

## Dimensioning of a drive system

### ■ Why is correct drive system dimensioning important?

Dimensioning of a drive system is a task where all factors have to be considered carefully. It requires knowledge of the whole system including electric supply, the driven machine, environmental conditions, motors and drives etc. Correct drive dimensioning will mean you get the correct drive installation, powerful enough for your requirements, yet not too large, forcing you to spend more money than you need.

Time spent at the dimensioning phase can mean considerable cost savings.



*Dimensioning a drive system is a question of methodically going through all the components in the right order*

### ■ How do I dimension my drive system?

Dimensioning an AC drive and motor system follows a set sequence, ensuring that the correct result is achieved. When the motor has been dimensioned, the dimensioning of each subsequent component in the drive chain depends on data decided or calculated in the previous stages.

Shown below is a table of the data needed for the dimensioning and selection of each component.

Component	What parameters need to be determined
<b>For a complete drive system</b>	<ul style="list-style-type: none"><li>• Required power and load type for the application</li><li>• Speed range</li></ul>
<b>Motor</b>	<ul style="list-style-type: none"><li>• Minimum speed <math>n_{\min}</math></li><li>• Maximum speed <math>n_{\max}</math></li><li>• Base speed <math>n_{\text{base}}</math></li><li>• Thermal loadability</li></ul>
<b>Frequency Converter</b>	<ul style="list-style-type: none"><li>• Required motor normal load and overload current.</li><li>• Duty cycle for overload</li><li>• Network/line supply unit output voltage</li></ul>
<b>Line supply unit</b>	<ul style="list-style-type: none"><li>• Required DC power in DC bus</li><li>• Duty cycle for overload</li><li>• Network voltage</li></ul>
<b>Transformer</b>	<ul style="list-style-type: none"><li>• Required load, apparent load power</li><li>• Primary and secondary side voltages</li></ul>



# TECHNICAL NOTES

*Proper dimensioning of drive systems will ensure you get the correct drive and motor combination, with the correct power and torque for your application. As a world-leading manufacturer of motors and drives, ABB sells a wide variety of products with a range of different power ratings. ABB staff are always ready to advise you on correct selection to ensure you get the best solution.*

## General steps for dimensioning the motor and the frequency converter

### 1. First check the initial conditions

In order to select the correct frequency converter and motor, check the mains supply voltage level (380 V ... 690 V) and frequency (50 Hz ... 60 Hz). The mains supply network's frequency does not limit the speed range of the application.

### 2. Check the process requirements

Is there a need for starting torque? What is the speed range used? What type of load will there be?

### 3. Select the motor

An electrical motor should be seen as a source of torque. The motor must withstand process overloads and be able to produce a specified amount of torque. The motor's thermal overloadability should not be exceeded. It is also necessary to leave a margin of around 30% for the motor's maximum torque when considering the maximum available torque.

### 4. Select the frequency converter

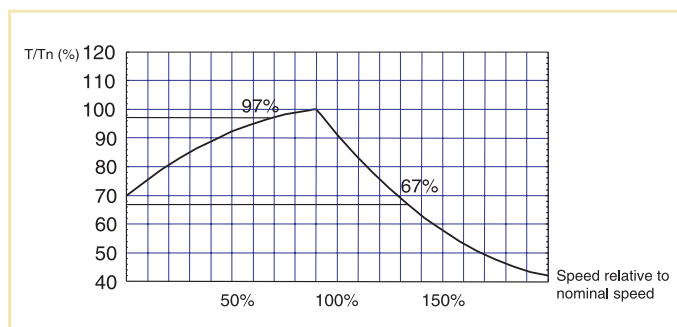
The frequency converter is selected to suit the initial conditions and the selected motor. The frequency converter's ability to produce the required current and power should be checked. Take advantage of the frequency converter's potential overloadability in case of a short-term cyclical load.

#### Example:

Centrifugal pumps, fans and mixers are typical drive applications.

An air-conditioning system, a fan, is to be converted for speed control. The application values are:

- Network voltage 400V, 50 Hz
- Power requirement 160 kW at a maximum speed of 2000 rpm.



Loadability curve

#### Motor Selection

In this application the torque requirement is proportional to the square of the speed, so only the operating point at the maximum speed needs to be considered.

The loadability curve shows loadability, at 2000 rpm, of 97% (2-pole motor) and 67% (4-pole motor), of the nominal torque.

Calculate the torque required at maximum speed:

$$T = (9550 * 160\text{kW}) / 2000 \text{ rpm} = 764 \text{ Nm}$$

The motor's nominal power should then be:

$$P_1 = ((764 \text{ Nm} / 0.97) * 3000 \text{ rpm}) / 9550 = 247 \text{ kW (2-poles)}$$

$$P_2 = ((764 \text{ Nm} / 0.67) * 1500 \text{ rpm}) / 9550 = 179 \text{ kW (4-poles)}$$

A 4-pole 200kW motor is selected.

#### Inverter selection

The motor current is calculated using the following formula and the loadability curve:

$$I_m = \text{motor rated current} * (\text{power requirement} / (\text{motor rated power} * 0.9)) = 351 \text{ A} * (160 \text{ kW} / (200 \text{ kW} * 0.9)) = 312 \text{ A}$$

The 0.9 factor comes from the loadability curve; loadability at 100% speed is 90%.

The selected inverter would have a value of  $I_{cont} = 312 \text{ A}$ .