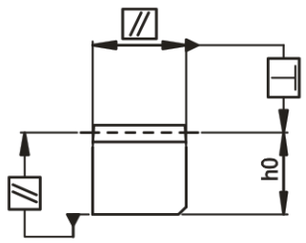
Declaration of Tolerance

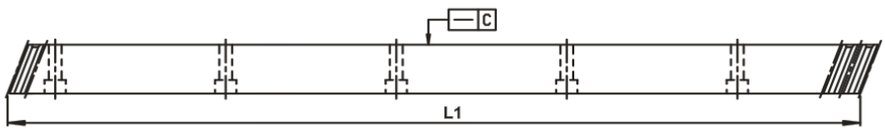
Parallelism and Perpendicularity



(mm)

Quality / Cross-Section	Q4 ~ Q5		Q6		Q6M		Q8 / Q9		Q10	
	⊥	//	⊥	//	⊥	//	⊥	//	⊥	//
> 10 ~ 16	0.004	0.006	0.006	0.01	0.015	0.025	0.025	0.04	0.04	0.06
> 16 ~ 25	0.005	0.008	0.008	0.012	0.02	0.03	0.03	0.05	0.05	0.08
> 25 ~ 40	0.006	0.01	0.01	0.015	0.025	0.04	0.04	0.06	0.06	0.1
> 40 ~ 63	0.008	0.012	0.012	0.02	0.03	0.05	0.05	0.08	0.08	0.12
> 63 ~ 100	0.01	0.015	0.015	0.025	0.04	0.06	0.06	0.1	0.1	0.15
> 100 ~ 160	0.012	0.02	0.02	0.03	0.05	0.08	0.08	0.12	0.12	0.2

Straightness *

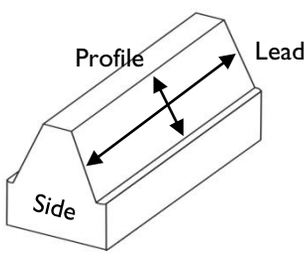


(mm)

Quality	Q 4 ~ Q 6		Q 6M		Q 8 ~ Q 9		Q 10	
Length 1000 mm	Fixed	Free	Fixed	Free	Fixed	Free	Fixed	Free
M1~M2, milled	-	-	0.04	0.45	0.05	0.45	0.08	0.5
M1~M2, ground	0.02	0.4	-	-	-	-	-	-
M3~M6, milled	-	-	0.04	0.45	0.05	0.45	0.08	0.5
M3~M6, ground	0.02	0.3	-	-	-	-	-	-
M8~M12, milled	-	-	0.04	0.45	0.05	0.45	0.08	0.5
M8~M12, ground	0.02	0.25	-	-	-	-	-	-

* Straightness is given either in a free situation (Free) or on a certified flat surface in a fixed mounted situation (Fixed). By the Free-case, the rack is lying on the certified surface with its teeth at the side.

Surface Roughness



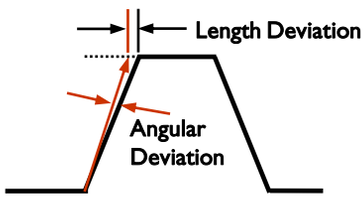
(µm)

Quality	Q 4 ~ Q 6	Q 6M	Q 8 ~ Q 9	Q 10
Lead	Ra ≤ 0.5	Ra ≤ 0.5	Ra ≤ 1.0	Ra ≤ 1.6
Profile	Ra ≤ 1.0	Ra ≤ 1.0	Ra ≤ 3.0	Ra ≤ 6.3
Side	Ra ≤ 0.8	Ra ≤ 2.0	Ra ≤ 2.0	Ra ≤ 2.0

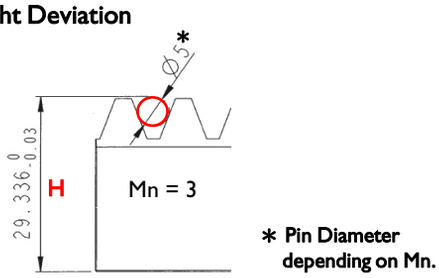
Tolerance of Rack Teeth

APEX declares clearly all the tolerances of rack dimension and geometry, beginning from the design through out the manufacturing.

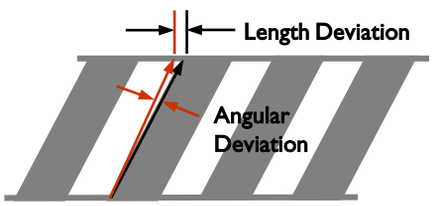
Pressure Angle Deviation

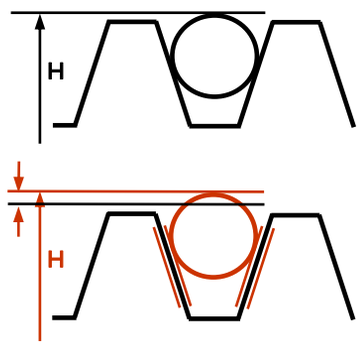


Height Deviation

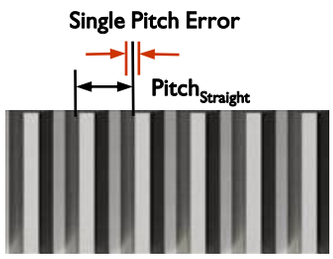


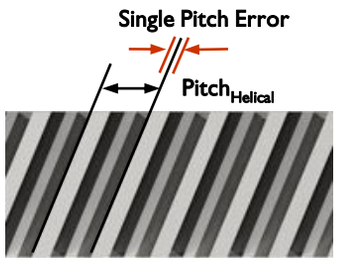
Helical Angle Deviation



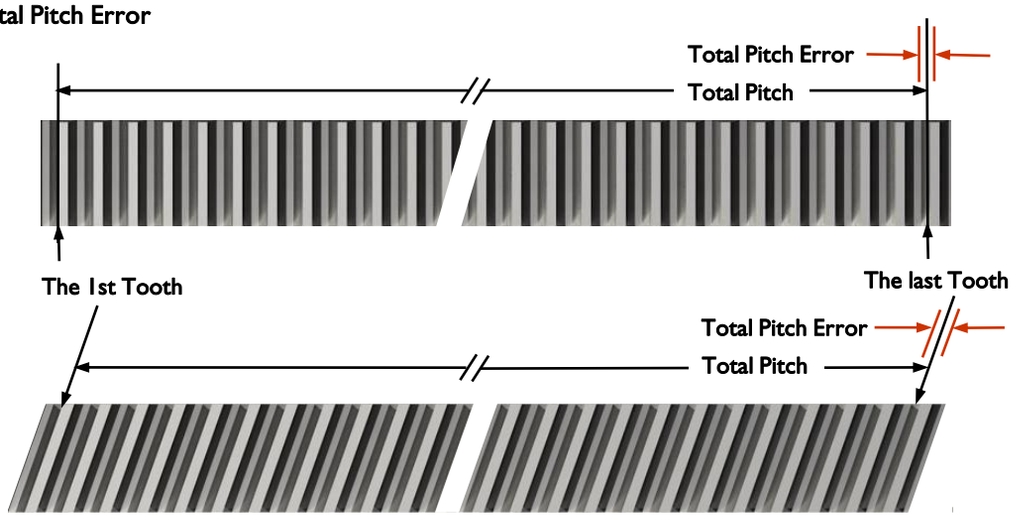


Single Pitch Error





Total Pitch Error



Declaration of Tolerance

Precision / Tolerance of Rack Teeth

Module No.	Deviation		Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
1	Pressure Angle Deviation	(μm)	≤ 4	≤ 6	≤ 8	≤ 16	≤ 23	≤ 36
	Helical Angle Deviation	(μm)	≤ 6	≤ 7	≤ 9	≤ 18	≤ 28	≤ 45
	Over Pin Height Deviation	(μm)	0	0	0	0	0	0
			- 19	- 21	- 30	- 66	-87	- 124
	Single Pitch Error (1)	(μm)	≤ 4.5	≤ 6	≤ 8	≤ 16	≤ 23	≤ 37
	Total Pitch Error (1)	(μm)	≤ 17	≤ 24	≤ 33	≤ 65	≤ 91	≤ 146

Module No.	Deviation		Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
1.5	Pressure Angle Deviation	(μm)	≤ 4	≤ 6	≤ 8	≤ 16	≤ 23	≤ 36
	Helical Angle Deviation	(μm)	≤ 6	≤ 7	≤ 9	≤ 18	≤ 28	≤ 45
	Over Pin Height Deviation	(μm)	0	0	0	0	0	0
			- 19	- 21	- 30	- 66	-87	- 124
	Single Pitch Error (1)	(μm)	≤ 4.5	≤ 6	≤ 8	≤ 16	≤ 23	≤ 37
	Total Pitch Error (1)	(μm)	≤ 17	≤ 24	≤ 34	≤ 66	≤ 91	≤ 148

Module No.	Deviation		Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
2	Pressure Angle Deviation	(μm)	≤ 4	≤ 6	≤ 8	≤ 16	≤ 23	≤ 36
	Helical Angle Deviation	(μm)	≤ 6.5	≤ 8	≤ 10	≤ 20	≤ 32	≤ 52
	Over Pin Height Deviation	(μm)	0	0	0	0	0	0
			- 19	- 20	- 30	- 66	-87	- 123
	Single Pitch Error (1)	(μm)	≤ 4.5	≤ 6	≤ 8	≤ 16	≤ 23	≤ 37
	Total Pitch Error (1)	(μm)	≤ 17	≤ 24	≤ 34	≤ 66	≤ 91	≤ 148

Module No.	Deviation		Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
2.5	Pressure Angle Deviation	(μm)	≤ 5	≤ 7	≤ 10	≤ 20	≤ 28	≤ 45
	Helical Angle Deviation	(μm)	≤ 6.5	≤ 8	≤ 10	≤ 20	≤ ***32***	≤ 52
	Over Pin Height Deviation	(μm)	0	0	0	0	0	0
			- 19	- 21	- 30	- 66	-87	- 124
	Single Pitch Error (1)	(μm)	≤ 4.5	≤ 6	≤ 9	≤ 18	≤ 25	≤ 39
	Total Pitch Error (1)	(μm)	≤ 19	≤ 26	≤ 36	≤ 72	≤ 100	≤ 160

Module No.	Deviation		Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
3	Pressure Angle Deviation	(μm)	≤ 5	≤ 7	≤ 10	≤ 20	≤ 28	≤ 45
	Helical Angle Deviation	(μm)	≤ 6.5	≤ 8	≤ 10	≤ 20	≤ 32	≤ 52
	Over Pin Height Deviation	(μm)	0	0	0	0	0	0
			- 19	- 21	- 30	- 66	-87	- 124
	Single Pitch Error (1)	(μm)	≤ 4.5	≤ 6	≤ 9	≤ 18	≤ 25	≤ 39
	Total Pitch Error (1)	(μm)	≤ 19	≤ 26	≤ 37	≤ 72	≤ 101	≤ 162

Module No.	Deviation		Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
4	Pressure Angle Deviation	(μm)	≤ 7	≤ 9	≤ 13	≤ 25	≤ 35	≤ 56
	Helical Angle Deviation	(μm)	≤ 6.5	≤ 8	≤ 10	≤ 20	≤ 32	≤ 52
	Over Pin Height Deviation	(μm)	0	0	0	0	0	0
			- 19	- 21	- 30	- 66	- 66	- 124
	Single Pitch Error (1)	(μm)	≤ 5	≤ 7	≤ 10	≤ 19	≤ 18	≤ 43
	Total Pitch Error (1)	(μm)	≤ 20	≤ 28	≤ 40	≤ 78	≤ 72	≤ 175

(1) For helical and straight teeth, basing on the nominal length 1000 mm.
Straightness is to measure on a certified flat surface in a fix mounted situation.

Precision / Tolerance of Rack Teeth

Module No.	Deviation	Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
5	Pressure Angle Deviation (μm)	≤ 7	≤ 9	≤ 13	≤ 25	≤ 35	≤ 56
	Helical Angle Deviation (μm)	≤ 8	≤ 10	≤ 13	≤ 25	≤ 41	≤ 65
	Over Pin Height Deviation (μm)	0	0	0	0	0	0
		-19	-21	-30	-66	-87	-124
	Single Pitch Error (1) (μm)	≤ 5	≤ 7	≤ 10	≤ 19	≤ 27	≤ 43
	Total Pitch Error (1) (μm)	≤ 20	≤ 28	≤ 40	≤ 78	≤ 109	≤ 175

Module No.	Deviation	Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
6	Pressure Angle Deviation (μm)	≤ 7	≤ 9	≤ 13	≤ 25	≤ 35	≤ 56
	Helical Angle Deviation (μm)	≤ 8	≤ 10	≤ 13	≤ 25	≤ 41	≤ 65
	Over Pin Height Deviation (μm)	0	0	0	0	0	0
		- 19	- 21	- 30	- 66	-87	- 124
	Single Pitch Error (1) (μm)	≤ 5	≤ 7	≤ 10	≤ 19	≤ 27	≤ 43
	Total Pitch Error (1) (μm)	≤ 20	≤ 28	≤ 40	≤ 78	≤ 109	≤ 175

Module No.	Deviation	Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
8	Pressure Angle Deviation (μm)	≤ 8	≤ 12	≤ 16	≤ 32	≤ 45	≤ 72
	Helical Angle Deviation (μm)	≤ 8	≤ 10	≤ 13	≤ 25	≤ 41	≤ 65
	Over Pin Height Deviation (μm)	0	0	0	0	0	0
		- 20	- 21	- 31	- 66	-87	- 124
	Single Pitch Error (1) (μm)	≤ 5.5	≤ 8	≤ 11	≤ 22	≤ 31	≤ 49
	Total Pitch Error (1) (μm)	≤ 22	≤ 31	≤ 43	≤ 84	≤ 118	≤ 188

Module No.	Deviation	Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
10	Pressure Angle Deviation (μm)	≤ 8	≤ 12	≤ 16	≤ 32	≤ 45	≤ 72
	Helical Angle Deviation (μm)	≤ 8	≤ 10	≤ 13	≤ 25	≤ 41	≤ 65
	Over Pin Height Deviation (μm)	0	0	0	0	0	0
		- 20	- 21	- 31	- 66	-87	- 124
	Single Pitch Error (1) (μm)	≤ 5.5	≤ 8	≤ 11	≤ 22	≤ 31	≤ 49
	Total Pitch Error (1) (μm)	≤ 22	≤ 31	≤ 43	≤ 84	≤ 118	≤ 188

Module No.	Deviation	Q4	Q5H / Q5	Q6 / Q6M	Q8H / Q8	Q9	Q10
12	Pressure Angle Deviation (μm)	≤ 11	≤ 15	≤ 21	≤ 42	≤ 58	≤ 93
	Helical Angle Deviation (μm)	≤ 10	≤ 13	≤ 16	≤ 32	≤ 51	≤ 82
	Over Pin Height Deviation (μm)	0	0	0	0	0	0
		- 20	- 21	- 31	- 66	-87	- 124
	Single Pitch Error (1) (μm)	≤ 7	≤ 10	≤ 13	≤ 26	≤ 37	≤ 59
	Total Pitch Error (1) (μm)	≤ 23	≤ 33	≤ 46	≤ 90	≤ 126	≤ 202

(1) For helical and straight teeth, basing on the nominal length 1000 mm.
Straightness is to measure on a certified flat surface in a fix mounted situation.