

Pinion with Helical Teeth

(Interface : Curvic Plate / EN ISO 9409-I-A)

Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

Case-Hardened and Teeth Ground

Bolt Circle Ø31.5

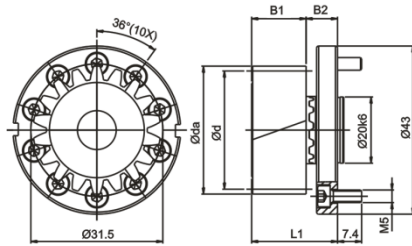


Fig. A

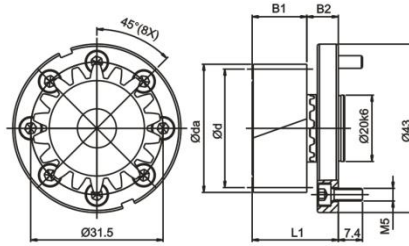


Fig. B

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
2	17	0.441	41.84	36.075	37.84	26	15	41	113.333	A	A02L17A03I	A02L17
										B	A02L17B03I	

Bolt Circle Ø50

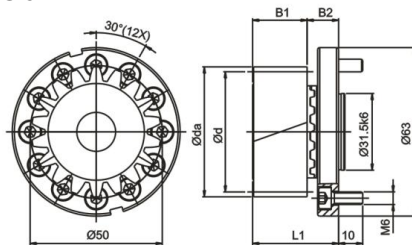


Fig. A

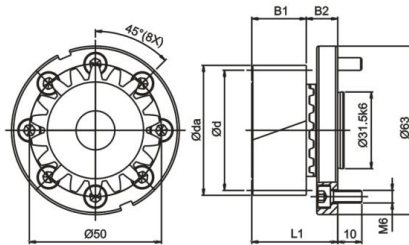


Fig. B

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
2	20	0.390	48.00	42.441	44.00	26	15	41	133.334	A	A02L20A050	A02L20
										B	A02L20B050	
3	17	0.441	62.76	54.113	56.76	31	15	46	170.000	A	A03L17A050	A03L17
										B	A03L17B050	

Bolt Circle Ø63

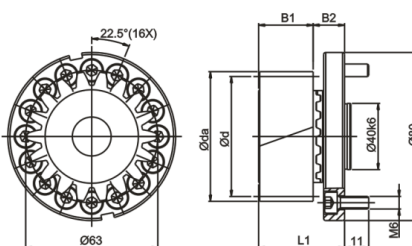


Fig. A

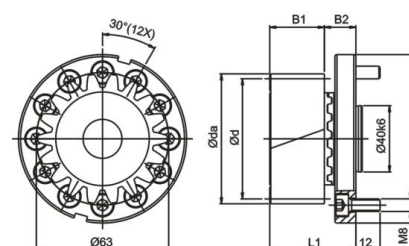


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
2	20	0.390	48	42.441	44	26	15.0	41.0	133.334	A	A02L20A063	A02L20
							19.5	45.5		C	A02L20C063	
							19.5	45.5				
3	20	0.390	72	63.662	66	31	15.0	46.0	200.000	A	A03L20A063	A03L20
							19.5	50.5		C	A03L20C063	
							19.5	50.5				

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

Case-Hardened and Teeth Ground

Bolt Circle Ø80

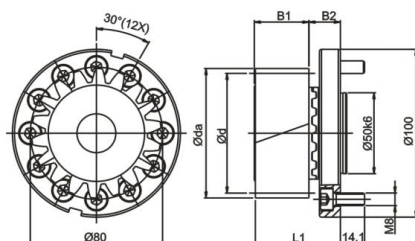


Fig. A

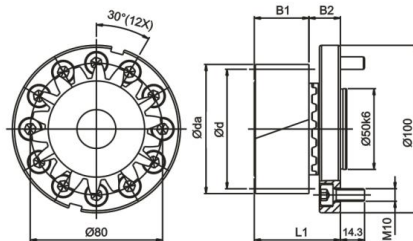


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
3	18	0.118	64	57.296	58	31	21.5	52.5	180.000	A	A03L18A080	A03L18
										C	A03L18C080	
	20	0.390	72	63.662	66	31	21.5	52.5	200.000	A	A03L20A080	A03L20
										C	A03L20C080	
4	19	0.410	91.92	80.639	83.92	41	21.5	62.5	253.335	A	A04L19A080	A04L19
										C	A04L19C080	

Bolt Circle Ø125

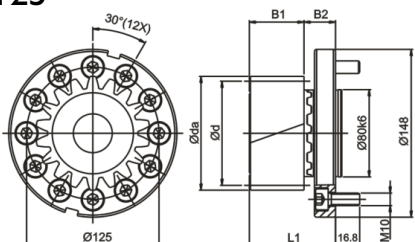


Fig. A

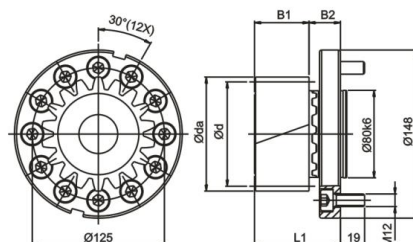


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
4	18	0.638	89.5	76.394	81.5	41	29	70	240.000	A	A04L18A125	A04L18
										C	A04L18C125	
	20	0.190	94.4	84.883	86.4	41	29	70	266.667	A	A04L20A125	A04L20
										C	A04L20C125	
5	19	0.400	114.8	100.798	104.8	51	29	80	316.666	A	A05L19A125	A05L19
										C	A05L19C125	

Bolt Circle Ø140 / Ø145

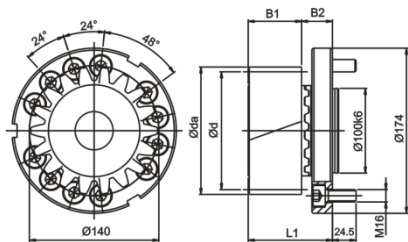


Fig. A

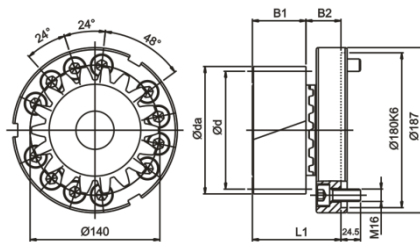


Fig. B

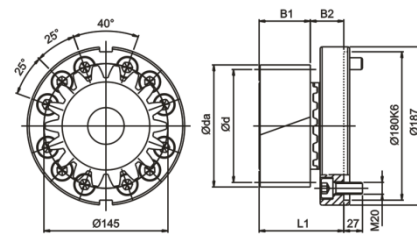


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
5	18	0.251	108.0	95.493	98.0	51	38	89	300.000	A	A05L18A140	A05L18
										B	A05L18B140	
										C	A05L18C145	
	19	0.400	114.8	100.798	104.8	51	38	89	316.667	A	A05L19A140	A05L19
										B	A05L19B140	
										C	A05L19C145	
6	19	0.404	137.8	120.958	125.8	61	38	99	380.000	A	A06L19A140	A06L19
										B	A06L19B140	
										C	A06L19C145	

Pinion with Helical Teeth

(Interface : Curvic Plate / EN ISO 9409-I-A)

Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

Case-Hardened and Teeth Ground

Bolt Circle Ø160 / Ø166

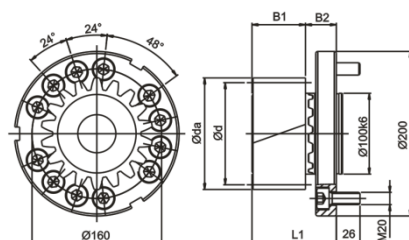


Fig. A

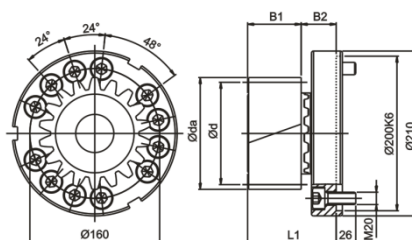


Fig. B

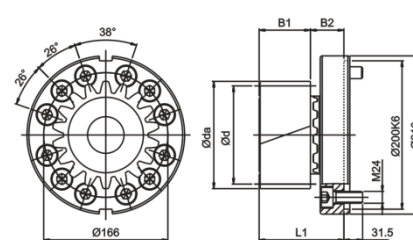
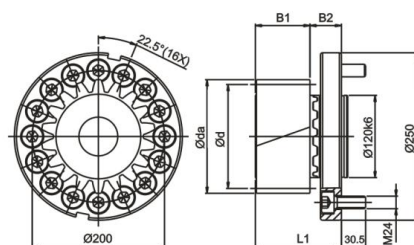


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Fig	Order Code	
											Set	Pinion only
6	18	0.201	129.00	114.592	117.0	61	49	110	360.000	A	A06L18A160	A06L18
										B	A06L18B160	
										C	A06L18C166	
	19	0.404	137.80	120.958	125.8	61	49	110	380.000	A	A06L19A160	A06L19
										B	A06L19B160	
										C	A06L19C166	
8	19	0.411	183.85	161.277	167.85	81	49	130	506.667	A	A08L19A160	A08L19
										B	A08L19B160	
										C	A08L19C166	

Bolt Circle Ø200

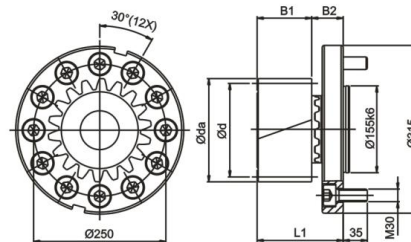


Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Order Code	
										Set	Pinion only
8	15	0.355	149.00	127.324	133.00	81	50	131	400.000	A08L15A200	A08L15
	19	0.411	183.85	161.277	167.85	81	50	131	506.667	A08L19A200	A08L19

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Quality DIN 4 / Alloy Steel
Tooth Thickness Tolerance : e24
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground

Bolt Circle Ø250



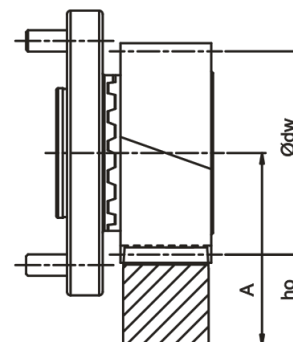
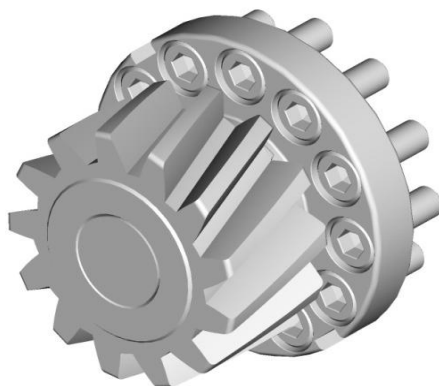
Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	B2	L1	L ⁽⁶⁾	Order Code	
										Set	Pinion only
10	14	0.523	179.0	148.545	159.0	101	62	163	466.667	A10L14A250	A10L14
	18	0.426	219.5	190.986	199.5	101	62	163	600.000	A10L18A250	A10L18

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Pinion material carburized, surface hardness reached 60 HRc

Teeth surface ground to reduce noise and improve wear resistance

Accessories include hexagon socket head cap screws (Strength 12.9 , DIN 912)



$$A = h_o + \frac{\phi dw}{2}$$

In Table I, the maximum permissible torque of the pinion Curvic Plate and the rack is calculated on the basis of a speed of 1.5 m/s and providing good lubrication (using an automatic lubrication system or manually applied grease every day), the tooth root strength factor $S_F \geq 1.4$, tooth surface strength coefficient $S_H \geq 1$, the safety factor $S_b \cong 1$, and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application.

Backlash changes by different center height. Please contact APEX under WWW.APEXDYNA.COM.

Pinion with Helical Teeth

(Interface : Curvic Plate / EN ISO 9409-I-A)

Table I. The max. permitted torque and feed-force of pinion Curvic Plate

Pinion Rack			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
2	17	37.84	F _{2T} ⁽⁸⁾ (N)		8,870	8,870		8,870	8,870	3,326	1,940		4,158
			T _{2B} ⁽⁹⁾ (Nm)		160	160		160	160	60	35		75
	20	44	F _{2T} ⁽⁸⁾ (N)		9,896	9,896		8,247	8,247	2,356	1,649		4,006
			T _{2B} ⁽⁹⁾ (Nm)		210	210		175	175	50	35		85
3	17	56.76	F _{2T} ⁽⁸⁾ (N)		18,110	18,110		17,741	17,741	8,501	4,435		12,197
			T _{2B} ⁽⁹⁾ (Nm)		390	390		480	480	230	120		330
	18	58	F _{2T} ⁽⁸⁾ (N)		20,420	20,420		18,850	18,850	10,472	5,585		14,661
			T _{2B} ⁽⁹⁾ (Nm)		585	585		540	540	300	160		420
	20	66	F _{2T} ⁽⁸⁾ (N)		18,535	18,535		15,708	15,708	6,911	3,142		10,838
			T _{2B} ⁽⁹⁾ (Nm)		590	590		500	500	220	100		345
4	18	81.5	F _{2T} ⁽⁸⁾ (N)		30,761		30,761	30,761	30,761	18,719	9,948		21,206
			T _{2B} ⁽⁹⁾ (Nm)		1,175		1,175	1,175	1,175	715	380		810
	19	83.92	F _{2T} ⁽⁸⁾ (N)		32,247		32,247	32,119	32,119	21,950	11,905		22,818
			T _{2B} ⁽⁹⁾ (Nm)		1,300		1,300	1,295	1,295	885	480		920
	20	86.4	F _{2T} ⁽⁸⁾ (N)		34,283		29,452	29,452	29,452	15,669	7,893		21,324
			T _{2B} ⁽⁹⁾ (Nm)		1,455		1,250	1,250	1,250	665	335		905
5	18	98	F _{2T} ⁽⁸⁾ (N)	56,339	56,339		56,339	56,339	56,339		20,630		47,438
			T _{2B} ⁽⁹⁾ (Nm)	2,690	2,690		2,690	2,690	2,690		985		2,265
	19	104.8	F _{2T} ⁽⁸⁾ (N)	56,649	56,648		56,649	56,549	56,549		21,826		47,620
			T _{2B} ⁽⁹⁾ (Nm)	2,855	2,855		2,855	2,850	2,850		1,100		2,400
6	18	117	F _{2T} ⁽⁸⁾ (N)	77,580	77,580		77,580	77,580	77,580		33,947		67,544
			T _{2B} ⁽⁹⁾ (Nm)	4,445	4,445		4,445	4,445	4,445		1,945		3,870
	19	125.8	F _{2T} ⁽⁸⁾ (N)	73,662	73,662		73,662	73,662	73,662		35,136		63,741
			T _{2B} ⁽⁹⁾ (Nm)	4,455	4,455		4,455	4,455	4,455		2,125		3,855
8	15	133	F _{2T} ⁽⁸⁾ (N)	135,717	135,795		135,717	135,638	135,638		40,919		102,966
			T _{2B} ⁽⁹⁾ (Nm)	8,640	8,645		8,640	8,635	8,635		2,605		6,555
	19	167.85	F _{2T} ⁽⁸⁾ (N)	131,761	131,761		131,761	131,699	131,699		62,315		95,736
			T _{2B} ⁽⁹⁾ (Nm)	10,625	10,625		10,625	10,620	10,620		5,025		7,720
10	14	159	F _{2T} ⁽⁸⁾ (N)	189,707	189,707		189,707	189,707	189,707		62,877		153,691
			T _{2B} ⁽⁹⁾ (Nm)	14,090	14,090		14,090	14,090	14,090		4,670		11,415
	18	199.5	F _{2T} ⁽⁸⁾ (N)	204,308	204,308		204,308	204,256	204,256		100,636		166,766
			T _{2B} ⁽⁹⁾ (Nm)	19,510	19,510		19,510	19,505	19,505		9,610		15,925

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 x T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth

(Interface : Welded Plate / EN ISO 9409-I-A)

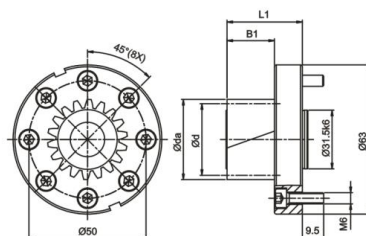
Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

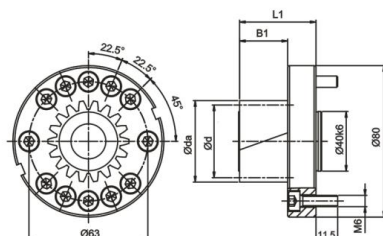
Case-Hardened and Teeth Ground

Bolt Circle Ø50



Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Order Code
2	12	0.5	31.465	25.465	27.465	26	41	80.000	B02L12A050
	16	0.0	37.953	33.953	33.953	26	41	106.667	B02L16A050

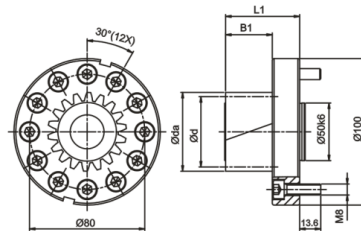
Bolt Circle Ø63



Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Order Code
2	12	0.5	31.465	25.465	27.465	26.0	41.0	80.000	B02L12A063
	17	0.0	40.075	36.075	36.075	26.0	41.0	113.333	B02L17A063
	19	0.0	44.319	40.319	40.319	26.0	41.0	126.667	B02L19A063
	23	0.0	52.808	48.808	48.808	26.0	41.0	153.334	B02L23A063
3	12	0.5	47.197	38.197	41.197	32.5	47.5	120.000	B03L12A063
	14	0.3	52.363	44.563	46.363	32.5	47.5	140.000	B03L14A063

Quality DIN 4 / Alloy Steel
Tooth Thickness Tolerance : e24
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground

Bolt Circle Ø80



Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Order Code
2	12	0.5	31.465	25.465	27.465	26.0	46.0	80.000	B02L12A080
	23	0.0	52.808	48.808	48.808	26.0	46.0	153.334	B02L23A080
	29	0.0	65.540	61.540	61.540	26.0	46.0	193.334	B02L29A080
3	12	0.5	47.197	38.197	41.197	32.5	52.5	120.000	B03L12A080
	16	0.0	56.930	50.930	50.930	32.5	52.5	160.000	B03L16A080
	17	0.0	60.113	54.113	54.113	32.5	52.5	170.000	B03L17A080
	19	0.0	66.479	60.479	60.479	32.5	52.5	190.000	B03L19A080
4	12	0.5	62.930	50.930	54.930	45.0	65.0	160.000	B04L12A080

Bolt Circle Ø125

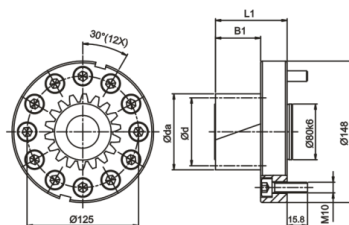


Fig. A

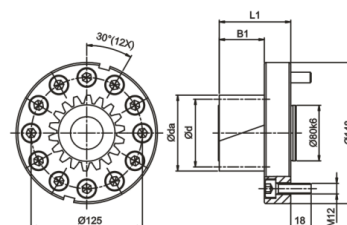


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Fig	Order Code
3	12	0.50	47.197	38.197	41.197	32.5	57.5	120.000	A	B03L12A125
									C	B03L12C125
	19	0.00	66.479	60.479	60.479	32.5	57.5	190.000	A	B03L19A125
									C	B03L19C125
	25	0.00	85.578	79.578	79.578	32.5	57.5	250.000	A	B03L25A125
	26	0.00	88.761	82.761	82.761	32.5	57.5	260.000	A	B03L26A125
									C	B03L26C125
	32	0.00	107.859	101.859	101.859	32.5	57.5	320.000	A	B03L32A125

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = L = \pi \times d$

Pinion with Helical Teeth

(Interface : Welded Plate / EN ISO 9409-I-A)

Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

Case-Hardened and Teeth Ground

Bolt Circle Ø125

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Fig	Order Code
4	12	0.50	62.930	50.930	54.930	45.0	70.0	160.000	A	B04LI2A125
									C	B04LI2C125
	15	0.00	71.662	63.662	63.662	45.0	70.0	200.000	A	B04LI5A125
	16	0.00	75.906	67.906	67.906	45.0	70.0	213.334	A	B04LI6A125
	17	0.00	80.150	72.150	72.150	45.0	70.0	226.667	A	B04LI7A125
									C	B04LI7C125
	19	0.11	89.519	80.639	81.519	45.0	70.0	253.334	A	B04LI9A125
									C	B04LI9C125
5	20	0.00	92.883	84.883	84.883	45.0	70.0	266.667	A	B04L20A125
									C	B04L20C125
	23	0.00	105.615	97.615	97.615	45.0	70.0	306.667	A	B04L23A125
	12	0.50	78.662	63.662	68.662	55	80	200.000	A	B05LI2A125
									C	B05LI2C125
	16	0.00	94.883	84.883	84.883	55	80	266.667	A	B05LI6A125
									C	B05LI6C125
	18	0.00	105.493	95.493	95.493	55	80	300.000	A	B05LI8A125
6									C	B05LI8C125
	12	0.50	94.394	76.394	82.394	65	90	240.000	A	B06LI2A125
									C	B06LI2C125
	13	0.50	100.761	82.761	88.761	65	90	260.000	A	B06LI3A125
	15	0.00	107.493	95.493	95.493	65	90	300.000	A	B06LI5A125

Bolt Circle Ø140 / Ø145

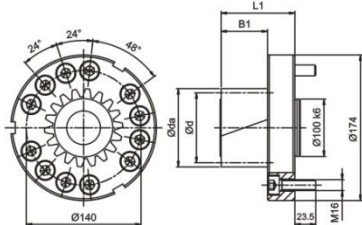


Fig. A

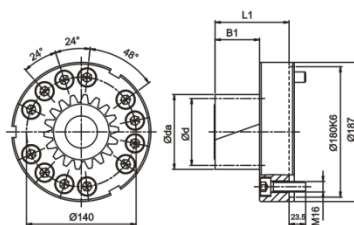


Fig. B

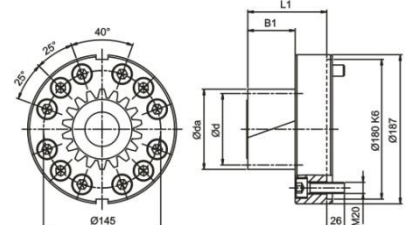


Fig. C

Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Fig	Order Code
4	12	0.50	62.930	50.930	54.930	45	79	160.000	A	B04LI2A140
									B	B04LI2B140
	19	0.11	89.519	80.639	81.519	45	79	253.334	A	B04LI9A140
									B	B04LI9B140
	20	0.00	92.883	84.883	84.883	45	79	266.667	A	B04L20A140
									B	B04L20B140
5									C	B04L20C145
	14	0.30	87.272	74.272	77.272	55	89	233.334	A	B05LI4A140
									B	B05LI4B140
	18	0.00	105.493	95.493	95.493	55	89	300.000	A	B05LI8A140
									B	B05LI8B140
	19	0.00	110.798	100.798	100.798	55	89	316.667	A	B05LI9A140
6									B	B05LI9B140
	12	0.50	94.394	76.394	82.394	65	99	240.000	A	B06LI2A140
									B	B06LI2B140
	15	0.00	107.493	95.493	95.493	65	99	300.000	A	B06LI5A140
									B	B06LI5B140
	16	0.00	113.859	101.859	101.859	65	99	320.000	A	B06LI6A140
									B	B06LI6B140

Pinion with Helical Teeth

(Interface : Welded Plate / EN ISO 9409-I-A)

Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

Case-Hardened and Teeth Ground

Bolt Circle Ø160

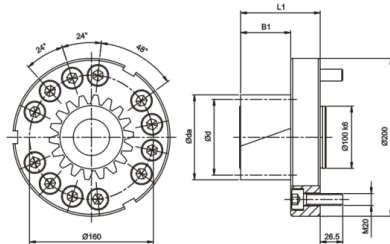


Fig. A

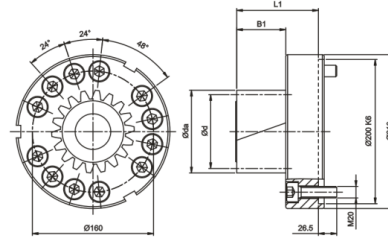


Fig. B

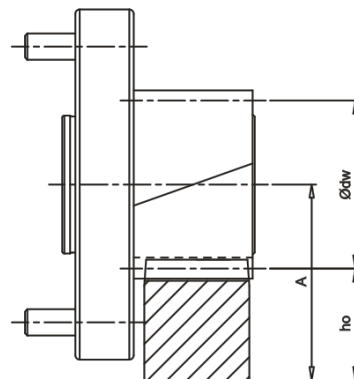
Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	BI	LI	L ⁽⁶⁾	Fig	Order Code
5	12	0.5	78.662	63.662	68.662	55	100	200.000	A	B05L12A160
									B	B05L12B160
	19	0.0	110.798	100.798	100.798	55	100	316.667	A	B05L19A160
									B	B05L19B160
6	12	0.5	94.394	76.394	82.394	65	110	240.000	A	B06L12A160
									B	B06L12B160
	16	0.0	113.859	101.859	101.859	65	110	320.000	A	B06L16A160
									B	B06L16B160
8	12	0.5	125.859	101.859	109.859	85	130	320.000	A	B08L12A160
									B	B08L12B160

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Pinion material carburized, surface hardness reached 60 HRc

Teeth surface ground to reduce noise and improve wear resistance

Accessories include hexagon socket head cap screws (Strength 12.9 , DIN 912)



$$A = h_o + \frac{\phi dw}{2}$$

In Table 2, the maximum permissible torque of the pinion Welded Plate and the rack is calculated on the basis of a speed of 1.5 m/s and providing good lubrication (using an automatic lubrication system or manually applied grease every day), the tooth root strength factor $S_F \geq 1.4$, tooth surface strength coefficient $S_H \geq 1$, the safety factor $S_B \approx 1$, and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application.

Backlash changes by different center height. Please contact APEX under WWW.APEXDYNA.COM.

Note : The strength of screws is limits the max. transmission torque. Please refer to the table blow for Pinion Welded Plate.

PCD of Flange	Bolt / Screw Size	Max. Torque (Nm)
Ø50	M6	175
Ø63	M6	335
Ø80	M8	810
Ø125	M10	2,055
	M12	3,060
Ø140	M16	6,620
Ø145	M20	10,885
Ø160	M20	12,000

Table 2. The max. permitted torque and feed-force of pinion Welded Plate

Pinion \ Rack			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
2	12	27.465	F _{2T} ⁽⁸⁾ (N)		6,676	6,676		6,283	6,283	1,571	1,178	-	2,356
			T _{2B} ⁽⁹⁾ (Nm)		85	85		80	80	20	15	-	30
	16	33.953	F _{2T} ⁽⁸⁾ (N)		10,603	10,603		9,425	9,425	3,240	1,767	-	5,596
			T _{2B} ⁽⁹⁾ (Nm)		180	180		160	160	55	30	-	95
	17	36.075	F _{2T} ⁽⁸⁾ (N)		10,811	10,811		9,425	9,425	3,881	1,663	-	5,544
			T _{2B} ⁽⁹⁾ (Nm)		195	195		170	170	70	30	-	100
	19	40.319	F _{2T} ⁽⁸⁾ (N)		11,161	11,161		9,673	9,673	4,960	2,480	-	5,704
			T _{2B} ⁽⁹⁾ (Nm)		225	225		195	195	100	50	-	115
	23	48.808	F _{2T} ⁽⁸⁾ (N)		10,654	10,654		8,810	8,810	3,893	2,049	-	4,507
			T _{2B} ⁽⁹⁾ (Nm)		260	260		215	215	95	50	-	110
	29	61.54	F _{2T} ⁽⁸⁾ (N)		10,725	10,725		8,937	8,937	6,012	2,925	-	4,225
			T _{2B} ⁽⁹⁾ (Nm)		330	330		275	275	185	90	-	130
3	12	41.197	F _{2T} ⁽⁸⁾ (N)		12,828	12,828		12,566	12,566	3,927	2,356	-	6,807
			T _{2B} ⁽⁹⁾ (Nm)		245	245		240	240	75	45	-	130
	14	46.363	F _{2T} ⁽⁸⁾ (N)		16,605	16,605		16,157	16,157	6,059	2,917	-	10,771
			T _{2B} ⁽⁹⁾ (Nm)		370	370		360	360	135	65	-	240
	16	50.93	F _{2T} ⁽⁸⁾ (N)		19,439	19,439		18,850	18,850	8,836	4,516	-	13,941
			T _{2B} ⁽⁹⁾ (Nm)		495	495		480	480	225	115	-	355
	17	54.113	F _{2T} ⁽⁸⁾ (N)		19,774	19,774		19,034	19,034	9,794	5,174	-	14,045
			T _{2B} ⁽⁹⁾ (Nm)		535	535		545	545	265	140	-	380
	19	60.479	F _{2T} ⁽⁸⁾ (N)		20,338	20,338		19,346	19,346	11,905	6,449	-	14,551
			T _{2B} ⁽⁹⁾ (Nm)		615	615		585	585	360	195	-	440
	25	79.578	F _{2T} ⁽⁸⁾ (N)		19,729	19,729		16,713	16,713	11,687	6,283	-	11,561
			T _{2B} ⁽⁹⁾ (Nm)		785	785		665	665	465	250	-	460
	26	82.761	F _{2T} ⁽⁸⁾ (N)		19,695	19,695		16,675	16,675	12,445	6,766	-	11,600
			T _{2B} ⁽⁹⁾ (Nm)		815	815		690	690	515	280	-	480
	32	101.859	F _{2T} ⁽⁸⁾ (N)		19,831	19,831		16,788	16,788	12,468	9,327	-	11,290
			T _{2B} ⁽⁹⁾ (Nm)		1,010	1,010		855	855	635	475	-	575

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 x T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth

(Interface : Welded Plate / EN ISO 9409-I-A)

Table 2. The max. permitted torque and feed-force of pinion Welded Plate

Rack Pinion			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
4	12	54.93	F _{2T} ⁽⁸⁾ (N)		22,187		22,187	21,991	21,991	9,032	3,927		12,174
			T _{2B} ⁽⁹⁾ (Nm)		565		565	560	560	230	100		310
	15	63.662	F _{2T} ⁽⁸⁾ (N)		31,102		31,102	31,102	31,102	16,336	8,482		21,991
			T _{2B} ⁽⁹⁾ (Nm)		990		990	990	990	520	270		700
	16	67.906	F _{2T} ⁽⁸⁾ (N)		33,870		33,870	33,870	33,870	18,260	9,719		25,182
			T _{2B} ⁽⁹⁾ (Nm)		1,150		1,150	1,150	1,150	620	330		855
	17	72.15	F _{2T} ⁽⁸⁾ (N)		36,729		35,897	35,897	35,897	20,236	10,949		28,551
			T _{2B} ⁽⁹⁾ (Nm)		1,325		1,295	1,295	1,295	730	395		1,030
	19	81.519	F _{2T} ⁽⁸⁾ (N)		36,707		36,211	36,211	36,211	23,686	13,145		27,778
			T _{2B} ⁽⁹⁾ (Nm)		1,480		1,460	1,460	1,460	955	530		1,120
	20	84.883	F _{2T} ⁽⁸⁾ (N)		35,107		30,159	30,159	30,159	16,493	8,364		22,148
			T _{2B} ⁽⁹⁾ (Nm)		1,490		1,280	1,280	1,280	700	355		940
	23	97.615	F _{2T} ⁽⁸⁾ (N)		35,240		30,323	30,323	30,323	21,001	11,269		22,025
			T _{2B} ⁽⁹⁾ (Nm)		1,720		1,480	1,480	1,480	1,025	550		1,075
5	12	68.662	F _{2T} ⁽⁸⁾ (N)	31,259	31,259		31,259	30,945	30,945		8,482		19,007
			T _{2B} ⁽⁹⁾ (Nm)	995	995		995	985	985		270		605
	14	77.272	F _{2T} ⁽⁸⁾ (N)	42,142	42,142		42,142	42,142	42,142		12,656		30,967
			T _{2B} ⁽⁹⁾ (Nm)	1,565	1,565		1,565	1,565	1,565		470		1,150
	16	84.883	F _{2T} ⁽⁸⁾ (N)	47,713	47,713		47,713	47,595	47,595		18,025		36,992
			T _{2B} ⁽⁹⁾ (Nm)	2,025	2,025		2,025	2,020	2,020		765		1,570
	18	95.493	F _{2T} ⁽⁸⁾ (N)	55,187	55,187		55,187	55,083	55,083		22,096		46,181
			T _{2B} ⁽⁹⁾ (Nm)	2,635	2,635		2,635	2,630	2,630		1,055		2,205
	19	100.798	F _{2T} ⁽⁸⁾ (N)	55,854	55,854		55,854	55,755	55,755		24,207		46,727
			T _{2B} ⁽⁹⁾ (Nm)	2,815	2,815		2,815	2,810	2,810		1,220		2,355
6	12	82.394	F _{2T} ⁽⁸⁾ (N)	41,233	41,233		41,233	41,102	41,102		14,792		26,965
			T _{2B} ⁽⁹⁾ (Nm)	1,575	1,575		1,575	1,570	1,570		565		1,030
	13	88.761	F _{2T} ⁽⁸⁾ (N)	45,311	45,311		45,311	45,191	45,191		17,400		31,295
			T _{2B} ⁽⁹⁾ (Nm)	1,875	1,875		1,875	1,870	1,870		720		1,295
	15	95.493	F _{2T} ⁽⁸⁾ (N)	57,701	57,701		57,701	57,596	57,596		26,285		44,611
			T _{2B} ⁽⁹⁾ (Nm)	2,755	2,755		2,755	2,750	2,750		1,255		2,130
	16	101.859	F _{2T} ⁽⁸⁾ (N)	62,832	62,832		62,832	62,832	62,832		29,452		50,854
			T _{2B} ⁽⁹⁾ (Nm)	3,200	3,200		3,200	3,200	3,200		1,500		2,590
8	12	109.859	F _{2T} ⁽⁸⁾ (N)	63,814	63,814		63,814	63,715	63,715		31,710		41,921
			T _{2B} ⁽⁹⁾ (Nm)	3,250	3,250		3,250	3,245	3,245		1,615		2,135

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 x T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth

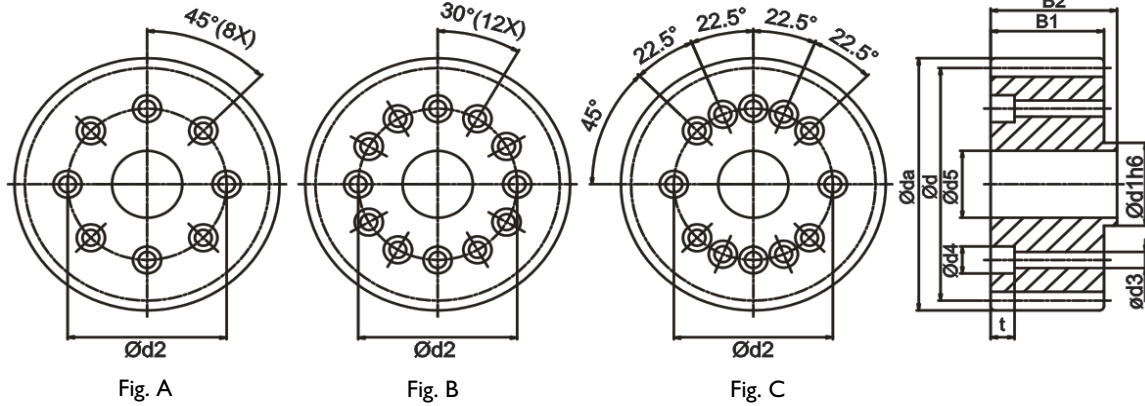
(Interface : Teeth Plate / EN ISO 9409-I-A)

Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

Case-Hardened and Teeth Ground



Mn	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1	d2	B1	B2	d3	d4	t	d5	L ⁽⁶⁾	Fig	Order Code
2	26	0.407	60.800	55.174	56.800	20.0	31.5	26	29	5.5	9.5	12.0	16.2	173.334	A	C02L26A03I
	27	0.000	61.296	57.296	57.296	20.0	31.5	30	33	5.5	9.5	11.0	16.2	180.000	A	C02L27A03I
	29	0.415	67.200	61.540	63.200	20.0	31.5	26	29	5.5	9.5	12.0	16.2	193.334	A	C02L29A03I
	35	0.382	79.800	74.272	75.800	20.0	31.5	26	29	5.5	9.5	12.0	16.2	233.334	A	C02L35A03I
	29	0.415	67.200	61.540	63.200	25.0	40.0	26	29	6.6	11.0	10.5	20.3	193.334	A	C02L29A040
	33	0.393	75.599	70.028	71.599	31.5	50.0	26	29	6.6	11.0	14.0	23.7	220.000	A	C02L33A050
	36	0.000	80.394	76.394	76.394	31.5	50.0	30	33	6.6	11.0	8.0	23.7	240.000	A	C02L36A050
	37	0.421	84.200	78.517	80.200	31.5	50.0	26	29	6.6	11.0	14.0	23.7	246.667	A	C02L37A050
	37	0.421	84.200	78.517	80.200	31.5	50.0	26	29	6.6	11.0	14.0	23.7	246.667	B	C02L37B050
	40	0.379	90.400	84.883	86.400	40.0	63.0	26	29	6.6	11.0	11.5	32.2	266.667	C	C02L40C063
3	45	0.327	100.800	95.493	96.800	40.0	63.0	26	29	6.6	11.0	11.5	32.2	300.000	C	C02L45C063
	30	0.000	101.493	95.493	95.493	40.0	63.0	35	39	6.6	11.0	9.5	32.2	300.000	C	C03L30C063
	31	0.354	106.800	98.676	100.800	31.5	50.0	31	35	6.6	11.0	9.0	23.7	310.000	A	C03L31A050
	35	0.365	119.600	111.409	113.600	50.0	80.0	31	35	9.0	14.0	10.5	32.2	350.000	B	C03L35B080
4	40	0.379	135.599	127.324	129.599	50.0	80.0	31	35	9.0	14.0	10.5	32.2	400.000	B	C03L40B080
	30	0.000	135.324	127.324	127.324	50.0	80.0	45	49	9.0	14.0	9.5	32.2	400.000	B	C04L30B080
	38	0.240	171.200	161.277	163.200	80.0	125.0	41	45	11.0	17.5	10.5	56.1	506.667	B	C04L38B125
5	21	0.000	121.409	111.409	111.409	50.0	80.0	59	64	9.0	14.0	11.5	32.2	350.000	B	C05L21B080
	36	0.000	200.986	190.986	190.986	80.0	125.0	55	60	11.0	17.5	12.5	56.1	600.000	B	C05L36B125

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter

(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

The surface hardness reaches to 60 HRC after case hardening

Teeth surface ground in order to reduce noise and improve wear resistance

Accessories include hexagon socket head cap screws (Strength 12.9 · DIN 912)

Note : The strength of screws is limits the max. transmission torque. Please refer to the table blow for Pinion Teeth Plate.

d1 _{h6}	d2	Bolt / Screw Size	Max. Torque (Nm)
20	31.5	M5	75
25	40	M6	140
31.5	50	M6	175
40	63	M6	335
50	80	M8	810
80	125	M10	2,055

Pinion with Helical Teeth

(Interface : Teeth Plate / EN ISO 9409-1-A)

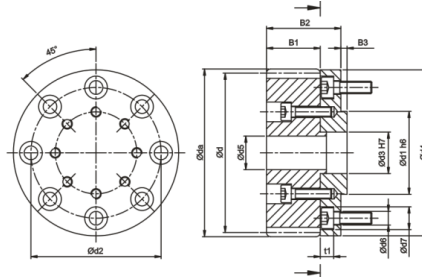
Quality DIN 4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left-Hand Helical Teeth

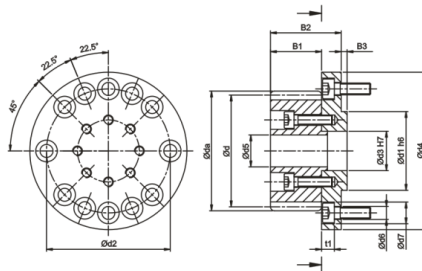
Case-Hardened and Teeth Ground

Bolt Circle Ø50



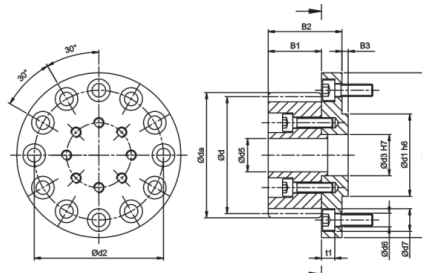
Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 h ₆	d2	d3 H ₇	d4	d5	B1	B2	B3	d6	d7	t1	L ⁽⁶⁾	Order Code	
																		Pinion	Flange
2	26	0.407	60.800	55.174	56.800	31.5	50	20	63	16.2	26	36	3	6.6	11	6.5	173.334	C02L26A03I	FA050
	27	0.000	61.296	57.296	57.296	31.5	50	20	63	16.2	30	40	3	6.6	11	6.5	180.000	C02L27A03I	FA050
	29	0.415	67.200	61.540	63.200	31.5	50	20	63	16.2	26	36	3	6.6	11	6.5	193.334	C02L29A03I	FA050
	29	0.415	67.200	61.540	63.200	31.5	50	25	63	16.2	26	36	3	6.6	11	6.5	193.334	C02L29A040	FB050
	35	0.382	79.800	74.272	75.800	31.5	50	20	63	16.2	26	36	3	6.6	11	6.5	233.334	C02L35A03I	FA050

Bolt Circle Ø63



Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 h ₆	d2	d3 H ₇	d4	d5	B1	B2	B3	d6	d7	t1	L ⁽⁶⁾	Order Code	
																		Pinion	Flange
2	26	0.407	60.800	55.174	56.800	40	63	20	80	16.2	26	36	3	6.6	11	6.5	173.334	C02L26A03I	FA063
	27	0.000	61.296	57.296	57.296	40	63	20	80	16.2	30	40	3	6.6	11	6.5	180.000	C02L27A03I	FA063
	29	0.415	67.200	61.540	63.200	40	63	20	80	16.2	26	36	3	6.6	11	6.5	193.334	C02L29A03I	FA063
	35	0.382	79.800	74.272	75.800	40	63	20	80	16.2	26	36	3	6.6	11	6.5	233.334	C02L35A03I	FA063

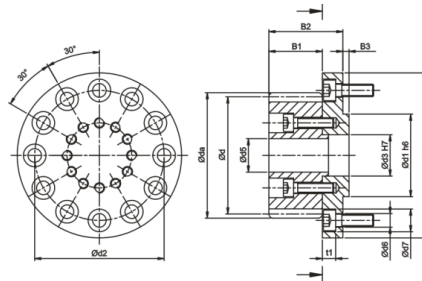
Bolt Circle Ø80



Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 h ₆	d2	d3 H ₇	d4	d5	B1	B2	B3	d6	d7	t1	L ⁽⁶⁾	Order Code	
																		Pinion	Flange
2	33	0.393	75.599	70.028	71.599	50	80	31.5	100	23.7	26	39	4	9	14	8.6	220.000	C02L33A050	FA080
	36	0.000	80.394	76.394	76.394	50	80	31.5	100	23.7	30	43	4	9	14	8.6	240.000	C02L36A050	FA080
	37	0.421	84.200	78.517	80.200	50	80	31.5	100	23.7	26	39	4	9	14	8.6	246.667	C02L37A050	FA080
3	31	0.354	106.800	98.676	100.800	50	80	31.5	100	23.7	31	44	4	9	14	8.6	310.000	C03L31A050	FA080

Quality DIN 4 / Alloy Steel
Tooth Thickness Tolerance : e24
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground

Bolt Circle Ø125



Mn.	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{h6}	d2	d3 _{H7}	d4	d5	B1	B2	B3	d6	d7	t1	L ⁽⁶⁾	Order Code	
																		Pinion	Flange
3	35	0.365	119.600	111.409	113.600	80	125	50	148	32.2	31	50	6	11	17.5	14	350	C03L35B080	FA125
	40	0.379	135.599	127.324	125.999	80	125	50	148	32.2	31	50	6	11	17.5	14	400	C03L40B080	FA125
4	30	0.000	135.324	127.324	127.324	80	125	50	148	32.2	45	64	6	11	17.5	14	400	C04L30B080	FA125
5	21	0.000	121.409	111.409	111.409	80	125	50	148	32.2	59	78	6	11	17.5	14	350	C05L21B080	FA125

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

The surface hardness reaches to 60 HRC after case hardening

Teeth surface ground in order to reduce noise and improve wear resistance

Accessories include hexagon socket head cap screws (Strength 12.9 , DIN 912)

Flange material is generally carbon steel, no heat treatment

When pinion combined with flange, the maximum allowable feed force should be checked according to bolt strength

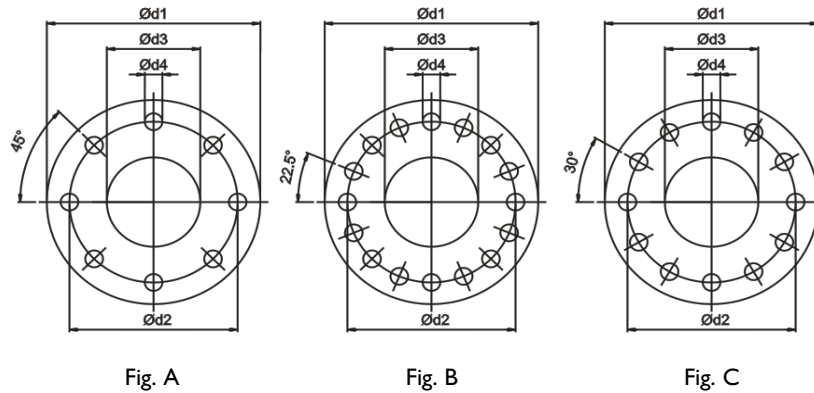
Note : The strength of screws is limits the max. transmission torque. Please refer to the table
blow for Pinion Teeth Plate with Flange.

d1 _{h6}	d2	Bolt / Screw Size	Max. Torque (Nm)
31.5	50	M6	175
40	63	M6	335
50	80	M8	810
80	125	M10	2,055

Pinion with Helical Teeth

(Interface : Teeth Plate / EN ISO 9409-I-A)

Friction Shim



ISO interface	d1	d2	d3	d4	Fig	Max. Torque (Nm)	Order code
A-31.5	39	31.5	20	5.5	A	98	FR031
A-50	62	50	31.5	6.6	A	228	FR050
A-63	80	63	40	6.6	B	435	FR063
A-80	100	80	50	9	C	1050	FR080
A-125	148	125	80	11	C	2670	FR125

To apply the diamond-coated friction shim between the teeth plate and the extending flange, the static friction coefficient is increased. Hence the effective transmission torque can be enhanced at about 30%. Please also refer to the torque limitation due to screws, Page.42.



In Table 3, the maximum permissible torque of pinion Teeth Plate, and the rack is calculated on the basis of a speed of 1.5 m/s and providing good lubrication (using an automatic lubrication system or manually applied grease every day), the tooth root strength factor $S_F \geq 1.4$, tooth surface strength coefficient $S_H \geq 1$, the safety factor $S_B \approx 1$, and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application. Backlash changes by different center height. Please contact APEX under WWW.APEXDYNA.COM.

Table 3. The max. permitted torque and feed-force of pinion Teeth Plate

Rack Pinion			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
2	26	56.8	F _{2T} ⁽⁸⁾ (N)		10,150	10,150		8,519	8,519	4,350	2,175		3,806
			T _{2B} ⁽⁹⁾ (Nm)		280	280		235	235	120	60		105
	27	57.296	F _{2T} ⁽⁸⁾ (N)		10,646	10,646		8,901	8,901	5,411	2,443		4,014
			T _{2B} ⁽⁹⁾ (Nm)		305	305		255	255	155	70		115
	29	63.2	F _{2T} ⁽⁸⁾ (N)		10,075	10,075		8,450	8,450	5,525	2,600		3,737
			T _{2B} ⁽⁹⁾ (Nm)		310	310		260	260	170	80		115
	33	70.028	F _{2T} ⁽⁸⁾ (N)		10,424	10,424		8,568	8,568	5,712	3,713		3,713
			T _{2B} ⁽⁹⁾ (Nm)		365	365		300	300	200	130		130
	35	75.8	F _{2T} ⁽⁸⁾ (N)		10,367	10,367		8,617	8,617	5,655	4,174		3,635
			T _{2B} ⁽⁹⁾ (Nm)		385	385		320	320	210	155		135
	36	76.394	F _{2T} ⁽⁸⁾ (N)		10,734	10,734		8,901	8,901	6,021	4,320		3,927
			T _{2B} ⁽⁹⁾ (Nm)		410	410		340	340	230	165		150
3	37	80.2	F _{2T} ⁽⁸⁾ (N)		10,444	10,444		8,661	8,661	5,731	4,076		3,566
			T _{2B} ⁽⁹⁾ (Nm)		410	410		340	340	225	160		140
	40	86.4	F _{2T} ⁽⁸⁾ (N)		10,485	10,485		8,718	8,718	5,655	4,123		3,652
			T _{2B} ⁽⁹⁾ (Nm)		445	445		370	370	240	175		155
	45	96.8	F _{2T} ⁽⁸⁾ (N)		10,577	10,577		8,796	8,796	5,760	4,189		3,560
			T _{2B} ⁽⁹⁾ (Nm)		505	505		420	420	275	200		170
	30	95.493	F _{2T} ⁽⁸⁾ (N)		19,792	19,792		16,755	16,755	12,462	9,006		11,310
			T _{2B} ⁽⁹⁾ (Nm)		945	945		800	800	595	430		540
	31	100.8	F _{2T} ⁽⁸⁾ (N)		19,153	19,153		16,215	16,215	11,958	8,817		10,742
			T _{2B} ⁽⁹⁾ (Nm)		945	945		800	800	590	435		530
	35	113.6	F _{2T} ⁽⁸⁾ (N)		19,298	19,298		16,247	16,247	11,938	8,976		10,592
			T _{2B} ⁽⁹⁾ (Nm)		1,075	1,075		905	905	665	500		590
4	40	129.599	F _{2T} ⁽⁸⁾ (N)		15,708	15,708		13,273	13,273	9,817	7,383		8,718
			T _{2B} ⁽⁹⁾ (Nm)		1,000	1,000		845	845	625	470		555
	30	127.324	F _{2T} ⁽⁸⁾ (N)		36,128		31,102	31,023	31,023	23,562	17,514		22,070
			T _{2B} ⁽⁹⁾ (Nm)		2,300		1,980	1,975	1,975	1,500	1,115		1,405
5	38	163.2	F _{2T} ⁽⁸⁾ (N)		37,079		31,871	31,809	31,809	24,492	18,229		22,508
			T _{2B} ⁽⁹⁾ (Nm)		2,890		2,570	2,565	2,565	1,975	1,470		1,815
	21	111.409	F _{2T} ⁽⁸⁾ (N)	47,483	55,112		47,483	47,393	47,393		17,683		37,609
			T _{2B} ⁽⁹⁾ (Nm)	2,645	3,070		2,645	2,640	2,640		985		2,095
5	36	190.986	F _{2T} ⁽⁸⁾ (N)	52,360	60,894		52,360	52,360	52,360		31,782		42,045
			T _{2B} ⁽⁹⁾ (Nm)	5,000	5,815		5,000	5,000	5,000		3,035		4,015

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

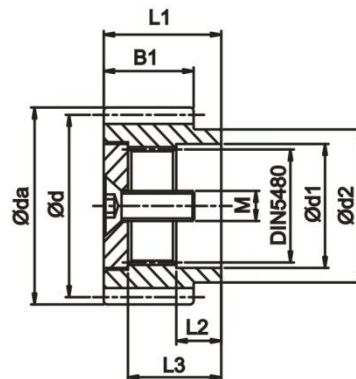
The Emergency Stop Torque T_{2NOT} = 2 × T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth

(Interface : DIN 5480 / Spline)

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e24
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground



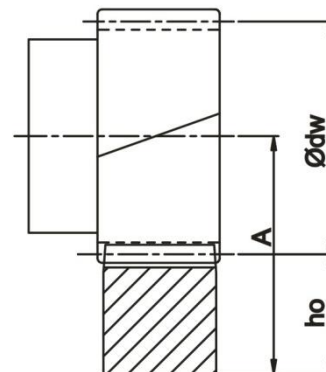
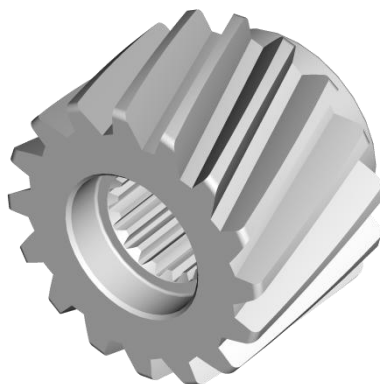
DIN 5480	Mn	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	L1	d1	d2	L2	L3	L ⁽⁶⁾	M	Order code
N16x0.8x30x18x7H	2	15	0.592	38.20	31.831	34.200	26	32	16	26	11	26.5	100.000	M5x15	D02L15N16
		16	0.612	40.40	33.953	36.400	26	32	16	28	11	26.5	106.667	M5x15	D02L16N16
		18	0.500	44.20	38.197	40.200	26	32	16	32	11	26.5	120.000	M5x15	D02L18N16
N22x1.25x30x16x7H	1.5	38	0.000	63.48	60.479	60.480	20	33	22	32	12	27.5	190.000	M8x25	D1JL38N22
	2	18	0.500	44.20	38.197	40.200	26	33	22	32	12	27.5	120.000	M8x25	D02L18N22
		20	0.490	48.40	42.441	44.400	26	33	22	34	12	27.5	133.334	M8x25	D02L20N22
		22	0.479	52.60	46.686	48.600	26	33	22	36	12	27.5	146.667	M8x25	D02L22N22
N32x1.25x30x24x7H	2	25	0.000	57.52	53.052	53.052	26	33	22	36	12	27.5	166.667	M8x25	D02L25N22
		23	0.498	54.80	48.808	50.800	26	34	32	42	13	27.0	153.334	M12x35	D02L23N32
		25	0.487	59.00	53.052	55.000	26	34	32	45	13	27.0	166.667	M12x35	D02L25N32
N40x2x30x18x7H	3	27	0.376	62.80	57.296	58.800	26	34	32	48	13	27.0	180.000	M12x35	D02L27N32
		20	0.456	72.40	63.662	66.400	31	51	40	55	20	41.0	200.000	M16x45	D03L20N40
		22	0.462	78.80	70.028	72.800	31	51	40	58	20	41.0	220.000	M16x45	D03L22N40
N55x2x30x26x7H	4	24	0.468	85.20	76.394	79.200	31	51	40	62	20	41.0	240.000	M16x45	D03L24N40
N70x2x30x34x7H	4	20	0.400	96.08	84.883	88.080	41	54	55	75	20	44.0	266.667	M20x50	D04L20N55
N80x2x30x38x7H	5	25	0.340	116.82	106.103	108.820	41	65	75	94	24	55.0	333.334	M20x50	D04L25N70
N80x2x30x38x7H	5	24	0.348	104.80	127.324	130.800	51	73	85	110	24	62.5	400.000	M20x50	D05L24N80

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Pinion material carburized, the surface hardness reaches to 60 HRc after case hardening

Teeth surface ground in order to reduce noise and improve wear resistance

Accessories include washers and hex head socket head cap screws (Strength 8.8 · ISO 10642 / DIN 7991)



$$A = h_o + \frac{\phi dw}{2}$$

In Table 4, the maximum permissible torque of pinion with DIN 5480, and the rack is calculated on the basis of a speed of 1.5 m/s and providing good lubrication (using an automatic lubrication system or manually applied grease every day), the tooth root strength factor $S_F \geq 1.4$, tooth surface strength coefficient $S_H \geq 1$, the safety factor $S_B \approx 1$, and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application. Backlash changes by different center height. Please contact APEX under WWW.APEXDYNA.COM.

Table 4. The max. permitted torque and feed-force of pinion with DIN 5480

Pinion \ Rack			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
1.5	38	60.48	F _{2T} ⁽⁸⁾ (N)					5,622			1,984		1,653
			T _{2B} ⁽⁹⁾ (Nm)					170			60		50
2	15	34.2	F _{2T} ⁽⁸⁾ (N)		8,482	8,482		8,168	8,168	2,199	1,571		3,456
			T _{2B} ⁽⁹⁾ (Nm)		135	135		130	130	35	25		55
	16	36.4	F _{2T} ⁽⁸⁾ (N)		9,130	9,130		8,541	8,541	2,651	1,767		4,418
			T _{2B} ⁽⁹⁾ (Nm)		155	155		145	145	45	30		75
	18	40.2	F _{2T} ⁽⁸⁾ (N)		10,472	10,472		8,901	8,901	3,665	2,094		4,974
			T _{2B} ⁽⁹⁾ (Nm)		200	200		170	170	70	40		95
	20	44.4	F _{2T} ⁽⁸⁾ (N)		9,896	9,896		8,247	8,247	2,356	1,649		4,006
			T _{2B} ⁽⁹⁾ (Nm)		210	210		175	175	50	35		85
	22	48.6	F _{2T} ⁽⁸⁾ (N)		9,853	9,853		8,354	8,354	2,999	1,714		4,070
			T _{2B} ⁽⁹⁾ (Nm)		230	230		195	195	70	40		95
	23	50.8	F _{2T} ⁽⁸⁾ (N)		10,039	10,039		8,195	8,195	3,278	1,843		3,893
			T _{2B} ⁽⁹⁾ (Nm)		245	245		200	200	80	45		95
	25	53.052	F _{2T} ⁽⁸⁾ (N)		10,744	10,744		8,859	8,859	4,712	2,262		4,524
			T _{2B} ⁽⁹⁾ (Nm)		285	285		235	235	125	60		120
	25	55	F _{2T} ⁽⁸⁾ (N)		9,990	9,990		8,294	8,294	3,958	2,073		3,958
			T _{2B} ⁽⁹⁾ (Nm)		265	265		220	220	105	55		105
	27	58.8	F _{2T} ⁽⁸⁾ (N)		10,297	10,297		8,552	8,552	4,887	2,269		3,840
			T _{2B} ⁽⁹⁾ (Nm)		295	295		245	245	140	65		110
3	20	66.4	F _{2T} ⁽⁸⁾ (N)		18,378	18,378		15,551	15,551	6,754	3,142		10,681
			T _{2B} ⁽⁹⁾ (Nm)		585	585		495	495	215	100		340
	22	72.8	F _{2T} ⁽⁸⁾ (N)		18,564	18,564		15,708	15,708	8,140	3,998		10,567
			T _{2B} ⁽⁹⁾ (Nm)		650	650		550	550	285	140		370
	24	79.2	F _{2T} ⁽⁸⁾ (N)		18,588	18,588		15,708	15,708	9,687	4,974		10,603
			T _{2B} ⁽⁹⁾ (Nm)		710	710		600	600	370	190		405
4	20	88.08	F _{2T} ⁽⁸⁾ (N)		33,340		28,628	28,628	28,628	14,726	7,304		20,381
			T _{2B} ⁽⁹⁾ (Nm)		1,415		1,215	1,215	1,215	625	310		865
	25	108.82	F _{2T} ⁽⁸⁾ (N)		34,118		29,311	29,217	29,217	21,865	12,064		20,546
			T _{2B} ⁽⁹⁾ (Nm)		1,810		1,555	1,550	1,550	1,160	640		1,090
5	24	130.8	F _{2T} ⁽⁸⁾ (N)	46,731	54,271		46,731	46,653	46,653		20,656		36,521
			T _{2B} ⁽⁹⁾ (Nm)	2,975	3,455		2,975	2,970	2,970		1,315		2,325

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 × T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth

(Interface : Keyway for APEX AF- / PII-Series)

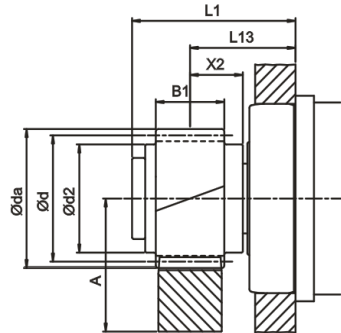
Quality DIN 5 / Alloy Steel

Tooth Thickness Tolerance : e25

Left-Hand Helical Teeth

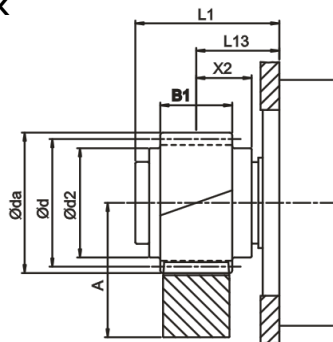
Case-Hardened and Teeth Ground

Combine with AF Series gearbox



Gearbox	Mn	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d2	B1	L1	L13	X2	L ⁽⁶⁾	Order code
AF/AFR KF 060	2	18	0.401	43.8	38.197	39.8	30	26	54	39	19	120.000	E02L18
AF/AFR KF 075	2	22	0.179	51.4	46.686	47.4	40	26	62	40	20	146.667	E02L22
AF/AFR KF 100	2	26	0.007	59.2	55.174	55.2	46	26	96	51	21	173.334	E02L26
AF/AFR KF 140	3	24	0.001	82.4	76.394	76.4	62	31	122	65.5	35.5	240.000	E03L24

Combine with PEII Series gearbox



Gearbox	Mn	z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d2	B1	L1	L13	X2	L ⁽⁶⁾	Order code
PEII 070 PEIIR 070	2	18	0.401	43.8	38.197	39.8	30	26	42	27	19	120.000	E02L18
PEII 090 PEIIR 090	2	22	0.179	51.4	46.686	47.4	40	26	52	30	20	146.667	E02L22
PEII 120 PEIIR 120	2	26	0.007	59.2	55.174	55.2	46	26	78	33	21	173.334	E02L26
PEII 155 PEIIR 155	3	24	0.001	82.4	76.394	76.4	62	31	107	50.5	35.5	240.000	E03L24

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

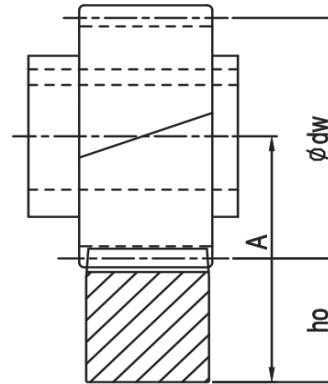
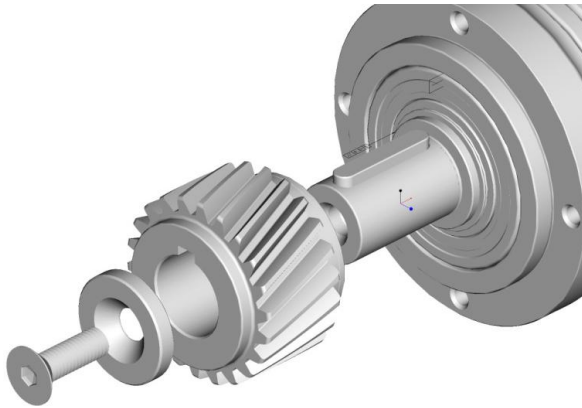
Pinion material carburized, the surface hardness reaches to 60 HRC after case hardening

Teeth surface ground in order to reduce noise and improve wear resistance

Accessories include hexagon socket head cap screws (Strength 12.9 , DIN 912)

Pinion with Helical Teeth (Interface : Keyway)

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e25
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground



$$A = h_o + \frac{\phi dw}{2}$$

In table 5, the maximum permissible torque of pinion with Keyway for APEX AF-/PII-Gearbox, and the rack is calculated on the basis of a speed of 1.5 m/s and providing good lubrication (using an automatic lubrication system or manually applied grease every day), the tooth root strength factor $S_F \geq 1.4$, tooth surface strength coefficient $S_H \geq 1$, the safety factor $S_B \approx 1$, and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application.

Backlash changes by different center height. Please contact APEX under WWW.APEXDYNA.COM.

Table 5, the max. permitted torque and feed-force of pinion with Keyway for APEX AF- / PII-Series

Pinion \ Rack			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
2	18	39.8	F _{2T} ⁽⁸⁾ (N)		10,734	10,734		9,163	9,163	3,665	2,094		4,974
			T _{2B} ⁽⁹⁾ (Nm)		205	205		175	175	70	40		95
	22	47.4	F _{2T} ⁽⁸⁾ (N)		10,496	10,496		8,568	8,568	3,213	1,928		4,284
			T _{2B} ⁽⁹⁾ (Nm)		245	245		200	200	75	45		100
	26	55.2	F _{2T} ⁽⁸⁾ (N)		10,693	10,693		8,881	8,881	4,894	2,356		4,350
			T _{2B} ⁽⁹⁾ (Nm)		295	295		245	245	135	65		120
3	24	76.4	F _{2T} ⁽⁸⁾ (N)		19,635	19,635		16,624	16,624	10,864	5,760		11,650
			T _{2B} ⁽⁹⁾ (Nm)		750	750		635	635	415	220		445

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 x T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth (Interface : Keyway)

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e25 *
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground

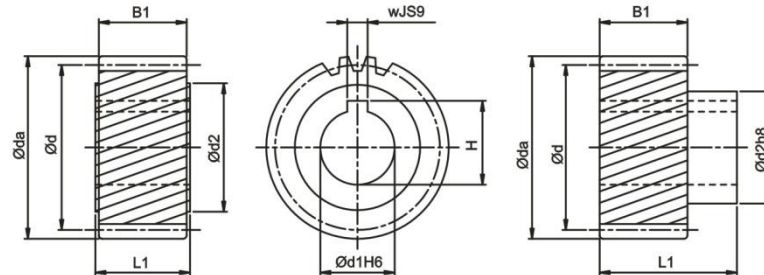


Fig. A

Fig. B

Module 1.5

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
20	0	34.831	31.831	31.831	11	25	20	22	4	12.8	100	A	FIJL20A11	
20	0	34.831	31.831	31.831	14	25	20	22	5	16.3	100	A	FIJL20A14	
20	0	34.831	31.831	31.831	16	25	20	22	5	18.3	100	A	FIJL20A16	
21	0	36.423	33.423	33.423	16	30	20	46	5	18.3	105	B	FIJL21B16	SSD-30

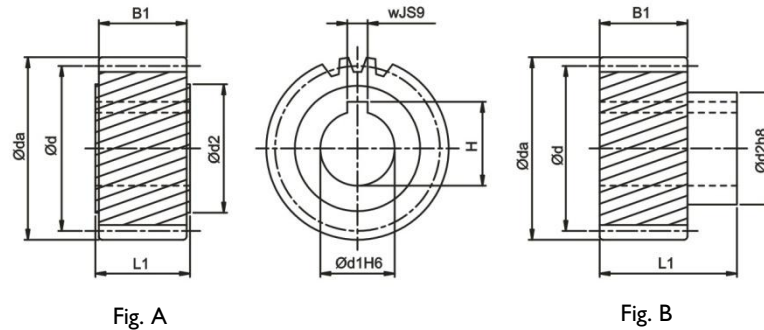
Module 2

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
18	0	42.197	38.197	38.197	16	25	28	30	5	18.3	120	A	F02L18A16	
20	0	46.441	42.441	42.441	19	30	28	30	6	21.8	133.334	A	F02L20A19	
20	0	46.441	42.441	42.441	19	30	28	56	6	21.8	133.334	B	F02L20B19	SSD-30
20	0	46.441	42.441	42.441	20	30	28	30	6	22.8	133.334	A	F02L20A20	
20	0	46.441	42.441	42.441	22	30	28	30	6	24.8	133.334	A	F02L20A22	
20	0	46.441	42.441	42.441	22	36	28	56	6	24.8	133.334	B	F02L20B22	SSD-36
21	0	48.563	44.563	44.563	16	25	28	30	5	18.3	140	A	F02L21A16	
21	0	48.563	44.563	44.563	22	36	28	56	6	24.8	140	B	F02L21B22	SSD-36
22	0	50.686	46.686	46.686	19	30	28	30	6	21.8	146.667	A	F02L22A19	
22	0	50.686	46.686	46.686	19	30	28	56	6	21.8	146.667	B	F02L22B19	SSD-30
22	0	50.686	46.686	46.686	22	30	28	30	6	24.8	146.667	A	F02L22A22	
22	0	50.686	46.686	46.686	22	36	28	56	6	24.8	146.667	B	F02L22B22	SSD-36
25	0	57.052	53.052	53.052	19	30	28	30	6	21.8	166.667	A	F02L25A19	
25	0	57.052	53.052	53.052	19	30	28	56	6	21.8	166.667	B	F02L25B19	SSD-30
25	0	57.052	53.052	53.052	20	30	28	30	6	22.8	166.667	A	F02L25A20	
25	0	57.052	53.052	53.052	22	30	28	30	6	24.8	166.667	A	F02L25A22	
25	0	57.052	53.052	53.052	22	36	28	56	6	24.8	166.667	B	F02L25B22	SSD-36
25	0	57.052	53.052	53.052	25	36	28	30	8	28.3	166.667	A	F02L25A25	

* By Module 1.5, the Tooth Thickness Tolerance = f 24.

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e25
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground



Module 2

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	dI _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
28	0	63.418	59.418	59.418	19	30	28	30	6	21.8	186.667	A	F02L28A19	
28	0	63.418	59.418	59.418	19	30	28	56	6	21.8	186.667	B	F02L28B19	SSD-30
28	0	63.418	59.418	59.418	22	30	28	30	6	24.8	186.667	A	F02L28A22	
28	0	63.418	59.418	59.418	22	36	28	56	6	24.8	186.667	B	F02L28B22	SSD-36
28	0	63.418	59.418	59.418	35	48	28	30	10	38.3	186.667	A	F02L28A35	
30	0	67.662	63.662	63.661	16	25	28	30	5	18.3	200	A	F02L30A16	
30	0	67.662	63.662	63.661	20	30	28	30	6	22.8	200	A	F02L30A20	
30	0	67.662	63.662	63.661	22	36	28	56	6	24.8	200	B	F02L30B22	SSD-36
30	0	67.662	63.662	63.661	25	36	28	30	8	28.3	200	A	F02L30A25	
30	0	67.662	63.662	63.661	30	45	28	30	8	33.3	200	A	F02L30A30	
30	0	67.662	63.662	63.661	30	50	28	60	8	33.3	200	B	F02L30B30	SSD-50
30	0	67.662	63.662	63.661	32	55	28	65	10	35.3	200	B	F02L30B32	SSD-55
32	0	71.906	67.906	67.906	20	30	28	30	6	22.8	213.334	A	F02L32A20	
32	0	71.906	67.906	67.906	22	30	28	30	6	24.8	213.334	A	F02L32A22	
32	0	71.906	67.906	67.906	22	36	28	56	6	24.8	213.334	B	F02L32B22	SSD-36
32	0	71.906	67.906	67.906	25	36	28	30	8	28.3	213.334	A	F02L32A25	
32	0	71.906	67.906	67.906	35	48	28	30	10	38.3	213.334	A	F02L32A35	
36	0	80.394	76.394	76.394	35	48	28	30	10	38.3	240	A	F02L36A35	
39	0	86.761	82.761	82.761	32	55	28	65	10	35.3	260	B	F02L39B32	SSD-55
40	0	88.883	84.883	84.883	35	48	28	30	10	38.3	266.667	A	F02L40A35	

Module 2.5

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	dI _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
24	0	68.662	63.662	63.662	25	36	28	30	8	28.3	200	A	F2JL24A25	
24	0	68.662	63.662	63.662	25	44	28	60	8	28.3	200	B	F2JL24B25	SSD-44

Pinion with Helical Teeth (Interface : Keyway)

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e25
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground

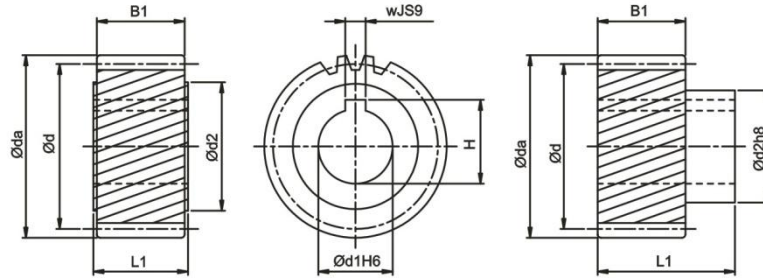


Fig. A

Fig. B

Module 3

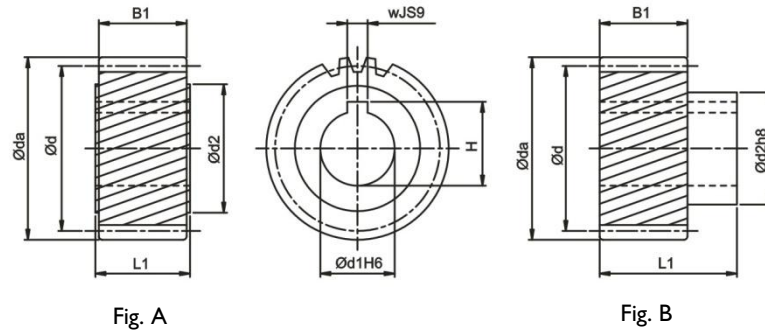
z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
20	0	69.661	63.662	63.662	22	36	28	56	6	24.8	200	B	F03L20B22	SSD-36
20	0	69.661	63.662	63.662	25	44	28	60	8	28.3	200	B	F03L20B25	SSD-44
20	0	69.661	63.662	63.662	30	45	28	30	8	33.3	200	A	F03L20A30	
20	0	69.661	63.662	63.662	30	50	28	60	8	33.3	200	B	F03L20B30	SSD-50
20	0	69.661	63.662	63.662	32	55	28	65	10	35.3	200	B	F03L20B32	SSD-55
20	0	69.661	63.662	63.662	35	48	28	30	10	38.3	200	A	F03L20A35	
22	0	76.028	70.028	70.028	25	36	28	30	8	28.3	220	A	F03L22A25	
22	0	76.028	70.028	70.028	30	45	28	30	8	33.3	220	A	F03L22A30	
22	0	76.028	70.028	70.028	32	55	28	65	10	35.3	220	B	F03L22B32	SSD-55
22	0	76.028	70.028	70.028	35	48	28	30	10	38.3	220	A	F03L22A35	
22	0	76.028	70.028	70.028	40	62	28	65	12	43.3	220	B	F03L22B40	SSD-62
25	0	85.578	79.578	79.578	22	36	28	56	6	24.8	250	B	F03L25B22	SSD-36
25	0	85.578	79.578	79.578	25	36	28	30	8	28.3	250	A	F03L25A25	
25	0	85.578	79.578	79.578	25	44	28	60	8	28.3	250	B	F03L25B25	SSD-44
25	0	85.578	79.578	79.578	30	45	28	30	8	33.3	250	A	F03L25A30	
25	0	85.578	79.578	79.578	30	50	28	60	8	33.3	250	B	F03L25B30	SSD-50
25	0	85.578	79.578	79.578	32	55	28	65	10	35.3	250	B	F03L25B32	SSD-55
25	0	85.578	79.578	79.578	35	48	28	30	10	38.3	250	A	F03L25A35	
25	0	85.578	79.578	79.578	35	55	28	65	10	38.3	250	B	F03L25B35	SSD-55
25	0	85.578	79.578	79.578	40	62	28	65	12	43.3	250	B	F03L25B40	SSD-62
25	0	85.578	79.578	79.578	40	70	28	50	12	43.3	250	A	F03L25A40	
28	0	95.127	89.127	89.127	32	55	28	65	10	35.3	280	B	F03L28B32	SSD-55
28	0	95.127	89.127	89.127	40	62	28	65	12	43.3	280	B	F03L28B40	SSD-62
32	0	107.859	101.859	101.859	32	55	28	65	10	35.3	320	B	F03L32B32	SSD-55
32	0	107.859	101.859	101.859	40	62	28	65	12	43.3	320	B	F03L32B40	SSD-62

Module 4

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
15	0	71.662	63.662	63.662	35	52	40	50	10	38.3	200.000	A	F04L15A35	
18	0	84.394	76.394	76.394	32	55	40	75	10	35.3	240.000	B	F04L18B32	SSD-55
20	0	92.883	84.883	84.883	35	52	40	50	10	38.3	266.667	A	F04L20A35	
20	0	92.883	84.883	84.883	45	65	40	50	14	48.8	266.667	A	F04L20A45	
21	0	97.127	89.127	89.127	32	55	40	75	10	35.3	280.000	B	F04L21B32	SSD-55
21	0	97.127	89.127	89.127	35	55	40	75	10	38.3	280.000	B	F04L21B35	SSD-55
21	0	97.127	89.127	89.127	40	62	40	75	12	43.3	280.000	B	F04L21B40	SSD-62
21	0	97.127	89.127	89.127	45	68	40	75	14	48.8	280.000	B	F04L21B45	SSD-68

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter
(5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e25
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground



Module 4

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
22	0	101.371	93.371	93.371	35	52	40	50	10	38.3	293.334	A	F04L22A35	
22	0	101.371	93.371	93.371	45	65	40	50	14	48.8	293.334	A	F04L22A45	
24	0	109.859	101.859	101.859	32	55	40	75	10	35.3	320.000	B	F04L24B32	SSD-55
24	0	109.859	101.859	101.859	35	55	40	75	10	38.3	320.000	B	F04L24B35	SSD-55
24	0	109.859	101.859	101.859	40	62	40	75	12	43.3	320.000	B	F04L24B40	SSD-62
24	0	109.859	101.859	101.859	45	68	40	75	14	48.8	320.000	B	F04L24B45	SSD-68
24	0	109.859	101.859	101.859	55	80	40	80	16	59.3	320.000	B	F04L24B55	SSD-80
25	0	114.103	106.103	106.103	35	52	40	50	10	38.3	333.334	A	F04L25A35	
25	0	114.103	106.103	106.103	45	65	40	50	14	48.8	333.334	A	F04L25A45	
25	0	114.103	106.103	106.103	55	80	40	80	16	59.3	333.334	B	F04L25B55	SSD-80

Module 5

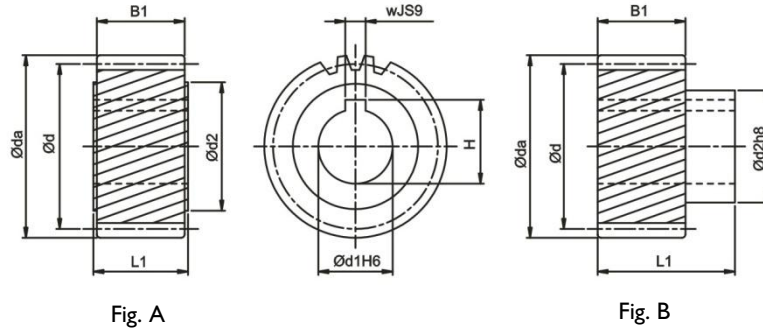
z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
18	0	105.493	95.493	95.493	45	68	50	85	14	48.8	300	B	F05L18B45	SSD-68
24	0	137.324	127.324	127.324	45	68	50	85	14	48.8	400	B	F05L24B45	SSD-68
24	0	137.324	127.324	127.324	55	80	50	90	16	59.3	400	B	F05L24B55	SSD-80
24	0	137.324	127.324	127.324	75	110	50	110	20	79.9	400	B	F05L24B75	SSD-110

Module 6

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
20	0	139.324	127.324	127.324	55	80	60	100	16	59.3	400	B	F06L20B55	SSD-80
20	0	139.324	127.324	127.324	75	110	60	120	20	79.9	400	B	F06L20B75	SSD-110
25	0	171.155	159.155	159.155	55	80	60	100	16	59.3	500	B	F06L25B55	SSD-80
25	0	171.155	159.155	159.155	75	110	60	120	20	79.9	500	B	F06L25B75	SSD-110

Pinion with Helical Teeth (Interface : Keyway)

Quality DIN 5 / Alloy Steel
Tooth Thickness Tolerance : e25 **
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground



Module 8

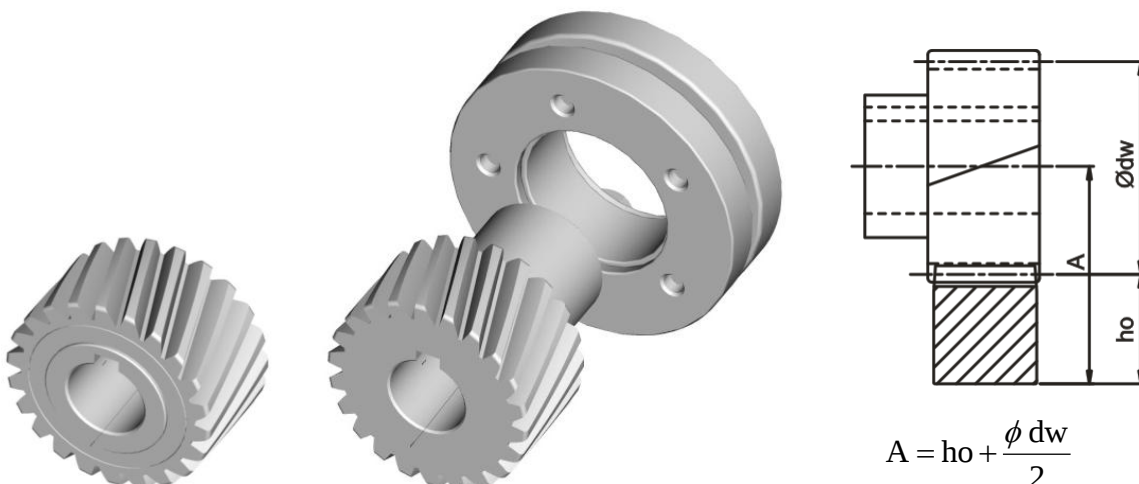
z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
18	0	168.789	152.789	152.789	75	110	80	140	20	79.9	480.000	B	F08L18B75	SSD-110
20	0	185.766	169.766	169.766	85	125	80	145	22	90.4	533.334	B	F08L20B85	SSD-125

Module 10

z ⁽¹⁾	x ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	d1 _{H6}	d2	B1	L1	w _{JS9}	H	L ⁽⁶⁾	Fig	Order code	
													Pinion	Shrink Disc
20	0	232.207	212.207	212.207	85	125	100	165	22	90.4	666.668	B	F10L20B85	SSD-125

** By Module 8 and 10, the Tooth Thickness Tolerance = f 23. (1) Number of teeth (2) Profile modification factor
(3) Diameter of addendum circle (4) Pitch circle diameter (5) Working pitch circle diameter (6) Pitch circle length $L = \pi \times d$

Pinion material carburized, the surface hardness reaches to 60 HRC after case hardening
Teeth surface ground in order to reduce noise and improve wear resistance



In Table 6, the maximum permissible torque of pinion with Keyway, and the rack is calculated on the basis of a speed of 1.5 m/s and providing good lubrication (using an automatic lubrication system or manually applied grease every day), the tooth root strength factor $S_F \geq 1.4$, tooth surface strength coefficient $S_H \geq 1$, the safety factor $S_B \cong 1$, and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application. Backlash changes by different center height. Please contact APEX under WWW.APEXDYNA.COM.

Table 6. The max. permitted torque and feed-force of pinion with Keyway

Rack Pinion			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
1.5	20	31.831	F _{2T} ⁽⁸⁾ (N)					5,027			628		1,257
			T _{2B} ⁽⁹⁾ (Nm)					80			10		20
	21	33.423	F _{2T} ⁽⁸⁾ (N)					5,086			598		1,197
			T _{2B} ⁽⁹⁾ (Nm)					85			10		20
2	18	38.197	F _{2T} ⁽⁸⁾ (N)		11,257	11,257		9,163	9,163	2,880	1,833		2,880
			T _{2B} ⁽⁹⁾ (Nm)		215	215		175	175	55	35		55
	20	42.441	F _{2T} ⁽⁸⁾ (N)		10,367	10,367		8,247	8,247	2,121	1,414		2,356
			T _{2B} ⁽⁹⁾ (Nm)		220	220		175	175	45	30		50
	21	44.563	F _{2T} ⁽⁸⁾ (N)		10,547	10,547		8,303	8,303	2,244	1,346		2,468
			T _{2B} ⁽⁹⁾ (Nm)		235	235		185	185	50	30		55
	22	46.686	F _{2T} ⁽⁸⁾ (N)		10,496	10,496		8,354	8,354	2,356	1,499		2,356
			T _{2B} ⁽⁹⁾ (Nm)		245	245		195	195	55	35		55
	25	53.052	F _{2T} ⁽⁸⁾ (N)		10,556	10,556		8,294	8,294	3,204	1,885		2,262
			T _{2B} ⁽⁹⁾ (Nm)		280	280		220	220	85	50		60
	28	59.418	F _{2T} ⁽⁸⁾ (N)		10,771	10,771		8,415	8,415	4,207	2,020		2,188
			T _{2B} ⁽⁹⁾ (Nm)		320	320		250	250	125	60		65
	30	63.661	F _{2T} ⁽⁸⁾ (N)		10,681	10,681		8,325	8,325	4,555	2,199		2,199
			T _{2B} ⁽⁹⁾ (Nm)		340	340		265	265	145	70		70
	32	67.906	F _{2T} ⁽⁸⁾ (N)		10,750	10,750		8,394	8,394	4,418	2,356		2,209
			T _{2B} ⁽⁹⁾ (Nm)		365	365		285	285	150	80		75
	36	76.394	F _{2T} ⁽⁸⁾ (N)		10,734	10,734		8,378	8,378	4,451	2,880		2,225
			T _{2B} ⁽⁹⁾ (Nm)		410	410		320	320	170	110		85
	39	82.761	F _{2T} ⁽⁸⁾ (N)		10,874	10,874		8,337	8,337	4,471	2,779		2,175
			T _{2B} ⁽⁹⁾ (Nm)		450	450		345	345	185	115		90
	40	84.883	F _{2T} ⁽⁸⁾ (N)		10,838	10,838		8,364	8,364	4,477	2,827		2,238
			T _{2B} ⁽⁹⁾ (Nm)		460	460		355	355	190	120		95
2.5	24	63.662	F _{2T} ⁽⁸⁾ (N)			16,022		13,195	13,195	5,184	2,827		5,027
			T _{2B} ⁽⁹⁾ (Nm)			510		420	420	165	90		160
3	20	63.662	F _{2T} ⁽⁸⁾ (N)		18,535	18,535		16,493	16,493	5,341	2,356		8,796
			T _{2B} ⁽⁹⁾ (Nm)		590	590		525	525	170	75		280
	22	70.028	F _{2T} ⁽⁸⁾ (N)		18,850	18,850		16,565	16,565	6,712	2,713		8,568
			T _{2B} ⁽⁹⁾ (Nm)		660	660		580	580	235	95		300
	25	79.578	F _{2T} ⁽⁸⁾ (N)		19,227	19,227		16,588	16,588	8,922	3,770		8,419
			T _{2B} ⁽⁹⁾ (Nm)		765	765		660	660	355	150		335
	28	89.127	F _{2T} ⁽⁸⁾ (N)		19,523	19,523		16,606	16,606	10,883	5,161		8,303
			T _{2B} ⁽⁹⁾ (Nm)		870	870		740	740	485	230		370
	32	101.859	F _{2T} ⁽⁸⁾ (N)		19,831	19,831		16,690	16,690	10,799	7,265		8,247
			T _{2B} ⁽⁹⁾ (Nm)		1,010	1,010		850	850	550	370		420

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 × T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque

Pinion with Helical Teeth

(Interface : Keyway)

Table 6. The max. permitted torque and feed-force of pinion with Keyway

Pinion			Rack										
			Quality	Q4	Q5H	Q5		Q6	Q6M	Q8H	Q8	Q9	Q10
			Material	Carbon Steel	Alloy Steel		Carbon Steel	Carbon Steel	Carbon Steel	Q&T Alloy Steel	Carbon Steel	Stainless Steel	Carbon Steel
			Heat Treatment	Induction Hardening	Case Hardening	Carburized Induction	Induction Hardening	Induction Hardening	Induction Hardening	Quenched Tempered	Normalizing	Solution	Induction Hardening
Mn	z ⁽¹⁾	dw ⁽⁵⁾	Max. Torque * and Feed-Force										
4	15	63.662	F _{2T} ⁽⁸⁾ (N)		31,730		32,201	32,201	32,201	13,038	5,027		13,509
			T _{2B} ⁽⁹⁾ (Nm)		1,010		1,025	1,025	1,025	415	160		430
	18	76.394	F _{2T} ⁽⁸⁾ (N)		34,557		34,557	34,557	34,557	18,850	8,639		18,457
			T _{2B} ⁽⁹⁾ (Nm)		1,320		1,320	1,320	1,320	720	330		705
	20	84.883	F _{2T} ⁽⁸⁾ (N)		35,107		30,159	30,159	30,159	12,959	4,830		14,962
			T _{2B} ⁽⁹⁾ (Nm)		1,490		1,280	1,280	1,280	550	205		635
	21	89.127	F _{2T} ⁽⁸⁾ (N)		35,118		30,294	30,182	30,182	14,362	5,610		14,810
			T _{2B} ⁽⁹⁾ (Nm)		1,565		1,350	1,345	1,345	640	250		660
	22	93.371	F _{2T} ⁽⁸⁾ (N)		35,236		30,309	30,202	30,202	15,851	6,533		14,780
			T _{2B} ⁽⁹⁾ (Nm)		1,645		1,415	1,410	1,410	740	305		690
	24	101.859	F _{2T} ⁽⁸⁾ (N)		35,343		30,434	30,238	30,238	18,850	8,443		14,530
			T _{2B} ⁽⁹⁾ (Nm)		1,800		1,550	1,540	1,540	960	430		740
	25	106.103	F _{2T} ⁽⁸⁾ (N)		35,343		30,442	30,253	30,253	19,321	9,425		14,514
			T _{2B} ⁽⁹⁾ (Nm)		1,875		1,615	1,605	1,605	1,025	500		770
5	18	95.493	F _{2T} ⁽⁸⁾ (N)	54,140	54,140		54,140	54,035	54,035		18,012		35,081
			T _{2B} ⁽⁹⁾ (Nm)	2,585	2,585		2,585	2,580	2,580		860		1,575
	24	127.324	F _{2T} ⁽⁸⁾ (N)	48,538	56,470		48,538	48,538	48,538		18,064		28,588
			T _{2B} ⁽⁹⁾ (Nm)	3,090	3,595		3,090	3,090	3,090		1,150		1,820
6	20	127.324	F _{2T} ⁽⁸⁾ (N)	69,036	79,011		69,036	69,036	69,036		21,756		47,359
			T _{2B} ⁽⁹⁾ (Nm)	4,395	5,030		4,395	4,395	4,395		1,385		3,015
	25	159.155	F _{2T} ⁽⁸⁾ (N)	72,131	82,058		72,131	72,068	72,068		33,552		49,574
			T _{2B} ⁽⁹⁾ (Nm)	5,740	6,530		5,740	5,735	5,735		2,670		3,945
8	18	152.789	F _{2T} ⁽⁸⁾ (N)	134,368	134,368		134,368	134,368	134,368		62,832		99,876
			T _{2B} ⁽⁹⁾ (Nm)	10,265	10,265		10,265	10,265	10,265		4,800		7,630
	20	169.766	F _{2T} ⁽⁸⁾ (N)	126,527	136,188		126,527	126,527	126,527		46,122		93,423
			T _{2B} ⁽⁹⁾ (Nm)	10,740	11,560		10,740	10,740	10,740		3,915		7,930
10	20	212.207	F _{2T} ⁽⁸⁾ (N)	193,490	190,899		193,490	193,443	193,443		85,812		143,492
			T _{2B} ⁽⁹⁾ (Nm)	20,530	20,255		20,530	20,525	20,525		9,105		15,225

* The Maximal Driving Torque is also to be understood as the Maximal Acceleration Torque T_{2B}.

The Emergency Stop Torque T_{2NOT} = 2 x T_{2B}, under the condition limited 1000 times in the whole service period.

(1) Number of Teeth (5) Working Pitch Circle Diameter (in mm) (8) Maximum Feed-Force (9) Maximum Driving Torque