 / 050	200 x 200 x 6
060 / 070	250 x 250 x 6
080 / 090	300 x 300 x 12
120 / 155 /160	450 x 370 x 30

Gearbox size: NP/SP+	Steel plate: l x w x d (in mm)
NP005	200 x 200 x 6
NP015/SP60	250 x 250 x 6
NP025/SP75	300 x 300 x 12
NP035/NP045 SP100/SP140/SP180/SP210	450 x 370 x 30
SP240	550 x 380 x 35

Gearbox size: TP+	Steel plate: l x w x d (in mm)
TP004	300 x 300 x 12
TP010	450 x 370 x 30
TP025	450 x 370 x 30
TP050	450 x 370 x 30
TP110	450 x 370 x 30
TP300	550 x 380 x 35
TP500	550 x 380 x 35

The data in the table refers to an ambient temperature of 40 °C (104 °F) and an installation altitude up to 1000 m above sea level.

Note

The mounting plate dissipates the heat to the machine foundation.

Influence of the mounting situation

Higher ambient temperatures, higher installation altitudes or smaller mounting surfaces have a negative impact on the amount of heat dissipated from the geared motor. You must reduce the power.

Geared motor cooling improves at lower ambient temperatures and for larger mounting surfaces. The power can be increased.

9.5 Pulling on drive output elements

This chapter provides important information for pulling on output elements.

NOTICE
Damage to the motor due to runout on the shaft extension Blows and pressure applied to the shaft extension can damage the gearbox. • Mount the geared motor without applying blows and forces to the shaft extension.

NOTICE
Damage to shaft sealing rings when heating up When pulling on input and output elements by applying heat, shaft sealing rings can be damaged. • Protect the shaft sealing rings using a thermal shield to prevent the temperature from increasing to above 100 °C due to radiant heat.

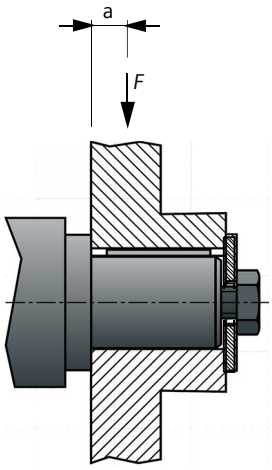
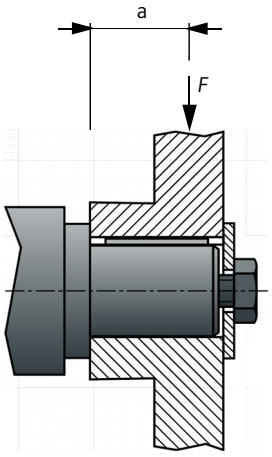
Note

When pulling on elements, distortion can damage the gearbox.

- Use suitable tools or fixtures when pulling on input and output elements.
- When pulling on or shrinking an element onto the output shaft, ensure that the maximum allowable static axial forces of the output bearing are not exceeded.

Pulling on instructions

Pull on input and output elements in such a way as to minimize the stress on shafts and bearings due to cantilever forces.

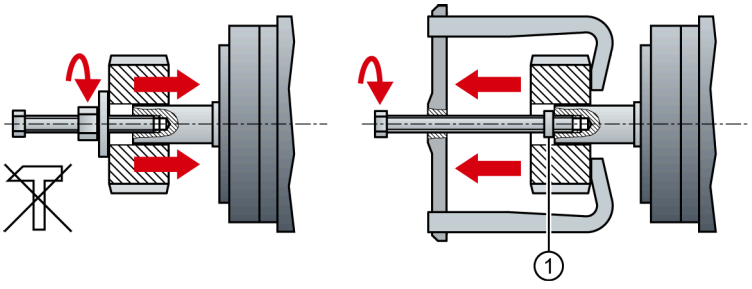
Optimal	Unfavorable
	
low stress on shafts and bearings	high stress on shafts and bearings

Mount or remove the power output elements (e.g. couplings, gear wheels, belt pulleys) using suitable devices only (see figure).

- Use the threaded hole in the shaft end.
- If required, heat up the output elements before mounting or removing.
- When removing the output elements, use an intermediate disk to protect the centering in the shaft extension.
- If necessary, completely balance the geared motor together with the output elements according to ISO 1940.

Note

Precision gearboxes with feather key are half-key balanced. They have been balanced with half a feather key.
The Eco gearboxes are not balanced.



1 Intermediate washer/disk (to protect the centering in the shaft extension)

Figure 9-2 Pulling on and pulling off output elements

The motor dimensions are provided in the Configuration Manual of the specific motor or in the associated catalog.

10 Commissioning

Instructions for commissioning are provided in the Operating Instructions of the servomotor.

11 Operation

Instructions and information on operating servomotors with planetary gearboxes is provided in the Operating Instructions for the motors.

Description

While the planetary gearbox is operational ensure that the specified parameters are maintained.

Make sure that:

- The power consumption is in the specified range
- There is no abnormal noise
- The gearbox housing temperature must not exceed 90 °C.

Maintenance 12

12.1 Safety instructions

If you have any questions, please contact the manufacturer, informing them of the machine type and serial number.

⚠ WARNING

Electric shock when live parts are touched

Death or serious injury can result when live parts are touched.

- Only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.

Six steps must always be followed when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the power supply.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that there is a no-voltage condition from phase conductor to phase conductor and phase conductor to protective conductor.
   - Check whether the existing auxiliary supply circuits are de-energized.
   - Carefully ensure that the motors cannot move.
3. Lock SIMOTICS S motors so they cannot make any inadvertent motion, which would generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources, e.g.

- By opening switches
- By grounding, short-circuiting or
- By closing valves

1. Take suitable measures to prevent energy sources from being reconnected.
2. Carefully ensure that the machine is completely locked out and that you have the right machine!

⚠ WARNING

Slipping on leaked oil

Leaked oil can result in slipping or falling and cause death or severe injury.

- Prevent oil from leaking.
- Remove any leaked oil immediately using an oil binding agent or similar.
- Reduce the level of risk at the hazardous location.
- Mark the hazardous location.

⚠ WARNING

Unintentional starting of the drive unit

Unintentional starting of the drive unit can result in death or severe injury.

- Secure the drive unit so that it cannot be started accidentally.
- Post a warning notice to this effect at the point where the switch is located.

⚠ CAUTION

Burning caused by hot surfaces

Some parts of the housing of electrical machines can reach temperatures in excess of 100 °C. Touching components when the machine is in operation can cause burns.

- Do not touch parts of the housing while the machine is in operation or immediately after machine operation.
- Allow parts of the housing to cool down before starting any work.

⚠ CAUTION

Danger of scalding from escaping hot oil

Escaping hot oil can cause burns.

- Before starting any work, allow the oil to cool down to below 30 °C.

⚠ CAUTION

Chemical burns and irritation caused by chemical cleaning agents

Chemical cleaning agents can be caustic or emit dangerous fumes. If these come into contact with skin or if you inhale the fumes, this can cause injuries, e.g. chemical burns on the skin or respiratory passages, or skin irritation.

- When cleaning, ensure that appropriate methods of extracting fumes are in place and that personal protective equipment such as gloves, goggles, face masks or similar items are worn.
- If you are using chemical cleaning agents, observe the instructions for use and any warnings provided in the accompanying safety data sheet. Chemical cleaning agents must be suitable for use with the parts and components of the machine, particularly where plastic components are concerned.

⚠ CAUTION

Injuries caused by stirred-up foreign bodies and dust when working with compressed air

Cleaning with compressed air can stir up dust, metal chips and cleaning agents therefore resulting in injuries.

- When cleaning using compressed air, make sure you use suitable extraction equipment and wear protective equipment (safety goggles, protective suit, etc.).

12.2 Inspection and maintenance

12.2.1 Maintenance and inspection intervals

General

Carry out maintenance work, inspections and revisions at regular intervals in order to be able to identify faults at an early stage and remove them.

Note

Inspection if there are faults or unusual conditions

Unusual conditions or faults that indicate that the planetary gearbox has been overstressed, e.g. overload or short-circuit, can result in consequential damage to the machine.

Immediately perform an inspection when faults or exceptional conditions occur.

Maintenance measures, inspection/maintenance times intervals

The maintenance intervals depend on the operating conditions.

- Adapt the maintenance intervals to match the local conditions, such as pollution/dirt, switching frequency, load, etc.

NOTICE

Improper maintenance

Service and maintenance must only be performed by properly authorized qualified personnel.

Only use original SIEMENS parts.

Maintenance and repair of the servomotor equipped with planetary gearbox can be performed by Siemens Service Centers throughout the world. To do this, contact your local Siemens representative.

- Perform the following maintenance measures as listed in the table.

Table 12-1 Maintenance measures after intervals

Intervals	Measure
Operation	
Daily; if possible, more frequently during operation	Monitor and check the motor and gearbox for unusual noise, vibration and changes.
As required or after 25 000 operating hours	Replacing motor and gearbox bearings

12.2.2 Checking tightness of fastening bolts

Procedure

Note

Replace unusable headless screws with headless screws of the same design and property class.

- Switch off the power supply to the drive unit.
- Check all fixing screws for tightness using a torque wrench.
  You will find the permissible torques in chapter Mounting instructions (Page 202)

❒

12.2.3 Cleaning servomotors with planetary gearbox

⚠ WARNING

Electric shock when cleaning due to failing to observe the protection class

When cleaning, especially with high-pressure cleaning equipment, water can enter energized parts and cause an electric shock.

- Clean the motor in a manner appropriate for its protection class.
- Avoid pressurized water on connectors, terminal boxes, and other live parts.
- Avoid aiming pressurized water at the gearbox shaft sealing rings.

When required, clean the motor and the gearbox to remove any dust and dirt as required. In this way, you ensure adequate heat dissipation.

12.2.4 Bearing replacement interval

Description

The bearings are subject to wear and must be replaced after a defined number of operating hours.

For average load levels, the bearings must be replaced after approx. 25,000 hours.

Bearing replacement intervals can be extended if the motor is operated under favorable conditions, e.g. low average speeds, low radial forces (cantilever forces), vibration load.

Note

Harsh operating conditions

If the motor is subject to harsh operating conditions (e.g. continuous operation at n_{max}, high vibration/shock loads, frequent reversing duty etc.), the bearing replacement intervals t_{LW} can decrease by up to 50%.

If the planetary gearbox has reached its calculated service life, we recommend that the bearings or the gearbox are replaced and checked for wear.

12.3 Repairing

Note regarding maintenance

The Siemens Service Center Bad Neustadt and other regional service sites throughout the world can handle or organize the maintenance/repair of the motor and/or gearbox.

Contact your regional sales person about this.

13 Decommissioning and disposal

13.1 Decommissioning

Instructions for decommissioning are provided in the Operating Instructions for the specific servomotor.

13.2 Disposal

Recycling and disposal

For environmentally sustainable recycling and disposal of your old device, contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

Appendix

A

A.1 Formula symbols

Formula symbols	Meaning
a	maximum acceleration occurring perpendicular to the motor axis
C_{T2}	Torsional stiffness of the planetary gearbox
D_C	Partial damage in the entire cycle
D_i	Partial damage in partial cycle *i*
Δt_i	Duration of time interval *i*
F_{AL}	Effective axial force (output shaft)
$F_{A, max}$	Maximum permissible axial force (output shaft)
F_{RL}	Effective radial force (output shaft)
$F_{R, eq}$	Average permissable radial force in relation to a specified nominal bearing lifetime and to a defined shaft force application point as well as a defined arithmetically averaged output speed
$F_{R\,L,eq}$	Equivalent radial shaft load. In its effect, it corresponds to the radial force curve of the complete load cycle.
$F_{R, max}$	Maximum permissible radial force (output shaft)
$F_{RL, i}$	Radial force in time interval *i*
i	Transmission ratio of gearbox
J_1	Moment of inertia of geared motor related to input
$J_{1, G}$	Moment of inertia of gearbox component related to input
J_L	Load moment of inertia (referred to the output)
$J_{M, Br}$	Moment of inertia of motor with brake
L	Service life
L_{10h}	Nominal service life in hours after which, on an average, max. 10% of the units considered failed.
L_{10h}	Nominal service life in hours after which, on an average, max. 10% of the units considered failed.
l_M	Motor length
M_1	Input torque applied to gearing of gearbox
M_2	Effective torque at gearbox output
$M_{2max, G}$	Maximum permissible output torque
$M_{2Em.Off}$	Maximum permissible EMERGENCY OFF torque of the gearbox
$M_{2L, i}$	Output torque in partial cycle *i*
$M_{2L, eq}$	Equivalent load torque. In its effect, it corresponds to the torque curve of the complete load cycle.
M_{2L}	Output torque of the application
$M_{2max, G}$	Maximum short-time permissible output torque of gearbox component
$M_{2N,G}$	Rated torque of the gearbox component
M_B	Actually occurring bending moment between motor and gearbox flange

Formula symbols	Meaning
$M_{B, G}$	Maximum permissible bending moment between motor and gearbox flange
$M_{Br, max}$	Maximum effective dynamic deceleration torque of brake
m	Geared motor weight
m_G	Gearbox weight
m_M	Mass of motor
$M_{M, eff}$	Effective motor torque over load cycle
$M_{M,i}$	Motor torque in time interval *i*
$n_{1av, G}$	Highest average input speed of the gearbox
$n_{1max, G}$	Maximum permissible input speed
n_{2max}	Maximum permissible output speed of the geared motor
$n_{2B, G}$	Reference speed of the gearbox At this speed and with an equivalent torque load of $M_{2N, G}$, the service life of the planetary gear bearing of the gearbox equals the specified service life of L_{10h}.
$n_{2L end, i}$	Speed at the end of partial cycle *i*
$n_{2L start, i}$	Speed at the beginning of partial cycle *i*
$n_{2L, av}$	Arithmetic mean of load speed (output side)
$n_{2L, i}$	Output speed in time interval *i*
$n_{M, av}$	Arithmetic mean of motor speed
$N_{R max, i}$	Total number of permissible revolutions at given overload S_i
$N_{R2, i}$	Number of revolutions in partial cycle *i*
p	Bearing exponent: 3 for ball bearings respectively 3.33 for roller bearings
Si	Overload in partial cycle *i*
T_C	Duration of overall load cycle
x	Distance of radial force application point from shaft shoulder
z	Number of gearbox stages
Z	Number of permissible cycles
η_G	Efficiency of the planetary gearbox
φ_2	Torsional backlash at the output shaft of the planetary gearbox

More information

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www.siemens.com/simotics

Industry Mall:
www.siemens.com/industrymall

Industry Online Support
www.siemens.com/online-support