

Gear Programme





Gears

NECKAR motors can be combined with a variety of spur, worm and planetary gears.

Gears are required to adapt the motor to the drive machine for which they have two important functions.

1) Gears reduce the speed by the gear reduction "i"

$$n_{\text{gear}} = \frac{n_{\text{Motor}}}{i}$$

2) Gears increase the torque of the motor:

$$M_{\text{gear}} = M_{\text{motor}} \times i \times \eta$$

$$\eta = (\text{Efficiency})$$

The efficiency η of the gear depends on the design, number of steps, lubrication and other factors.

If the efficiency is 50% for example, i.e. $\eta = 0.5$

for a gear reduction of

$$i = 10,$$

the motor torque will be increased by a factor of

$$= i \times \eta = 5.$$

The (required) increase in torque must not of course exceed the **maximum permitted** torque for the gear.

$$M_{\text{gear}} \leq M_{\text{max}}$$

M_{max} is therefore always given in the following tables.

In order to get a uniform service life for the motor and gear various "types of load" must be taken into consideration.

Depending on whether the load is

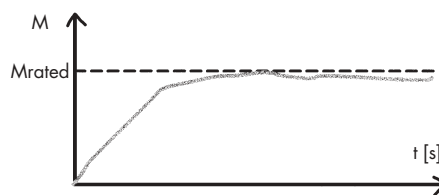
- uniform
- pulsating
- surging

the maximum torque M_{max} given in the table is reduced by the application factor f_B , which is then the actually useable torque on the output of the gear.

$$M_{\text{useable}} = f_B \times M_{\text{max}}$$

The application factors for the 3 types of load are given in Diagrams 1 to 3.

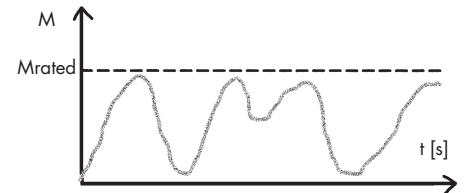
Load type: uniform



Application factor f_B			
Operation type	Operation type		
	3h/day	8h/day	24h/day
One rotation direction	1	0.83	0.66
Rotation reversal	0.83	0.63	0.52

Diagram 1

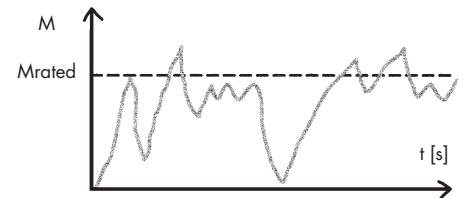
Load type: pulsating



Application factor f_B			
Operation type	Operation type		
	3h/day	8h/day	24h/day
One rotation direction	0.77	0.66	0.55
Rotation reversal	0.63	0.53	0.43

Diagram 2

Load type: surging



Application factor f_B			
Operation type	Operation type		
	3h/day	8h/day	24h/day
One rotation direction	0.66	0.55	0.45
Rotation reversal	0.50	0.43	0.35

Diagram 3

For a surging load (Diagram 3) the application factor is

$$f_B = 0.5$$

for an operating period of < 3 hours per day as well as for possible rotation reversal.

This is a considerable reduction of the table value and must not never be forgotten when designing a drive. In general, "driving against a block" or "blocking" the gear is not permitted. The resulting torque is of short duration and extremely large and can destroy the gear.



High Power Spur Gears

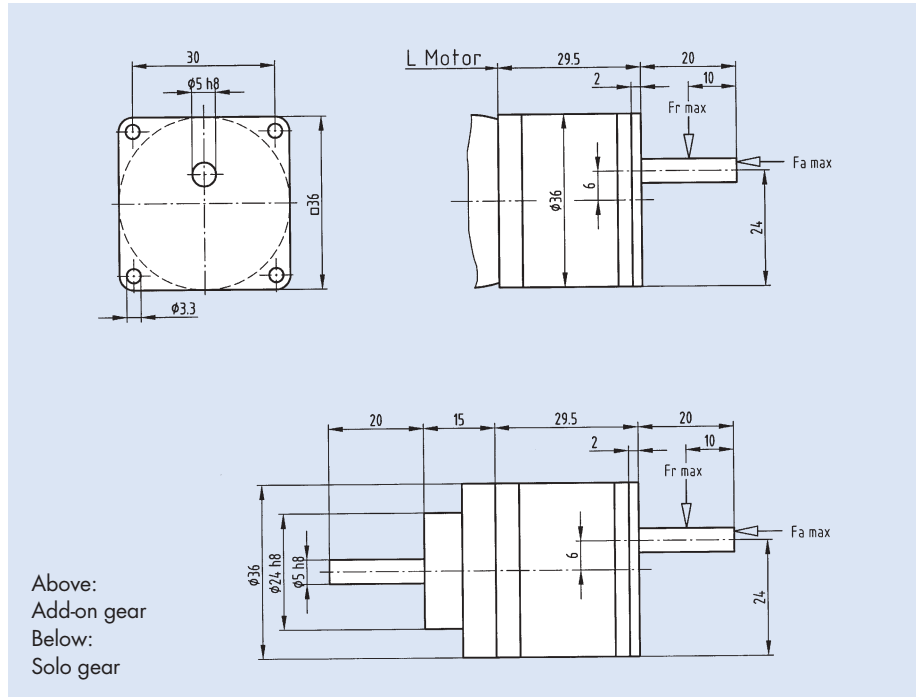
Series Z, Type 3

Advantages:

- Series optimised for high torque
- For many application the series offers cost-effective alternatives to planetary gears
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Properties:

- Through the use of a new construction principle a starting torque has been achieved which is *2 to 10 times greater than that for previous models at the same transmission ratio.*
- This considerable increase in torque does not impair the long service life of the Z-gears.
- Z-gears can be installed in any chosen position. All the models can be supplied as solo gears.



Above:
Add-on gear
Below:
Solo gear

Design

Component	Z3
Input stage	Spiral gearing, hardened steel
Housing material	Aluminium
Wheel, pinion material	Hardened steel
Output shaft bearing	A-side Roller bearing B-side Plain bearing
Output shaft max. load capacity	50 N radial 3 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5,000 rev/min ⁻¹

Series Z3 Output torque 0.5 – 1.2 Nm

Transmission ratio $i^{(2)}$	No. of stages	$M_{\max}^{(1)}$ Nm	η	Weight g
4.96	2	0.5	0.90	76
10.1	2	0.5	0.90	
16.3	2	0.5	0.90	
23.1	3	1.2	0.85	84
28.7	3	1.2	0.85	
37.3	3	1.2	0.85	
46.3	3	1.2	0.85	
52.9	4	1.2	0.81	92
65.5	4	1.2	0.81	
85.3	4	1.2	0.81	
106	4	1.2	0.81	
131	4	1.2	0.81	

¹⁾ M_{\max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



High Power Spur Gears

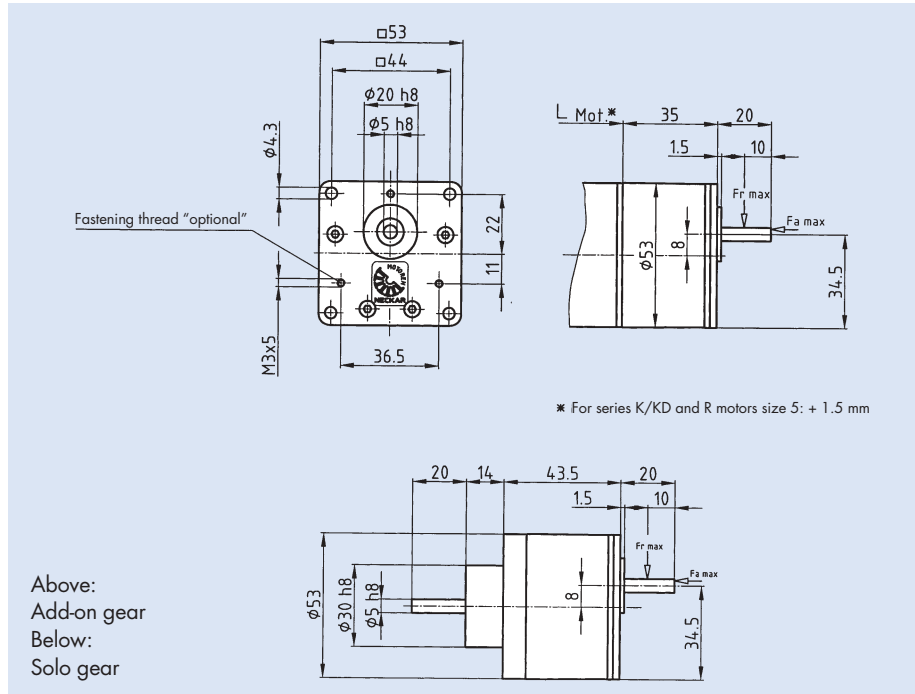
Series Z, Type 5

Advantages:

- Series optimised for high torque
- For many application the series offers cost-effective alternatives to planetary gears
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Properties:

- Through the use of a new construction principle a starting torque has been achieved which is *2 to 10 times greater than that for previous models at the same transmission ratio.*
- This considerable increase in torque does not impair the long service life of the Z-gears.
- Z-gears can be installed in any chosen position. All the models can be supplied as solo gears.



Design

Component	Z5
Input stage	Spiral gearing, hardened steel
Housing material	Zinc diecasting
Wheel, pinion material	Hardened steel
Output shaft bearing	A-side Roller bearing B-side Plain bearing
Output shaft max. load capacity	90 N radial 5 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5,000 rev/min ⁻¹

Series Z5 Output torque 1 – 3.3 Nm

Transmission ratio $i^{(2)}$	No. of stages	$M_{max}^{(1)}$ Nm	η	Weight g
4.55	2	1.0	0.90	200
8.9	2	2.0	0.90	
13	2	2.0	0.90	
17.4	2	2.0	0.90	
25	3	3.0	0.85	225
35.5	3	3.0	0.85	
43.5	3	3.0	0.85	
46.2	4	3.3	0.81	
62.2	4	3.3	0.81	
82	4	3.3	0.81	
96	4	3.3	0.81	
110	4	3.3	0.81	
128	4	3.3	0.81	
145	4	3.3	0.81	
158	4	3.3	0.81	
194	4	3.3	0.81	

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



High Power Spur Gears

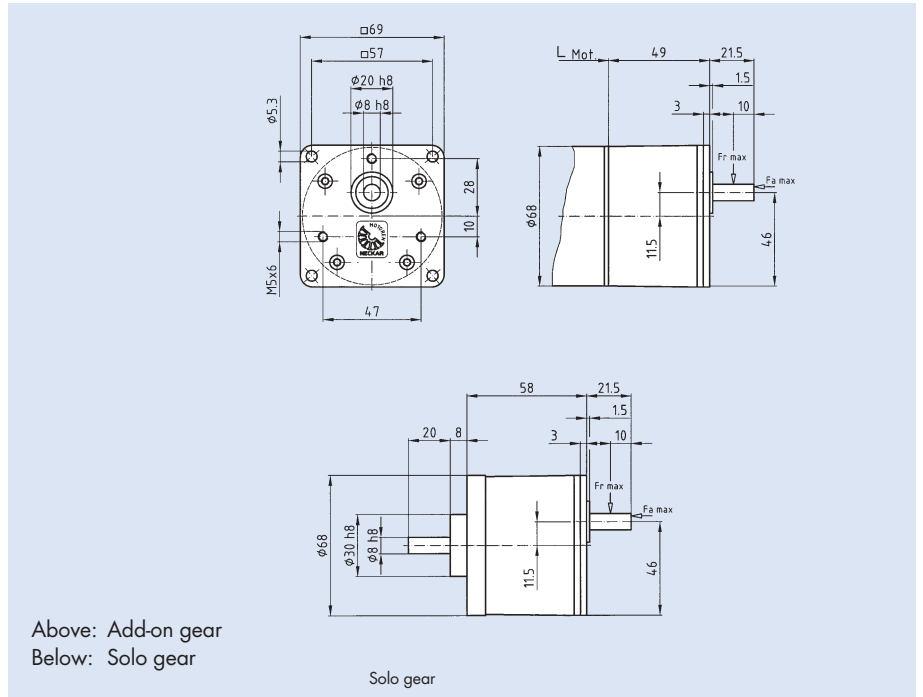
Series Z, Type 6

Advantages:

- Series optimised for high torque
- For many application the series offers cost-effective alternatives to planetary gears
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Properties:

- Through the use of a new construction principle a starting torque has been achieved which is *2 to 10 times greater than that for previous models at the same transmission ratio.*
- This considerable increase in torque does not impair the long service life of the Z-gears.
- Z-gears can be installed in any chosen position. All the models can be supplied as solo gears.



Design

Component	Z 6
Input stage	Spiral gearing, hardened steel
Housing material	Zinc diecasting
Wheel, pinion material	Hardened steel
Output shaft bearing	A-side Roller bearing B-side Plain bearing
Output shaft max. load capacity	220 N radial 22 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5,000 rev/min ⁻¹

Series Z 6 Output torque 2.5–7 Nm

Transmission ratio $i^{(2)}$	No. of stages	$M_{\max}^{(1)}$ Nm	η	Weight g
4.82	2	2.5	0.90	300
10.4	2	5.5	0.90	
15.4	2	5.5	0.90	
20.5	2	5.5	0.90	
24.7	3	6.5	0.85	340
31.6	3	6.5	0.85	
42	3	6.5	0.85	
48.9	3	6.5	0.85	
64.8	4	7	0.81	380
86.1	4	7	0.81	
100	4	7	0.81	
117	4	7	0.81	
136	4	7	0.81	
155	4	7	0.81	
181	4	7	0.81	
210	4	7	0.81	
279	4	7	0.81	

¹⁾ M_{\max} = maximum permitted load for application factor $f_b = 1$ (see Page 56)

²⁾ Value rounded off



High Power Spur Gears

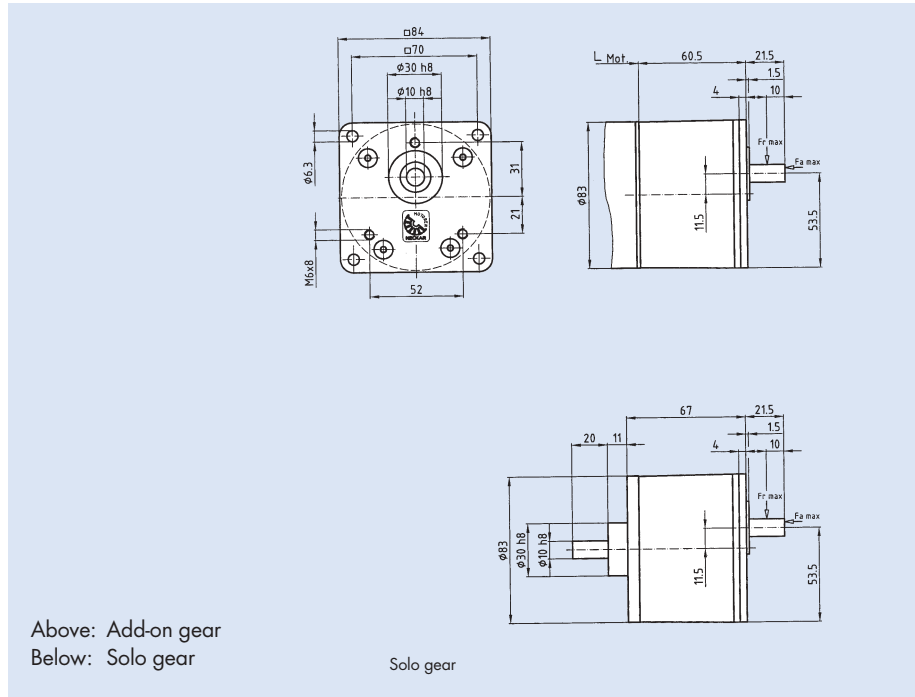
Series Z, Type 8

Advantages:

- Series optimised for high torque
- For many application the series offers cost-effective alternatives to planetary gears
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Properties:

- Through the use of a new construction principle a starting torque has been achieved which is *2 to 10 times greater than that for previous models at the same transmission ratio.*
- This considerable increase in torque does not impair the long service life of the Z-gears.
- Z-gears can be installed in any chosen position. All the models can be supplied as solo gears.



Design

Component	Z8
Input stage	Spiral gearing, hardened steel
Housing material	Zinc diecasting
Wheel, pinion material	Hardened steel
Output shaft bearing	A-side Roller bearing B-side Plain bearing
Output shaft max. load capacity	400 N radial 40 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5.000 rev/min ⁻¹

Series Z8 Output torque 3–12 Nm

Transmission ratio $i^{(2)}$	No. of stages	$M_{\max}^{(1)}$ Nm	η	Weight g
5.6	2	3	0.90	660
13	2	7	0.90	
17.5	2	7	0.90	
25	2	7	0.90	
36.5	3	10.5	0.85	720
43	3	10.5	0.85	
49.5	3	10.5	0.85	
58.5	3	10.5	0.85	
71	3	10.5	0.85	
84	3	10.5	0.85	780
96.5	4	12	0.81	
103	4	12	0.81	
111	4	12	0.81	
121	4	12	0.81	
131	4	12	0.81	
143	4	12	0.81	
165	4	12	0.81	
194	4	12	0.81	
237	4	12	0.81	
279	4	12	0.81	

¹⁾ M_{\max} = maximum permitted load for application factor $f_b = 1$ (see Page 56)

²⁾ Value rounded off



Power Spur Gears

Series Z, Type 67

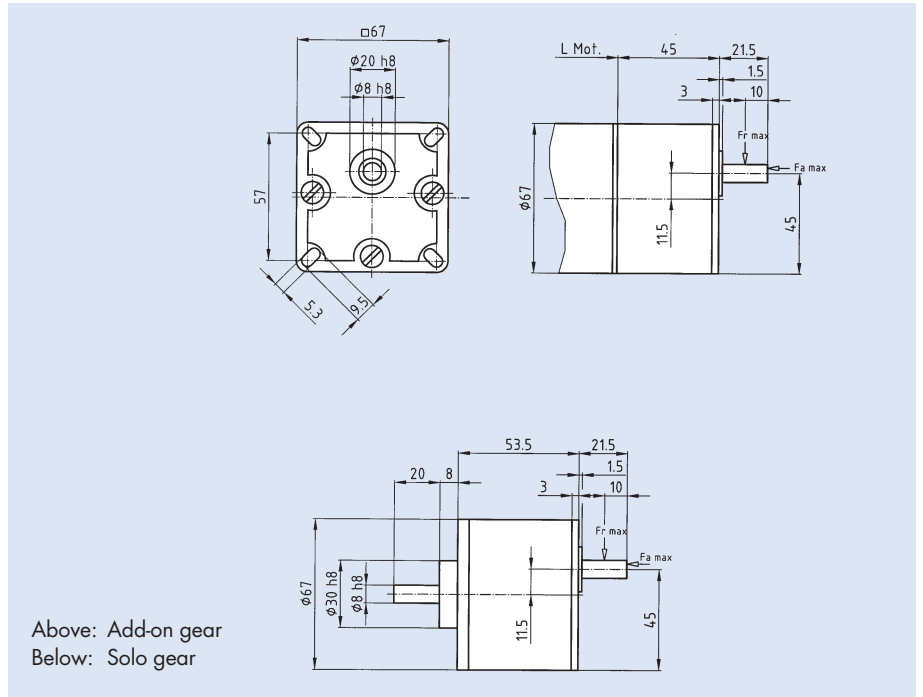
Advantages:

- Series optimised for wide torque range, cost effective series
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Z-gears can be installed in any chosen position. All the models can be supplied as add-on designs or as solo gears.

Solo gears:

Input bearing arrangement; 2 ball bearings arranged in tandem



Design

Component	Z 67
Input stage	Spiral gearing
Housing material	Zinc diecasting
Wheel, pinion material	Steel
Output shaft bearing	
A-side	Porous plain bearing
B-side	Porous plain bearing
Output shaft max. load capacity	220 N radial 22 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	4,500 rev/min ⁻¹
Input shaft max. load	50 N radial

Series Z 67

Output torque 0.35 – 4 Nm

$i=^{2)}$	No. of stages	$M_{max}^{1)}$ Nm	η	Weight kg
5	2	0.35	0.82	0.42
10	2	0.35	0.82	
12.5	2	0.35	0.82	
20	3	1.4	0.74	0.42
25	3	1.4	0.74	
30	3	1.4	0.74	
37.5	3	1.4	0.74	
40	4	2.8	0.66	0.42
50	4	2.8	0.66	
60	4	2.8	0.66	
62.5	4	2.8	0.66	
75	4	2.8	0.66	
93.8	4	2.8	0.66	
80	5	4	0.6	0.42
100	5	4	0.6	
120	5	4	0.6	
125	5	4	0.6	
150	5	4	0.6	
156.3	5	4	0.6	
187.5	5	4	0.6	
234.4	5	4	0.6	

$i=^{2)}$	No. of stages	$M_{max}^{1)}$ Nm	η	Weight kg
160	6	4	0.54	0.42
200	6	4	0.54	
240	6	4	0.54	
250	6	4	0.54	
300	6	4	0.54	
312.5	6	4	0.54	
375	6	4	0.54	
390.6	6	4	0.54	
468.8	6	4	0.54	
585.9	6	4	0.54	

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



Power Spur Gears

Series Z, Type 89

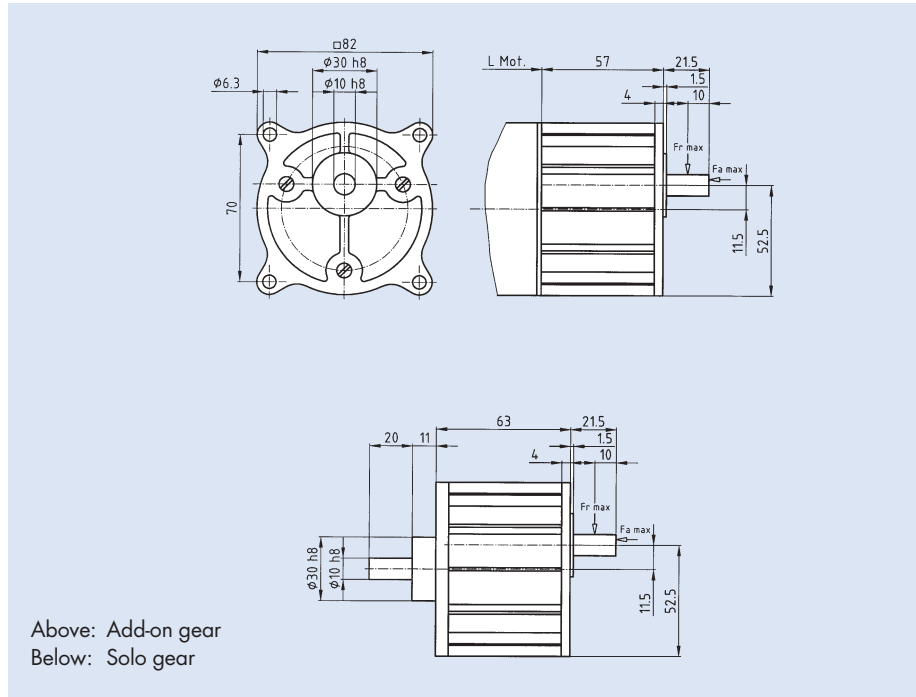
Advantages:

- Series optimised for wide torque range, cost effective series
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Z-gears can be installed in any chosen position. All the models can be supplied as add-on designs or as solo gears.

Solo gears:

Input bearing arrangement; 2 ball bearings arranged in tandem



Design

Component	Z89
Input stage	Spiral gearing
Housing material	Zinc diecasting
Wheel, pinion material	Steel
Output shaft bearing	
A-side	Ball bearing
B-side	Porous plain bearing
Output shaft max. load capacity	400 N radial 40 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	4,500 rev/min ⁻¹
Input shaft max. load	63 N radial

Series Z 89

Output torque 0.7–6 Nm

$i=^2)$	No. of stages	$M_{max}^1)$ Nm	η	Weight kg
5	2	0.7	0.82	0.6
10	2	0.7	0.82	
15	2	0.7	0.82	
20	3	2.8	0.74	0.6
25	3	2.8	0.74	
30	3	2.8	0.74	
40	4	5.6	0.66	0.6
50	4	5.6	0.66	
60	4	5.6	0.66	
62.5	4	5.6	0.66	
75	4	5.6	0.66	
100	5	6	0.6	0.6
120	5	6	0.6	
125	5	6	0.6	
156.3	5	6	0.6	
180	5	6	0.6	
187.5	5	6	0.6	
225	5	6	0.6	
270	5	6	0.6	

$i=^2)$	No. of stages	$M_{max}^1)$ Nm	η	Weight kg
160	6	6	0.54	0.6
200	6	6	0.54	
240	6	6	0.54	
250	6	6	0.54	
300	6	6	0.54	
312.5	6	6	0.54	
360	6	6	0.54	
390.6	6	6	0.54	
540	6	6	0.54	
562.5	6	6	0.54	
675	6	6	0.54	
810	6	6	0.54	

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off

Further transmission ratios on the next page

Continued on the following page →



Power Spur Gears

Series Z, Type 89

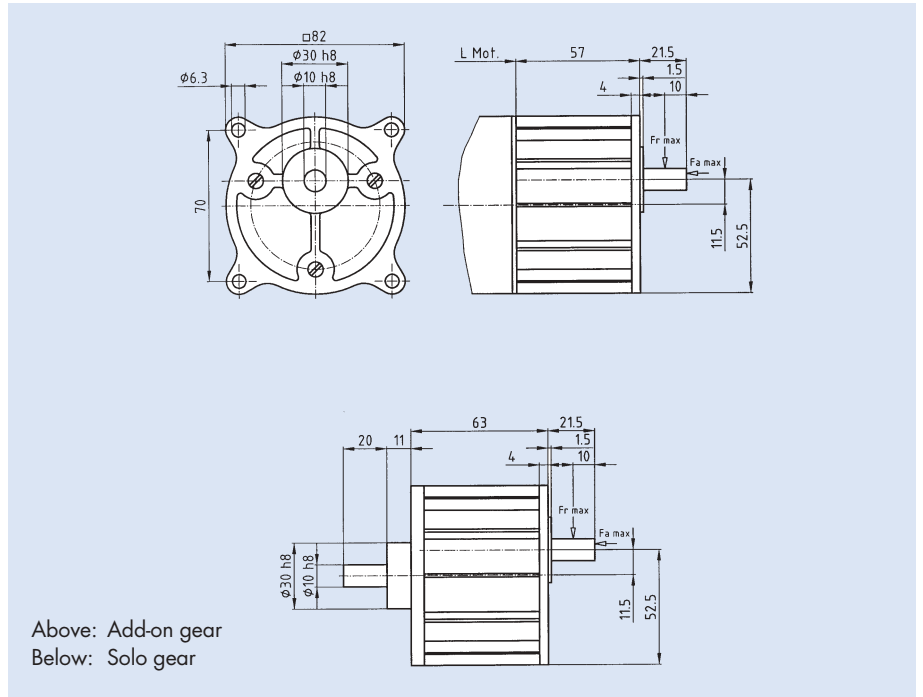
Advantages:

- Series optimised for wide torque range, cost effective series
- Z-Gears have the same diameter as motors of the corresponding series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Z-gears can be installed in any chosen position. All the models can be supplied as add-on designs or as solo gears.

Solo gears:

Input bearing arrangement; 2 ball bearings arranged in tandem



Design

Component	Z89
Input stage	Spiral gearing
Housing material	Zinc diecasting
Wheel, pinion material	Steel
Output shaft bearing	
A-side	Ball bearing
B-side	Porous plain bearing
Output shaft max. load capacity	400 N radial 40 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	4,500 rev/min ⁻¹
Input shaft max. load	63 N radial

Series Z89

Output torque 6 Nm

$i=2^1$	No. of stages	M_{max}^1 Nm	η	Weight kg
400	7	6	0.48	0.6
480	7	6	0.48	
500	7	6	0.48	
600	7	6	0.48	
720	7	6	0.48	
750	7	6	0.48	
781.3	7	6	0.48	
976.6	7	6	0.48	
1080	7	6	0.48	
1171.9	7	6	0.48	
1406.3	7	6	0.48	
1620	7	6	0.48	
1687.5	7	6	0.48	
2025	7	6	0.48	
2430	7	6	0.48	

$i=2^1$	No. of stages	M_{max}^1 Nm	η	Weight kg
640	8	6	0.44	0.6
800	8	6	0.44	
960	8	6	0.44	
1000	8	6	0.44	
1250	8	6	0.44	
1440	8	6	0.44	
1562.5	8	6	0.44	
1953.1	8	6	0.44	
2160	8	6	0.44	
2340	8	6	0.44	
2441.4	8	6	0.44	
3240	8	6	0.44	
3516	8	6	0.44	
4218.8	8	6	0.44	
4860	8	6	0.44	
5062.5	8	6	0.44	
6075	8	6	0.44	
7290	8	6	0.44	

See previous page for other transmission ratios
Continued on the following page

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



High Power Spur Gears

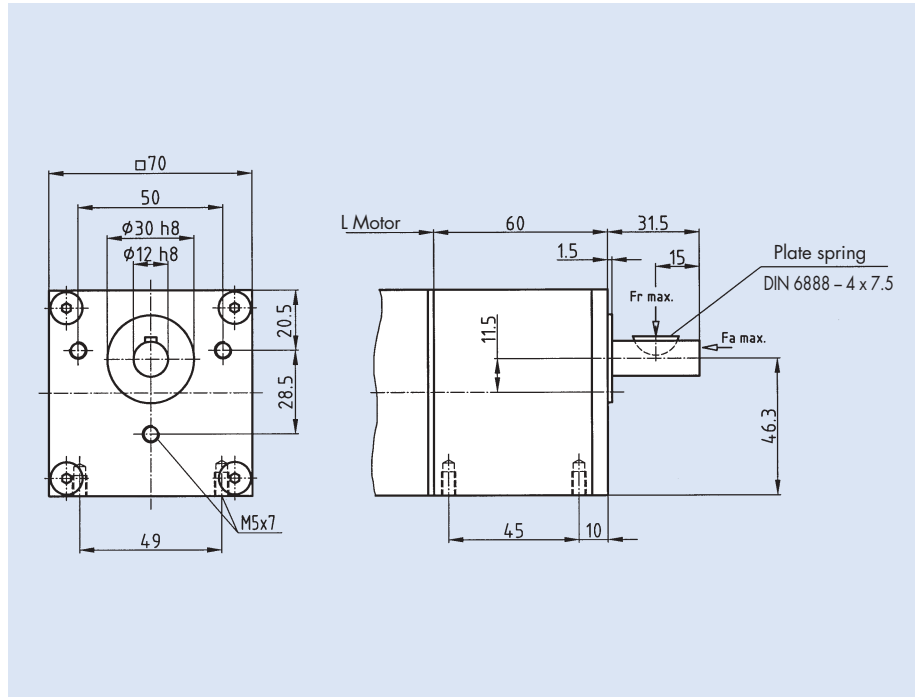
Series M, Type 7

Advantages:

- Series optimised for high torque as add-on gears
- With oil lubrication on request
- For many application the series offers cost-effective alternatives to planetary gears
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Properties:

- Through the use of a new construction principle a starting torque has been achieved which is *2 to 10 times greater than that for previous models at the same transmission ratio.*
- This considerable increase in torque does not impair the long service life of the gears.
- M-gears can be installed in any chosen position.
- With oil lubrication installation position by agreement



Design

Component	M 7
Input stage	Spiral gearing, hardened steel
Housing material	Aluminium
Wheel, pinion material	Hardened steel
Output shaft bearing	A-side Roller bearing B-side Plain bearing
Output shaft max. load capacity	90 N radial 5 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5,000 rev/min ⁻¹

Series M 7

Output torque 2.5–7 Nm

Transmission ratio $i^{(2)}$	No. of stages	$M_{\max}^{(1)}$ Nm	η	Weight g
4.82	2	2.5	0.90	830
10.4	2	5.5	0.90	
15.4	2	5.5	0.90	
20.5	2	5.5	0.90	
24.7	3	6.5	0.85	870
31.6	3	6.5	0.85	
42	3	6.5	0.85	
48.9	3	6.5	0.85	
64.8	4	7	0.81	
86.1	4	7	0.81	
100	4	7	0.81	
117	4	7	0.81	910
136	4	7	0.81	
155	4	7	0.81	
181	4	7	0.81	
210	4	7	0.81	
279	4	7	0.81	

¹⁾ M_{\max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



High Power Spur Gears

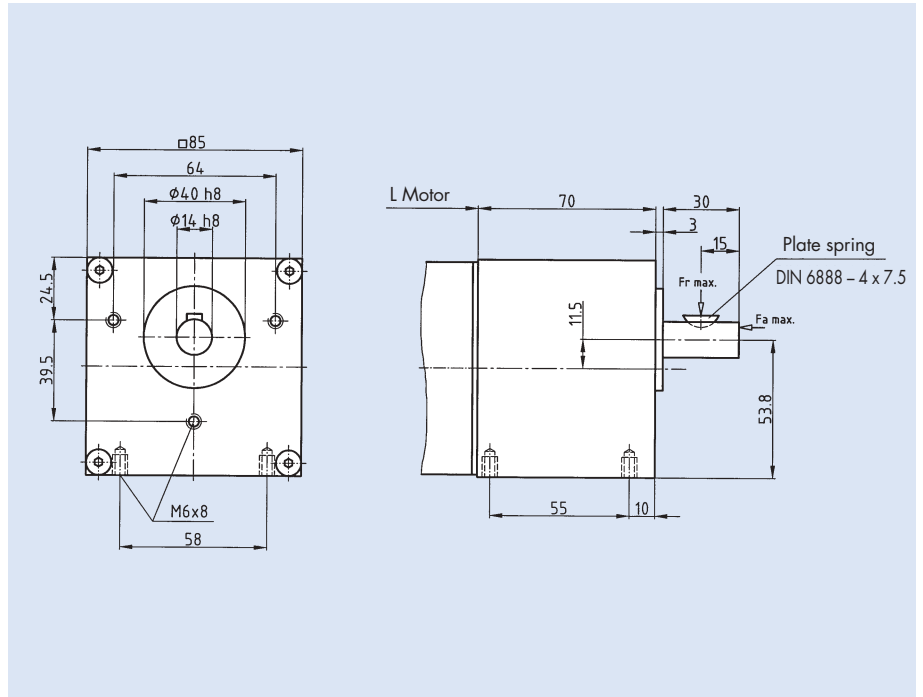
Series M, Type 8

Advantages:

- Series optimised for high torque as add-on gears
- With oil lubrication on request
- For many application the series offers cost-effective alternatives to planetary gears
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

Properties:

- Through the use of a new construction principle a starting torque has been achieved which is *2 to 10 times greater than that for previous models at the same transmission ratio.*
- This considerable increase in torque does not impair the long service life of the gears.
- M-gears can be installed in any chosen position.
- With oil lubrication installation position by agreement



Design

Component	M 8
Input stage	Spiral gearing, hardened steel
Housing material	Aluminium
Wheel, pinion material	Hardened steel
Output shaft bearing	A-side Roller bearing B-side Plain bearing
Output shaft max. load capacity	220 N radial 22 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5,000 rev/min ⁻¹

Series M 8 Output torque 3–12 Nm

Transmission ratio $i^{(2)}$	No. of stages	$M_{\max}^{(1)}$ Nm	η	Weight g
5.6	2	3	0.90	1320
13	2	7	0.90	
17.5	2	7	0.90	
25	2	7	0.90	
36.5	3	10.5	0.85	
43	3	10.5	0.85	
49.5	3	10.5	0.85	
58.5	3	10.5	0.85	
71	3	10.5	0.85	1440
84	3	10.5	0.85	
96.5	4	12	0.81	
103	4	12	0.81	
111	4	12	0.81	
121	4	12	0.81	1440
131	4	12	0.81	
143	4	12	0.81	
165	4	12	0.81	
194	4	12	0.81	
237	4	12	0.81	
279	4	12	0.81	

¹⁾ M_{\max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



Power Spur Gears

Series M, Type 67

Advantages:

- Series optimised for wide torque range, cost effective series
 - Good efficiency
 - Minimal gear play
 - Can be combined with various motors, shaft encoders and electronics to give complex drive systems.
- M-gears can be installed in any chosen position. All the models can be supplied as add-on designs or as solo gears.

Solo gears:

- Input bearing arrangement; 2 ball bearings arranged in tandem

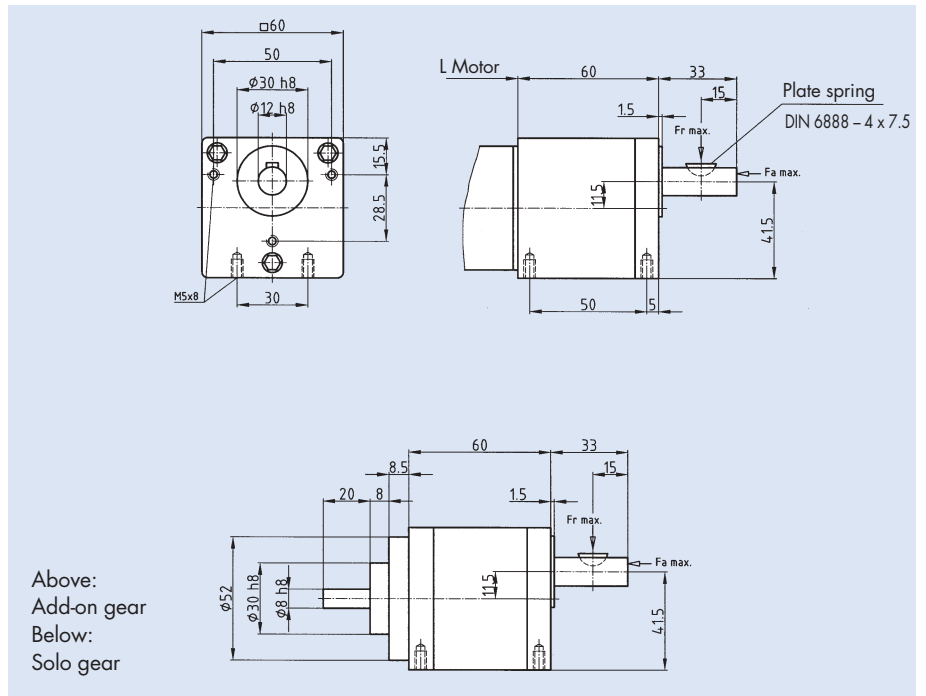
Design

Component	M 67
Input stage	Spiral gearing
Housing material	Zinc diecasting
Wheel, pinion material	Special steel
Shaft bearing A-side	Ball bearing
B-side	Porous plain bearing
Output shaft max. load capacity	300 N radial 40 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	4,500 rev/min ⁻¹
Input shaft max. load	50 N radial
Weight	0.5 kg

Series M 67

Output torque 0.35 – 4.0 Nm

$i=^2)$	No. of stages	$M_{max}^{1)}$ Nm	η
5	2	0.35	0.82
10	2	0.35	0.82
12.5	2	0.35	0.82
20	3	1.4	0.74
25	3	1.4	0.74
30	3	1.4	0.74
37	3	1.4	0.74
40	4	2.8	0.66
50	4	2.8	0.66
60	4	2.8	0.66
63	4	2.8	0.66
75	4	2.8	0.66
94	4	2.8	0.66



Series M 67

Output torque 4.0 Nm

$i=^2)$	No. of stages	$M_{max}^{1)}$ Nm	η
80	5	4	0.6
100	5	4	0.6
120	5	4	0.6
125	5	4	0.6
150	5	4	0.6
156	5	4	0.6
187	5	4	0.6
234	5	4	0.6
160	6	4	0.54
200	6	4	0.54
240	6	4	0.54
250	6	4	0.54
300	6	4	0.54
313	6	4	0.54
375	6	4	0.54
391	6	4	0.54
468	6	4	0.54
586	6	4	0.54
320	7	4	0.48
400	7	4	0.48
480	7	4	0.48

$i=^2)$	No. of stages	$M_{max}^{1)}$ Nm	η
500	7	4	0.48
600	7	4	0.48
625	7	4	0.48
750	7	4	0.48
781	7	4	0.48
937	7	4	0.48
977	7	4	0.48
1172	7	4	0.48
640	8	4	0.44
800	8	4	0.44
960	8	4	0.44
1000	8	4	0.44
1200	8	4	0.44
1250	8	4	0.44
1500	8	4	0.44
1563	8	4	0.44
1875	8	4	0.44
1953	8	4	0.44
2344	8	4	0.44
2441	8	4	0.44
2930	8	4	0.44

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off



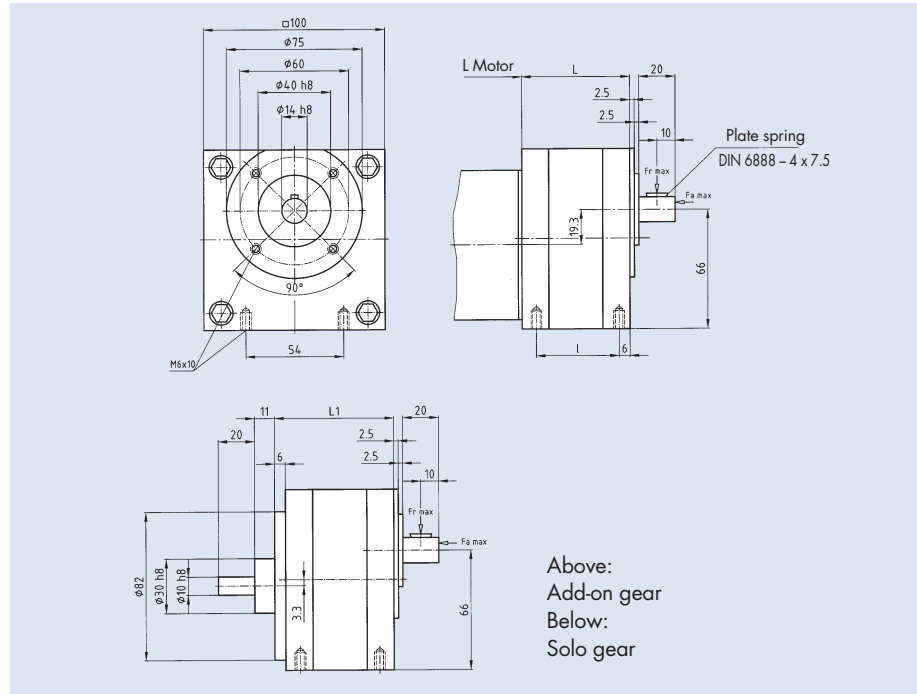
High Power Spur Gears

Series M, Type 189

Advantages:

- High starting torque up to 18Nm
- Series optimised for wide torque range, cost effective series
- Good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

M-gears can be installed in any chosen position. All the models can be supplied as add-on designs or as solo gears.



Design

Component	M 189
Housing material	Zinc diecasting
Wheel, pinion	Special steel
Shaft bearing	A-side: Ball bearing B-side: Porous plain bearing
Operating temperature	-20° to +40°
Lubrication	Lifetime
Weight	Table
Input shaft (motor shaft)	Milled pinion
Output shaft max. load capacity	400 N radial 50 N axial
Input shaft load	63 N shaft middle, radial
Input speed max.	4,500 rev/min
Installation position	Optional

Series M 189 Output torque 2.5–18 Nm

$i^{(2)}$	No. of stages	$M_{max}^{(1)}$ Nm	η	L mm	L1 mm	l mm	Weight kg
4	1	2.5	0.91	60	66	44	1.4
8.4	2	6.5	0.82	60	66	44	1.5
10.81	2	6.5	0.82	60	66	44	1.5
12.95	2	6.5	0.82	60	66	44	1.5
17.5	2	6.5	0.82	60	66	44	1.5
25.2	3	10	0.74	60	66	44	1.6
32.43	3	10	0.74	60	66	44	1.6
38.85	3	10	0.74	60	66	44	1.6
52.5	3	10	0.74	60	66	44	1.6
75.6	4	15	0.66	80	86	64	1.9
97.28	4	15	0.66	80	86	64	1.9
166.55	4	15	0.66	80	86	64	1.9
157.5	4	15	0.66	80	86	64	1.9
226.8	5	15	0.6	80	86	64	2.0
291.65	5	15	0.6	80	86	64	2.0
348.65	5	15	0.6	80	86	64	2.0
472.5	5	15	0.6	80	86	64	2.0
680.4	6	15	0.54	80	86	64	2.1
875.41	6	15	0.54	80	86	64	2.1
1048.95	6	15	0.54	80	86	64	2.1
1417.5	6	15	0.54	80	86	64	2.1

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off

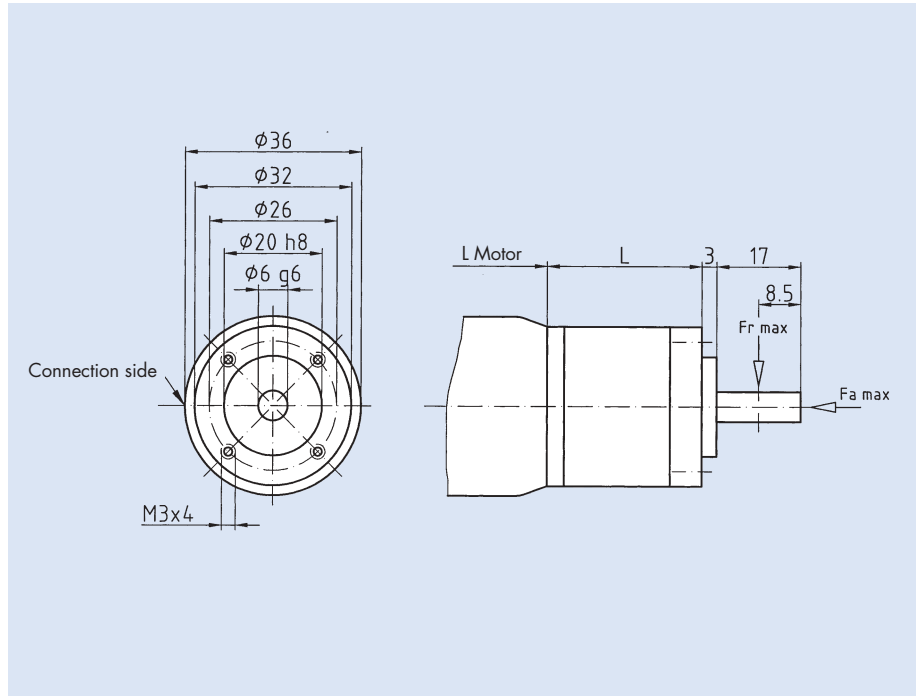


Planetary Gears

Series P, Type 30

Advantages:

- Series optimised for high torque
- The most elegant solution for demanding tasks
- Planetary gears have similar diameters to motors of the corresponding series
- Very good efficiency
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Design

Component	P 30
Input shaft	Milled pinion
Housing material	Aluminium/Steel
Wheel, pinion material	Hardened steel
Bearing arrangement	2 ball bearings arranged in tandem
Max. load capacity middle of output shaft	See table
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5.000 rev/min ⁻¹
Gear play	1stage 1.5° 2stage 2° 3stage 2.5° 4stage 3.0°

Series P30

Output torque 0.75–4.5 Nm

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
7	1	0.75	0.80	0.177
25	2	2.25	0.75	0.167
29	2	2.25	0.75	0.167
35	2	2.25	0.75	0.167
46	2	2.25	0.75	0.167
93	3	4.5	0.70	0.217
107	3	4.5	0.70	0.217
124	3	4.5	0.70	0.217
130	3	4.5	0.70	0.217
150	3	4.5	0.70	0.217
169	3	4.5	0.70	0.247
181	3	4.5	0.70	0.247
195	3	4.5	0.70	0.247
236	3	4.5	0.70	0.217
308	3	4.5	0.70	0.217

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
344	4	4.5	0.65	0.247
397	4	4.5	0.65	0.247
459	4	4.5	0.65	0.247
480	4	4.5	0.65	0.247
531	4	4.5	0.65	0.247
556	4	4.5	0.65	0.247
626	4	4.5	0.65	0.247
642	4	4.5	0.65	0.247
672	4	4.5	0.65	0.247
724	4	4.5	0.65	0.247
778	4	4.5	0.65	0.247
837	4	4.5	0.65	0.247
875	4	4.5	0.65	0.247
939	4	4.5	0.65	0.247
1012	4	4.5	0.65	0.247
1140	4	4.5	0.65	0.247
1223	4	4.5	0.65	0.247
1318	4	4.5	0.65	0.247
1594	4	4.5	0.65	0.247
2076	4	4.5	0.65	0.247

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off

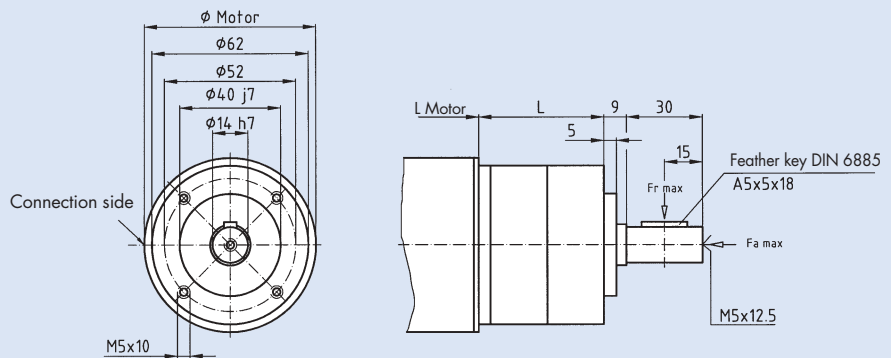


Planetary Gears

Series P, Type 60

Advantages:

- Series optimised for high torque
- The most elegant solution for demanding tasks
- Planetary gears have similar diameters to motors of the corresponding series
- Very good efficiency
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Design

Component	P 60
Input shaft	Milled pinion
Housing material	Aluminium/Steel
Wheel, pinion material	Hardened steel
Bearing arrangement	2 ball bearings arranged in tandem
Max. load capacity middle of output shaft	See table
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	3.000 rev/min ⁻¹
Gear play	1stage 1.5° 2stage 2° 3stage 2.5° 4stage 3.0°

Series P 60 Output torque 8–50 Nm

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
7	1	8	0.80	0.7
25	2	25	0.75	1.1
29	2	25	0.75	1.1
35	2	25	0.75	1.1
46	2	25	0.75	1.1
93	3	50	0.70	1.5
107	3	50	0.70	1.5
124	3	50	0.70	1.5
130	3	50	0.70	1.5
150	3	50	0.70	1.5
169	3	50	0.70	1.5
181	3	50	0.70	1.5
195	3	50	0.70	1.5
236	3	50	0.70	1.5
308	3	50	0.70	1.5

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off

Further transmission ratios on request

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
344	4	50	0.65	1.9
397	4	50	0.65	1.9
459	4	50	0.65	1.9
480	4	50	0.65	1.9
531	4	50	0.65	1.9
556	4	50	0.65	1.9
626	4	50	0.65	1.9
642	4	50	0.65	1.9
672	4	50	0.65	1.9
724	4	50	0.65	1.9
778	4	50	0.65	1.9
837	4	50	0.65	1.9
875	4	50	0.65	1.9
939	4	50	0.65	1.9
1012	4	50	0.65	1.9
1140	4	50	0.65	1.9
1223	4	50	0.65	1.9
1318	4	50	0.65	1.9
1594	4	50	0.65	1.9
2076	4	50	0.65	1.9

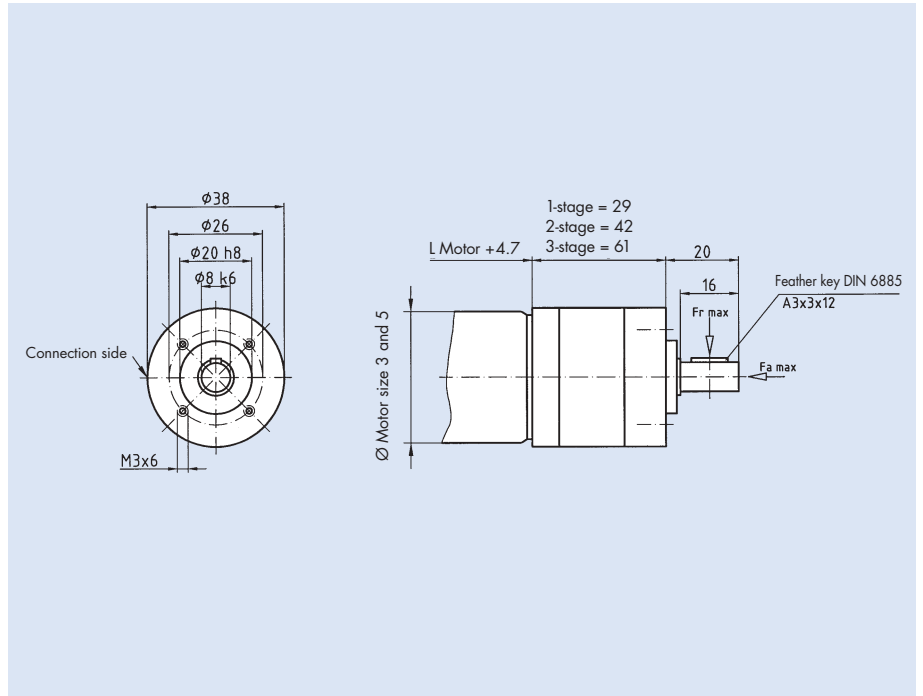


High Performance Planetary Gears

Series PE, Type 3

Advantages:

- Series optimised for high torque
- The most elegant solution for demanding tasks
- High performance planetary gears have similar diameters to motors of the corresponding series
- Very good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Design

Component	PE 3
Input shaft	Milled pinion
Housing material	Aluminium/steel
Wheel, pinion material	Hardened steel
Bearing arrangement	2 ball bearings arranged in tandem
Max. load capacity of output shaft	80 N radial 30 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	5,000 rev/min ⁻¹
Gear play	1stage 0.7° 2stage 1° 3stage 1.4°
Low play option	1stage 15' 2stage 25' 3stage 35'

Series PE 3

Output torque 2–15 Nm

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
3.63	1	2	0.85	0.25
4.84	1	2	0.85	0.25
8.14	1	2	0.85	0.25
13.17	2	8	0.8	0.33
17.56	2	8	0.8	0.33
21.78	2	8	0.8	0.33
23.42	2	8	0.8	0.33
29.05	2	8	0.8	0.33
39.39	2	8	0.8	0.33
48.84	2	8	0.8	0.33
66.25	2	8	0.8	0.33

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
79.06	3	15	0.75	0.48
85.01	3	15	0.75	0.48
105.45	3	15	0.75	0.48
113.35	3	15	0.75	0.48
140.6	3	15	0.75	0.48
177.28	3	15	0.75	0.48
190.64	3	15	0.75	0.48
236.38	3	15	0.75	0.48
320.65	3	15	0.75	0.48
397.55	3	15	0.75	0.48
539.27	3	15	0.75	0.48

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off

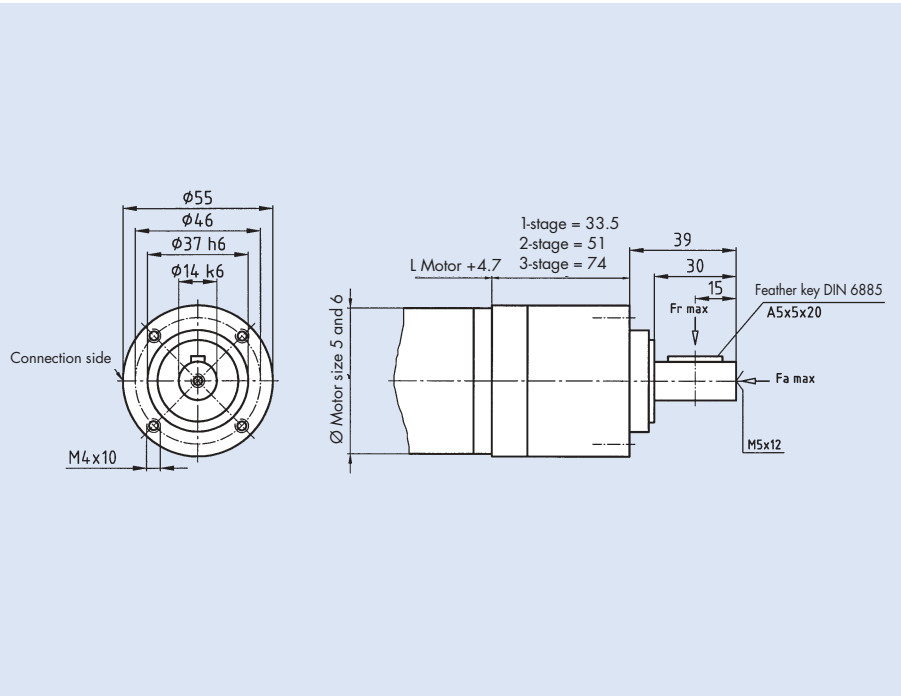


High Performance Planetary Gears

Series PE, Type 5

Advantages:

- Series optimised for high torque
- The most elegant solution for demanding tasks
- High performance planetary gears have similar diameters to motors of the corresponding series
- Very good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Design

Component	PE 5
Input shaft	Milled pinion
Housing material	Aluminium/steel
Wheel, pinion material	Hardened steel
Bearing arrangement	2 ball bearings arranged in tandem
Max. load capacity of output shaft	310 N radial 140 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	3,000 rev/min ⁻¹
Gear play	1 stage 0.7° 2 stage 1° 3 stage 1.4°
Low play option	1 stage 15' 2 stage 25' 3 stage 35'

Series PE 5

Output torque 6–30 Nm

Transm. ratio $i=^{2)}$	No. of stages	$M_{max}^{1)}$ Nm	η	Weight kg
3.83	1	6	0.85	0.58
4.4	1	6	0.85	0.58
5.25	1	6	0.85	0.58
9.5	1	6	0.85	0.58
14.68	1	20	0.8	0.79
16.85	2	20	0.8	0.79
19.36	2	20	0.8	0.79
23.1	2	20	0.8	0.79
25.5	2	20	0.8	0.79
27.56	2	20	0.8	0.79
29.3	2	20	0.8	0.79
34.96	2	20	0.8	0.79
36.38	2	20	0.8	0.79
41.8	2	20	0.8	0.79
49.87	2	20	0.8	0.79
63.27	2	20	0.8	0.79
90.25	2	20	0.8	0.79

Transm. ratio $i=^{2)}$	No. of stages	$M_{max}^{1)}$ Nm	η	Weight kg
101.64	3	30	0.75	1.28
112.2	3	30	0.75	1.28
128.92	3	30	0.75	1.28
139.46	3	30	0.75	1.28
153.82	3	30	0.75	1.28
160.07	3	30	0.75	1.28
183.92	3	30	0.75	1.28
191	3	30	0.75	1.28
219.45	3	30	0.75	1.28
278.38	3	30	0.75	1.28
332.12	3	30	0.75	1.28

¹⁾ M_{max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Value rounded off

Further transmission ratios on request

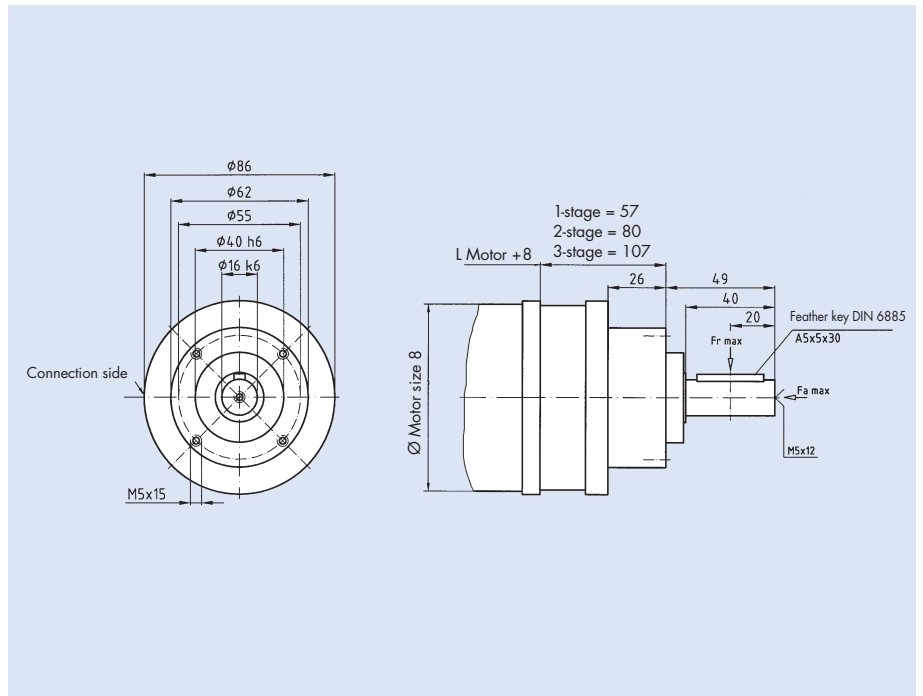


High Performance Planetary Gears

Series PE, Type 8

Advantages:

- Series optimised for high torque
- The most elegant solution for demanding tasks
- High performance planetary gears have similar diameters to motors of the corresponding series
- Very good efficiency
- Minimal gear play
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Design

Component	PE 8
Input shaft	Milled pinion
Housing material	Aluminium/steel
Wheel, pinion material	Hardened steel
Bearing arrangement	2 ball bearings arranged in tandem
Max. load capacity of output shaft	600 N radial 350 N axial
Operating temperature	-20° to +40°
Lubrication	Lifetime
Input speed max.	3,000 rev/min ⁻¹
Gear play	1stage 0.7° 2stage 1° 3stage 1.4°
Low play option	1stage 15' 2stage 25' 3stage 35'

Series PE 8

Output torque 20 – 80 Nm

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
2.9	1	20	0.85	1.18
3.3	1	20	0.85	1.18
4.05	1	20	0.85	1.18
5.35	1	20	0.85	1.18
8.62	1	20	0.85	1.18
9.68	2	50	0.8	1.76
10.89	2	50	0.8	1.76
11.74	2	50	0.8	1.76
13.36	2	50	0.8	1.76
15.51	2	50	0.8	1.76
16.4	2	50	0.8	1.76
17.65	2	50	0.8	1.76
21.88	2	50	0.8	1.76
24.98	2	50	0.8	1.76
26.52	2	50	0.8	1.76
28.44	2	50	0.8	1.76
34.91	2	50	0.8	1.76
35.04	2	50	0.8	1.76
46.11	2	50	0.8	1.76
56.46	2	50	0.8	1.76
74.3	2	50	0.8	1.76

Transm. ratio $i=^2$	No. of stages	M_{max}^1 Nm	η	Weight kg
93.82	3	80	0.75	2.4
101.61	3	80	0.75	2.4
133.71	3	80	0.75	2.4
141.9	3	80	0.75	2.4
152.16	3	80	0.75	2.4
163.73	3	80	0.75	2.4
186.31	3	80	0.75	2.4
215.47	3	80	0.75	2.4
246.18	3	80	0.75	2.4
300.91	3	80	0.75	2.4
397.5	3	80	0.75	2.4
486.68	3	80	0.75	2.4
640.46	3	80	0.75	2.4

¹⁾ M_{max} = maximum permitted load for application factor $f_b = 1$ (see Page 56)

²⁾ Value rounded off

Further gear ratios on request

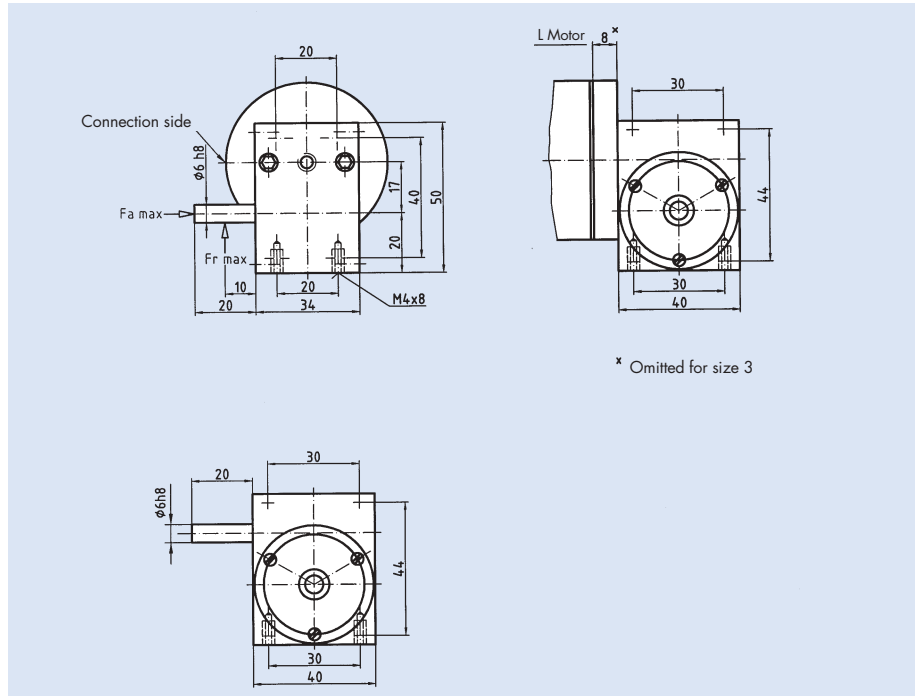


Worm Gears

Series S, Type 345

Advantages:

- Reliable solution for a variety of drive tasks
- Power deflection 90°
- 2 shaft ends possible (Optional)
- Self-locking at high gear reduction
- Maintenance free with long service life
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



* Omitted for size 3

Series S 345

Output torque 1.4–2 Nm

Component	S 345
Housing material	Aluminium
Worm material	Special steel
Housing material	Aluminium
Power loss Watts	15
Shaft bearing add-on gear	A and B side ball bearing
Lubrication	Lifetime
Max. load capacity of output shaft	100 N radial 50 N axial
Operating temperature	-20° to +40°
Input speed max.	5,000 rev/min ⁻¹
Installation position	Pref. floor space
Shaft position * Identification letters for shaft position	Left = Standard Right = "R" both sides = "B"
Fastening * Identification letters for fastening	Base = Standard Front side = "S" Head side = "K" Drive side = "L" Opposite to drive side = "G"
Weight	0.225 kg

Transmission ratio <i>i</i>	$M_{\max}^{1)}$ Nm	η
5	1.8	0.65
10	1.9	0.6
15	1.9	0.5
25	1.8	0.4
30	1.9	0.35
40	1.4	0.2
50	2	0.3
60	1.6	0.25

¹⁾ M_{\max} = max. permitted load for application factor $f_B = 1$ (see Page 56)

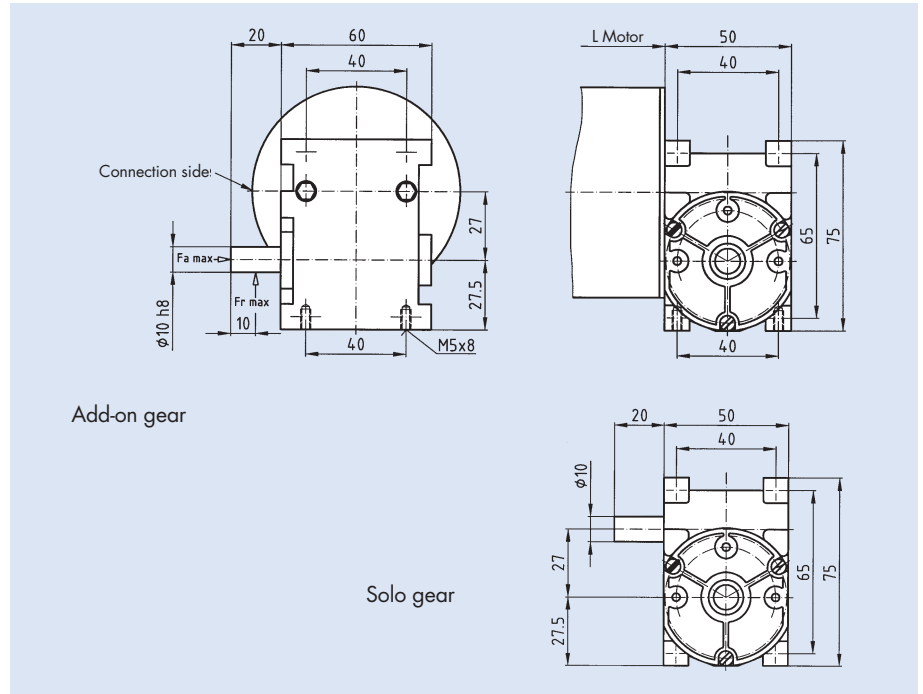


Worm Gears

Series S, Type 567

Advantages:

- Reliable solution for a variety of drive tasks
- Power deflection 90°
- 2 shaft ends possible (Optional)
- Self-locking at high gear reduction
- Maintenance free with long service life
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Series S 567

Output torque 1.5 – 3.2 Nm

Component	S 567
Housing material	Zinc diecasting
Worm material	Special steel
Worm wheel material	Bronze alloy
Power loss Watts	Max. 20
Shaft bearing add-on gear	A and B side ball bearing
Solo gear	2x ball bearing
Lubrication	Lifetime
Max. load. capacity of output shaft	200 N radial 100 N axial
Operating temperature	-20° to +40°
Input speed max.	4,500 rev/min ⁻¹
Load capacity of input shaft (Solo gear)	80 N max.
Installation position	Optional
Shaft position * Identification letters for shaft positions	Left = Standard Right = „R“ both sides = „B“
Fastening * Identification letters for fastening	Base = Standard Front side = „S“ Head side = „K“ Drive side = „L“ Opposite to drive side = „G“
Weight	0.75 kg

Transmission ratio <i>i</i>	$M_{\max}^{1)}$ Nm	η
3.625	1.6	0.7
5	2.2	0.65
10	1.8	0.55
20	3.2	0.54
24	2.5	0.48
30	2.7	0.43
40	3.2	0.4
50	2.5	0.36
60	2.7	0.4
80	1.9	0.2 ²⁾
100	1.5	0.1 ²⁾

¹⁾ M_{\max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

²⁾ Input power max. 20 Watt

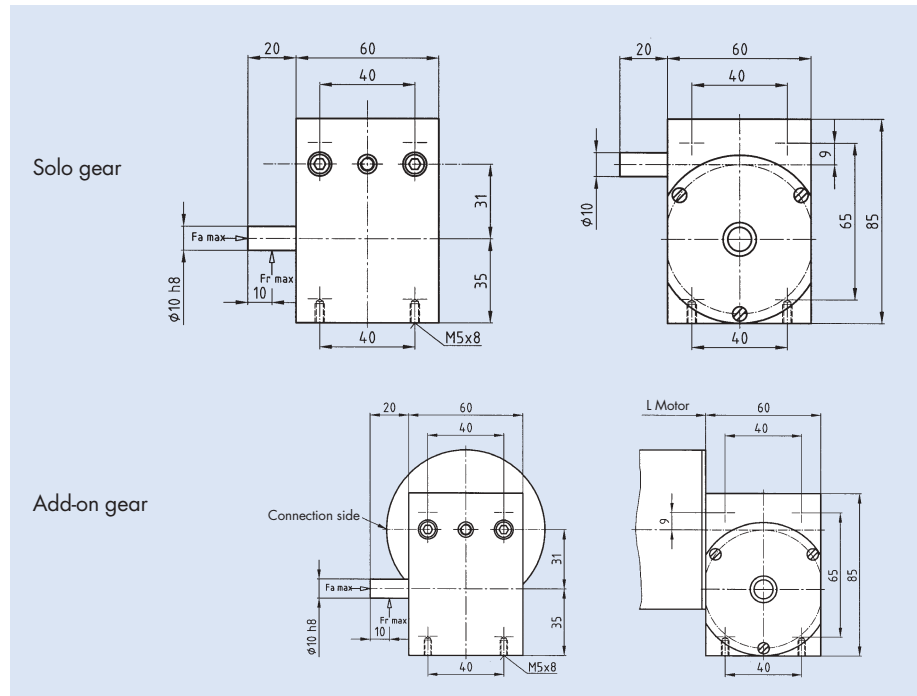


Worm Gears

Series S, Type 668

Advantages:

- Reliable solution for a variety of drive tasks
- Power deflection 90°
- 2 shaft ends possible (Optional)
- Self-locking at high gear reduction
- Maintenance free with long service life
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Series S 668

Output torque 5.4–8.4 Nm

Component	S 668
Housing material	Aluminium
Worm material	Special steel
Worm wheel material	Bronze alloy
Power loss Watts	35
Operating temperature	-20° to +40°
Shaft bearing	A and B side
add-on gear	ball bearing
Solo gear	2 x ball bearings
Lubrication	Lifetime
Max. load capacity of output shaft	200 N radial 100 N axial
Input speed max.	5,000 rev/min ⁻¹
Installation position	Optional
Shaft position	Left = Standard
* Identifications letters for shaft position	Right = "R" both sides = "B"
Fastening	Base = Standard
* Identifications letters for fastening	Front side = "S" Head side = "K" Drive side = "L" Opposite to drive side = "G"
Weight	0.8 kg

Transmission ratio <i>i</i>	$M_{\max}^{1)}$ Nm	η
5	7.1	0.7
10	7.1	0.65
20	7.6	0.55
24	6.8	0.45
38	8.4	0.4
60	6.1	0.25
75	5.4	0.25

¹⁾ M_{\max} = maximum permitted load for application factor $f_B = 1$ (see Page 56)

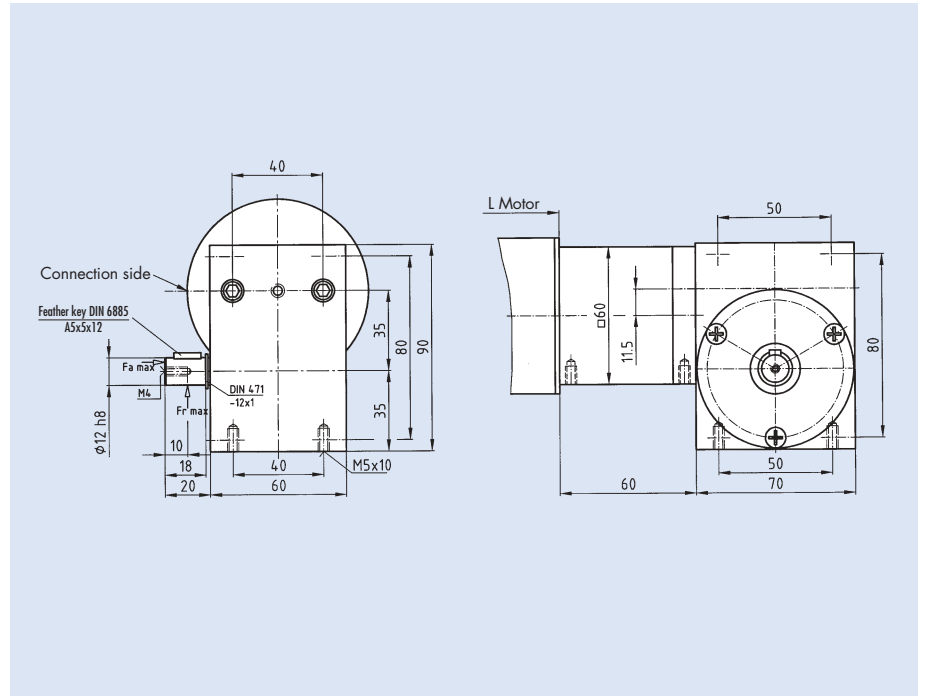


Worm Gears

Series S, Type 769

Advantages:

- Reliable solution for a variety of drive tasks
- Power deflection 90°
- 2 shaft ends possible (Optional)
- Self-locking at high gear reduction
- Maintenance free with long service life
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.



Series S 769
Output torque 11–15 Nm

Component	S 769
Housing material	Aluminium alloy
Worm material	Special steel
Worm wheel	Bronce alloy
Power loss Watts	50
Operating temperature	-20° to +40°
Shaft bearing	A and B side
add-on gear	ball bearing
Solo gear	2x ball bearings
Lubrication	Lifetime
Max. load capacity of output shaft	300 N radial 150 N axial
Input speed max.	5,000 rev/min ⁻¹
Installation position	Floor space Motor horizontal
Shaft position	Left = Standard
* Identification letters for shaft position	Right = "R" both sides = "B"
Fastening	Base = Standard
* Identification letters for fastening	Front side = "S" Head side = "K" Drive side = "L" Opposite to drive side = "G"
Weight	0.82 kg

Transmission ratio <i>i</i>	$M_{\max}^{1)}$ Nm	η
5	13	0.7
8	15	0.65
10	14	0.6
15	13	0.5
20	13	0.45
25	11	0.4
30	13	0.35
40	13	0.3
50	11	0.25
58	13	0.25

¹⁾ M_{\max} = maximum permitted load for application factor $f_b = 1$ (see Page 56)



Gear Combinations MM 61 / MS 65 / MS 67

Advantages:

- Used for specific tasks with long transmission at high torque and low motor power
- A combination of two spur gears M 67 and M 189 gives e.g. transmission ratio modifications up to $i_{max.} = 4,151,610$
- For other advantages see the corresponding gear series
- Can be combined with various motors, shaft encoders and electronics to give complex drive systems.

MM 61 = Combination of two optional spur gears of the series M 67 and M 189.

The transmission ratio and the total efficiency for M 61 is calculated by multiplying the corresponding values in the table for the series M 67 and M 189 on Pages 68 and 69 as follows:

$$i_{MM\ 61} = i_{M\ 67} \times i_{M\ 189}$$

$$\eta_{MM\ 61} = \eta_{M\ 67} \times \eta_{M\ 189}$$

Combination example:

M 67 $i = 375$, $\eta = 0.54$ with
M 189 $i = 1417$, $\eta = 0.54$ gives
MM 61 $i = 531,375$, $\eta = 0.29$

MS 65 = Combination of a spur gear M 67 with a worm gear S 567 connected downstream.

The transmission ratio and the total efficiency is calculated by multiplying the corresponding values in the table for the series M 67 and S 567 on Pages 68 and 76 as follows:

$$i_{MS\ 65} = i_{M\ 67} \times i_{S\ 567}$$

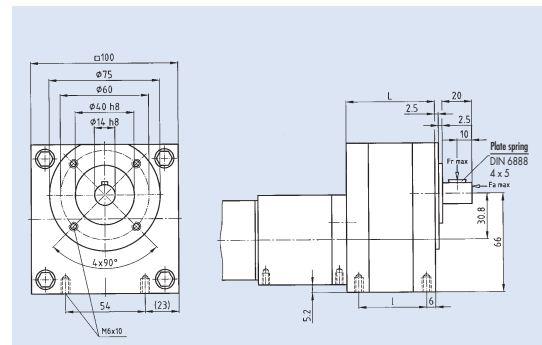
$$\eta_{MS\ 65} = \eta_{M\ 67} \times \eta_{S\ 567}$$

Design

Component	MM 61	MS 65	MS 67
Housing material	See individual gear table		
Gearwheel material	See individual gear table		
Noise dB (A)	See Page 9		
Shaft bearings	B-S. Porous plain bearing A-side bearing ball	A- and B-side ball bearing	
Load capacity	400 N radial	200 N radial	300 N radial
Output shaft	40 N axial	100 N axial	150 N axial
Temperature	- 20° C to + 40° C		
Lubrication	Lifetime		
Installation position	Optional		
Shaft position		Left = Standard design Right = Letter "R" Both ends = Letter "B"	
Fastening		Base = Standard design Front end = Letter "S" Head side = Letter "K" Drive = Letter "L" Opposite to drive = Letter "G"	

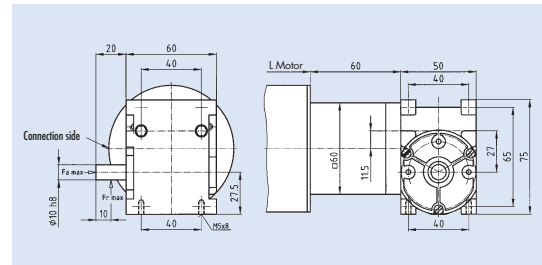
Gear combination MM 61

Dimensions are calculated by adding the individual values from the table for series M 67 and M 189 on Pages 68 + 69. The same is done for the weight.

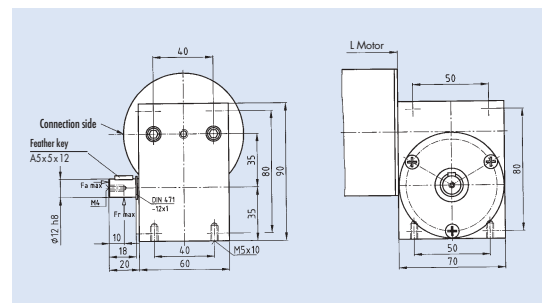


Gear combination MS 65

Dimensions are calculated by adding the individual values from the table for series M 67 on Page 68 and S 567 on Page 76.



MS 67 = Combination of a spur gear M 67 with worm gear S 769 connected downstream. See pages 68 and 78.





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