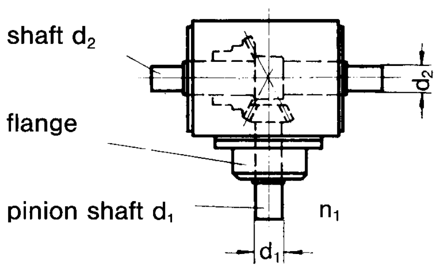
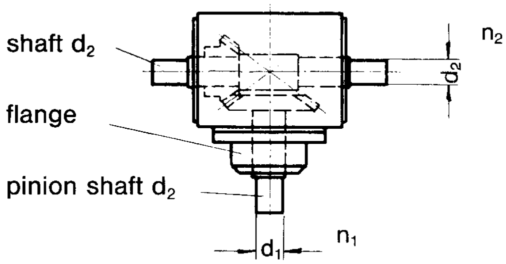
# Determination of Application Data

| | | | | | |
|---|---|---|---|---|---|
| Power | P | Kilowatt | kW | 1 kW = 1,36 hp | Output torque $= T_{out}$ |
| Torque | T | Newton-Metre | Nm | 1 Nm = 0,102 kpm | Input torque $= T_{in}$ |
| Speed | n | Revs.per minute | r/min | 1 r/min = 0,1047 rad/s | Total ratio $= \boxed{i_{tot}}$ |
| $T = \frac{30\,000}{\pi} \cdot \frac{P}{n} \approx 9550 \cdot \frac{P}{n}$ | | | | | $T_{out} = T_{in} \cdot \boxed{i_{tot}}$ |

## Determining the ratio and direction of rotation




**Generally applicable:** $i = \frac{n_1}{n_2} = \frac{\text{speed } n_1 \text{ of pinion } d_1}{\text{speed } n_2 \text{ of shaft } d_2}$

**Note:** The term ratio always applies regardless whether speed is increased or reduced.

**Example 1:** Speed $n_1$ of pinion $d_1$ = 1500 r/min
Speed $n_2$ of driven shaft $d_2$ = 750 r/min

$$i = \frac{n_1}{n_2} = \frac{1500}{750} = \frac{2}{1} = 2:1$$

i.e. relative to $n_1$, speed reduction

When placing an order, the ratio specified by the Tandler must be observed. In order to avoid errors Tandler will assume that $n_1$ applies to pinion shaft $d_1$ (flange side) and $n_2$ applies to shaft $d_2$.

If $d_2$ is the driving shaft, a ratio of up to i = 3 is permissible, provided that the speed $n_1$ stated in this brochure is not significantly exceeded.

For speed increasing ratios from $d_1$ several options are available: 1:1,25, 1:1,5, 1:1,75, 1:2.

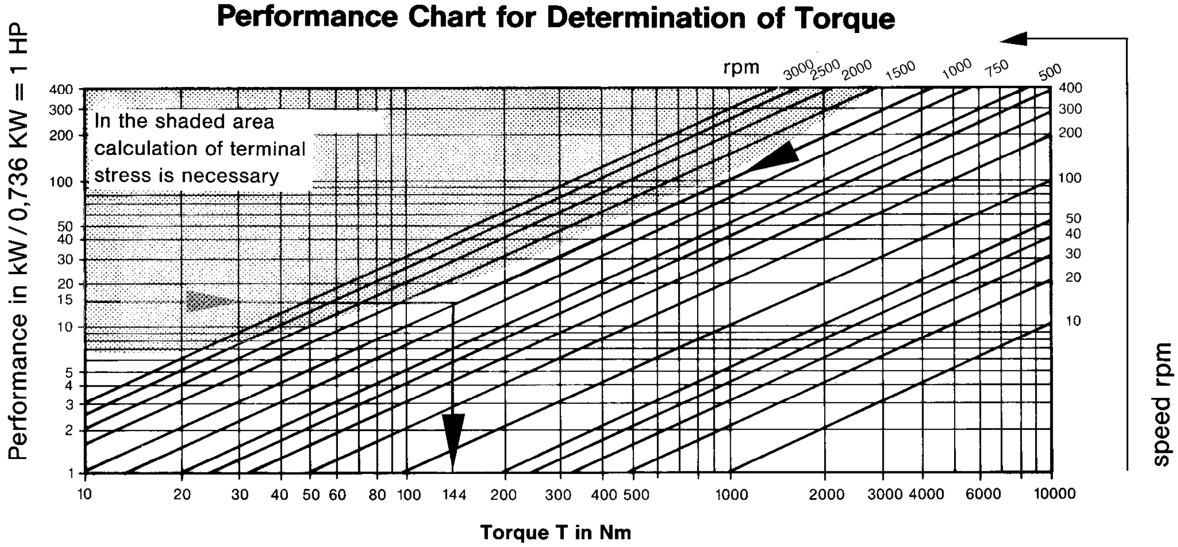
**Example 2:**

$$i = \frac{n_1}{n_2} = \frac{\text{speed } n_1 \text{ of pinion } d_1}{\text{speed } n_2 \text{ of shaft } d_2} = \frac{1000}{2000} = 1:2$$

i.e. relative to $n_1$ speed increase

Direction of rotation:
The directions of rotation indicated on gear arrangements are assumed. Opposite directions of rotation can also be selected.

## Performance Chart for Determination of Torque




Example: given that N = 15 kW with n = 1.000 rpm, the resultant torque T = 144 Nm

# Service Factors for the Selection of Gearboxes

The power characteristics of sizes/types 00-F1 represent the max. performance limits of the gearboxes. These ratings have been confirmed not only by calculation but also by extensive running on the test bench. Temperatures of 80⁰ - 100⁰ C were considered acceptable with oils having a viscosity of 46 C St at 40⁰ C, or alternatively synthetic lubricating oils may be used. If, however, design data indicate that maximum ratings may be reached (e.g. the type of load applied), the 'c' factors (derived from Prof. Niemann) must be included in the calculation.

| Degree of shock of driven machine | Prime Mover | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Electric motor Running time in h per day | | | | Piston motor, hydraulic motor Running time in h per day | | | | Single-cylinder piston motor Running time in h per day | | | |
| | 0,5 | 3 | 8 | 24 | 0,5 | 3 | 8 | 24 | 0,5 | 3 | 8 | 24 |
| I | 0,5 | 0,8 | 1,0 | 1,25 | 0,8 | 1,0 | 1,25 | 1,5 | 1,0 | 1,25 | 1,5 | 1,75 |
| II | 0,8 | 1,0 | 1,25 | 1,5 | 1,0 | 1,25 | 1,5 | 1,75 | 1,25 | 1,5 | 1,75 | 2,0 |
| III | 1,25 | 1,5 | 1,75 | 2,0 | 1,5 | 1,75 | 2,0 | 2,25 | 1,75 | 2,0 | 2,25 | 2,5 |

I almost shock-free, e.g. electric generators, screw conveyors, lightweight elevators, electric hoists, ventilators, agitators.

II moderate shock, e.g. heavy elevators, crane slewing gear, reciprocating pumps, shaft ventilators, cable hoists.

III heavy shock, e.g. punching and cutting machines, machinery used in rolling mills and the steel and iron industry, pug mills, weaving looms.

$P_1$ is the standard power in kW produced by the drive motor. $T_2$ is the standard torque in Nm delivered to the driven machine and c is derived from the table above as follows:

$$P_K = P_{1kW} \times c \qquad T_K = T_2 \times c$$

$P_K$ = power as shown
$T_K$ = torque as shown — to characteristic lines of diagram

With high speeds and power rates **maximum thermal stress values** are also to be taken into account when selecting gearbox size, - see page 26.

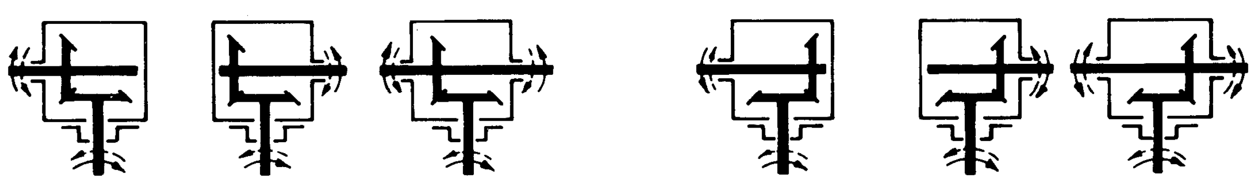
## Examples of Gearbox Selection

$n_1 = 1800$ r/min; drive provided by an 8.8 kW piston engine with coninuous operation 22 h per day driving a reciprocating pump.
From the table above: degree of shock = II; 'c' factor = 1.75; therefore a load of up to 15.4 kW.
Size of gear required: A1 (see diagram of power characteristics).

$n_1 = 1500$ r/min; drive provided by an 8 kW electric motor with 9 h operation per day driving a reciprocating pump.
From the table above: degree of shock II: 'c' factor = 1.25; therefore a load of up to 10 kW.
Size of gear required: 01.

## Internal Gear Arrangement

I | II | III | IV = II | V = I | VI = III



**Example of ordering:**

HW - A1 - 2:1 - III

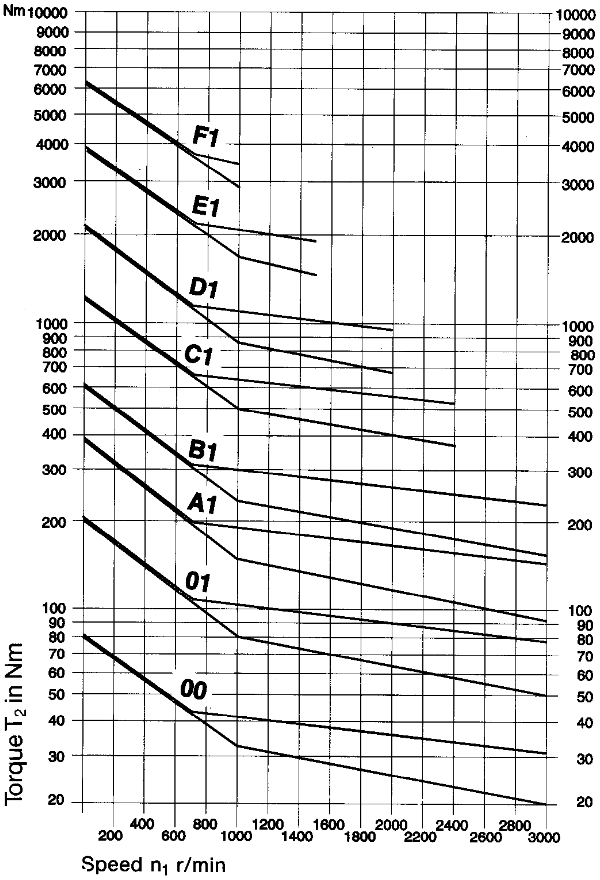
- Type/Series — HW
- size of gearboxes — A1
- Total ratio $i_{tot} = n_1 : n_2$ — 2:1
- Gear arrangement — III

**Further important data required for the preparation of quotations:**

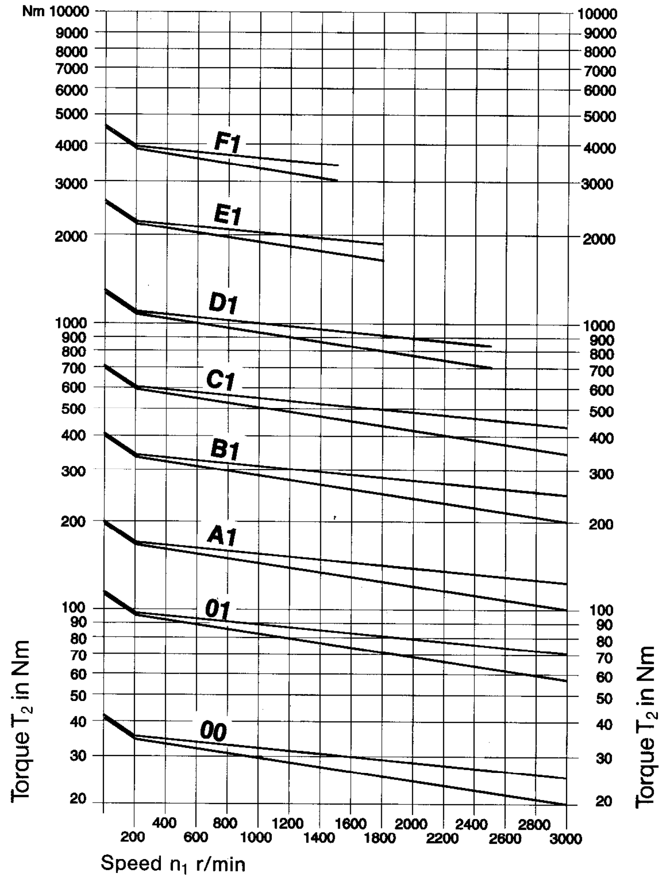
- Position of gears (shafts horizontal or vertical)
- Additional loads at shaft ends (e.g. belt drive)
- Gearbox environment (temperature, humidity, etc.)

# Permissible Torque

i = 1:1




i = 1,25:1 u. 1,5:1




**Standard box:** ————
**Power box:** ————

## Performance Data

Max. input power $P_1$ in kW and output torque $T_2$ in Nm

| speed | | ratios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | i = 1 | | i = 2 | | i = 3 | | i = 4 | | i = 5 | | i = 6 | |
| | $n_1$ r/min | $P_1$ kW | $T_2$ Nm | $P_1$ kW | $T_2$ Nm | $P_1$ kW | $T_2$ Nm | $P_1$ kW | $T_2$ Nm | $P_1$ kW | $T_2$ Nm | $P_1$ kW | $T_2$ Nm |
| **00** | 1000 | 4,4 | 42 | 1,6 | 31 | 1,0 | 30 | 0,68 | 26 | – | – | – | – |
| | 1500 | 6,1 | 39 | 2,3 | 29 | 1,4 | 27 | 0,94 | 24 | – | – | – | – |
| | 3000 | 9,7 | 31 | 4,1 | 26 | 2,5 | 24 | 1,4 | 18 | – | – | – | – |
| **01** | 1000 | 11,5 | 110 | 4,5 | 85 | 2,9 | 82 | 1,8 | 67 | 1,4 | 65 | 0,91 | 52 |
| | 1500 | 15,0 | 97 | 6,3 | 80 | 4,0 | 77 | 2,5 | 64 | 1,9 | 62 | 1,3 | 48 |
| | 3000 | 25,0 | 78 | 11,0 | 68 | 6,8 | 65 | 4,5 | 57 | 3,4 | 54 | 1,9 | 36 |
| **A1** | 1000 | 20,0 | 190 | 8,9 | 170 | 5,8 | 165 | 3,6 | 137 | 2,8 | 134 | 1,8 | 105 |
| | 1500 | 28,0 | 180 | 13,0 | 160 | 8,1 | 155 | 5,1 | 130 | 4,0 | 127 | 2,4 | 92 |
| | 3000 | 47,0 | 150 | 21,0 | 135 | 14,0 | 130 | 8,6 | 110 | 6,6 | 105 | 3,7 | 70 |
| **B1** | 1000 | 31,4 | 300 | 17,0 | 320 | 11,0 | 315 | 6,5 | 248 | 5,0 | 240 | 3,3 | 190 |
| | 1500 | 44,0 | 280 | 24,0 | 300 | 15,0 | 290 | 9,2 | 235 | 7,2 | 228 | 4,5 | 170 |
| | 3000 | 72,0 | 230 | 41,0 | 260 | 26,0 | 245 | 16,0 | 205 | 12,0 | 195 | 6,8 | 130 |
| **C1** | 500 | 41,0 | 780 | 15,0 | 590 | 10,0 | 580 | 6,2 | 470 | 4,8 | 460 | 3,4 | 390 |
| | 1000 | 67,0 | 640 | 30,0 | 570 | 19,0 | 540 | 12,0 | 440 | 9,0 | 430 | 6,1 | 350 |
| | 1500 | 94,0 | 600 | 41,0 | 520 | 27,0 | 510 | 17,0 | 430 | 13,0 | 420 | 8,1 | 310 |
| **D1** | 500 | 78,0 | 1500 | 29,0 | 1100 | 19,0 | 1080 | 11,0 | 830 | 8,5 | 810 | 6,1 | 700 |
| | 1000 | 120,0 | 1150 | 52,0 | 1000 | 35,0 | 995 | 21,0 | 800 | 16,0 | 780 | 11,0 | 640 |
| | 1500 | 160,0 | 1050 | 74,0 | 940 | 49,0 | 935 | 30,0 | 760 | 23,0 | 740 | 16,0 | 600 |
| **E1** | 500 | 140,0 | 2750 | 58,0 | 2200 | 38,0 | 2200 | 29,0 | 2180 | 23,0 | 2150 | 11,0 | 1300 |
| | 1000 | 225,0 | 2150 | 110,0 | 2100 | 73,0 | 2100 | 55,0 | 2100 | 42,0 | 2000 | 21,0 | 1200 |
| | 1500 | 310,0 | 1950 | 150,0 | 1900 | 97,0 | 1850 | 73,0 | 1850 | 53,0 | 1700 | 29,0 | 1100 |
| **F1** | 500 | 230,0 | 4400 | 99,0 | 3800 | 65,0 | 3700 | 48,0 | 3680 | 38,0 | 3650 | – | – |
| | 1000 | 355,0 | 3400 | 190,0 | 3600 | 120,0 | 3500 | 92,0 | 3500 | 72,0 | 3450 | – | – |

subject to modification

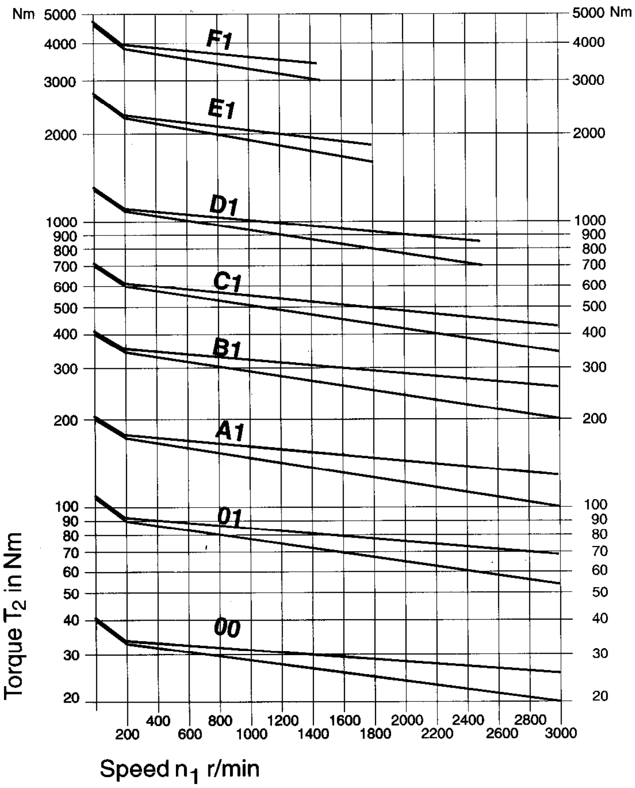
**Permissible radial load in N for shafts $d_1/d_2$**

| Permissible load $F_r$ in N[1] for shaft jornal $d_1$ $d_2$ | | Permissible load $F_r$ in N[1] for shaft jornal $d_1$ $d_2$ | |
|---|---|---|---|
| at ratio n i=1 up to 3 | | at ratio n i=4 up to 6 | |
| $d_1$ | $d_2$ | $d_1$ | $d_2$ |
| 300 | 300 | – | – |
| 1100 | 1100 | 1000 | 1100 |
| 1500 | 2700 | 1300 | 2700 |
| 2000 | 3700 | 1700 | 3700 |
| 3250 | 5000 | 2200 | 5000 |
| 3800 | 7500 | 2500 | 7500 |
| 4500 | 9200 | 3000 | 9200 |
| 7000 | 12000 | 3700 | 12000 |

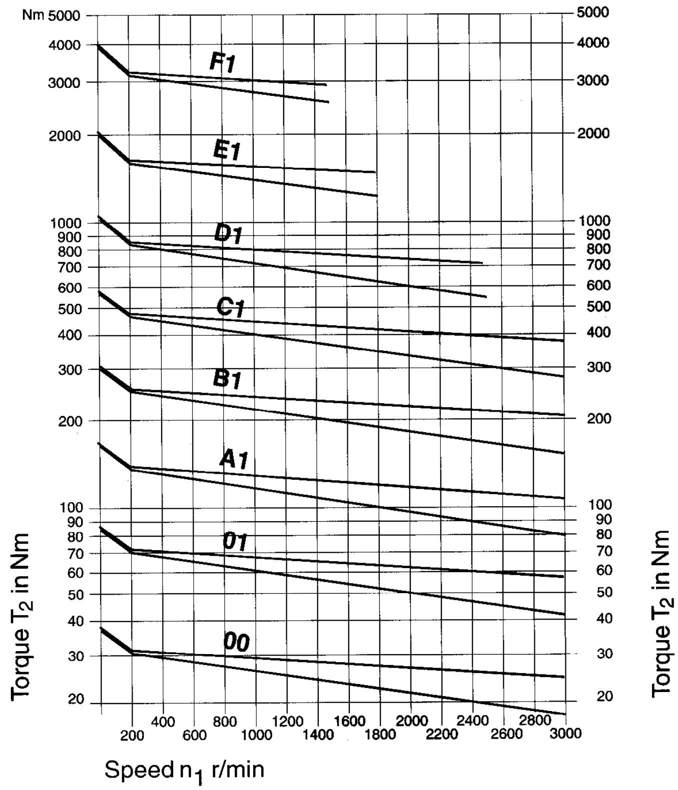
[1] permissible load values represent standard values

# Permissible Torque

i = 2:1 i = 3:1

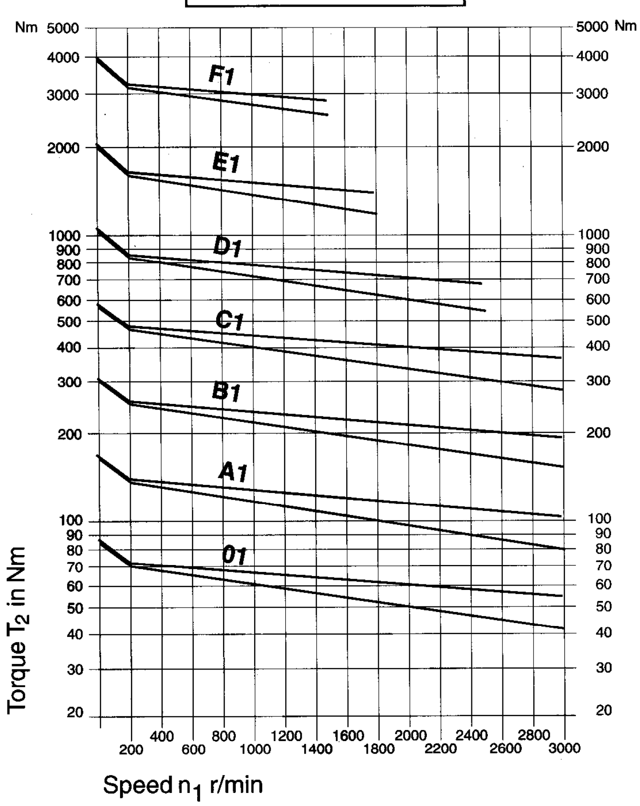



i = 4:1

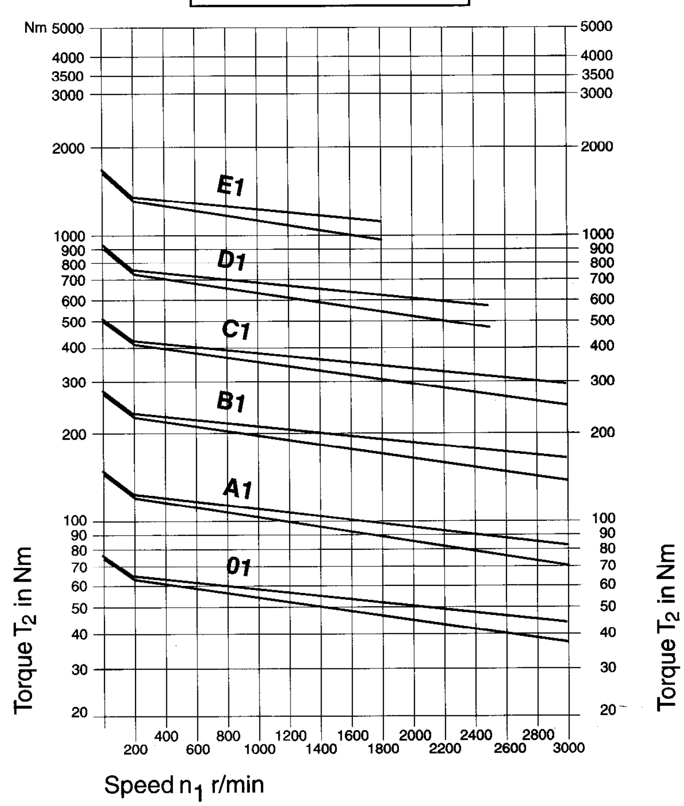



**Standard box:** ——————
**Powerbox:** ——————

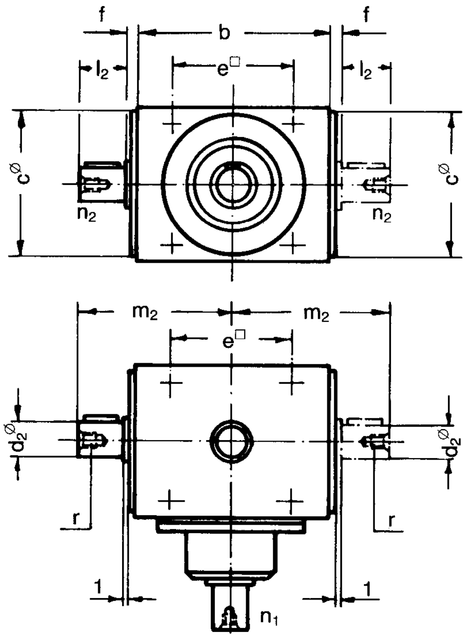
i = 5:1

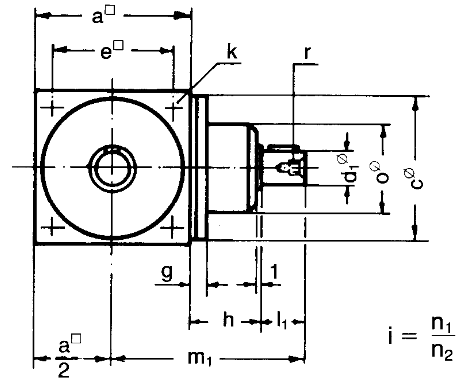



i = 6:1



# Standard Version




**Standard Version**
Ratios from 1 to 6 for speed reduction
8 gearbox sizes max. torque up to 6200 Nm
palloid spiral bevel gears

## Dimensions

| Gearbox-size | General | | | | | | | | | $d_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | a□ | b | $c^{ø}_{j7}$ | $d^{ø}_{2j6}$ | e□ | $m_2$ | f | h | k[1]) | r DIN 332 | Key DIN 6885 |
| 00* | 80 | 110 | 74 | 14 | 60 | 88,5 | 3,5 | 40 | M 6 | M 6 | 5x 5 |
| 01* | 110 | 145 | 102 | 22 | 82 | 111 | 3,5 | 45 | M 8 | M 8 | 6x 6 |
| A1* | 140 | 175 | 130 | 32 | 105 | 137 | 4,5 | 50 | M10 | M10 | 10x 8 |
| B1* | 170 | 215 | 160 | 42 | 130 | 172 | 4,5 | 65 | M12 | M12 | 12x 8 |
| C1* | 210 | 260 | 195 | 55 | 160 | 220 | 5,0 | 85 | M16 | M16 | 16x10 |
| D1 | 260 | 330 | 245 | 65 | 200 | 270 | 5,0 | 110 | M16 | M16 | 18x11 |
| E1 | 330 | 430 | 310 | 75 | 260 | 340 | 5,0 | 150 | M20 | M20 | 20x12 |
| F1 | 400 | 530 | 380 | 90 | 320 | 420 | 5,0 | 200 | M24 | M24 | 25x14 |

**Ratios i=1:1; 1,25:1; 1,5:1; 1,75:1; 2:1; 2,5:1**

| Gearbox-size | i=1:1 bis 2,5:1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{ø}_{1j6}$ | $l_1$ | $m_1$ | $o^{ø}$ | r DIN 332 | Key DIN 6885 |
| 00* | 30 | 13 | 14 | 30 | 110 | 52 | M 6 | 5x 5 |
| 01* | 35 | 14 | 22 | 35 | 135 | 70 | M 8 | 6x 6 |
| A1* | 45 | 14 | 32 | 45 | 165 | 90 | M10 | 10x 8 |
| B1* | 60 | 18 | 42 | 60 | 210 | 110 | M12 | 12x 8 |
| C1* | 85 | 18 | 55 | 85 | 275 | 135 | M16 | 16x10 |
| D1 | 100 | 23 | 65 | 100 | 340 | 150 | M16 | 18x11 |
| E1 | 120 | 29 | 75 | 120 | 435 | 230 | M20 | 20x12 |
| F1 | 150 | 40 | 90 | 150 | 550 | 270 | M24 | 25x14 |

**Ratios i=3:1**

| Gearbox-size | i=3:1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{ø}_{1j6}$ | $l_1$ | $m_1$ | $o^{ø}$ | r DIN 332 | Key DIN 6885 |
| 00* | 30 | 13 | 12 | 25 | 105 | 52 | M 5 | 4x 4 |
| 01* | 35 | 14 | 22 | 35 | 135 | 70 | M 8 | 6x 6 |
| A1* | 45 | 14 | 32 | 45 | 165 | 90 | M10 | 1x 8 |
| B1* | 68 | 18 | 36 | 55 | 205 | 100 | M12 | 10x 8 |
| C1* | 85 | 18 | 38 | 65 | 255 | 135 | M12 | 10x 8 |
| D1 | 95 | 23 | 55 | 85 | 325 | 135 | M16 | 16x10 |
| E1 | 120 | 29 | 55 | 85 | 400 | 190 | M16 | 16x10 |
| F1 | 150 | 40 | 75 | 120 | 520 | 270 | M20 | 20x12 |

**Ratios i=3,5:1**

| Gearbox-size | i=3,5:1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{ø}_{1j6}$ | $l_1$ | $m_1$ | $o^{ø}$ | r DIN 332 | Key DIN 6885 |
| 00* | 30 | 13 | 12 | 25 | 105 | 52 | M 5 | 4x 4 |
| 01* | 35 | 14 | 16 | 30 | 130 | 70 | M 6 | 5x 5 |
| A1* | 45 | 14 | 20 | 32 | 152 | 80 | M 8 | 6x 6 |
| B1* | 68 | 23 | 26 | 45 | 200 | 80 | M 8 | 8x 7 |
| C1* | 85 | 18 | 32 | 45 | 235 | 105 | M10 | 10x 8 |
| D1 | 95 | 28 | 42 | 70 | 310 | 110 | M12 | 12x 8 |
| E1 | 120 | 29 | 50 | 75 | 390 | 190 | M16 | 14x 9 |
| F1 | 150 | 40 | 60 | 95 | 495 | 200 | M16 | 18x11 |

**Ratios i=4:1**

| Gearbox-size | i=4:1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{ø}_{1j6}$ | $l_1$ | $m_1$ | $o^{ø}$ | r DIN 332 | Key DIN 6885 |
| 00* | 30 | 13 | 9 | 20 | 100 | 47 | M 4 | 3x 3 |
| 01* | 35 | 14 | 16 | 30 | 130 | 70 | M 6 | 5x 5 |
| A1* | 45 | 14 | 20 | 32 | 152 | 80 | M 8 | 6x 6 |
| B1* | 68 | 23 | 26 | 45 | 200 | 80 | M 8 | 8x 7 |
| C1* | 85 | 18 | 32 | 45 | 235 | 105 | M10 | 10x 8 |
| D1 | 95 | 28 | 42 | 70 | 310 | 110 | M12 | 12x 8 |
| E1 | 120 | 29 | 50 | 75 | 390 | 190 | M16 | 14x 9 |
| F1 | 150 | 40 | 60 | 95 | 495 | 200 | M16 | 18x11 |

**Ratios i=5:1**

| Gearbox-size | i=5:1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{ø}_{1j6}$ | $l_1$ | $m_1$ | $o^{ø}$ | r DIN 332 | Key DIN 6885 |
| 00* | – | – | – | – | – | – | – | – |
| 01* | 35 | 14 | 12 | 22 | 122 | 55 | M 5 | 4x 4 |
| A1* | 45 | 14 | 16 | 30 | 150 | 65 | M 6 | 5x 5 |
| B1* | 68 | 24 | 22 | 40 | 195 | 70 | M 8 | 6x 6 |
| C1* | 85 | 18 | 26 | 45 | 235 | 95 | M 8 | 8x 7 |
| D1 | 95 | 23 | 32 | 58 | 298 | 105 | M10 | 10x 8 |
| E1 | 120 | 29 | 42 | 70 | 385 | 190 | M12 | 12x 8 |
| F1 | 150 | 40 | 55 | 85 | 485 | 200 | M16 | 16x10 |

**Ratios i=6:1**

| Gearbox-size | i=6:1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{ø}_{1j6}$ | $l_1$ | $m_1$ | $o^{ø}$ | r DIN 332 | Key DIN 6885 |
| 00* | – | – | – | – | – | – | – | – |
| 01* | 35 | 14 | 10 | 22 | 122 | 50 | M 4 | 3x 3 |
| A1* | 45 | 14 | 12 | 30 | 150 | 55 | M 5 | 4x 4 |
| B1* | 68 | 24 | 16 | 30 | 185 | 70 | M 6 | 5x 5 |
| C1* | 85 | 18 | 20 | 40 | 230 | 95 | M 8 | 6x 6 |
| D1 | 95 | 23 | 26 | 45 | 285 | 105 | M 8 | 8x 7 |
| E1 | 120 | 29 | 40 | 70 | 385 | 190 | M10 | 12x 8 |
| F1 | – | – | – | – | – | – | – | – |

[1]) tapped depth = k x 1,5 / * Available in aluminium version or corrosion proof with nickel-plated exterior / Keys to BS 4235 / DIN 6885 / shaft centrings type D to DIN 322 / Subject to modification.

# Korrektur / Correction

**Spiralkegelgetriebe** Prospekte A 00/1 und A00/2
***Spiral Bevel Gearboxes*** *Catalogues A 00/1e*

Auf Seite 8
Die gedruckten Angaben für den Wellen-Durchmesser d2 j6 und Länge m2 sind für die Getriebe Baugröße B1 und D1 nicht immer korrekt. Sie sind abhängig von der Übersetzung.

*Page 8*
*The printed values for diameter on shaft d2 j6 are not always correct in sizes B1 and D1. They are dependent on ratio.*

**B1**

| | |
|---|---|
| i=1:1...2,5:1 | m2 = 172mm |
| i=3:1...6:1 | m2 = 180mm |

**D1**

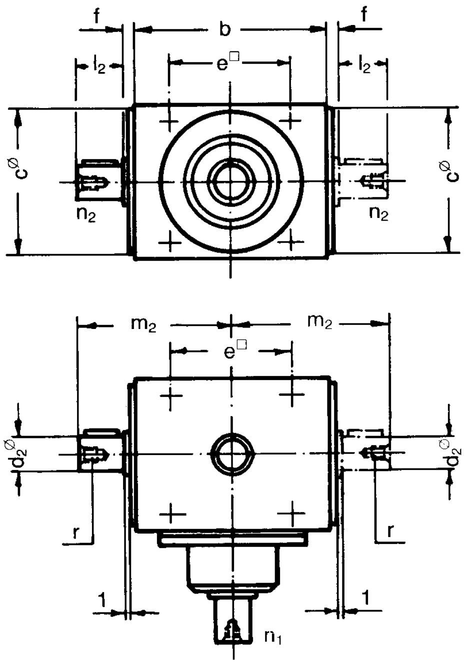
| | |
|---|---|
| i=1:1...2,5:1 | d2 j6 = 65mm |
| i=3:1...6:1 | d2 j6 = 60mm |

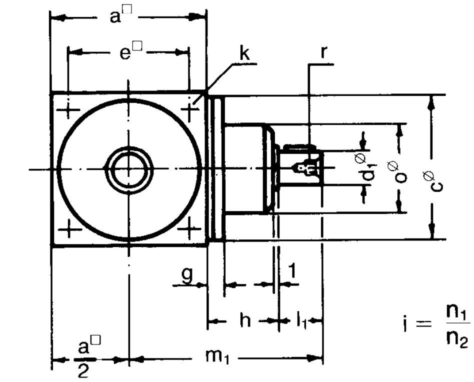
**D1**

| | |
|---|---|
| i=1:1...2,5:1 | m2 = 270mm |
| i=3:1...6:1 | m2 = 265mm |

13.07.2000

# Speed-Increasing Ratios



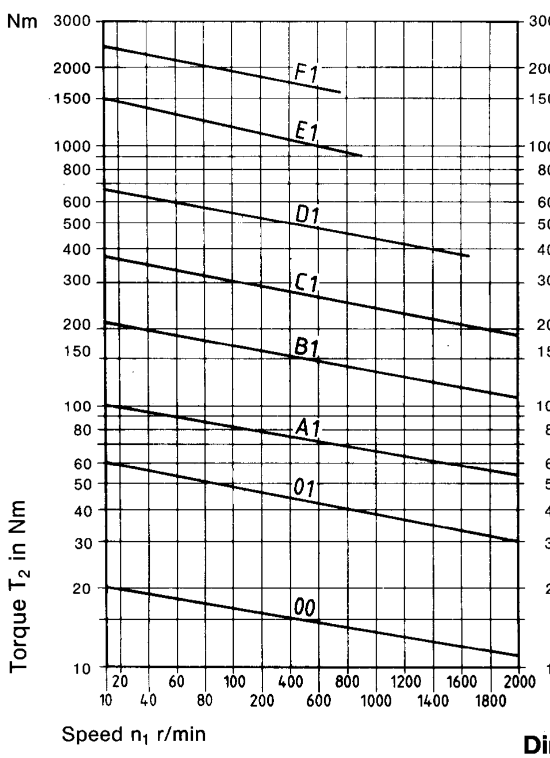



For special applications a gearbox series is available with speed-increasing ratio relative to $n_1$. It has to be taken into account here that it will be assumed by Tandler that $n_1$ applies to shaft $d_1$ and $n_2$ applies to shaft $d_2$. Ratios for this gearbox series are listed in the table below.

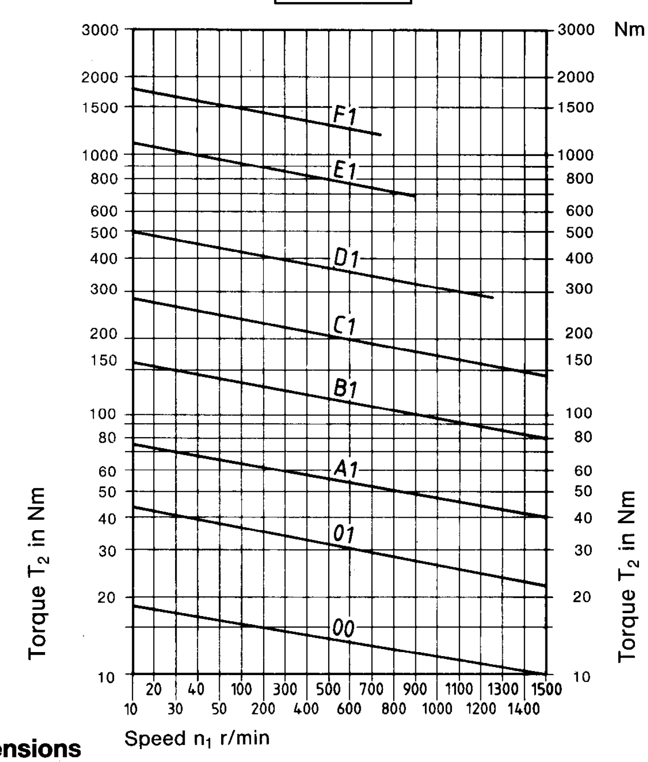
| | |
|---|---|
| Speed-increasing Ratios | i = 1 : 1.25<br>i = 1 : 1.5<br>i = 1 : 1.75<br>i = 1 : 2 |

Please note: **There are dimensional changes to shaft $d_2$** in this series when ratio i = 1 : 2, compared with the standard version.

i = 1:1,25 and 1:1,5




i = 1:2

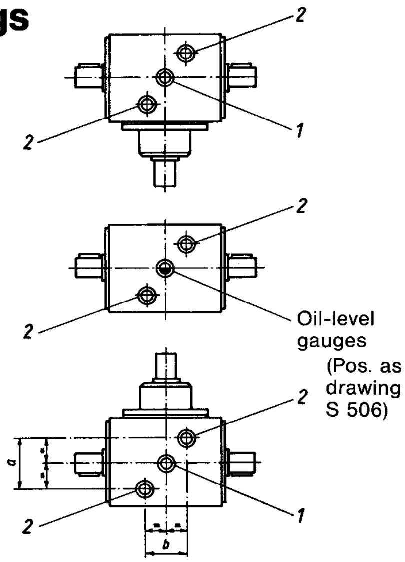



## Dimensions

| Ratios | | | | | | | | | | | | | | | i = 1 : 1,25 und 1 : 1,5 | | | | | i = 1 : 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | General | | | | | | | | | | | | $d_1$ | | | | | $d_2$ | | | | | $d_2$ | |
| Gearbox-size | □ a | b | Ø $c_{j7}$ | Ø $d_{1j6}$ | □ e | $m_1$ | $l_1$ | f | g | h | k[1]) | Ø o | r DIN 332 | Key DIN 6885 | Ø $d_{2j6}$ | $l_2$ | $m_2$ | r DIN 332 | Key DIN 6885 | Ø $d_{2j6}$ | $l_2$ | $m_2$ | r DIN 332 | Key DIN 6885 |
| **00*** | 80 | 110 | 74 | 14 | 60 | 110 | 30 | 3,5 | 13 | 40 | M 6 | 52 | M 6 | 5x 5 | 14 | 30 | 88,5 | M 6 | 5x 5 | 12 | 25 | 83,5 | M 5 | 4x4 |
| **01*** | 110 | 145 | 102 | 22 | 82 | 135 | 35 | 3,5 | 14 | 45 | M 8 | 70 | M 8 | 6x 6 | 22 | 35 | 111 | M 8 | 6x 6 | 16 | 30 | 106 | M 6 | 5x5 |
| **A1*** | 140 | 175 | 130 | 32 | 105 | 165 | 45 | 4,5 | 14 | 50 | M10 | 90 | M10 | 10x 8 | 32 | 45 | 137 | M10 | 10x 8 | 24 | 42 | 134 | M 8 | 8x7 |
| **B1*** | 170 | 215 | 160 | 42 | 130 | 210 | 60 | 4,5 | 18 | 65 | M12 | 110 | M12 | 12x 8 | 42 | 60 | 172 | M12 | 12x 8 | 28 | 50 | 162 | M 8 | 8x7 |
| **C1*** | 210 | 260 | 195 | 55 | 160 | 275 | 85 | 5,0 | 18 | 85 | M16 | 135 | M16 | 16x10 | 55 | 85 | 220 | M16 | 16x10 | 38 | 60 | 195 | M12 | 10x8 |
| **D1** | 260 | 330 | 245 | 65 | 200 | 340 | 100 | 5,0 | 23 | 110 | M16 | 150 | M16 | 18x11 | 65 | 100 | 270 | M16 | 18x11 | 50 | 80 | 250 | M16 | 14x9 |
| **E1** | 330 | 430 | 310 | 75 | 260 | 435 | 120 | 5,0 | 29 | 150 | M20 | 230 | M20 | 20x12 | 75 | 120 | 340 | M20 | 20x12 | 50 | 90 | 310 | M16 | 14x9 |
| **F1** | 400 | 530 | 380 | 90 | 320 | 550 | 150 | 5,0 | 40 | 200 | M24 | 270 | M24 | 25x14 | 90 | 150 | 420 | M24 | 25x14 | 65 | 130 | 400 | M16 | 18x11 |

[1]) tapped depth = k x 1.5 / * Available in aluminium version or corrosion proof with nickel-plated exterior / Keys to BS 4235 DIN 6885 / shaft centrings type D to DIN 322 / Subject to modification

# Position of Oil Filler and Drain Plugs

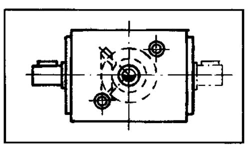



| Gearbox-size | Screw plug DIN 908 | | | | Dimensions | |
|---|---|---|---|---|---|---|
| | Quantity | Pos. 1 | Quantity | Pos. 2 | a | b |
| 00* | 2 | R 3/4 " * | 6 | M 12 x 1,5 | 39,6 | 39,6 |
| 01 | 2 | M 30 x 1,5 | 6 | M 12 x 1,5 | 58 | 67 |
| A1 | 2 | M 30 x 1,5 | 6 | M 12 x 1,5 | 90 | 70 |
| B1 | 2 | M 30 x 1,5 | 6 | M 30 x 1,5 | 100 | 68 |
| C1 | 2 | M 30 x 1,5 | 6 | M 30 x 1,5 | 110 | 98 |
| D1 | 2 | M 30 x 1,5 | 6 | M 30 x 1,5 | 146 | 134 |
| E1 | 2 | M 42 x 1,5 | 6 | M 42 x 1,5 | 180 | 168 |
| F1 | 2 | M 48 x 1,5 | 6 | M 48 x 1,5 | 120 | 230 |

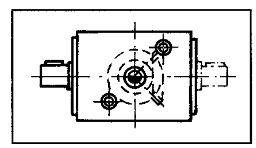
* Note! Opposite diagonal of screws. Screw plug pos. 1 not to DIN 908.

# Arrangement of the oil-level gauges as per drawing S 506

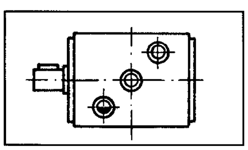
## Gearbox Sizes 00; 01; and A1



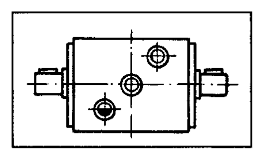
In standard gearboxes in sizes 00, 01 and A1 the oil-level gauge is located in the centre of the gear housing opposite shaft journal $d_1$. The correct oil level is half-way up the oil-level gauge, irrespective of the gear ratio.

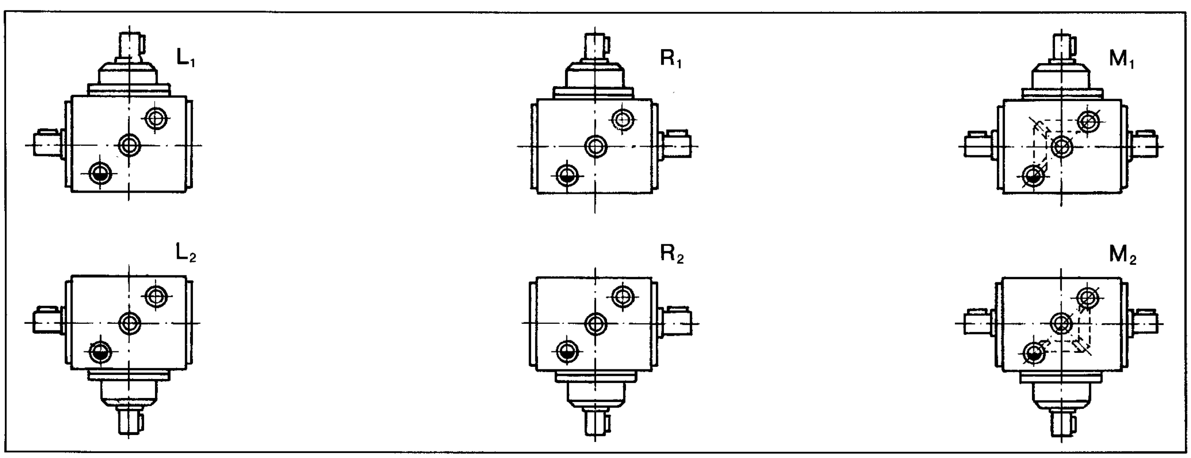


## Gearbox Sizes B1; C1; D1; E1; F1



With gearbox sizes B1, C1, D1, E1 and F1 the oil-level gauges are always mounted on which ever screwconnection is the lowest according to the position of the gearbox and oil should reach halfway up the gauge. If i = 1 : 1 oil-level gauge has to be in the middle of the gearbox. If the gearbox is installed in one of the positions shown below, the oil-level gauge with O-ring seal must be repositioned. To make things simpler the position of the oil-level gauge may be specified using the following designations shown in the diagrams when an order is placed.

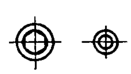




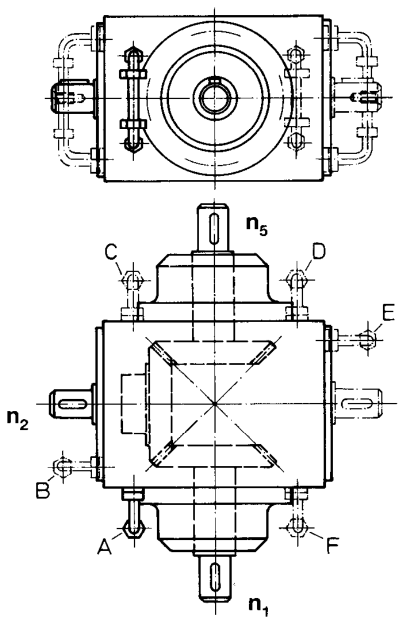

Note: Additional details for a different arrangement of the oil-level gauge must accompany the normal order description, e.g.

Spiral bevel gearboxes, standard model, size A1,
ratio $i = n_1 : n_2$, gear arrangement I

plus additional description: „Oil-level gauge as per dimension diagram S 506 R1".

 Oil-level gauge  Screw plug

# Oil Gauge for One-Way and Multiple-Way Auxiliary (Branch-Off) Gearboxes – S 545

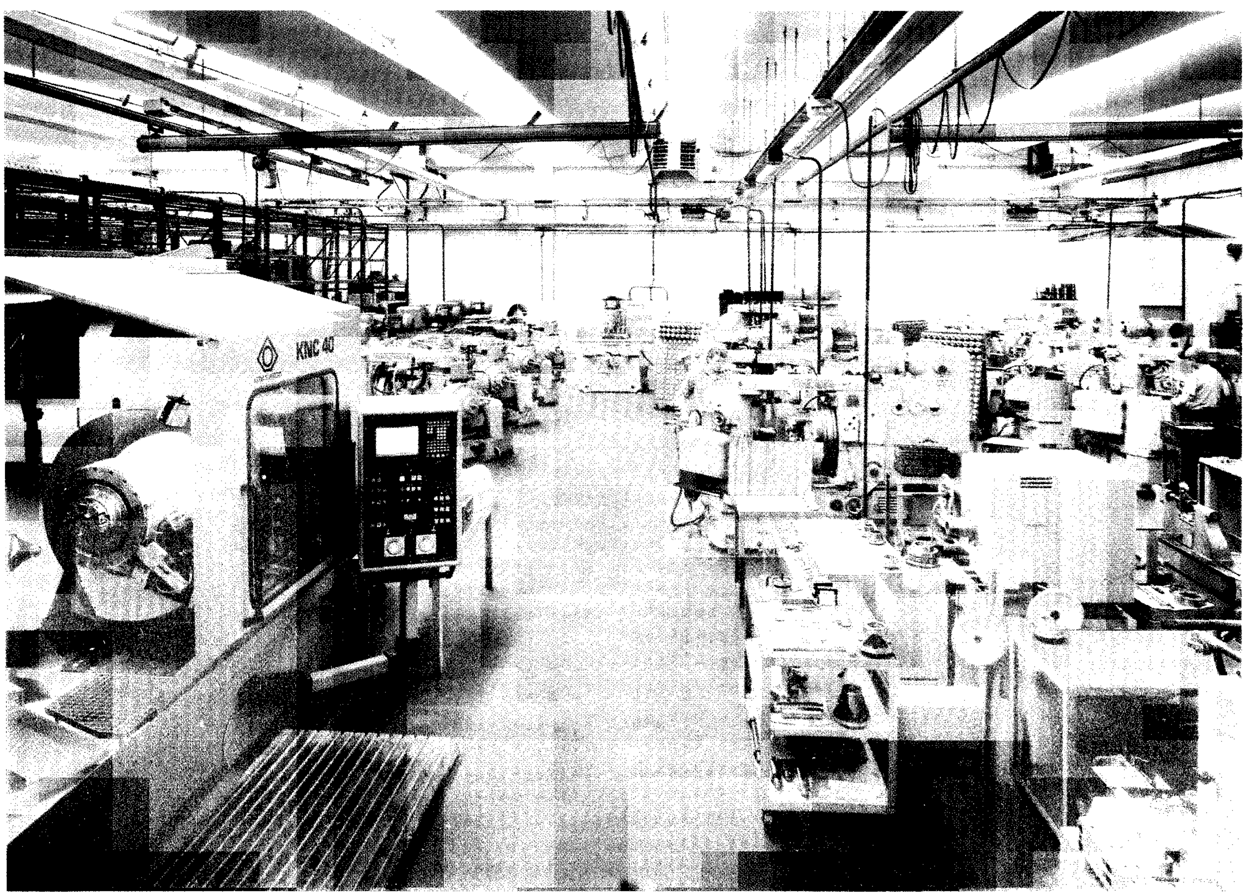



**Vertical shafts $n_1$ and $n_5$**
If one-way auxiliary gearboxes are installed vertically, the oil-level is monitored by the oil sight glass.

**Horizontal Installation**
If one-way auxiliary gearboxes are installed horizontally, the shafts are also horizontal and an oil level sight glass as shown is required. In order to position the oil gange correctly in relation to the particular gearbox design, the particular gearbox version (e. g. A, as shown in the drawing) has to be quoted.

Unless otherwise agreed, the gearboxes are supplied with oil filler elbow in the normal position, (Version B + E from type C1 onwards).

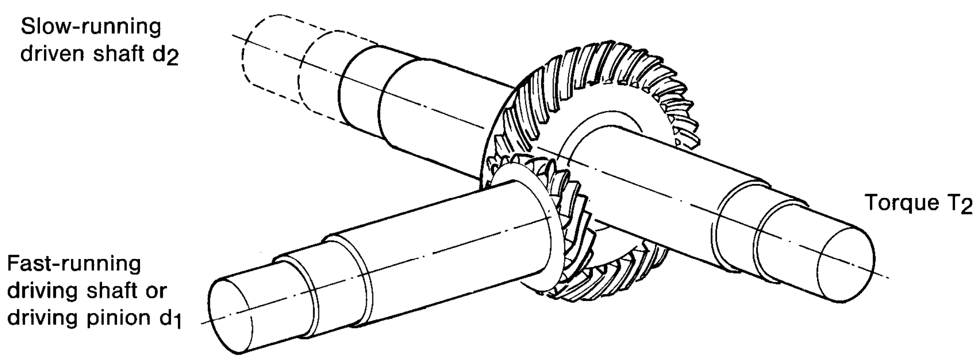
**Example for Ordering:**
Spiral bevel gearbox as one-way auxiliary gearbox
Type A1 Internal gear arrangement EA III
$i = n_1 : n_2 = 3 : 1$ $i = n_1 : n_5 = 1 : 1$
oil-level gauge according to version „A" S 545.



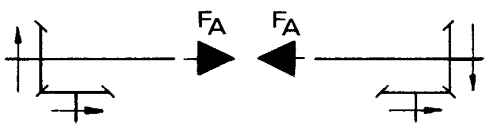

**Werk II Bremen**

# Calculation of the permissible axial forces $F_A$ on shaft $d_2$ of spiral bevel gearboxes

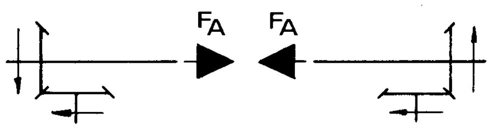
## Standard Version



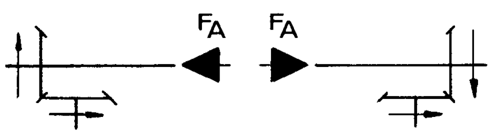

With drive on shaft $d_1$ ist $T_2 = i \cdot T_1$
e. g. drive on $d_1$ with $i = 2:1$; (fast to slow) $T_2 = 2 \cdot T_1$



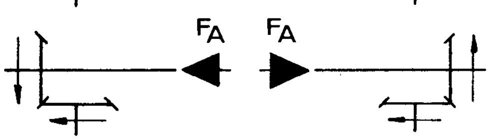

$F_A = 2{,}5 \cdot (f + A \cdot T_2) \quad = \qquad N$




$F_A = \ 8 \cdot \ (f + A \cdot T_2) \quad = \qquad N$




$F_A = \ 8 \cdot \ (f - A \cdot T_2) \quad = \qquad N$




$F_A$ = on inquiry

**Axial load factor f**

| n | Type 00<br>A = 2,4 | Type 01<br>A = 1,6 | Type A1<br>A = 1,25 | Type B1<br>A = 1,0 | Type C1<br>A = 0,85 | Type D1<br>A = 0,65 | Type E1<br>A = 0,55 |
|---|---|---|---|---|---|---|---|
| 50 | 400 | 680 | 1370 | 1940 | 2600 | 4000 | 4900 |
| 100 | 335 | 540 | 1090 | 1540 | 2100 | 3215 | 3920 |
| 200 | 265 | 430 | 865 | 1220 | 1670 | 2550 | 3115 |
| 300 | 230 | 375 | 755 | 1070 | 1460 | 2230 | 2720 |
| 500 | 195 | 315 | 635 | 900 | 1230 | 1880 | 2295 |
| 750 | 170 | 275 | 555 | 785 | 1075 | 1640 | 2000 |
| 1000 | 155 | 250 | 505 | 715 | 975 | 1490 | 1820 |
| 1260 | 140 | 235 | 470 | 665 | 905 | 1385 | 1690 |
| 1500 | 135 | 220 | 440 | 625 | 850 | 1300 | 1590 |
| 2000 | 120 | 200 | 400 | 565 | 775 | 1185 | |
| 2500 | 110 | 185 | 370 | 525 | 720 | | |
| 3000 | 100 | 170 | 350 | 495 | | | |

A = factor for calculation

# Heat Build-Up and Lubrication

The operational reliability of a gearbox is largely dependent on lubrication and is affected by the choice of lubricant.

The oil has to lubricate both bevel gears and roller bearings and also provide cooling.

Heat is mainly created within the gearboxes by the meshing force of gears, - sliding and rolling friction-, bearing and shaft seal friction and by churning losses, (if no oil circulation system is fitted). If no external cooling is provided the above-mentioned internal heat sources must be counterbalanced by the natural heat radiation of the gearbox outer surfaces.

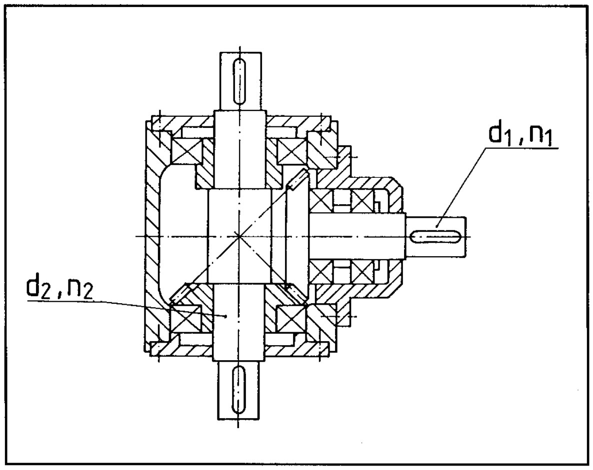
For low circumferential speeds of the bevel pinion (v = approx. 1,5 m/s) **grease lubrication** has proved successful when applied to the gears and the bearings.

| Gearbox Size $i \geqq 1:1$ | Circumferential speed of the bevel pinion |
|---|---|
| 00 | $v = 2{,}9 \cdot 10^{-3} \cdot n_2$ (m/s) |
| 01 | $v = 4{,}2 \cdot 10^{-3} \cdot n_2$ (m/s) |
| A1 | $v = 5{,}2 \cdot 10^{-3} \cdot n_2$ (m/s) |
| B1 | $v = 6{,}5 \cdot 10^{-3} \cdot n_2$ (m/s) |
| C1 | $v = 7{,}8 \cdot 10^{-3} \cdot n_2$ (m/s) |
| D1 | $v = 9{,}9 \cdot 10^{-3} \cdot n_2$ (m/s) |
| E1 | $v = 11{,}8 \cdot 10^{-3} \cdot n_2$ (m/s) |
| F1 | $v = 15{,}7 \cdot 10^{-3} \cdot n_2$ (m/s) |

Table 1: Calculation of circumferential speed
(Note: For speed increasing ratio $i < 1:1$ speed $n_2$ has to replace $n_1$ in Table 1)

In most cases, spiral bevel gearboxes with a very efficient **oil sump lubrication** are used for moderate circumferential speeds and powers.

If, however, speeds and powers reach a level close to permitted maxima, heat build up has to be monitored closely. In order to prevent deficient lubrication at high circumferential speeds and to dissipate the heat generated, **pressure feed lubrication** instead of oil sump lubrication should be used.




Vertical shaft arrangement

Lubrication of the rolling bearings can present a problem depending on the **position in which the gearbox is installed.** In a vertical arrangement of driving or driven shaft one bearing position is at the top (Fig. 1). To avoid bearing failure due to insufficient lubrication, it may ne necessary to install a shaft seal with separate lubrication. In such cases we can advise the necessary modification.

## Thermal Limit

Heat generation in spiral bevel gearboxes has to be monitored particularly at high speeds and power rates.
80-100° C is considered the maximum operating temperature (see also power diagram page 4).

If the power $P_1$ which is to be transmitted, exceeds the permitted thermal limit $Pg_1$, additional cooling, e. g. by means of cooling ribs and oil circulation system, is required.

Permitted thermal limit $Pg_1$ values quoted in the table apply to high gear speeds (from n = approx. 0,7 x n max.), an environmental temperature of 20° C, 100 % operating time per hour, and gearbox position with horizontal shafts. Please advise if other conditions apply.

Technical details regarding connection of oil feed pipes, cooling ribs and oil cooling systems on request.

| Gearbox Type | Permitted thermal Limit $Pg_1$ in kW |
|---|---|
| 00 | 4 |
| 01 | 7 |
| A1 | 10 |
| B1 | 15,5 |
| C1 | 23 |
| D1 | 35,5 |
| E1 | 60,5 |
| F1 | 90 |

Values quoted as permitted thermal limits $Pg_1$ are standard values.

# Weights

| Gearbox Size | Standard Vesion kg | Aluminium Version kg | Gearbox Size | kg | Gearbox Size | kg |
|---|---|---|---|---|---|---|
| 00 | 5 | 3 | – | – | – | – |
| 01 | 11 | 7 | S 01 | 12,5 | W 01 | 15 |
| A1 | 21 | 12 | S A1 | 25 | W A1 | 29,5 |
| B1 | 36 | 23 | S B1 | 42 | W B1 | 50 |
| C1 | 64 | 44 | S C1 | 75 | W C1 | 88 |
| D1 | 124 | – | S D1 | 145 | W D1 | 172 |
| E1 | 250 | – | S E1 | 295 | W E1 | 350 |
| F1 | 455 | – | S F1 | 535 | W F1 | 630 |

Quoted weights are approximate values.

# Lubricants

The selection of lubricants and their degree of viscosity has been made taking into account the design, circumferential speed, backlash of the teeth and operating temperature of the gearboxes. The doped mineral oils and gear lubricants shown provide the highest possible operational reliability under normal operating conditions and a long working life. At extreme temperatures and operating conditions synthetic lubricants can also be used following consultation.

| Company | Type of Oil | Type of Grease |
|---|---|---|
| Aral | Degol BG 46 | Aralub FDP 00 |
| Shell | TellusOel 46 | Shell Spezial Getriebefett H<br>Shell Grease S 3655 |
| Mobil-Oil | D.T.E. 25 | Mobilplex 44 |
| Esso | NUTO H 46 | FIBRAX EP 370<br>FIBRAX 370 |
| BP | GR-XP 46 (ISO) | BP Energrease HT-EP 00<br>BP Energrease FG 00-EP |
| Texaco | Rando Oil HD B-46 | Marfak<br>Glissando FG 30 |
| Castrol | HYSPIN AWS 46 | IMPERVIA MMO |
| Kluber | GEM 1-46 | NATOSBIN B 1600 EP |

Synthetic lubricants on request.
Random listing of oil manufacturers – independent of quality.

# Quantities

The gearboxes are supplied ready for installation and filled with a specific quantity of oil depending on upon gearbox size and ratio. To ensure operational reliability the quantity of oil should not be altered. If the oil level is too low inadequate cooling and insufficient lubrication of the bevel gears will occur. If the oil level is too high, strong oil turbulence is created with the result that churning losses and oil temperature rise unnecessarily. Once the gearboxes have been run in, they should have an oil change every 2000 h – just like cars; a gearbox operated for 24 h/day should have an oil change every 1000 h.

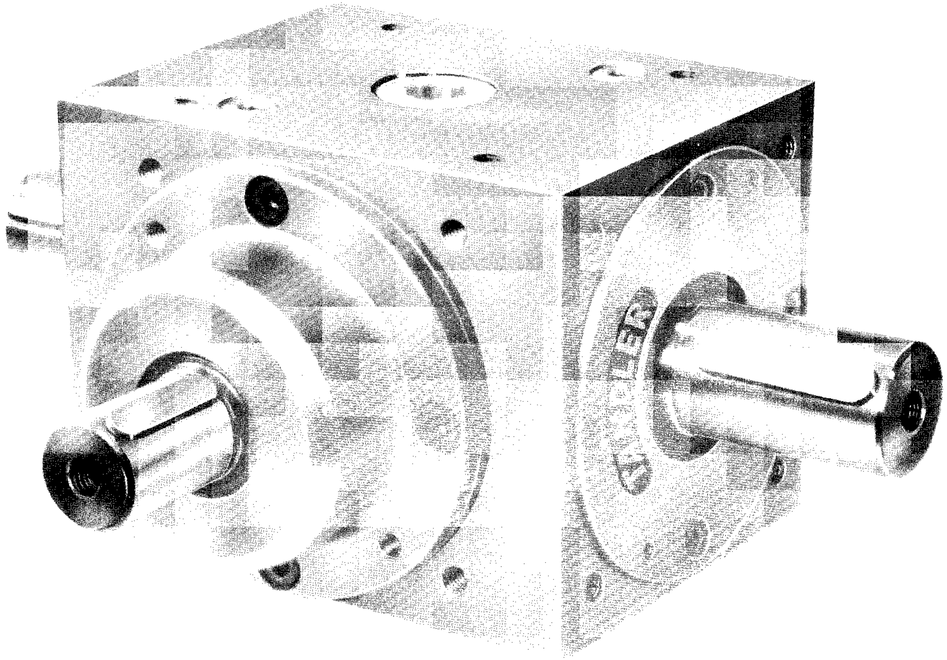
| Gearbox Size | i = 1:1 | i ≠ 1:1 | Grease |
|---|---|---|---|
| | litre | litre | kg |
| 00 | 0,10 | 0,10 | 0,20 |
| 01 | 0,25 | 0,25 | 0,45 |
| A1 | 0,60 | 0,60 | 1,00 |
| B1 | 0,75 | 1,10 | 1,60 |
| C1 | 1,50 | 2,25 | 3,00 |
| D1 | 3,00 | 4,50 | 6,00 |
| E1 | 8,00 | 11,00 | 15,00 |
| F1 | 13,00 | 15,00 | 19,00 |

Listed quantities are approximate values.
The oil-level sight glass can be used for measuring the quantity.

# Spiral Bevel Gearboxes
# Series WV
## Version - Reinforced Shaft

It is the function of WV spiral bevel gearboxes to take off only partial torques from a main line or drive shaft (comparable to a canal system with several outlets), and greatly reduce the price of new set-ups due to the ability to transmit the entire initial torque through the reinforced, continuous shaft $d_2$.
They allow the use of considerably smaller and therefore cheaper units and enable the designer to work more cost-effectively.

The maximum input torque is 9000 Nm for the sizes shown below. The number of gearboxes connected in line is only limited by the available space, whilst the sum of the take-offs should be equal to the total input torque. The permissible torque which can be applied to the reinforced shaft together with the correct gearbox to use are both shown in the following table.

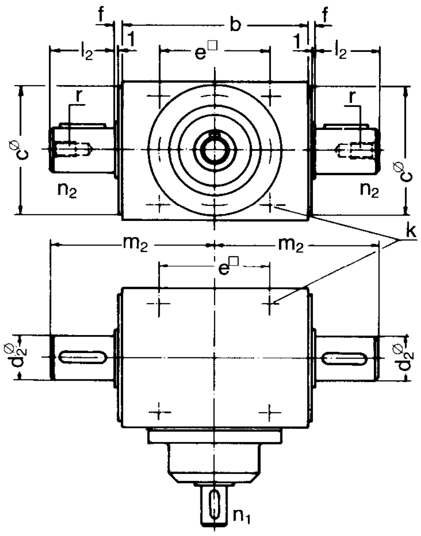


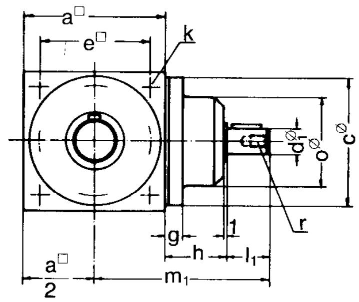
**The following $T_2$ values listed in the table refer to continuous shaft $d_2$.**
See pages 6 and 7 for the max. permissible loads for the gear arrangement.

| Type | Continuous shaft $d_2$ | | Shaft dia. Ø $d_{1j6}$ dependent on ratio i | | | | |
|---|---|---|---|---|---|---|---|
| | $d_2Ø_{j6}$ | $T_2$ perm | 1 : 1 – 2,5 : 1 | 3 : 1 | 3,5 : 1 – 4 : 1 | 5 : 1 | 6 : 1 |
| WV **00** | 20 | 80 Nm | 14 | 12 | 12 9 | – | – |
| WV **01** | 35 | 380 Nm | 22 | 22 | 16 | 12 | 10 |
| WV **A1** | 40 | 580 Nm | 32 | 32 | 20 | 16 | 12 |
| WV **B1** | 50 | 1150 Nm | 42 | 36 | 26 | 22 | 16 |
| WV **C1** | 60 | 1950 Nm | 55 | 38 | 32 | 26 | 20 |
| WV **D1** | 75 | 3900 Nm | 65 | 55 | 42 | 32 | 26 |
| WV **E1** | 85 | 5800 Nm | 75 | 55 | 50 | 42 | 40 |
| WV **F1** | 100 | 9000 Nm | 90 | 75 | 60 | 55 | – |

The permissible torque on shaft $d_2$ has been calculated on the full torque basis of reversal, coefficient of restitution of 1.25 and a 2.5-fold safety margin. If the operating conditions are different, appropriate additional factors must be included. The dimensions of WV gearboxes are shown in the table opposite. Dimensions, gears and teeth data are identical with those listed for the standard range of gearboxes.

# Series WV





**Spiral Bevel Gearboxes – Reinforced Shaft**

8 gearbox sizes: Shaft $d_2$ up to 9000 Nm
gears up to 6200 Nm maximum torque
Palloid spiral bevel gears.

## Dimensions

| Gearbox-size | General | | | | | | | | $d_2$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | a□ | b | $c^{\varnothing}_{j7}$ | e□ | $m_2$ | f | h | k¹) | $d^{\varnothing}_{2j6}$ | r DIN 332 | Key DIN 6885 |
| WV **00*** | 80 | 110 | 74 | 60 | 93,5 | 3,5 | 40 | M 6 | 20 | M 8 | 6x6 |
| WV **01*** | 110 | 145 | 102 | 82 | 131 | 3,5 | 45 | M 8 | 35 | M 10 | 10x8 |
| WV **A1*** | 140 | 175 | 130 | 105 | 157 | 4,5 | 50 | M10 | 40 | M 12 | 12x8 |
| WV **B1*** | 170 | 215 | 160 | 130 | 192 | 4,5 | 65 | M12 | 50 | M 16 | 14x9 |
| WV **C1*** | 210 | 260 | 195 | 160 | 230 | 5,0 | 85 | M16 | 60 | M 16 | 18x11 |
| WV **D1** | 260 | 330 | 245 | 200 | 285 | 5,0 | 110 | M16 | 75 | M 20 | 20x12 |
| WV **E0** | 330 | 430 | 310 | 260 | 350 | 5,0 | 150 | M20 | 85 | M 20 | 22x14 |
| WV **F1** | 400 | 530 | 380 | 320 | 430 | 5,0 | 200 | M24 | 100 | M 24 | 28x16 |

**Ratios i = 1 : 1; 1,25 : 1; 1,5 : 1; 1,75 : 1; 2 : 1; 2,5 : 1**

| Gearbox-size | i = 1 : 1 bis 2,5 : 1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{\varnothing}_{1j6}$ | $l_1$ | $m_1$ | $o^{\varnothing}$ | r DIN 332 | Key DIN 6885 |
| WV **00*** | 35 | 13 | 14 | 30 | 110 | 52 | M 6 | 5x 5 |
| WV **01*** | 55 | 14 | 22 | 35 | 135 | 70 | M 8 | 6x 6 |
| WV **A1*** | 65 | 14 | 32 | 45 | 165 | 90 | M10 | 10x 8 |
| WV **B1*** | 80 | 18 | 42 | 60 | 210 | 110 | M12 | 12x 8 |
| WV **C1*** | 95 | 18 | 55 | 85 | 275 | 135 | M16 | 16x10 |
| WV **D1** | 115 | 23 | 65 | 100 | 340 | 150 | M16 | 18x11 |
| WV **E0** | 130 | 29 | 75 | 120 | 435 | 230 | M20 | 20x12 |
| WV **F1** | 160 | 40 | 90 | 150 | 550 | 270 | M24 | 25x14 |

**Ratios i = 3 : 1**

| Gearbox-size | i = 3 : 1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{\varnothing}_{1j6}$ | $l_1$ | $m_1$ | $o^{\varnothing}$ | r DIN 332 | Key DIN 6885 |
| WV **00*** | 35 | 13 | 12 | 25 | 105 | 52 | M 5 | 4x 4 |
| WV **01*** | 55 | 14 | 22 | 35 | 135 | 70 | M 8 | 6x 6 |
| WV **A1*** | 65 | 14 | 32 | 45 | 165 | 90 | M10 | 10x 8 |
| WV **B1*** | 80 | 18 | 36 | 55 | 205 | 100 | M12 | 10x 8 |
| WV **C1*** | 95 | 18 | 38 | 65 | 255 | 135 | M12 | 10x 8 |
| WV **D1** | 115 | 23 | 55 | 85 | 325 | 135 | M16 | 16x10 |
| WV **E0** | 130 | 29 | 55 | 85 | 400 | 190 | M16 | 16x10 |
| WV **F1** | 160 | 40 | 75 | 120 | 520 | 270 | M20 | 20x12 |

**Ratios i = 3,5 : 1**

| Gearbox-size | i = 3,5 : 1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{\varnothing}_{1j6}$ | $l_1$ | $m_1$ | $o^{\varnothing}$ | r DIN 332 | Key DIN 6885 |
| WV **00*** | 35 | 13 | 12 | 25 | 105 | 52 | M 5 | 4x 4 |
| WV **01*** | 55 | 14 | 16 | 30 | 130 | 70 | M 6 | 5x 5 |
| WV **A1*** | 65 | 14 | 20 | 32 | 152 | 80 | M 8 | 6x 6 |
| WV **B1*** | 80 | 23 | 26 | 45 | 200 | 80 | M 8 | 8x 7 |
| WV **C1*** | 95 | 18 | 32 | 45 | 235 | 105 | M10 | 10x 8 |
| WV **D1** | 115 | 28 | 42 | 70 | 310 | 110 | M12 | 12x 8 |
| WV **E0** | 130 | 29 | 50 | 75 | 390 | 190 | M16 | 14x 9 |
| WV **F1** | 160 | 40 | 60 | 95 | 495 | 200 | M16 | 18x11 |

**Ratios i = 4 : 1**

| Gearbox-size | i = 4 : 1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{\varnothing}_{1j6}$ | $l_1$ | $m_1$ | $o^{\varnothing}$ | r DIN 332 | Key DIN 6885 |
| WV **00*** | 35 | 13 | 9 | 20 | 100 | 47 | M 4 | 3x 3 |
| WV **01*** | 55 | 14 | 16 | 30 | 130 | 70 | M 6 | 5x 5 |
| WV **A1*** | 65 | 14 | 20 | 32 | 152 | 80 | M 8 | 6x 6 |
| WV **B1*** | 80 | 23 | 26 | 45 | 200 | 80 | M 8 | 8x 7 |
| WV **C1*** | 95 | 18 | 32 | 45 | 235 | 105 | M10 | 10x 8 |
| WV **D1** | 115 | 28 | 42 | 70 | 310 | 110 | M12 | 12x 8 |
| WV **E0** | 130 | 29 | 50 | 75 | 390 | 190 | M16 | 14x 9 |
| WV **F1** | 160 | 40 | 60 | 95 | 495 | 200 | M16 | 18x11 |

**Ratios i = 5 : 1**

| Gearbox-size | i = 5 : 1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{\varnothing}_{1j6}$ | $l_1$ | $m_1$ | $o^{\varnothing}$ | r DIN 332 | Key DIN 6885 |
| WV **00** | – | – | – | – | – | – | – | – |
| WV **01*** | 55 | 14 | 12 | 22 | 122 | 55 | M 5 | 4x 4 |
| WV **A1*** | 65 | 14 | 16 | 30 | 150 | 65 | M 6 | 5x 5 |
| WV **B1*** | 80 | 24 | 22 | 40 | 195 | 70 | M 8 | 6x 6 |
| WV **C1*** | 95 | 18 | 26 | 45 | 235 | 95 | M 8 | 8x 7 |
| WV **D1** | 115 | 23 | 32 | 58 | 298 | 105 | M10 | 10x 8 |
| WV **E0** | 130 | 29 | 42 | 70 | 385 | 190 | M12 | 12x 8 |
| WV **F1** | 160 | 40 | 55 | 85 | 485 | 200 | M16 | 16x10 |

**Ratios i = 6 : 1**

| Gearbox-size | i = 6 : 1 | | | | | | $d_1$ | |
|---|---|---|---|---|---|---|---|---|
| | $l_2$ | g | $d^{\varnothing}_{1j6}$ | $l_1$ | $m_1$ | $o^{\varnothing}$ | r DIN 332 | Key DIN 6885 |
| WV **00** | – | – | – | – | – | – | – | – |
| WV **01*** | 55 | 14 | 10 | 22 | 122 | 50 | M 4 | 3x 3 |
| WV **A1*** | 65 | 14 | 12 | 30 | 150 | 55 | M 5 | 4x 4 |
| WV **B1*** | 80 | 24 | 16 | 30 | 185 | 70 | M 6 | 5x 5 |
| WV **C1*** | 95 | 18 | 20 | 40 | 230 | 95 | M 8 | 6x 6 |
| WV **D1** | 115 | 23 | 26 | 45 | 285 | 105 | M 8 | 8x 7 |
| WV **E0** | 130 | 29 | 40 | 70 | 385 | 190 | M10 | 12x 8 |
| WV **F1** | – | – | – | – | – | – | – | – |

¹) tapped depth = k x 1,5 / * Available in aluminium version or corrosion proof with nickel-plated exterior / Keys to BS 4235 / DIN 6885 / Centrings type D to DIN 322 / Subject to modification.