

# What mechanical engineers and plant operators need to know when buying geared motors

Gear Purchasing Guide



Motors | Automation | Energy | Transmission & Distribution | Coatings



*Gears are among the most important components in many drive trains in industry. They are primarily used in combination with an electric motor to set machines and systems in motion and keep them moving. When procuring a geared motor, technical buyers at machine and plant manufacturers have to consider numerous aspects to ensure that the purchased technology ultimately guarantees high plant availability and an optimum cost-benefit ratio.*

*To be able to assess the cost-effectiveness of a geared motor adequately, the responsible engineers first have to analyse the key technical criteria and areas of application before a purchase.*

*Whether a retrofit, or newly developed machine/system, the technical purchasing department is faced with the following questions:*

- **Which gear unit best suits my application?**
- **How can I identify a good gear unit?**
- **What do I have to pay attention to when purchasing besides the cost-benefit ratio?**

*This purchasing guide answers all of these questions while helping decision-makers, technical buyers and design engineers to select the right gear for their application.*

Responsible for the content: Watt Drive Antriebstechnik GmbH  
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First, we will consider the objectives and key selection criteria when purchasing a gear unit. This will show which criteria can be used to identify a good gear unit. A detailed explanation will then be given of how engineers at a machine or plant manufacturer can assess the technical suitability for a specific application. After all, no geared motor should be purchased without the green light from the engineering department. Finally, there is a short checklist summarizing the most important questions that arise when purchasing a geared motor.

### **The basis of the buyer's evaluation?**

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- Cost-benefit ratio
- Logistics, global availability and service

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### **Which technical parameters have to be fulfilled?**

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- Standard mounting dimensions to ensure interchangeability
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# The basis of the buyer's evaluation?



## Technical specifications

Technical requirements are fundamental for choosing the right gear unit. The more clearly defined, the better. After all, if the wrong gear is selected, the cost-benefit ratio will not be right either. This is the case, for example, if a gear unit does not meet the application requirements, i.e. is oversized or undersized, or has an insufficient lifespan in the application. The spatial conditions of the application and the installation dimensions of the geared motors are also key factors, especially when retrofitting. The reason being that when purchasing a gear unit, no design changes should be necessary to the company's own machines or systems.



## Cost-benefit ratio

First of all, it is important to get an overview of which gear units with which power can be supplied by which supplier. The costs must then be counterbalanced by as many compelling positive points as possible. This determines the cost-benefit ratio.

A gear unit with a good cost-benefit ratio will generally be preferred to a gear unit that performs very well but is too expensive to purchase. When assessing the cost-effectiveness, however, possible follow-up costs must always be taken into account – these arise quickly if the technical requirements of the application are not optimally met or the reliability leaves something to be desired.

Gearmotor efficiency should also be considered in the operating costs of the unit and balanced with the initial up-front costs. Optimal efficiency come at a higher upfront cost, but can save the plant operator significant costs in the mid/long-term, as well as having a lower CO2 footprint.



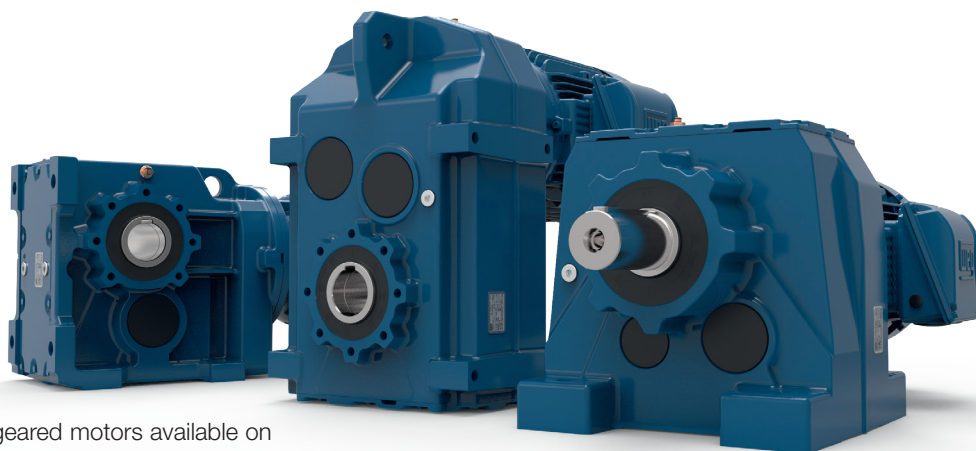
## Logistics, global availability and service

Fast delivery is crucial, as plant operators want to avoid downtimes as much as possible. Regardless of whether a company uses the gear units globally in its own plants or installs them and sells them as a solution, the key points of efficiency in the supply chain and plant availability at the end user are fast availability and worldwide service.

If, for example, production takes place in various countries, it must be ensured that the gear units can be delivered where they are needed. Otherwise there is a risk of productivity losses in the company itself or at the end customer. In the latter case, this may also damage the company image. It must therefore be established whether the gear manufacturer has sufficient stocks to make large quantities available at short notice.

Consequently, manufacturers who offer a global service network and can ensure fast delivery of the desired gear units are preferred when it comes to procurement. An inexpensive gear unit, which cannot be delivered quickly enough and may increase the risk for downtimes at the end user or not meet the "time to market" for an OEM, is not a good option and does not offer a good cost-benefit ratio. For follow-up orders, it is also important to know how quickly a gear unit of the same design can be replaced.

## Which technical parameters have to be fulfilled?



Due to the large number of geared motors available on the market, there are innumerable technical characteristics that can be used to assess the quality and cost-benefit ratio of a geared motor. However, they are not all relevant in the same way. Before a buyer makes a purchasing decision, the technical specifications must be checked by the company's own engineers. This is the only way to ensure that the gear units actually deliver the required power, reliability and cost-effectiveness in a specific application. From a technical point of view, two factors are decisive when selecting a gear unit: the application requirements and the available space. This always depends on the location of the gear unit. Only if these two factors are fully known can the right gear unit be selected – one that will prove itself in practice with its long lifespan and its reliability.

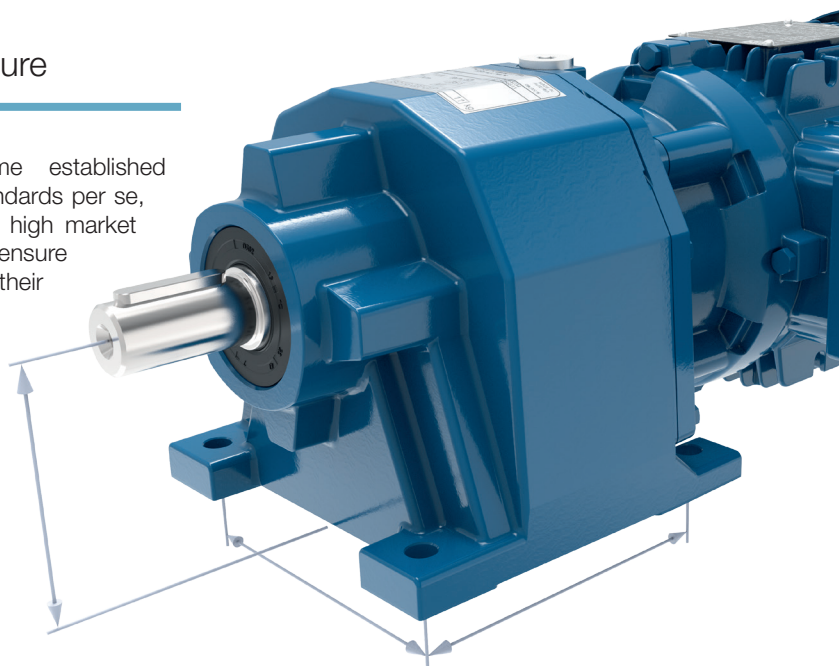
### Type of gear

In industry, gear drives are primarily used. These include helical gear, bevel gear, parallel shaft gear and worm gear units which make up the majority of all installed gears. Planetary gears are also used to a lesser extent. Design basically differs depending on the industry in which the geared motors are to be used.

Factors such as power (kW), speed (rpm) and torque (Nm) always have an effect on size and costs. If a geared motor – i.e. the combination of motor and gear unit – is incorrectly sized, for example, it will only run on half the power in the application; this will have a negative effect on the cost-benefit ratio.

### Standard mounting dimensions to ensure interchangeability

Standardized mounting dimensions have become established worldwide for gear units. These are not based on standards per se, but have already become the “standard” due to the high market penetration of certain geared motors. It is important to ensure that only those gear units are installed that, due to their market-compliant mounting dimensions, can easily be integrated and replaced without conversions and system modifications. The market-compliant mounting dimensions facilitate the use of geared motors both for retrofitting by the end customer and for newly developed machines in the OEM market.





## Efficiency

Since gear units in industry are primarily used in combination with electric motors (asynchronous motors) as geared motors, efficiency also plays an important role in the selection of gear units. If a gear unit is selected, an integral motor is also required in the vast majority of cases. High energy efficiency is an important criterion for reducing the operating costs and CO2 emissions of drives, especially in plants and productions where many motors and gear units are installed or which are particularly energy-intensive.

Modern gear units are ultra-efficient: Only about 1.5 percent of dissipated power is assumed for each ratio stage. In the case of a two-stage gear unit, this corresponds to a degree of mechanical efficiency of around 97 percent. Keeping the number of stages to a minimum of two to three and optimizing the gearing are key to the efficiency of a gear unit. With a good gear unit, the developers will have analyzed and optimized potential sources of dissipation, e.g. by reducing the gear splashing losses. The efficiency of the motor plays an important role in the overall efficiency of the geared motor.

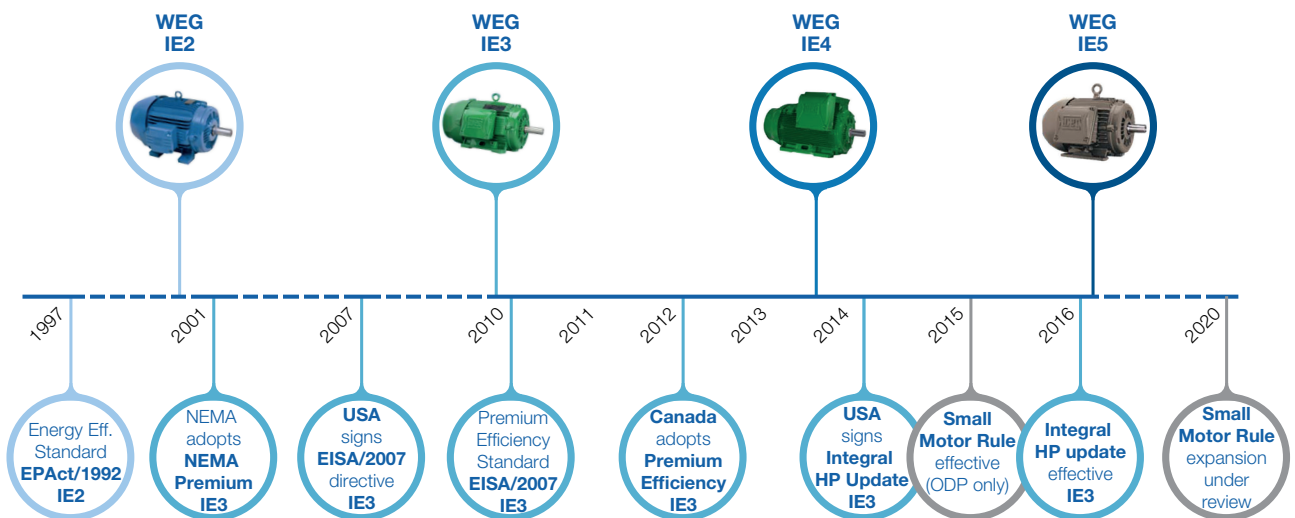
In the USA, electric motors are divided into efficiency classes in accordance with the EISA/2007 standard. The combination of gear units offering efficient power transmission and mounted motors of the currently highest available energy efficiency classes (NEMA Premium / IE3) is the ideal solution. The result is geared motors with high power density.

When it comes to electric motors, regional legislation must also be observed. In the USA, for example, the last stage of DoE regulation has been in force since June 1, 2016. This currently stipulates the legally binding use of energy efficiency classes per NEMA table 12-12 (NEMA Premium®) for across the line operation, or with Variable Frequency Drives (VFD) if a motor is capable of across the line operation. This applies to rated outputs of 1 – 500 HP for motors designed for 60 Hz and 600 V or less. For manufacturers of machines and systems, this means always using motors with at least NEMA Premium efficiency levels for corresponding applications with gear units. While currently fractional HP motors are only regulated in ODP enclosures, the DoE is working with energy advocates and industry groups to expand the Small Motor Rule to include enclosed motors in the future.

**Energy costs account for approx. 90 percent of the total life cycle costs of geared motors.**

This means that investments in energy-efficient drives generally pay for themselves within a relatively short period of time. This is not only important for the plant operator, but also for the machine or plant manufacturer. The following applies: The more efficient the entire drive train, the more economical it will be. This, in turn, can be passed on to the end customer as a financially beneficial sales argument.

### Timeline Motor Efficiency Classes



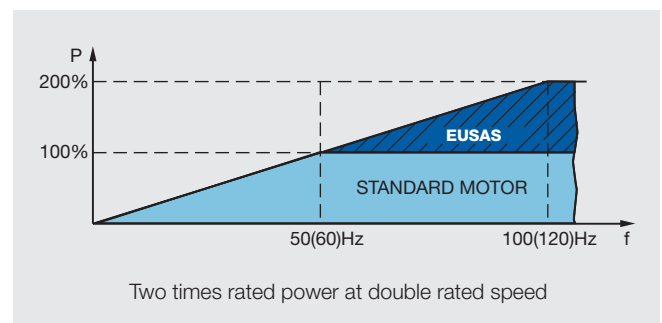
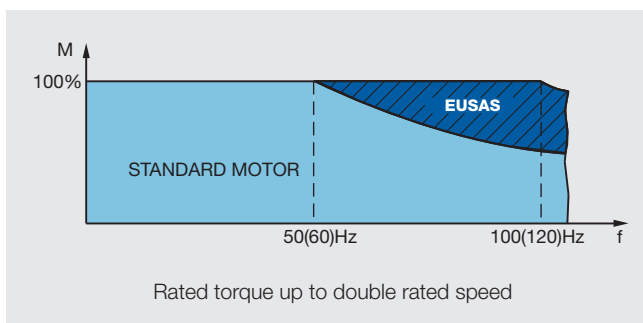
## Versatility

There is no global standard line voltage; it can vary significantly depending on the country concerned. In Germany, it is 400 V at a frequency of 50 Hz; in the USA, on the other hand, it is 480 V at 60 Hz – to name a couple of examples. If the plan is to use the purchased geared motors worldwide, it is advisable to use a switchable integral motor that is suitable for most world voltages (110–690 V – 50/60 Hz). A versatile all-in-one solution, e.g. the **EUSAS** motor (**EUROPE - USA - ASIA**) from WEG covers the line voltages in use in the major global markets. Thanks to the large voltage range and simple voltage switching in the terminal box, these motors can be flexibly used worldwide for a whole variety of line voltages (110 V to 690 V) and frequencies (50 Hz and 60 Hz).



This reduces the expense considerably, as many asynchronous motors are very limited in terms of voltage switching due to their winding design. For users, this means that a suitable motor must be used and stocked for any level deviating from the international standard IEC 60038 (which defines a quantity of line voltages from the low-voltage range for use in power supply systems); this results in considerable additional costs and longer delivery times, especially for small quantities. This also means more time and money for logistics.

Geared motors are often also used in speed-controlled drive trains. In frequency inverter operation, a gear unit in combination with an integral motor like the **EUSAS** offers another major advantage: Double the speed – double the power with a constant torque. This is particularly useful where a lot of power is required, but space is limited. A special stator winding makes this possible, allowing a constant torque to be maintained over the entire speed range of the motor up to 120 Hz. The winding also ensures that **EUSAS** motors can be operated at double power using an inverter. This saves costs, space and weight, i.e. the same power can be achieved with a smaller motor.



## Certification for global use

When purchasing geared motors, certifications are also very important when they are used worldwide. The CE marking is mandatory for Europe, but UL certification is required for the USA. Also very important for Canada, for example, is CSA certification and, in the Eurasian Economic Union, the EAC marking. EAC certification proves, for instance, that a product meets the applicable safety requirements laid down in the technical regulations of the Eurasian Economic Union. Certification is therefore mandatory if a geared motor is to be used in a particular region of the world.

## Low maintenance costs

Maintenance costs are another important selection criterion. They are low if there are few service calls, claims or complaints from end customers during the lifetime of a gear unit. This means that low maintenance costs always make for a good sales argument. If a gear unit is particularly robust and reliable, its reliability has a positive effect on system availability. In addition to processing high-quality materials, lifetime lubrication, for example, is an important indicator that should be taken into account. A good gear unit is therefore robust and well manufactured which also means low maintenance.

## Application-specific characteristics

The following technical characteristics must be defined for the specific application before the final purchase decision is made:

### **Drive control:**

It also has to be determined how the application is to be designed in terms of control technology.

For example, will the geared motor be used in line or frequency inverter operation? Are additional drive components such as decentralized inverters, brakes, encoders or back stops required?

Complete suppliers who can offer entire modular drive solutions with short delivery times have clear advantages for the user.

When selecting suppliers, care should also be taken to ensure that the necessary support and technical expertise are available with regard to drive dimensioning and component selection.

### **Ambient conditions:**

To make the right choice it should also be clear what loads the gear unit will be exposed to in the specific application.

Ambient conditions are therefore very important: What is the ambient temperature and what are the requirements for the particular installation site? Depending on where the geared motor is used – for example in the offshore sector, the cement industry or in a steelworks – appropriate designs must be carefully considered. These include different coating systems, in particular a multi-layer coating structure, the protection class as well as the type of shaft seal rings and shaft material.

For example: Will the gear unit be used to drive a conveyor belt, which means exposure to shock loads? This can significantly shorten the lifespan and reliability of an unsuitable gear unit. Extremely robust and torsionally stiff systems are required for very high torques, especially for demanding applications with great loads and high accelerations, in which the motor and gear have to absorb extremely high starting torques. During operation, this also results in radial and axial impacts that the gear unit has to absorb, for example, during start-up or one-sided loading of conveyor belts.

Another example of special ambient conditions is an application in hazardous areas. In this case, the use of suitable integral motors that comply with Directive 2014/34/EU (ATEX) is essential to ensure safe operation. The smoother the housing surface, the easier it is to clean a gear unit, which enables it to be used in industries requiring intensive cleaning, such as the food industry.



### Space requirements:

Which gear unit is used ultimately in an application depends primarily on the available space in addition to the characteristics of torque transmission.

Helical gear units are used in many applications. A special type of helical gear is the parallel shaft gear. In contrast to the helical gear, however, the input and output shafts of parallel shaft gears are offset as parallel as possible. As a result, they have a very flat design which allows them to be installed in a very space-saving manner. The output shaft is usually designed as a hollow shaft, allowing the gear unit to be mounted on an existing machine shaft. If the axial installation space is limited, a bevel gear is typically used.

### Drive output:

A geared motor basically converts electrical energy into mechanical energy at a required speed. Usually, high speeds are converted into lower ones. The power requirement first has to be specified by the engineering team.

This determines the motor power required and the gear size to be used. Depending on the application, electric motors of different strengths have to be used to cover the requirements of the application and at the same time ensure trouble-free operation. At the same time, oversizing or undersizing of the drive components is to be avoided.

The interactive product catalog „**cat4CAD**“ will help you to choose the best drive component from our entire range of gear units/geared motors and modular motor systems.

**cat4CAD**

Online Version: [www.cat4cad.com](http://www.cat4cad.com)  
Offline Version available as download at  
[www.wattdrive.com](http://www.wattdrive.com)

# Checklist: What are the key questions when purchasing geared motors?

## Basics

- What are the exact power requirements for the gear unit (power, speed, torque, service factor)?
- What type of gear is required?
- Which main and mounting dimensions are required?

## Ambient Conditions

- What installation space/room is available? Where will the gear unit be installed?
- What are the special ambient conditions (e.g. installation site, dirt/dust, explosion hazard, temperature, etc.)?

## Additional Information

- What processing characteristics are required (corrosion protection, coating structure, paint, etc.)?
- Housing material? Shaft material?
- Is the geared motor required for frequency inverter operation?

## Markets

- Does the motor have to be suitable for different markets (supply voltage, frequency)?
- Which certifications are required (CE, CSA, UL, EAC etc.)?
- Which efficiency guidelines and standards must be observed?

## Service

- What delivery times can the manufacturer offer?
- What is the gear manufacturer's global service network like?
- Can the gear manufacturer offer solutions for the entire drive train?



If you have any questions about geared motors or need some advice about your planned application, please get in touch with us:

**WEG Electric Corporation**  
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## About WEG

WEG is one of the world's leading manufacturers of electrical components and systems. The business is divided into five divisions: motors, power generation, power transmission and distribution, automation and varnishes. The company employs more than 31,000 people worldwide and in 2018 achieved sales of approx. 3 billion USD across a broad range of products. These include the latest generation of low/medium and high-voltage motors, transformers, generators, geared motors, low-voltage switchgear, frequency inverters, soft starters, ATEX-compliant flameproof motors, smoke extraction motors and full turnkey systems.

The company's solutions in the field of power generation, transmission and distribution guarantee more efficient plant operation in various industries, e.g. the oil and gas industry, water management, power distribution and the chemical and petrochemical industries. This means that they not only help to reduce energy consumption and CO2 emissions, but also improve environmental sustainability. WEG also provides comprehensive solutions for renewable energy projects, e.g. complete wind turbines.

## About Watt Drive

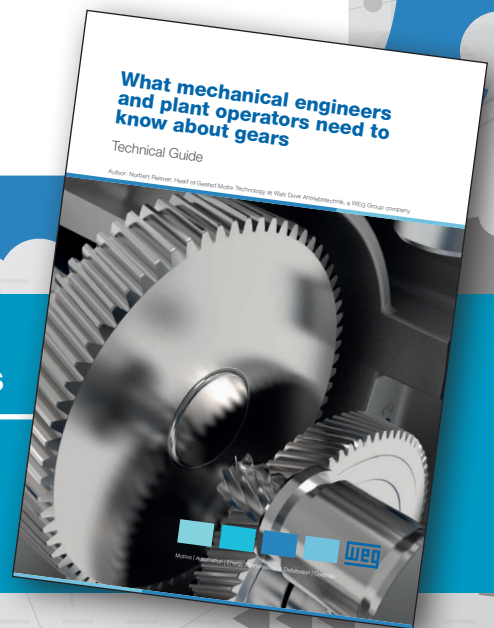
Watt Drive, specialized in the development and manufacture of gear technology based in Markt Piesting, is part of the Brazilian WEG Group, one of the world's leading manufacturers of electric motors. Watt Drive sells products and solutions in the fields of drive technology and automation all over the world. With its modular motor and gear system, the company offers a complete range of combinable drive systems for production machines and industrial manufacturing plants.

More informationen:

[www.weg.net](http://www.weg.net)  
[www.wattdrive.com](http://www.wattdrive.com)

## Everything you always wanted to know about gears

Read our Technical Guide, available here:  
[www.weg.net/us/WG20TechGuide](http://www.weg.net/us/WG20TechGuide)





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