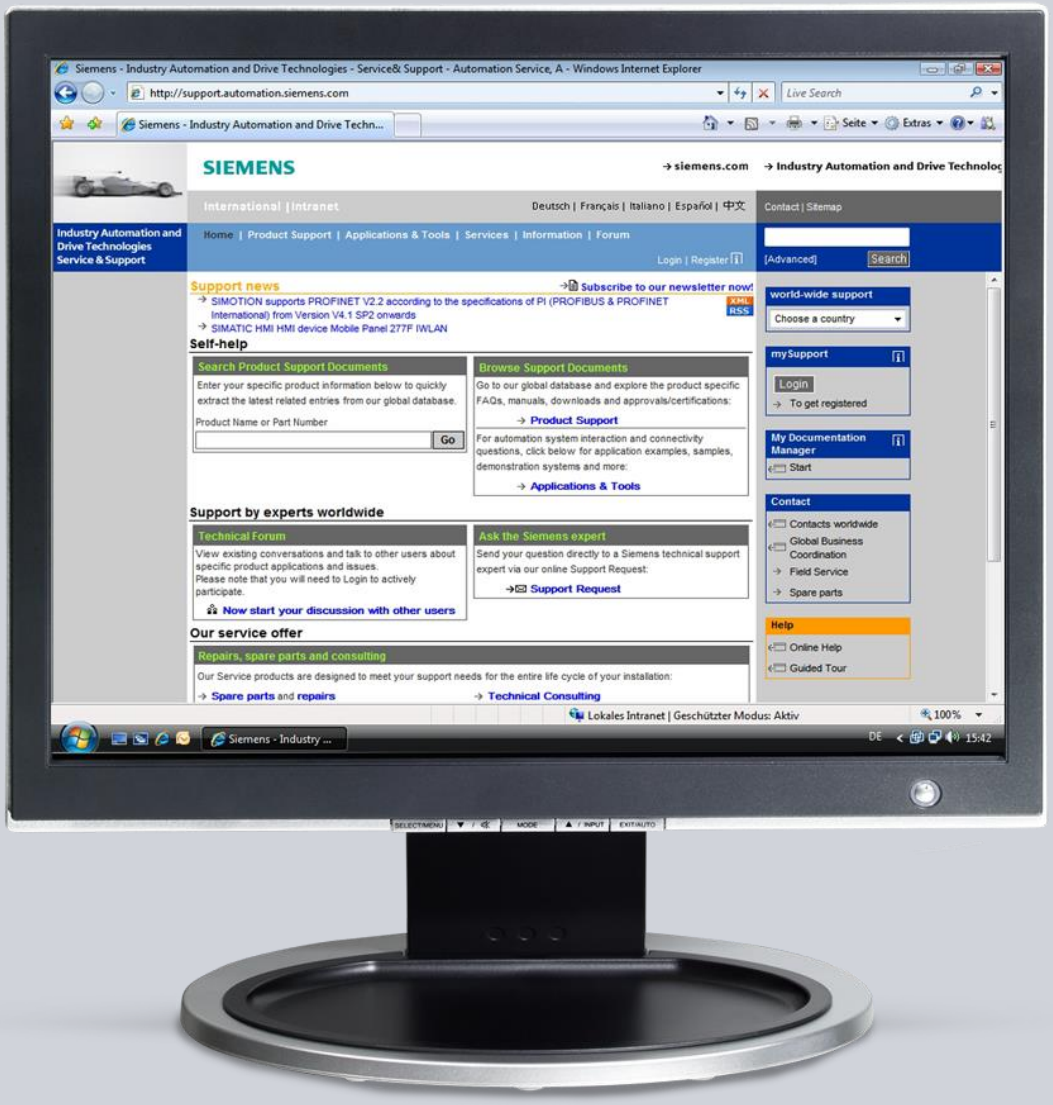
Creation of Efficiency Characteristics

Visualization of the partial load efficiency table in SIZER

FAQ • November 2013 (Update October 2016)



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Question

How can the partial load efficiency data created by SIZER be visualized?

Answer

To fully answer this question, follow the handling instructions and notes listed in this document.

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1 Supplementary conditions for the creation of partial load efficiency tables

Partial load efficiencies can be calculated under the following supplementary conditions.

1.1 Supply systems

- 230 V
- 400 V
- 500 V
- 690 V

1.2 Converter types / motor types

- G120 PM240/250 with standard induction motor
- G130 with standard induction motor
- G150 6-pulse/12-pulse with standard induction motor
- S120 AC/AC with standard induction motor, 1FT6/7, 1FK7, 1PH7/8, 1PL6, 1FW3, 1FW6,

  1FE, 1FN
- S150 with standard induction motor

1.3 Load types

- Simple Motor Selection

2 Creating a drive system – single drive

Create a new project via SIZER, specify the supply system properties and create a new drive system.

Fig. 2-1

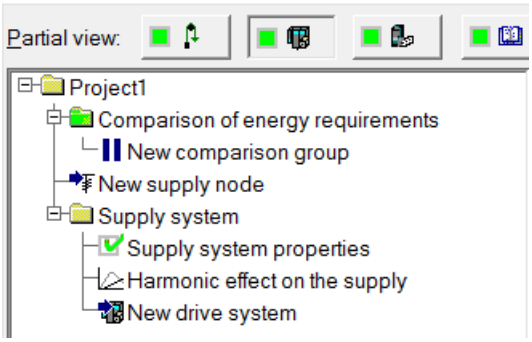
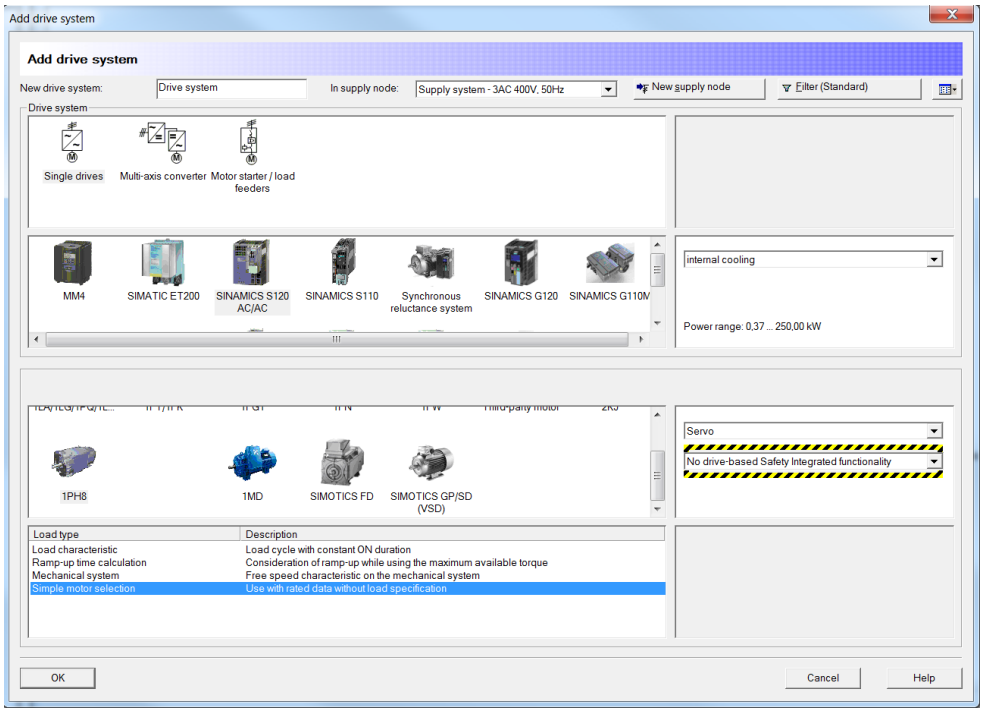


Fig. 2-2



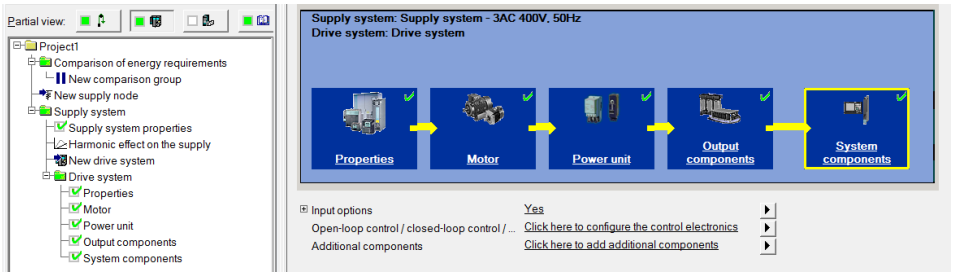
You can select the required converter and motor in the drive system. The supported components are listed in Chapter 1.

3 Configuring the complete drive system

The complete drive system (motor, power unit, output/system components) must be configured so that the partial load efficiency table can be displayed. Each checkbox must have a green check mark. (See Fig. 3-1)

Afterwards the motor required for calculation must be selected.

Fig. 3-1

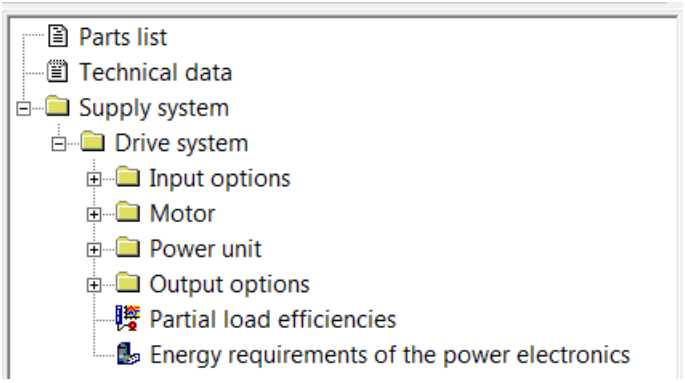


4 Display of the partial load efficiencies

4.1 Display in tabular form in the SIZER screen form

As soon as the drive system has been completely configured, the "Partial load efficiencies" item can be found in the "Results" tab, see Fig. 4-1.

Fig. 4-1



The power loss of the motor/converter and the partial load efficiencies of the entire system are displayed on the right in tabular form.

Fig. 4-2

Partial load efficiencies: Drive system "Drive system / Supply system"

Motor data: 1PH8	
n-rated	1500,00 rpm
P-rated	11,00 kW
M-rated	70,00 Nm

Converter data: SINAMICS S120 AC/AC - servo	
I-rated	25,00 A
I-max	38,00 A

Typical average motor power loss [kW]

Share of permissible constant torque	40%	60%	80%	100%
Speed [rpm]				
300,00	0,45	0,77	1,23	1,82
375,00	0,47	0,80	1,26	1,85
495,00	0,53	0,86	1,32	1,90
750,00	0,67	0,96	1,35	1,87
1005,00	0,87	1,12	1,46	1,90
1500,00	1,46	1,64	1,88	2,20

Typical average converter power loss [kW]

Share of permissible constant torque	40%	60%	80%	100%
Speed [rpm]				
300,00	0,20	0,24	0,28	0,33
375,00	0,20	0,24	0,28	0,33
495,00	0,20	0,24	0,29	0,33
750,00	0,20	0,24	0,28	0,33
1005,00	0,20	0,24	0,28	0,32
1500,00	0,20	0,23	0,26	

Drive system efficiency (converter and motor)

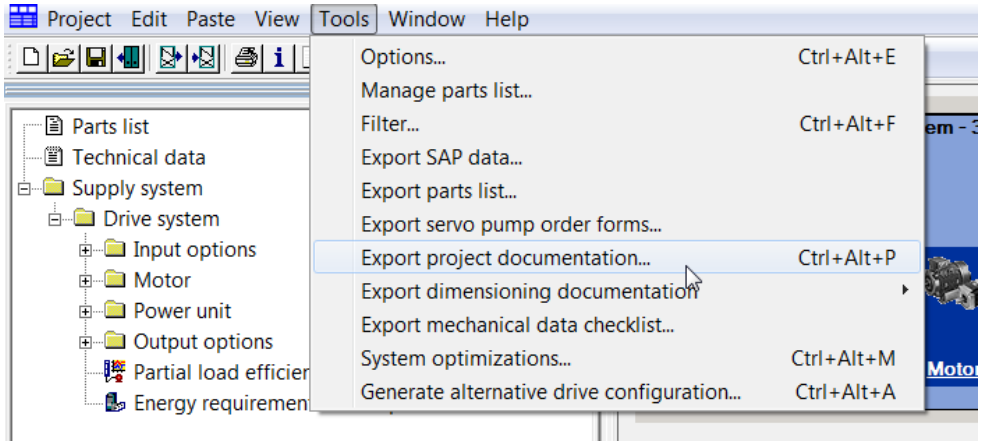
Share of permissible constant torque	40%	60%	80%	100%
Speed [rpm]				
300,00	0,650	0,640	0,614	0,583
375,00	0,689	0,683	0,660	0,633
495,00	0,729	0,729	0,712	0,689
750,00	0,762	0,778	0,774	0,761
1005,00	0,764	0,794	0,800	0,797
1500,00	0,726	0,780	0,804	

Liability for the correctness of the energy requirement data is excluded. The energy consumption of a drive system depends on the operation and ambient conditions and contains physical power losses that cannot be fully determined.

4.2 Exporting the project documentation

Since the data cannot be copied from the integrated table, a Word document must be created via the menu command "Tools" > "Export project documentation". (See Fig. 4-3)

Fig. 4-3



5 Excel tool for the visualization of the partial load efficiencies

Excel tool:

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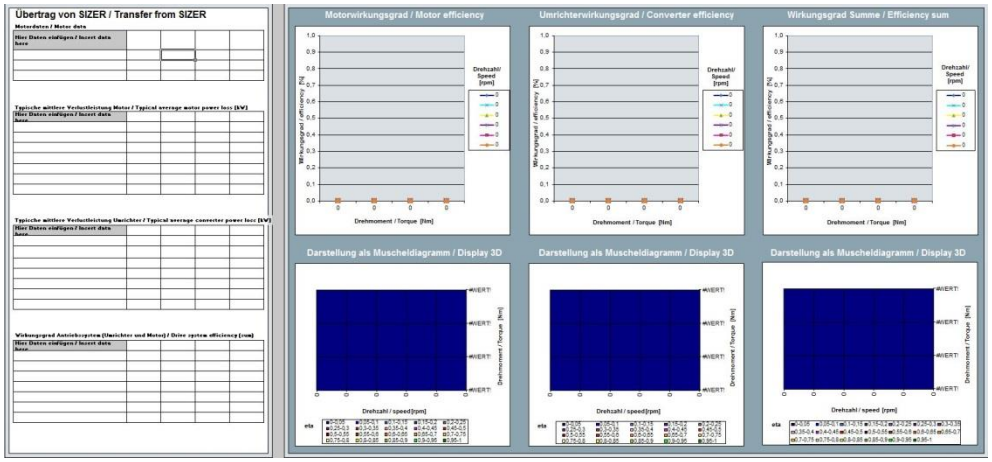
The Excel tool provides the opportunity to display of the partial load efficiencies of the motor, the converter and the entire system, see Fig. 5-1.

The table values from SIZER are inserted in the left-hand area. The visual display is located in the right-hand area. Here, the top diagram displays the efficiency curve for various speeds in relationship to the torque. The bottom diagram displays the complete calculated speed/torque range. The efficiency is shown in color. So a three dimensional diagram is obtained.

Fig. 5-1



6 Transfer of the values calculated with SIZER to the Excel tool

The exported Word document is opened in order to copy the individual tables of Section 2.2.1.

For this purpose, the cursor must be moved over the table and then the displayed cross right-clicked in order to be able to select "Copy". (See Fig. 6-1)

Fig. 6-1

2.2. Drive system "Drive system"

2.2.1. Partial load efficiencies

Motor data: 1PH8		Converter data: SINAMICS S120 AC/AC - servo	
n-rated	1500,00 rpm	I-rated	25,00 A
P-rated	11,00 kW	I-max	38,00 A
M-rated	70,00 Nm		

Typical average motor power loss [kW]

Share of permissible constant torque	40%	60%	80%	100%
Speed [rpm]				

The table values are now stored on the clipboard.

Now switch to the opened Excel tool. The copied table can be inserted in the provided cell. In this step it is important to transfer only the contents but not the format. For this purpose the shortcut “Ctrl+ALT+V” or the context menu can be used (see Fig. 6-2). In case of the context menu select “Paste Special…” and use the format “Text” in the following dialog window. (See Fig. 6-3)

Fig. 6-2

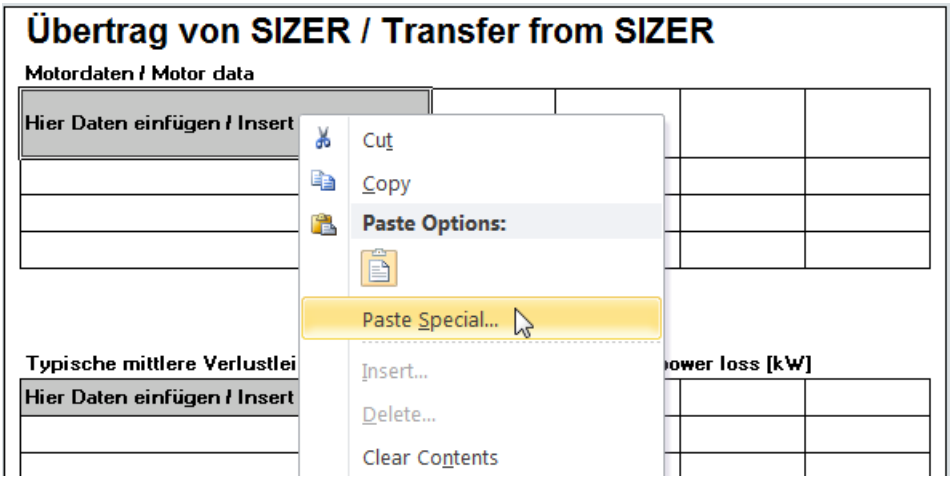
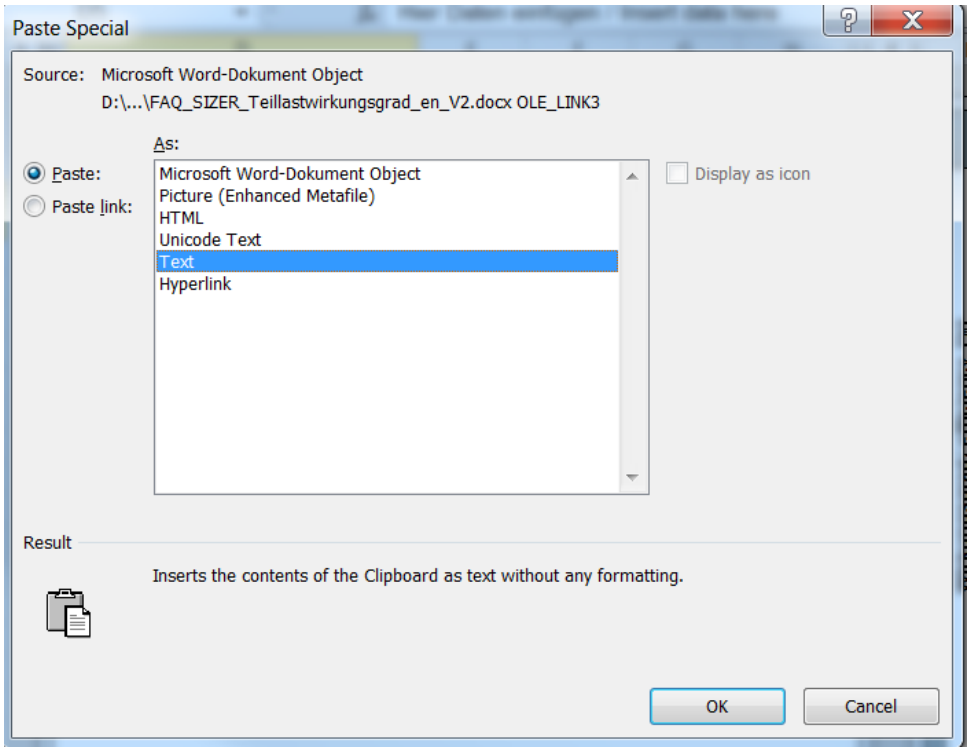


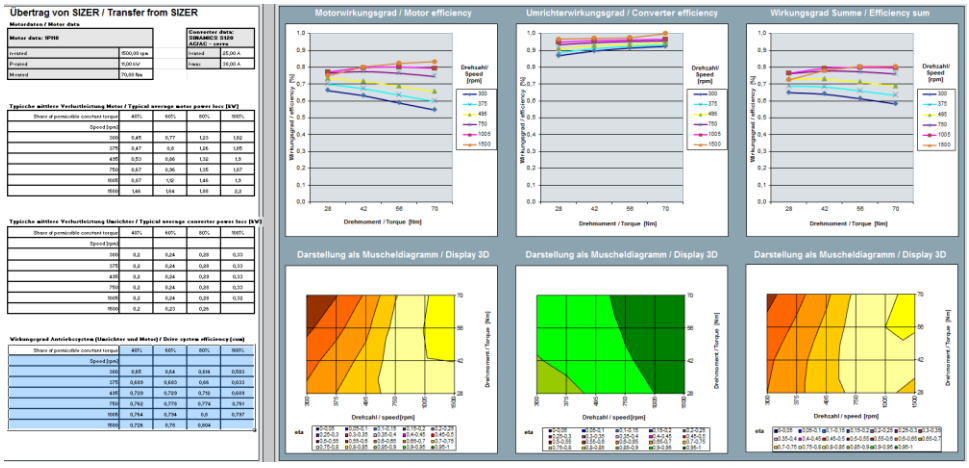
Fig. 6-3



In general, the shortcut „Ctrl+V“ could be used as well or inserting via the context menu. In this case the feature “locked cells” from the SIZER project documentation will be copied as well. This means that after saving and opening again the Excel file, the input cells cannot be changed anymore.

Fig. 6-4, for example, shows motor, converter and system efficiency characteristics.

Fig. 6-4

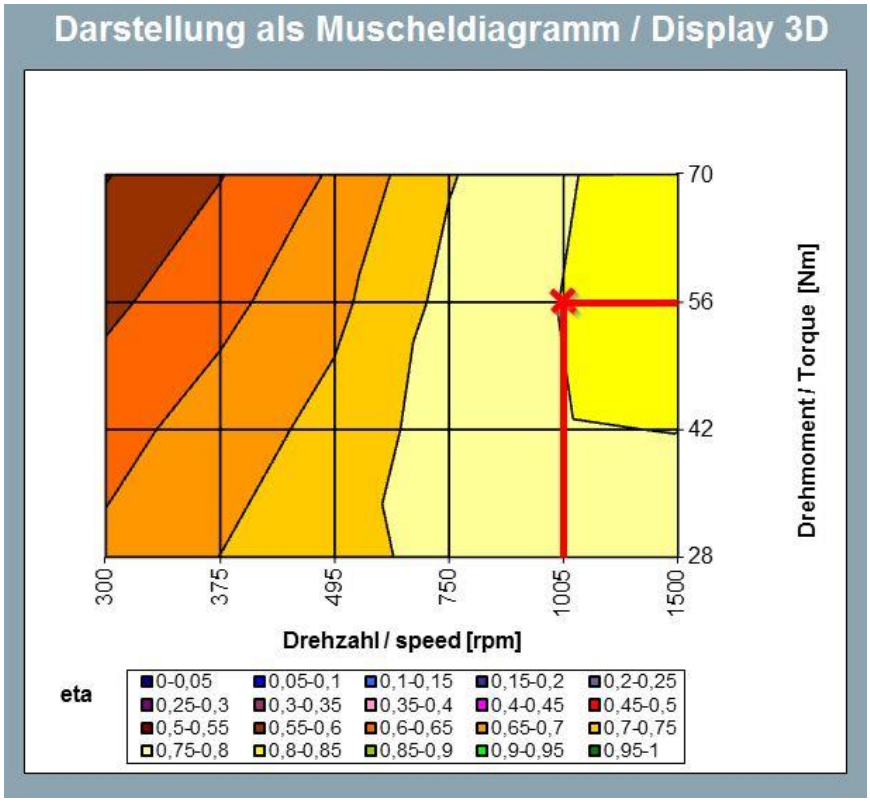


Example: Reading the efficiency in the output contour diagram

The operating point is read on from the horizontal and vertical diagram axis (x-axis: speed, y-axis: torque). The colored area specifies in each case an efficiency area of 5%.

Fig. 6-5, for example, shows the operating point 56 Nm at 1005 rpm. The efficiency in this case is between 0,8 and 0,85.

Fig. 6-5



7 Possible lack of definition effects during the motor efficiency calculation via SIZER

- Converter operation / sinusoidal infeed

  SIZER always calculates during converter operation. With some motors, the efficiency in the catalog / configuration manual is specified for sinusoidal infeed. The efficiency with sinusoidal infeed tends to be higher than in converter operation because of the lower current ripple.

- Spread of the physical motor properties

  Depending on the value, a spread of up to 10% is possible in the specified range. Table 7-1, for example, shows the tolerances of a 1FK7 motor.

  Table 7-1

Motor list data		Typ. value	Guaranteed value
Stall current	I_0	± 3 %	± 7.5 %
Electrical time constant	T_{el}	± 5 %	± 10 %
Torque constant	k_T	± 3 %	± 7.5 %
Voltage constant	k_E	± 3 %	± 7.5 %
Winding resistance	R_{ph}	± 5 %	± 10 %
Moment of inertia	J_{mot}	± 2 %	± 10 %

- Simplification of the calculation required

  The efficiency is not calculated via a thermal model because this would be very time-consuming.

8 Summary

With the procedure described above and the use of the Excel tool, it is very easy to display efficiency curves in 2D and 3D. This provides a much better basic understanding of the range in which the motor should be operated, for example, in order to achieve the best possible efficiency. Whereby, greater emphasis should be placed on the range than on the specification of an absolute value. The system can be optimized when the optimum range is known.

Example of system optimization approaches:

- Optimum gear ratio in order to obtain the optimum efficiency range
- Optimum spindle gear ratio
- Optimum pinion diameter
- Optimum roller diameter
- Etc.

Note Liability for the correctness of the energy consumption data is excluded. The energy consumption of a drive system depends on the operating and ambient conditions and contains physical losses that cannot be completely determined.