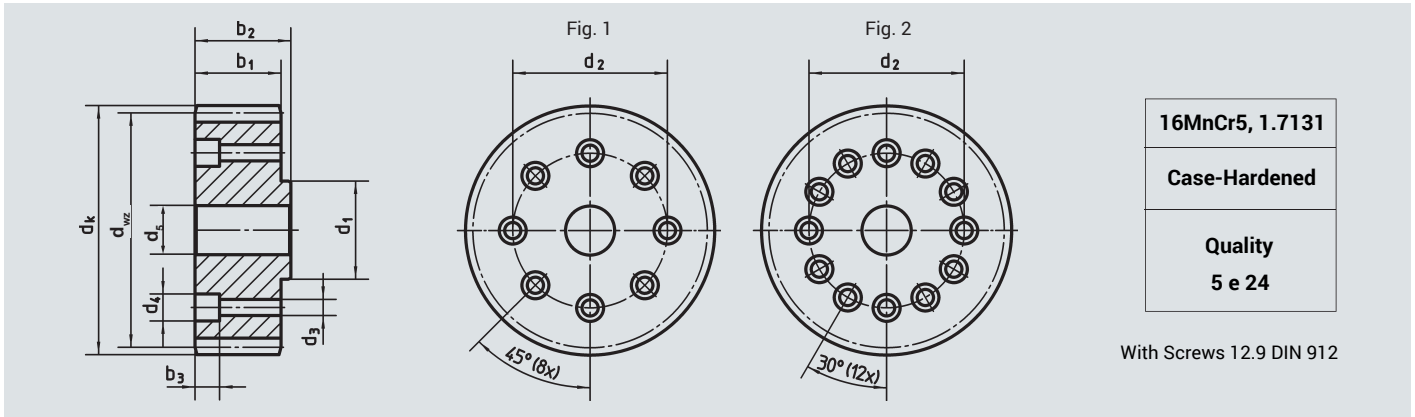


Series	Module	Tolerance of Teeth	Page
<b>78 .. 5..</b> Hardened & Ground Pinions With ISO 9409-1-A Flange	2, 3, 4, 5	5 e 24	C-24 – C-27
<b>78 .....</b> TR and TRS Flanged Pinions	2, 3, 4, 5, 6, 8, 10	5 e 24	C-28 – C-36
<b>79 .....</b> Hardened & Ground Pinions and spline profile according DIN 5480	1.5, 2, 3, 4	5 e 24	C-38
<b>24 .....</b> Hardened & Ground Bored & Keyed Pinions	1.5, 2, 3, 4, 5, 6, 8, 10	7 e 25	C-39 – C-41
<b>24 .....</b> Hardened & Ground Pinions with plain bore for rework	2, 3, 4, 5, 6, 8	6 e 25	C-42

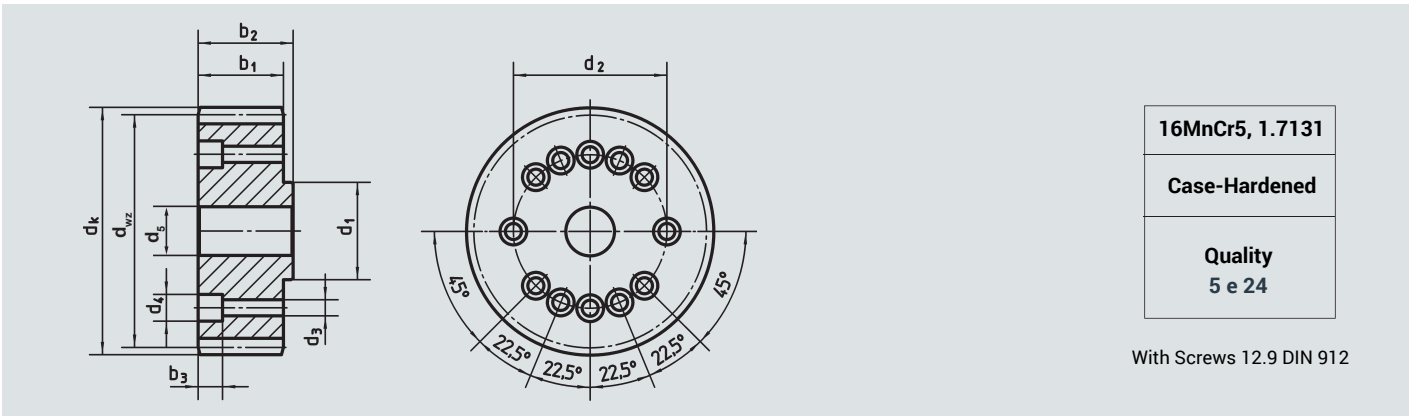


## Helical-Tooth, 19° 31' 42" left-hand, A-31.5 to A-63 flange



Order Code	Fig.	Module	N° of Teeth z	x <sup>(1)</sup>	d <sub>0</sub>	d <sub>wz</sub>	d <sub>k</sub>	d <sub>th6</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>5</sub> <sup>H6</sup>	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	L=PI*d		ISO Interface
																L	kg	
78 20 526	1	2	26	0.4065	55.17	56.80	60.60	20.0	31.5	5.5	10	15	26	29.0	12	173.33	0.4	9409-1-A-31.5
78 20 527	1	2	27	0	57.30	57.30	61.29	20.0	31.5	5.5	10	15	30	33.5	11	180.00	0.5	9409-1-A-31.5
78 20 529	1	2	29	0.4150	61.54	63.20	67.00	20.0	31.5	5.5	10	15	26	29.0	12	193.33	0.5	9409-1-A-31.5
78 20 535	1	2	35	0.3819	74.27	75.80	79.60	20.0	31.5	5.5	10	15	26	29.0	12	233.33	0.8	9409-1-A-31.5
78 25 529	1	2	29	0.4150	61.54	63.20	67.00	25.0	40.0	6.6	11	20	26	30.0	14	193.33	0.5	9409-1-A-40
78 21 533	1	2	33	0.3928	70.03	71.60	75.30	31.5	50.0	6.6	11	20	26	30.0	14	220.00	0.7	9409-1-A-50
78 20 536	1	2	36	0	76.40	76.40	80.39	31.5	50.0	6.6	11	20	30	34.0	8	240.00	1.2	9409-1-A-50
78 21 537	1	2	37	0.4209	78.52	80.20	84.00	31.5	50.0	6.6	11	20	26	30.0	14	246.67	0.9	9409-1-A-50
78 31 531	1	3	31	0.3540	98.68	100.80	106.60	31.5	50.0	6.6	11	20	31	35.5	9	310.00	1.8	9409-1-A-50

<sup>(1)</sup> Profile Modification Factor

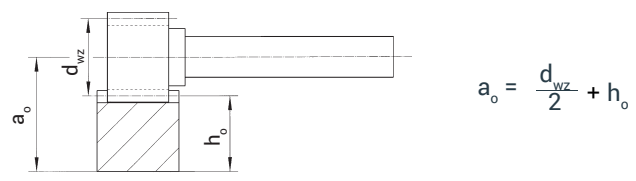


Order Code	Module	N° of Teeth z	x <sup>(1)</sup>	d <sub>0</sub>	d <sub>wz</sub>	d <sub>k</sub>	d <sub>th6</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>5</sub> <sup>H6</sup>	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	L=PI*d		ISO Interface
															L	kg	
78 22 540	2	40	0.3792	84.88	86.40	90.20	40.0	63.0	6.6	11	31.5	26	30	14	266.69	1.0	9409-1-A-63
78 22 545	2	45	0.3267	96.80	96.80	100.60	40.0	63.0	6.6	11	31.5	26	30	14	300.00	1.4	9409-1-A-63
78 30 530	3	30	0	95.49	95.49	101.49	40.0	63.0	6.6	11	20.0	35	39	10	300.00	2.2	9409-1-A-63

<sup>(1)</sup> Profile Modification Factor

The maximum torque is limited by the threaded connection

Calculation of center distance 'a' between pinion and rack.



Helical-Tooth, 19° 31' 42" left-hand, A-80 to A-125 flange

**16MnCr5, 1.7131**

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**Case-Hardened**

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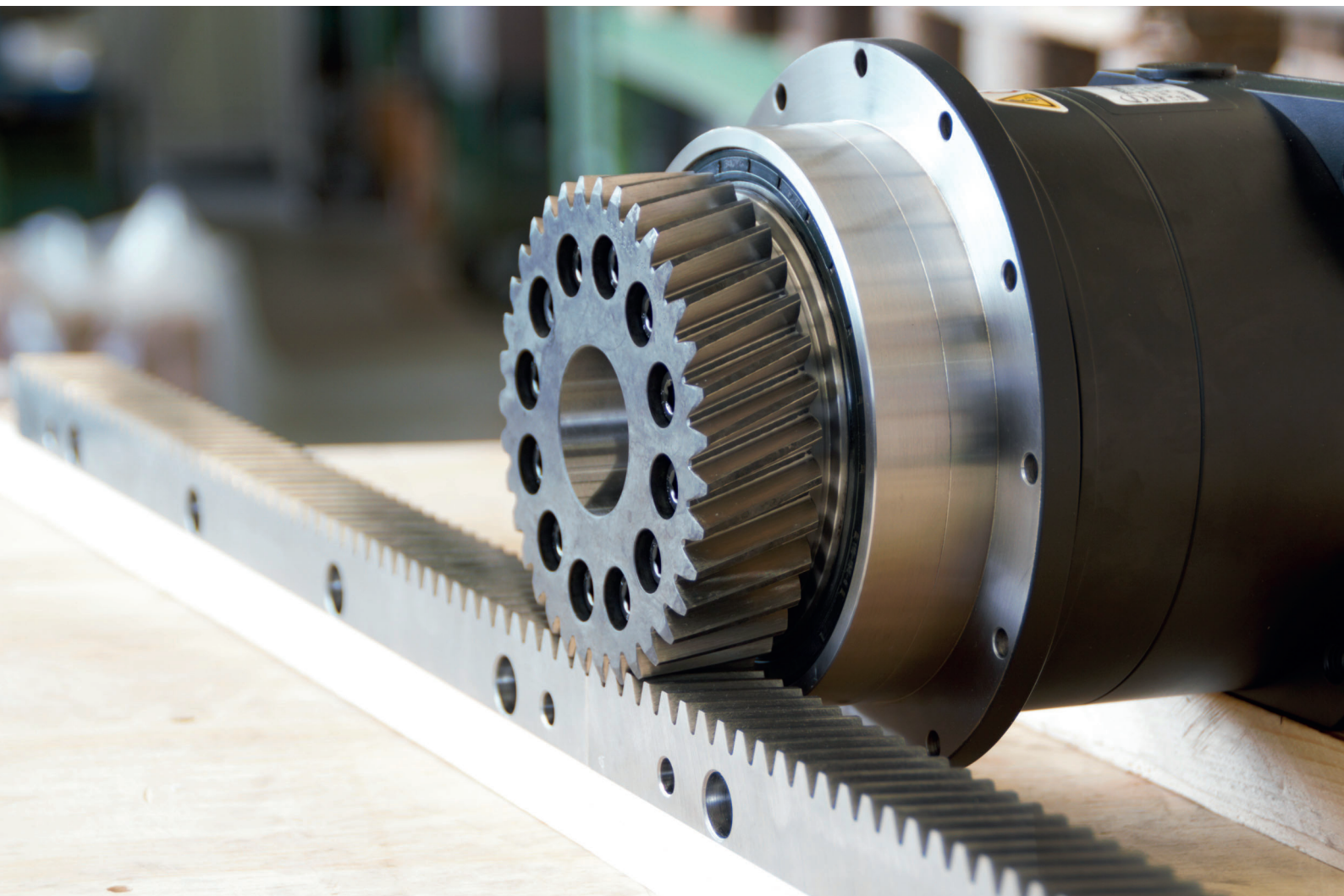
**Quality**  
**5 e 24**

With Screws 12.9 DIN 912

Order Code	Module	N° of Teeth z	x <sup>(1)</sup>	d <sub>0</sub>	d <sub>wz</sub>	d <sub>k</sub>	d <sub>1h6</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>5</sub> <sup>H6</sup>	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	L=PI*d		ISO Interface
															L	kg	
<b>78 33 535</b>	3	35	0.3652	113.60	119.40	50	80	9	15	40	31	35.0	11	350.00	1.8	9409-1-A-80	
<b>78 33 540</b>	3	40	0.3792	129.60	135.40	50	80	9	15	40	31	35.0	11	400.00	2.5	9409-1-A-80	
<b>78 40 530</b>	4	30	0	127.32	135.32	50	80	9	15	40	45	49.0	11	400.00	3.5	9409-1-A-80	
<b>78 50 521</b>	5	21	0	111.40	121.40	50	80	9	-	40	59	64.5	-	350.00	3.5	9409-1-A-80	
<b>78 50 536</b>	5	36	0	190.99	200.98	80	125	11	18	60	55	61.0	13	600.00	8.0	9409-1-A-125	

<sup>(1)</sup> Profile Modification Factor

The max. torque is limited by the threaded connection.



## Helical-Tooth, 19° 31' 42" left-hand, A-50 to A-63 flange

Set consists of pinion and flange

Interface A50

**16MnCr5, 1.7131**

**Case-Hardened**

**Quality**  
**5 e 24**

With Screws 12.9 DIN 912

Order Code Pinion	Order Code Flange	Module	N° of Teeth z	x <sup>(1)</sup>	d <sub>o</sub>	d <sub>wz</sub>	dk	d <sub>1h6</sub>	d2	d3	d4	d5	d6	d7	b1	b2	b3	b4	L=PI*d	L	kg	ISO Interface
78 20 526	2 65 78 001	2	26	0.4065	55.17	56.80	60.60	31.5	50	63	20	15	6.6	11	26	36	2.5	6.5	173.33	0.6	9409-1-A-31.5/50	
78 20 527	2 65 78 001	2	27	0	57.30	57.30	61.29	31.5	50	63	20	15	6.6	11	30	40	2.5	6.5	180.00	0.7	9409-1-A-31.5/50	
78 20 529	2 65 78 001	2	29	0.4150	61.54	63.20	67.00	31.5	50	63	20	15	6.6	11	26	36	2.5	6.5	193.33	0.7	9409-1-A-31.5/50	
78 20 535	2 65 78 001	2	35	0.3819	74.27	75.80	79.60	31.5	50	63	20	15	6.6	11	26	36	2.5	6.5	233.33	1.0	9409-1-A-31.5/50	

<sup>(1)</sup> Profile Modification Factor

Set consists of pinion and flange

Interface A63

**16MnCr5, 1.7131**

**Case-Hardened**

**Quality**  
**5 e 24**

With Screws 12.9 DIN 912

Order Code Pinion	Order Code Flange	Module	N° of Teeth z	x <sup>(1)</sup>	d	d <sub>wz</sub>	dk	d <sub>1h6</sub>	d2	d3	d4	d5	d6	d7	b1	b2	b3	b4	L=PI*d	L	kg	ISO Interface
78 20 526	2 65 78 002	2	26	0.4065	55.17	56.80	60.60	40	63	80	20	15	6.6	11	26	36	3	6.5	173.33	0.7	9409-1-A-31.5/63	
78 20 527	2 65 78 002	2	27	0	57.30	57.30	61.29	40	63	80	20	15	6.6	11	30	40	3	6.5	180.00	0.8	9409-1-A-31.5/63	
78 20 529	2 65 78 002	2	29	0.4150	61.54	63.20	67.0	40	63	80	20	15	6.6	11	26	36	3	6.5	193.33	0.8	9409-1-A-31.5/63	
78 20 535	2 65 78 002	2	35	0.3819	74.27	75.80	79.60	40	63	80	20	15	6.6	11	26	36	3	6.5	233.33	1.1	9409-1-A-31.5/63	

<sup>(1)</sup> Profile Modification Factor

The maximum torque is limited by the threaded connection

### Helical-Tooth, 19° 31' 42" left-hand, A-80 to A-125 flange

Set consists pinion and flange

Interface A80

16MnCr5, 1.7131  
Case-Hardened  
Quality 5 e 24

With Screws 12.9 DIN 912

Order Code Pinion	Order Code Flange	Module	N° of Teeth z	$x^{(1)}$	$d_o$	$d_{wz}$	$d_k$	$d_{h6}$	$d_2$	$d_3$	$d_4$	$d_5$	$d_6$	$d_7$	$b_1$	$b_2$	$b_3$	$b_4$	L=PI*d L	$\frac{L}{kg}$	ISO Interface
78 20 526	2 65 78 001 <sup>(2)</sup> 2 65 78 003 <sup>(2)</sup>	2	26	0.4065	55.17	56.80	60.60	50	80	100	31.5	15	9	15	26	49	4	9	173.33	1.2	9409-1-A-31.5/50/80
78 20 527	2 65 78 001 <sup>(2)</sup> 2 65 78 003 <sup>(2)</sup>	2	27	0	57.30	57.30	61.29	50	80	100	31.5	15	9	15	30	53	4	9	180.00	1.3	9409-1-A-31.5/50/80
78 20 529	2 65 78 001 <sup>(2)</sup> 2 65 78 003 <sup>(2)</sup>	2	29	0.4150	61.54	63.20	67.00	50	80	100	31.5	15	9	15	26	49	4	9	193.33	1.3	9409-1-A-31.5/50/80
78 20 535	2 65 78 001 <sup>(2)</sup> 2 65 78 003 <sup>(2)</sup>	2	35	0.3819	74.27	75.80	79.60	50	80	100	31.5	15	9	15	26	49	4	9	233.33	1.6	9409-1-A-31.5/50/80
78 21 533	2 65 78 003	2	33	0.3928	70.03	71.60	75.30	50	80	100	31.5	20	9	15	26	39	4	9	220.00	1.3	9409-1-A-50/80
78 20 536	2 65 78 003	2	36	0	76.40	76.40	80.40	50	80	100	31.5	20	9	15	30	43	4	9	240.00	1.4	9409-1-A-50/80
78 21 537	2 65 78 003	2	37	0.4209	78.52	80.20	84.00	50	80	100	31.5	20	9	15	26	39	4	9	246.67	1.5	9409-1-A-50/80
78 31 531	2 65 78 003	3	31	0.3540	98.68	100.80	106.60	50	80	100	31.5	20	9	15	31	44	4	9	310.00	2.4	9409-1-A-50/80

<sup>(1)</sup> Profile Modification Factor

<sup>(2)</sup> Uses two flanges

Set consists of pinion and flange

Interface A125

16MnCr5, 1.7131  
Case-Hardened  
Quality 5 e 24

With Screws 12.9 DIN 912

Order Code Pinion	Order Code Flange	Module	N° of Teeth z	$x^{(1)}$	$d_o$	$d_{wz}$	$d_k$	$d_{h6}$	$d_2$	$d_3$	$d_4$	$d_5$	$d_6$	$d_7$	$b_1$	$b_2$	$b_3$	$b_4$	L=PI*d L	$\frac{L}{kg}$	ISO Interface
78 31 531	2 65 78 003 <sup>(2)</sup> 2 65 78 004 <sup>(2)</sup>	3	31	0.3540	98.68	100.80	106.60	80	125	148	50	20	11	18	31	63	6	14	310.00	3.4	9409-1-A-50/80/125
78 33 535	2 65 78 004	3	35	0.3652	111.41	113.60	119.40	80	125	148	50	40	11	18	31	50	6	14	350.00	3.8	9409-1-A80/125
78 33 540	2 65 78 004	3	40	0.3792	127.32	129.60	135.40	80	125	148	50	40	11	18	31	50	6	14	400.00	4.5	9409-1-A80/125
78 40 530	2 65 78 004	4	30	0	127.32	127.32	135.32	80	125	148	50	40	11	18	45	64	6	14	400.00	5.5	9409-1-A80/125
78 50 521	2 65 78 004	5	21	0	111.40	111.40	121.40	80	125	148	50	40	11	18	59	78	6	14	350.00	5.5	9409-1-A80/125

<sup>(1)</sup> Profile Modification Factor

<sup>(2)</sup> Uses two flanges

The maximum torque is limited by the threaded connection

## TR and TRS Pinions

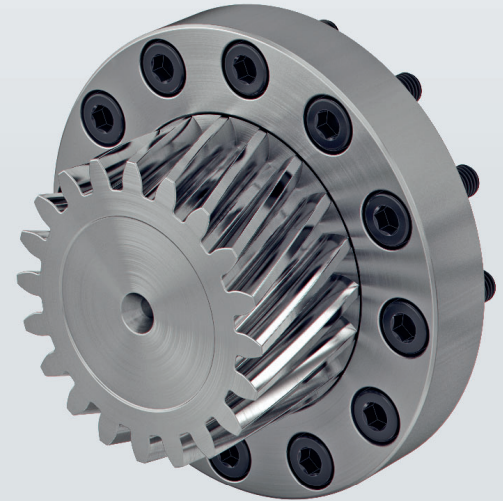
Our high-precision TR and TRS Pinions (TR = Torque Reduction, TRS = Torque Reduction Supporter) for highly dynamic applications have been specially developed for use on planetary reducers. They comply with the ISO 9409-1-A interface. Used together with ATLANTA racks they open up new possibilities. The compact dimensions of TR and TRS Pinions offer impressive performance: they transmit high circumferential forces and generate low drive torques. This allows you to use smaller and more cost-effective reducers and motors without sacrificing performance.

The TR and TRS Pinions are manufactured in quality 5, which maximizes their load capacity. This makes it possible to realise extremely backlash-free and smooth-running rack drives that offer the highest precision and reliability. Our TR and TRS Pinions enable the implementation of highly rigid and highly dynamic drives due to their unique combination of high stiffness, low mass moment of inertia and minimal backlash.

The teeth of the TR and TRS Pinions are designed in such a way that it is possible to switch between spur and helical geared drives without having to adjust the centre distance. The bolted flange design also allows for easy replacement of the pinion without having to carry out major disassembly work.



German Patent  
Nr. 10 2008 024 070.2



## The Advantages of TR/TRS Pinions With An Example Calculation:

The following example recalculates 2 pinions for a horizontal traveling operation axis and the suitable planetary gearboxes will be chosen.

### Given Values:

Mass to be moved:  $m = 10000 \text{ kg}$   
 Speed:  $v = 0.7 \text{ m/s}$   
 Acceleration time:  $t_b = 0.67 \text{ s}$   
 Coefficient of friction:  $\mu = 0.05$   
 Motor rpm:  $n_{Mot} = 1500 \text{ min}^{-1}$

Acceleration due to gravity:  $g = 9.81 \text{ m/s}^2$   
 Load factor:  $K_A = 1.25$   
 Safety coefficient:  $S = 1.3$   
 Operating time factor:  $b_B = 1.2$

### Acceleration:

$$a = \frac{v}{t_b} = \frac{0.7}{0.67} = 1.05 \text{ m/s}^2$$

### Tangential force at the pinion:

$$F_u = m \cdot g \cdot \mu + m \cdot a = 10000 \cdot 9.81 \cdot 0.05 + 10000 \cdot 1.05 = 15400 \text{ N}$$

### TR-Pinion

Module:  $m = 5$   
 Number of teeth:  $z = 12$   
 Pitch diameter  $\varnothing$  of pinion:  $d = 63.66 \text{ mm}$

$$T_{2req} = \frac{F_u \cdot d}{2000} = \frac{15400 \cdot 63.66}{2000} = 490 \text{ Nm}$$

$$n_{pinion} = 60000 \cdot \frac{v}{\pi \cdot d} = 60000 \cdot \frac{0.7}{\pi \cdot 63.66} = 210 \text{ min}^{-1}$$

$$T_{2per} = \frac{T_{2Tab.}}{K_A \cdot S \cdot b_B} = \frac{1050}{1.25 \cdot 1.3 \cdot 1.2} = 538 \text{ Nm}$$

$$i_{max-gearbox} = \frac{n_{Motor}}{n_{pinion}} = \frac{1500}{210} = 7.14$$

### Conventional Pinion

Module:  $m = 5$   
 Number of teeth:  $z = 36$   
 Pitch diameter  $\varnothing$  of pinion:  $d = 190.99 \text{ mm}$

$$T_{2req} = \frac{F_u \cdot d}{2000} = \frac{15400 \cdot 190.99}{2000} = 1471 \text{ Nm}$$

$$n_{pinion} = 60000 \cdot \frac{v}{\pi \cdot d} = 60000 \cdot \frac{0.7}{\pi \cdot 190.99} = 69.9 \text{ min}^{-1}$$

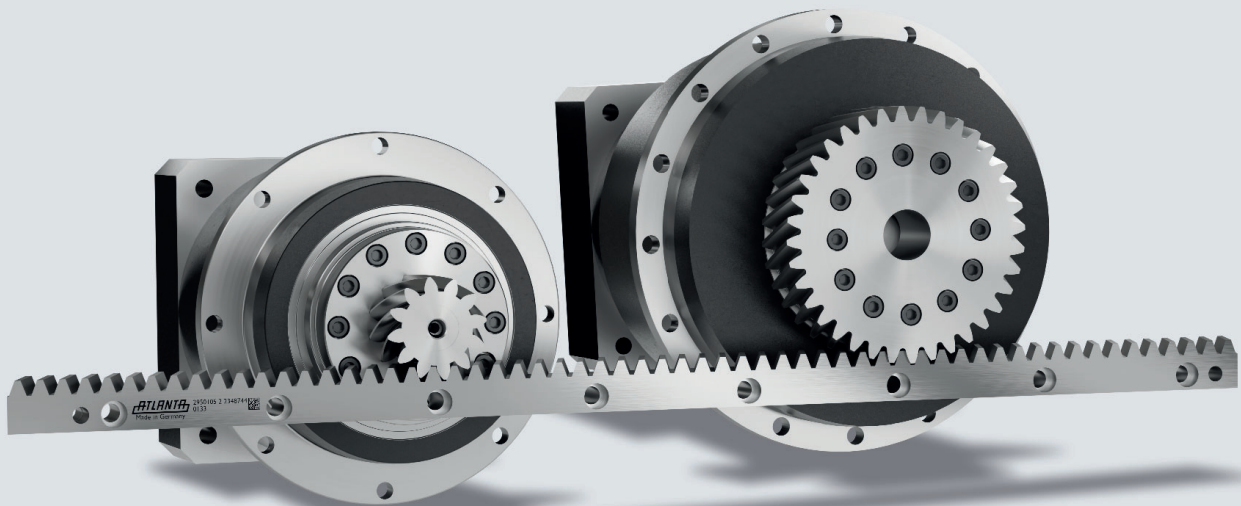
$$T_{2per} = \frac{T_{2Tab.}}{K_A \cdot S \cdot b_B} = \frac{3300}{1.25 \cdot 1.3 \cdot 1.2} = 1692 \text{ Nm}$$

$$i_{max-gearbox} = \frac{n_{Motor}}{n_{Ritzel / pinion}} = \frac{1500}{67.1} = 22.3$$

## Comparison Results

Pinion Used	TR-Pinion m = 5 z = 12	Conventional Pinion m = 5 z = 36
Pitch Diameter $\phi$ of Pinion	d = 63.66 mm	d = 190.99 mm
Required Torque	490 Nm	1471 Nm
Planetary Gearbox Size	$\phi$ 200 mm	$\phi$ 250 mm
Gearbox Ratio	i = 7:1 (1-stage)	i = 20:1 (2-stage)

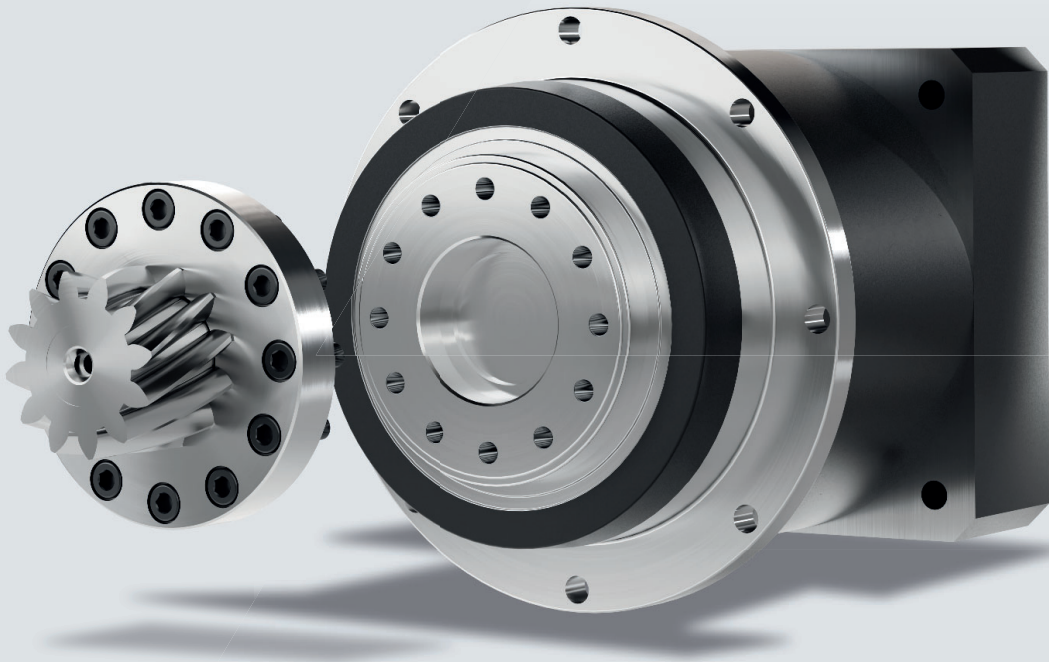
By using a TR-pinion with a smaller pitch diameter, the required torque in this example was reduced by ~66%, allowing a smaller gearbox size to be used and reducing the reduction ratio so only a single stage gearbox is needed.



Size Comparison When Using A TR Pinion And A Conventional Pinion

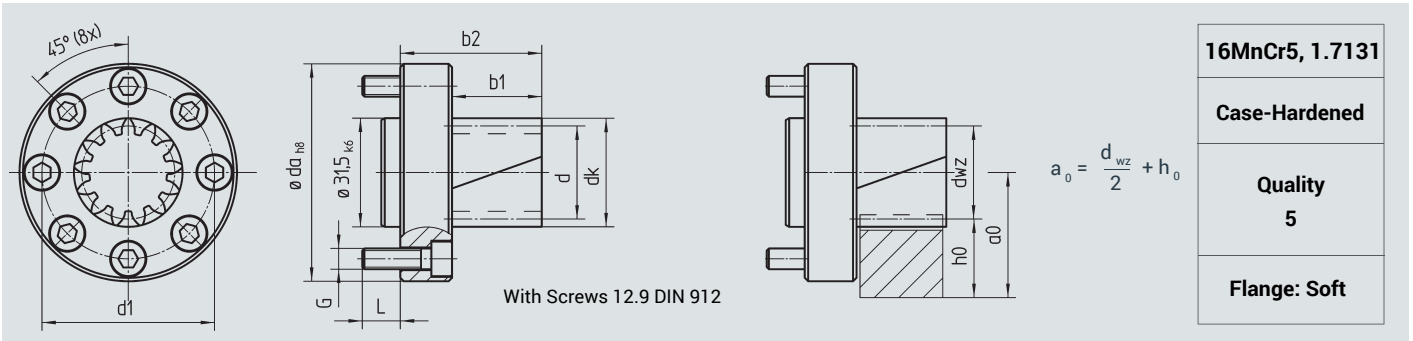
## ATLANTA TR and TRS Pinions Offer A Variety Of Advantages:

- ⊗ **More Compact Design:** The smaller pitch diameter saves you valuable installation space in your machine. The compact design allows you to use the available space more efficiently and opens up additional freedom in the design of your system.
- ⊗ **Reduced Torque:** With a smaller pinion, you reduce the required torque for your rack and pinion drive. At the same time, smaller drives and motors can be used, resulting in cost savings.
- ⊗ **Precise Positioning:** The smaller pinion reduces backlash and increases the accuracy of your machine. As a result, you achieve more precise positioning and improved quality of your manufactured products.
- ⊗ **Higher Accelerations:** Thanks to the lower inertia of the smaller gear, higher acceleration and shorter machining times can be realized in your machine.
- ⊗ **Increased Linear Stiffness:** The use of a TR and TRS Pinions helps increase linear stiffness and improves the precision and repeatability of the entire rack drive. The use of the TRS pinion and a counter-bearing to the gear enables additional stiffness and associated dynamics and accuracy of your application.



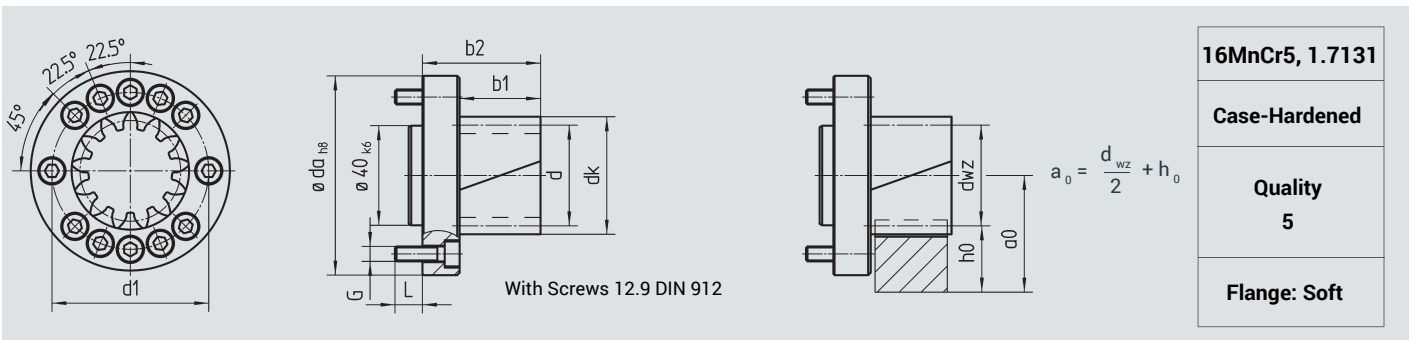


Helical-Tooth Pinion, 19° 31' 42" left-hand, A-50 flange



Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 2</b>														
78 21 912	12	0.5	25.46	27.46	31.50	26.0	41	35.73	9409-1-A-50	50	M6	63	11	0.5
78 21 916	16	0	33.95	33.95	37.95	26.0	41	38.98	9409-1-A-50	50	M6	63	11	0.6

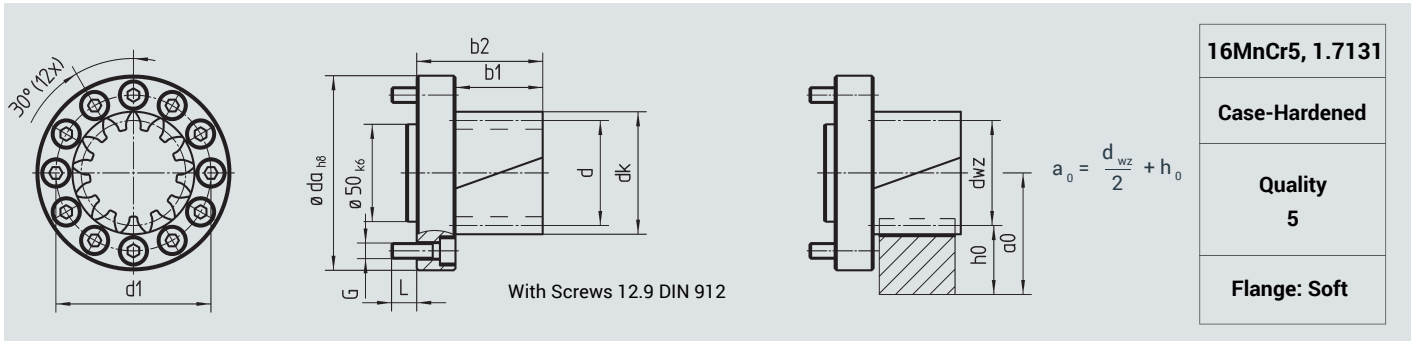
Helical-Tooth Pinion, 19° 31' 42" left-hand, A-63 flange



Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 2</b>														
78 22 912	12	0.5	25.46	27.46	31.5	26.0	41	35.73	9409-1-A-63	63	M6	80	11	0.8
78 22 919	19	0	40.32	40.32	44.3	26.0	41	42.16	9409-1-A-63	63	M6	80	11	0.9
78 22 923	23	0	48.81	48.81	52.8	26.0	41	46.40	9409-1-A-63	63	M6	80	11	1.0
<b>Module 3</b>														
78 32 912	12	0.5	38.20	41.20	47.2	32.5	47.5	46.60	9409-1-A-63	63	M6	80	11	1.0
78 32 914	14	0.3	44.56	46.36	52.4	32.5	47.5	49.18	9409-1-A-63	63	M6	80	11	1.0

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.

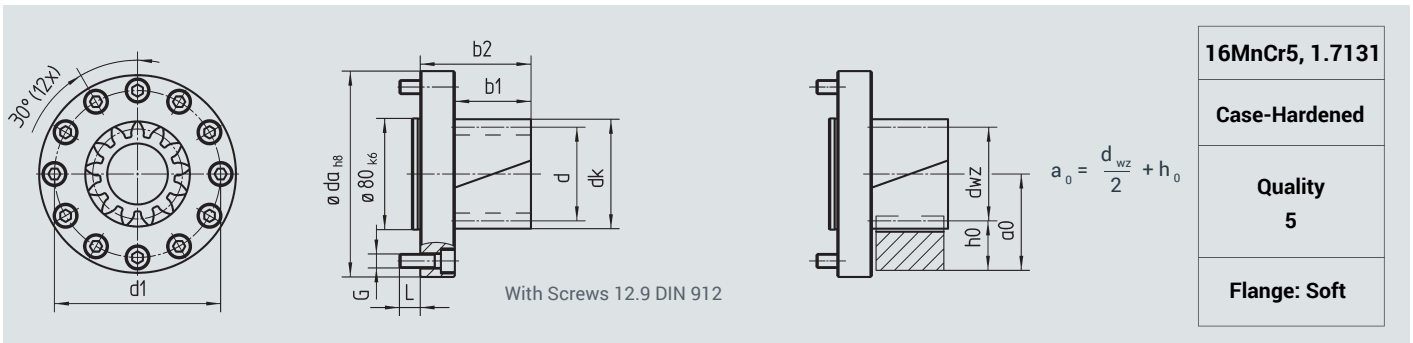
## Helical-Tooth Pinion, 19° 31' 42" left-hand, A-80 flange



Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 2</b>														
78 23 912	12	0.5	25.46	27.46	31.5	26.0	46	35.73	9409-1-A-80	80	M8	100	13	1.4
78 23 923	23	0	48.81	48.81	52.8	26.0	46	46.40	9409-1-A-80	80	M8	100	8	1.6
<b>Module 3</b>														
78 33 916	16	0	50.93	50.93	56.9	32.5	52.5	51.46	9409-1-A-80	80	M8	100	8	1.8
78 33 917	17	0	54.11	54.11	60.1	32.5	52.5	53.06	9409-1-A-80	80	M8	100	8	1.9
78 33 919	19	0	60.48	60.48	66.5	32.5	52.5	56.24	9409-1-A-80	80	M8	100	8	2.0
<b>Module 4</b>														
78 43 912	12	0.5	50.93	54.93	62.9	45.0	65	62.46	9409-1-A-80	80	M8	100	8	2.1

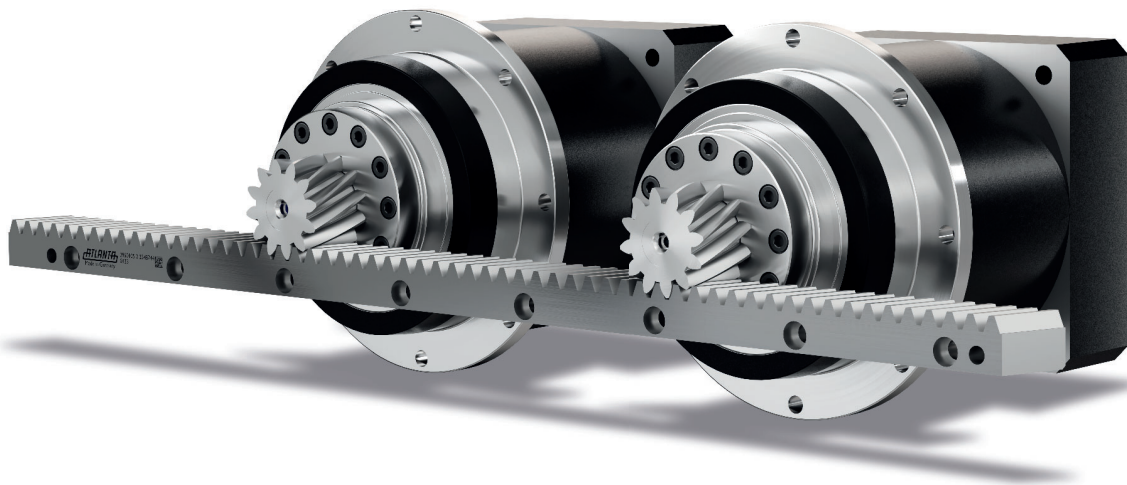
Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.

## Helical-Tooth Pinion, 19° 31' 42" left-hand, A-125 flange



Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 3</b>														
78 34 919	19	0	60.48	60.48	66.50	32.5	57.5	56.24	9409-1-A-125	125	M10	148	15	4.2
78 34 926	26	0	82.76	82.76	88.80	32.5	57.5	67.38	9409-1-A-125	125	M10	148	15	4.9
78 34 932	32	0	101.86	101.86	107.90	32.5	57.5	76.93	9409-1-A-125	125	M10	148	15	5.6
<b>Module 4</b>														
78 44 912	12	0.5	50.93	54.93	62.90	45.0	70.0	62.46	9409-1-A-125	125	M10	148	15	4.4
78 44 917	17	0	72.15	72.15	80.15	45.0	70.0	71.07	9409-1-A-125	125	M10	148	15	5.0
78 44 919	19	0.11	80.64	81.52	89.50	45.0	70.0	75.76	9409-1-A-125	125	M10	148	15	5.4
78 44 920	20	0	84.88	84.88	92.90	45.0	70.0	77.44	9409-1-A-125	125	M10	148	15	5.5
<b>Module 5</b>														
78 54 912	12	0.5	63.66	68.66	78.70	55	80	68.33	9409-1-A-125	125	M10	148	15	5.1
78 54 916	16	0	84.88	84.88	94.90	55	80	76.44	9409-1-A-125	125	M10	148	15	6.0
78 54 918	18	0	95.49	95.49	105.50	55	80	81.75	9409-1-A-125	125	M10	148	15	6.6
<b>Module 6</b>														
78 64 915	15	0	95.49	95.49	107.50	65	90	90.75	9409-1-A-125	125	M10	148	15	6.8

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.



Multiple Pinion Contact For Electrical Preloading

### Helical-Tooth Pinion, 19° 31' 42" left-hand, A-140 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 4</b>														
78 46 919	19	0.11	80.64	81.52	89.50	45	79	75.76		140	M16	187	22	9.1
<b>Module 5</b>														
78 56 918	18	0	95.49	95.49	105.50	55	89	81.75		140	M16	187	22	10.3
78 56 919	19	0	100.80	100.80	110.80	55	89	84.40	–	140	M16	187	22	10.6
<b>Module 6</b>														
78 66 916	16	0	101.86	101.86	113.90	65	99	93.93	–	140	M16	187	22	11.3

### Helical-Tooth Pinion, 19° 31' 42" left-hand, A-160 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 5</b>														
78 57 919	19	0	100.80	100.80	110.8	55	100	84.40	–	160	M20	210	30	15.6
<b>Module 6</b>														
78 67 916	16	0	101.86	101.86	113.9	65	110	93.93	–	160	M20	210	30	15.9
<b>Module 8</b>														
78 87 912	12	0.5	101.86	109.86	125.9	85	130	125.93	–	160	M20	210	30	17.8

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.

## Helical-Tooth Pinion, 19° 31' 42" left-hand, A-80 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

With Screws 12.9 DIN 912

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	b <sub>3</sub>	d <sub>s</sub>	a0	ISO Interface	d1	G	d <sub>a,h8</sub>	L	kg
<b>Module 2</b>																
<b>2 78 00 701</b>	23	0	48.81	48.81	52.8	26.0	46	64	25.024	46.40	9409-1-A-80	80	M8	100	13	1.6
<b>Module 3</b>																
<b>2 78 00 703</b>	17	0	54.11	54.11	60.1	32.5	52.5	70.5	25.024	53.06	9409-1-A-80	80	M8	100	13	1.9

## Helical-Tooth Pinion, 19° 31' 42" left-hand, A-125 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

With Screws 12.9 DIN 912

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	b <sub>3</sub>	d <sub>s</sub>	a0	ISO Interface	d1	G	d <sub>a,h8</sub>	L	kg
<b>Module 3</b>																
<b>2 78 00 801</b>	26	0	82.76	82.76	88.80	42	67	96	48.024	67.38	9409-1-A-125	125	M10	148	15	4.9
<b>2 78 00 802</b>	32	0	101.86	101.86	107.90	42	67	96	48.024	76.93	9409-1-A-125	125	M10	148	15	5.6
<b>Module 4</b>																
<b>2 78 00 803</b>	20	0	84.88	84.88	92.90	45	70	96	48.024	77.44	9409-1-A-125	125	M10	148	15	5.5
<b>Module 5</b>																
<b>2 78 00 804</b>	16	0	84.88	84.88	94.90	55	80	106	48.024	76.44 <sup>(1)</sup>	9409-1-A-125	125	M10	148	15	6.0

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.

## Helical-Tooth Pinion, 19° 31' 42" left-hand, A-140 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

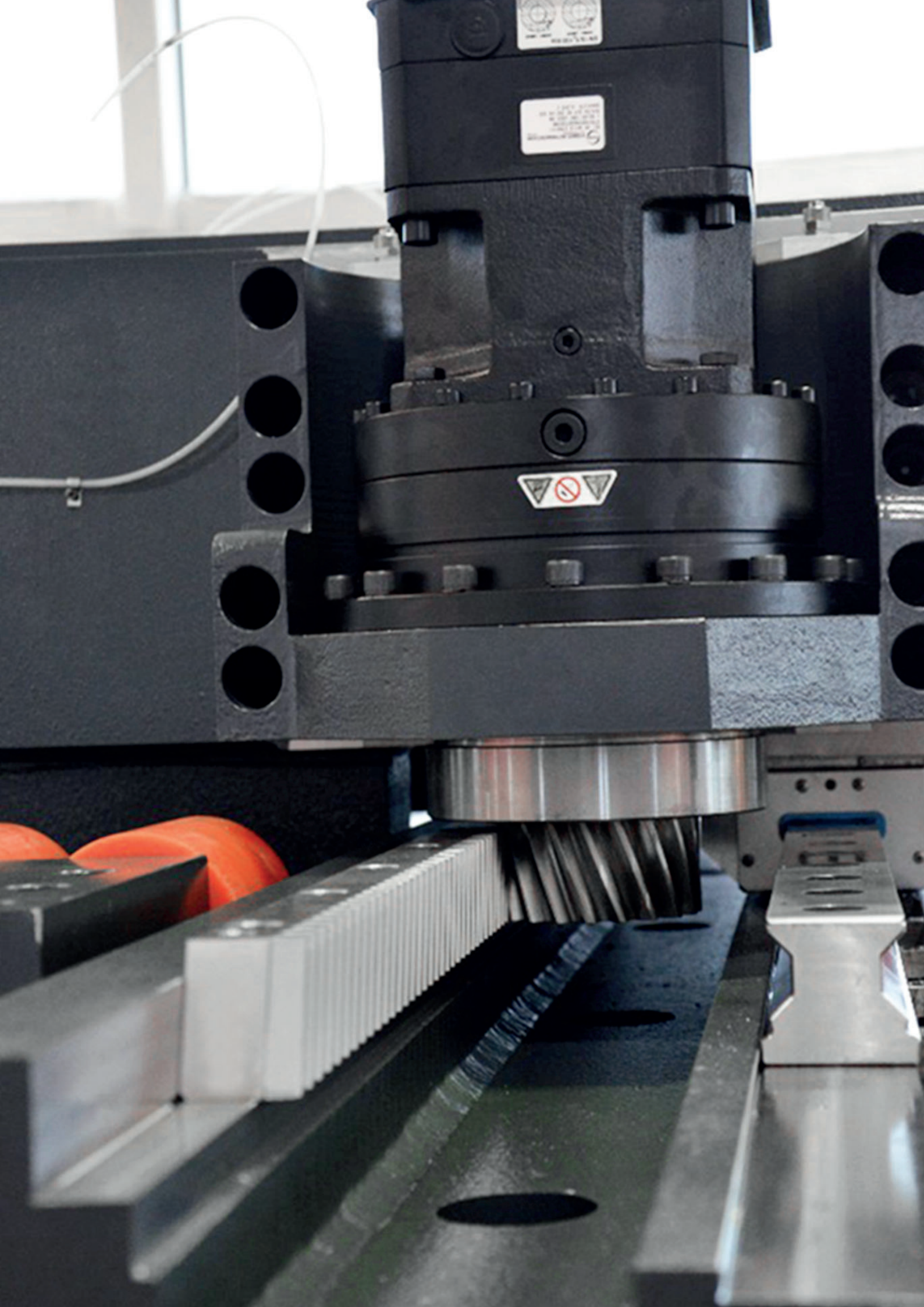
Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	d <sub>s</sub>	a <sub>0</sub>	ISO Interface	d <sub>1</sub>	G	d <sub>aH8</sub>	L	kg
<b>Module 5</b>																
2 78 00 901	20	0	106.10	106.10	116.1	55	89	131	50.026	87.05	–	140	M16	187	22	10.3
<b>Module 6</b>																
2 78 00 902	16	0	101.86	101.86	113.86	65	99	141	50.026	93.93	–	140	M16	187	22	11.3

## Helical-Tooth Pinion, 19° 31' 42" left-hand, A-170 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	d <sub>s</sub>	a <sub>0</sub>	ISO Interface	d <sub>1</sub>	G	d <sub>aH8</sub>	L	kg
<b>Module 8</b>																
2 78 00 101	19	0	161.28	161.28	177.28	100	157	205	55.026	151.64	–	170	M20	210	25	26.7
<b>Module 10</b>																
2 78 00 102	15	0.25	159.16	164.16	184.16	100	157	205	55.026	171.08	–	170	M20	210	25	27.5

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.



Helical-Tooth Pinion, 19° 31' 42" left-hand, splined bore

**16MnCr5, 1.7131**

**Carborized & Hardened**

**Quality 5 e 24**

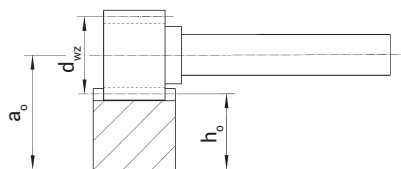
With washer and screw DIN 7991

Screw Size	Strength Class	Tightening Torque (Nm)
M5	10.9	7
M8	8.8	20
M12	8.8	68
M16	8.8	168
M20	8.8	340

Order Code	N° of Teeth	Module	Profile Modification		Fu Tab.	d	d <sub>wz</sub>	dk	d1	L	d2	L1	L2	b	M	Spline, Soft DIN 5480 *	kg
			Factor x														
79 11 538	38	1.5	-	6.8	60.48	60.48	63.48	30	33	24	12	27.5	20	M8x25	N22x1.25x30x16x7H	0.1	
79 20 515	15	2	0.5922	4.5	31.83	34.20	38.0	24	32	18	11	26.5	26	M5x16	N16x0.8x30x18x7H	0.2	
79 20 516	16	2	0.6117	4.5	33.95	36.40	40.1	24	32	18	11	26.5	26	M5x16	N16x0.8x30x18x7H	0.2	
79 20 518	18	2	0.5000	4.5	38.20	40.20	44.0	24	32	18	11	26.5	26	M5x16	N16x0.8x30x18x7H	0.3	
79 21 518	18	2	0.5000	6.8	38.20	40.20	44.0	30	33	24	12	27.5	26	M8x25	N22x1.25x30x16x7H	0.3	
79 21 520	20	2	0.4900	6.8	42.44	44.40	48.2	30	33	24	12	27.5	26	M8x25	N22x1.25x30x16x7H	0.3	
79 21 522	22	2	0.4786	6.8	46.69	48.60	52.5	30	33	24	12	27.5	26	M8x25	N22x1.25x30x16x7H	0.4	
79 21 525	25	2	-	6.8	53.05	53.05	57.05	30	33	24	12	27.5	26	M8x25	N22x1.25x30x16x7H	0.4	
79 22 523	23	2	0.4981	19.0	48.81	50.80	54.6	40	34	35	13	27.0	26	M12x35	N32x1.25x30x24x7H	0.4	
79 22 525	25	2	0.4871	20.0	53.05	55.00	59.0	40	34	35	13	27.0	26	M12x35	N32x1.25x30x24x7H	0.4	
79 22 527	27	2	0.3760	20.0	57.30	58.80	62.6	40	34	35	13	27.0	26	M12x35	N32x1.25x30x24x7H	0.5	
79 33 520	20	3	0.4563	28.5	63.66	66.40	72.2	50	51	41	20	41.0	31	M16x45	N40x2x30x18x7H	0.7	
79 33 522	22	3	0.4620	29.5	70.03	72.80	78.6	50	51	41	20	41.0	31	M16x45	N40x2x30x18x7H	0.8	
79 33 524	24	3	0.4676	29.5	76.39	79.20	85.0	50	51	41	20	41.0	31	M16x45	N40x2x30x18x7H	1.0	
79 44 520	20	4	0.4000	54.0	84.88	88.08	96.1	75	54	56	20	44.0	41	M20x50	N55x2x30x26x7H	1.5	
79 45 525	25	4	0.3400	57.5	106.10	108.82	116.8	90	65	72	24	55.0	41	M20x50	N70x2x30x34x7H	3.0	

\* Put MoS2-powder or suitable grease in spline area to reduce micro corrosion

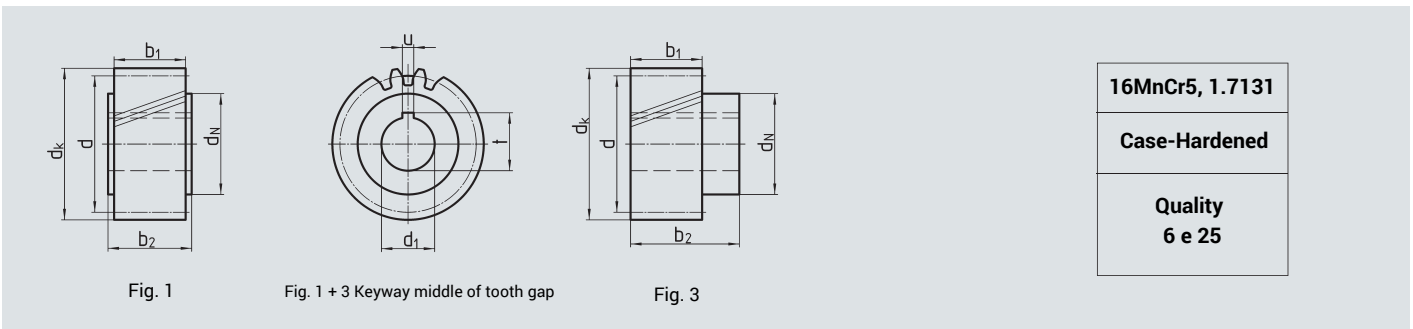
Calculation of center distance 'a' between pinion and rack



$$a_o = \frac{d_{wz}}{2} + h_o$$



Helical-Tooth Pinion, 19° 31' 42" left-hand, with bore ØH6 and keyway acc. to DIN 6885

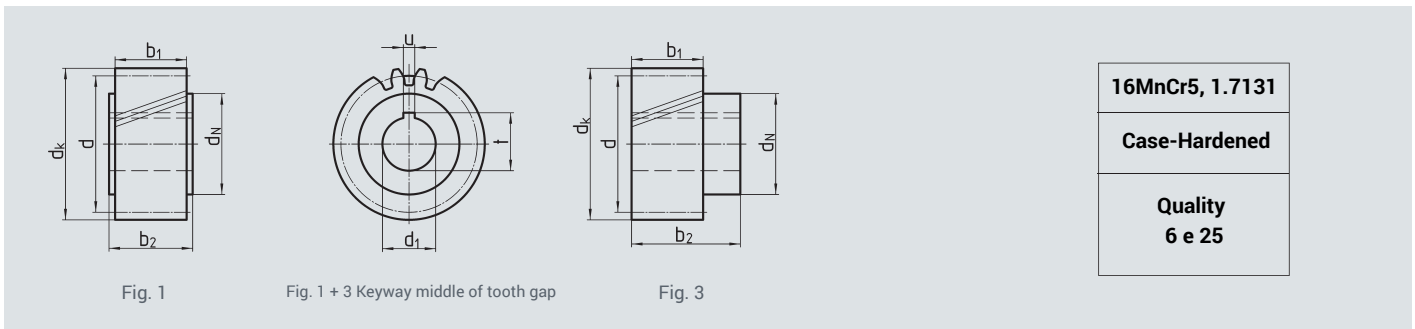


Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d*PI	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	kg	Couplings on Page C-76
<b>Module 1.5</b>													
24 11 520 <sup>1)</sup>	1	20	31.83	100.00	34.83	11	25	20	22	4	12.8	0.13	
24 14 520 <sup>1)</sup>	1	20	31.83	100.00	34.83	14	25	20	22	5	16.3	0.13	
24 16 520 <sup>1)</sup>	1	20	31.83	100.00	34.83	16	25	20	22	5	18.3	0.13	
24 16 321 <sup>1)</sup>	3	21	33.42	105.00	36.42	16	30	20	46	5	18.3	0.15	80 83 030
<b>Module 2</b>													
24 26 518	1	18	38.197	120.00	42.2	16	25	28	30	5	18.3	0.2	
24 29 520	1	20	42.44	133.33	46.4	19*	30	28	30	6	21.8	0.3	
24 29 320	3	20	42.44	133.33	46.4	19*	30	28	56	6	21.8	0.3	80 83 030
24 22 520	1	20	42.44	133.33	46.4	20	30	28	30	6	22.8	0.3	
24 20 320	3	20	42.44	133.33	46.4	22*	36	28	56	6	24.8	0.3	80 84 036
24 23 520	1	20	42.44	133.33	46.4	22	30	28	30	6	24.8	0.3	
24 26 521	1	21	44.56	140.00	48.6	16	25	28	30	5	18.3	0.3	
24 20 321	3	21	44.56	140.00	48.6	22	36	28	56	6	24.8	0.2	80 84 036
24 29 522	1	22	46.69	146.67	50.7	19*	30	28	30	6	21.8	0.2	
24 29 322	3	22	46.69	146.67	50.7	19*	30	28	56	6	21.8	0.4	80 83 030
24 20 522	1	22	46.69	146.67	50.7	22*	30	28	30	6	24.8	0.3	
24 20 322	3	22	46.69	146.67	50.7	22*	36	28	56	6	24.8	0.4	80 84 036
24 29 525	1	25	53.05	166.67	57.1	19*	30	28	30	6	21.8	0.4	
24 29 325	3	25	53.05	166.67	57.1	19*	30	28	56	6	21.8	0.5	80 83 030
24 22 525	1	25	53.05	166.67	57.1	20	30	28	30	6	22.8	0.4	
24 20 525	1	25	53.05	166.67	57.1	22*	30	28	30	6	24.8	0.3	
24 20 325	3	25	53.05	166.67	57.1	22*	36	28	56	6	24.8	0.5	80 84 036
24 23 525	1	25	53.05	166.67	57.1	25	36	28	30	8	28.3	0.4	
24 29 528	1	28	59.42	186.67	63.4	19*	30	28	30	6	21.8	0.4	
24 29 328	3	28	59.42	186.67	63.4	19*	30	28	56	6	21.8	0.6	80 83 030
24 20 528	1	28	59.42	186.67	63.4	22*	30	28	30	6	24.8	0.4	
24 20 328	3	28	59.42	186.67	63.4	22*	36	28	56	6	24.8	0.7	80 84 036
24 25 528	1	28	59.42	186.67	63.4	35	48	28	30	10	38.3	0.4	
24 26 530	1	30	63.66	200.00	67.7	16	25	28	30	5	18.3	0.7	
24 22 530	1	30	63.66	200.00	67.7	20	30	28	30	6	22.8	0.6	
24 20 330	3	30	63.66	200.00	67.7	22	36	28	56	6	24.8	0.6	80 84 036
24 23 530	1	30	63.66	200.00	67.7	25	36	28	30	8	28.3	0.8	
24 24 530	1	30	63.66	200.00	67.7	30	45	28	30	8	33.3	0.6	
24 22 330	3	30	63.66	200.00	67.7	30	50	28	60	8	33.3	0.8	80 85 050
24 23 330	3	30	63.66	200.00	67.7	32	55	28	65	10	35.3	0.8	80 80 055
24 22 532	1	32	67.91	213.33	71.9	20	30	28	30	6	22.8	0.8	
24 20 532	1	32	67.91	213.33	71.9	22*	30	28	30	6	24.8	0.7	
24 20 332	3	32	67.91	213.33	71.9	22*	36	28	56	6	27.8	0.9	80 84 036
24 23 532	1	32	67.91	213.33	71.9	25	36	28	30	8	28.3	0.7	
24 25 532	1	32	67.91	213.33	71.9	35	48	28	30	10	38.3	0.6	
24 25 536	1	36	76.39	240.00	80.4	35	48	28	30	10	38.3	0.8	
24 23 339	3	39	82.76	260.00	86.8	32	55	28	65	10	35.3	1.3	80 80 055
24 25 540	1	40	84.88	266.67	88.9	35	48	28	30	10	38.3	1.1	

\* Bore tolerance G6

<sup>1)</sup> Tooth quality 6 f 24

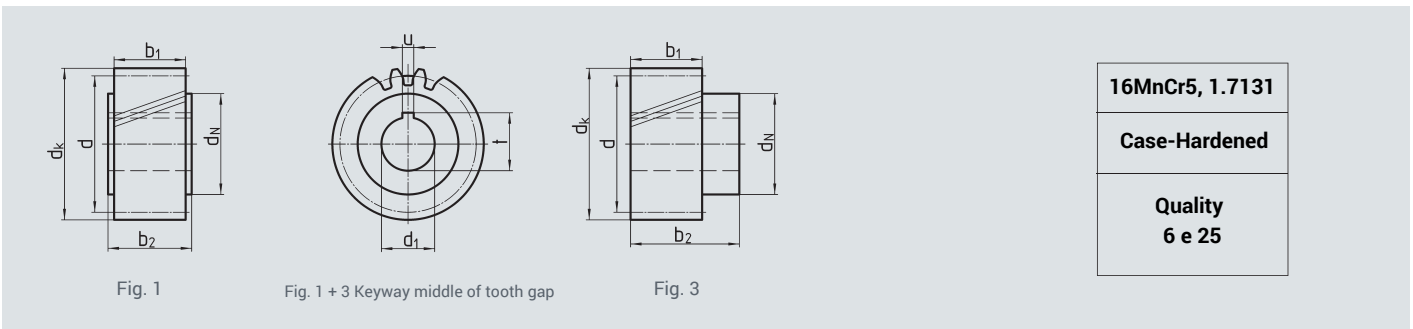
Helical-Tooth Pinion, 19° 31' 42" left-hand, with bore ØH6 and keyway acc. to DIN 6885



Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d*PI	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	kg	Couplings on Page C-76
<b>Module 3</b>													
24 30 320	3	20	63.66	200.00	69.7	22	36	28	56	6	24.8	0.6	80 84 036
24 31 320	3	20	63.66	200.00	69.7	25	44	28	60	8	28.3	0.7	80 80 044
24 34 520	1	20	63.66	200.00	69.7	30	45	28	30	8	33.3	0.8	
24 32 320	3	20	63.66	200.00	69.7	30	50	28	60	8	33.3	0.8	80 85 050
24 33 320	3	20	63.66	200.00	69.7	32	55	28	65	10	35.3	0.8	80 80 055
24 35 520	1	20	63.66	200.00	69.7	35	48	28	30	10	38.3	0.7	
24 33 522	1	22	70.03	220.00	76.0	25	36	28	30	8	28.3	0.8	
24 34 522	1	22	70.03	220.00	76.0	30	45	28	30	8	33.3	0.7	
24 33 322	3	22	70.03	220.00	76.0	32*	55	28	65	10	35.3	1.0	80 80 055
24 35 522	1	22	70.03	220.00	76.0	35	48	28	30	10	38.3	0.7	
24 35 322	3	22	70.03	220.00	76.0	40*	62	28	65	12	43.3	1.0	80 86 062
24 30 325	3	25	79.58	250.00	85.6	22	36	28	56	6	24.8	1.0	80 84 036
24 33 525	1	25	79.58	250.00	85.6	25	36	28	30	8	28.3	1.0	
24 31 325	3	25	79.58	250.00	85.6	25	44	28	60	8	28.3	1.1	80 80 044
24 34 525	1	25	79.58	250.00	85.6	30	45	28	30	8	33.3	1.0	
24 32 325	3	25	79.58	250.00	85.6	30	50	28	60	8	33.3	1.2	80 85 050
24 33 325	3	25	79.58	250.00	85.6	32	55	28	65	10	35.3	1.2	80 80 055
24 35 525	1	25	79.58	250.00	85.6	35	48	28	30	10	38.3	0.9	
24 34 325	3	25	79.58	250.00	85.6	35	55	28	65	10	38.3	1.1	80 80 055
24 36 525	1	25	79.58	250.00	85.6	40	70	28	50	12	43.3	1.1	
24 35 325	3	25	79.58	250.00	85.6	40*	62	28	65	12	43.3	1.1	80 86 062
24 33 328	3	28	89.13	280.00	95.1	32*	55	28	65	10	35.3	1.1	80 80 055
24 35 328	3	28	89.13	280.00	95.1	40*	62	28	65	12	43.3	1.1	80 86 062
24 33 332	3	32	101.86	320.00	107.85	32*	55	28	65	10	35.3	2.1	80 80 055
24 35 332	3	32	101.86	320.00	107.85	40*	62	28	65	12	43.3	2.1	80 86 062

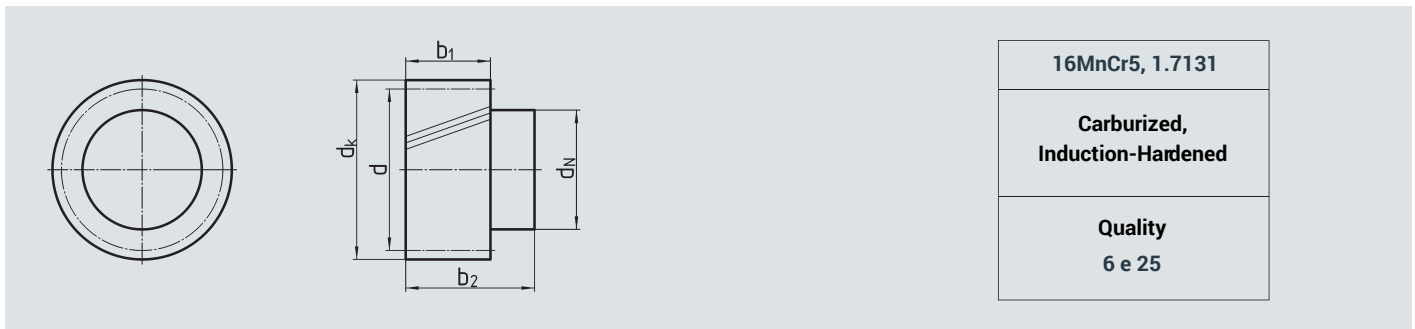
\* Bore tolerance G6

Helical-Tooth Pinion, 19° 31' 42" left-hand, with bore ØH6 and keyway acc. to DIN 6885



Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d*PI	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	T kg	Couplings on Page C-76
<b>Module 4</b>													
24 45 515	1	15	63.66	200.00	71.7	35	52	40	50	10	38.3	1.4	
24 43 318	3	18	76.39	240.00	84.4	32	55	40	75	10	35.3	1.5	80 80 055
24 45 520	1	20	84.88	266.67	92.9	35	52	40	50	10	38.3	1.9	
24 47 520	1	20	84.88	266.67	92.9	45	65	40	50	14	48.8	1.6	
24 43 321	3	21	89.13	280.00	97.1	32	55	40	75	10	35.3	2.0	80 80 055
24 44 321	3	21	89.13	280.00	97.1	35	55	40	75	10	38.3	1.9	80 80 055
24 45 321	3	21	89.13	280.00	97.1	40	62	40	75	12	43.3	1.9	80 86 062
24 46 321	3	21	89.13	280.00	97.1	45	68	40	75	14	48.8	1.7	80 80 068
24 45 522	1	22	93.37	293.33	101.4	35	52	40	50	10	38.3	2.3	
24 47 522	1	22	93.37	293.33	101.4	45	65	40	50	14	48.8	2.0	
24 43 324	3	24	101.86	320.00	109.9	32	55	40	75	10	35.3	2.6	80 80 055
24 44 324	3	24	101.86	320.00	109.9	35	55	40	75	10	38.3	2.5	80 80 055
24 45 324	3	24	101.86	320.00	109.9	40	62	40	75	12	43.3	2.5	80 86 062
24 46 324	3	24	101.86	320.00	109.9	45	68	40	75	14	48.8	2.3	80 80 068
24 47 324	3	24	101.86	320.00	109.9	55	80	40	80	16	59.3	2.4	80 87 080
24 45 525	1	25	106.10	333.33	114.1	35	52	40	50	10	38.3	3.1	
24 47 525	1	25	106.10	333.33	114.1	45	65	40	50	14	48.8	2.8	
24 47 325	3	25	106.10	333.33	114.1	55	80	40	80	16	59.3	2.9	80 87 080
<b>Module 5</b>													
24 56 318	3	18	95.49	300.00	105.5	45	68	50	85	14	48.8	2.7	80 80 068
24 56 324	3	24	127.32	400.00	137.3	45	68	50	85	14	48.8	4.9	80 80 068
24 57 324	3	24	127.32	400.00	137.3	55	80	50	90	16	59.3	4.9	80 87 080
24 58 324	3	24	127.32	400.00	137.3	75	110	50	110	20	79.9	5.6	80 80 110
<b>Module 6</b>													
24 67 320	3	20	127.32	400.00	139.3	55	80	60	100	16	59.3	5.7	80 87 080
24 68 320	3	20	127.32	400.00	139.3	75	110	60	120	20	79.9	6.3	80 80 110
24 67 325	3	25	159.16	500.00	171.2	55	80	60	100	16	59.3	9.0	80 87 080
24 68 325	3	25	159.16	500.00	171.2	75	110	60	120	20	79.9	9.6	80 80 110
<b>Module 8</b>													
24 88 318	3	18	152.79	480.00	168.8	75	110	80	140	20	79.9	10.8	80 80 110
24 89 320	3	20	169.80	533.44	185.8	85	125	80	145	22	90.4	13.6	80 80 125
<b>Module 10</b>													
24 09 720	3	20	212.21	666.68	232.2	85	125	100	165	22	90.4	26.2	80 80 125

## Helical-Tooth Pinion, 19° 31' 42" left-hand, with plain bore



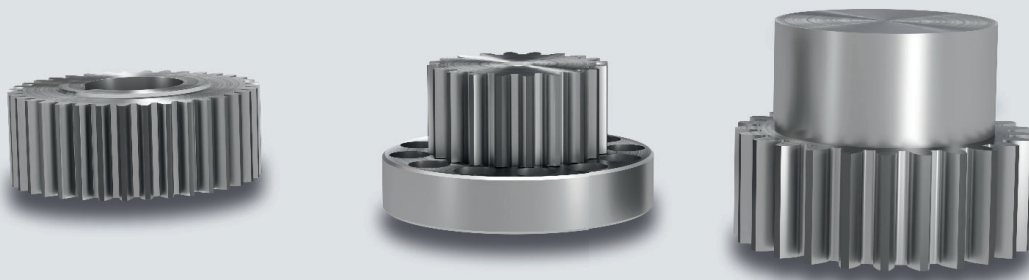
Order Code	Module	N° of Teeth z	d (=d <sub>wz</sub> )	d*PI	d <sub>k</sub>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	kg	Couplings on Page C-76
24 99 121	1.5	21	33.42	105.00	36.4	30	20	46	0.3	80 83 030
24 99 218	2	18	38.20	120.00	42.2	30	28	56	0.3	80 83 030
24 99 220	2	20	42.44	133.33	46.4	30	28	56	0.4	80 83 030
24 99 222	2	22	46.69	146.67	50.7	36	28	56	0.5	80 84 036
24 99 225	2	25	53.05	166.67	57.1	44	28	60	0.8	80 80 044
24 99 228	2	28	59.42	186.67	63.4	50	28	60	1.0	80 85 050
24 99 230	2	30	63.66	200.00	67.7	50	28	60	1.1	80 85 050
24 99 232	2	32	67.91	213.33	71.9	55	28	65	1.4	80 80 055
24 99 318	3	18	57.30	180.00	63.3	44	28	60	0.8	80 80 044
24 99 320	3	20	63.66	200.00	69.7	50	28	60	1.0	80 85 050
24 99 322	3	22	70.03	220.00	76.0	55	28	65	1.4	80 80 055
24 99 325	3	25	79.58	250.00	85.6	62	28	65	1.8	80 86 062
24 99 328	3	28	89.13	280.00	95.1	68	28	65	2.3	80 80 068
24 99 418	4	18	76.39	240.00	84.4	62	40	77	2.0	80 86 062
24 99 420	4	20	84.88	266.67	92.9	62	40	77	2.4	80 86 062
24 99 421	4	21	89.13	280.00	97.1	68	40	77	2.8	80 80 068
24 99 422	4	22	93.37	293.33	101.4	68	40	77	2.9	80 80 068
24 99 424	4	24	101.86	320.00	109.9	80	40	80	3.9	80 87 080
24 99 425	4	25	106.10	333.33	114.1	80	40	80	4.0	80 87 080
24 99 522	5	22	116.71	366.67	126.7	80	50	90	5.5	80 87 080
24 99 524	5	24	127.32	400.00	137.3	110	50	110	9.6	80 80 110
24 99 525	5	25	132.63	416.67	142.6	110	50	110	9.1	80 80 110
24 99 620	6	20	127.32	400.00	139.3	110	60	120	9.7	80 80 110
24 99 820 <sup>1)</sup>	8	20	169.77	533.33	185.8	125	80	145	19.4	80 80 125

<sup>1)</sup> With bore Ø 40<sup>H7</sup>

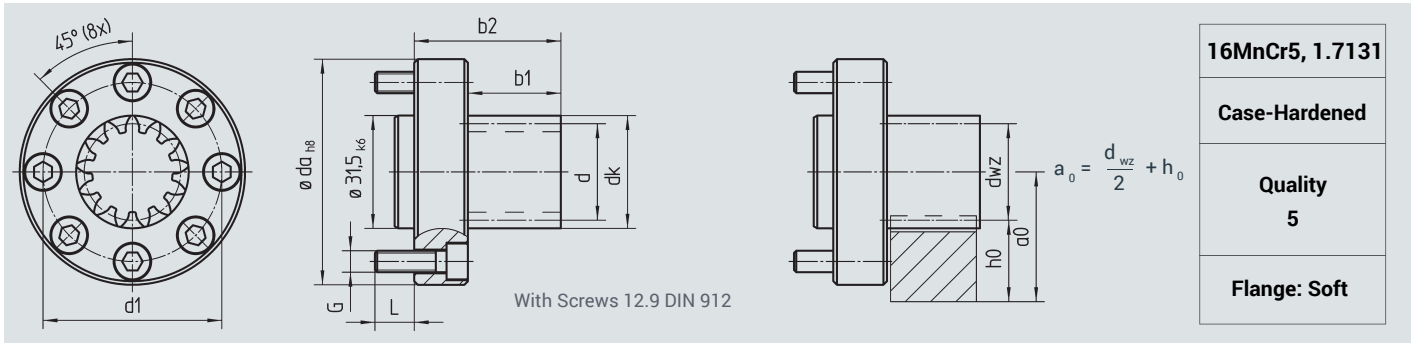
The pinion could be fixed at d<sub>k</sub> or d<sub>N</sub> to be reworked.

Maximum bore diameter of the pinion on request.

Series	Module	Tolerance of Teeth	Page
<b>78 .....</b> TR Flanged Pinions	2, 3, 4, 5, 6, 8	5 e 24	C-66 – C-68
<b>24 .....</b> Hardened & Ground Bored & Keyed Pinions	2, 3, 4, 5, 6, 8, 10	5 e 24	C-69 – C-74
<b>24 .....</b> Hardened & Ground Plain Bore Pinions For Rework	2, 3, 4, 5, 6, 8	6 e 25	C-75

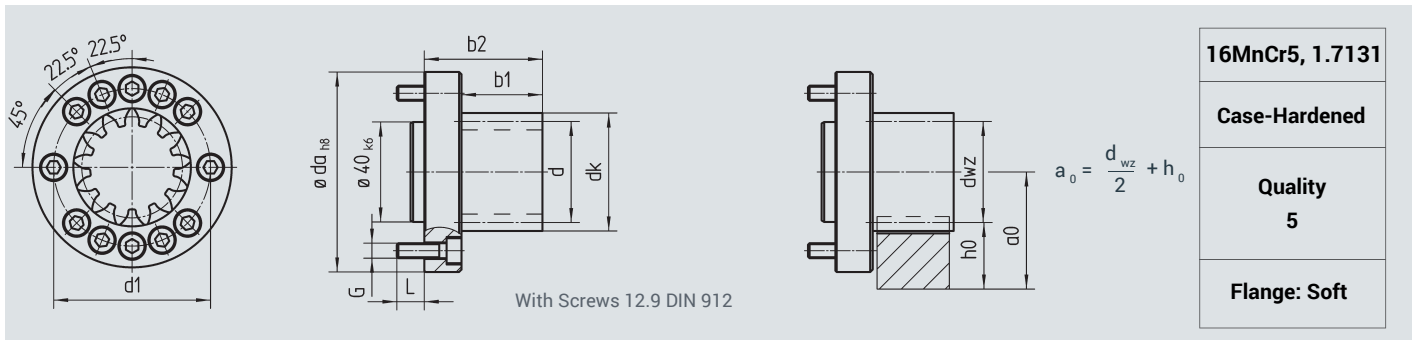


Straight Pinion, A-50 flange



Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 2</b>														
78 21 813	13	0.366	27.59	27.47	31.5	26	41	35.73	9409-1-A-50	50	M6	63	11	0.5
78 21 817	17	-0.012	36.08	33.95	38.0	26	41	38.98	9409-1-A-50	50	M6	63	11	0.6

Straight Pinion, A-63 flange



Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 2</b>														
78 22 817	17	-0.012	36.08	33.95	38.0	26	41	38.98	9409-1-A-63	63	M6	80	11	0.8
78 22 824	24	0.202	50.93	48.81	52.8	26	41	46.40	9409-1-A-63	63	M6	80	11	1.0
<b>Module 3</b>														
78 32 813	13	0.366	41.38	41.20	47.2	32.5	47.5	46.60	9409-1-A-63	63	M6	80	11	1.0

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.

Straight Pinion, A-80 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 2</b>														
<b>78 23 824</b>	24	0.202	50.93	48.81	52.8	26	46	46.40	9409-1-A-80	80	M8	100	8	1.6
<b>Module 3</b>														
<b>78 33 820</b>	20	0.080	63.66	60.48	66.5	32.5	52.5	56.24	9409-1-A-80	80	M8	100	8	2.0
<b>Module 4</b>														
<b>78 43 813</b>	13	0.366	55.17	54.93	62.9	45	65	62.47	9409-1-A-80	80	M8	100	13	2.1

Straight Pinion, A-125 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 3</b>														
<b>78 34 820</b>	20	0.080	63.66	60.48	66.5	32.5	57.5	56.24	9409-1-A-125	125	M10	148	15	4.2
<b>Module 4</b>														
<b>78 44 821</b>	21	0.110	89.13	84.88	92.9	45	70	77.44	9409-1-A-125	125	M10	148	15	5.5
<b>Module 5</b>														
<b>78 54 819</b>	19	0.049	100.80	95.49	105.5	55	80	81.75	9409-1-A-125	125	M10	148	15	6.6
<b>Module 6</b>														
<b>78 64 816</b>	16	-0.042	101.86	95.49	107.5	65	90	90.75	9409-1-A-125	125	M10	148	15	6.8

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001e.

### Straight Pinion, A-140 flange

<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 5</b>														
<b>78 56 820</b>	20	0.080	106.10	100.80	110.8	55	89	84.40	–	140	M16	187	22	10.6
<b>Module 6</b>														
<b>78 66 817</b>	17	-0.012	108.23	101.86	113.9	65	99	93.93	–	140	M16	187	22	10.9

### Straight Pinion, A-160 flange

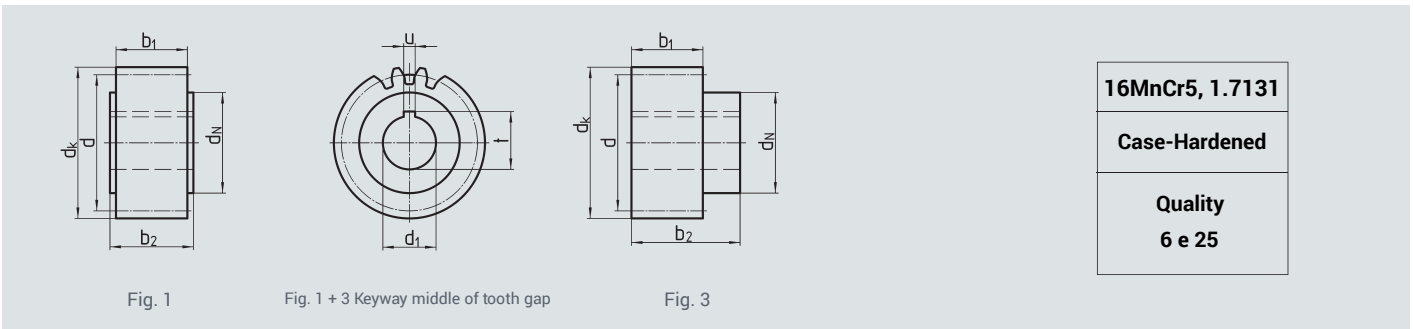
<b>16MnCr5, 1.7131</b>
<b>Case-Hardened</b>
<b>Quality 5</b>
<b>Flange: Soft</b>

Order Code	No. of Teeth z	Profile Modification Factor x	d	d <sub>wz</sub>	dk	b1	b2	a0	ISO Interface	d1	G	da <sub>h8</sub>	L	kg
<b>Module 8</b>														
<b>78 87 813</b>	13	0.366	110.35	109.86	125.9	85	130	125.93	–	160	M20	210	30	17.8

Note: The rack and pinion drive must be installed with backlash present, not pressed into engagement with no backlash! Please refer to the ATLANTA operating manual MPZ 001 e.



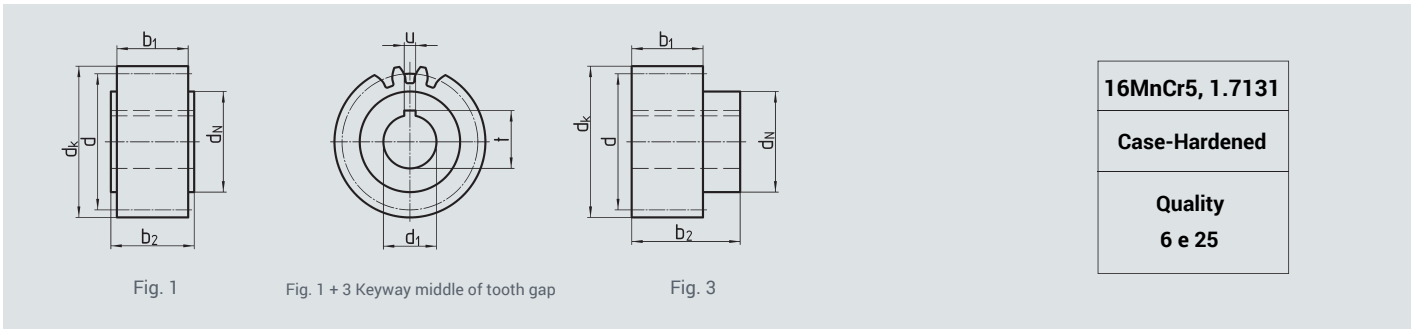
**Straight Pinion**, with bore  $\emptyset H6$  and keyway according to DIN 6885




Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	kg	Coupling on Page C-76
<b>Module 2</b>												
24 21 216	1	16	32	36	15	25	28	30.0	5	17.3	0.1	
24 21 218	1	18	36	40	15	28	28	30.0	5	17.3	0.2	
24 22 218	1	18	36	40	20	28	28	30.0	6	22.8	0.2	
24 21 220	1	20	40	44	15	25	28	30.0	5	17.3	0.2	
24 29 420	3	20	40	44	19*	30	28	56.0	6	21.8	0.2	80 83 030
24 29 220	1	20	40	44	19*	30	28	30.0	6	21.8	0.2	
24 22 220	1	20	40	44	20*	30	28	30.0	6	22.8	0.2	
24 20 120	3	20	40	44	22*	36	28	56.0	6	24.8	0.3	80 84 036
24 20 220	1	20	40	44	22*	30	28	30.0	6	24.8	0.2	
24 21 222	1	22	44	48	15	25	28	30.0	5	17.3	0.3	
24 29 222	1	22	44	48	19*	30	28	30.0	6	21.8	0.3	
24 29 422	3	22	44	48	19*	30	28	56.0	6	21.8	0.3	80 83 030
24 22 222	1	22	44	48	20*	30	28	30.0	6	22.8	0.3	
24 20 222	1	22	44	48	22*	30	28	30.0	6	24.8	0.2	
24 20 122	3	22	44	48	22	36	28	56.0	6	27.8	0.2	80 84 036
24 23 222	1	22	44	48	25	36	28	30.0	8	28.3	0.2	
24 21 225	1	25	50	54	15	25	28	30.0	5	17.3	0.4	
24 26 225	3	25	50	54	16	30	28	54.0	5	18.3	0.3	80 83 030
24 29 225	1	25	50	54	19*	30	28	30.0	6	21.8	0.3	
24 29 425	3	25	50	54	19*	30	28	56.0	6	21.8	0.3	80 83 030
24 22 225	1	25	50	54	20	30	28	30.0	6	22.8	0.4	
24 20 225	1	25	50	54	22	30	28	30.0	6	24.8	0.3	
24 20 425	3	25	50	54	22*	36	28	56.0	6	24.8	0.4	80 84 036
24 23 225	1	25	50	54	25	36	28	30.0	8	28.3	0.3	
24 24 225	1	25	50	54	30	45	28	30.0	8	33.3	0.3	
24 21 228	1	28	56	60	15	25	28	30.0	5	17.3	0.5	
24 29 228	1	28	56	60	19*	30	28	30.0	6	21.8	0.5	
24 29 428	3	28	56	60	19*	30	28	56.0	6	21.8	0.5	80 83 030
24 22 228	1	28	56	60	20	30	28	30.0	6	22.8	0.5	
24 20 128	3	28	56	60	22*	36	28	56.0	6	24.8	0.3	80 84 036
24 20 228	1	28	56	60	22*	30	28	30.0	6	24.8	0.3	
24 23 228	1	28	56	60	25	36	28	30.0	8	28.3	0.4	
24 22 428	3	28	56	60	30	50	28	60.0	8	33.3	0.4	80 85 050
24 24 228	1	28	56	60	30	45	28	30.0	8	33.3	0.4	
24 25 228	1	28	56	60	35	48	28	30.0	10	38.3	0.3	
24 21 232	1	32	64	68	15	36	28	30.0	5	17.3	0.6	
24 26 232	3	32	64	68	16	30	28	54.0	5	18.3	0.6	80 83 030
24 22 232	1	32	64	68	20	30	28	30.0	6	22.8	0.6	
24 20 232	1	32	64	68	22*	30	28	30.0	6	24.8	0.4	
24 20 432	3	32	64	68	22	36	28	56.0	6	24.8	0.6	80 84 036
24 23 232	1	32	64	68	25	36	28	30.0	8	28.3	0.6	
24 22 432	3	32	64	68	30	50	28	60.0	8	33.3	0.6	80 85 050
24 24 232	1	32	64	68	30	45	28	30.0	8	33.3	0.6	
24 23 432	3	32	64	68	32	55	28	65.0	10	35.3	0.5	80 80 055
24 25 232	1	32	64	68	35	48	28	30.0	10	38.3	0.5	
24 22 236	1	36	72	76	20	30	28	30.0	6	22.8	0.8	
24 23 236	1	36	72	76	25	36	28	30.0	8	28.3	0.8	
24 24 236	1	36	72	76	30	45	28	30.0	8	33.3	0.7	
24 25 236	1	36	72	76	35	48	28	30.0	10	38.3	0.7	
24 25 436	3	36	72	76	40	62	28	65.0	12	43.3	0.5	80 86 062
24 27 236	1	36	72	76	45	58	28	30.0	14	48.8	0.6	

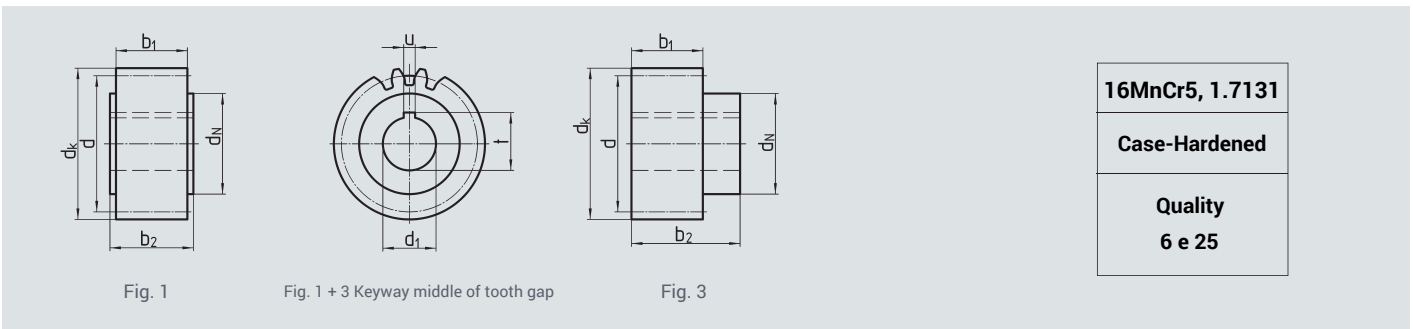
\* Bore G6 or H7

**Straight Pinion**, with bore  $\varnothing H6$  and keyway according to DIN 6885



Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	 kg	Coupling on Page C-76
<b>Module 2</b>												
24 21 240	1	40	80	84	15	36	28	30.0	5	17.3	1.0	
24 22 240	1	40	80	84	20	30	28	30.0	6	22.8	1.0	
24 23 240	1	40	80	84	25	36	28	30.0	8	28.3	1.0	
24 24 240	1	40	80	84	30	45	28	30.0	8	33.3	1.0	
24 23 440	3	40	80	84	32	55	28	65.0	10	35.3	0.9	80 80 055
24 25 240	1	40	80	84	35	48	28	30.0	10	38.3	0.9	
24 25 440	3	40	80	84	40	62	28	65.0	12	43.3	0.7	80 86 062
24 26 440	3	40	80	84	45	68	28	65.0	14	48.8	1.3	80 80 068
24 27 240	1	40	80	84	45	58	28	30.0	14	48.8	0.8	
24 22 245	1	45	90	94	20	30	28	30.0	6	22.8	1.3	
24 23 245	1	45	90	94	25	36	28	30.0	8	28.3	1.2	
24 25 245	1	45	90	94	35	48	28	30.0	10	38.3	1.2	
24 27 245	1	45	90	94	45	58	28	30.0	14	48.8	1.1	
24 22 250	1	50	100	104	20	30	28	30.0	6	22.8	1.6	
24 23 250	1	50	100	104	25	36	28	30.0	8	28.3	1.5	
24 25 250	1	50	100	104	35	48	28	30.0	10	38.3	1.5	
24 27 250	1	50	100	104	45	58	28	30.0	14	48.8	1.4	
24 26 450	3	50	100	104	45	68	28	65.0	14	48.8	2.0	80 80 068
24 23 256	1	56	112	116	25	36	28	30.0	8	28.3	1.9	
24 25 256	1	56	112	116	35	48	28	30.0	10	38.3	1.8	
24 23 263	1	63	126	130	25	36	28	30.0	8	28.3	2.5	
24 25 271	1	71	142	146	35	48	28	30.0	10	38.3	3.15	
24 25 280	1	80	160	164	35	48	28	30.0	10	38.3	4.2	
24 27 290	1	90	180	184	45	58	28	30.0	14	48.8	5.7	

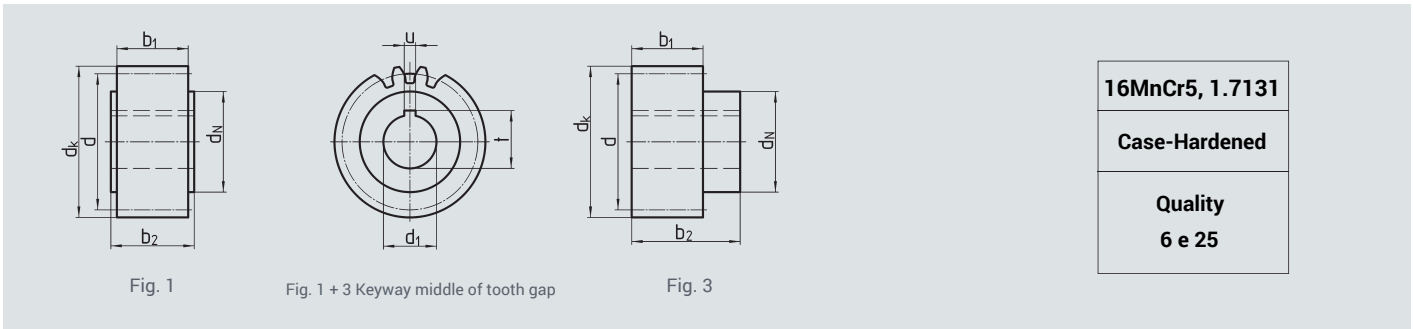
**Straight Pinion**, with bore ØH6 and keyway according to DIN 6885




Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	kg	Coupling on Page C-76
<b>Module 3</b>												
24 33 218	1	18	54	60	25	36	28	30.0	8	28.3	0.4	
24 33 220	1	20	60	66	25	36	28	30.0	8	28.3	0.5	
24 34 220	1	20	60	66	30	45	28	30.0	8	33.3	0.5	
24 35 220	1	20	60	66	35	48	28	30.0	10	38.3	0.4	
24 30 422	3	22	66	72	22	36	28	56.0	6	24.8	0.8	80 84 036
24 31 422	3	22	66	72	25	44	28	60.0	8	28.3	0.9	80 80 044
24 33 222	1	22	66	72	25	36	28	30.0	8	28.3	0.6	
24 32 422	3	22	66	72	30	50	28	60.0	8	33.3	0.9	80 85 050
24 34 222	1	22	66	72	30	45	28	30.0	8	33.3	0.6	
24 33 422	3	22	66	72	32	55	28	65.0	10	35.3	1.0	80 80 055
24 34 422	3	22	66	72	35	55	28	65.0	10	38.3	0.9	80 80 055
24 35 222	1	22	66	72	35	48	28	30.0	10	38.3	0.6	
24 35 422	3	22	66	72	40*	62	28	65	12	43.3	1.0	80 86 062
24 33 225	1	25	75	81	25	36	28	30.0	8	28.3	0.9	
24 34 225	1	25	75	81	30	45	28	30.0	8	33.3	0.8	
24 33 425	3	25	75	81	32*	55	28	65	10	35.3	1.2	80 80 055
24 35 225	1	25	75	81	35	48	28	30.0	10	38.3	0.8	
24 35 425	3	25	75	81	40	62	28	65.0	12	43.3	1.2	80 86 062
24 37 225	1	25	75	81	45	58	28	30.0	14	48.8	0.6	
24 30 428	3	28	84	90	22	36	28	56.0	6	24.8	1.3	80 84 036
24 31 428	3	28	84	90	25	44	28	60.0	8	28.3	1.4	80 80 044
24 33 228	1	28	84	90	25	36	28	30.0	8	28.3	1.1	
24 32 428	3	28	84	90	30	50	28	60.0	8	33.3	1.4	80 85 050
24 34 228	1	28	84	90	30	45	28	30.0	8	33.3	1.1	
24 33 428	3	28	84	90	32	55	28	65.0	10	35.3	1.5	80 80 055
24 34 428	3	28	84	90	35	55	28	65.0	10	38.3	1.4	80 80 055
24 35 228	1	28	84	90	35	48	28	30.0	10	38.3	1.0	
24 35 428	3	28	84	90	40*	62	28	65	12	43.3	1.4	80 86 062
24 36 428	3	28	84	90	45	68	28	65.0	14	48.8	1.5	80 80 068
24 37 228	1	28	84	90	45	58	28	30.0	14	48.8	0.9	
24 33 232	1	32	96	102	25	36	28	30.0	8	28.3	1.5	
24 34 232	1	32	96	102	30	45	28	30.0	8	33.3	1.4	
24 33 432	3	32	96	102	32*	55	28	65	10	35.3	1.8	80 80 055
24 35 232	1	32	96	102	35	48	28	30.0	10	38.3	1.4	
24 35 432	3	32	96	102	40	62	28	65.0	12	43.3	1.8	80 86 062
24 37 232	1	32	96	102	45	58	28	30.0	14	48.8	1.3	
24 39 232	1	32	96	102	60	80	28	30.0	18	64.4	1.1	
24 33 236	1	36	108	114	25	36	28	30.0	8	28.3	1.9	
24 35 236	1	36	108	114	35	48	28	30.0	10	38.3	1.8	
24 36 436	3	36	108	114	45	68	28	65.0	14	48.8	2.2	80 80 068
24 37 236	1	36	108	114	45	58	28	30.0	14	48.8	1.7	
24 39 236	1	36	108	114	60	80	28	30.0	18	64.4	1.4	
24 33 240	1	40	120	126	25	36	28	30	8	28.3	2.3	
24 35 240	1	40	120	126	35	48	28	30.0	10	38.3	2.3	
24 37 240	1	40	120	126	45	58	28	30.0	14	48.8	2.1	
24 39 240	1	40	120	126	60	80	28	30.0	18	64.4	1.9	
24 33 245	1	45	135	141	25	36	28	30.0	8	28.3	3.0	
24 35 245	1	45	135	141	35	48	28	30.0	10	38.3	2.7	
24 37 245	1	45	135	141	45	58	28	30.0	14	48.8	2.4	

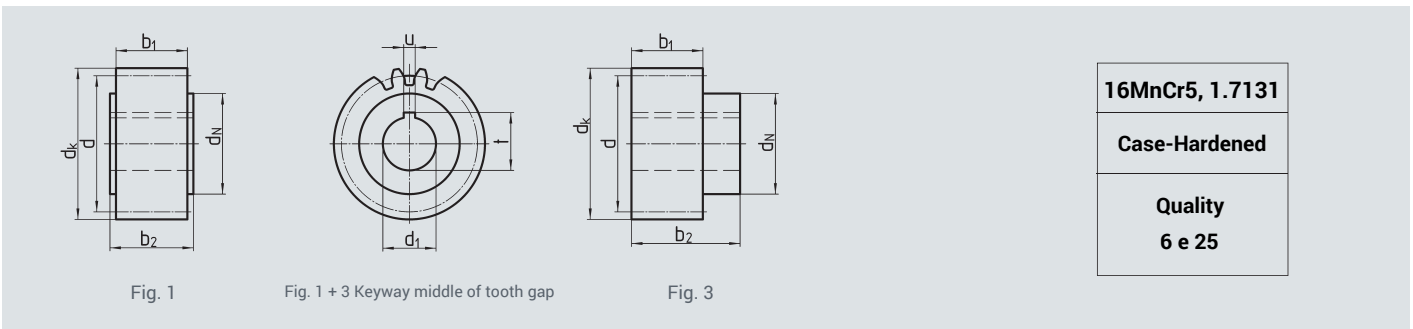
\* Bore G6


**Straight Pinion**, with bore  $\emptyset H6$  and keyway according to DIN 6885



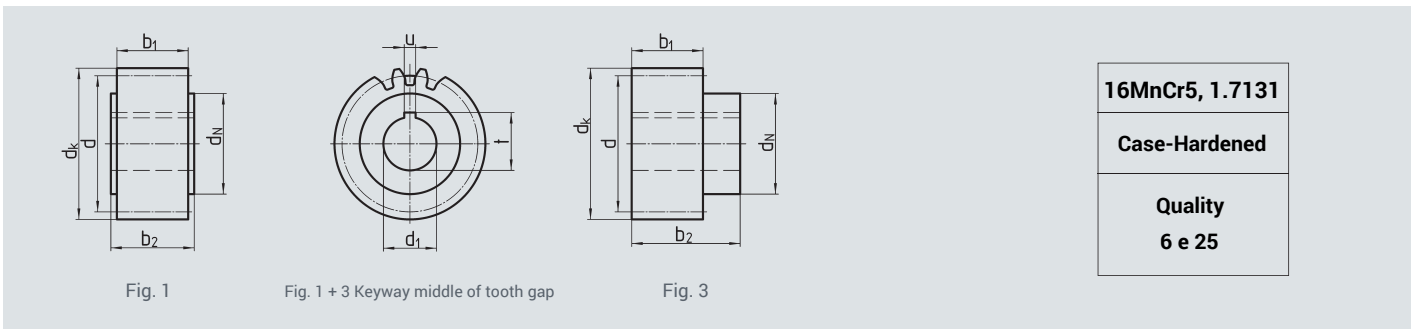
Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	
<b>Module 3</b>											
<b>24 39 245</b>	1	45	135	141	60	80	28	30.0	18	64.4	2.4
<b>24 35 250</b>	1	50	150	156	35	48	28	30.0	10	38.3	3.6
<b>24 37 250</b>	1	50	150	156	45	58	28	30	14	48.8	3.5
<b>24 37 256</b>	1	56	168	174	45	58	28	30.0	14	48.8	4.4
<b>24 37 263</b>	1	63	189	195	45	58	28	30.0	14	48.8	5.4
<b>24 39 263</b>	1	63	189	195	60	80	28	30.0	18	64.4	5.4


**Straight Pinion**, with bore  $\varnothing H6$  and keyway according to DIN 6885



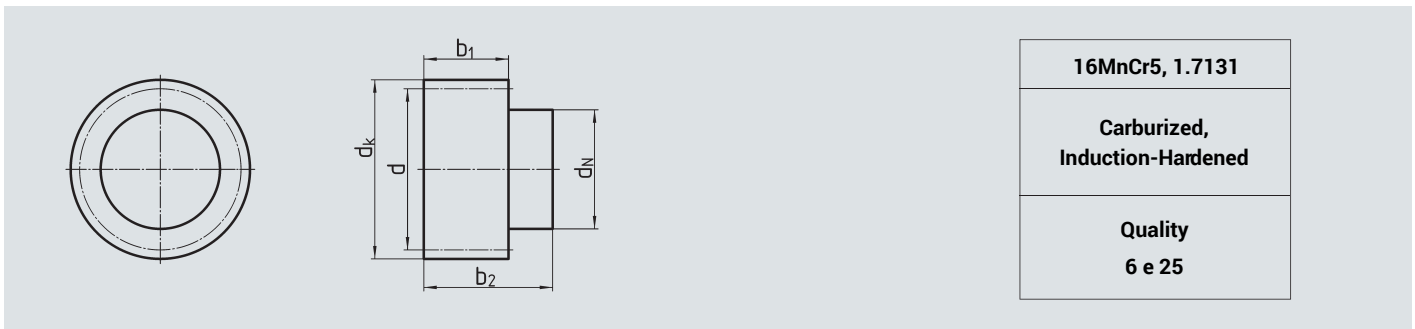
Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	 kg	Coupling on Page C-76
<b>Module 4</b>												
24 43 420	3	20	80	88	32	55	40	75.0	10	35.3	1.7	80 80 055
24 45 220	1	20	80	88	35	52	40	50.0	10	38.3	1.3	
24 44 420	3	20	80	88	35	55	40	75.0	10	38.3	1.7	80 80 055
24 45 420	3	20	80	88	40	62	40	75.0	12	43.3	1.7	80 86 062
24 47 220	1	20	80	88	45	65	40	50.0	14	48.8	1.2	
24 45 222	1	22	88	96	35	52	40	50.0	10	38.3	1.7	
24 47 222	1	22	88	96	45	65	40	50.0	14	48.8	1.5	
24 46 422	3	22	88	96	45	68	40	75.0	14	48.8	2.0	80 80 068
24 43 425	3	25	100	108	32	55	40	75.0	10	35.3	2.6	80 80 055
24 45 225	1	25	100	108	35	52	40	50.0	10	38.3	2.2	
24 44 425	3	25	100	108	35	55	40	75.0	10	38.3	2.5	80 80 055
24 45 425	3	25	100	108	40	62	40	75.0	12	43.3	2.5	80 86 062
24 47 225	1	25	100	108	45	65	40	50.0	14	48.8	2.0	
24 47 425	3	25	100	108	55	80	40	80.0	16	59.3	2.5	80 87 080
24 45 228	1	28	112	120	35	52	40	50.0	10	38.3	2.9	
24 47 228	1	28	112	120	45	65	40	50.0	14	48.8	2.7	
24 46 428	3	28	112	120	45	68	40	75.0	14	48.8	3.1	80 80 068
24 45 232	1	32	128	136	35	52	40	50.0	10	38.3	3.8	
24 47 232	1	32	128	136	45	65	40	50.0	14	48.8	3.7	
24 47 432	3	32	128	136	55	80	40	80.0	16	59.3	4.1	80 87 080
24 48 432	3	32	128	136	75	110	40	100.0	20	79.9	5.0	80 80 110
24 47 240	1	40	160	168	45	65	40	50.0	14	48.8	5.9	
24 49 240	1	40	160	168	60	80	40	50.0	18	64.4	5.6	
24 48 440	3	40	160	168	75	110	40	100.0	20	79.9	7.3	80 80 110

**Straight Pinion**, with bore  $\emptyset H6$  and keyway according to DIN 6885



Order Code	Fig.	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>1</sub> <sup>H6</sup>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	u	t	 kg	Coupling on Page C-76
<b>Module 5</b>												
24 56 421		21	105	115	45	68	50	85.0	14	48.8	3.7	80 80 068
24 57 421		21	105	115	55	80	50	90.0	16	59.3	3.7	80 87 080
24 56 425		25	125	135	45	68	50	85.0	14	48.8	5.2	80 80 068
24 57 425		25	125	135	55	80	50	90.0	16	59.3	5.1	80 87 080
24 58 425		25	125	135	75	110	50	110.0	20	80.4	4.7	80 80 110
<b>Module 6</b>												
24 67 421		21	126	138	55	80	60	100.0	16	59.3	5.6	80 87 080
24 68 421		21	126	138	75	110	60	120.0	20	79.9	4.7	80 80 110
24 67 425		25	150	162	55	80	60	100.0	16	59.3	8.0	80 87 080
24 68 425		25	150	162	75	110	60	120.0	20	79.9	7.1	80 80 110
<b>Module 8</b>												
24 88 420		20	160	176	75	110	80	140	20	79.9	12.0	80 80 110
24 89 420		20	160	176	85	125	80	145	22	90.4	12.1	80 80 125
<b>Module 10</b>												
24 09 620		20	200	220	85	125	100	165	22	90.4	23	80 80 125

Straight-Tooth Pinion, with plain bore



Order Code	Module	N° of Teeth z	d (=d <sub>wz</sub> )	d <sub>k</sub>	d <sub>N</sub>	b <sub>1</sub>	b <sub>2</sub>	T kg	Coupling on page C-76
24 98 218	2	18	36	40	30	28	56	0.3	80 83 030
24 98 220	2	20	40	44	30	28	56	0.4	80 83 030
24 98 222	2	22	44	48	36	28	56	0.5	80 84 036
24 98 225	2	25	50	54	44	28	60	0.7	80 80 044
24 98 228	2	28	56	60	50	28	60	0.9	80 85 050
24 98 230	2	30	60	64	50	28	60	1.0	80 85 050
24 98 232	2	32	64	68	55	28	65	1.3	80 80 055
24 98 236	2	36	72	76	62	28	65	1.6	80 86 062
24 98 240	2	40	80	84	68	28	65	2.0	80 80 068
24 98 318	3	18	54	60	44	28	60	0.8	80 80 044
24 98 320	3	20	60	66	50	28	60	1.0	80 85 050
24 98 322	3	22	66	72	55	28	65	1.3	80 80 055
24 98 325	3	25	75	81	62	28	65	1.7	80 86 062
24 98 328	3	28	84	90	68	28	65	2.1	80 80 068
24 98 330	3	30	90	96	68	28	65	2.2	80 80 068
24 98 332	3	32	96	102	68	28	65	2.4	80 80 068
24 98 336	3	36	108	114	68	28	65	2.8	80 80 068
24 98 340	3	40	120	126	68	28	65	3.3	80 80 068
24 98 418	4	18	72	80	55	40	77	1.7	80 80 055
24 98 420	4	20	80	88	62	40	77	2.2	80 86 062
24 98 422	4	22	88	96	68	40	77	2.7	80 80 068
24 98 425	4	25	100	108	80	40	80	3.7	80 87 080
24 98 428	4	28	112	120	80	40	80	4.4	80 87 080
24 98 430	4	30	120	128	80	40	80	4.6	80 87 080
24 98 432	4	32	128	136	110	40	100	7.9	80 80 110
24 98 436	4	36	144	152	110	40	100	8.9	80 80 110
24 98 440	4	40	160	168	110	40	100	9.9	80 80 110
24 98 521	5	21	105	115	80	50	90	4.9	80 87 080
24 98 522	5	22	110	120	80	50	90	5.0	80 87 080
24 98 525	5	25	125	135	110	50	110	9.0	80 80 110
24 98 528	5	28	140	150	110	50	110	10.2	80 80 110
24 98 530	5	30	150	160	110	50	110	10.9	80 80 110
24 98 621	6	21	126	138	110	60	120	5.9	80 80 110
24 98 625	6	25	150	162	110	60	120	8.9	80 80 110
24 98 820 <sup>1)</sup>	8	20	160	176	125	80	145	18.5	80 80 125

<sup>1)</sup> With bore Ø 40<sup>H7</sup>

The pinion could be fixed at d<sub>k</sub> or d<sub>N</sub> to be reworked.

Maximum bore diameter of the pinion on request.