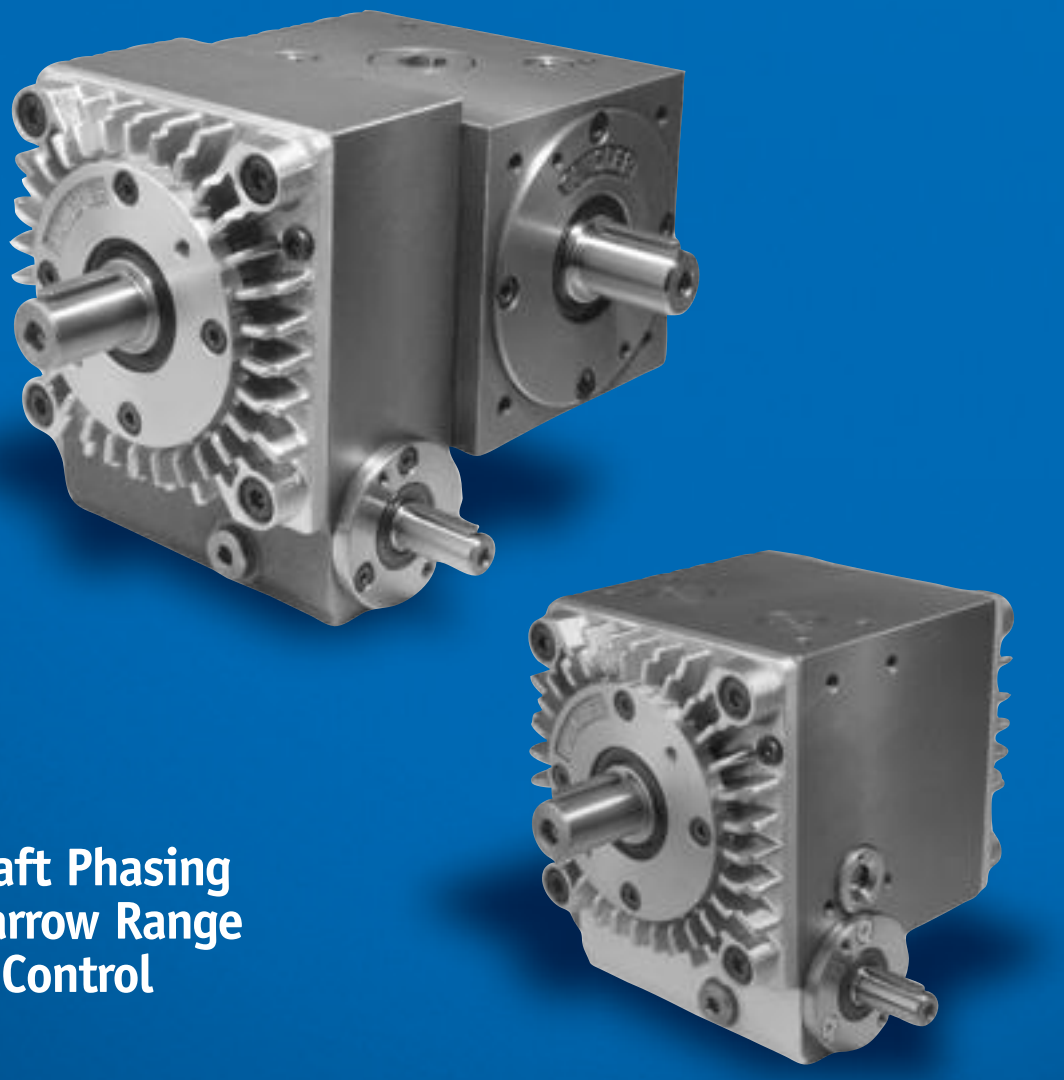
TANDLER

Speed Correction Drives



For Shaft Phasing and Narrow Range Speed Control

- Low Backlash
- Low Transmission Error
- Wide Range of Ratios
- Variety of Specialty Models

AVAILABLE THROUGH

DIEQUA Corporation

Motion Components and Engineering Services

www.diequa.com

DIEQUA Corporation

Tandler, the world leader in precision shaft phaseable gearbox manufacturing, has been satisfying the most demanding gearing requirements for over 50 years. In cooperation with DieQua Corporation, we are providing the most extensive and highest quality speed correction drive program available. With the lowest backlash, the lowest transmission error, and the widest range of ratios and specialty models, you can be assured of maximum design versatility and superior performance.

Contents

Speed Correction Gearboxes

Unmatched Design Flexibility for controlling speed and position

Speed correction gearboxes allow changes in the angular position of the output shaft relative to the input shaft, and provide the capability to vary the output speed within a narrow range. Through the integration of a secondary input shaft, extremely precise positioning and speed control can be easily achieved.

SP2 with standard right angle

SP2 with hollow shaft

SP2 with reinforced shaft

SP2 with switch

SP2 with one-way auxiliary

SP2 with two-way auxiliary

PE2 Single planetary in-line

KD Differential

PD2 Double planetary in-line

KD2 Differential

Sizing Speed Correction Gearboxes

Pertinent Data

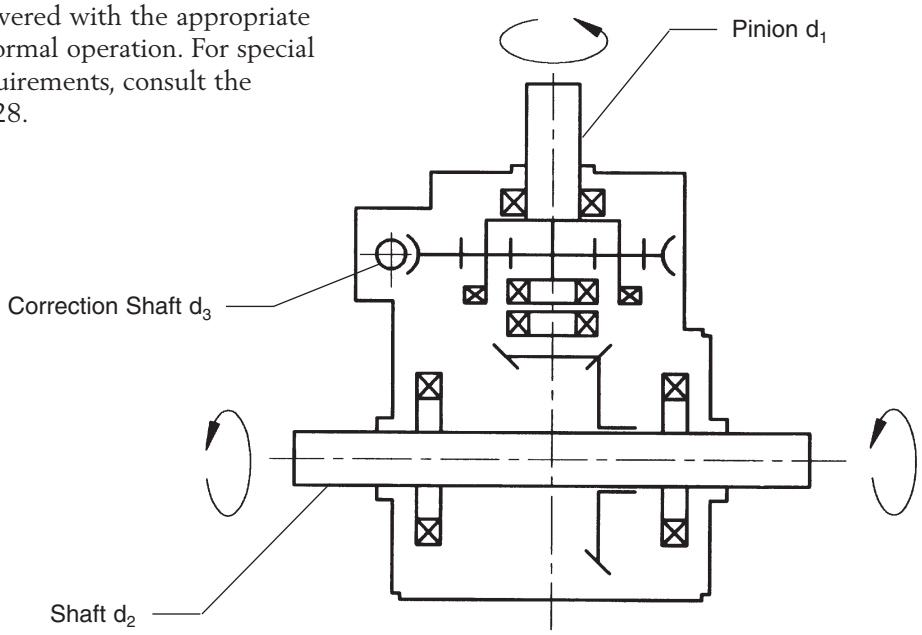
1. Input speed.
2. Gear ratio.
3. Horsepower requirement.
4. Method of shaft connection.
5. Mounting position.

Explanation of Symbols

To select any gearbox, use the appropriate charts and tables in this catalog. All of them use the following symbols:

n_{in} = input rpm
n_{out} = output rpm
n_1 = rpm on d_1
n_2 = rpm on d_2
i = gear ratio = $n_{in} : n_{out}$
i_{tot} = $d_1 : d_2$
d = a shaft or a pinion
Hp = horsepower
M = torque
Md_{in} = input torque, in Newton-meters, Nm
Md_{out} = output torque, in Newton-meters, Nm
Nm = Newton-meters
N1 = input power, in kilowatts, kW
N2 = output power, in kilowatts, kW
C = operational factor

All Tandler gearboxes are delivered with the appropriate quantity and type of oil for normal operation. For special lubrication and mounting requirements, consult the Technical Data section, page 28.



Steps for Gearbox Selection

1. Calculate input torque. Input torque is defined as the torque entering the gearbox or driving torque, regardless if it is on the d_1 pinion or the d_2 shaft.

$$Md_{in} = \frac{7160 \times Hp}{n_{in}}$$

2. Find the appropriate sizing chart for your gear ratio on pages 6, 7, 12, 16, 20 or 24.

3.Find input torque on the vertical axis and input rpm on the horizontal axis. The point of intersection will fall in a range that identifies the size gearbox you need.

4. If your selection approaches the torque capacity of the gearbox, or if it is subject to extreme conditions, consult the operational factor chart on page 28.

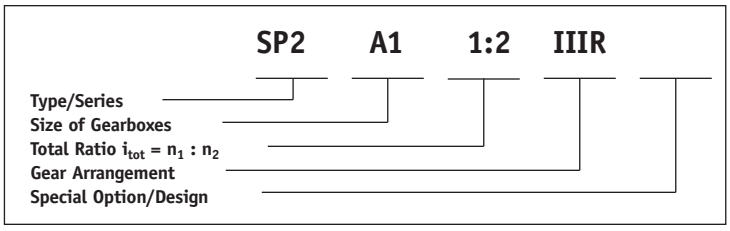
5. Tandler's gear boxes are designed to operate without special cooling at temperatures up to 90°C (200°F). If your application approaches the maximum speed of the gearbox, or is subject to high ambient temperatures, consult your DieQua representative for special cooling options.

6. Select the appropriate internal gear arrangement which specifies shaft rotations and correct shaft position.

7. Consider how the gearbox is mounted...
   - If connecting with rigid or flexible couplings, consider alignment requirements. Consult your DieQua representative.
   - If connecting with a pulley or gear, check the radial load capacity for each shaft. Consult your DieQua representative.
   - If any shafts are mounted vertically, consider special bearing lubrication options. Consult your DieQua representative.

8. Specify the Tandler part number.
   (See example below).

Specifying the Tandler Part Number



Note: When ordering, total ratio must be specified as $i_{tot} = d_1 : d_2$

Actual operational usage and ratio specification may be reversed.

Standard Right Angle

Type SP2 Speed Correction Gearbox

This design combines a planetary gear system with a right angle spiral bevel gearbox. The result is unparalleled design flexibility. The SP2 gearbox is available in 7 standard sizes and 8 standard ratios.

Available Ratios

Type SP2 gearbox is available, for applications driving on pinion d_1, $i = d_1/d_2 = n_1/n_2$, in 8 ratios:

1.66:1*	**1:1.5**
1.33:1*	**1:2**
1:1	**1:3**
1:1.2*	**1:3.75***

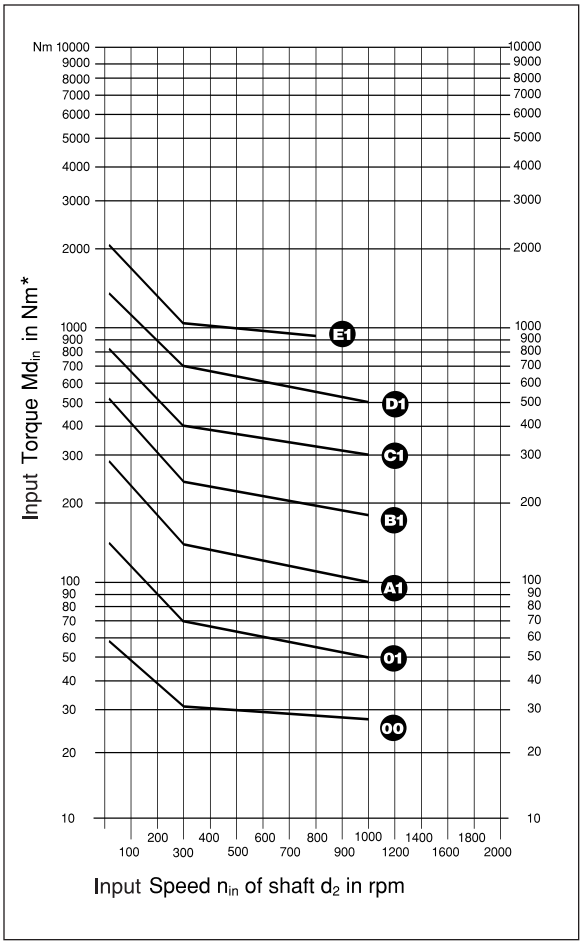
and applications driving on shaft d_2, $i = d_2/d_1 = n_2/n_1$, in 8 ratios:

4.5:1*	**1.5:1**
3.75:1*	**1.2:1***
3:1	**1:1**
2:1	**1:1.33***

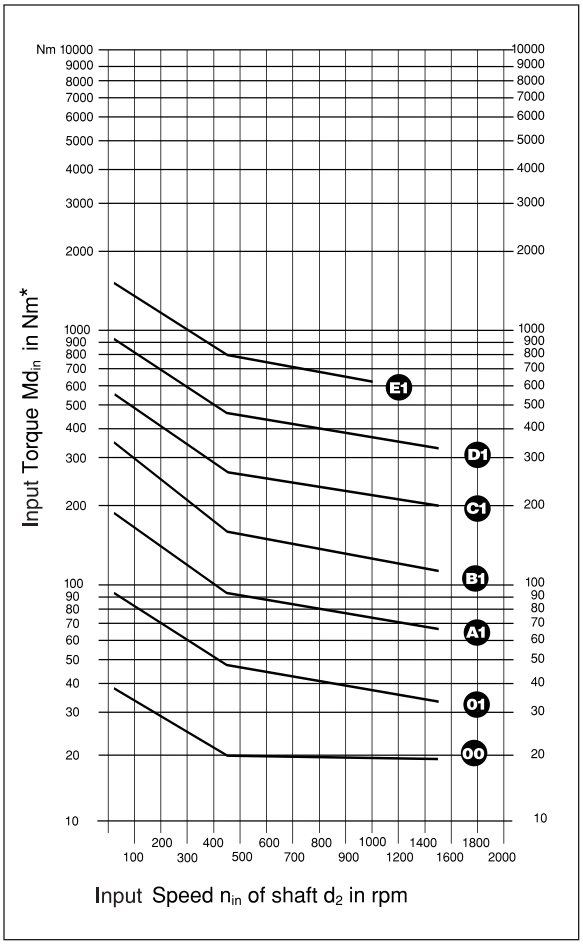
* Not available in SP2 00

Sizing Charts for Driving on Shaft d_2

Gear Ratio d_2:d_1 of 1:1



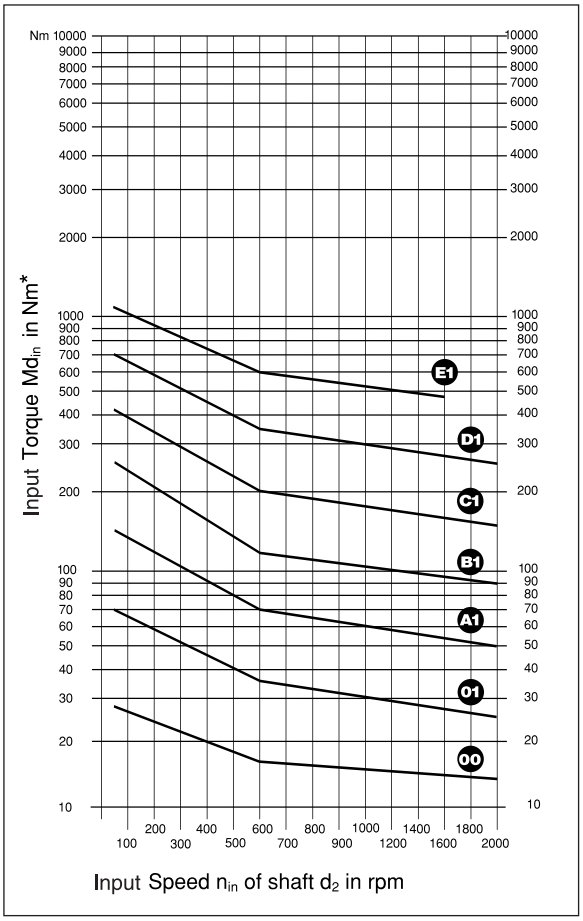
Gear Ratio d_2:d_1 of 1.2:1 and 1.5:1



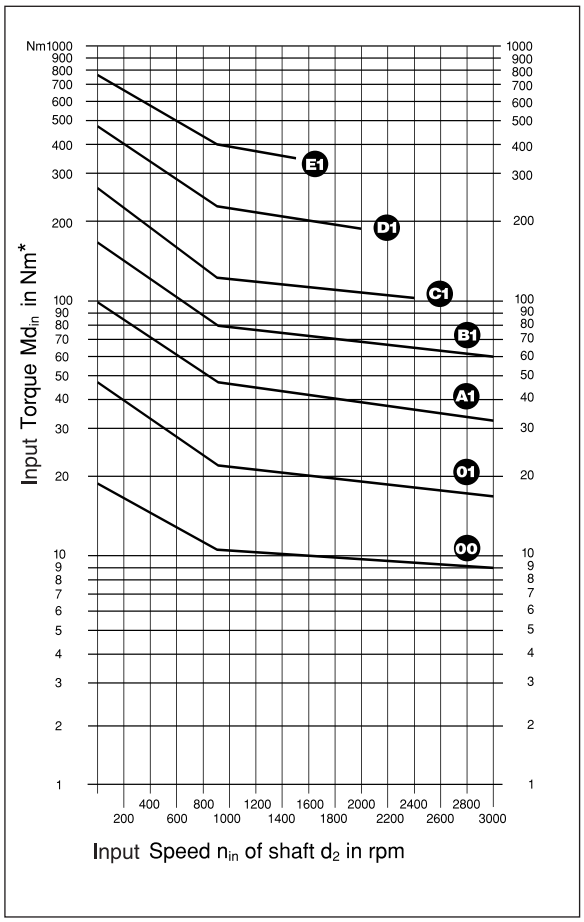
*1Nm = 8.85 in. lbs.

Selection note: Lines represent the maximum **input torque** capacity of each size.

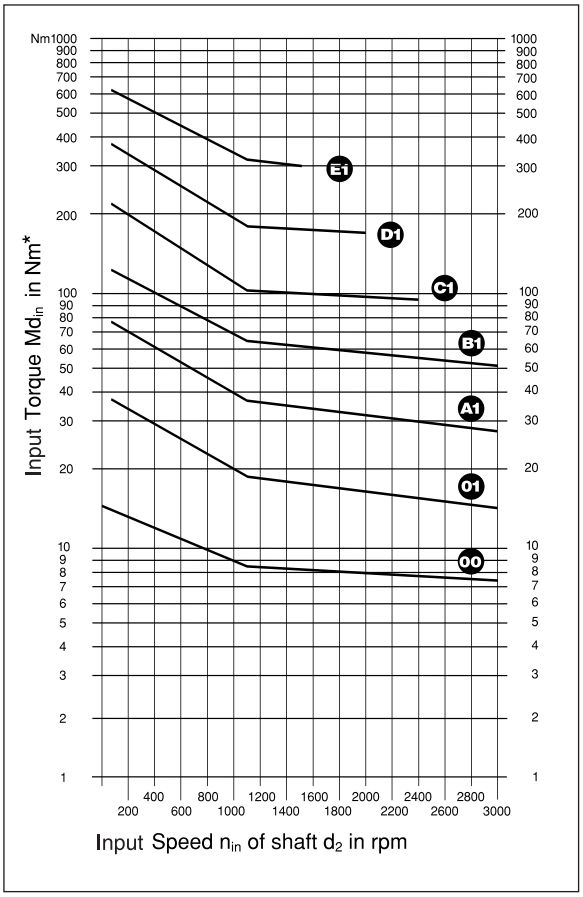
Gear Ratio d_2:d_1 of 2:1



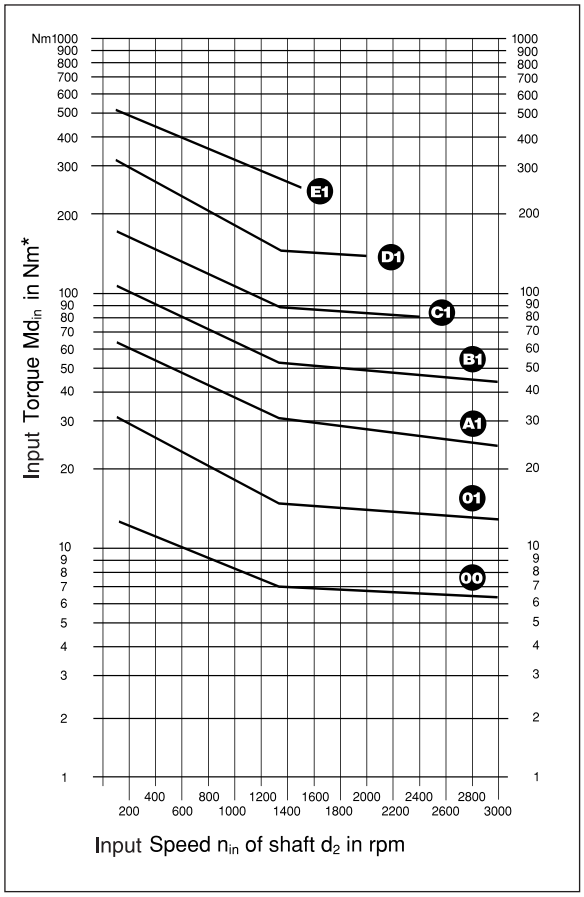
Gear Ratio d_2:d_1 of 3:1



Gear Ratio d_2:d_1 of 3.75:1

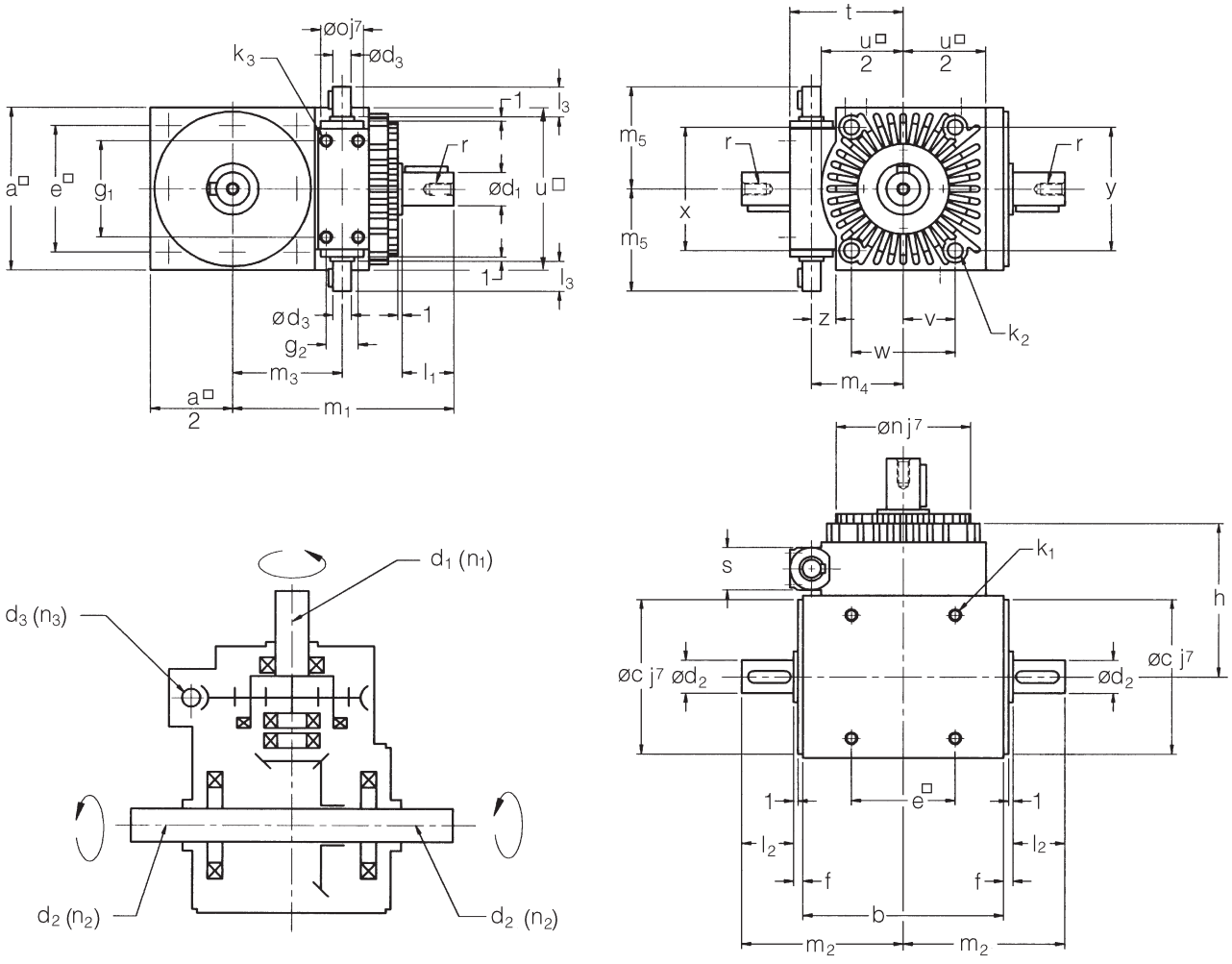


Gear Ratio d_2:d_1 of 4.5:1



*1Nm = 8.85 in. lbs.

Schematic:



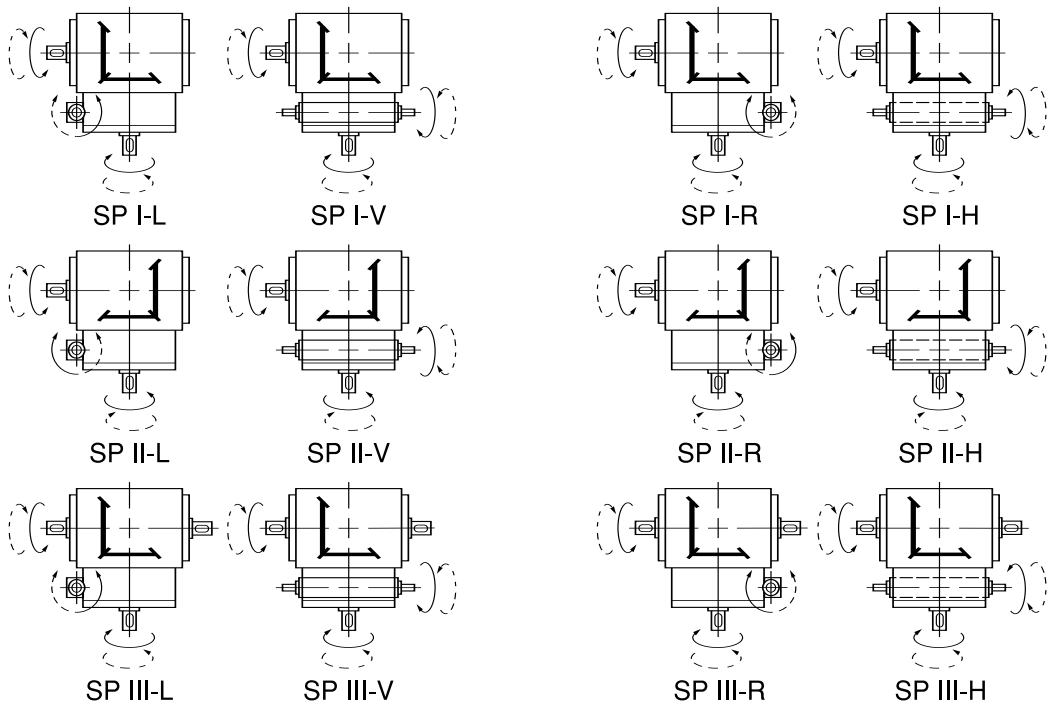
Dimensions

Size	a□	b	$c_{j7}^{ø}$	$d_{1j6}^{ø}$	$d_{2j6}^{ø}$	$d_{3j6}^{ø}$	e□	f	g_1	g_2	h	k_1 [1)]	k_2	k_3	l_1	l_2	l_3	m_1	m_2	m_3	m_4	m_5	$n_{j7}^{ø}$	$o_{j7}^{ø}$	r	s	t	u□	v	w	x	y	z
SP2 **00**	80	110	74	16	20	12	60	3.5	70	32	105	M 6	M 6	M 6	25	35	20	135	93.5	65.5	55.5	77	80	48	M 6	48	79.5	100	40	80	80	80	0
SP2 **01**	110	145	102	22	22	14	82	3.5	80	35	133	M 8	M 8	M 8	35	35	30	174	111	85	69	100	116	55	M 8	55	98	125	50	100	100	100	0
SP2 **0A**	110	145	102	22	22	14	82	3.5	80	40	148	M 8	M 8	M 8	35	35	30	189	111	89	81.75	106	130	60	M 8	60	112	150	55	110	110	110	26
SP2 **A1**	140	175	130	32	32	14	105	4.5	80	40	163	M10	M 8	M 8	45	45	30	214	137	104	81.75	106	130	60	M10	60	112	150	55	110	110	110	26
SP2 **AB**	140	175	130	32	32	14	105	4.5	80	40	171	M10	M10	M 8	45	45	30	222	137	108	93	94	155	60	M10	60	124	170	65	118	145	145	28
SP2 **B1**	170	215	160	42	42	14	130	4.5	80	40	186	M12	M10	M 8	60	60	30	252	172	123	93	94	155	60	M12	60	124	170	65	118	145	145	28
SP2 **BC**	170	215	160	42	42	18	130	4.5	95	45	194	M12	M10	M 8	60	60	30	261	172	125	112.75	105	185	70	M12	70	148	210	70	140	160	160	32
SP2 **C1**	210	260	195	55	55	18	160	5	95	45	214	M16	M10	M 8	85	85	30	306	220	145	112.75	105	185	70	M16	70	148	210	70	140	160	160	32
SP2 **CD**	210	260	195	55	55	26	160	5	140	60	233	M16	M10	M 8	85	85	45	326	220	153	132.5	150	225	85	M16	85	175	260	110	220	140	140	44.5
SP2 **D1**	260	330	245	60	60	26	200	5	140	60	258	M16	M10	M 8	95	95	45	361	265	178	132.5	150	225	85	M16	85	175	260	110	220	140	140	44.5
SP2 **DE**	260	330	245	60	60	32	200	5	180	60	269	M16	M12	M 8	95	95	45	373	265	182	165	172	290	90	M16	90	210	330	150	300	140	124	53
SP2 **E1**	330	430	310	65	75	32	260	5	180	60	304	M20	M12	M 8	100	120	45	413	340	217	165	172	290	90	M16/20	90	210	330	150	300	140	124	53

Dimensions in mm

1) Screwed-in length = k • 1.5
Keys according to DIN 6885, Centering DIN 332
Subject to changes.

Internal Gear Arrangements



Key Dimensions

Gearbox Size	$d_1 = d_2$	d_3
SP2 **00**	5 x 5 (d_1) 6 x 6 (d_2)	4 x 4
SP2 **01**	6 x 6	5 x 5
SP2 **0A**	6 x 6	5 x 5
SP2 **A1**	10 x 8	5 x 5
SP2 **AB**	10 x 8	5 x 5
SP2 **B1**	12 x 8	5 x 5
SP2 **BC**	12 x 8	6 x 6
SP2 **C1**	16 x 10	6 x 6
SP2 **CD**	16 x 10	8 x 7
SP2 **D1**	18 x 11	8 x 7
SP2 **DE**	18 x 11	10 x 8
SP2 **E1**	18 x 11 (d_1) 20 x 12 (d_2)	10 x 8

Keys according to DIN 6885, dimensions in mm
Subject to changes.

Ordering Example

SP2	**A1**	**1:2**	**III-V**	_____
Type	Size	Total Ratio	Gear Arrangement	Special Design (Optional)

Backlash:

Standard	7 - 9 arc minutes
Reduced	4 - 6 arc minutes

Transmission Error:

Standard	6 - 8 arc minutes
G2	4 - 6 arc minutes
G1	2 - 3 arc minutes

Note: Disengage and Reversing models may add up to 1.5 times these values.

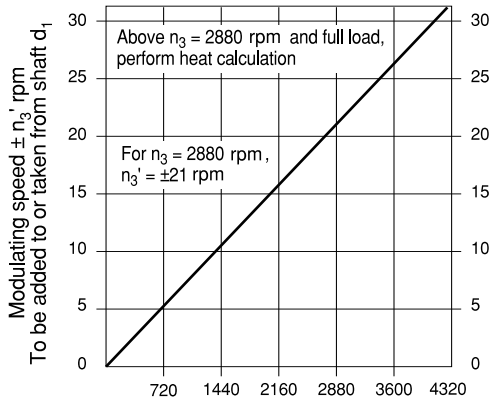
Positional Correction Factors (phasing)

1 revolution = 360° on worm shaft d_3 **for drive on shaft d_1** corresponds to:									
For output shaft d_2 (thru-shaft)	1° 36'	2°	2° 40'	3° 12'	4°	5° 20'	8°	10°	12°
Ratio of the overall drive ($i = d_1 : d_2$)	1.66:1	1.33:1	1:1	1:1.2	1:1.5	1:2	1:3	1:3.75	1:4.5
For drive on the thru-shaft d_2 , for all the above ratios, the differential movement on the shaft d_1 = ± 2° 40' for one revolution of the worm shaft d_3 .									

Note: Other correction rates are available.

Speed Correction Factors for Worm Shaft d_3

To be added to or taken from shaft d_1 when driving on d_2



n_3 = speed of worm shaft d_3 in rpm
n_3:nl = 135:1
Other ratios available

Power Requirements for Worm Shaft d_3

To size the correction motor for shaft d_3, use the following formula to determine the required input torque Md_3, with main drive on shaft d_2:

$$Md_3 = \frac{\text{Output torque}}{88}$$

To determine the horsepower requirement of the correction motor, use the following formula:

$$Hp = \frac{Md_3 \times n_3 \text{ (correction shaft speed)}}{7160}$$

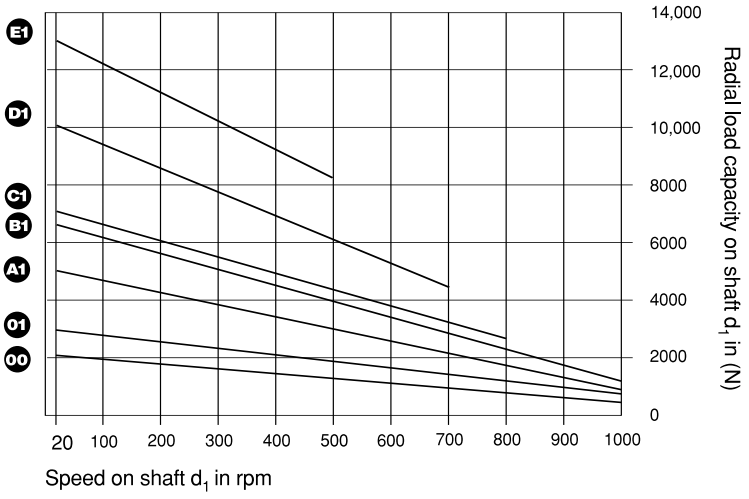
Note: When driving on shaft d_1 for speed increasing applications, consult your DieQua representative for sizing instructions.

Operational Factors

The sizing charts for SP2 gearboxes identify the torque carrying capacity for sizes SP2 00 through SP2 E1 gearboxes. These ratings were created by computations and verified by extensive test stand operations. Maximum acceptable operating temperatures are 90°C. To maintain proper lubrication, ISO VG 46 mineral based oils are used.

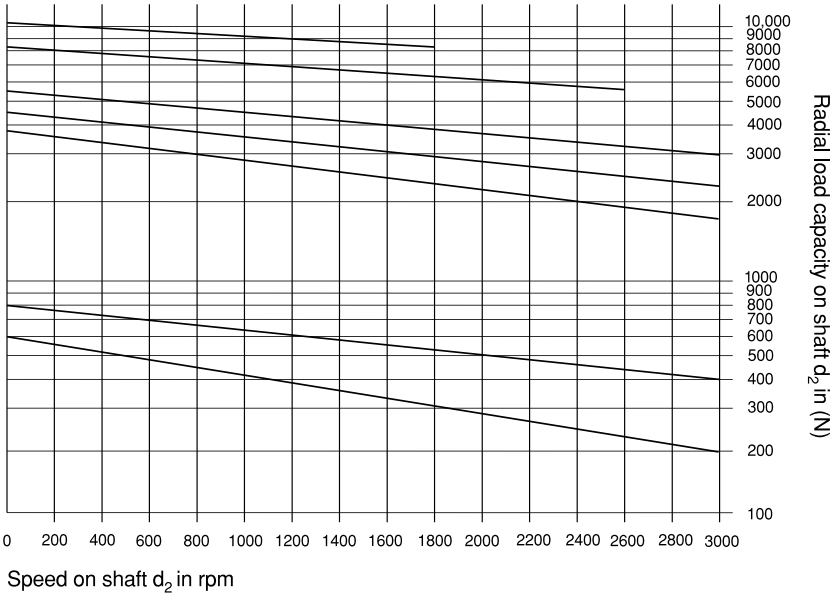
For applications of continuous high temperature operation, ISO VG 68 synthetic oils are used. If the design data indicates that maximum torque ratings may be reached, for any given size gearbox, operational factors need to be considered in the sizing calculations. See page 28 for more information, or consult your DieQua representative.

Radial Load Capacities F_R on Shaft d_1



Size	@ Min. rpm	@ Max. rpm
SP2 **00**	2000 N	500 N
SP2 **01**	3000 N	800 N
SP2 **A1**	5000 N	1000 N
SP2 **B1**	6500 N	1400 N
SP2 **C1**	7000 N	2780 N
SP2 **D1**	10,000 N	4590 N
SP2 **E1**	13,000 N	8200 N

Radial Load Capacities F_R on Shaft d_2



Size	@ Min. rpm	@ Max. rpm
SP2 **00**	600 N	200 N
SP2 **01**	800 N	400 N
SP2 **A1**	3900 N	1700 N
SP2 **B1**	4800 N	2200 N
SP2 **C1**	5600 N	3000 N
SP2 **D1**	8500 N	5600 N
SP2 **E1**	10,900 N	8300 N

Values are higher with taper bearing option.

Note: For axial load capacities F_A on shaft d_1 or d_2, consult your DieQua representative.
1 N = .22 lbs.

Single-Planetary

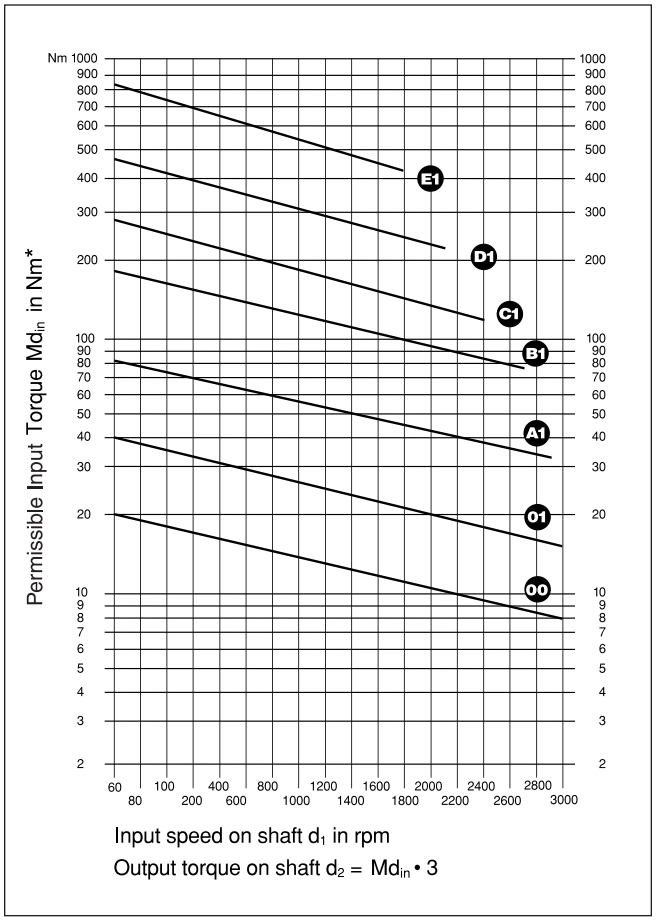
Type PE2 Speed Correction Gearbox

Available Ratios
PE2 gearbox is available in 2 ratios: **3:1** **1:3**

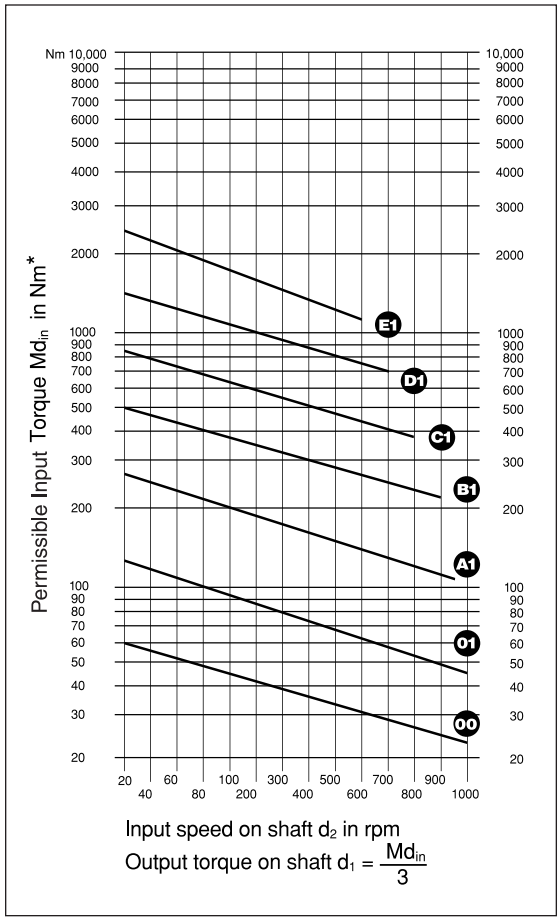
The PE2 is a single stage planetary gearbox used for in-line shaft phasing or narrow range speed control. The unit is used as a 3:1 reducer or a 1:3 increaser, depending on whether the d_1 or d_2 shaft is used as the input. This gearbox is available in 7 standard sizes.

Sizing Charts

Input Speed on Shaft d_1



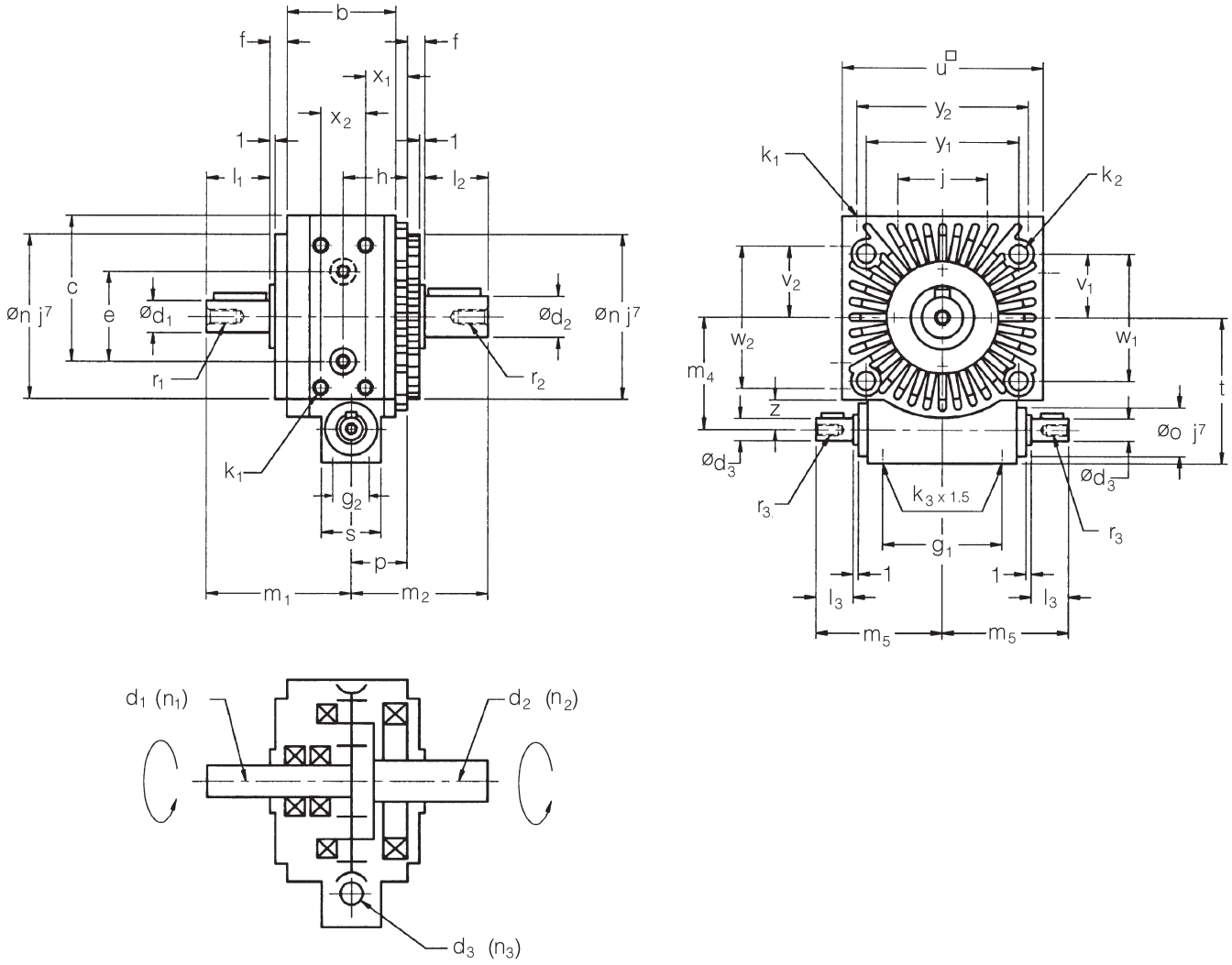
Input Speed on Shaft d_2



*1Nm = 8.85 in. lbs.

Selection note: Lines represent the maximum **input torque** capacity of each size.

Schematic:



Dimensions

Size	u□	b	d_{1j6} ø	d_{2j6} ø	d_{3j6} ø	f	g_1	g_2	l_1	l_2	l_3	m_1	m_2	m_4	m_5	n_{j7} ø	o_{j7} ø	s	t	v_1	w_1	y_1	z	r_1 thread	d_1 key	r_2 thread	d_2 key	r_3 thread	d_3 key
PE2 **00**	100	74.5	14	16	12	5	70	32	25	25	20	65	69.5	55.5	77	80	48	48	79.5	40	80	80	0	M 6	5 x 5	M 6	5 x 5	M 5	4 x 4
PE2 **01**	125	87	16	22	14	6	80	35	30	35	30	75	89	69	100	116	55	55	98	50	100	100	0	M 6	5 x 5	M 8	6 x 6	M 6	5 x 5
PE2 **A1**	150	105	22	32	14	6	80	40	35	45	30	87	110	81.75	106	130	60	60	112	55	110	110	26	M 8	6 x 6	M10	10 x 8	M 6	5 x 5
PE2 **B1**	170	117	32	42	14	6	80	40	45	60	30	105	129	93	94	155	60	60	124	65	118	145	28	M10	10 x 8	M12	12 x 8	M 6	5 x 5
PE2 **C1**	210	127	42	55	18	7	95	45	60	85	30	125	161	112.75	105	185	70	70	148	70	140	160	32	M12	12 x 8	M16	16 x 10	M 6	6 x 6
PE2 **D1**	260	150	50	60	26	8	140	60	75	95	45	153	183	132.5	150	225	85	85	175	110	220	140	44.5	M16	14 x 9	M16	18 x 11	M 8	8 x 7
PE2 **E1**	330	164	60	65	32	9	180	60	80	100	45	166	196	165	172	290	90	90	210	150	300	124/140	53	M16	18 x 11	M16	18 x 11	M10	10 x 8

Dimensions in mm
Keys according to DIN 6885, Centering DIN 332
Subject to changes.

Dimensions for Mounting Holes and Oil Sight-Glass

Size PD2 and PE2	v_2	w_2	y_2	x_1	x_2	k_1 1)	k_2	k_3	Standard Sight Glass c	j	h	Optional Sight Glass c	e = j	h
00	33	60	80	29.5	30	M 5	M 6	M 6	68	50	44.5	---	---	---
01	50	85	100	36	32	M 6	M 8	M 8	92	58	52	92	76	52
A1	55	95	110	40	42	M 8	M 8	M 8	112	72	61	112	76	61
B1	65	118	145	52	38	M10	M10	M 8	124	78	71	123	76	71
C1	70	140	160	50	46	M12	M10	M 8	145	112	76	164	127	73
D1	100	170	220	57	58	M12	M10	M 8	185	110	90	192	127	90
E1	125	220	290	63	60	M16	M12	M 8	235	140	106	227	127	118

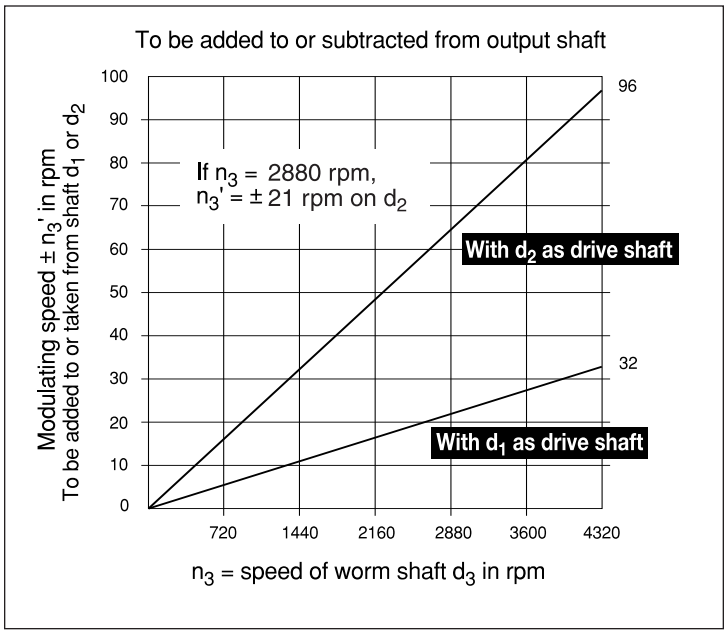
Dimensions in mm
1) Screwed-in length = k • 1.5

Positional Correction Factors (phasing)

One revolution of 360 degrees of the worm gear shaft equals 1/135 of a revolution (2 degrees 40 minutes) in drive output on shaft d_2, or 1/45 of a revolution (8 degrees) in drive output on shaft d_1.

Note: Other correction rates are available.

Speed Correction Factors



Power Requirements for Worm Shaft d_3

To size the correction motor for shaft d_3, use the following formula to determine the required input torque Md_3, with main drive on shaft d_1:

$$Md_3 = \frac{\text{Output torque}}{88}$$

To determine the horsepower requirement of the correction motor, use the following formula:

$$Hp = \frac{Md_3 \times n_3 \text{ (correction shaft speed)}}{7160}$$

Note: When driving on shaft d_2 for speed increasing applications, consult your DieQua representative for sizing instructions.

Backlash:

Standard	4 - 5 arc minutes
Reduced	2 - 3 arc minutes

Transmission Error:

Standard	5 - 7 arc minutes
G2	4 - 5 arc minutes
G1	2 - 3 arc minutes

Ordering Example

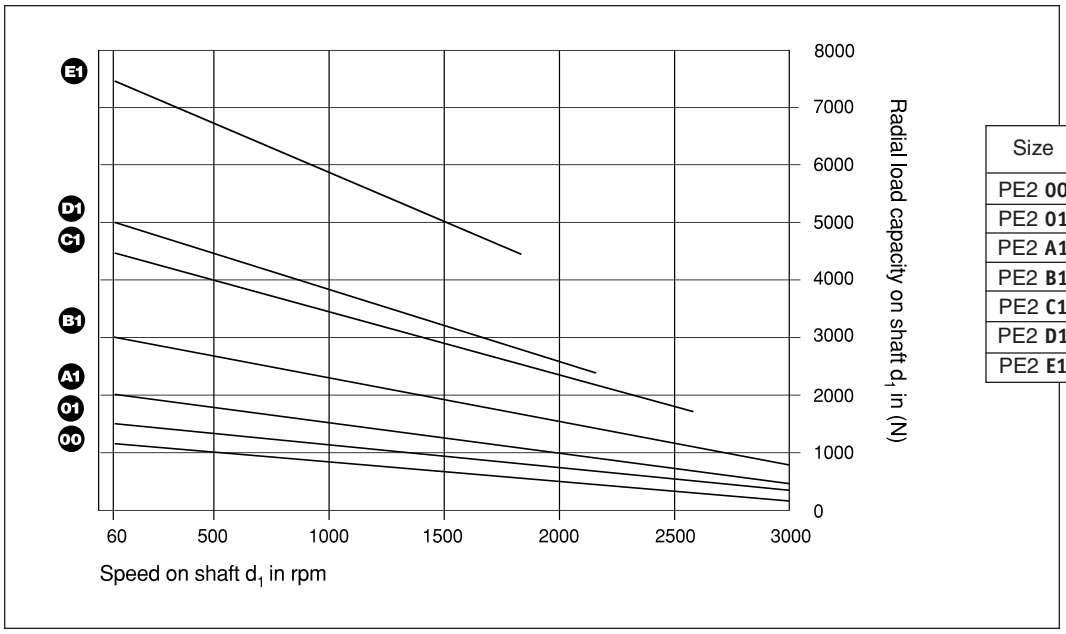
PE2	A1	3:1	_____
Type	Size	Total Ratio	Special Design (Optional)

Operational Factors

The sizing charts for PE2 gearboxes identify the torque carrying capacity for sizes PE2 00 through PE2 E1 gearboxes. These ratings were created by computations and verified by extensive test stand operations. Maximum acceptable operating temperatures are 90°C. To maintain proper lubrication, ISO VG 46 mineral based oils are used.

For applications of continuous high temperature operation, ISO VG 68 synthetic oils are used. If the design data indicates that maximum torque ratings may be reached, for any given size gearbox, operational factors need to be considered in the sizing calculations. See page 28 for more information, or consult your DieQua representative.

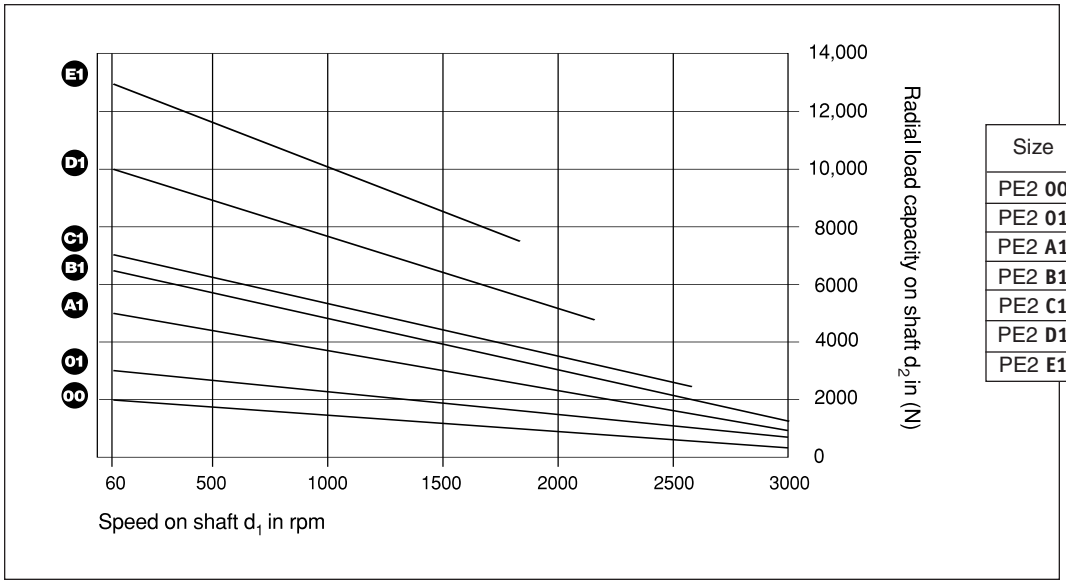
Radial Load Capacities FR on Shaft d_1



Size	@ Min. rpm	@ Max. rpm
PE2 **00**	1100 N	250 N
PE2 **01**	1500 N	450 N
PE2 **A1**	2000 N	500 N
PE2 **B1**	3000 N	750 N
PE2 **C1**	4500 N	1670 N
PE2 **D1**	5000 N	2380 N
PE2 **E1**	7500 N	4370 N

Radial load capacities may be increased using different bearing types.

Radial Load Capacities FR on Shaft d_2



Size	@ Min. rpm	@ Max. rpm
PE2 **00**	2000 N	500 N
PE2 **01**	3000 N	800 N
PE2 **A1**	5000 N	1000 N
PE2 **B1**	6500 N	1400 N
PE2 **C1**	7000 N	2420 N
PE2 **D1**	10,000 N	4320 N
PE2 **E1**	13,000 N	7530 N

Note: For axial load capacities F_A on shaft d_1 or d_2, consult your DieQua representative.
1 N = .22 lbs.

Double-Planetary

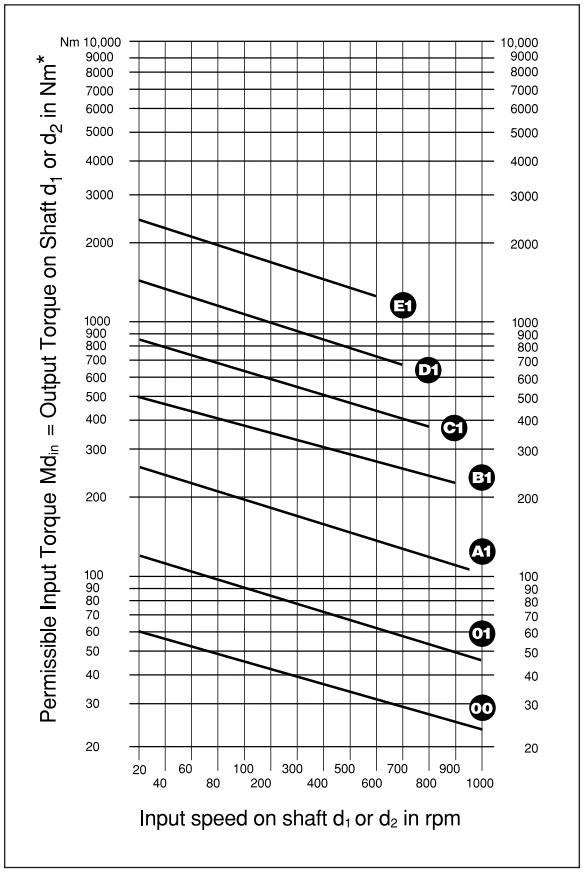
Type PD2 Speed Correction Gearbox

Available Ratios
PD2 gearbox is available in1 ratio: **1:1**

The PD2 is a dual stage planetary gearbox used for in-line shaft phasing or narrow range speed control. The unit is offered in a 1:1 ratio and is available in 7 standard sizes.

Sizing Chart

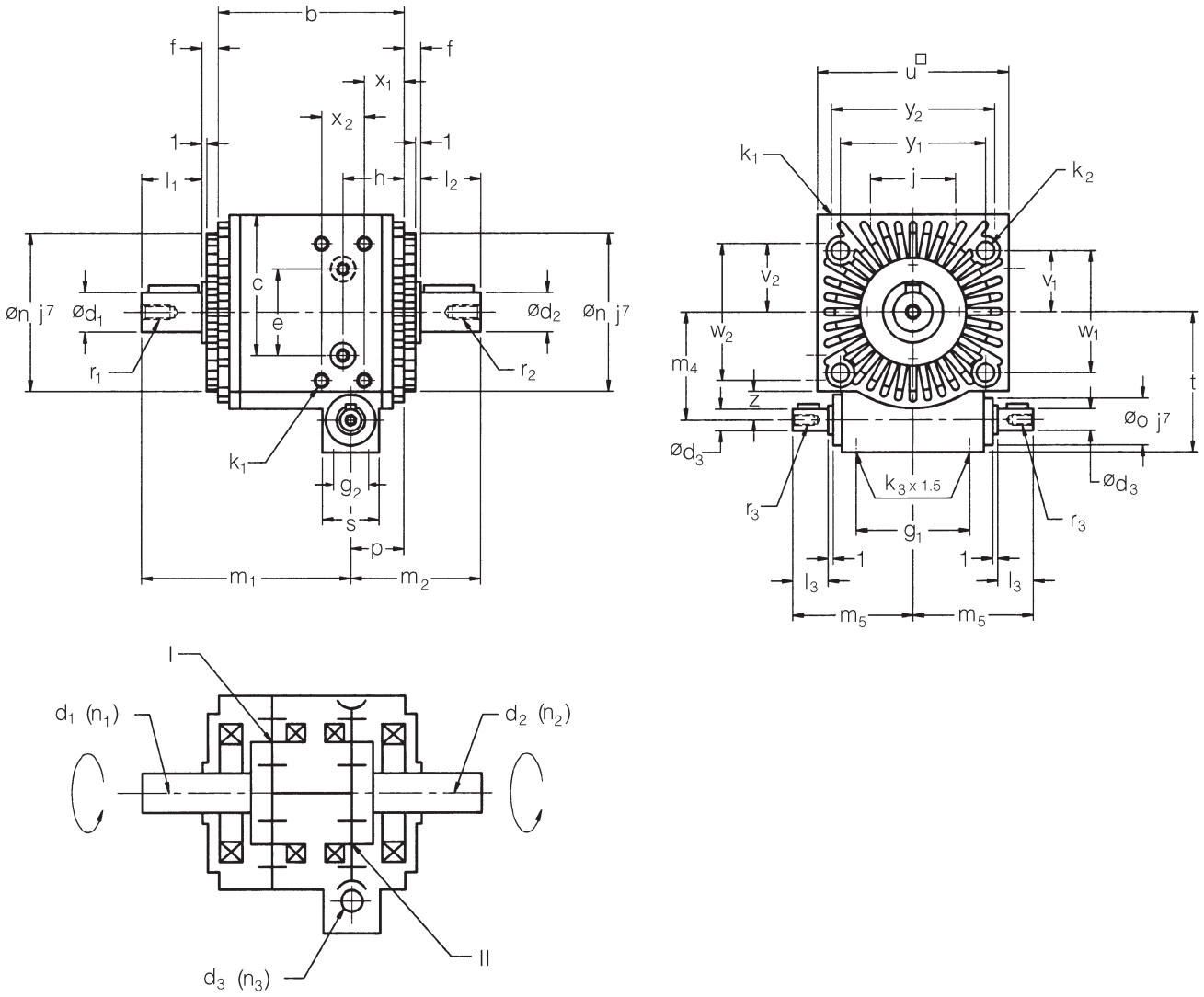
Input Speed on Shaft d_1 or d_2



*1Nm = 8.85 in. lbs.

Selection note: Lines represent the maximum **input torque** capacity of each size.

Schematic:



Dimensions

Size	u□	b	d_1 ø j6	d_2 ø j6	d_3 ø j6	f	g_1	g_2	l_1	l_2	l_3	m_1	m_2	m_4	m_5	n_1 ø j7	o_1 ø j7	p	s	t	v_1	w_1	y_1	z	$r_1 = r_2$ thread	$d_1 = d_2$	r_3 thread	d_3
PD2 **00**	100	130	16	16	12	5	70	32	25	25	20	120.5	69.5	55.5	77	80	48	39.5	48	79.5	40	80	80	0	M 6	5 x 5	M 5	4 x 4
PD2 **01**	125	148	22	22	14	6	80	35	35	35	30	141	89	69	100	116	55	48	55	98	50	100	100	0	M 8	6 x 6	M 6	5 x 5
PD2 **A1**	150	171	32	32	14	6	80	40	45	45	30	163	110	81.75	106	130	60	59	60	112	55	110	110	26	M10	10 x 8	M 6	5 x 5
PD2 **B1**	170	186	42	42	14	6	80	40	60	60	30	189	129	93	94	155	60	63	60	124	65	118	145	28	M12	12 x 8	M 6	5 x 5
PD2 **C1**	210	212	55	55	18	7	95	45	85	85	30	235	161	112.75	105	185	70	69	70	148	70	140	160	32	M16	16 x 10	M 6	6 x 6
PD2 **D1**	260	242	60	60	26	7	140	60	95	95	45	263	183	132.5	150	225	85	81	85	175	110	220	140	44.5	M16	18 x 11	M 8	8 x 7
PD2 **E1**	330	276	65	65	32	9	180	60	100	100	45	298	196	165	172	290	90	87	90	210	150	300	140	53	M16	18 x 11	M10	10 x 8

Dimensions in mm
Keys according to DIN 6885, Centering DIN 332
Subject to changes.

Dimensions for Mounting Holes and Oil Sight-Glass

Size PD2 and PE2	v_2	w_2	y_2	x_1	x_2	k_1 1)	k_2	k_3	Standard Sight Glass c	j	h	Optional Sight Glass c	e = j	h
00	33	60	80	29.5	30	M 5	M 6	M 6	68	50	44.5	---	---	---
01	50	85	100	36	32	M 6	M 8	M 8	92	58	52	92	76	52
A1	55	95	110	40	42	M 8	M 8	M 8	112	72	61	112	76	61
B1	65	118	145	52	38	M10	M10	M 8	124	78	71	123	76	71
C1	70	140	160	50	46	M12	M10	M 8	145	112	76	164	127	73
D1	100	170	220	57	58	M12	M10	M 8	185	110	90	192	127	90
E1	125	220	290	63	60	M16	M12	M 8	235	140	106	227	127	118

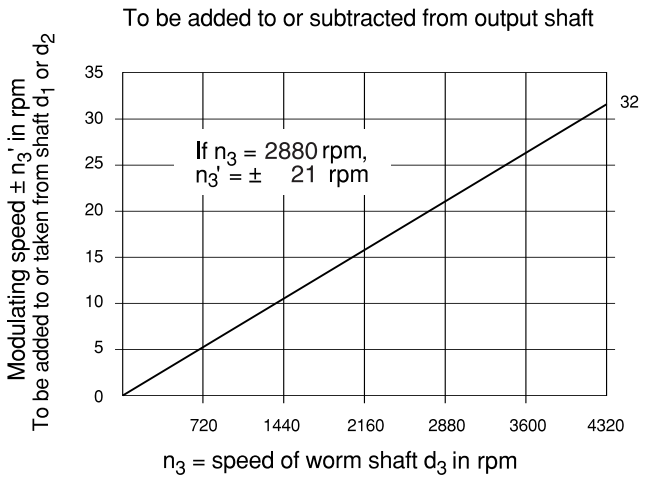
Dimensions in mm
1) Screwed-in length = k • 1.5

Positional Correction Factors (phasing)

One revolution of 360 degrees of the worm gear shaft equals 1/135 of a revolution (2 degrees 40 minutes) on shafts d_1 or d_2.

Note: Other correction rates are available.

Speed Correction Factors



Power Requirements for Worm Shaft d_3

To size the correction motor for shaft d_3, use the following formula to determine the required input torque Md_3, with main drive on shaft d_1:

$$Md_3 = \frac{\text{Output torque}}{88}$$

To determine the horsepower requirement of the correction motor, use the following formula:

$$Hp = \frac{Md_3 \times n_3 \text{ (correction shaft speed)}}{7160}$$

Note: When driving on shaft d_2, consult your DieQua representative for sizing instructions.

Backlash:

Standard	7 - 9 arc minutes
Reduced	4 - 5 arc minutes

Transmission Error:

Standard	6 - 8 arc minutes
G2	5 - 6 arc minutes
G1	2 - 3 arc minutes

Ordering Example

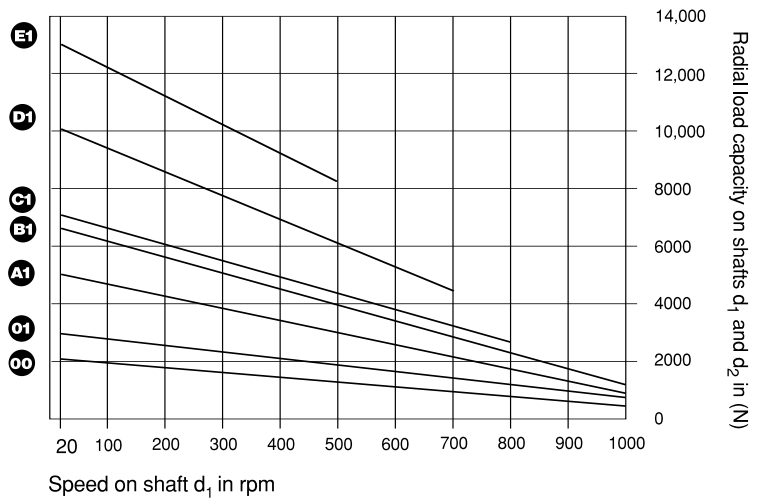
PD2	A1	1:1	_____
Type	Size	Total Ratio	Special Design (Optional)

Operational Factors

The sizing charts for PD2 gearboxes identify the torque carrying capacity for sizes PD2 00 through PD2 E1 gearboxes. These ratings were created by computations and verified by extensive test stand operations. Maximum acceptable operating temperatures are 90°C. To maintain proper lubrication, ISO VG 46 mineral based oils are used.

For applications of continuous high temperature operation, ISO VG 68 synthetic oils are used. If the design data indicates that maximum torque ratings may be reached, for any given size gearbox, operational factors need to be considered in the sizing calculations. See page 28 for more information, or consult your DieQua representative.

Radial Load Capacities FR on Shaft d_1 and Shaft d_2



Size	@ Min. rpm	@ Max. rpm
PD2 **00**	2000 N	500 N
PD2 **01**	3000 N	800 N
PD2 **A1**	5000 N	1000 N
PD2 **B1**	6500 N	1400 N
PD2 **C1**	7000 N	2780 N
PD2 **D1**	10,000 N	4590 N
PD2 **E1**	13,000 N	8200 N

Note: For axial load capacities F_A on shaft d_1 or d_2, consult your DieQua representative.
1 N = .22 lbs.

Differential KD

Type KD Speed Correction Gearbox

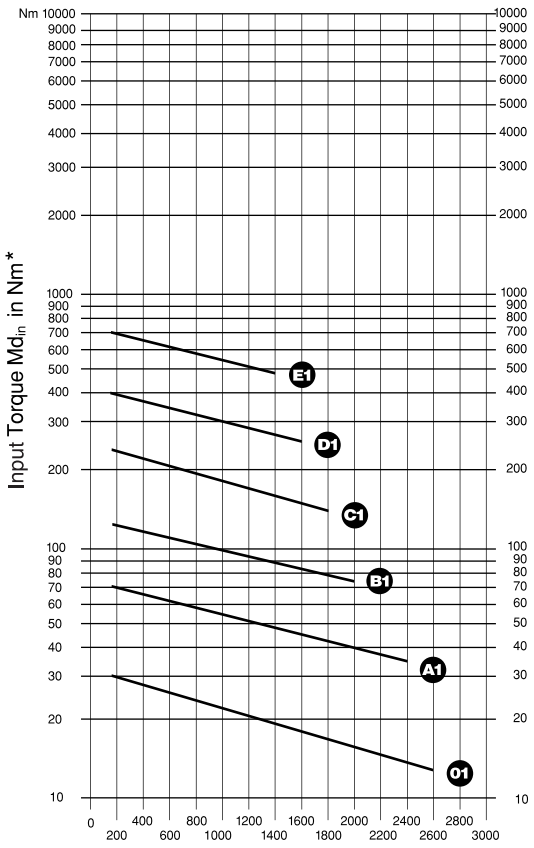
Available Ratios
KD gearbox is available in 2 ratios: **1:2** **2:1**

The KD gearbox is used for in-line shaft phasing or narrow range speed control. The unit is used as a 2:1 reducer or 1:2 increaser, depending on whether the d1 or the d2 shaft is used as the input. This gearbox is available in 6 standard sizes.

Sizing Charts

Input Speed on Shaft d_1

For drive on shaft d_1 (bevel gear side) fast to slow



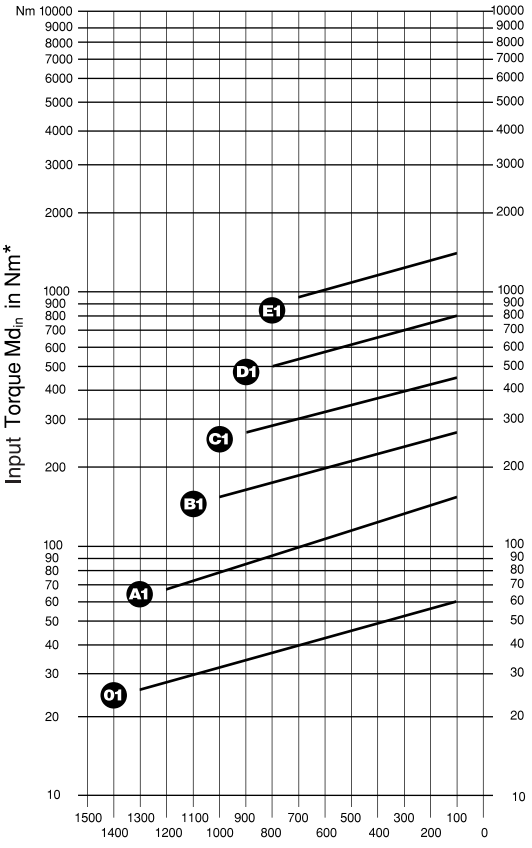
Input speed n_{in} on shaft d_1 in rpm

Output torque for d_2 = (input torque) x 2

Output speed for $d_2 = \frac{n_{in}}{2}$

Input Speed on Shaft d_2

For drive on shaft d_2 (worm gear side) slow to fast



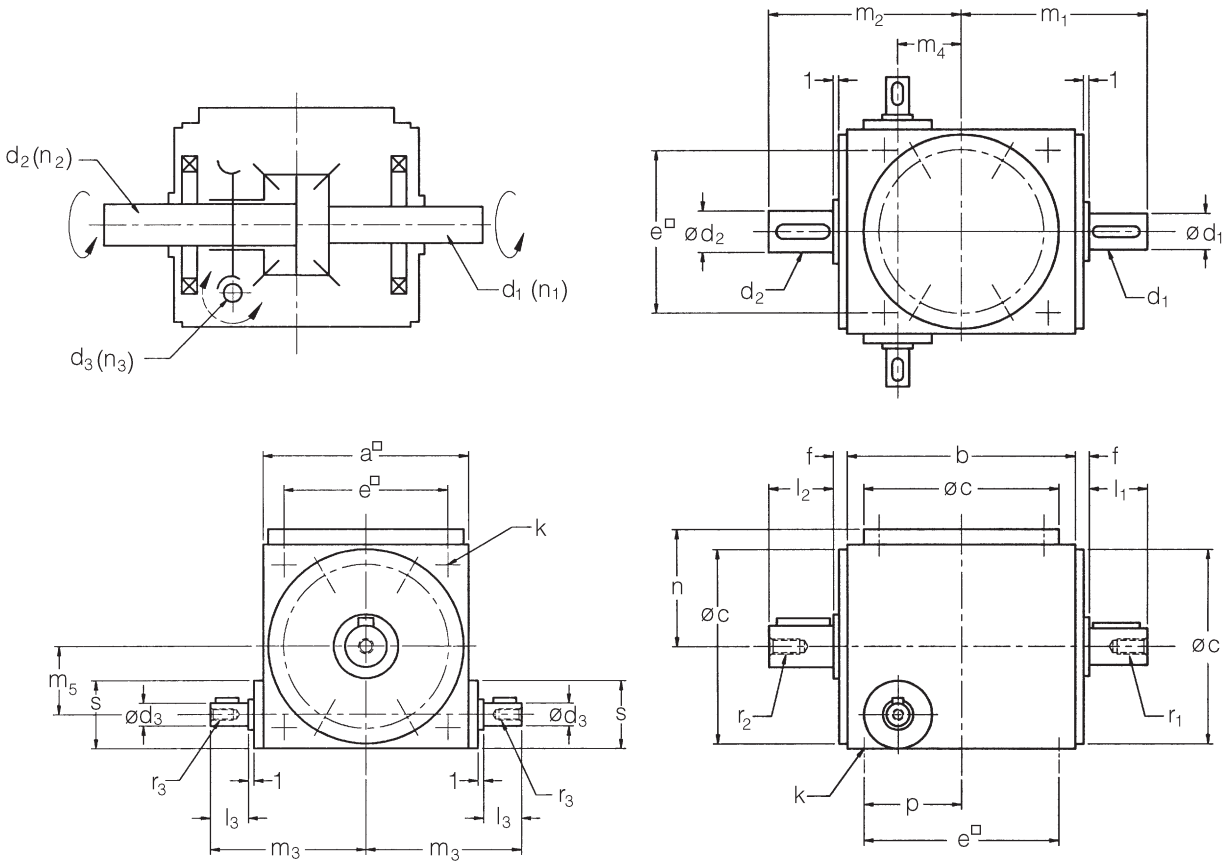
Input speed n_{in} on shaft d_2 in rpm

Output torque for $d_1 = \frac{\text{(input torque)}}{2}$

Output speed for $d_1 = 2 \times n_{in}$

*1Nm = 8.85 in. lbs.

Schematic:



Dimensions

Size	a□	b	$c^{\varnothing}_{j7}$	$d^{\varnothing}_{1j6}$	$d^{\varnothing}_{2j6}$	$d^{\varnothing}_{3j6}$	e□	f	k[1)]	l_1	l_2	l_3	m_1	m_2	m_3	m_4	m_5	n	p	r_1	r_2	r_3	S_{j7}
KD **01**	110	145	102	14	18	10	82	3.5	M 8	30	35	20	106	111	82	29	37.5	61	50	M 6	M 6	–	50
KD **A1**	140	175	130	22	28	14	105	4.5	M10	35	45	30	127	137	107	38.5	48.5	79	61	M 8	M 8	M 5	56
KD **B1**	170	215	160	28	36	18	130	4.5	M12	45	55	30	157	167	122	49	60	95	77	M 8	M10	M 6	62
KD **C1**	210	260	195	36	45	22	160	5	M16	55	60	35	190	195	147	58	74	115	95	M10	M12	M 8	74
KD **D1**	260	330	245	45	55	26	200	5	M16	70	85	45	240	255	184	74	88	143	110	M12	M16	M 8	83
KD **E1**	330	430	310	55	65	38	260	5	M20	85	100	65	305	320	241	100	113.5	180	150	M16	M16	M10	103

Dimensions in mm
Keys according to DIN 6885, Centering DIN 332
1) Screwed-in length = k • 1.5
Subject to changes

Key Dimensions

Gearbox Size	d_1	d_2	d_3
KD **01**	5 x 5 x 25	6 x 6 x 30	3 x 3 x 16
KD **A1**	6 x 6 x 30	8 x 7 x 40	5 x 5 x 25
KD **B1**	8 x 7 x 40	10 x 8 x 50	6 x 6 x 25
KD **C1**	10 x 8 x 50	14 x 9 x 50	6 x 6 x 30
KD **D1**	14 x 9 x 63	16 x 10 x 70	8 x 7 x 36
KD **E1**	16 x 10 x 70	18 x 11 x 90	10 x 8 x 56

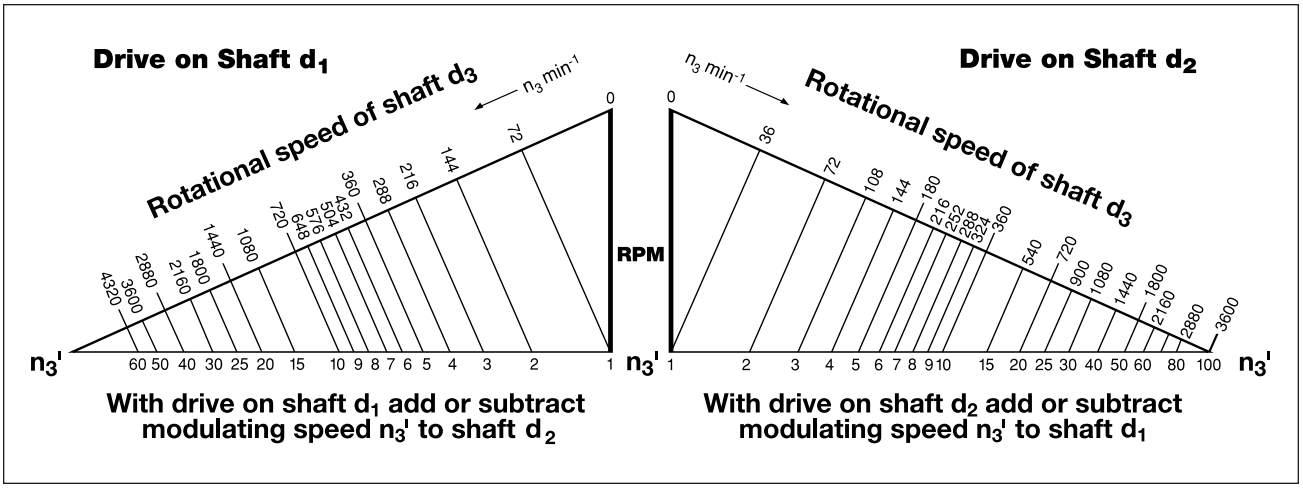
Keys according to DIN 6885, dimensions in mm
Subject to changes.

Positional Correction Factors (phasing)

One revolution of 360 degrees of the worm shaft d_3 equals 5 degrees in drive output on shaft d_2 or 10 degrees in drive output on shaft d_1.

Note: Other correction rates are available.

Speed Correction Factors



Power Requirements for Worm Shaft d_3

To size the correction motor for shaft d_3, use the following formula to determine the required input torque Md_3, with main drive on shaft d_1:

$$Md_3 = \frac{Md_1}{23.50}$$

To determine the horsepower requirement of the correction motor, use the following formula:

$$Hp = \frac{Md_3 \times n_3 \text{ (correction shaft speed)}}{7160}$$

Note: When driving on shaft d_2, consult your DieQua representative for sizing instructions.

Ordering Example

KD	A1	1:2	_____
Type	Size	Total Ratio	Special Design (Optional)

Operational Factors

The sizing charts for KD gearboxes identify the torque carrying capacity for sizes KD 01 through KD E1 gearboxes. These ratings were created by computations and verified by extensive test stand operations. Maximum acceptable operating temperatures are 90°C. To maintain proper lubrication, ISO VG 46 mineral based oils are used.

For applications of continuous high temperature operation, ISO VG 68 synthetic oils are used. If the design data indicates that maximum torque ratings may be reached, for any given size gearbox, operational factors need to be considered in the sizing calculations. See page 28 for more information, or consult your DieQua representative.

Radial Load Capacities FR on Shaft d_1 and Shaft d_2

Gearbox Size	Radial Load Capacity on shaft d_1 or shaft d_2
KD **01**	200 N
KD **A1**	300 N
KD **B1**	400 N
KD **C1**	550 N
KD **D1**	750 N
KD **E1**	1000 N

1 N = .22 lbs.

For higher radial capacities, use the KD2 series.

Backlash:

Standard	5 - 7 arc minutes
Reduced	3 - 4 arc minutes

Transmission Error:

Standard	6 - 8 arc minutes
G2	5 - 6 arc minutes
G1	2 - 3 arc minutes

Differential KD2

Type KD2 Speed Correction Gearbox

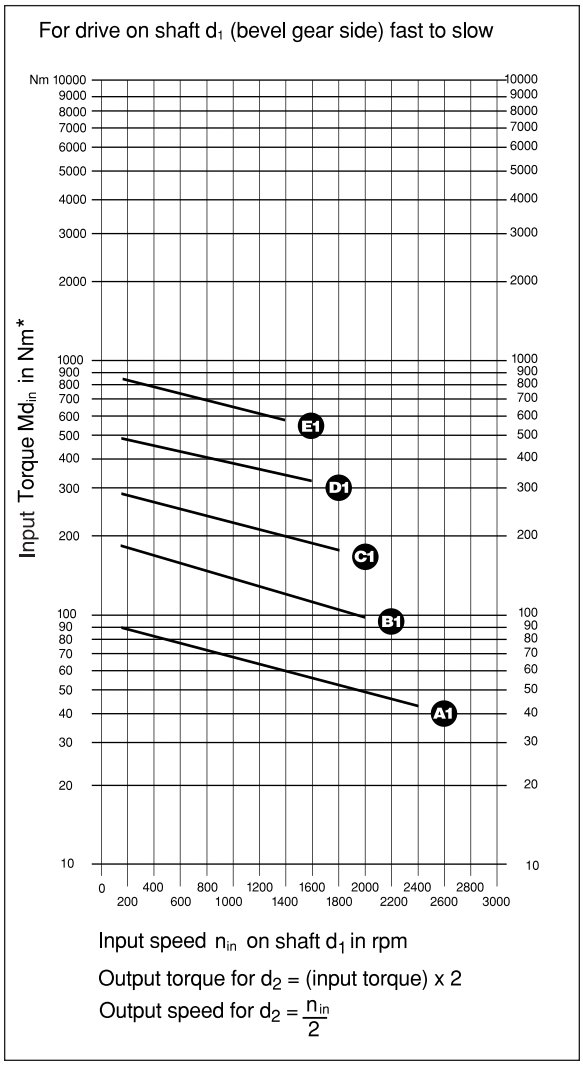
Available Ratios
KD2 gearbox is available in 2 ratios: **1:2** **2:1**

The KD2 model has a number of design advantages over the KD model. They include a higher correction ratio for more precise speed control, a self-locking worm gear, and a modified bearing configuration providing for higher radial load and torque transmission capacities.

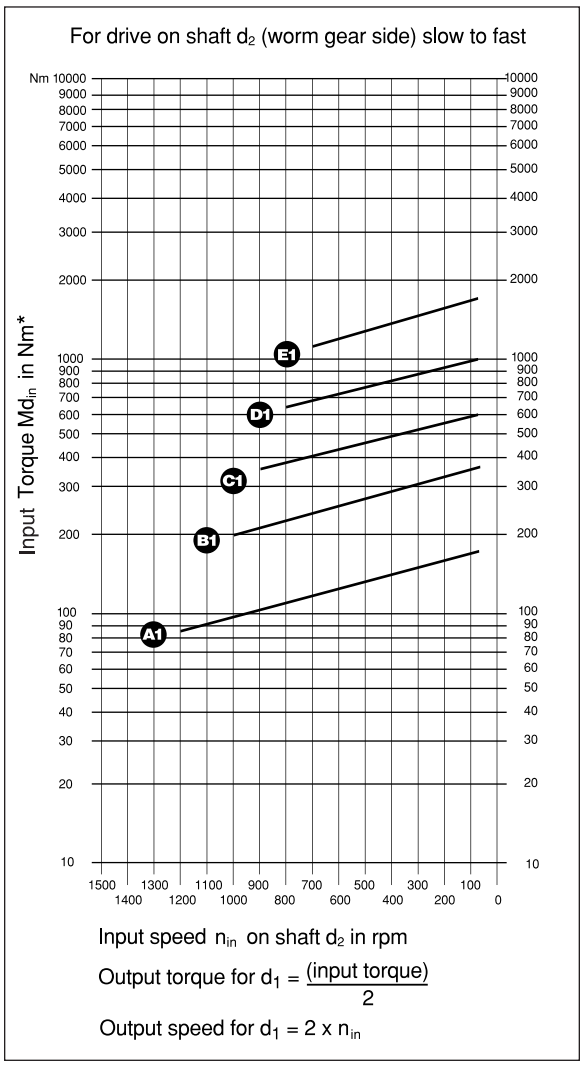
This unit is also used as a 2:1 reducer or 1:2 increaser, depending on whether the d_1 or the d_2 shaft is used as the input. It is available in 5 standard sizes.

Sizing Charts

Input Speed on Shaft d_1

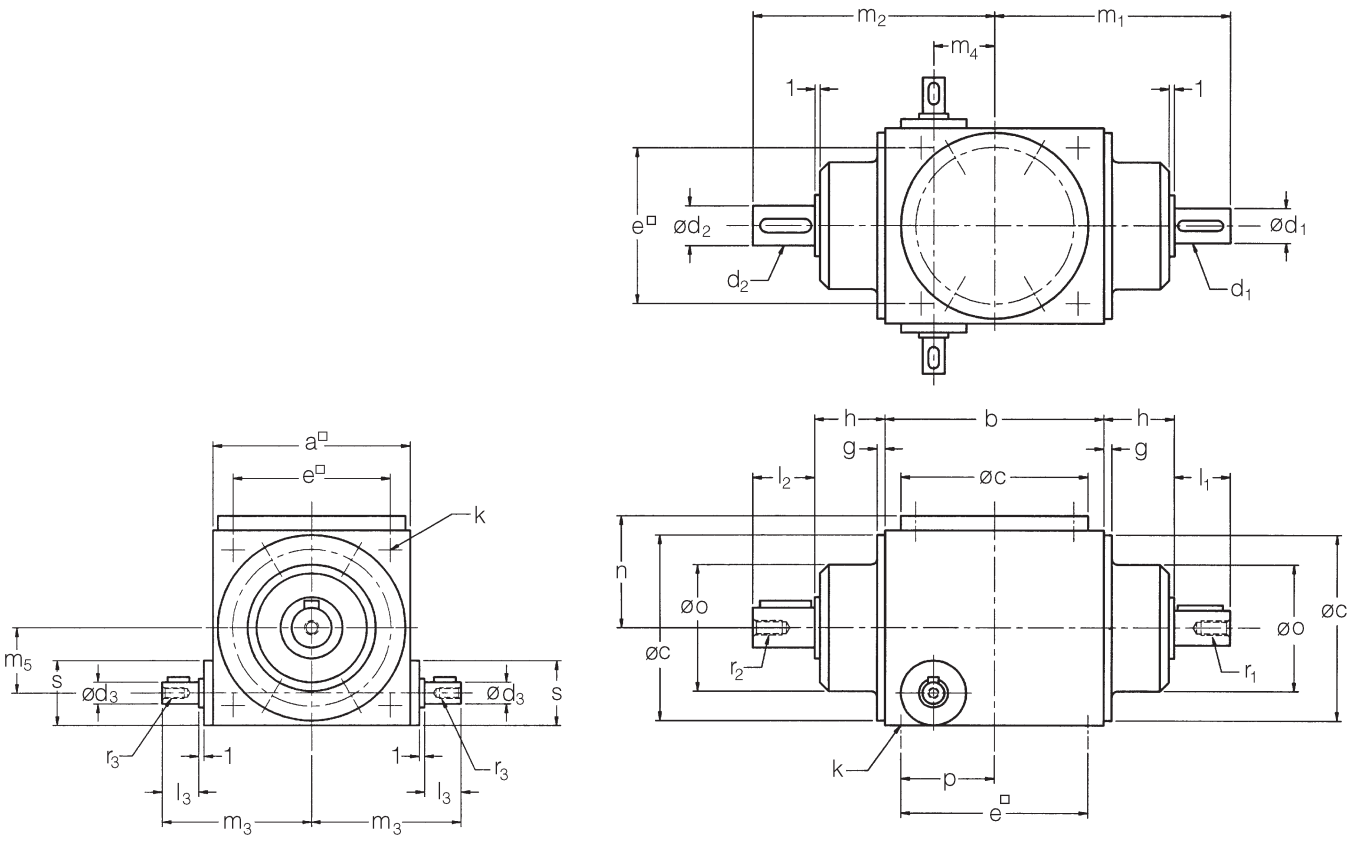


Input Speed on Shaft d_2



*1Nm = 8.85 in. lbs.

Schematic:



Dimensions

Size	a□	b	c$^{ø}_{j7}$	d$^{ø}_{1j6}$	d$^{ø}_{2j6}$	d$^{ø}_{3j6}$	e□	g	h	k[1)]	l_1	l_2	l_3	m_1	m_2	m_3	m_4	m_5	n	ø$_o$	p	r_1	r_2	r_3	S_{j7}
KD2 **A1**	140	175	130	22	28	14	105	5.5	41.5	M10	35	45	30	164	174	107	38.5	48.5	79	90	61	M 8	M 8	M 5	56
KD2 **B1**	170	215	160	28	36	18	130	7.5	54.5	M12	45	55	30	207	217	122	49	60	95	110	77	M 8	M10	M 6	62
KD2 **C1**	210	260	195	36	45	22	160	6	73	M16	55	60	35	258	263	147	58	74	115	135	95	M10	M12	M 8	74
KD2 **D1**	260	330	245	45	55	26	200	7	94	M16	70	85	45	329	344	184	74	88	143	150	110	M12	M16	M 8	83
KD2 **E1**	330	430	310	55	65	38	260	9	130	M20	85	100	65	430	445	241	100	113.5	180	230	150	M16	M16	M10	103

Dimensions in mm
Keys according to DIN 6885, Centering DIN 332
1) Screwed-in length = k • 1.5
Subject to changes

Key Dimensions

Gearbox Size	d_1	d_2	d_3
KD2 **A1**	6 x 6 x 30	8 x 7 x 40	5 x 5 x 25
KD2 **B1**	8 x 7 x 40	10 x 8 x 50	6 x 6 x 25
KD2 **C1**	10 x 8 x 50	14 x 9 x 50	6 x 6 x 30
KD2 **D1**	14 x 9 x 63	16 x 10 x 70	8 x 7 x 36
KD2 **E1**	16 x 10 x 70	18 x 11 x 90	10 x 8 x 56

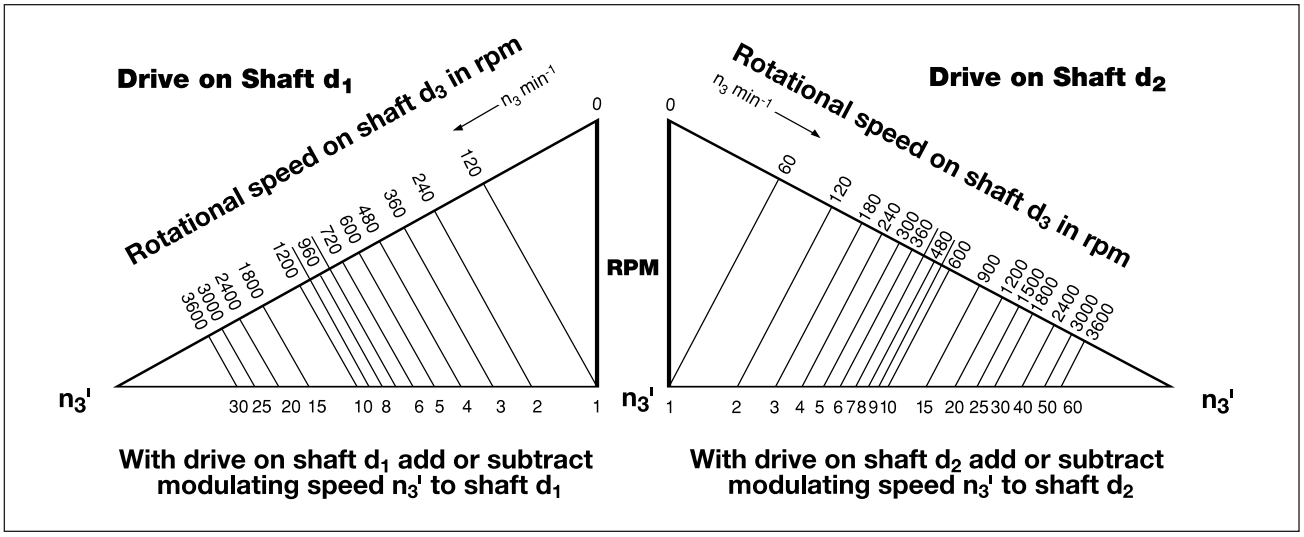
Keys according to DIN 6885, dimensions in mm
Subject to changes.

Positional Correction Factors (phasing)

One revolution of 360 degrees of the worm shaft d_3 equals 3 degrees in drive output on shaft d_2 or 6 degrees in drive output on shaft d_1.

Note: Other correction rates are available.

Speed Correction Factors



Power Requirements for Worm Shaft d_3

To size the correction motor for shaft d_3, use the following formula to determine the required input torque Md_3, with main drive on shaft d_1:

$$Md_3 = \frac{Md_1}{39}$$

To determine the horsepower requirement of the correction motor, use the following formula:

$$Hp = \frac{Md_3 \times n_3 \text{ (correction shaft speed)}}{7160}$$

Note: When driving on shaft d_2 for speed increasing applications, consult your DieQua representative for sizing instructions.

Ordering Example

KD2	A1	1:2	_____
Type	Size	Total Ratio	Special Design (Optional)

Operational Factors

The sizing charts for KD2 gearboxes identify the torque carrying capacity for sizes KD2 A1 through KD2 E1 gearboxes. These ratings were created by computations and verified by extensive test stand operations. Maximum acceptable operating temperatures are 90°C. To maintain proper lubrication, ISO VG 46 mineral based oils are used.

For applications of continuous high temperature operation, ISO VG 68 synthetic oils are used. If the design data indicates that maximum torque ratings may be reached, for any given size gearbox, operational factors need to be considered in the sizing calculations. See page 28 for more information, or consult your DieQua representative.

Radial Load Capacities F_R on Shaft d_1 and Shaft d_2

Gearbox Size	Shaft d_1	Shaft d_2
KD2 **A1**	1250 N	1500 N
KD2 **B1**	1700 N	2200 N
KD2 **C1**	2400 N	3250 N
KD2 **D1**	3000 N	3800 N
KD2 **E1**	3500 N	4500 N

1 N = .22 lbs.

Backlash:

Standard	5 - 7 arc minutes
Reduced	3 - 4 arc minutes

Transmission Error:

Standard	6 - 8 arc minutes
G2	5 - 6 arc minutes
G1	2 - 3 arc minutes

Technical Data

Speed Correction Gearboxes

Operational Factors

In order to properly size a gearbox for any application, it is important to consider the environment in which the gearbox must operate. The sizing charts shown earlier in this catalog contain the characteristic output torque limit lines for SP2, PE2, PD2, KD and KD2 type gearboxes. These values were created by extensive computations and test stand operations in a controlled environment. Actual applications require that the following factors be taken into consideration, especially when approaching the torque limits for any given gearbox.

Degree of shock of the driven machine	Driving machine											
	Electric motor – running time in hours per day				Piston engine, hydraulic motor – running time in hours per day				Single cylinder piston engine – running time in hours 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, conveyor screws, light elevators, electric trains, ventilators, stirrers.
II Moderate shocks, e.g., heavy elevators, crane turrets, piston pumps, mine ventilators, cable winches.
III Heavy shocks, e.g., punch presses, shears, steel rolling machines, mills, looms.
HP_1 is the normal input power produced by the drive motor in HP.
Md_c is the corrected input torque in Nm, and
c is the correction factor given in the table above.

$$HP_c = HP_1 \times c \qquad Md_c = Md_{in} \times c$$

HP_c = corrected input power
Md_{in} = calculated input torque
Md_c = corrected input torque

Thermal Stress

Although a specific gearbox may have the mechanical capability to operate at high speeds, thermal considerations may reduce its actual capacity. The gearboxes are designed to operate at temperatures up to 90°C. If the gearboxes are running at high speeds under heavy load in an enclosed environment, overheating may result, substantially reducing the life of the unit.

Ventilation

It is extremely important that the gearbox have sufficient airflow over it. The gearbox dissipates most of its excess heat by convection. If the gearbox is built into an enclosure without sufficient airflow, overheating may occur, substantially reducing the life of the unit.

External Cooling Options

If your gearbox is running at high speeds, or it is in an environment where it cannot dissipate enough excess heat, additional cooling devices will need to be installed. Several cooling options are listed below. Please consult your DieQua representative for the appropriate special design number and pricing.

External Cooling Ribs. Extruded aluminum cooling ribs can be made to fit onto any exposed side of a gearbox. These ribs are designed to provide additional surface area to increase the convection cooling properties of the gearbox.

Oil Circulation Fittings. The gearbox can be assembled to include oil circulation fittings. These fittings are designed such that the heated oil is drained from the box, and filtered cooled oil is re-injected into the gearbox over the gears while the unit is running.

Liquid Cooled Heat Sinks. In some applications, heat sinks can be attached to an exposed side of a gearbox through which a cooled liquid (i.e. water) is pumped. These heat sinks draw the excess heat out of the gearbox, providing an economical, often cleaner heat dissipation solution.

Lubrication Requirements

The operational life of any Tandler gearbox depends greatly on proper lubrication. The correct lubricant applied to the gears and bearings acts both as a lubricant and as a coolant. The main heat source in a gearbox is friction generated by meshing gear teeth, bearing friction, radial shaft seal friction, and the turbulent activity of the oil as the gear teeth plunge into it. The heat generated by friction must be dissipated by the outer surfaces of the gearbox. In most cases, where the gearbox is running below its maximum rated speed, adequate

lubrication and cooling is provided by the amount and type of oil in the oil reservoir. Tandler gearboxes are designed to operate at temperatures up to 90°C (200°F).

In some high speed and/or heavy load applications, excessive temperature must be carefully monitored. If your application exceeds the maximum temperatures noted above, additional cooling with the attachment of cooling ribs, or an oil circulation system, or a water cooled heat sink will be required. Contact your DieQua representative for all technical data regarding external cooling systems.

In some very low speed applications, the use of liquid grease for virtual lifetime lubrication is possible. Consult your DieQua representative for conditions where this may apply.

Change Intervals and Oil Capacities

For optimum performance, the first oil change should take place after an initial 500 hours of operation. Subsequent oil changes should be performed every 2000 hours for maximum gearbox life. If the gearbox is constantly running at high speed, or under heavy loads, a shorter interval may be required.

The recommended lubricants and viscosity have been selected, taking into account the wide variety of designs and applications where these gearboxes are used. Considering backlash, rotational speed and operating temperatures, other oils may perform better or worse under these conditions. Tandler gearboxes are filled at the factory with an ISO VG 46 oil. Approved suppliers and their products are listed at the right.

IMPORTANT: DO NOT USE HEAVY WEIGHT GEAR OIL! This type of oil may cause excessive heat and gear tooth wear. Use only one of the recommended oils or contact DieQua for lubrication options. To ensure proper operation, the oil level must be maintained as indicated by the oil level sight glass. Too little oil will result in insufficient cooling and lubrication. Too much oil will cause overheating and thermal breakdown of the oil.

The chart at right indicates the approximate oil quantities for each size gearbox.

Vertical Shaft Applications

Gearboxes mounted with a shaft in a vertical position will require special lubrication options. The bearings supporting the upper portion of the vertical shaft generally do not receive sufficient quantities of oil for proper lubrication and cooling. Several options exist:

1. S1515 – for vertical planet systems: The planetary system is sealed off from the spiral bevel gear section with a special seal. It has a separate oil sight-glass and is filled with the proper amount and type of oil.

2. S515 d2 – for vertical d2 shafts: The ball bearing supporting the upper portion of the vertical shaft is replaced with a permanently lubricated sealed ball bearing.

3. S515 d3 – for vertical correction d3 shafts: The ball bearing supporting the upper portion of the vertical shaft is replaced with a permanently lubricated sealed ball bearing.

Approved Gearbox Oils and Grease

Producer	Oil	Grease
BP Kluber Lubriplate Mobil Petro Canada Shell Texaco	GR-XP 46 (ISO) LAMORA 46 SPO-222 D.T.E. 25 Enduratex EP68 Tellus Oil 46 Rando Oil HD B-46	Lubriplate No. 1500 Mobilplex 44 Shell Grease S 3655 Shell Special Gear Grease H

Oil and Grease Capacities

Tandler gearboxes are filled at the factory with the appropriate quantity of oil. To ensure proper operation and peak performance, the oil level must be maintained as indicated by the oil sight glass. Too little oil will result in insufficient cooling and lubrication. Too much oil will cause overheating and thermal breakdown of the oil. In low rpm applications, the oil is replaced with grease.

Gearbox Size	Ltr.
SP2 **00**	0.25
SP2 **01**	0.4
SP2 **A1**	1.0
SP2 **B1**	1.5
SP2 **C1**	3.0
SP2 **D1**	6.0
SP2 **E1**	12.5

Gearbox Size	Ltr.
SP2 **0A**	0.6
SP2 **AB**	0.9
SP2 **BC**	1.7
SP2 **CD**	3.4
SP2 **DE**	8.5

Gearbox Size	Ltr.
PE2 **00**	0.10
PE2 **01**	0.15
PE2 **A1**	0.25
PE2 **B1**	0.4
PE2 **C1**	0.5
PE2 **D1**	0.8
PE2 **E1**	1.5

Gearbox Size	Ltr.
PD2 **00**	0.15
PD2 **01**	0.2
PD2 **A1**	0.3
PD2 **B1**	0.6
PD2 **C1**	0.8
PD2 **D1**	1.3
PD2 **E1**	3.2

Gearbox Size	Ltr.
KD **01**	0.25
KD **A1**	0.5
KD **B1**	1.0
KD **C1**	2.0
KD **D1**	3.5
KD **E1**	13.0

Gearbox Size	Ltr.
KD2 **A1**	0.7
KD2 **B1**	1.3
KD2 **C1**	2.3
KD2 **D1**	4.0
KD2 **E1**	15.0

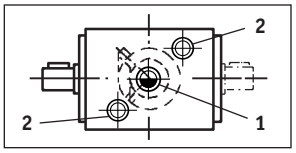
Oil capacities are approximate 1 liter = 1.06 qts. 1 kg = 2.2 lbs.

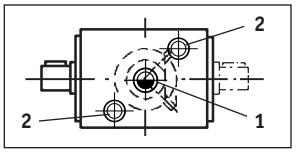
Technical Data

Speed Correction Gearboxes

Monitoring the Oil Level

For all gearbox sizes, the oil sight-glass is located in the middle of the housing, position 1, directly opposite of pinion d_1.

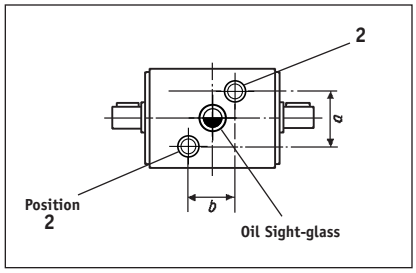




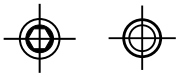
Oil Fill/Drain Plug and Sight Glass Positions

Gearbox Size	Fill/Drain Plug per DIN 908				Dimensions (mm)	
	*	Position 1	*	Position 2	a	b
SP2 **00**	2	R 3/4"	6	M12 x 1.5	39.6	39.6
SP2 **01**	2	M30 x 1.5	6	M12 x 1.5	58	67
SP2 **A1**	2	M30 x 1.5	6	M12 x 1.5	90	70
SP2 **B1**	2	M30 x 1.5	6	M30 x 1.5	100	68
SP2 **C1**	2	M30 x 1.5	6	M30 x 1.5	110	98
SP2 **D1**	2	M30 x 1.5	6	M30 x 1.5	146	134
SP2 **E1**	2	M42 x 1.5	6	M42 x 1.5	180	168

* Number of locations - Refer to diagram below.




Oil Sight-glass


Fill/Drain Plug

Special External Oil Sight-glass

In some cases, the normal oil sight-glass is not accessible or can not be used because the gearbox is mounted vertically. For these situations, Tandler offers special external oil sight-glasses which can be mounted on any major surface of the gearbox. The Tandler special design number is S-545. For ordering purposes, the position of the sight- glass must also be specified. Please consult your DieQua representative for the proper ordering information.

Gearbox Weights

Gearbox Size	Weight
SP2 **00**	8.00 kg
SP2 **01**	16.00 kg
SP2 **A1**	25.50 kg
SP2 **B1**	46.00 kg
SP2 **C1**	87.00 kg
SP2 **D1**	155.00 kg
SP2 **E1**	290.00 kg

Gearbox Size	Weight
PE2 **00**	4.5 kg
PE2 **01**	9.00 kg
PE2 **A1**	14.00 kg
PE2 **B1**	22.00 kg
PE2 **C1**	35.50 kg
PE2 **D1**	60.00 kg
PE2 **E1**	94.00 kg

Gearbox Size	Weight
PD2 **00**	6.50 kg
PD2 **01**	13.50 kg
PD2 **A1**	21.00 kg
PD2 **B1**	29.00 kg
PD2 **C1**	51.00 kg
PD2 **D1**	86.00 kg
PD2 **E1**	--------

Gearbox Size	Weight
KD **01**	9.00 kg
KD **A1**	18.00 kg
KD **B1**	33.00 kg
KD **C1**	55.00 kg
KD **D1**	110.00 kg
KD **E1**	215.00 kg

Gearbox Size	Weight
KD2 **A1**	24.00 kg
KD2 **B1**	43.00 kg
KD2 **C1**	71.00 kg
KD2 **D1**	143.00 kg
KD2 **E1**	280.00 kg

Gearbox weights are approximate. 1 kg = 2.2 lbs.

Special Design Options

Speed Correction Gearboxes

Upgraded Performance

1. **Reduced Backlash.** All gearboxes are available with a reduced backlash option.
2. **Reduced Transmission Error.** Tandler offers two additional improved gear classifications: a G2 and a higher G1 classification. These two classifications refer to improved transmission error.

Increased Radial Load Capacity

Bearings

The radial load capacity for some shafts can be increased by substituting tapered roller bearings for the existing bearings. For technical data and pricing, please consult your DieQua representative.

Special Shafts

Custom shaft designs are available to meet many shafting requirements. Shafts can be lengthened, shortened, increased or decreased in diameter, stepped, or have any key configuration machined into them.

Special Ratios

Tandler has complete design and fabrication facilities to produce custom gear sets for many whole or fractional ratios.

Special Housings

1. **Corrosion-resistant plating.** All of the external components can be plated for corrosion resistance. A variety of plating options are available.
2. **Dimension modifications.** Tandler will custom design gearbox housings to meet any special design criteria. For larger production runs, Tandler will also have custom castings produced to minimize costs.

Remote Phase Adjusting

DieQua can design and fabricate brackets, motor flanges, and any hardware needed to mount correction motors onto any Tandler phasing gearbox. DieQua can also provide the motors and simple electronics for remote phasing applications.

Remote Switching Actuators

For types SP2S, and SP2AS gearboxes, DieQua offers pneumatic actuators for remote switching applications. A 3-position actuator is used for SP2S gearboxes, and a 2-position actuator is used for the SP2AS gearbox. Simple electronics and control mechanisms can also be supplied. Consult your DieQua representative for complete details.

Complete Repair Service

DieQua Corporation is a complete factory service center for all Tandler gearboxes. DieQua maintains a staff of highly skilled technicians along with a large inventory of spare parts. Should a Tandler gearbox experience any type of failure in the field, simply contact your DieQua representative to obtain a Return Material Authorization (RMA) number and return instructions. Return the gearbox to our factory, and our technicians will inspect and evaluate the unit free of charge. A repair or replacement quote will be generated and immediately sent to your attention. Upon completion of the repair, the gearbox is inspected to ensure that it meets or exceeds original factory specifications. It is then refilled with oil and returned.

The Benefits of Choosing Tandler

Low Backlash
Low standard backlash and a reduced backlash option optimize and enhance positioning accuracies while providing smooth, quiet, and efficient torque transmission.

Low Transmission Error
Precision matched set spiral bevel gears and ground planetary gears, along with reduced tolerance component manufacturing and custom assembly, result in the ultimate in rotary motion control.

Specialty Models
The widest range of shaft configurations and connection options provide unmatched design versatility.

More Ratios
The greatest number of ratios offered anywhere in a phaseable gearbox program assures that the required output speed is achieved.

Mounting Features
Centering pilots, machined housings with tapped holes on all sides, shaft shoulders, and tapped shaft ends guarantee precise and trouble-free installation.

Custom Designs
Modification of all standard dimensions and complete special designs are available to allow the best possible design solutions.

Worldwide Support
A global network of sales partners and technical centers assures the highest levels of customer service.

TANDLER

Speed Correction Drives

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Motion Components and Engineering Services

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