

Reliance Instrumentation Gears

from

Schlenker Enterprises, Ltd



Reliance Standard & Custom Components



Quality system

Reliance operations are controlled by a quality management system approved to BS EN ISO 9001.



Standard products and assemblies

Accurate positioning from modifiable standards for instrumentation, measurement and light actuation applications.



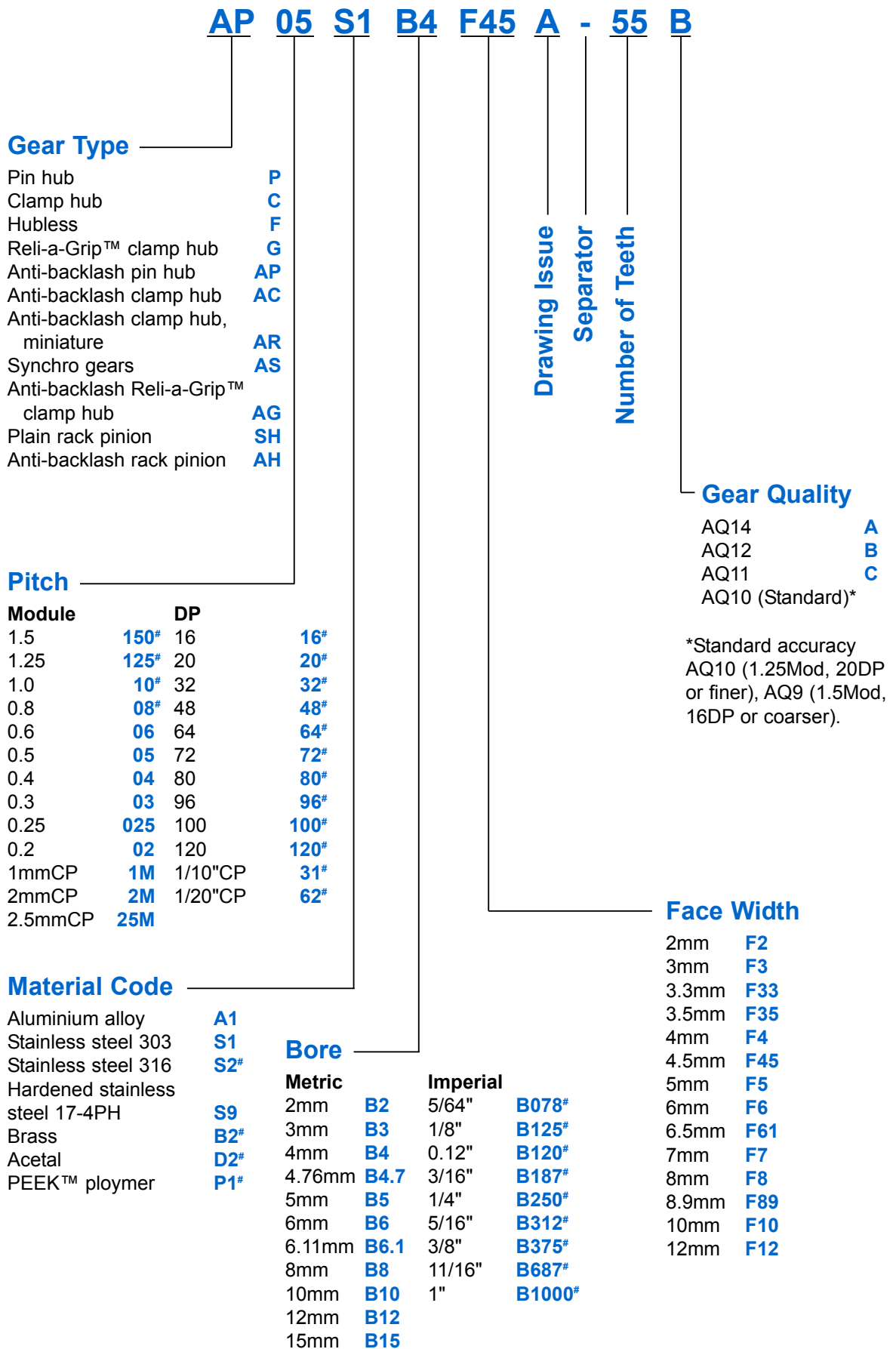
Gearboxes

Size 11 speed reducers with ratios up to 3600:1.
Modular servo gearboxes, accurate positioning at low torque with ratios up to 1000:1.

Page title	Page
Basic part numbering	2
Gear pairs.....	3
Anti-backlash Reli-a-Grip™ clamp hub pinions.....	4
Anti-backlash Reli-a-Grip™ clamp hub gears	6
Anti-backlash clamp hub pinions - Miniature	10
Anti-backlash clamp hub pinions	12
Anti-backlash clamp hub gears	14
Anti-backlash pin hub pinions	18
Anti-backlash pin hub gears.....	20
Reli-a-Grip™ clamp hub spur gears	24
Clamp hub spur gears.....	28
Pin hub spur gears.....	32
Hubless spur gears	36
Anti-backlash synchro gears	38
Bevel gears	40
Worms and wheels	43
Worm gear formulae.....	45
Pinion shafts	46
Hardened pin hub spur gears	48
Gears to special order	50
Gear clamps	52
Standard belts and pulleys	54
Technical information	55

Gear Range

Basic Part Numbering



indicates non-standard items. Please enquire for details regarding large modules, imperial pitches and bores, and alternative materials.

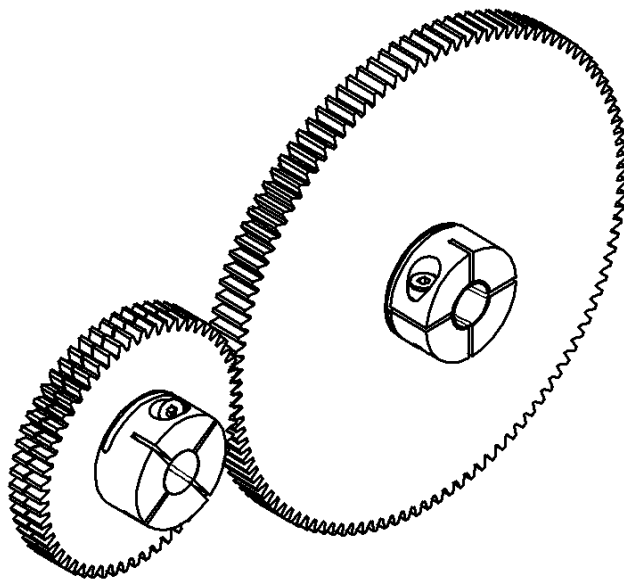
Gear Ratios

Gear Pairs

The following table presents a range of gear pairs listed by ratio. To purchase a gear pair please use the order number to ensure you receive the full set including gear clamps where required. This table is by no means exhaustive, if you cannot find exactly what you want, please enquire.

Ratio	Center Distance (mm)	Bore Size (mm)	Part Number		
			Pinion	Wheel	Order No.
6:1	42	4	AR02S1B4F33A-60*	G02A1B4F4A-360	BGP0601B4B4-42
5:1	42	5	AR05S1B5F33A-28*	G05A1B5F4A-140	BGP0501B5B5-42
4:1	42	6	AG04S1B6F45A-42	G04A1B6F6A-168	BGP0401B6B6-42
	36	6	AR02S1B6F33A-72*	G02A1B6F4A-288	BGP0401B6B6-36
3:1	42	6	AG05S1B6F45A-42	G05A1B6F6A-126	BGP0301B6B6-42
	36	6	AG05S1B6F45A-36	G05A1B6F6A-108	BGP0301B6B6-36
2:1	42	6	AG05S1B6F45A-56	G05A1B6F6A-112	BGP0201B6B6-42
	36	6	AG06S1B6F45A-40	G06A1B6F6A-80	BGP0201B6B6-36
1:1	42	6	AG05S1B6F35A-84	G05A1B6F4A-84	BGP0101B6B6-42
	36	6	AG05S1B6F45A-72	G05A1B6F6A-72	BGP0101B6B6-36

* indicates a standard clamp hub style gear. Clamp will be supplied with the gear set.
All other gears stated use the Reli-a-Grip™ integral clamp.
See pages 4, 6, 10, 24 and 26 for pinion and wheel dimensions.



Anti-backlash Reli-a-Grip™ Clamp Hub Pinions

3 - 6mm Bore

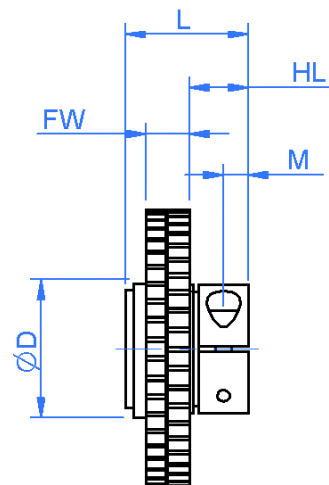
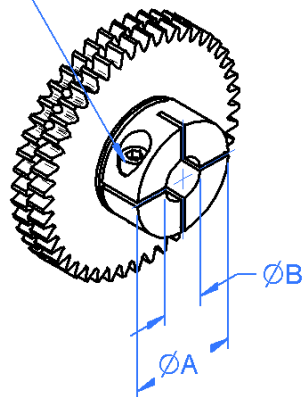
General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Skt. hd. cap
screw S
supplied



Drawing dimension table

Bore Size	Bore Dia	Overall Length	Gear Face Width	Reli-a-Grip™ Dia	Clearance Dia ØD	Hub Length	Hole Position	Set Screw
Nom	ØB	L ±0.3	FW	ØA	Max †	HL	M	S
3	3.003 2.995	12.5	4.55 4.10	13.00	19.00	6.0	2.50	M1.6
4	4.003 3.995							
5	5.003 4.995							
6	6.003 5.995							

† ØD will not exceed the root diameter of the teeth.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 1/8", 3/16" & 1/4".

Schlenker Ent. Ltd. Sales :
www.schlenkent.com

Phone:708.449.5700

Fax: 708.449.5703
sales@schlenkent.com

Part number selection table

Example Part No:- <u>AG06S1B5F45A-</u> <u>45</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min*	Max
3	0.6	AG06S1B3F45A	AG06A1B3F45A	29	59
	0.5	AG05S1B3F45A	AG05A1B3F45A	34	72
	0.4	AG04S1B3F45A	AG04A1B3F45A	42	90
	0.3	AG03S1B3F45A	AG03A1B3F45A	55	121
	0.25	AG025S1B3F45A	AG025A1B3F45A	65	146
	0.2	AG02S1B3F45A	AG02A1B3F45A	80	183
4	0.6	AG06S1B4F45A	AG06A1B4F45A	29	59
	0.5	AG05S1B4F45A	AG05A1B4F45A	34	72
	0.4	AG04S1B4F45A	AG04A1B4F45A	42	90
	0.3	AG03S1B4F45A	AG03A1B4F45A	55	121
	0.25	AG025S1B4F45A	AG025A1B4F45A	65	146
	0.2	AG02S1B4F45A	AG02A1B4F45A	80	183
5	0.6	AG06S1B5F45A	AG06A1B5F45A	29	59
	0.5	AG05S1B5F45A	AG05A1B5F45A	34	72
	0.4	AG04S1B5F45A	AG04A1B5F45A	42	90
	0.3	AG03S1B5F45A	AG03A1B5F45A	55	121
	0.25	AG025S1B5F45A	AG025A1B5F45A	65	146
	0.2	AG02S1B5F45A	AG02A1B5F45A	80	183
6	0.6	AG06S1B6F45A	AG06A1B6F45A	29	59
	0.5	AG05S1B6F45A	AG05A1B6F45A	34	72
	0.4	AG04S1B6F45A	AG04A1B6F45A	42	90
	0.3	AG03S1B6F45A	AG03A1B6F45A	55	121
	0.25	AG025S1B6F45A	AG025A1B6F45A	65	146
	0.2	AG02S1B6F45A	AG02A1B6F45A	80	183

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°

*For smaller numbers of teeth, see miniature anti-backlash pinions on pages 10 and 11.

Anti-backlash Reli-a-Grip™ Clamp Hub Gears

3 - 6mm Bore

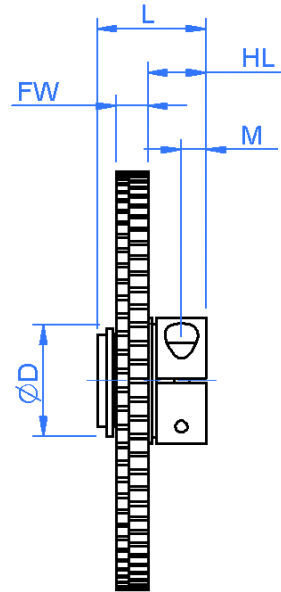
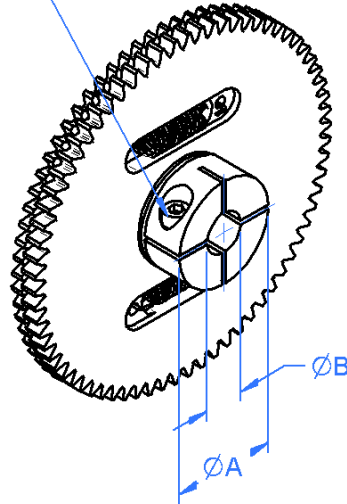
General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Skt. hd. cap
screw S
supplied



Drawing dimension table

Bore Size	Bore Dia	Overall Length	Gear Face Width	Reli-a-Grip™ Dia	Clearance Dia ØD	Hub Length	Hole Position	Set Screw
Nom	ØB	L	FW	ØA	Max †	HL	M	S
3	3.003 2.995	11.25	3.60 3.17	13.00	15.00	6.0	2.50	M1.6
4	4.003 3.995							
5	5.003 4.995							
6	6.003 5.995				18.80			

† ØD will not exceed the root diameter of the teeth.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 1/8", 3/16" & 1/4".

Schlenker Ent. Ltd. Sales :
www.schlenkent.com

Phone: 708.449.5700

Fax: 708.449.5703
sales@schlenkent.com

Part number selection table

Example Part No:- <u>AG06S1B5F35A-</u> <u>70</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
3	0.6	AG06S1B3F35A	AG06A1B3F35A	55	119
	0.5	AG05S1B3F35A	AG05A1B3F35A	66	143
	0.4	AG04S1B3F35A	AG04A1B3F35A	81	180
	0.3	AG03S1B3F35A	AG03A1B3F35A	107	241
	0.25	AG025S1B3F35A	AG025A1B3F35A	128	289
	0.2	AG02S1B3F35A	AG02A1B3F35A	159	362
4	0.6	AG06S1B4F35A	AG06A1B4F35A	55	119
	0.5	AG05S1B4F35A	AG05A1B4F35A	66	143
	0.4	AG04S1B4F35A	AG04A1B4F35A	81	180
	0.3	AG03S1B4F35A	AG03A1B4F35A	107	241
	0.25	AG025S1B4F35A	AG025A1B4F35A	128	289
	0.2	AG02S1B4F35A	AG02A1B4F35A	159	362
5	0.6	AG06S1B5F35A	AG06A1B5F35A	55	119
	0.5	AG05S1B5F35A	AG05A1B5F35A	66	143
	0.4	AG04S1B5F35A	AG04A1B5F35A	81	180
	0.3	AG03S1B5F35A	AG03A1B5F35A	107	241
	0.25	AG025S1B5F35A	AG025A1B5F35A	128	289
	0.2	AG02S1B5F35A	AG02A1B5F35A	159	362
6	0.6	AG06S1B6F35A	AG06A1B6F35A	55	119
	0.5	AG05S1B6F35A	AG05A1B6F35A	66	143
	0.4	AG04S1B6F35A	AG04A1B6F35A	81	180
	0.3	AG03S1B6F35A	AG03A1B6F35A	107	241
	0.25	AG025S1B6F35A	AG025A1B6F35A	128	289
	0.2	AG02S1B6F35A	AG02A1B6F35A	159	362

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°

Anti-backlash Reli-a-Grip™ Clamp Hub Gears

8 - 10mm Bore

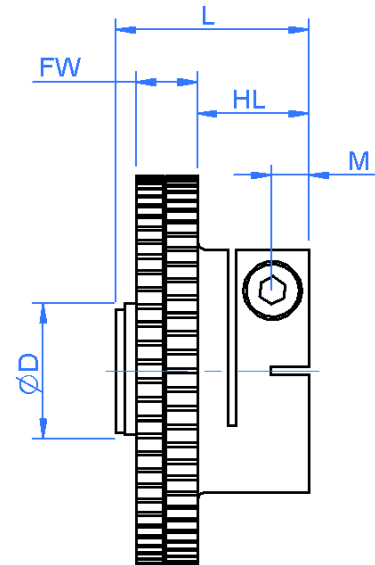
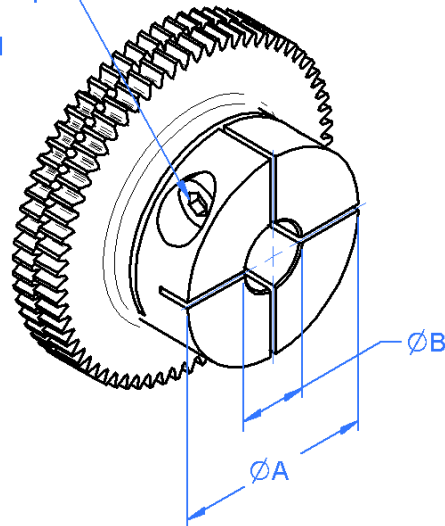
General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Skt. hd. cap
screw S
supplied



Drawing dimension table

Bore Size	Bore Dia	Overall Length	Gear Face Width	Reli-a-Grip™ Dia	Clearance Dia	Hub Length	Hole Position	Set. Screw
Nom	ØB	L	FW	ØA	ØD Max †	HL ±0.34	M	S
8	8.003 7.995	20.0	6.65 6.17	25.00	18.80	11.54	3.80	M3
10	10.003 9.995							

† ØD will not exceed the root diameter of the teeth.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/16" & 3/8".

Schlenker Ent. Ltd. Sales :
www.schlenkent.com

Phone:708.449.5700

Fax: 708.449.5703
sales@schlenkent.com

Part number selection table

Example Part No:- <u>AG06S1B10F61A-</u> <u>50</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
8	0.6	AG06S1B8F61A	AG06A1B8F61A	48	108
	0.5	AG05S1B8F61A	AG05A1B8F61A	56	130
	0.4	AG04S1B8F61A	AG04A1B8F61A	70	164
	0.3	AG03S1B8F61A	AG03A1B8F61A	92	219
	0.25	AG025S1B8F61A	AG025A1B8F61A	110	263
	0.2	AG02S1B8F61A	AG02A1B8F61A	136	330
10	0.6	AG06S1B10F61A	AG06A1B10F61A	48	108
	0.5	AG05S1B10F61A	AG05A1B10F61A	56	130
	0.4	AG04S1B10F61A	AG04A1B10F61A	70	164
	0.3	AG03S1B10F61A	AG03A1B10F61A	92	219
	0.25	AG025S1B10F61A	AG025A1B10F61A	110	263
	0.2	AG02S1B10F61A	AG02A1B10F61A	136	330

**General
Information**

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°



Anti-backlash Clamp Hub Pinions - Miniature

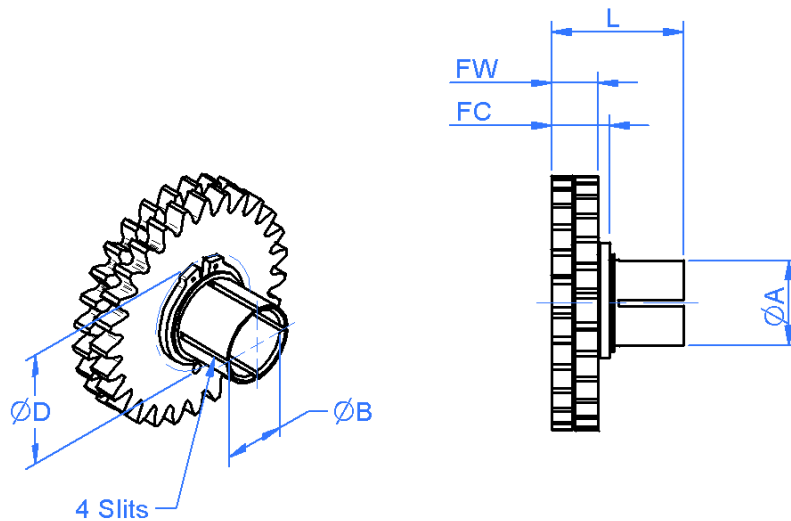
2 - 6mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Hub Dia ØA	Circlip Dims		Recommended Clamp #
					Clearance ØD Max	Length FC	
2	2.003 1.995	9.00	3.58 3.08	3.60 3.56	7.30	3.99 3.58	CGAM-2A or CGM1-2
3	3.003 2.995			4.60 4.56			CGAM-3A or CGM1-3
4	4.003 3.995			5.60 5.56	8.20	4.25 3.85	CGAM-4A or CGM1-4
5	5.003 4.995			6.60 6.56	10.90		CGAM-5A or CGM1-5
6	6.003 5.995			7.60 7.56	13.20		CGAM-6A or CGM1-6

see gear clamps on pages 52 - 53 for information. NB Clamp diameter may be greater than gear diameter.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120", 1/8", 3/16" & 1/4" .

Part number selection table

Example Part No:-

AR06S1B5F33A- 27

Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max*
2	0.6	AR06S1B2F33A	AR06A1B2F33A	21	29
	0.5	AR05S1B2F33A	AR05A1B2F33A	24	36
	0.4	AR04S1B2F33A	AR04A1B2F33A	30	45
	0.3	AR03S1B2F33A	AR03A1B2F33A	38	61
	0.25	AR025S1B2F33A	AR025A1B2F33A	45	74
	0.2	AR02S1B2F33A	AR02A1B2F33A	56	93
3	0.6	AR06S1B3F33A	AR06A1B3F33A	21	29
	0.5	AR05S1B3F33A	AR05A1B3F33A	24	36
	0.4	AR04S1B3F33A	AR04A1B3F33A	30	45
	0.3	AR03S1B3F33A	AR03A1B3F33A	38	61
	0.25	AR025S1B3F33A	AR025A1B3F33A	45	74
	0.2	AR02S1B3F33A	AR02A1B3F33A	56	93
4	0.6	AR06S1B4F33A	AR06A1B4F33A	22	29
	0.5	AR05S1B4F33A	AR05A1B4F33A	26	36
	0.4	AR04S1B4F33A	AR04A1B4F33A	32	45
	0.3	AR03S1B4F33A	AR03A1B4F33A	41	61
	0.25	AR025S1B4F33A	AR025A1B4F33A	49	74
	0.2	AR02S1B4F33A	AR02A1B4F33A	60	93
5	0.6	AR06S1B5F33A	AR06A1B5F33A	24	29
	0.5	AR05S1B5F33A	AR05A1B5F33A	28	36
	0.4	AR04S1B5F33A	AR04A1B5F33A	34	45
	0.3	AR03S1B5F33A	AR03A1B5F33A	44	61
	0.25	AR025S1B5F33A	AR025A1B5F33A	52	74
	0.2	AR02S1B5F33A	AR02A1B5F33A	65	93
6	0.6	AR06S1B6F33A	AR06A1B6F33A	26	29
	0.5	AR05S1B6F33A	AR05A1B6F33A	31	36
	0.4	AR04S1B6F33A	AR04A1B6F33A	38	45
	0.3	AR03S1B6F33A	AR03A1B6F33A	49	61
	0.25	AR025S1B6F33A	AR025A1B6F33A	58	74
	0.2	AR02S1B6F33A	AR02A1B6F33A	72	93

General Information

All dimensions in mm
 General tolerances:
 $\pm 0.13\text{mm}$
 Material:
 Stainless steel
 or
 Aluminium alloy
 Pressure angle 20°

* For larger numbers of teeth, see anti-backlash Reli-a-Grip™ pinions on pages 4 and 5.

Anti-backlash Clamp Hub Pinions

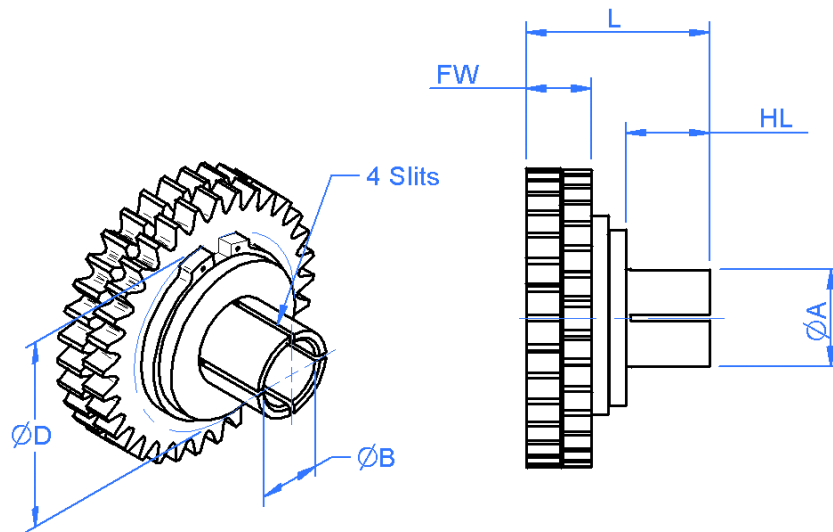
2 - 6mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size	Bore Dia	Overall Length	Gear Face Width	Hub Dia	Clearance Dia	Hub Length	Recommended Clamp #
Nom	ØB	L	FW	ØA	ØD Max†	HL	
2	2.003 1.995	10.50	4.90 4.10	3.60 3.56	18.10	3.70	CGAM-2A or CGM1-2
3	3.003 2.995	12.50		4.60 4.56		5.70	CGAM-3A or CGM1-3
4	4.003 3.995			5.60 5.56			CGAM-4A or CGM1-4
5	5.003 4.995			6.60 6.56			CGAM-5A or CGM1-5
6	6.003 5.995			7.60 7.56			CGAM-6A or CGM1-6

see gear clamps on pages 52 - 53 for information.

† ØD will not exceed the root diameter of the teeth.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120", 1/8", 3/16" & 1/4".

Part number selection table

Example Part No:- <u>AC06S1B5F45A-</u> <u>32</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
2	0.6	AC06S1B2F45A	AC06A1B2F45A	29	59
	0.5	AC05S1B2F45A	AC05A1B2F45A	34	72
	0.4	AC04S1B2F45A	AC04A1B2F45A	42	90
	0.3	AC03S1B2F45A	AC03A1B2F45A	55	121
	0.25	AC025S1B2F45A	AC025A1B2F45A	65	146
	0.2	AC02S1B2F45A	AC02A1B2F45A	80	183
3	0.6	AC06S1B3F45A	AC06A1B3F45A	29	59
	0.5	AC05S1B3F45A	AC05A1B3F45A	34	72
	0.4	AC04S1B3F45A	AC04A1B3F45A	42	90
	0.3	AC03S1B3F45A	AC03A1B3F45A	55	121
	0.25	AC025S1B3F45A	AC025A1B3F45A	65	146
	0.2	AC02S1B3F45A	AC02A1B3F45A	80	183
4	0.6	AC06S1B4F45A	AC06A1B4F45A	29	59
	0.5	AC05S1B4F45A	AC05A1B4F45A	34	72
	0.4	AC04S1B4F45A	AC04A1B4F45A	42	90
	0.3	AC03S1B4F45A	AC03A1B4F45A	55	121
	0.25	AC025S1B4F45A	AC025A1B4F45A	65	146
	0.2	AC02S1B4F45A	AC02A1B4F45A	80	183
5	0.6	AC06S1B5F45A	AC06A1B5F45A	29	59
	0.5	AC05S1B5F45A	AC05A1B5F45A	34	72
	0.4	AC04S1B5F45A	AC04A1B5F45A	42	90
	0.3	AC03S1B5F45A	AC03A1B5F45A	55	121
	0.25	AC025S1B5F45A	AC025A1B5F45A	65	146
	0.2	AC02S1B5F45A	AC02A1B5F45A	80	183
6	0.6	AC06S1B6F45A	AC06A1B6F45A	29	59
	0.5	AC05S1B6F45A	AC05A1B6F45A	34	72
	0.4	AC04S1B6F45A	AC04A1B6F45A	42	90
	0.3	AC03S1B6F45A	AC03A1B6F45A	55	121
	0.25	AC025S1B6F45A	AC025A1B6F45A	65	146
	0.2	AC02S1B6F45A	AC02A1B6F45A	80	183

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°

Anti-backlash Clamp Hub Gears

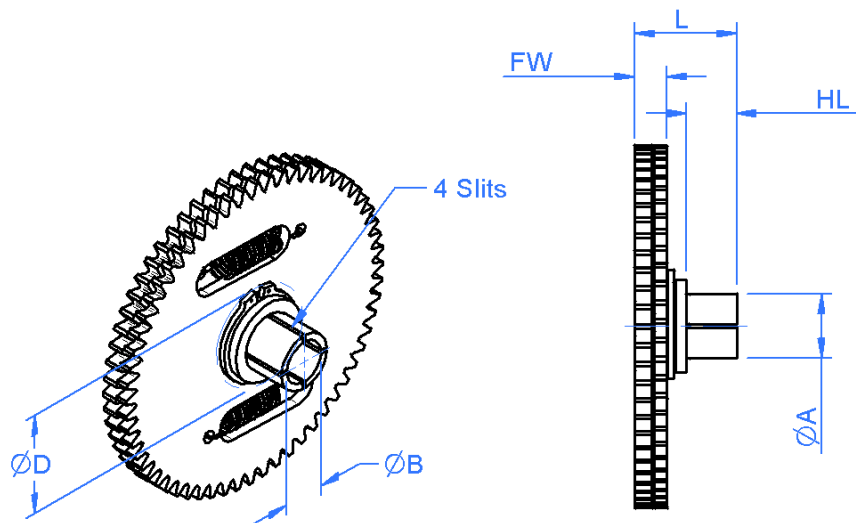
2 - 6mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size	Bore Dia	Overall Length	Gear Face Width	Hub Dia	Clearance Dia ØD Max	Hub Length	Recommended Clamp #
Nom	ØB	L	FW	ØA		HL	
2	2.003 1.995	9.00	3.91 3.14	3.60 3.56	15.00	4.20	CGAM-2A or CGM1-2
3	3.003 2.995	9.50		4.60 4.56			CGAM-3A or CGM1-3
4	4.003 3.995	10.50		5.60 5.56		5.20	CGAM-4A or CGM1-4
5	5.003 4.995			6.60 6.56			CGAM-5A or CGM1-5
6	6.003 5.995	12.00		7.60 7.56	18.80	5.70	CGAM-6A or CGM1-6

see gear clamps on pages 52 - 53 for information.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120", 1/8", 3/16" & 1/4".

Schlenker Ent. Ltd. Sales :
www.schlenkent.com

Phone:708.449.5700

Fax: 708.449.5703
sales@schlenkent.com

Part number selection table

Example Part No:- <u>AC06S1B5F35A-</u> <u>60</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
2	0.6	AC06S1B2F35A	AC06A1B2F35A	55	119
	0.5	AC05S1B2F35A	AC05A1B2F35A	66	143
	0.4	AC04S1B2F35A	AC04A1B2F35A	81	179
	0.3	AC03S1B2F35A	AC03A1B2F35A	107	240
	0.25	AC025S1B2F35A	AC025A1B2F35A	128	289
	0.2	AC02S1B2F35A	AC02A1B2F35A	159	361
3	0.6	AC06S1B3F35A	AC06A1B3F35A	55	119
	0.5	AC05S1B3F35A	AC05A1B3F35A	66	143
	0.4	AC04S1B3F35A	AC04A1B3F35A	81	179
	0.3	AC03S1B3F35A	AC03A1B3F35A	107	240
	0.25	AC025S1B3F35A	AC025A1B3F35A	128	289
	0.2	AC02S1B3F35A	AC02A1B3F35A	159	361
4	0.6	AC06S1B4F35A	AC06A1B4F35A	55	119
	0.5	AC05S1B4F35A	AC05A1B4F35A	66	143
	0.4	AC04S1B4F35A	AC04A1B4F35A	81	179
	0.3	AC03S1B4F35A	AC03A1B4F35A	107	240
	0.25	AC025S1B4F35A	AC025A1B4F35A	128	289
	0.2	AC02S1B4F35A	AC02A1B4F35A	159	361
5	0.6	AC06S1B5F35A	AC06A1B5F35A	55	119
	0.5	AC05S1B5F35A	AC05A1B5F35A	66	143
	0.4	AC04S1B5F35A	AC04A1B5F35A	81	179
	0.3	AC03S1B5F35A	AC03A1B5F35A	107	240
	0.25	AC025S1B5F35A	AC025A1B5F35A	128	289
	0.2	AC02S1B5F35A	AC02A1B5F35A	159	361
6	0.6	AC06S1B6F35A	AC06A1B6F35A	55	119
	0.5	AC05S1B6F35A	AC05A1B6F35A	66	143
	0.4	AC04S1B6F35A	AC04A1B6F35A	81	179
	0.3	AC03S1B6F35A	AC03A1B6F35A	107	240
	0.25	AC025S1B6F35A	AC025A1B6F35A	128	289
	0.2	AC02S1B6F35A	AC02A1B6F35A	159	361

General Information

All dimensions in mm
 General tolerances:
 $\pm 0.13\text{mm}$
 Material:
 Stainless steel
 or
 Aluminium alloy
 Pressure angle 20°

Anti-backlash Clamp Hub Gears

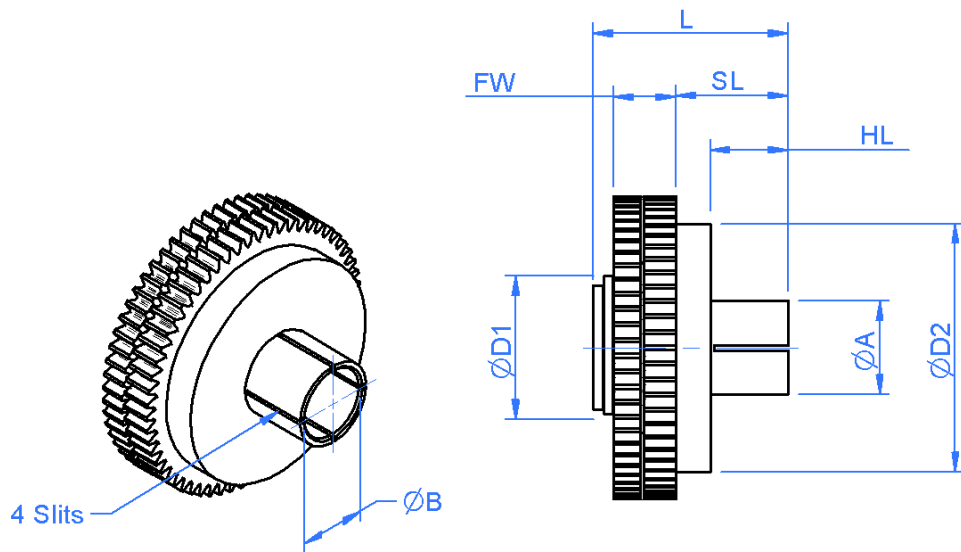
8 - 10mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Hub Dia ØA	Clearance Dia		Hub Length HL	Length SL	Recommended Clamp #
					Circlip ØD1 Max	ØD2 Max			
8	8.003 7.995	20.00	6.86 6.17	9.60 9.56	19.2	25.40	8.0	11.88 11.20	CGAM-8A or CGM1-8
10	10.003 9.995			11.60 11.56					CGAM-10A or CGM1-10

see gear clamps on pages 52 - 53 for information.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/16" & 3/8".

Part number selection table

Example Part No:- <u>AC05S1B8F61A-</u> <u>60</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
8	0.6	AC06S1B8F61A	AC06A1B8F61A	48	127
	0.5	AC05S1B8F61A	AC05A1B8F61A	56	152
	0.4	AC04S1B8F61A	AC04A1B8F61A	70	190
	0.3	AC03S1B8F61A	AC03A1B8F61A	92	254
	0.25	AC025S1B8F61A	AC025A1B8F61A	110	304
	0.2	AC02S1B8F61A	AC02A1B8F61A	136	381
10	0.6	AC06S1B10F61A	AC06A1B10F61A	48	127
	0.5	AC05S1B10F61A	AC05A1B10F61A	56	152
	0.4	AC04S1B10F61A	AC04A1B10F61A	70	190
	0.3	AC03S1B10F61A	AC03A1B10F61A	92	254
	0.25	AC025S1B10F61A	AC025A1B10F61A	110	304
	0.2	AC02S1B10F61A	AC02A1B10F61A	136	381

**General
Information**

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°



Anti-backlash Pin Hub Pinions

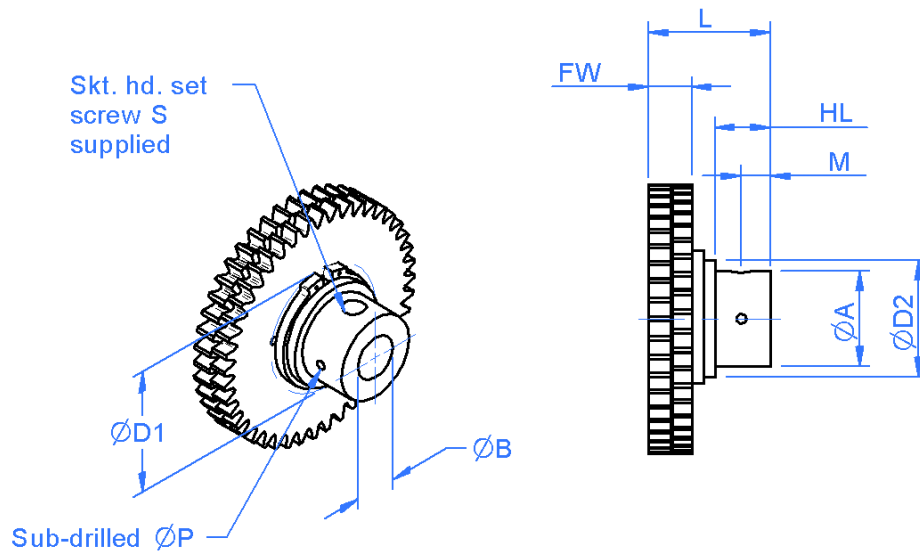
2 - 6mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Hub Dia ØA	Clearance		Hub Length HL	Hole Position M	Set Screw S	Sub-Drill ØP
					ØD1 Max †	ØD2				
2	2.003 1.995	10.50	4.90 4.10	6.80	18.10	11.987 11.975	3.70	2.20 1.80	M1.6	0.75
3	3.003 2.995	12.50		7.80			5.70	3.20 2.80	M2	
4	4.003 3.995			9.80					M3	1.00
5	5.003 4.995									
6	6.003 5.995									

† ØD will not exceed the root diameter of the teeth.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120", 1/8", 3/16" & 1/4".

Part number selection table

Example Part No:- <u>AP06S1B5F45A-</u> <u>44</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
2	0.6	AP06S1B2F45A	AP06A1B2F45A	29	59
	0.5	AP05S1B2F45A	AP05A1B2F45A	34	72
	0.4	AP04S1B2F45A	AP04A1B2F45A	42	90
	0.3	AP03S1B2F45A	AP03A1B2F45A	55	121
	0.25	AP025S1B2F45A	AP025A1B2F45A	65	146
	0.2	AP02S1B2F45A	AP02A1B2F45A	80	183
3	0.6	AP06S1B3F45A	AP06A1B3F45A	29	59
	0.5	AP05S1B3F45A	AP05A1B3F45A	34	72
	0.4	AP04S1B3F45A	AP04A1B3F45A	42	90
	0.3	AP03S1B3F45A	AP03A1B3F45A	55	121
	0.25	AP025S1B3F45A	AP025A1B3F45A	65	146
	0.2	AP02S1B3F45A	AP02A1B3F45A	80	183
4	0.6	AP06S1B4F45A	AP06A1B4F45A	29	59
	0.5	AP05S1B4F45A	AP05A1B4F45A	34	72
	0.4	AP04S1B4F45A	AP04A1B4F45A	42	90
	0.3	AP03S1B4F45A	AP03A1B4F45A	55	121
	0.25	AP025S1B4F45A	AP025A1B4F45A	65	146
	0.2	AP02S1B4F45A	AP02A1B4F45A	80	183
5	0.6	AP06S1B5F45A	AP06A1B5F45A	29	59
	0.5	AP05S1B5F45A	AP05A1B5F45A	34	72
	0.4	AP04S1B5F45A	AP04A1B5F45A	42	90
	0.3	AP03S1B5F45A	AP03A1B5F45A	55	121
	0.25	AP025S1B5F45A	AP025A1B5F45A	65	146
	0.2	AP02S1B5F45A	AP02A1B5F45A	80	183
6	0.6	AP06S1B6F45A	AP06A1B6F45A	29	59
	0.5	AP05S1B6F45A	AP05A1B6F45A	34	72
	0.4	AP04S1B6F45A	AP04A1B6F45A	42	90
	0.3	AP03S1B6F45A	AP03A1B6F45A	55	121
	0.25	AP025S1B6F45A	AP025A1B6F45A	65	146
	0.2	AP02S1B6F45A	AP02A1B6F45A	80	183

General Information

All dimensions in mm
 General tolerances:
 $\pm 0.13\text{mm}$
 Material:
 Stainless steel
 or
 Aluminium alloy
 Pressure angle 20°

Anti-backlash Pin Hub Gears

2 - 6mm Bore

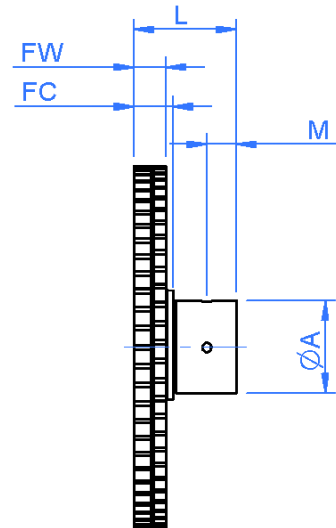
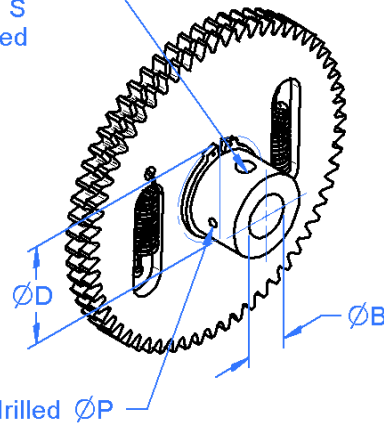
General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Skt. hd. set
screw S
supplied



Drawing dimension table

Bore Size	Bore Dia	Overall Length	Gear Face Width	Hub Dia	Circlip Dims		Hole Position	Set Screw	Sub-Drill
					Clearance ØD Max	Length			
Nom	ØB	L	FW	ØA		FC	M	S	ØP
2	2.003 1.995	9.00	3.62 3.17	9.40	15.00	4.49 3.91	2.00	M1.6	0.75
3	3.003 2.995	9.50					2.50	M2	
4	4.003 3.995	10.50					3.00	M2.5	1.00
5	5.003 4.995								
6	6.003 5.995	12.00		12.60	18.80	4.75 4.16	4.00	M3	1.50

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120", 1/8", 3/16" & 1/4".

Schlenker Ent. Ltd. Sales :
www.schlenkent.com

Phone:708.449.5700

Fax: 708.449.5703
sales@schlenkent.com

Part number selection table

Example Part No:- <u>AP06S1B5F35A-</u> <u>60</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
2	0.6	AP06S1B2F35A	AP06A1B2F35A	55	119
	0.5	AP05S1B2F35A	AP05A1B2F35A	66	143
	0.4	AP04S1B2F35A	AP04A1B2F35A	81	179
	0.3	AP03S1B2F35A	AP03A1B2F35A	107	240
	0.25	AP025S1B2F35A	AP025A1B2F35A	128	289
	0.2	AP02S1B2F35A	AP02A1B2F35A	159	361
3	0.6	AP06S1B3F35A	AP06A1B3F35A	55	119
	0.5	AP05S1B3F35A	AP05A1B3F35A	66	143
	0.4	AP04S1B3F35A	AP04A1B3F35A	81	179
	0.3	AP03S1B3F35A	AP03A1B3F35A	107	240
	0.25	AP025S1B3F35A	AP025A1B3F35A	128	289
	0.2	AP02S1B3F35A	AP02A1B3F35A	159	361
4	0.6	AP06S1B4F35A	AP06A1B4F35A	55	119
	0.5	AP05S1B4F35A	AP05A1B4F35A	66	143
	0.4	AP04S1B4F35A	AP04A1B4F35A	81	179
	0.3	AP03S1B4F35A	AP03A1B4F35A	107	240
	0.25	AP025S1B4F35A	AP025A1B4F35A	128	289
	0.2	AP02S1B4F35A	AP02A1B4F35A	159	361
5	0.6	AP06S1B5F35A	AP06A1B5F35A	55	119
	0.5	AP05S1B5F35A	AP05A1B5F35A	66	143
	0.4	AP04S1B5F35A	AP04A1B5F35A	81	179
	0.3	AP03S1B5F35A	AP03A1B5F35A	107	240
	0.25	AP025S1B5F35A	AP025A1B5F35A	128	289
	0.2	AP02S1B5F35A	AP02A1B5F35A	159	361
6	0.6	AP06S1B6F35A	AP06A1B6F35A	55	119
	0.5	AP05S1B6F35A	AP05A1B6F35A	66	143
	0.4	AP04S1B6F35A	AP04A1B6F35A	81	179
	0.3	AP03S1B6F35A	AP03A1B6F35A	107	240
	0.25	AP025S1B6F35A	AP025A1B6F35A	128	289
	0.2	AP02S1B6F35A	AP02A1B6F35A	159	361

General Information

All dimensions in mm
 General tolerances:
 $\pm 0.13\text{mm}$
 Material:
 Stainless steel
 or
 Aluminium alloy
 Pressure angle 20°

Anti-backlash Pin Hub Gears

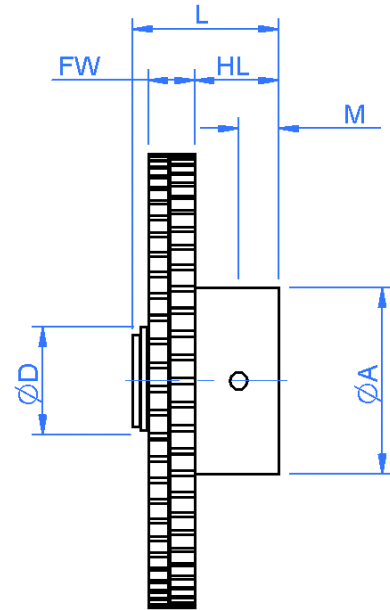
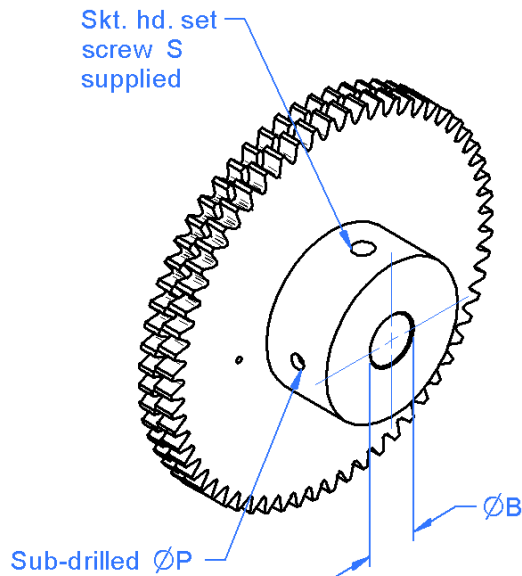
8 - 10mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Hub Dia ØA	Clearance ØD Max	Hub Length HL	Hole Position M	Set Screw S	Sub-Drill ØP
8	8.003 7.995	20.00	6.65 6.17	25.40	18.80	11.88 11.20	5.50	M4	2.40
10	10.003 9.995							M5	

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore size 5/16" & 3/8".

Part number selection table

Example Part No:- <u>AP06S1B8F61A-</u> <u>60</u>					
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
8	0.6	AP06S1B8F61A	AP06A1B8F61A	48	127
	0.5	AP05S1B8F61A	AP05A1B8F61A	56	152
	0.4	AP04S1B8F61A	AP04A1B8F61A	70	190
	0.3	AP03S1B8F61A	AP03A1B8F61A	92	254
	0.25	AP025S1B8F61A	AP025A1B8F61A	110	304
	0.2	AP02S1B8F61A	AP02A1B8F61A	136	381
10	0.6	AP06S1B10F61A	AP06A1B10F61A	48	127
	0.5	AP05S1B10F61A	AP05A1B10F61A	56	152
	0.4	AP04S1B10F61A	AP04A1B10F61A	70	190
	0.3	AP03S1B10F61A	AP03A1B10F61A	92	254
	0.25	AP025S1B10F61A	AP025A1B10F61A	110	304
	0.2	AP02S1B10F61A	AP02A1B10F61A	136	381

General
Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°



Reli-a-Grip™ Clamp Hub Gears

3 - 5mm Bore

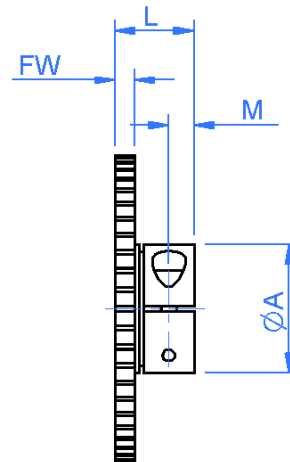
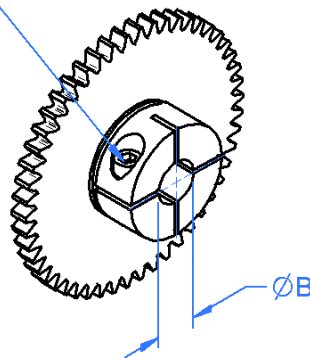
General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Skt. hd. cap
screw S
supplied



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Reli-a-Grip™ Dia ØA	Hole Position M	Screw Supplied S
3	3.003	8	2	13.00	2.50	M1.6
	2.995	10	4			
4	4.003	8	2			
	3.995	10	4			
5	5.003	8	2			
	4.995	10	4			

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 1/8", 3/16" & 1/4".

Part number selection table

Example Part No:- **G06S1B5 F2A- 50**

Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth		
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max	
						F2A	F4A
3	0.6	G06S1B3	G06A1B3	F2A- (2mm) or F4A- (4mm)	25	55	124
	0.5	G05S1B3	G05A1B3		29	67	149
	0.4	G04S1B3	G04A1B3		36	84	187
	0.3	G03S1B3	G03A1B3		47	113	250
	0.25	G025S1B3	G025A1B3		56	136	301
	0.2	G02S1B3	G02A1B3		69	171	377
4	0.6	G06S1B4	G06A1B4	F2A- (2mm) or F4A- (4mm)	25	55	124
	0.5	G05S1B4	G05A1B4		29	67	149
	0.4	G04S1B4	G04A1B4		36	84	187
	0.3	G03S1B4	G03A1B4		47	113	250
	0.25	G025S1B4	G025A1B4		56	136	301
	0.2	G02S1B4	G02A1B4		69	171	377
5	0.6	G06S1B5	G06A1B5	F2A- (2mm) or F4A- (4mm)	25	55	124
	0.5	G05S1B5	G05A1B5		29	67	149
	0.4	G04S1B5	G04A1B5		36	84	187
	0.3	G03S1B5	G03A1B5		47	113	250
	0.25	G025S1B5	G025A1B5		56	136	301
	0.2	G02S1B5	G02A1B5		69	171	377

General Information

All dimensions in mm
General tolerances: ±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°



Reli-a-Grip™ Clamp Hub Gears

6 - 10mm Bore

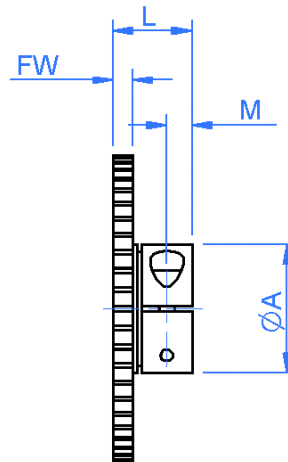
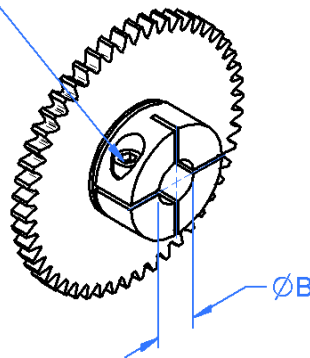
General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Skt. hd. cap
screw S
supplied



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Reli-a-Grip™ Dia ØA	Hole Position M	Screw Supplied S
6	6.003 5.995	9	3	13.00	2.50	M1.6
		10	4			
		12	6			
8	8.003 7.995	11	4	16.00	3.00	M2
		13	6			
10	10.003 9.995	12	4	20.00	3.50	M2.5
		14	6			

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities, see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 1/4", 5/16" & 3/8".

Schlenker Ent. Ltd. Sales :
www.schlenkent.com

Phone:708.449.5700

Fax: 708.449.5703
sales@schlenkent.com

Part number selection table

Example Part No:- G06S1B5 F2A- 50						
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth	
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max
6	0.6	G06S1B6	G06A1B6	F3A- (3mm)	25	124
	0.5	G05S1B6	G05A1B6		29	149
	0.4	G04S1B6	G04A1B6	F4A- (4mm)	36	187
	0.3	G03S1B6	G03A1B6		47	250
	0.25	G025S1B6	G025A1B6	F6A- (6mm)	56	301
	0.2	G02S1B6	G02A1B6		69	377
8	0.6	G06S1B8	G06A1B8	F4A- (4mm)	30	124
	0.5	G05S1B8	G05A1B8		35	149
	0.4	G04S1B8	G04A1B8	F6A- (6mm)	43	187
	0.3	G03S1B8	G03A1B8		57	250
	0.25	G025S1B8	G025A1B8		68	301
	0.2	G02S1B8	G02A1B8		84	377
10	0.6	G06S1B10	G06A1B10	F4A- (4mm)	36	124
	0.5	G05S1B10	G05A1B10		43	149
	0.4	G04S1B10	G04A1B10	F6A- (6mm)	53	187
	0.3	G03S1B10	G03A1B10		70	250
	0.25	G025S1B10	G025A1B10		84	301
	0.2	G02S1B10	G02A1B10		104	377

General Information

All dimensions in mm
General tolerances: ±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°



Clamp Hub Spur Gear

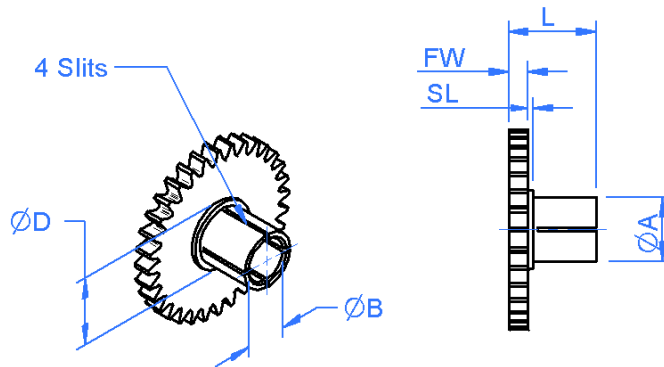
2 - 5mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face width FW	Clamp Dia ØA	Shoulder Dia ØD	Shoulder Length SL	Recommended Clamp #	
2	2.003	7	2	3.60	7.4	0.50	CGAM-2A or CGM1-2	
	1.995	9	4	3.56				
3	3.003	7	2	4.60	6.6		CGAM-3A or CGM1-3	
	2.995	9	4	4.56				
4	4.003	9	2	5.60	8.4		CGAM-4A or CGM1-4	
	3.995	11	4	5.56				
5	5.003	9	2	6.60			7.6	CGAM-5A or CGM1-5
	4.995	11	4	6.56				

See gear clamps on pages 52 - 53 for information.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Special 0.120" bore to suit resolvers available.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120", 1/8" & 3/16".
- Larger numbers of teeth.

Part number selection table

Example Part No:-

C06S1B5 F2A- 25

Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth		
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max	
						F2A	F4A
2	0.6	C06S1B2	C06A1B2	F2A- (2mm) or F4A- (4mm)	14 †	56	127
	0.5	C05S1B2	C05A1B2		14 †	67	152
	0.4	C04S1B2	C04A1B2		15 †	85	190
	0.3	C03S1B2	C03A1B2		17	114	254
	0.25	C025S1B2	C025A1B2		18	137	304
	0.2	C02S1B2	C02A1B2		20	172	381
3	0.6	C06S1B3	C06A1B3	F2A- (2mm) or F4A- (4mm)	15 †	25 #	
	0.5	C05S1B3	C05A1B3		16 †	29 #	
	0.4	C04S1B3	C04A1B3		18	36 #	
	0.3	C03S1B3	C03A1B3		20	47 #	
	0.25	C025S1B3	C025A1B3		22	56 #	
	0.2	C02S1B3	C02A1B3		25	69 #	
4	0.6	C06S1B4	C06A1B4	F2A- (2mm) or F4A- (4mm)	17	25 #	
	0.5	C05S1B4	C05A1B4		18	29 #	
	0.4	C04S1B4	C04A1B4		20	36 #	
	0.3	C03S1B4	C03A1B4		24	47 #	
	0.25	C025S1B4	C025A1B4		26	56 #	
	0.2	C02S1B4	C02A1B4		30	69 #	
5	0.6	C06S1B5	C06A1B5	F2A- (2mm) or F4A- (4mm)	19	25 #	
	0.5	C05S1B5	C05A1B5		20	29 #	
	0.4	C04S1B5	C04A1B5		23	36 #	
	0.3	C03S1B5	C03A1B5		27	47 #	
	0.25	C025S1B5	C025A1B5		30	56 #	
	0.2	C02S1B5	C02A1B5		35	69 #	

General Information

All dimensions in mm

General tolerances:

±0.13mm

Material:

Stainless steel

or

Aluminium alloy

Pressure angle 20°

† Gears of 16 teeth or fewer will be modified, see page 63.

For greater numbers of teeth, see Reli-a-Grip™ gears on page 24. Although larger numbers of teeth are available on this style if required.



Clamp Hub Spur Gear

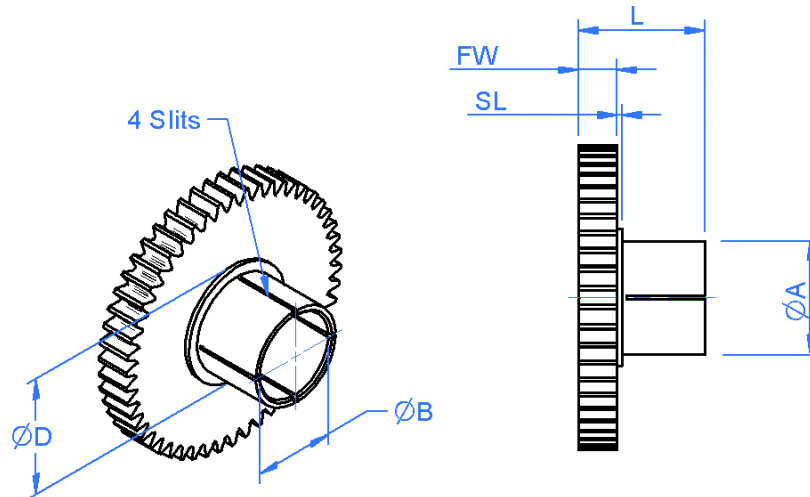
6 - 12mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face width FW	Clamp Dia ØA	Shoulder Dia ØD	Shoulder Length SL	Recommended Clamp #
6	6.003	10	3	7.60	10.40	0.50	CGAM-6A
	5.995	11	4	7.56	9.60		
		13	6				
8	8.003	13	4	9.60	12.40		CGAM-8A
	7.995	15	6	9.56	11.60		
10	10.003	13	4	11.60	14.40		CGAM-10A
	9.995	15	6	11.56	13.60		
12	12.003	15	6	13.60	16.40		CGAM-12A
	11.995	19	10	13.56	15.60		

see gear clamps on page 53 for information.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 1/4", 5/16", 3/8" & 1/2".
- Larger numbers of teeth.

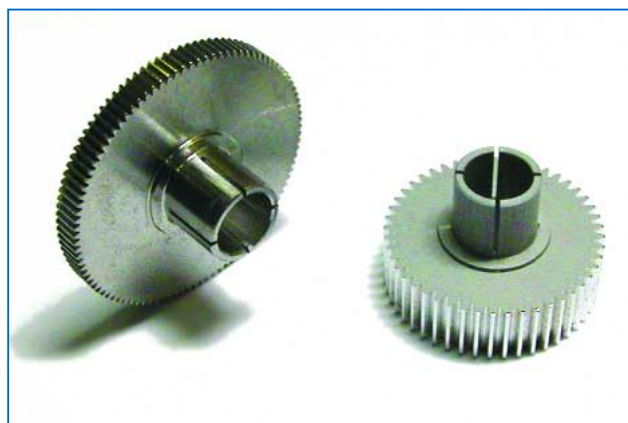
Part number selection table

Example Part No:- C06S1B6 F2A- 32						
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth	
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max
6	0.6	C06S1B6	C06A1B6	F3A- (3mm)	20	25#
	0.5	C05S1B6	C05A1B6		22	29#
	0.4	C04S1B6	C04A1B6	F4A- (4mm)	25	36#
	0.3	C03S1B6	C03A1B6		30	47#
	0.25	C025S1B6	C025A1B6	F6A- (6mm)	34	56#
	0.2	C02S1B6	C02A1B6		40	69#
8	0.6	C06S1B8	C06A1B8	F4A- (4mm)	24	30#
	0.5	C05S1B8	C05A1B8		26	35#
	0.4	C04S1B8	C04A1B8	F6A- (6mm)	30	43#
	0.3	C03S1B8	C03A1B8		37	57#
	0.25	C025S1B8	C025A1B8	F6A- (6mm)	42	68#
	0.2	C02S1B8	C02A1B8		50	84#
10	0.6	C06S1B10	C06A1B10	F4A- (4mm)	27	36#
	0.5	C05S1B10	C05A1B10		30	43#
	0.4	C04S1B10	C04A1B10	F6A- (6mm)	35	53#
	0.3	C03S1B10	C03A1B10		44	70#
	0.25	C025S1B10	C025A1B10	F6A- (6mm)	50	84#
	0.2	C02S1B10	C02A1B10		60	104#
12	0.6	C06S1B12	C06A1B12	F6A- (6mm)	30	127
	0.5	C05S1B12	C05A1B12		34	152
	0.4	C04S1B12	C04A1B12	F10A- (10mm)	40	190
	0.3	C03S1B12	C03A1B12		50	254
	0.25	C025S1B12	C025A1B12	F10A- (10mm)	58	304
	0.2	C02S1B12	C02A1B12		70	381

General Information

All dimensions in mm
General tolerances: ±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°

For greater numbers of teeth, see Reli-a-Grip™ gears on page 26. Although larger numbers of teeth are available on this style if required.



Pin Hub Spur Gear

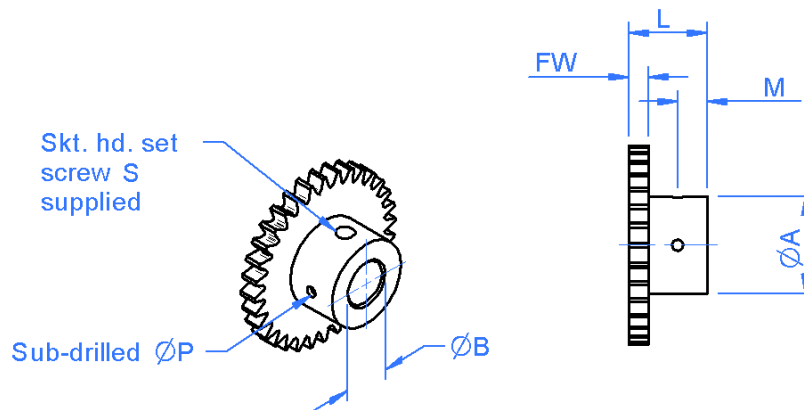
2 - 5mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Boss Dia ØA	Hole Position M	Set Screw S	Sub-Drill ØP
2	2.003	7	2	7.00	2.70 2.30	M1.6	0.8
	1.995	9	4			M2	
3	3.003	7	2	8.00	3.20 2.80	M2.5	1.2
	2.995	9	4				
4	4.003	8	2	9.00	3.20 2.80	M2.5	1.2
	3.995	10	4				
5	5.003	8	2	10.00	3.20 2.80	M2.5	1.2
	4.995	10	4				

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 5/64", 0.120" ,1/8" & 3/16".

Part number selection table

Example Part No:-

P06S1B5 F2A- 32

Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth		
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max	
						F2A	F4A
2	0.6	P06S1B2	P06A1B2	F2A- (2mm) or F4A- (4mm)	15 †	56	127
	0.5	P05S1B2	P05A1B2		18	67	152
	0.4	P04S1B2	P04A1B2		21	85	190
	0.3	P03S1B2	P03A1B2		27	114	254
	0.25	P025S1B2	P025A1B2		31	137	304
	0.2	P02S1B2	P02A1B2		38	172	381
3	0.6	P06S1B3	P06A1B3	F2A- (2mm) or F4A- (4mm)	17	56	127
	0.5	P05S1B3	P05A1B3		20	67	152
	0.4	P04S1B3	P04A1B3		23	85	190
	0.3	P03S1B3	P03A1B3		30	114	254
	0.25	P025S1B3	P025A1B3		35	137	304
	0.2	P02S1B3	P02A1B3		43	172	381
4	0.6	P06S1B4	P06A1B4	F2A- (2mm) or F4A- (4mm)	19	56	127
	0.5	P05S1B4	P05A1B4		22	67	152
	0.4	P04S1B4	P04A1B4		26	85	190
	0.3	P03S1B4	P03A1B4		34	114	254
	0.25	P025S1B4	P025A1B4		39	137	304
	0.2	P02S1B4	P02A1B4		48	172	381
5	0.6	P06S1B5	P06A1B5	F2A- (2mm) or F4A- (4mm)	21	56	127
	0.5	P05S1B5	P05A1B5		24	67	152
	0.4	P04S1B5	P04A1B5		29	85	190
	0.3	P03S1B5	P03A1B5		37	114	254
	0.25	P025S1B5	P025A1B5		43	137	304
	0.2	P02S1B5	P02A1B5		53	172	381

General Information

All dimensions in mm
General tolerances: ±0.13mm
Material:
Stainless steel
or
Aluminium alloy
Pressure angle 20°

† Gears of 16 teeth or fewer will be modified, see page 63.



Pin Hub Spur Gear

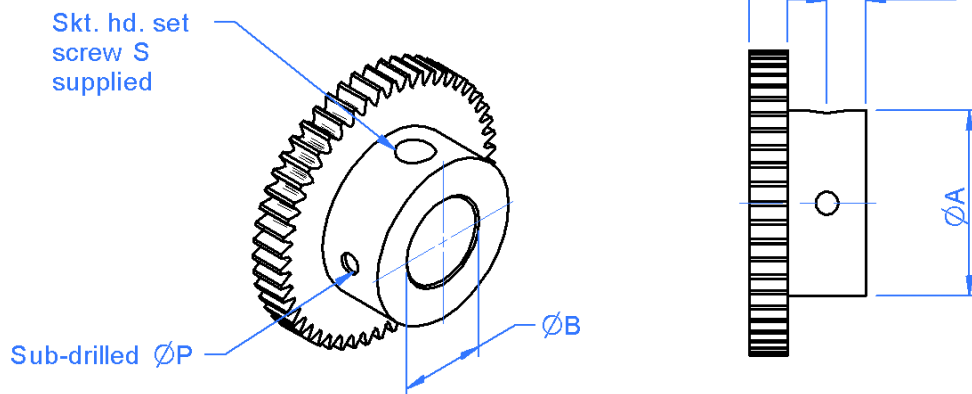
6 - 12mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Boss Dia ØA	Hole Position M	Set Screw S	Sub-Drill ØP
6	6.003 5.995	9	3	12.00	3.20 2.80	M3	1.6
		10	4				
		12	6				
8	8.003 7.995	10	4	16.00		M4	2.0
		12	6				
10	10.003 9.995	12	4	19.00	4.20 3.80	M5	2.4
		14	6				
12	12.003 11.995	20	8	24.00	6.20 5.80	M6	
		24	12				

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 1/4", 5/16", 3/8" & 1/2".

Part number selection table

Example Part No:- P06S1B8 F4A- 32						
Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth	
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max
6	0.6	P06S1B6	P06A1B6	F3A- (3mm)	23	127
	0.5	P05S1B6	P05A1B6		27	152
	0.4	P04S1B6	P04A1B6	F4A- (4mm)	33	190
	0.3	P03S1B6	P03A1B6		43	254
	0.25	P025S1B6	P025A1B6	F6A- (6mm)	50	304
	0.2	P02S1B6	P02A1B6		62	381
8	0.6	P06S1B8	P06A1B8	F4A- (4mm)	30	127
	0.5	P05S1B8	P05A1B8		35	152
	0.4	P04S1B8	P04A1B8	F6A- (6mm)	43	190
	0.3	P03S1B8	P03A1B8		56	254
	0.25	P025S1B8	P025A1B8	F6A- (6mm)	66	304
	0.2	P02S1B8	P02A1B8		82	381
10	0.6	P06S1B10	P06A1B10	F4A- (4mm)	34	127
	0.5	P05S1B10	P05A1B10		40	152
	0.4	P04S1B10	P04A1B10	F6A- (6mm)	50	190
	0.3	P03S1B10	P03A1B10		65	254
	0.25	P025S1B10	P025A1B10	F6A- (6mm)	77	304
	0.2	P02S1B10	P02A1B10		95	381
12	0.6	P06S1B12	P06A1B12	F8A- (8mm)	41	127
	0.5	P05S1B12	P05A1B12		48	152
	0.4	P04S1B12	P04A1B12	F12A- (12mm)	59	190
	0.3	P03S1B12	P03A1B12		77	254
	0.25	P025S1B12	P025A1B12	F12A- (12mm)	92	304
	0.2	P02S1B12	P02A1B12		113	381

General Information

All dimensions in mm
 General tolerances:
 ±0.13mm
 Material:
 Stainless steel
 or
 Aluminium alloy
 Pressure angle 20°

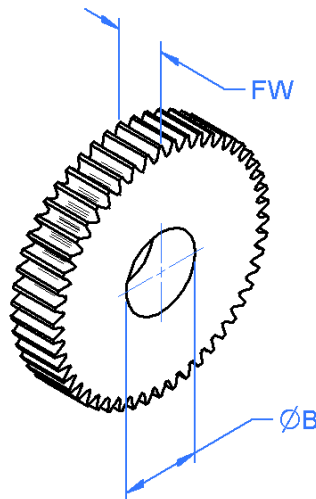


General Information

All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Gear Face Width FW
5	5.003	3
	4.995	6
10	10.003	3
	9.995	6
15	15.003	3
	14.995	6
25	25.003	3
	24.995	6

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Alternative bore sizes.
- Imperial diametral pitches.
- Imperial bore sizes 3/16", 3/8", 11/16" & 1".

Part number selection table

Example Part No:-

F06S1B10 F6A- 50

Bore Size Nom	Standard Modules	Basic Part Number Standard Materials		Face Width	Number of Teeth	
		Stainless Steel	Aluminium Alloy	Dim FW	Min	Max
5	0.6	F06S1B5	F06A1B5	F3A- (3mm) or F6A- (6mm)	19	127
	0.5	F05S1B5	F05A1B5		20	152
	0.4	F04S1B5	F04A1B5		23	190
	0.3	F03S1B5	F03A1B5		27	254
	0.25	F025S1B5	F025A1B5		30	304
	0.2	F02S1B5	F02A1B5		35	381
10	0.6	F06S1B10	F06A1B10	F3A- (3mm) or F6A- (6mm)	27	127
	0.5	F05S1B10	F05A1B10		30	152
	0.4	F04S1B10	F04A1B10		35	190
	0.3	F03S1B10	F03A1B10		44	254
	0.25	F025S1B10	F025A1B10		50	304
	0.2	F02S1B10	F02A1B10		60	381
15	0.6	F06S1B15	F06A1B15	F3A- (3mm) or F6A- (6mm)	35	127
	0.5	F05S1B15	F05A1B15		40	152
	0.4	F04S1B15	F04A1B15		48	190
	0.3	F03S1B15	F03A1B15		60	254
	0.25	F025S1B15	F025A1B15		70	304
	0.2	F02S1B15	F02A1B15		85	381
25	0.6	F06S1B25	F06A1B25	F3A- (3mm) or F6A- (6mm)	52	127
	0.5	F05S1B25	F05A1B25		60	152
	0.4	F04S1B25	F04A1B25		73	190
	0.3	F03S1B25	F03A1B25		94	254
	0.25	F025S1B25	F025A1B25		110	304
	0.2	F02S1B25	F02A1B25		135	381

General Information

All dimensions in mm

General tolerances:

±0.13mm

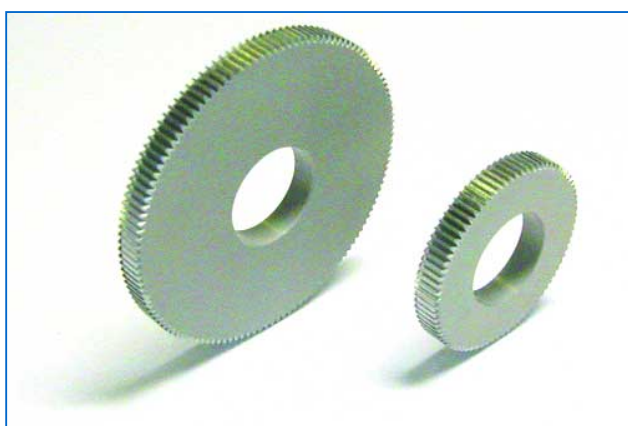
Material:

Stainless steel

or

Aluminium alloy

Pressure angle 20°



Anti-backlash Synchro Gears

4.76mm Bore

General Information

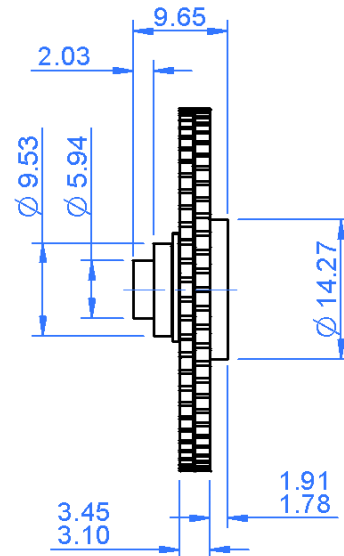
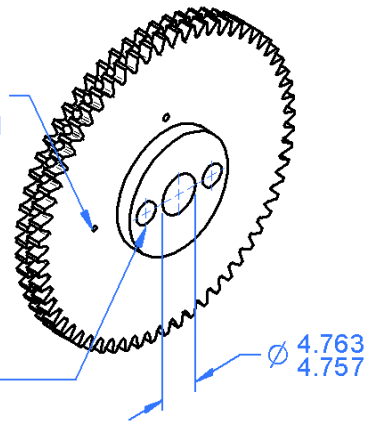
All dimensions in mm
General tolerances:
±0.13mm

Material:
Stainless steel
or
Aluminium alloy

Pressure angle 20°

Fitting pin
to be removed
after meshing

Two holes to
suit lugs on
drive washer



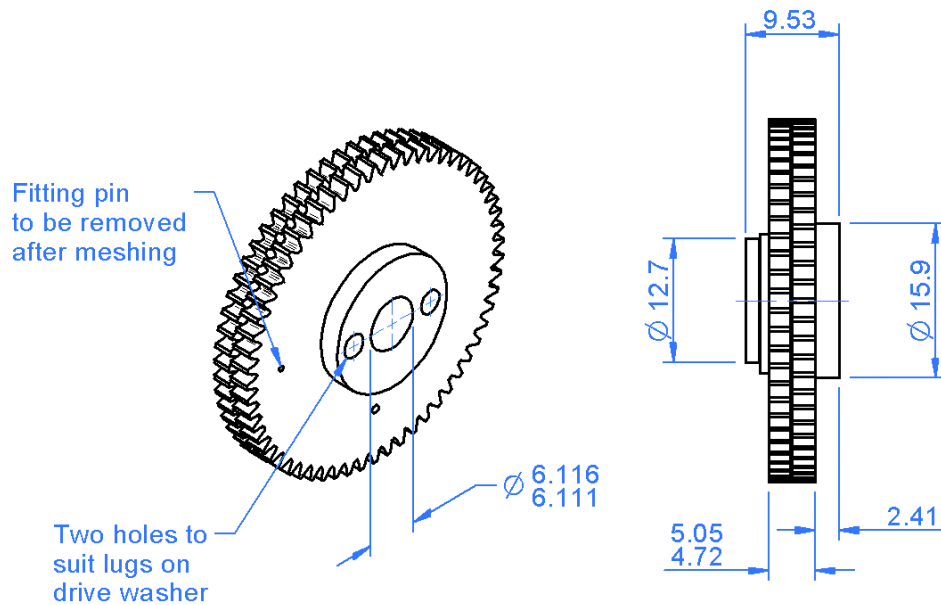
Part number selection table

Example Part No:- AS06S1B4.7F33A- 60					
Bore Size	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
4.76	0.6	AS06S1B4.7F33A-	AS06A1B4.7F33A-	30	102
	0.5	AS05S1B4.7F33A-	AS05A1B4.7F33A-	36	123
	0.4	AS04S1B4.7F33A-	AS04A1B4.7F33A-	44	154
	0.3	AS03S1B4.7F33A-	AS03A1B4.7F33A-	57	207
	0.25	AS025S1B4.7F33A-	AS025A1B4.7F33A-	68	248
	0.2	AS02S1B4.7F33A-	AS02A1B4.7F33A-	84	311

- Standard gear quality AQ10 - see page 56.
- To suit size 11, 15, & 18 synchros.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore size 0.187".



General Information

All dimensions in mm
 General tolerances:
 ± 0.13 mm
 Material:
 Stainless steel
 or
 Aluminium alloy
 Pressure angle 20°

Part number selection table

Example Part No:-

AS06S1B6.1F49A- 60

Bore Size	Standard Modules	Basic Part Number Standard Materials		Number of Teeth	
		Stainless Steel	Aluminium Alloy	Min	Max
6.11	0.6	AS06S1B6.1F49A-	AS06A1B6.1F49A-	39	144
	0.5	AS05S1B6.1F49A-	AS05A1B6.1F49A-	46	174
	0.4	AS04S1B6.1F49A-	AS04A1B6.1F49A-	57	218
	0.3	AS03S1B6.1F49A-	AS03A1B6.1F49A-	75	291
	0.25	AS025S1B6.1F49A-	AS025A1B6.1F49A-	89	350
	0.2	AS02S1B6.1F49A-	AS02A1B6.1F49A-	111	438

- Standard gear quality AQ10 - see page 56.
- To suit size 23 synchro.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore size 0.2406".

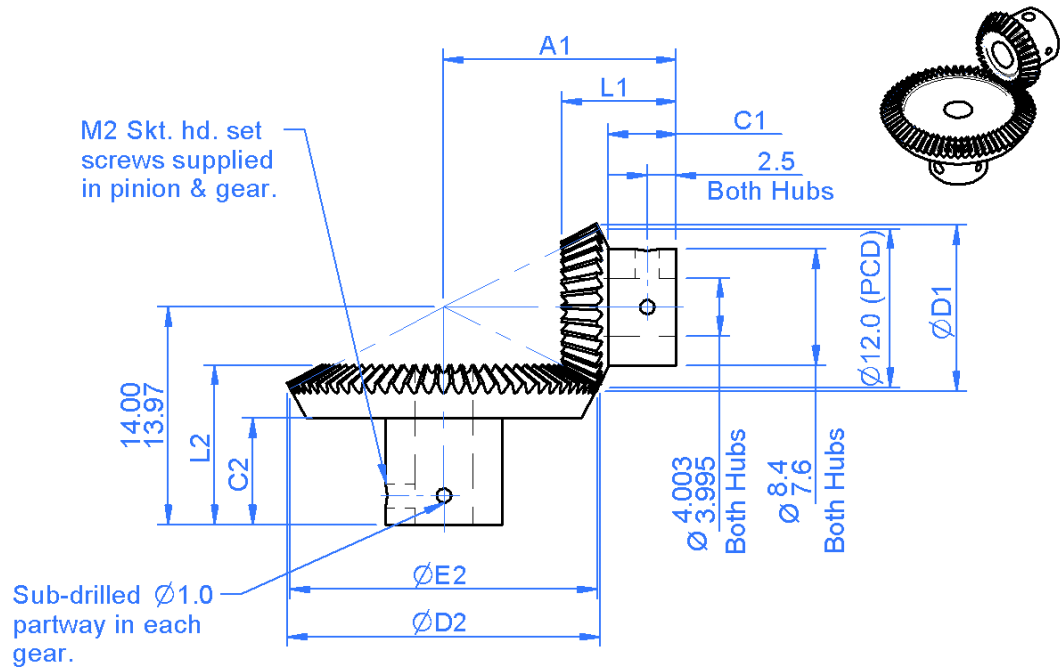
Bevel Gears

4mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel 303

Pressure angle 20°
Gleason system

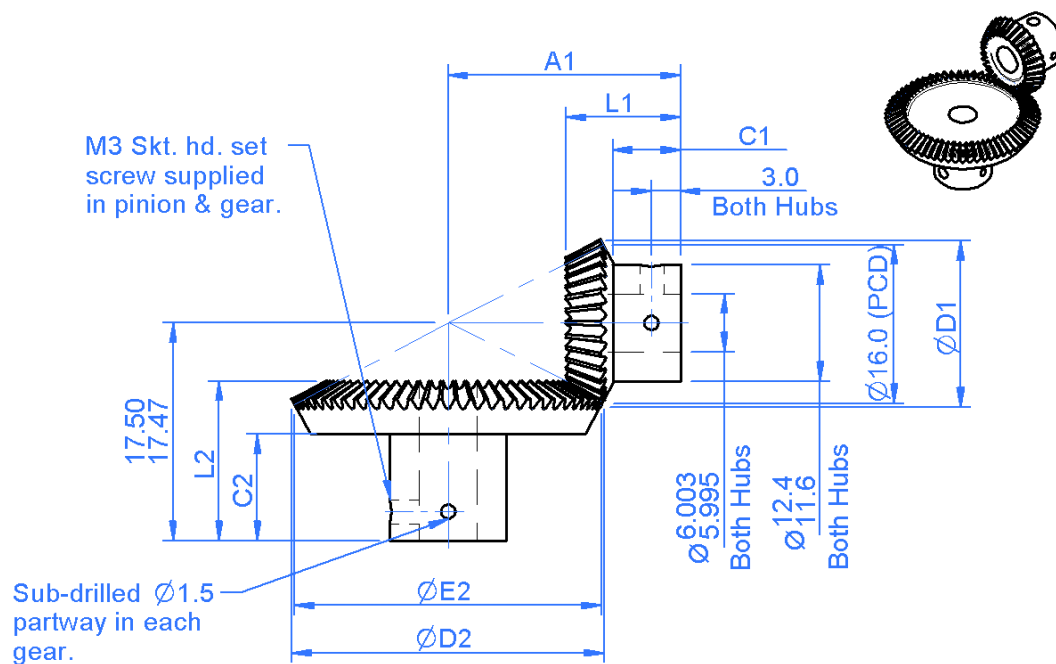


Drawing dimension table

Part Number (pair)	Overall Length ±0.15		Outside Dia +0.00 / -0.05		Pitch Dia	Hub Lengths ±0.25		Distance to Apex +0.00 / -0.03
	Pinion L1	Gear L2	Pinion ØD1	Gear ØD2	Gear ØE2	Pinion C1	Gear C2	Pinion A1
M04N-1S	10.28	10.28	12.56	12.56	12.0	6.00	6.00	14.00
M04N-2S	9.86	9.50	12.96	24.23	24.0	6.00	5.00	19.00
M04N-3S	9.00	9.13	13.07	36.15	36.0	5.33	5.00	24.00
M04N-4S	8.03	8.91	13.11	48.11	48.0	4.50	5.00	29.00

Specifications table

Part Number (pair)	Ratio	Pitch (module)	Number of Teeth		Max. Tooth to Tooth Comp. Error (pair)	Max. Total Comp. Error (pair)
			Pinion	Gear		
M04N-1S	1:1	0.4	30	30	0.025	0.050
M04N-2S	2:1		30	60		
M04N-3S	3:1		30	90		
M04N-4S	4:1		30	120		



General Information

All dimensions in mm
 General tolerances:
 $\pm 0.13\text{mm}$
 Material:
 Stainless steel 303
 Pressure angle 20°
 Gleason system

Drawing dimension table

Part Number (pair)	Overall Length ± 0.15		Outside Dia $+0.00 / -0.05$		Pitch Dia	Hub Lengths ± 0.25		Distance to Apex $+0.00 / -0.03$
	Pinion L1	Gear L2	Pinion ØD1	Gear ØD2	Gear ØE2	Pinion C1	Gear C2	Pinion A1
M05N-1S	12.52	12.52	16.71	16.71	16.0	7.50	7.50	17.50
M05N-2S	11.80	11.49	17.20	32.29	32.0	7.00	6.00	24.00
M05N-3S	9.98	10.98	17.34	48.19	48.0	5.30	6.00	30.00
M05N-4S	10.03	10.70	17.39	64.14	64.0	5.50	6.00	38.00

Specifications table

Part Number (pair)	Ratio	Pitch (module)	Number of Teeth		Max. Tooth to Tooth Comp. Error (pair)	Max. Total Comp. Error (pair)
			Pinion	Gear		
M05N-1S	1:1	0.5	32	32	0.025	0.050
M05N-2S	2:1		32	64		
M05N-3S	3:1		32	96		
M05N-4S	4:1		32	128		

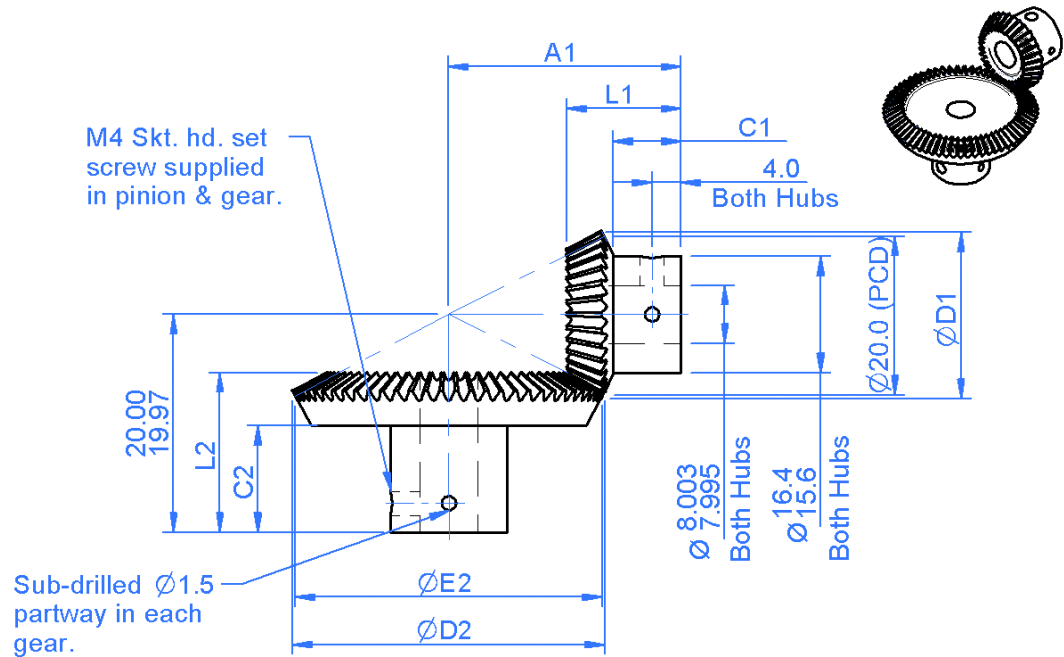
Bevel Gears

8mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel 303

Pressure angle 20°
Gleason system

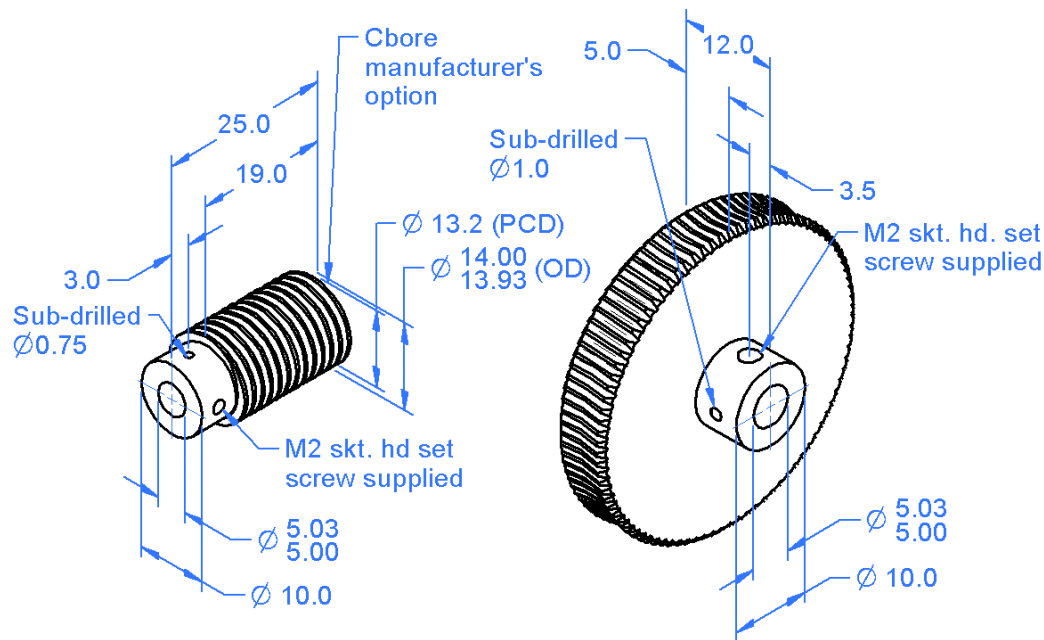


Drawing dimension table

Part Number (pair)	Overall Length ±0.15		Outside Dia +0.00 / -0.05		Pitch Dia	Hub Lengths ±0.25		Distance to Apex +0.00 / -0.03
	Pinion L1	Gear L2	Pinion ØD1	Gear ØD2	Gear ØE2	Pinion C1	Gear C2	Pinion A1
M08N-1S	14.51	14.51	21.13	21.13	20.0	8.30	8.30	20.00
M08N-2S	15.70	13.00	21.93	40.47	40.0	9.00	7.50	30.00

Specifications table

Part Number (pair)	Ratio	Pitch (module)	Number of Teeth		Max. Tooth to Tooth Comp. Error (pair)	Max. Total Comp. Error (pair)
			Pinion	Gear		
M08N-1S	1:1	0.8	25	25	0.025	0.050
M08N-2S	2:1		25	50		



General Information

All dimensions in mm
 General tolerances:
 $\pm 0.5\text{mm}$
 Material:
 Stainless steel
 (DIN 1.4305) worm.
 Brass (Naval
 QQ-B-637) wheels.
 Pressure angle 14.5°
 Right hand.

Part number selection tables

Worm		Wormwheel		
Lead Angle	$1^\circ 44'$	Part Number	Number of Teeth	Pitch Diameter
Lead	1.257	WGB83-S40	40	16.00
P.A.	14.5°	WGB83-S50	50	20.00
Part Number	WGS-5S	WGB83-S60	60	24.00
		WGB83-S70	70	28.00
		WGB83-S80	80	32.00
		WGB83-S90	90	36.00
		WGB83-S100	100	40.00
		WGB83-S110	110	44.00
		WGB83-S120	120	48.00

- Accuracy AQ10 - see page 56.
- Material and treatment specifications - see page 59.
- See page 45 for worm gear formulae.

Non-standard options, please enquire....

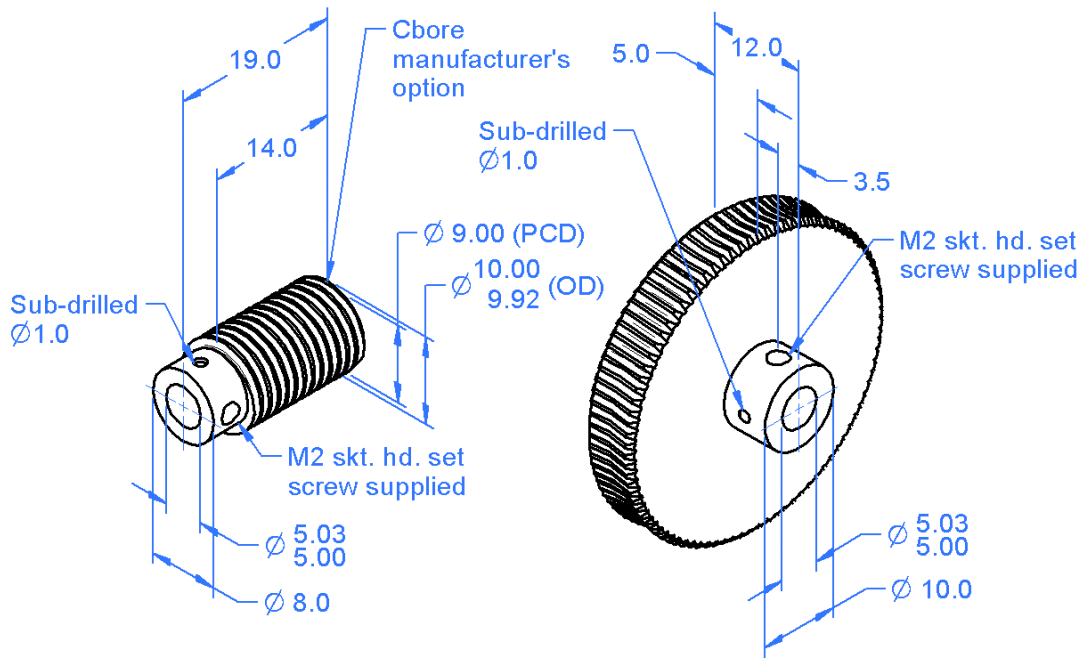
- Higher accuracies.
- Anti-backlash.

General Information

All dimensions in mm
General tolerances:
±0.5mm
Material:

Stainless steel
(DIN 1.4305) worm.
Brass (Naval
QQ-B-637) wheels.

Pressure angle 14.5°
Right hand.



Part number & drawing dimension table

Worm		Wormwheel		
Lead Angle	3° 10'	Part Number	Number of Teeth	Pitch Diameter
Lead	1.571	WFB83-S30	30	15.00
P.A.	14.5°	WFB83-S40	40	20.00
Part Number	WFS-5S	WFB83-S50	50	25.00
		WFB83-S60	60	30.00
		WFB83-S70	70	35.00
		WFB83-S80	80	40.00
		WFB83-S90	90	45.00
		WFB83-S100	100	50.00
		WFB83-S120	120	60.00

- Accuracy AQ10 - see page 56.
- Material and treatment specifications - see page 59.
- See page 45 for worm gear formulae.

Non-standard options, please enquire....

- Higher accuracies.
- Anti-backlash.

$$\text{Ratio (R)} = \frac{\text{No. of teeth on wormwheel (T)}}{\text{No. of starts on worm (t)}}$$

$$\text{Center Distance (CD)} = \frac{\text{PCD worm}}{2} + \frac{\text{PCD wheel}}{2}$$

$$\text{Lead (L)} = \text{The axial distance by which a thread advances in one revolution} = \pi \times t \times m$$

Where m (metric) = Axial module

$$m \text{ (imperial)} = \frac{1}{\text{DP}}$$

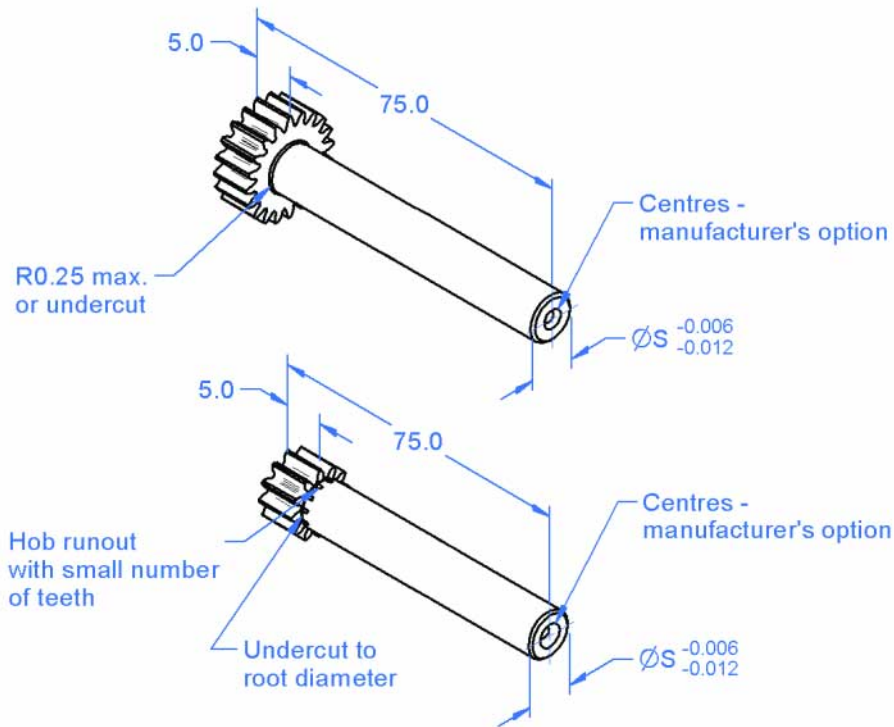
$$\text{Actual outside diameter of worm } OD_w = \text{PCD} + (2 \times m)$$

$$\text{Typical outside diameter of wormwheel } OD_{ww} = \text{PCD} + (3 \times m)$$



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel 303
Pressure angle 20°



Part number selection table

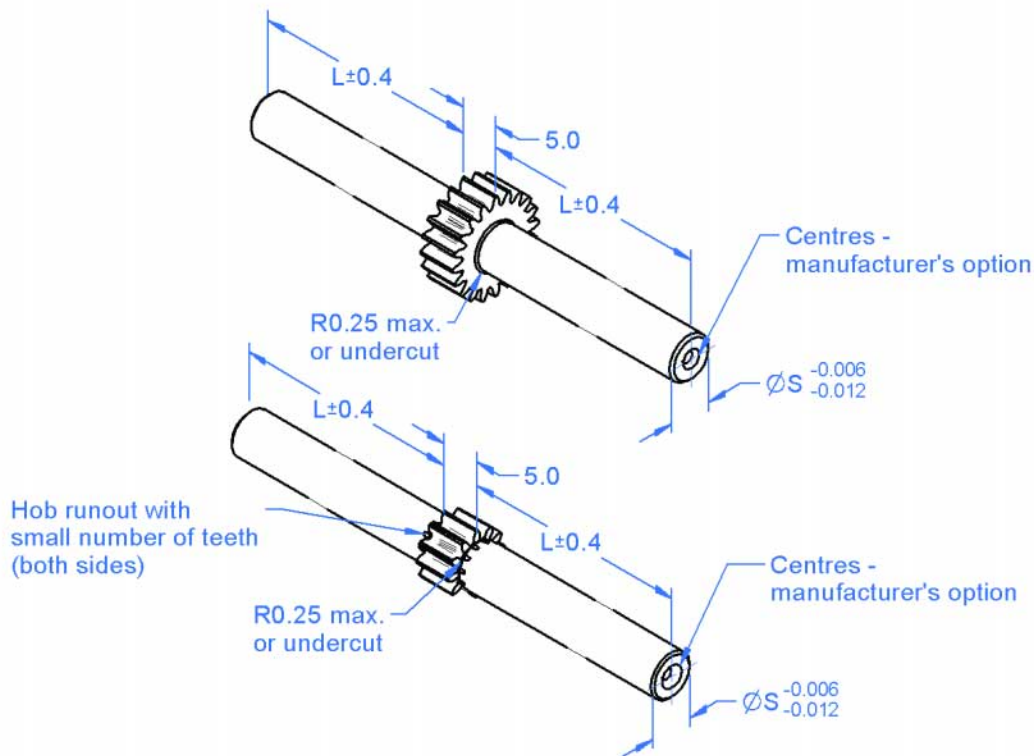
Shaft Diameter, ØS = 4.0				Shaft Diameter, ØS = 6.0			
Example Part No:- 5PS4T06- 12				Example Part No:- 5PS6T06- 20			
Basic Part Number	Module	Number of Teeth		Basic Part Number	Module	Number of Teeth	
		Min	Max			Min	Max
5PS4T06	0.6	12†	18	5PS6T06	0.6	12†	31
5PS4T05	0.5	12†	22	5PS6T05	0.5	12†	38
5PS4T04	0.4	14†	28	5PS6T04	0.4	14†	48
5PS4T03	0.3	16†	38	5PS6T03	0.3	16†	64
5PS4T025	0.25	16†	46	5PS6T025	0.25	20	78
5PS4T02	0.2	16†	58	5PS6T02	0.2	22	98

† Gears of 16 teeth or fewer will be modified - see technical section, page 63.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Shorter shaft lengths.



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel 303
Pressure angle 20°

Part number selection table

Shaft Diameter, ØS = 4.0 Shaft Lengths, L = 40.0				Shaft Diameter, ØS = 6.0 Shaft Lengths, L = 50.0			
Example Part No:- 5PD4T06- 12				Example Part No:- 5PD6T06- 20			
Basic Part Number	Module	Number of Teeth		Basic Part Number	Module	Number of Teeth	
		Min	Max			Min	Max
5PD4T06	0.6	12†	18	5PD6T06	0.6	12†	31
5PD4T05	0.5	12†	22	5PD6T05	0.5	12†	38
5PD4T04	0.4	14†	28	5PD6T04	0.4	14†	48
5PD4T03	0.3	16†	38	5PD6T03	0.3	16†	64
5PD4T025	0.25	16†	46	5PD6T025	0.25	20	78
5PD4T02	0.2	16†	58	5PD6T02	0.2	22	98

† Gears of 16 teeth or fewer will be modified - see technical section, page 63.

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

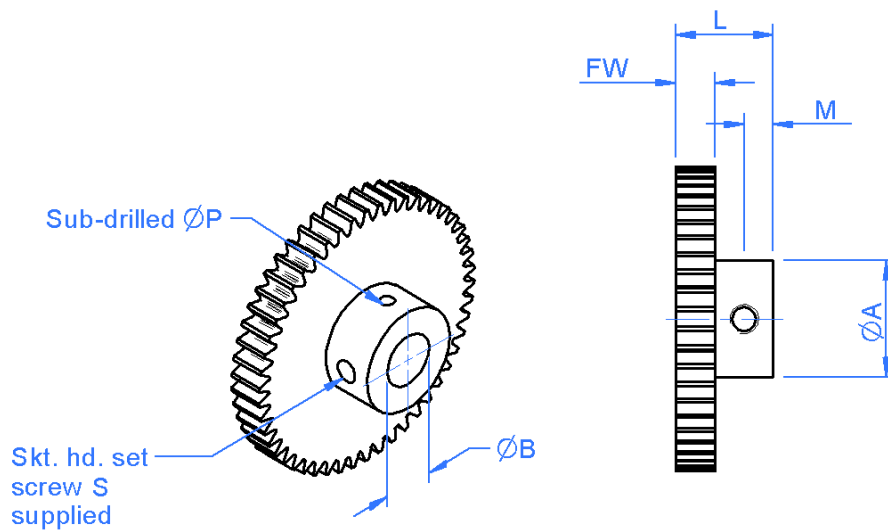
- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Shorter shaft lengths.

Hardened Pin Hub Spur Gear

5 - 8mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel,
17-4PH
Hardened to:
36-40 HRc
Pressure angle 20°



Drawing dimension table

Bore Size Nom	Bore Dia ØB	Overall Length L	Gear Face Width FW	Boss Dia ØA	Hole Position M	Set Screw S	Sub- Drill ØP
5	5.003	8	2	10.00	3.20 2.80	M2.5	1.2
	4.995	10	4				
6	6.003	9	3	12.00		M3	1.6
	5.995	10	4				
		12	6				
8	8.003	10	4	16.00		M4	2.0
	7.995	12	6				

- Standard gear quality AQ10 - see page 56.
- Material and treatment specifications - see page 59.

Non-standard options, please enquire....

- Higher gear qualities - see page 56.
- Alternative modules.
- Imperial diametral pitches.
- Imperial bore sizes 3/16", 1/4" & 5/16".
- # 17.75° helix angle available to order, (max number of teeth reduced by 5%).

Part number selection table

Example Part No:- <u>P06S9B6</u> <u>F4A-</u> <u>50</u>						
Bore Size Nom	Standard Modules	Basic Part Number Standard Material Hardened Stainless Steel #	Face Width	Number of Teeth		
			Dim FW	Min	Max	
					F2A	F4A
5	0.6	P06S9B5	F2A- (2mm) or F4A- (4mm)	21	56	127
	0.5	P05S9B5		24	67	152
	0.4	P04S9B5		29	85	190
	0.3	P03S9B5		37	114	254
	0.25	P025S9B5		43	137	304
	0.2	P02S9B5		53	172	381
6	0.6	P06S9B6	F3A- (3mm) or F4A- (4mm) or F6A- (6mm)	23	127	
	0.5	P05S9B6		27	152	
	0.4	P04S9B6		33	190	
	0.3	P03S9B6		43	254	
	0.25	P025S9B6		50	304	
	0.2	P02S9B6		62	381	
8	0.6	P06S9B8	F4A- (4mm) or F6A- (6mm)	30	127	
	0.5	P05S9B8		35	152	
	0.4	P04S9B8		43	190	
	0.3	P03S9B8		56	254	
	0.25	P025S9B8		66	304	
	0.2	P02S9B8		82	381	

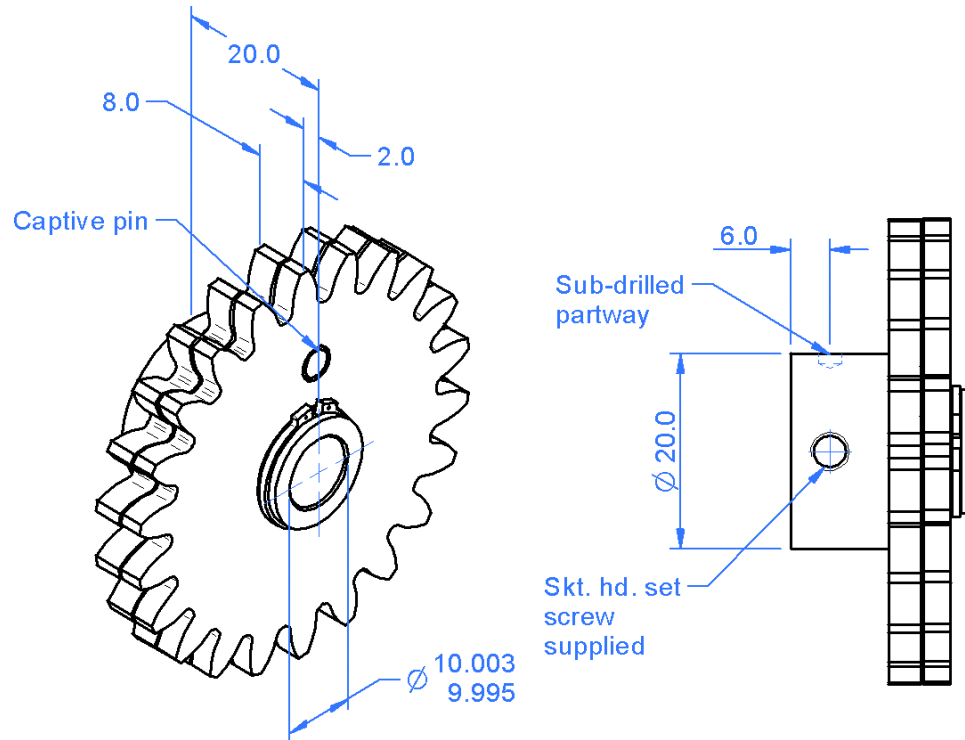
General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel,
17-4PH
Hardened to:
36-40 HRC
Pressure angle 20°



General Information

All dimensions in mm
 General tolerances:
 ±0.13mm
 Material:
 Stainless steel or
 Aluminium alloy
 Pressure angle 20°



Typical component

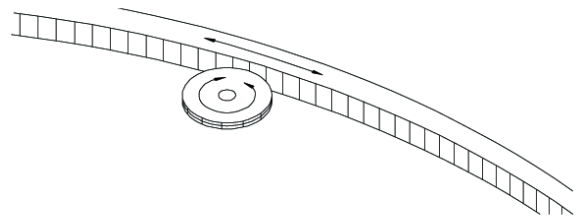
Process Capabilities:

Stainless steel or aluminium alloy.

Module range: 2 to 8 mod.

Pitch diameters from 60 to 120 mm.

Standard gear quality AQ9.

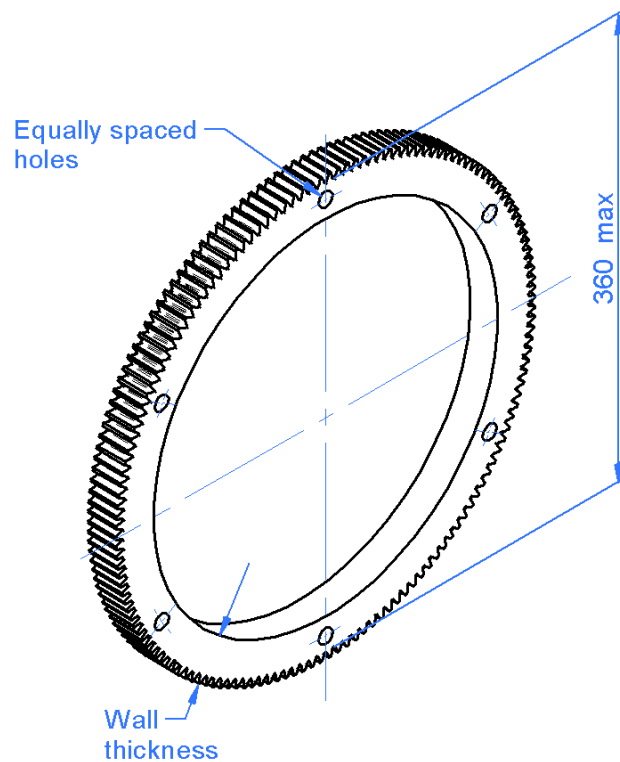


Features:

Anti-backlash mechanism.

Compact, cost effective angular measurement.

Ideal for large diameter gear driven turntables.



General Information

All dimensions in mm
General tolerances:
 $\pm 0.13\text{mm}$

Material:
Stainless steel or
Aluminium alloy or
Brass

Pressure angle 20°

Typical component

Process Capabilities:

Stainless steel, aluminium alloy or brass.

Module range: 0.4 to 1 mod.
(larger modules available, depending on blank dimensions).

Pitch diameters up to 360 mm.

Standard gear quality AQ8.

Typical Applications:

Rotary tables.

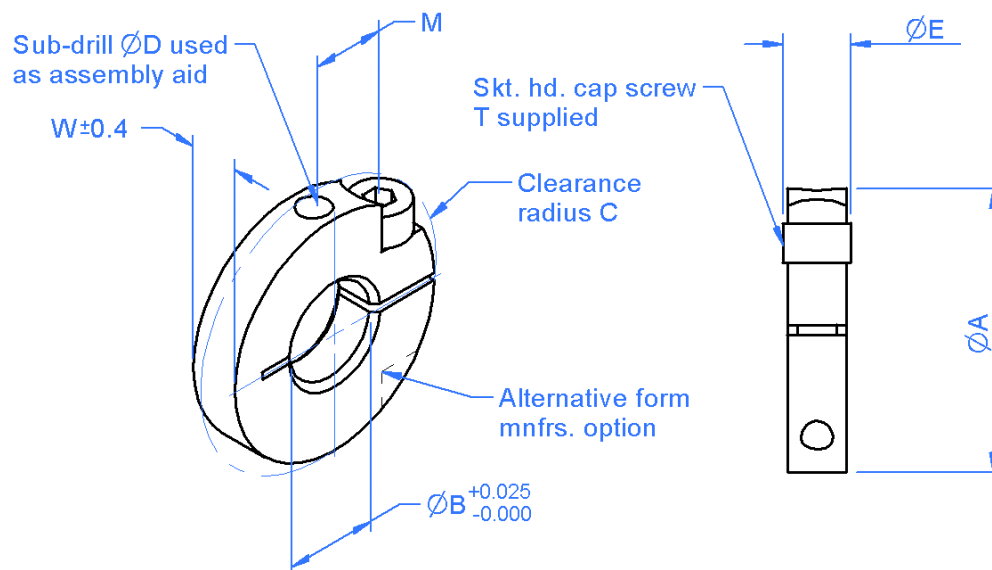
Radar antenna pick-off.

Robot waist joint pick-off.

Gear Clamps

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel 303



Part number selection table

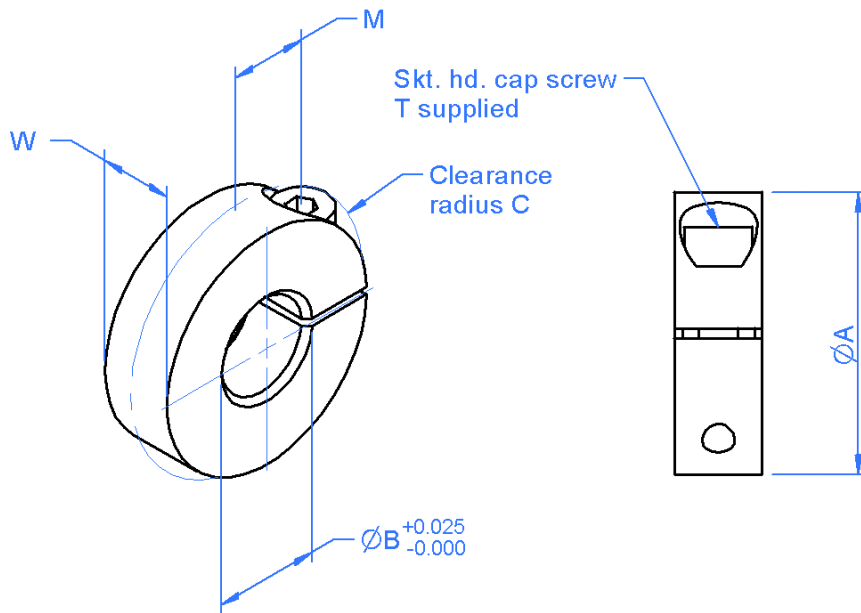
Part Number	To suit gear of bore dia	Bore ØB	O.Dia ØA	Width W	Head dia ØE (max)	Clearance radius C	Screw supplied T	Screw offset M	Sub-drill ØD
CGM1-2	2	3.6	16.0	4.0	3.8	8.7	M2	5.3	1.5
CGM1-3	3	4.6							
CGM1-4	4	5.6	22.0	5.0	5.5	12.8	M3	7.5	3.0
CGM1-5	5	6.6							
CGM1-6	6	7.6							
CGM1-8	8	9.6	29.0	6.0	7.0	17.1	M4	9.5	4.0
CGM1-10	10	11.6							
CGM1-12	12	13.6				18.0		11.0	

- Used with standard clamp hub style gears and pinions.

Non-standard options, please enquire....

- Imperial bores.

Gear Clamps - Low Inertia



General Information

All dimensions in mm
 General tolerances:
 ±0.13mm
 Material:
 Aluminium alloy
 L168

Part number selection table

Part Number	To suit gear of bore dia	Bore ØB	O.Dia ØA	Width W	Clearance radius C	Screw supplied T	Screw offset M
CGAM-2A	2	3.6	12.0	5.0	7.2	M2	3.5
CGAM-3A	3	4.6	13.0		7.8		4.0
CGAM-4A	4	5.6	17.0	7.0	10.0	M3	5.0
CGAM-5A	5	6.6	18.0		10.6		5.5
CGAM-6A	6	7.6	19.0		11.3		6.2
CGAM-8A	8	9.6	24.0	9.0	13.8	M4	7.5
CGAM-10A	10	11.6	26.0		14.8		8.5
CGAM-12A	12	13.6	28.0		16.2		9.8

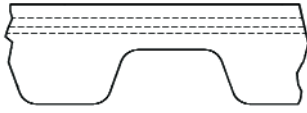
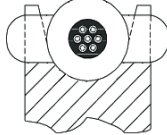
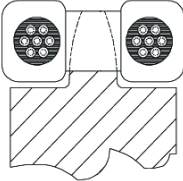
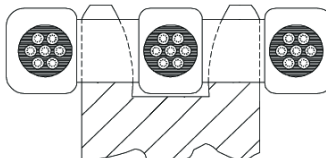
- Used with standard clamp hub style gears and pinions.

Non-standard options, please enquire....

- Imperial bores.

Standard Belts & Pulleys

Basic Range

Timing Belts TXM Series Pitch: 2.5mm Width: 6 & 10mm Material: High tensile steel reinforced polyurethane		• Temperature range: -30°C to +80°C • Maximum allowable peripheral load: 65N (14lbs) to 117N (26lbs) • Maximum peripheral speed: 80 m/s • Belt width tolerance +/-0.3mm • Weight: 15g/m (10mm width)
Drive Belt 32GBF Series Pitch: 2.5mm (0.0982 inch) Material: Stainless steel cable & reinforced polyurethane		• Temperature range: -50°C to +80°C • Weight: 10g/m (0.11oz/ft) • Very low backlash • Virtually silent chain • No lubrication required
Cable Chain 3CCF Series Pitch: 4mm (0.15708 inch) Material: Stainless steel cable & reinforced polyurethane		• Temperature range: -50°C to +80°C • Weight: 12g/m (0.13oz/ft) • Very low backlash • Virtually silent chain • No lubrication required
Cable Chain 3DCF Series Pitch: 4mm (0.15708 inch) Material: Stainless steel cable & reinforced polyurethane		• Temperature range: -50°C to +80°C • Weight: 20g/m (0.21oz/ft) • Very low backlash • Virtually silent chain • No lubrication required



Technical section index	Page
Gear tolerances	56
Standards for fine pitch gears.....	57
Metric modules and circular pitches.....	58
Materials and specifications	59
Spur gear geometry	60
Spur gear terminology	61
Gears with small numbers of teeth.....	63
Engineering data	64

Reliance precision instrumentation gears are manufactured using high accuracy gearcutting equipment. Standard gears are produced in stainless steel, hardened stainless steel, aluminium alloy and brass (wormwheels only). Alternative materials such as PEEK™ polymer or Delrin are available on request.

GEAR TOLERANCES

Gears are generally offered as Quality 10 (see the individual product pages). Higher qualities are available as shown in the table below. Most gears in the catalogue can be produced in these qualities to order.

Reliance standard tolerances are largely based on AGMA 390-03 backlash.

Reliance Standard Gear Qualities						Table values in 0.001mm (0.0001")
Quality Class	Modular Range	Total Composite Error	Tooth to Tooth Composite Error	Indicator Limits Gauge zeroed at std. pitch rad.		Gear Quality Code
				Max	Min	
AQ10	0.8 to 0.5mod	26 (10)	13 (5)	-18 (-7)	-61 (-24)	-
AQ11		18 (7)	10 (4)		-53 (-21)	C
AQ12		13 (5)	8 (3)		-48 (-19)	B
AQ14		7 (2.7)	3.6 (1.4)		-41 (-16)	A
AQ10	0.4 to 0.2mod	26 (10)	13 (5)	-13 (-5)	-51 (-20)	-
AQ11		18 (7)	10 (4)		-43 (-17)	C
AQ12		13 (5)	8 (3)		-38 (-15)	B
AQ14		7 (2.7)	3.6 (1.4)		-33 (-13)	A

The above table values refer to measurements obtained by means of the dual flank tester.

To specify a gear other than the standard quality, add the quality code to the gear part number.

Example of a quality 12 gear - **P05S1B10F6A-100 B**

_____ Quality code

Comparison of National Gear Quality Standards						
Reliance Quality Class	American AGMA 390.03 (1980)	British BS. 4582 (pt.1 : 1970)	German DIN. 867 & 3963	International ISO	Japan JIS	Admiralty BR.6001
AQ10	Q 10	Class B	Q 7	7	3	Class 2
AQ11	Q 11	Class A	Q 6	6	2	Class 1
AQ12	Q 12	Class A	Q 5	5	1	†
AQ14	Q 14	†	Q 3	3	0	†

† Reliance quality higher than any equivalent in this specification.

Table applies to gears up to 50mm diameter.

RELIANCE GEAR STANDARDS FOR FINE PITCH GEARS

The table below is a comparison between Reliance (AGMA) and equivalent UK specifications.

AGMA 390.02 1964 Backlash Designation "C"						Admiralty Standard BR 6001(1)						BS 4582 Pt1 (BS 978 Pt1)			
Quality Number						Class						Class			
14	12	10	14	12	10	1	2	3	1	2	3	A	B	C	D
0.8 to 0.5mod			0.4 to 0.2mod			Method 'A'			Method 'B'						
Standard Pitch Circle Radius															
Total indicator range (0.001mm)															
Total indicator range (0.0001")															
*Total Composite Error															
†															
(0.001mm)															
(0.0001")															
*Tooth to Tooth Composite Error															
(0.001mm)															
(0.0001")															

*AGMA values quoted are for over 20T up to 50mm (2") diameter Admiralty & B.S.

Tooth to tooth errors are for over 30T.

† Minimum indicator level 0.006" or 0.15mm.

For numbers of teeth outside the range consult the relevant specification.

STANDARD MODULES AND CIRCULAR PITCHES - METRIC

Reliance precision instrumentation spur gears are available as standard in the following modules and circular pitches, being those most commonly used in the design and manufacture of gear control mechanisms and instruments:

Module 0.2, 0.25, 0.3, 0.4, 0.5, 0.6.

Circular pitch 1, 2.

Pressure Angle and Rack Form

Except where stated otherwise, gears in this catalogue are cut to 20° pressure angle involute form teeth. Reliance standard gears will mesh satisfactorily with gears of the same module cut to the following standards:-

- (i) BS 4582 (1970) Part 1, Figure 1.
- (ii) DIN 867 and 58412.
- (iii) AGMA 207.06 (Assuming the pitch is cut to an equivalent module)

The gears will not mesh satisfactorily with gears cut to DIN 58400 unless the outside diameter of the latter is reduced to $PCD + (2 \times \text{module})$.

DIN 58400 tooth proportions are:

Addendum	1.1 x Module
Dedendum	1.5 x Module for pitch 0.1 to 0.6 Module

Metric Tooth Proportions						(Dimensions in mm)
Module	Circular Pitch	Addendum	Dedendum	Working Depth	Whole Depth	Equivalent Inch Diametral Pitch
1.5	4.712	1.5	1.875	3.0	3.375	16.933
1.25	3.927	1.25	1.563	2.5	2.8125	20.300
1.0	3.142	1.0	1.400	2.0	2.4	25.400
0.8	2.513	0.8	1.120	1.6	1.92	31.750
0.6	1.885	0.6	0.840	1.2	1.44	42.333
0.5	1.571	0.5	0.700	1.0	1.2	50.800
0.4	1.257	0.4	0.560	0.8	0.96	63.500
0.3	0.942	0.3	0.420	0.6	0.72	84.667
0.25	0.785	0.25	0.350	0.5	0.6	101.600
0.2	0.628	0.2	0.280	0.4	0.48	127.000
0.318	1.0	0.318	0.446	0.637	0.764	79.796
0.637	2.0	0.637	0.891	1.273	1.528	39.898
0.796	2.5	0.796	1.114	1.592	1.910	31.919
0.955	3.0	0.955	1.337	1.910	2.292	26.599

The above list is by no means exhaustive. Please enquire if you require a special module as Reliance holds a large stock of non-standard cutters.

MATERIALS AND SPECIFICATIONS

Reliance precision instrumentation gears are manufactured from the materials listed below. We reserve the right to change the actual material to an equivalent specification without notice depending on availability.

Reliance Standard Gear Materials				
Material	Specification		Used on	Material Code
Stainless steel	303S31 (303S21) or 303S42 (303S42) or 302S31 (302S25) or 303 to MIL QQ-S-764	BS 970	Pin hub gears Clamp hub gears Hubless gears Worms Gear clamp & hubs	S1
Stainless steel (hardened)	17-4PH hardened to 36-40 HRc		Hardened pin hub gears	S9
Aluminium alloy	L168 or HE 15-TF or 2024-T4 to MIL QQ-A-225/6	BS 1474	Pin hub gears Clamp hub gears Hubless gears Gear clamp & hubs	A1
Phosphor bronze	PB 102	BS 2874	Worm wheels	B1
Brass (Naval)	Alloy 464 to MIL QQ-B-637		Worm wheels	B3

Finishes

Stainless steel, bronze and brass gears remain in their natural condition. Passivation to DEF STAN 03-2, process M can be carried out if required. Aluminium components are anodised to specification DEF STAN, 03-24 (chromic acid process) or DEF STAN 03-25 (sulphuric acid process). Gear teeth are not normally anodised.

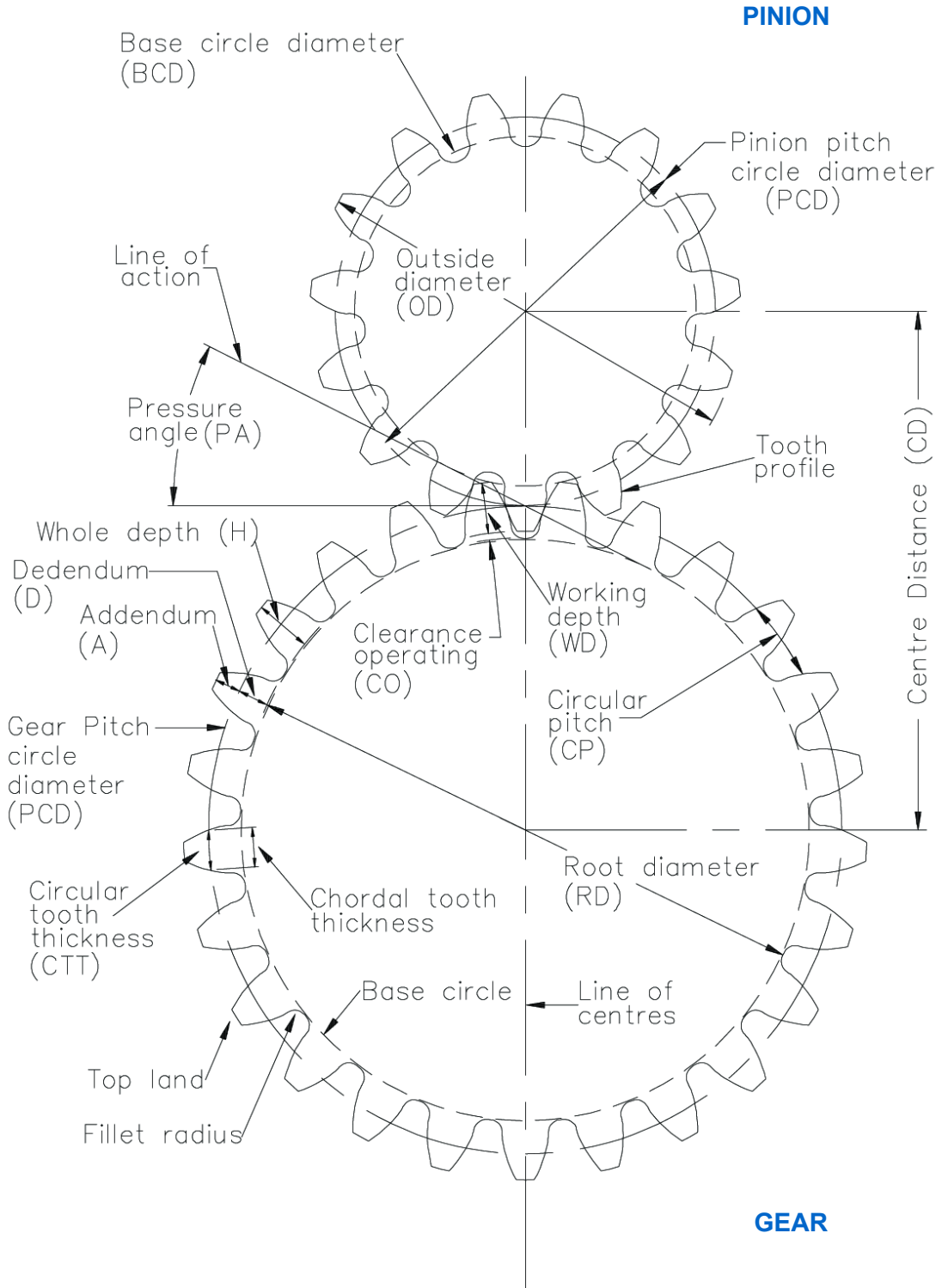
Anti-backlash Gears

Materials and finishes of standard anti-backlash gear components.

Where possible, circlips, anti-backlash springs, shims and set screws will be stainless steel. However some smaller pinions may have beryllium copper or zinc plated carbon steel circlips as standard.

SPUR GEAR GEOMETRY

A basic description of gear tooth terms is shown below. General formulae to enable correct understanding of spur gear geometry is shown overleaf.



TERMINOLOGY FOR METRIC SPUR GEARS

TERM	DEFINITION	FORMULAE
Addendum (A)	The radial distance between the pitch circle and the outside diameter.	$A=M$
Addendum modification (K)	A method of modifying low tooth number gears to avoid undercutting and alter gear size to allow use of non standard centers.	See page 63
Backlash (B)	The circumferential clearance between mating gear teeth.	See page 70
Base circle diameter (BCD)	The diameter of the base cylinder from which the involute is generated.	$BCD = N \cdot M \cos PA$
Base pitch (BP)	The pitch along the base circle or line of action.	$BP = \pi M \cos PA$
Basic rack	The straight sided rack shape from which teeth are generated.	See BS 4582.
Center distance (CD)	Distance between the axes of rotation of mating spur gears.	$CD = \frac{PCD_{pinion} + PCD_{gear}}{2}$
Circular pitch (CP)	The distance along the pitch circle between corresponding points on adjacent teeth.	$CP = \pi M$
Circular tooth thickness (CTT)	The distance between opposite faces on the same tooth, measured at the pitch circle diameter.	$CTT = \frac{\pi M}{2}$
Clearance operating (CO)	The amount by which the dedendum in a given gear exceeds the addendum of the mating gear.	$CO = D - A$
Dedendum (D)	The radial distance between the pitch circle and the root diameter.	$D = 1.4M$
Diametral pitch (DP)	The size of the tooth expressed in teeth per inch of pitch diameter.	
Face width	The width of the tooth in an axial plane.	
Fillet radius	The radius of the fillet curve at the base of the gear tooth.	
Length of action	The distance on an involute line of action through which the point of contact moves during the action of the tooth profiles.	

Standard Gear Range

Technical Information

Indicator limits	The size band of manufacture for the gear measured radially from the PCD.	
Module (M)	The size of the tooth expressed in mm of pitch diameter.	
Number of teeth (N)	Number of teeth on the gear.	
Outside diameter (OD)	The diameter over the tops of the teeth.	$OD = PCD + (2M)$
Pitch circle diameter (PCD)	An imaginary circle whose diameter is formed by meshing gears so that the circles actually touch each other, as if gears were driven purely by the friction of the circles.	$PCD = (N+2K) M$ Note: for unmodified gears $K=0$
Pressure angle (PA)	The angle between a line tangential to the pitch circles and a line perpendicular to the tooth profiles at the point of contact. (Equal to the side angle of the basic rack for standard gears).	Standard = 20°
Root diameter (RD)	The diameter of the base of the teeth.	$RD = OD - (2H)$
Total composite error (TCE)	The total error in the gear measured by the dual flank gear test. TTCE and pitch line runout are included.	
Tooth to tooth composite error (TTCE)	The change in error of each tooth on the gear measured by the dual flank tester.	
Undercut	The loss of profile in the vicinity of the involute start at the base circle due to tool cutter action generating gear with low tooth numbers. (N_{min} = minimum teeth for no undercut)	$N_{min} = \frac{2}{\sin^2 PA}$
Whole depth (H)	The total depth of a tooth space.	$H = A + D$
Working depth (WD)	The depth of engagement between mating gear teeth.	$WD = 2A$

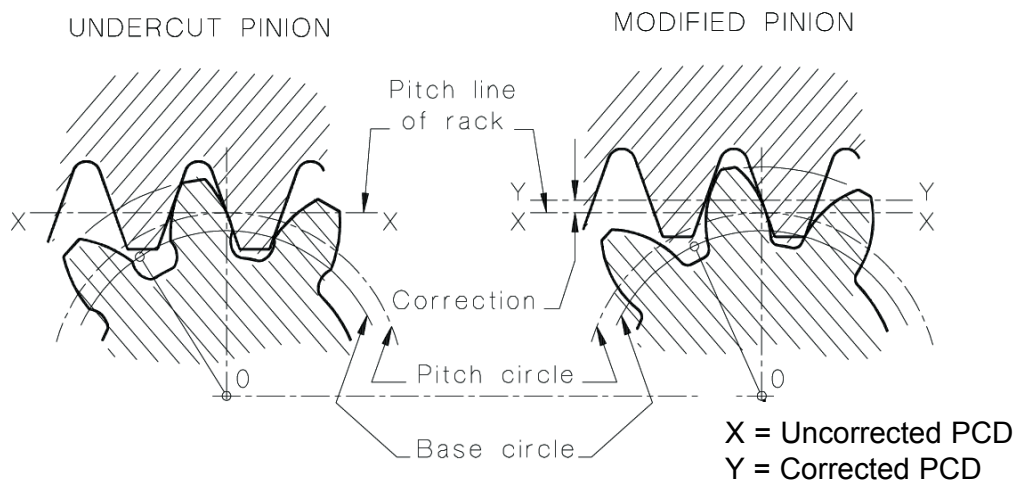
Note: for imperial gears to BS 978 Part 1, Equivalent Module = $\frac{25.4}{DP}$

GEARS WITH SMALL NUMBER OF TEETH

Unless otherwise requested, all gears in this catalogue having 16 teeth or under will be enlarged by applying addendum modification in accordance with BS4582 Part 1 (metric) as shown in the table below. These gears are indicated (†) against the appropriate tooth numbers on the product pages.

A small amount of backlash will be introduced between corrected pinions and mating gears when the modification sum is other than zero and the nominal center distance is adjusted only by an amount equal to the modification sum.

For minimum backlash it will be necessary to either reduce the center distance further, or to apply a secondary correction to the pinion or wheel. See the above B.S specification for details



Data for Addendum Modified Gears of Unit Module and Unit DP			
No. of Teeth	Addendum Modification	Enlarged PCD	Enlarged OD (PCD+2)
10	0.4151	10.8302	12.8302
11	0.3566	11.7132	13.7132
12	0.2982	12.5964	14.5964
13	0.2397	13.4794	15.4794
14	0.1812	14.3624	16.3624
15	0.1227	15.2454	17.2454
16	0.0642	16.1284	18.1284

Example. (Module)

Find P.C.D. and O.D. of enlarged gear having 13 teeth, 0.6 module

$$\begin{aligned} \text{P.C.D.} &= 13.4794 \text{ (from table)} \times 0.6 \text{ module} &= 8.088\text{mm} \\ \text{(Standard P.C.D. would be } 13 \times 0.6 &= 7.800\text{mm)} \end{aligned}$$

Similarly,

$$\begin{aligned} \text{O.D.} &= 15.4794 \text{ (from table)} \times 0.6 \text{ module} &= 9.288\text{mm} \\ \text{(Standard O.D. would be } 7.8 + (2 \times 0.6) &= 9.00\text{mm)} \end{aligned}$$

Note:

For Imperial (diametral pitch) gears, divide the PCD or OD value in the table by the diametral pitch. The answer will be in inches.

ENGINEERING DATA

For instrumentation Reliance normally recommend stainless steel pinions mating with aluminium alloy gears. Generally the pinion is subjected to most wear since it experiences a higher number of stress cycles than the wheel. This combination of materials tends to balance the wear between the pinion and the gear.

1. Gear materials

Stainless steel

The 300 series stainless steels are used for gears when maximum corrosion resistance is required. They are 'true' stainless steels containing 18% chromium and 8% nickel. Gears made from 303 stainless steel are essentially nonmagnetic and cannot be hardened by heat treatment. They are recommended for low torque applications as their mechanical properties and resistance are low.

Aluminium alloy

Gears made from aluminium alloy are widely used in measuring applications. Its light weight offers reduced inertia. The inertia of an aluminium alloy gear is approximately 35% that of a steel gear. In particular, aluminium alloy L168 offers excellent corrosion resistance when anodised, moderately good mechanical properties and good stability.

Hardened stainless steel

17-4PH is a precipitation hardening stainless steel that offers a remarkable combination of high strength and hardness. Its high chromium content, (15-17.5%), makes it an excellent material for arduous environments.

Phosphor bronze

As a gear material phosphor bronze has a fine grain and good resistance to tooth sliding wear hence its use as a worm wheel material.

2. Installation

Gears in this catalogue are designed to be a slide fit on the shafts. The gears are available with four fixing methods: standard clamp, Reli-a-Grip™ clamp, pins and set screws.

Traditional clamp hub style gears have a gear hub with a relatively thin wall partially split. The clamp is a close fit on the hub and is compressed when the clamp screw is tightened. Clamping gears on to the shaft offers extremely easy assembly with the best assembled accuracy. However, as the fastening depends upon friction it can only be used in low torque applications.

Reli-a-Grip™ clamps are designed as an integral clamp alternative to the standard separate gear clamp, reducing component count and improving ease of assembly yet maintaining a high level of assembled accuracy. When the clamp screw is tightened the clamp deflects in such a manner providing an even pressure over the contact area. As with the standard clamp, this fastening depends on friction and should only be used in lower torque applications.

Pin type gears are supplied as standard with a set screw and a sub-drilled hole. The set screw should be used to position the gear on the shaft during the drilling and pinning operation and can be removed once the gear is secure.

The sub-drilled hole provides a lead in for the drilling operation. It is recommended that drilling and pinning is completed outside the gear box and the gear is thoroughly cleaned afterwards.

In less critical applications the set screw may be used to retain the gear on the shaft. To avoid damaging the shaft and to make removal of the gear easier the set screw should seat on a small flat, or dimple on the shaft.

3. Lubrication

All gears should be lubricated, but there are variations in degree.

Highly loaded precision gears should be in enclosed assemblies with complete lubrication to obtain the best possible hydrodynamic film. The system can be splash, spray or force fed, depending on the application. Moderately loaded precision gears, such as fractional horsepower systems, should be enclosed with oil or grease lubrication which can be spread by splash or dip lubrication.

Lightly loaded gears in instrumentation systems need only have a marginal boundary lubrication as provided by periodically wiped on oils or grease. In many instances a light coat of Rocol MT-LM or similar molybdenum disulphide grease will suffice for the life of the system. Anti-backlash gears should not be directly lubricated except via a very light application on the mating pinion.

Negligibly loaded fine instrument gears need only a brushed on film of light oil as a simple means of reducing friction.

4. Speed

The maximum pitch line velocity for stainless steel meshing with aluminium alloy with boundary lubrication is approximately 5,300 mm/sec, (for a pair of meshing actuation gears correctly lubricated, this rises to approximately 8,000 mm/sec). This represents 5,000 rpm on measurement gears of 20mm diameter, (and 7,500 rpm on actuation gears of 20mm diameter).

For speeds in excess of this and other material combinations please consult Reliance technical sales.

5. Gear Loading

The gears in this catalogue can be used for both feedback and actuation systems. The loads and material selection will depend on the application. In general a feedback system is designed to maintain accuracy and an actuation system is designed to transmit power.

Actuation Gears

The following analysis is intended to give a guide to the load capacity of a pair of spur gears. To simplify the calculations, a number of assumptions have been made. It must be noted that in many applications this will give a conservative estimate of the gear capacity, therefore, in critical applications an exact analysis must be completed. Please consult the relevant gear standards or Reliance technical sales.

The analysis is based on AGMA 2001-B88 and assumes the following:

1. The gears are simply supported in rolling element bearings.
2. Pinion revolutions $>10^7$.
3. Gears are grease lubricated.
4. Reliability of 1 failure in 100 is acceptable.
5. Gear material is 17-4PH hardened.

The basic load capacity (F_b) of a pair of spur gears is defined as the maximum tangential force at which they can operate indefinitely.

F_b has two values: one calculated from tooth root strength, (F_{bs}) and one for tooth flank pitting (F_{bw}). The useful or transmitted load capacity, F_t , is usually less than F_b due to transient or dynamic loads generated within the mechanism.

For tooth root strength $F_{ts} = F_{bs}/K_a$ K_a & C_a = Application factors
For tooth flank pitting (wear) $F_{tw} = F_{bw}/C_a$

Both calculation should be made and the lower value used.

The application factors K_a and C_a make allowance for any externally applied loads in excess of the nominal tangential force F_b and they are most accurately determined by direct measurement. In determining application factors, consideration should be given to the fact that many prime movers develop momentary peak torques appreciably greater than those determined by the nominal ratings of either the prime mover or the driven equipment. There are many possible sources of overload which should be considered, including system vibrations, acceleration torques, overspeeds, variations in system operation and changes in process load. Impact loads due to reversing across backlash can be significant in servo systems.

As a general guide application factors for a motor gear system range from 1.0 for uniform loads up to 1.75 where heavy shock loads are anticipated.

For strength	$F_{bs} = 177.7 \times J \times F \times M \times K$	[N]	F_b = Basic load capacity (F_{bs} & F_{bw})
			N = Number of teeth
			J = Geometry factor, strength
For wear	$F_{bw} = 14.64 \times N \times I \times F \times M \times K_v$	[N]	I = Geometry factor, wear
			F = Face width of smallest gear
			M = Module
			K_v = Dynamic factor

(i) Number or teeth - this is the number of teeth in the gear being analysed.

(ii) Geometry factors, I and J

These factors take account of the effect of tooth proportions on stress. The bending strength geometry factor, (J) takes account of the shape of the tooth. The wear resistance geometry factor, (I) takes account of the radii of curvature of the contacting tooth profiles. Please see the graphs on page 67 and 68.

(iii) Face width, F

This is the face width of the smallest gear in mm.

(iv) Module, M

This is the gear module expressed as shown on the respective gear pages.

(v) Dynamic factor, K_v

This accounts for internally generated gear tooth loads which are induced by the non-conjugate meshing action of the gear teeth.

$$K_v = \left(\frac{84}{84 + \sqrt{200V_t}} \right)^{0.4}$$

For quality 10 gears only
 V_t = Pitch line velocity (m/s)

Example calculation to find the theoretical load capacity of a 5:1 pass of 17-4PH spur gears as follows:

Pinion - P06S9B6F4A-25

Gear - P06S9B8F6A-125

Pinion speed is 500rpm.

(i) Number of teeth from part number = 25

(ii) Geometry factors from graph

$$J = 0.37$$

$$I = 0.118$$

(iii) Smallest gear face width from part number

$$F = 4$$

(iv) Gear module from part number

$$M = 0.6$$

(v) Dynamic factor from equation

$$K_v = \left(\frac{84}{84 + \sqrt{200V_t}} \right)^{0.4} = \left(\frac{84}{84 + \sqrt{200 \times 0.393}} \right)^{0.4} = 0.96$$

$$\text{where : } V_t = \frac{\text{rpm} \times \pi \times N \times M}{60000} \text{ [m/s]}$$

$$F_{bs} = 177.7 \times 0.37 \times 4 \times 0.6 \times 0.96 = 151.5\text{N}$$

$$F_{bw} = 14.64 \times 25 \times 0.118 \times 4 \times 0.6 \times 0.96 = 99.5\text{N}$$

For alternative materials the above values need to be modified as shown below.

Gear Material Modification Factors			
Material	Specification	Strength	Wear
Hardened Stainless steel	17-4PH	1.00	1.00
Stainless steel	303S31	0.43	0.15
Stainless steel	316S31	0.47	0.20
Aluminium alloy	L168	0.37	0.10
Brass	CZ121	0.35	0.13

Example:

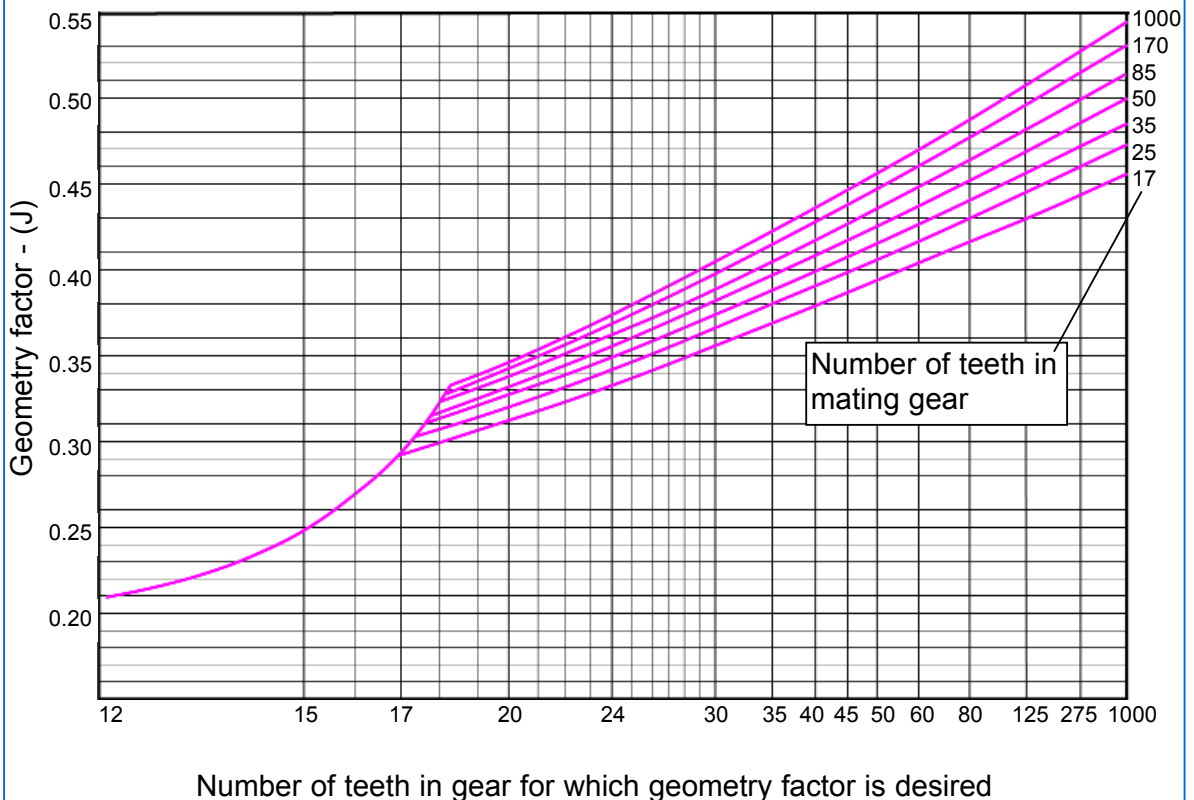
If the gears in the example on the previous page were made from 303S31

$$F_{bs} = 151.5 \times 0.43 = 65.1N$$

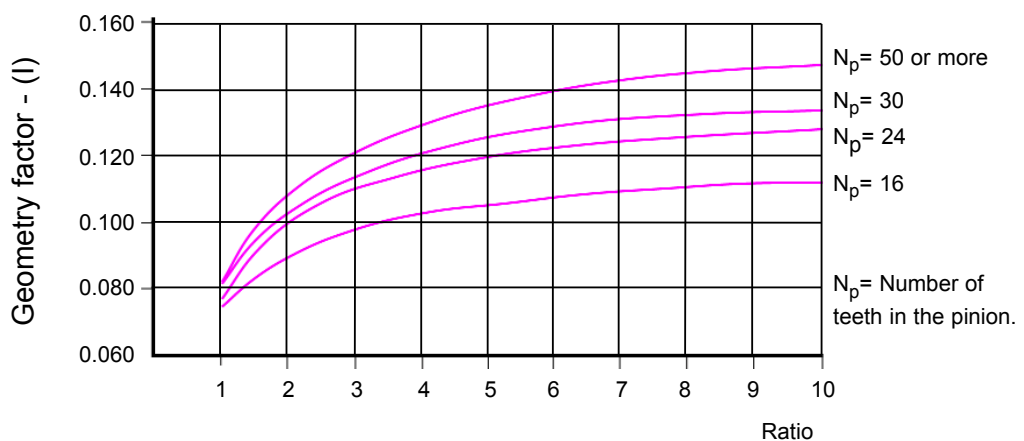
$$F_{bw} = 99.5 \times 0.15 = 14.9N$$

The application factors should be applied after the reduction for material.

Geometry factor, Strength (J), 20° spur



Geometry factor, Wear (I), 20° spur



Instrumentation and Feedback Systems

Gears and components designed for the precise transmission of angular position generally work at the low torque levels normally associated with servo components such as synchros, resolvers, optical encoders etc. Tooth loads of 1.2N per mm face width should result in an adequate accurate life. Higher loads will tend to increase deflections of gear teeth, shafts, bearings etc, resulting in significant values of lost motion and a decrease in life.

eg. To find the maximum advisable torque on a gear 40mm diameter x 3mm face width.

Torque = force x radius = $1.2 \times 3 \times 0.04/2 = 0.072\text{Nm}$ (10oz.in.)

Anti-backlash Gear Spring Tension

In order for anti-backlash gears to function as anti-backlash devices, it is necessary to ensure that the spring tension will provide sufficient torque to overcome the friction and acceleration torque in the system, ie the spring torque must be capable of driving/accelerating the gear train and any associated components.

The spring tension capability of anti-backlash gears listed in this catalogue will adequately cope with the low torques normally encountered.

As a general guide, torque settings on anti-backlash gears of 108 to 180 gmcm (1.5 to 2.5 oz.in.) will suffice in most applications. Ideally the spring torque should be set to the minimum at which the anti-backlash gear performs satisfactory, thus avoiding unnecessary high preload on the gear teeth and premature wear.

6. Lost Motion and Backlash Control

The following section deals with lost motion, which we know to be one of the basic problems in designing fine pitch gear trains. The accepted definition of lost motion is the amount by which the output shaft may be turned without turning the input shaft.

It may be thought that lost motion is a function of the gear cutting operation alone, but, in fact the teeth of the gears may contribute very little to the overall lost motion value. A complete understanding of all the elements which induce lost motion is essential in order to achieve a well designed gear train. The following factors must be individually considered for their own contribution to overall lost motion in the gear train.

- (a) Nominal center distance.
- (b) Center distance tolerance.
- (c) Size and tolerance of mating gears.
- (d) Total composite error of gears.
- (e) Fits between bores, shafts and bearings.
- (f) Bearing accuracy (class).
- (g) Radial play of bearings.
- (h) Shaft straightness and alignment.
- (i) Fits between electrical and/or mechanical component spigot diameters, and housing bores.

- (j) Eccentricity and radial play of electrical and/or mechanical component shafts.
- (k) Torsional elasticity.
- (l) Differential expansion.

Each of the above, except nominal center distance, tend to induce a change in center distance which will push together or pull apart the mating gears. This push-pull action produces two backlash values, minimum at the point of the tightest mesh, and maximum at the point of loosest mesh.

a) Calculation of Nominal Center Distance

Nominal center distance can be considered as the starting point in the calculation of overall backlash values. Nominal center distance is calculated by taking half the sum of the (theoretical) pitch diameters of the mating gears.

$$\text{i.e.} \quad CD = \frac{PCD_1 + PCD_2}{2}$$

(b) Center Distance Tolerance

Center distance tolerance is an extremely important area for consideration. Any increase in center distance in excess of the nominal value will increase the backlash. A decrease in nominal center distance will decrease the backlash. In this case caution must be exercised to avoid interference between mating gears as a result of this decrease.

The relationship between center distance change to backlash for 20° PA spur gear is given by:

$$B = 2 \tan \phi \cdot \Delta C \quad \text{where} \quad \begin{aligned} B &= \text{Circumferential backlash} \\ \phi &= \text{Pressure angle (Tan } 20^\circ = 0.36397) \\ \Delta C &= \text{Distance between theoretical nominal} \\ &\quad \text{and actual center distance} \end{aligned}$$

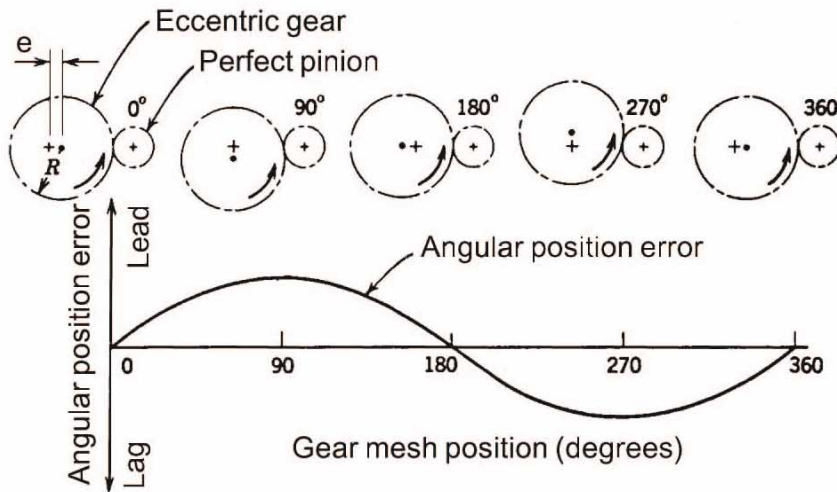
Note: Maximum Angular Backlash = $\frac{\text{Maximum Circumferential Backlash} \times 57.3 \times 60}{\text{Pitch Circle Radius}}$
(minutes of arc)

7. Gear Error

The error function of a gear is approximately sinusoidal and for practical considerations can be assumed to be so. The first derivative of the time displacement curve yields the velocity function, therefore, the output velocity variable will also be an approximate sinusoid but the maximum velocity error will be displaced 90° from the maximum position error.

In summation, pitch circle runout will cause a sinusoidal error which is revealed as an output transmission error when meshed with a mating gear. The magnitude is given by the following example:

In the example on page 71, if the small pinion were not a perfect gear its error would be seen superimposed on the large gear error cycling at pinion frequency.



$$\text{Angular position error } E_A = \frac{e}{R} \sin \theta$$

$$\text{Linear position error } E_L = e \sin \theta$$

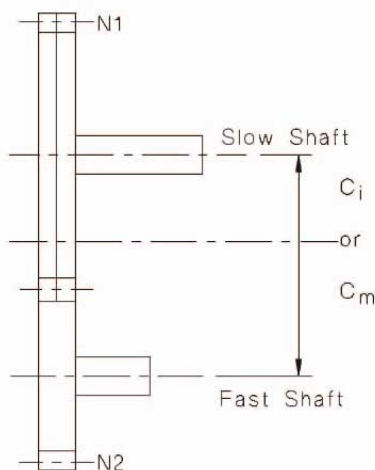
8. Transmission Accuracy of Gear Trains

The following section is based on work carried out by Reliance to provide some guidance in the design of accurate data transmission gearing.

The transmission error referred to by equations 1 and 2 below represent the maximum statistical point to point error during a forward and reverse cycle of a single pass of quality 14 anti-backlash gearing assembled in a data transmission gearbox.

For quality 10 or 12 gearing add 50% or 30% respectively to the error calculated for quality 14 gearing.

For average transmission error substitute the numbers 3.25 and 83 in the equations for the numbers 4.4 and 112 respectively.



$$\Sigma_1 = \left(1 + \frac{N_2}{N_1} \right) \cdot \left(\frac{112}{C_m} \text{ or } \frac{4.4}{C_i} \right) \text{-----(1)}$$

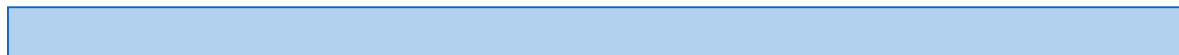
$$\Sigma_2 = \left(1 + \frac{N_1}{N_2} \right) \cdot \left(\frac{112}{C_m} \text{ or } \frac{4.4}{C_i} \right) \text{-----(2)}$$

C_m and C_i = Center distance in mm and inches respectively.

N_2 and N_1 = Number of teeth in pinion and wheel respectively.

Σ_1 and Σ_2 = Maximum statistical transmission error in minutes of arc measured at the slow and fast shafts respectively.

Note - As a result of continuous product development, Reliance reserves the right without prior notice to change dimensions where this does not affect the function of the item.



For full range of our products please visit us at:

www.schlenkent.com

ISO 9001

Quality assured to BS/EN/ISO 9001, Reliance specializes in gears, gearboxes, assemblies and associated components which are used in instrumentation, measurement, diagnostic equipment and light actuation systems. Reliance aims to provide its customers with a single source for the design, production, assembly and testing of high quality mechanical components and electro-mechanical assemblies.

Standard Products

For over thirty years, Reliance has provided a standard range of precision mechanical components from stock or on short delivery. This service allows design engineers to order in small quantities at stock prices in order to develop prototypes effectively. Dedicated manufacturing facilities enable larger quantities to be supplied for full production requirements.

Dust Free Assembly

Reliance also has over 350 square metres of clean room space for the assembly, wiring and testing of precision gearboxes, optical equipment and scientific instruments to customers' specifications. Particle counts in the clean rooms meet ISO 14644-1 Class ISO 7, but are readily adaptable to more stringent standards if required.

For engineering assistance and to place an order please contact us at:

(USA) 708.449.5700

Schlenker Enterprises, Ltd.

P.O. Box 9277, Lombard, IL 60148-9277, U.S.A.

Phone: (USA) 708.449.5700

Fax: (USA) 708.449.5703

www.schlenkent.com

e-mail: sales@schlenkent.com