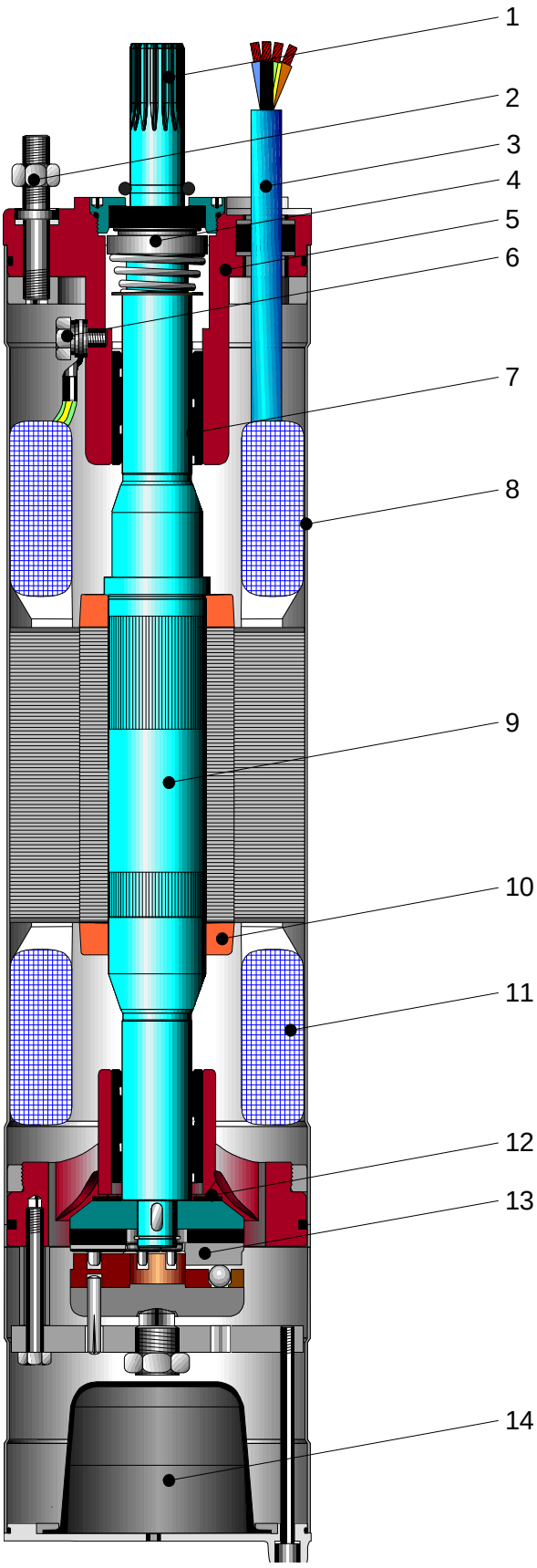
## Design of oddesse submersible motor

**Example: po-mo6.4**




1 shaft-end made of stainless steel

2 screws and nuts made of stainless steel

3 motor cable, usable for drinking water

4 wear-resistant mechanical seal

5 Motor flange

6 ground connection inside

7 bearings are lubricated by the motor filling

8 motor casing made of stainless steel

9 rotor dynamic balanced

10 short circuit rotor with copper rods for high efficiency

11 rewindable stator with a watertight insulated winding

12 up thrust bearing balance for negative axial thrust

13 thrust bearing with self-adjusting tilting pads, for both rotating directions

14 reliable pressure balance system

Subject to alterations

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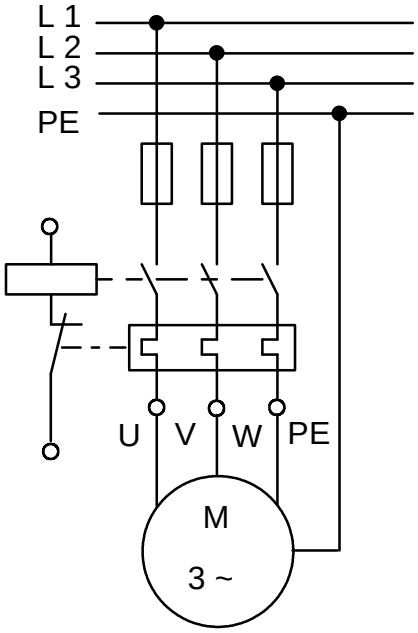
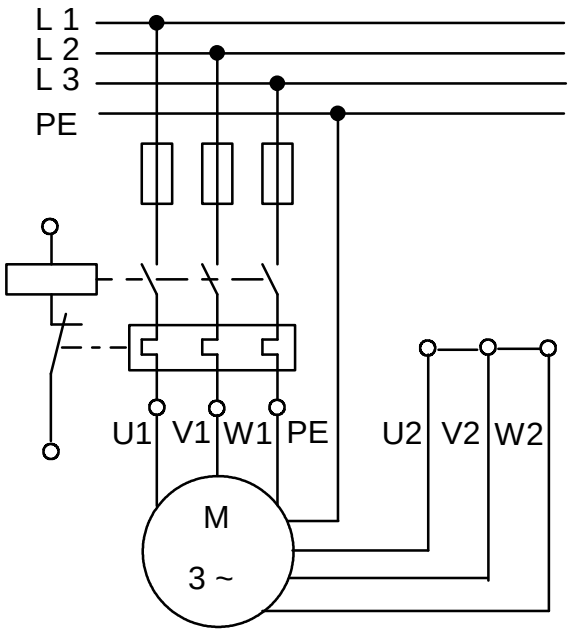
## Motor connection diagrams

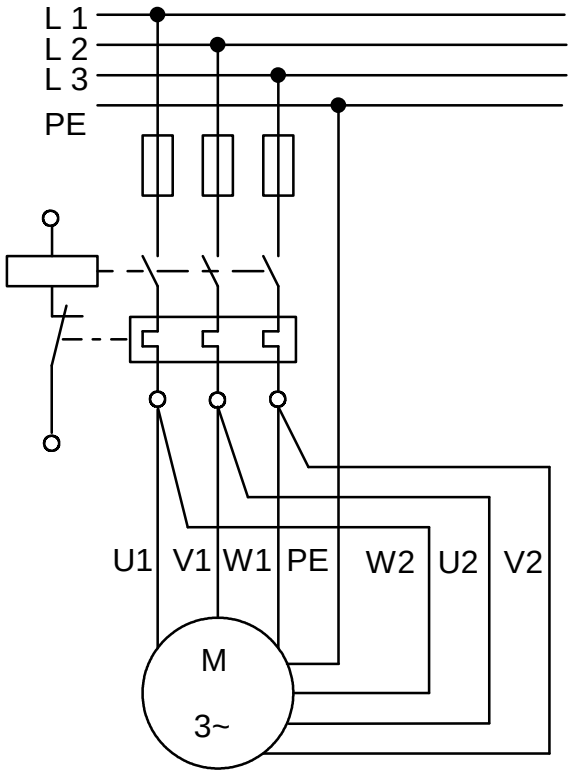
### Direct on line starting



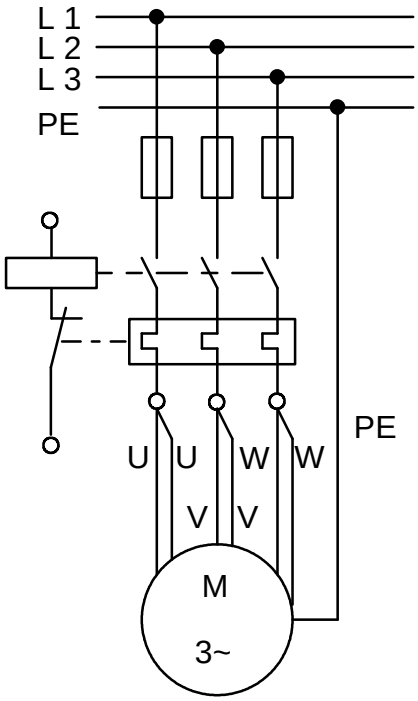

one power supply cable




two power supply cables
star circuit in switchboard



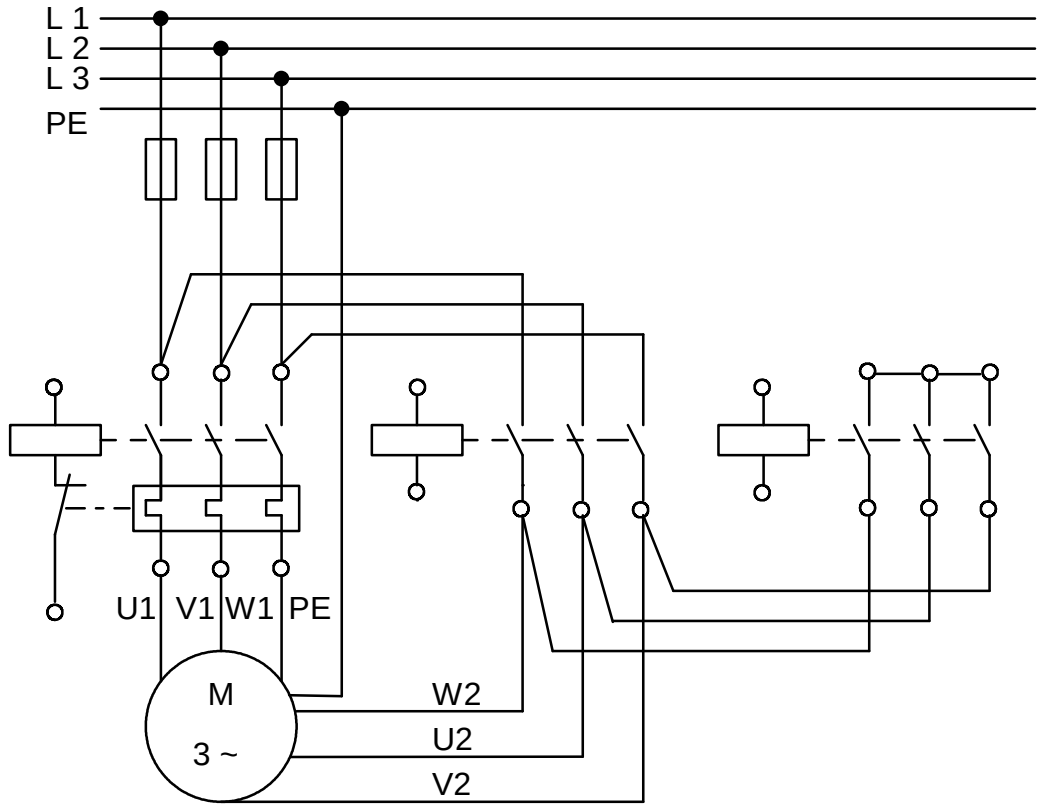

two power supply cables
delta circuit in switchboard




two power supply cables
parallel

Subject to alterations

**Star-delta-starting**




**Identification of the motor leads**

The colour and lettering identification of the cable ends of the motor leads see Table 1

| wire designation | | | colour designation |
|---|---|---|---|
| U | U1 | U2 | black |
| V | V1 | V2 | blue or grey |
| W | W1 | W2 | brown |
| PE | | | green / yellow |

Table 1:

Subject to alterations

## Instructions for cable dimensioning of submersible pumps

The minimum cross-section of the cable required results from the current charge while the current charge depends on the maximum ambient temperature (cf. tables). Another criterion for the cable selection (cable cross-section) is the voltage drop. In order to keep line losses at a reasonable level, we recommend a permissible voltage drop below 3 %.

The following diagrams will help you determine the cable cross-section for cable on D.O.L. starting (also applicable to auto-transformer starting) or star-delta starting. The curves shown characterise the range that ensures a voltage drop of 3 %. The power-factor is 0.85 and the voltage 400 V.

The diagrams are designed for **oddesse** multi-core cables with an ambient temperature of 30 °C, they are not depending on current frequency.

For higher temperatures and single-core cable use the tables to re-calculate found values.

For other service voltages than 400 V, the current has to be re-calculated. See also example 2

When specifying cross section dimensions, it should be considered that higher voltage loss means higher power loss and thus higher energy cost. Depending on operating time, it may be advisable to specify a value below the voltage losses to ensure trouble-free operation.

## Using of the diagrams

**General:**

Bring values on vertical (current) and horizontal (length) diagram axis to a projected cross-point to find right hand from there the required cross-section given for the cable line.

**Example 1:**

| | |
|---|---|
| D.O.L. starting: | |
| Service voltage: | 400 V |
| Rated current: | 75 A |
| Single cable length: | 180 m |
| Ambient temperature air/water: | 40 °C / 20 °C |

With a rated current of 75 A and a single cable length of 180 m you find in the diagram 1 a cross-section of 35 mm². The maximum allowed length is 210 m. The voltage loss is

$$U_V = \frac{180\ m}{210\ m} \cdot 3\% = 2.57\%$$

The next smaller cross-section is 25 mm². It is use able up to 98 m length. The voltage losses in this case is

$$U_V = \frac{180\ m}{98\ m} \cdot 3\% = 5.51\%$$

You have to select the cross-section of 35 mm² with a voltage losses of $U_V$ = 2.57 %.

The re-calculation of the current charge (see table below diagram 1) shows that this cross-section given may be used at 40 °C up to 147 A . The current charge i s in this case not a criterion for the cross-section to be defined.

subject to alterations

**Example 2**

| | |
|---|---|
| D.O.L. starting (service voltage different from 400 V !) | |
| Service voltage: | 440 V |
| Rated current: | 55 A |
| Single cable length: | 100 m |
| Ambient temperature air/water: | 40 ℃ / 20 ℃ |

Use the diagram correctly to re-calculate current charge

$$I_{calculated} = \frac{400\ V}{nom.voltage} \cdot nom.current$$

$$I_{calculated} = \frac{400\ V}{440\ V} \cdot 55\ A = 50\ A$$

With the calculated current you find in diagram 1 a cross-section of 16 mm² and a usable cable length of 160 m. The voltage loss at 100 m is:

$$U_v = \frac{100\ m}{160\ m} \cdot 3\ \% = 1.87\ \%$$

Select a cross-section of 16 mm² with a voltage loss of UV = 1.87 %.

For re-calculation of the current charge, use the rated current of 55 A (see table below diagram 1) that may be used (this cross-section) at 40 ℃ up to 90 A . The rated-current is, in this case, not a criterion for the cross-section.

**Example 3:**

| | |
|---|---|
| Star-delta starting | |
| Service voltage: | 400 V |
| Rated current: | 45 A |
| Single cable length: | 220 m |
| Ambient temperature air/water: | 40 ℃ / 20 ℃ |

The procedures are the same as in example 1 and 2. In this case use the diagram 2.

With a rated current of 45 A and a single cable length of 220 m you find in diagram 2 a cross-section of 16 mm². The maximum permissible length is 210 m. The voltage loss is

$$U_v = \frac{220\ m}{255\ m} \cdot 3\ \% = 2.59\ \%$$

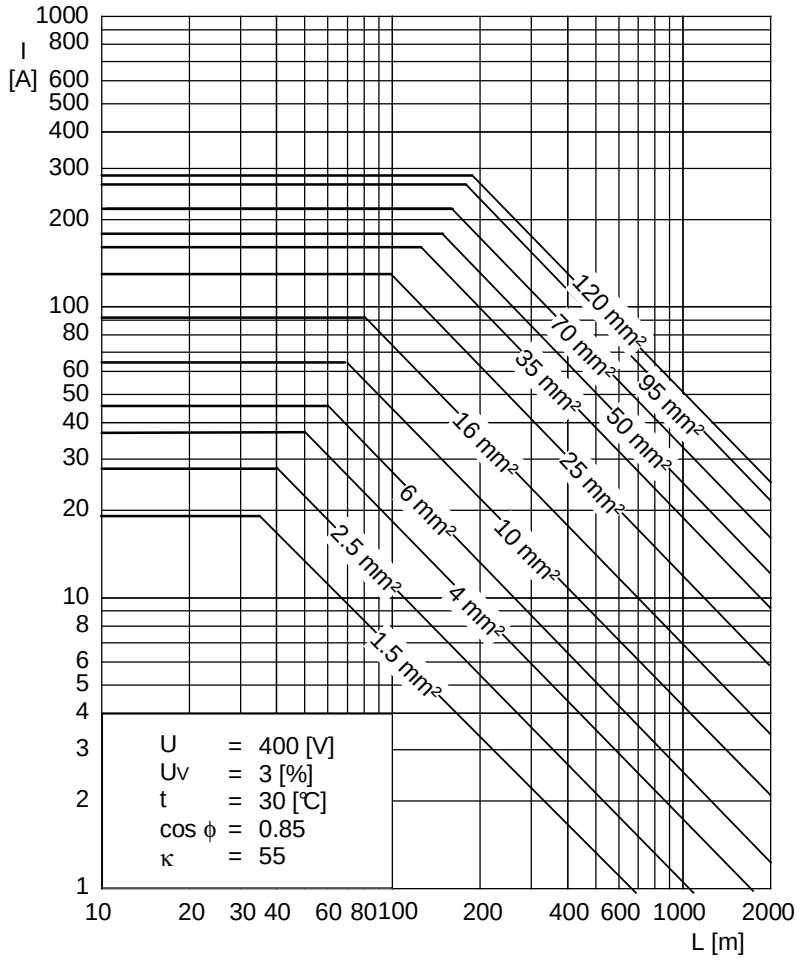
The next smaller cross-section is 10 mm². It is applicable up to 150 m length. The voltage losses in this case are

$$U_v = \frac{220\ m}{150\ m} \cdot 3\ \% = 4.40\ \%$$

Select cross-section of 16 mm² with a voltage loss of $U_V$ = 2.59 %.

The re-calculation of the current charge (see table below diagram 2) shows that this cross-section may be used at 40 ℃ up to 178 A . The current charge is, in this case, not a criterion for the cross-section.

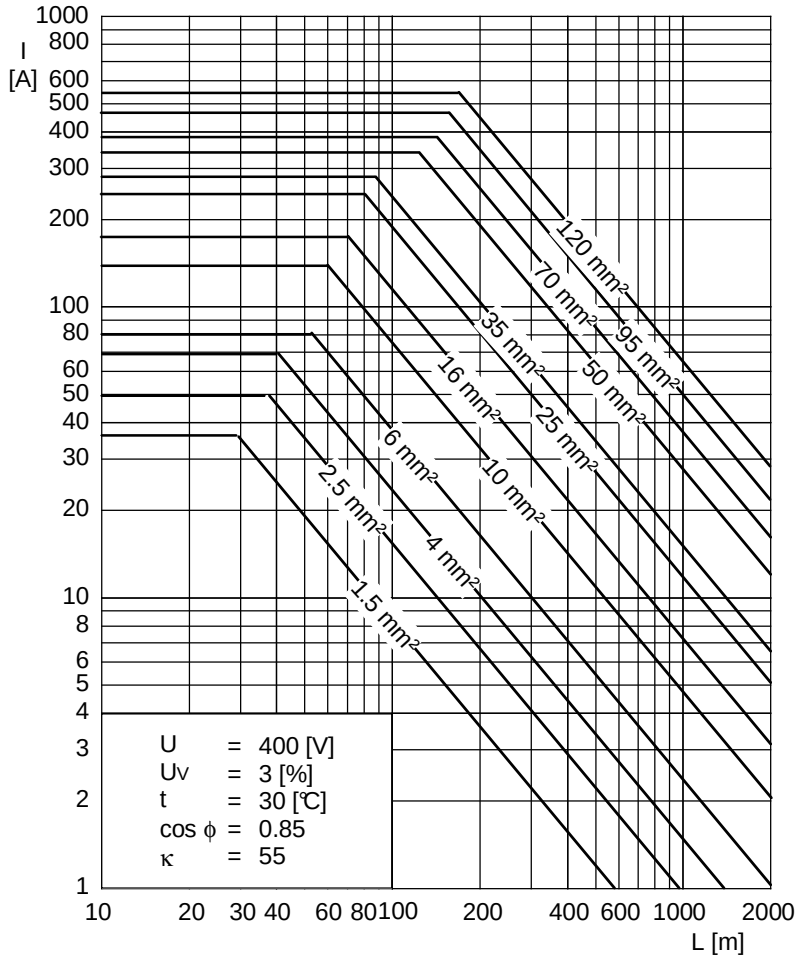
## Diagram 1: D.O.L and auto-transformer starting




| ambient temp. [℃] | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
|---|---|---|---|---|---|---|---|
| cross-section [mm²] | max. permissible current-carrying capacity multi-wire cables, 3 **current-carrying wires** | | | | | | |
| | Motor rated current [A] | | | | | | |
| 1.5 | 18 | 17 | 16 | 15 | 13 | 11 | 10 |
| 2.5 | 26 | 25 | 24 | 22 | 19 | 17 | 14 |
| 4 | 34 | 33 | 31 | 28 | 25 | 22 | 18 |
| 6 | 44 | 42 | 40 | 37 | 33 | 28 | 23 |
| 10 | 61 | 59 | 56 | 51 | 46 | 39 | 32 |
| 16 | 82 | 79 | 75 | 68 | 61 | 52 | 43 |
| 25 | 108 | 104 | 98 | 90 | 81 | 69 | 57 |
| 35 | 135 | 130 | 123 | 113 | 101 | 86 | 72 |
| 50 | 168 | 161 | 153 | 140 | 125 | 107 | 89 |
| 70 | 207 | 199 | 188 | 173 | 154 | 131 | 110 |
| 95 | 250 | 240 | 228 | 209 | 187 | 159 | 132 |
| 120 | 292 | 280 | 266 | 244 | 218 | 185 | 155 |

| ambient temp. [℃] | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
|---|---|---|---|---|---|---|---|
| cross-section t [mm²] | max. permissible current-carrying capacity multi-wire cables, **single wire cable** | | | | | | |
| | Motor rated current [A] | | | | | | |
| 6 | 54 | 52 | 49 | 45 | 40 | 34 | 29 |
| 10 | 73 | 70 | 66 | 61 | 54 | 46 | 39 |
| 16 | 98 | 94 | 89 | 82 | 73 | 62 | 52 |
| 25 | 129 | 124 | 117 | 108 | 96 | 82 | 68 |
| 35 | 158 | 152 | 144 | 132 | 118 | 100 | 84 |
| 50 | 198 | 190 | 180 | 165 | 148 | 126 | 105 |
| 70 | 245 | 235 | 223 | 205 | 183 | 156 | 130 |
| 95 | 292 | 280 | 266 | 244 | 218 | 185 | 155 |
| 120 | 344 | 330 | 313 | 287 | 257 | 218 | 182 |

## Diagram 2: star-delta-starting




| ambient temp. [℃] | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
|---|---|---|---|---|---|---|---|
| cross-section [mm²] | max. permissible current-carrying capacity multi-wire cables, 3 **current-carrying wires** | | | | | | |
| | Motor rated current [A] | | | | | | |
| 1.5 | 31 | 30 | 28 | 26 | 23 | 20 | 16 |
| 2.5 | 45 | 43 | 41 | 38 | 34 | 29 | 24 |
| 4 | 59 | 56 | 54 | 49 | 44 | 37 | 31 |
| 6 | 76 | 73 | 69 | 64 | 57 | 48 | 40 |
| 10 | 106 | 101 | 96 | 88 | 79 | 67 | 56 |
| 16 | 142 | 136 | 129 | 118 | 106 | 90 | 75 |
| 25 | 187 | 179 | 170 | 156 | 139 | 119 | 99 |
| 35 | 234 | 224 | 213 | 195 | 174 | 148 | 124 |
| 50 | 291 | 279 | 264 | 243 | 217 | 184 | 154 |
| 70 | 358 | 344 | 326 | 299 | 267 | 227 | 190 |
| 95 | 433 | 415 | 394 | 361 | 323 | 275 | 229 |
| 120 | 505 | 485 | 460 | 422 | 377 | 321 | 268 |

| ambient temp. [℃] | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
|---|---|---|---|---|---|---|---|
| cross-section [mm²] | max. permissible current-carrying capacity multi-wire cables, **single wire cable** | | | | | | |
| | Motor rated current [A] | | | | | | |
| 6 | 93 | 90 | 85 | 78 | 70 | 59 | 49 |
| 10 | 126 | 121 | 115 | 105 | 94 | 80 | 67 |
| 16 | 170 | 163 | 154 | 142 | 127 | 108 | 90 |
| 25 | 223 | 214 | 203 | 186 | 167 | 142 | 118 |
| 35 | 273 | 262 | 249 | 228 | 204 | 174 | 145 |
| 50 | 343 | 329 | 312 | 286 | 256 | 217 | 181 |
| 70 | 424 | 407 | 386 | 354 | 316 | 269 | 225 |
| 95 | 505 | 485 | 460 | 422 | 377 | 321 | 268 |
| 120 | 595 | 571 | 542 | 497 | 444 | 378 | 315 |

## Product range of oddesse submersible motors - 50 Hz

| motor power [kW] | motor power [HP] | 4 "-motors | single phase | three phase | rewindable motors | 6"-motors | 8"-motors | 10"-motors | 12"-motors | G-version | C-version AISI 304 | X-version AISI 316 | Y-versionl AISI 904L | 25K-motors $\Delta\upsilon \leq 25$ K (v = 0 m/s) | 50 °C water-temperature | 70/80 °C water-temperature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.37 | 0.5 | | × | × | | | | | | × | × | | | | | |
| 0.55 | 0.75 | | × | × | | | | | | × | × | | | | | |
| 0.75 | 1.0 | | × | × | | | | | | × | × | | | | | |
| 1.1 | 1.5 | | × | × | | | | | | × | × | | | | | |
| 1.5 | 2 | | × | × | | | | | | × | × | | | | | |
| 2.2 | 3 | | × | × | | | | | | × | × | | | | | |
| 3 | 4 | | | × | | | | | | × | × | | | | | |
| 4 | 5.5 | | | × | | × | | | | × | × | × | × | × | × | × |
| 5.5 | 7.5 | | | × | | × | | | | × | × | × | × | × | × | × |
| 7.5 | 10 | | | × | | × | × | | | × | × | × | × | × | × | × |
| 9.2 | 12.5 | | | | | × | | | | × | × | × | × | × | × | × |
| 11 | 15 | | | | | × | × | | | × | × | × | × | × | × | × |
| 13 | 17.5 | | | | | × | | | | × | × | × | × | × | × | × |
| 15 | 20 | | | | | × | × | | | × | × | × | × | × | × | × |
| 18.5 | 25 | | | | | × | × | | | × | × | × | × | × | × | × |
| 22 | 20 | | | | | × | × | | | × | × | × | × | × | × | × |
| 26 | 35 | | | | | × | | | | × | × | × | × | × | × | × |
| 30 | 40 | | | | | × | × | | | × | × | × | × | × | × | × |
| 34 | 45 | | | | | × | | | | × | × | × | × | × | × | × |
| 37 | 50 | | | | | × | × | | | × | × | × | × | × | × | × |
| 45 | 60 | | | | | × | × | | | × | × | × | × | × | × | × |
| 55 | 75 | | | | | | × | | | × | × | × | × | | × | × |
| 63 | 85 | | | | | | × | | | × | × | × | × | | × | × |
| 75 | 100 | | | | | | × | × | | × | × | × | × | | × | × |
| 90 | 125 | | | | | | × | × | | × | × | × | × | | × | |
| 110 | 150 | | | | | | × | × | | × | × | × | × | | | |
| 130 | 175 | | | | | | | × | | × | × | × | × | | | |
| 132 | 175 | | | | | | × | | | × | × | × | × | | | |
| 150 | 200 | | | | | | | × | × | × | × | × | × | | | |
| 170 | 230 | | | | | | | × | × | × | × | × | × | | | |
| 185 | 250 | | | | | | | | × | × | × | × | × | | | |
| 190 | 260 | | | | | | | × | | × | × | × | × | | | |
| 220 | 300 | | | | | | | × | | × | × | × | × | | | |
| 225 | 300 | | | | | | | | × | × | × | × | × | | | |
| 260 | 350 | | | | | | | | × | × | × | × | × | | | |
| 330 | 450 | | | | | | | | × | × | × | × | × | | | |
| 375 | 500 | | | | | | | | × | × | × | × | × | | | |
| 400 | 550 | | | | | | | | × | × | × | × | × | | | |

## Product range of oddesse submersible motors - 60 Hz

| motor power [kW] | motor power [HP] | 4 "-motors | single phase | three phase | rewindable motors | 6"-motors | 8"-motors | 10"-motors | 12"-motors | G-version | C-version AISI 304 | X-version AISI 316 | Y-versionl AISI 904L | 25K-motors $\Delta\upsilon \leq 25$ K (v = 0 m/s) | 50 °C water-temperature | 70/80 °C water-temperature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.37 | 0.5 | X | × | × | | | | | | × | × | | | | | |
| 0.55 | 0.75 | X | × | × | | | | | | × | × | | | | | |
| 0.75 | 1.0 | X | × | × | | | | | | × | × | | | | | |
| 1.1 | 1.5 | X | × | × | | | | | | × | × | | | | | |
| 1.5 | 2 | X | × | × | | | | | | × | × | | | | | |
| 2.2 | 3 | X | × | × | | | | | | × | × | | | | | |
| 3 | 4 | X | × | × | | | | | | × | × | | | | | |
| 4 | 5.5 | X | | × | X | × | | | | × | × | × | × | × | × | × |
| 4.6 | 6.3 | | | | X | × | | | | × | × | × | × | × | × | × |
| 5.5 | 7.5 | X | | × | X | × | | | | × | × | × | × | × | × | × |
| 6.3 | 8.5 | | | | X | × | | | | × | × | × | × | × | × | × |
| 7.5 | 10 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 8.5 | 11.5 | | | | X | | × | | | × | × | × | × | × | × | × |
| 9.2 | 12.5 | | | | X | × | | | | × | × | × | × | × | × | × |
| 11 | 15 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 13 | 17.5 | | | | X | × | | | | × | × | × | × | × | × | × |
| 15 | 20 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 17 | 23 | | | | X | | × | | | × | × | × | × | × | × | × |
| 18.5 | 25 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 22 | 20 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 26 | 35 | | | | X | × | | | | × | × | × | × | × | × | × |
| 30 | 40 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 34 | 45 | | | | X | × | | | | × | × | × | × | × | × | × |
| 37 | 50 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 45 | 60 | | | | X | × | × | | | × | × | × | × | × | × | × |
| 55 | 75 | | | | X | | × | | | × | × | × | × | | × | × |
| 63 | 85 | | | | X | | × | | | × | × | × | × | | × | × |
| 75 | 100 | | | | X | | × | | | × | × | × | × | | × | |
| 85 | 115 | | | | X | | | × | | × | × | × | × | | | |
| 90 | 125 | | | | X | | × | | | × | × | × | × | | | |
| 100 | 150 | | | | X | | × | | | × | × | × | × | | | |
| 110 | 150 | | | | X | | × | × | | × | × | × | × | | | |
| 125 | 170 | | | | X | | | × | | × | × | × | × | | | |
| 130 | 175 | | | | X | | | × | | × | × | × | × | | | |
| 132 | 175 | | | | X | | × | × | | × | × | × | × | | | |
| 150 | 200 | | | | X | | | × | × | × | × | × | × | | | |
| 170 | 230 | | | | X | | | × | × | × | × | × | × | | | |
| 185 | 250 | | | | X | | | | × | × | × | × | × | | | |
| 190 | 260 | | | | X | | | × | | × | × | × | × | | | |
| 220 | 300 | | | | X | | | × | | × | × | × | × | | | |
| 225 | 300 | | | | X | | | | × | × | × | × | × | | | |
| 260 | 350 | | | | X | | | | × | × | × | × | × | | | |
| 330 | 450 | | | | X | | | | × | × | × | × | × | | | |
| 375 | 500 | | | | X | | | | × | × | × | × | × | | | |
| 400 | 550 | | | | X | | | | × | × | × | × | × | | | |
| 450 | 600 | | | | X | | | | × | | | | | | | |