

Tolerancing of bevel gears

Tolerances for individual parameters

DIN
3965
 Part 2

Toleranzen für Kegelradverzahnungen;
 Toleranzen für Abweichungen einzelner Bestimmungsgrößen

Supersedes September 1981 edition.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

1 Scope and field of application

The parameters for which tolerances have been given in this standard are defined in DIN 3971. The tolerances specified apply for straight, skew and spiral bevel gears with and without axial offset. See also DIN 3965 Part 1.

2 Tolerances

This standard specifies tolerances for the following parameters:

- adjacent pitch error, f_p ;
- difference between adjacent pitches, f_u ;
- cumulative pitch error, F_p ;
- deviation from radial run-out, F_r .

Continued on pages 2 to 16

Normal module, m_{mn} : 1 mm to 2 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10	1,5	2,5	3,5	4,5	6,5	9,0	13	18	28	45	72	115
Over 10 up to 50	2,0	2,5	3,5	5,0	6,5	9,5	13	19	30	47	76	121
Over 50 up to 125	2,0	2,5	3,5	5,0	7,0	10	14	20	32	51	91	130
Over 125 up to 280	2,0	3,0	4,0	5,5	7,5	11	15	21	34	54	87	139
Over 280 up to 560												
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Mean reference diameter, d_m , in mm	Error f_u for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10	2,0	3,0	4,0	5,5	8,0	11	16	22	35	56	90	145
Over 10 up to 50	2,0	3,0	4,5	6,0	8,5	12	17	23	37	59	95	152
Over 50 up to 125	2,5	3,5	4,5	6,5	9,0	13	18	25	40	63	102	163
Over 125 up to 280	2,5	3,5	5,0	7,0	9,5	14	19	27	43	68	109	175
Over 280 up to 560												
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Normal module, m_{mn} : 1 mm to 2 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10	3,5	5,0	7,0	9,5	13	19	26	36	58	93	149	239
Over 10 up to 50	5,0	7,0	10	14	19	27	38	53	85	135	217	347
Over 50 up to 125	6,5	9,0	13	18	25	34	48	67	108	172	276	441
Over 125 up to 280	7,5	11	15	21	29	40	57	79	127	203	325	520
Over 280 up to 560												
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Mean reference diameter, d_m , in mm	Error F_r for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10	3,0	4,0	5,5	7,5	11	15	21	29	41	57	80	112
Over 10 up to 50	3,5	5,0	7,0	9,5	14	19	27	37	52	73	102	143
Over 50 up to 125	4,5	6,0	8,5	12	16	23	32	45	63	88	123	172
Over 125 up to 280	5,0	7,0	9,5	13	19	26	37	52	72	101	142	198
Over 280 up to 560												
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Normal module, m_{mn} : over 2 mm up to and including 3,55 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	2,0	2,5	3,5	5,0	7,5	10	14	20	32	51	82	131
Over 50 up to 125	2,0	3,0	4,0	5,5	8,0	11	15	21	34	54	87	139
Over 125 up to 280	2,0	3,0	4,0	6,0	8,5	12	16	23	36	58	93	149
Over 280 up to 560	2,5	3,5	4,5	6,5	9,0	13	18	25	39	63	101	161
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Mean reference diameter, d_m , in mm	Error f_u for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	2,5	3,5	4,5	6,5	9,0	13	18	25	40	64	103	165
Over 50 up to 125	2,5	3,5	5,0	7,0	9,5	14	19	27	43	68	109	175
Over 125 up to 280	2,5	4,0	5,5	7,5	10	15	20	29	46	73	117	187
Over 280 up to 560	3,0	4,0	6,0	8,0	11	16	22	31	50	79	127	203
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Normal module, m_{mn} : over 2 mm up to and including 3,55 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	5,5	7,5	11	15	21	30	41	58	93	148	237	379
Over 50 up to 125	7,0	10	14	19	27	38	53	74	118	189	302	483
Over 125 up to 280	8,0	12	16	23	32	44	62	87	139	222	355	569
Over 280 up to 560	9,5	13	19	26	36	51	72	100	160	256	410	656
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Mean reference diameter, d_m , in mm	Error F_r for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	4,0	6,0	8,0	11	16	22	31	44	61	85	120	168
Over 50 up to 125	5,0	7,0	9,5	14	19	27	37	52	73	103	144	201
Over 125 up to 280	5,5	8,0	11	16	22	31	43	60	84	118	165	231
Over 280 up to 560	6,5	9,0	13	18	25	35	49	68	96	134	187	262
Over 560 up to 1000												
Over 1000 up to 1600												
Over 1600 up to 2500												

Normal module, m_{mn} : over 3,55 mm up to and including 6 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	2,0	3,0	4,0	6,0	8,0	11	16	22	36	57	92	147
Over 50 up to 125	2,0	3,0	4,5	6,0	8,5	12	17	24	38	61	97	155
Over 125 up to 280	2,5	3,5	4,5	6,5	9,0	13	18	25	40	64	103	164
Over 280 up to 560	2,5	3,5	5,0	7,0	10	14	19	27	43	69	110	177
Over 560 up to 1000	3,0	4,0	5,5	7,5	11	15	21	29	47	75	120	192
Over 1000 up to 1600	3,0	4,0	6,0	8,5	12	16	23	32	51	81	130	208
Over 1600 up to 2500												

Mean reference diameter, d_m , in mm	Error f_u for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	2,5	3,5	5,0	7,5	10	14	20	28	45	72	115	184
Over 50 up to 125	3,0	4,0	5,5	7,5	11	15	21	30	48	76	122	195
Over 125 up to 280	3,0	4,0	6,0	8,0	11	16	23	32	50	81	129	207
Over 280 up to 560	3,0	4,5	6,5	9,0	12	17	24	34	54	87	139	222
Over 560 up to 1000	3,5	5,0	7,0	9,5	13	19	26	37	59	94	151	241
Over 1000 up to 1600	4,0	5,5	7,5	10	15	20	29	40	64	102	164	262
Over 1600 up to 2500												

Normal module, m_{mn} : over 3,55 mm up to and including 6 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	6,0	8,5	12	16	23	32	45	63	100	160	257	410
Over 50 up to 125	7,5	11	15	21	29	41	57	80	127	204	326	522
Over 125 up to 280	9,0	12	17	24	34	48	67	94	150	240	384	615
Over 280 up to 560	10	14	20	28	39	55	77	108	173	277	443	710
Over 560 up to 1000	12	16	23	32	45	62	87	122	196	313	501	801
Over 1000 up to 1600	13	18	25	35	49	69	96	135	216	346	553	885
Over 1600 up to 2500												

Mean reference diameter, d_m , in mm	Error F_t for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	5,5	6,5	9,5	13	18	26	36	50	70	99	138	193
Over 50 up to 125	5,5	8,0	11	16	22	31	43	60	84	117	164	230
Over 125 up to 280	6,5	9,0	13	18	25	35	49	68	96	134	188	263
Over 280 up to 560	7,5	10	14	20	28	40	55	78	109	152	213	298
Over 560 up to 1000	8,0	12	16	23	32	44	62	87	121	170	238	333
Over 1000 up to 1600	9,0	13	18	25	35	49	68	95	134	187	262	366
Over 1600 up to 2500												

Normal module, m_{mn} : over 6 mm up to and including 10 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	2,5	3,5	5,0	7,0	9,5	13	19	26	42	67	107	172
Over 50 up to 125	2,5	3,5	5,0	7,0	10	14	20	27	44	70	112	180
Over 125 up to 280	2,5	4,0	5,5	7,5	11	15	21	29	46	74	118	189
Over 280 up to 560	3,0	4,0	5,5	8,0	11	16	22	31	49	79	126	202
Over 560 up to 1000	3,0	4,5	6,0	8,5	12	17	24	33	53	85	135	216
Over 1000 up to 1600	3,5	4,5	6,5	9,0	13	18	25	35	57	91	145	233
Over 1600 up to 2500	3,5	5,0	7,0	10	14	20	27	38	61	98	157	251

Mean reference diameter, d_m , in mm	Error f_a for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	3,0	4,5	6,0	8,5	12	17	24	33	53	84	135	216
Over 50 up to 125	3,5	4,5	6,5	9,0	13	18	25	35	55	88	141	226
Over 125 up to 280	3,5	5,0	7,0	9,5	13	19	26	36	58	93	149	238
Over 280 up to 560	3,5	5,0	7,0	10	14	20	28	39	62	99	159	254
Over 560 up to 1000	4,0	5,5	7,5	11	15	21	30	42	67	107	170	273
Over 1000 up to 1600	4,0	6,0	8,5	12	16	23	32	45	72	115	183	293
Over 1600 up to 2500	4,5	6,5	9,0	13	18	25	34	48	77	124	198	316

Normal module, m_{mn} : over 6 mm up to and including 10 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	6,5	9,0	13	18	25	34	48	67	108	173	276	442
Over 50 up to 125	8,0	11	16	22	31	44	61	86	137	220	351	562
Over 125 up to 280	9,5	13	19	26	37	52	72	101	162	259	414	662
Over 280 up to 560	11	15	22	30	42	59	83	117	187	298	478	764
Over 560 up to 1000	12	17	24	34	48	67	94	132	211	337	539	863
Over 1000 up to 1600	14	19	27	38	53	74	104	145	233	372	596	953
Over 1600 up to 2500	15	21	30	41	58	81	113	159	254	406	650	1040

Mean reference diameter, d_m , in mm	Error F_r for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50	5,5	7,5	11	15	21	30	41	58	81	113	159	222
Over 50 up to 125	6,5	9,0	13	18	25	35	49	68	96	134	187	262
Over 125 up to 280	7,5	10	14	20	28	40	55	78	109	152	213	298
Over 280 up to 560	8,5	12	16	23	32	45	62	87	122	171	240	336
Over 560 up to 1000	9,0	13	18	25	35	50	70	97	136	191	267	374
Over 1000 up to 1600	10	14	20	28	39	55	76	107	150	210	293	411
Over 1600 up to 2500	11	15	22	30	42	59	83	116	163	228	319	447

Normal module, m_{mn} : over 10 mm up to and including 16 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	3,0	4,5	6,0	8,5	12	17	24	33	53	85	137	219
Over 125 up to 280	3,5	4,5	6,5	9,0	13	18	25	35	56	89	143	228
Over 280 up to 560	3,5	5,0	7,0	9,5	13	19	26	37	59	94	150	240
Over 560 up to 1000	3,5	5,0	7,0	10	14	20	28	39	62	100	160	255
Over 1000 up to 1600	4,0	5,5	7,5	11	15	21	30	41	66	106	170	272
Over 1600 up to 2500	4,0	6,0	8,0	12	16	23	32	44	71	113	181	290

Mean reference diameter, d_m , in mm	Error f_a for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	4,0	5,5	8,0	11	15	21	30	42	67	108	172	276
Over 125 up to 280	4,0	6,0	8,0	11	16	22	31	44	70	112	180	288
Over 280 up to 560	4,5	6,0	8,5	12	17	24	33	46	74	119	190	303
Over 560 up to 1000	4,5	6,5	9,0	13	18	25	35	49	79	126	201	322
Over 1000 up to 1600	5,0	7,0	9,5	14	19	27	37	52	84	134	214	343
Over 1600 up to 2500	5,5	7,5	10	15	20	28	40	56	89	143	229	366

Normal module, m_{mn} : over 10 mm up to and including 16 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	8,5	12	17	24	34	47	66	92	147	236	377	603
Over 125 up to 280	10	14	20	28	40	55	77	108	173	278	444	710
Over 280 up to 560	12	17	23	33	46	64	89	125	200	320	512	820
Over 560 up to 1000	13	19	26	37	51	72	101	141	226	361	578	925
Over 1000 up to 1600	15	21	29	41	57	80	111	156	250	399	639	1022
Over 1600 up to 2500	16	23	32	44	62	87	122	170	272	436	697	1116

Mean reference diameter, d_m , in mm	Error F_r for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	7,5	10	14	20	28	40	56	78	109	152	213	299
Over 125 up to 280	8,5	12	16	23	32	45	63	88	123	172	241	337
Over 280 up to 560	9,5	13	18	26	36	50	70	98	138	193	270	378
Over 560 up to 1000	10	14	20	28	40	56	78	109	153	214	299	419
Over 1000 up to 1600	11	16	22	31	43	61	85	119	167	234	327	458
Over 1600 up to 2500	12	17	24	34	47	66	92	129	181	253	355	497

Normal module, m_{mn} : over 16 mm up to and including 25 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	4,0	5,5	8,0	11	15	22	30	42	68	108	173	277
Over 125 up to 280	4,0	6,0	8,0	11	16	22	31	44	70	112	179	286
Over 280 up to 560	4,5	6,0	8,5	12	17	23	33	46	73	117	187	299
Over 560 up to 1000	4,5	6,5	9,0	12	17	24	34	48	77	122	196	314
Over 1000 up to 1600	5,0	6,5	9,5	13	18	26	36	50	81	129	206	330
Over 1600 up to 2500	5,0	7,0	10	14	19	27	38	53	85	136	217	348

Mean reference diameter, d_m , in mm	Error f_u for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	5,0	7,0	10	14	19	27	38	53	85	137	219	350
Over 125 up to 280	5,0	7,5	10	14	20	28	39	55	88	141	226	362
Over 280 up to 560	5,5	7,5	11	15	21	29	41	58	92	147	236	377
Over 560 up to 1000	5,5	8,0	11	16	22	31	43	60	97	155	248	396
Over 1000 up to 1600	6,0	8,5	12	17	23	32	45	64	102	163	261	417
Over 1600 up to 2500	6,5	9,0	12	17	24	34	48	67	107	172	275	440

Normal module, m_{mn} : over 16 mm up to and including 25 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	9,5	13	18	26	36	50	70	98	157	251	402	644
Over 125 up to 280	11	15	22	30	42	59	83	116	185	296	474	759
Over 280 up to 560	13	18	25	35	49	68	95	134	214	342	547	875
Over 560 up to 1000	14	20	28	39	55	77	108	151	241	386	617	988
Over 1000 up to 1600	16	22	31	43	61	85	119	167	267	426	682	1092
Over 1600 up to 2500	17	24	34	47	66	93	130	182	291	465	744	1191

Mean reference diameter, d_m , in mm	Error F_r for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125	8,5	12	16	23	32	45	63	88	123	173	242	339
Over 125 up to 280	9,5	13	18	26	36	50	71	99	138	194	271	379
Over 280 up to 560	10	15	20	29	40	56	79	110	154	216	302	423
Over 560 up to 1000	12	16	23	32	44	62	87	121	170	238	333	467
Over 1000 up to 1600	13	18	25	34	48	68	95	132	185	259	363	509
Over 1600 up to 2500	14	19	27	37	52	73	102	143	200	280	393	550

Normal module, m_{mn} : over 25 mm up to and including 50 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error f_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125												
Over 125 up to 280	6,0	8,5	12	16	23	32	44	62	100	159	255	408
Over 280 up to 560	6,0	8,5	12	17	23	33	46	64	103	164	263	421
Over 560 up to 1000	6,5	9,0	12	17	24	34	47	66	106	170	272	435
Over 1000 up to 1600	6,5	9,0	13	18	25	35	49	69	110	176	282	452
Over 1600 up to 2500	7,0	9,5	13	19	26	37	51	72	115	183	294	470

Mean reference diameter, d_m , in mm	Error f_u for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125												
Over 125 up to 280	7,5	10	15	21	29	40	56	79	126	202	323	516
Over 280 up to 560	7,5	11	15	21	30	41	58	81	130	208	333	532
Over 560 up to 1000	8,0	11	16	22	31	43	60	84	134	215	344	551
Over 1000 up to 1600	8,5	12	16	23	32	44	62	87	140	223	357	571
Over 1600 up to 2500	8,5	12	17	24	33	46	65	91	145	232	372	595

Normal module, m_{mn} : over 25 mm up to and including 50 mmTolerances in μm

Mean reference diameter, d_m , in mm	Error F_p for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125												
Over 125 up to 280	12	17	23	33	46	64	90	126	201	321	514	823
Over 280 up to 560	14	19	27	38	53	74	103	145	232	371	593	949
Over 560 up to 1000	16	22	30	43	60	83	117	163	262	419	670	1071
Over 1000 up to 1600	17	24	34	47	66	92	129	181	289	463	740	1184
Over 1600 up to 2500	19	26	37	51	72	101	141	197	315	505	808	1292

Mean reference diameter, d_m , in mm	Error F_r for tolerance class											
	1	2	3	4	5	6	7	8	9	10	11	12
Over 1 up to 10												
Over 10 up to 50												
Over 50 up to 125												
Over 125 up to 280	11	15	21	30	42	59	82	115	161	226	316	443
Over 280 up to 560	12	17	24	33	46	65	91	128	179	250	350	490
Over 560 up to 1000	13	19	26	36	51	71	100	140	196	274	384	537
Over 1000 up to 1600	14	20	28	39	55	77	108	152	212	297	416	582
Over 1600 up to 2500	15	22	30	42	59	83	116	163	228	320	447	626

Standards referred to

DIN 3965 Part 1 Tolerancing of bevel gears; basic concepts

DIN 3971 Terminology and parameters for bevel gears and bevel gear pairs

Previous editions

DIN 3965 Part 2: 09.81.

Amendments

The following amendments have been made in comparison with the September 1981 edition.

- a) The status of the standard is no longer that of a preliminary standard.
- b) The standard has been editorially revised.

Explanatory notes

DIN 3965 Parts 1 to 4 provide only information on the gear blank and on errors that can be measured by conventional means.

The finer tolerances cannot yet be measured under production conditions. Nevertheless, the tables shown in DIN 3965 Parts 2 and 3 cover all diameter ranges, the fields crossed out indicating that for these diameter ranges no tolerances can currently be specified.

In futurè, more advanced gauging and calculation methods may allow errors to be dealt with, which have not as yet been specified, such as profile errors, and more information to be provided regarding the accuracy of bevel gears.

The parameters (see clause 3) have been defined in DIN 3971, the aim of which was to include as many quantities as possible without regard for the current feasibility or difficulty of their measurement.

The structure of the tolerance system for bevel gears has been brought into line with that for cylindrical gears. The relationship between the parameters are the same, except for an overall shift in the tolerance system by one tolerance class. The tolerance system proposed may thus serve as an adequate basis for international discussion.

International Patent Classification

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