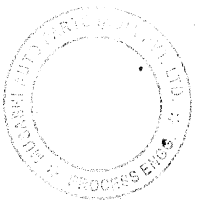
UDC 621.833.1 : 621.753.1 DEUTSCHE NORMEN August 1978

Tolerances for Cylindrical Gear Teeth

Tolerances for Diviations of Individual Parameters

DIN 3962 Part 1

Toleranzen für Stirnradverzahnungen; Toleranzen für Abweichungen einzelner Bestimmungsgrössen



1 Scope

The tolerances listed in this Standard apply to the amounts of the deviations defined in DIN 3960. It contains tolerances for:

- profile form deviation f_f
- profile angle deviation $f_{H\alpha}$
- total profile deviation F_f
- individual pitch deviation f_p
- normal base pitch deviation f_{pe}
- pitch error f_u
- total pitch deviation F_p
- pitch-span deviation over 1/8 of periphery $F_{p\,z/8}$
- concentricity deviation F_r
- tooth thickness fluctuation R_s [1)]

2 Other relevant Standards

DIN 3960 Definitions and parameters for cylindrical gears and cylindrical gear pairs with involute teeth

DIN 3961 Tolerances for cylindrical gear teeth; bases

DIN 3962 Part 3 Tolerances for cylindrical gear teeth; tolerances for pitch-span deviations

DIN 3967 System of gear fits; backlash, tooth thickness allowances and tooth thickness tolerances; bases, calculation of tooth thickness allowances, conversion of allowances for the different measuring methods

---

1) For necessary variants of the different measuring methods see DIN 3967

Continued on pages 2 to 18
Explanations on page 18

3 Tolerance data

Normal module from 1 to 2 mm

Tolerances in µm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	1	1,5	2	3	4,5	6
$f_{H\alpha}$	1	1,5	2	3	4	5
F_f	1,5	2	3	4	6	8

Reference circle diameter d in mm	Deviation f_p, f_{pe}						f_u						F_p					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
up to 10	1	1,5	2,5	3	4,5	6	1,5	2	3	4	5,5	8	2,5	4	5	7	10	14
over 10 to 50	1	1,5	2,5	3,5	5	7	1,5	2	3	4,5	6	9	3,5	5	7	10	14	18
over 50 to 125	1,5	2	2,5	4	5	7	2	2,5	3	5	6	9	4,5	6	9	14	18	25
over 125 to 280	1,5	2	3	4	5,5	8	2	2,5	3,5	5	7	10	5	8	11	16	20	28
over 280 to 560	1,5	2	3	4,5	6	8	2	2,5	3,5	5,5	8	10	6	9	12	18	25	32
over 560 to 1000	2	2,5	3,5	5	7	9	2,5	3	4	6	9	11	7	10	14	20	28	36
over 1000 to 1600	2	2,5	4	5	8	10	2,5	3	4,5	6	10	12	8	11	16	20	32	40
over 1600 to 2500	2	3	4	6	8	11	2,5	3,5	5	7	10	14	8	12	16	22	32	45
over 2500 to 4000	2,5	3,5	4,5	6	9	12	3	4	5	8	11	16	9	14	18	25	36	50
over 4000 to 6300	2,5	3,5	5	7	10	14	3	4,5	6	9	12	18	10	14	20	28	40	56
over 6300 to 10000	2,8	4,0	6	8	11	16	3,5	5	7	10	14	20	11	16	22	28	40	63

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						F_r						R_s					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
up to 10	1,5	2	3	4	6	8	2	3	3,5	5,5	8	11	1	1,5	2,5	3,5	4,5	7
over 10 to 50	2	3	5	4	6	8	2,5	3,5	5	7	10	14	1,5	2	3	4,5	6	8
over 50 to 125	3	4	6	8	11	16	3	4	6	8	12	16	2	2,5	3,5	5	7	10
over 125 to 280	3	5	7	9	12	16	3,5	5	7	9	14	18	2	3	4,5	6	8	12
over 280 to 560	4	5,5	8	11	14	22	4	5,5	8	11	16	22	2,5	3,5	5	7	10	14
over 560 to 1000	4,5	6	9	12	16	25	4,5	6	9	12	18	25	3	4	5,5	8	11	14
over 1000 to 1600	5	7	10	14	18	25	5	7	10	14	18	28	3	4,5	6	8	12	16
over 1600 to 2500	5	7	10	14	20	28	5	7	10	14	20	28	3,5	4,5	7	9	12	18
over 2500 to 4000	6	8	11	16	22	32	5,5	8	11	16	22	32	3,5	5	7	10	14	20
over 4000 to 6300	6	9	12	18	25	36	6	9	12	18	25	36	4	5	7	10	14	20
over 6300 to 10000	7	9	14	18	28	36	7	10	14	20	28	40	4	5,5	8	11	16	22

Normal module from 1 to 2 mm

Tolerances in µm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	9	12	16	28	45	71
$f_{H\alpha}$	7	10	14	22	36	56
F_f	12	16	22	36	56	90

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
up to 10	9	12	18	28	45	71	11	16	22	36	56	90	20	25	36	56	90	160
over 10 to 50	9	14	18	28	50	80	11	18	22	36	63	100	28	36	50	80	140	220
over 50 to 125	10	14	20	32	50	80	12	18	25	40	63	100	32	50	63	110	180	280
over 125 to 280	11	16	22	36	56	90	14	20	25	45	71	110	40	56	80	125	200	320
over 280 to 560	12	16	22	36	56	100	16	20	25	45	71	125	45	63	90	140	220	360
over 560 to 1000	14	18	25	40	63	100	16	22	32	50	80	125	50	71	100	160	250	400
over 1000 to 1600	14	20	28	45	71	110	18	25	36	56	90	140	56	80	110	180	280	450
over 1600 to 2500	16	22	32	50	80	125	20	28	40	63	100	160	63	90	125	200	320	500
over 2500 to 4000	18	25	36	56	90	140	22	32	45	71	100	180	71	100	140	220	360	560
over 4000 to 6300	20	28	40	63	100	160	25	36	50	80	125	200	80	110	160	250	400	630
over 6300 to 10000	22	32	45	71	110	180	28	40	56	90	140	220	80	125	180	280	450	710

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
up to 10	12	16	22	36	63	90	16	22	32	45	63	80	9	12	18	25	36	50
over 10 to 50	18	25	32	50	90	140	20	28	40	56	80	110	12	16	22	32	45	63
over 50 to 125	22	32	40	71	110	180	22	32	45	63	90	125	14	20	28	40	56	80
over 125 to 280	25	36	50	80	125	200	28	36	56	71	110	160	16	22	32	45	63	90
over 280 to 560	28	40	56	90	140	220	32	45	63	90	125	180	18	25	36	50	71	100
over 560 to 1000	32	45	63	100	160	250	36	50	71	100	140	200	20	28	40	56	80	110
over 1000 to 1600	36	50	71	110	180	280	36	56	80	110	160	220	22	32	45	63	90	125
over 1600 to 2500	40	56	80	125	200	320	40	56	80	110	160	220	25	36	50	71	100	140
over 2500 to 4000	45	63	90	140	220	360	45	63	90	125	180	250	28	40	56	80	110	140
over 4000 to 6300	50	71	100	160	250	400	50	71	100	140	200	280	28	40	56	80	110	160
over 6300 to 10000	50	71	100	180	280	450	56	80	110	160	220	320	32	45	63	90	125	180

Normal module from 2 to 3.55 mm

Tolerances in µm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	1,5	2	3	4	6	8
$f_{H\alpha}$	1	1,5	2	3	4,5	6
F_f	2	3	4	5	7	10

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 10 to 50	1	2	2,5	3,5	5	7	1,5	2,5	3	4,5	6	9	4	6	8	11	16	20
over 50 to 125	1,5	2	2,5	3,5	5	7	2	2,5	3	4,5	6	9	5	7	10	14	20	28
over 125 to 280	1,5	2	3	4	6	8	2	2,5	3,5	5	8	10	6	8	12	16	22	32
over 280 to 560	1,5	2	3	4	6	8	2	2,5	3,5	5	8	10	7	10	14	18	25	36
over 560 to 1000	1,5	2,5	3,5	4,5	6	9	2	3	4,5	5,5	8	11	8	11	16	20	28	40
over 1000 to 1600	2	3	4	5	7	11	2,5	3,5	5	7	9	12	9	12	18	22	32	45
over 1600 to 2500	2	3	4,5	6	8	12	2,5	3,5	5,5	8	10	14	9	12	18	25	36	50
over 2500 to 4000	2,5	3,5	5	7	9	14	3	4	6	9	11	16	10	14	20	28	40	56
over 4000 to 6300	2,5	3,5	5	7	10	14	3	4,5	7	9	14	18	11	16	22	32	40	63
over 6300 to 10000	2,8	4	6	8	12	16	3,5	5,5	8	11	16	22	12	16	22	32	45	63

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 10 to 50	2,5	3,5	5	7	10	16	3	4	5,5	8	11	16	2	2,5	3,5	5	7	10
over 50 to 125	3	4	6	9	12	18	3,5	5	7	10	14	20	2	3	4,5	6	8	12
over 125 to 280	4	5	7	10	14	20	4	5,5	8	11	16	22	2,5	3,5	5	7	10	14
over 280 to 560	4,5	6	8	12	16	22	4,5	6	9	12	18	25	3	4	5,5	8	11	16
over 560 to 1000	5	7	9	14	18	25	5	7	10	14	20	28	3	4,5	6	9	12	18
over 1000 to 1600	5	8	10	14	20	28	5,5	8	11	16	22	32	3,5	5	7	10	14	20
over 1600 to 2500	6	8	11	16	22	32	6	8	12	16	25	32	4	5,5	8	11	14	20
over 2500 to 4000	6	9	12	18	25	36	7	9	14	18	25	36	4,5	6	8	12	16	22
over 4000 to 6300	7	9	14	18	28	36	7	10	14	20	28	40	4,5	6	8	12	16	25
over 6300 to 10000	7	10	14	20	28	40	8	11	16	22	32	45	5	7	9	14	18	25

Normal module from 2 to 3.55 mm

Tolerances in µm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	11	16	22	36	56	90
$f_{H\alpha}$	9	12	18	28	45	71
F_f	14	20	28	45	71	110

Reference circle diameter d in mm	Deviation																	
	f_p, f_{pe}						f_u						F_p					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 10 to 50	10	14	20	32	50	80	12	18	25	40	63	100	28	40	56	90	140	250
over 50 to 125	10	14	20	32	50	80	12	18	25	40	63	100	36	50	71	125	180	320
over 125 to 280	11	16	22	36	56	90	14	20	28	45	71	110	45	63	90	140	220	360
over 280 to 560	12	16	22	36	56	90	16	20	28	45	71	110	50	71	100	160	250	400
over 560 to 1000	12	18	25	40	63	100	16	22	32	50	80	125	56	80	110	180	280	450
over 1000 to 1600	14	22	28	45	71	125	18	25	36	56	90	160	63	90	125	200	320	500
over 1600 to 2500	16	25	32	50	80	140	20	28	40	63	100	180	71	100	140	220	360	560
over 2500 to 4000	18	25	36	56	90	140	22	32	45	71	110	180	80	110	160	250	400	630
over 4000 to 6300	20	25	40	63	100	160	25	36	50	80	125	200	80	125	160	250	400	630
over 6300 to 10000	28	32	45	71	110	180	28	40	63	100	160	250	90	125	180	280	450	710

Reference circle diameter d in mm	Deviation																	
	$F_{p\,z/8}$						F_r						R_s					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 10 to 50	20	25	36	56	90	140	22	32	45	63	90	125	14	20	28	36	56	71
over 50 to 125	25	32	45	71	125	180	28	40	56	80	110	160	16	22	32	45	63	90
over 125 to 280	28	40	56	90	140	220	32	45	63	90	125	180	20	28	36	50	71	100
over 280 to 560	32	45	63	100	160	250	36	50	71	100	140	180	22	32	40	56	80	110
over 560 to 1000	36	50	71	110	180	280	40	56	80	110	160	220	25	36	45	63	90	125
over 1000 to 1600	40	56	80	125	200	320	45	63	90	125	180	250	28	36	50	71	100	140
over 1600 to 2500	45	63	90	140	220	360	50	71	100	140	200	280	28	40	56	80	110	160
over 2500 to 4000	50	71	90	160	250	400	50	71	100	140	200	280	32	45	63	90	125	180
over 4000 to 6300	56	71	110	180	280	450	56	80	110	160	220	320	32	45	63	90	140	180
over 6300 to 10000	56	80	110	180	280	450	63	90	125	180	250	360	36	50	71	100	140	200

Normal module from 3.55 to 6 mm

Tolerances in μm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	2	3	4	5	7	10
$f_{H\alpha}$	1,5	2	3	4	5,5	7
F_f	2,5	3,5	5	7	9	12

Reference circle diameter d in mm	Deviation																	
	Gear tooth quality	f_p, f_{pe}						f_u						F_p					
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 10 to 50		1,5	2	3	4	6	8	2	2,5	4	5	8	10	1	6	8	12	16	22
over 50 to 125		1,5	2	3	4	6	9	2	2,5	4	5	8	11	5	8	10	16	20	28
over 125 to 280		1,5	2,5	3,5	4,5	7	9	2	3	4	5,5	9	11	6	9	12	18	25	36
over 280 to 560		2	2,5	3,5	5	7	10	2,5	3	4,5	6	9	12	7	10	14	20	28	40
over 560 to 1000		2	3	4	5,5	8	11	2,5	4	5	7	10	14	8	12	16	22	32	45
over 1000 to 1600		2	3	4	6	8	12	2,5	4	5	8	10	16	9	12	18	25	36	50
over 1600 to 2500		2,5	3	4,5	6	9	12	3	4	5,5	8	11	16	10	14	20	28	36	56
over 2500 to 4000		2,5	3,5	5	7	10	14	3	4,5	6	9	12	18	11	16	22	32	40	63
over 4000 to 6300		3	4	5,5	8	11	16	3,5	5	7	10	14	20	12	16	22	32	45	63
over 6300 to 10000		3,5	4,5	6	9	12	18	4	5,5	8	11	16	22	12	18	25	36	50	71

Reference circle diameter d in mm	Deviation																		
	Gear tooth quality	$F_{p\,z/8}$						F_r						R_s					
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 10 to 50		2,5	4	5	7	10	14	3	4,5	7	9	14	18	2	3	4	6	8	11
over 50 to 125		3	5	7	9	14	18	4	5,5	8	11	16	22	2,5	3,5	5	7	10	14
over 125 to 280		4	6	8	11	16	22	4,5	6	9	12	18	25	3	4	5,5	8	11	16
over 280 to 560		5	6	9	14	18	25	5	7	10	14	20	28	3	4,5	6	9	12	18
over 560 to 1000		5	7	10	14	20	28	5,5	8	11	16	22	32	3,5	5	7	10	14	20
over 1000 to 1600		6	8	11	16	22	32	6	9	12	18	25	36	4	5,5	8	11	16	22
over 1600 to 2500		6	9	12	18	25	36	7	10	14	20	28	40	4,5	6	9	12	16	25
over 2500 to 4000		7	10	14	20	25	36	7	10	14	20	28	40	5	7	9	12	18	25
over 4000 to 6300		7	10	14	20	28	40	8	11	16	22	32	45	5	7	9	14	18	28
over 6300 to 10000		8	11	16	22	32	45	9	12	18	25	36	50	5	7	10	14	20	28

Normal module from 3.55 to 6 mm

Tolerances in μm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	14	20	28	45	71	125
$f_{H\alpha}$	10	14	20	32	50	80
F_f	18	25	36	56	90	140

Reference circle diameter d in mm	Deviation																	
	f_p, f_{pe}						f_u						F_p					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 10 to 50	11	16	22	36	56	90	14	20	28	45	71	110	32	45	63	100	160	250
over 50 to 125	12	16	25	40	63	100	16	20	32	50	80	125	40	56	80	125	200	320
over 125 to 280	12	18	25	40	63	100	16	22	32	50	80	125	45	71	90	140	250	360
over 280 to 560	14	20	28	45	71	110	18	25	36	56	90	140	56	80	110	180	280	450
over 560 to 1000	16	20	28	45	75	125	20	25	36	56	90	160	63	90	125	200	320	500
over 1000 to 1600	16	22	32	50	80	125	20	28	40	63	100	160	71	100	140	220	360	560
over 1600 to 2500	18	25	36	56	90	140	22	32	45	71	110	180	71	110	140	250	360	630
over 2500 to 4000	20	28	40	63	100	160	25	36	50	80	125	200	80	125	160	250	400	630
over 4000 to 6300	22	32	45	71	110	180	28	40	56	90	140	220	90	125	180	280	450	710
over 6300 to 10000	25	36	50	80	125	200	32	45	63	100	160	250	100	140	200	320	500	800

Reference circle diameter d in mm	Deviation																	
	$F_{p\,z/8}$						F_r						R_s					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 10 to 50	20	28	40	63	100	160	25	36	50	71	100	140	16	22	32	45	63	90
over 50 to 125	28	36	50	80	125	200	32	45	63	90	125	180	20	28	36	50	71	100
over 125 to 280	36	45	56	100	160	250	36	50	71	100	140	200	22	32	45	63	80	110
over 280 to 560	36	50	71	110	180	280	40	56	80	110	160	220	25	36	50	71	90	125
over 560 to 1000	40	56	80	125	200	320	45	63	90	125	180	250	28	36	56	80	100	140
over 1000 to 1600	40	63	90	140	220	360	50	71	100	140	200	280	32	40	63	80	110	160
over 1600 to 2500	45	63	90	140	250	400	56	80	110	160	220	320	32	45	63	90	125	180
over 2500 to 4000	50	71	100	160	250	400	56	80	110	160	220	320	36	50	71	100	140	200
over 4000 to 6300	56	80	110	180	280	450	63	90	125	180	250	360	36	56	71	110	160	220
over 6300 to 10000	63	90	125	200	320	500	71	100	140	200	280	400	40	56	80	110	160	220

Normal module from 6 to 10 mm

Tolerances in µm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	2,5	3,5	5	7	10	14
$f_{H\alpha}$	2	2,5	3,5	5	7	9
F_f	3	4	6	8	12	16

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 10 to 50	2	2,5	3,5	5	7	10	2,5	3	4,5	6	9	12	4,5	6	9	14	18	25
over 50 to 125	2	2,5	3,5	5	7	10	2,5	3	4,5	6	9	12	6	8	11	16	22	32
over 125 to 280	2	2,5	4	5,5	8	11	2,5	3	5	7	10	14	7	10	14	20	25	36
over 280 to 560	2	3	4	6	8	11	2,5	3,5	5	8	10	14	8	11	16	22	28	40
over 560 to 1000	2,5	3	4,5	6	9	11	3	3,5	5,5	8	11	14	9	12	18	25	32	45
over 1000 to 1600	2,5	3,5	5	7	9	12	3	4,5	6	9	11	16	10	14	18	28	36	50
over 1600 to 2500	2,5	3,5	5	7	10	14	3	4,5	6	9	12	18	11	15	22	28	40	56
over 2500 to 4000	3	4	5,5	8	11	16	3,5	5	7	10	14	20	12	16	22	32	45	63
over 4000 to 6300	3	4,5	6	9	12	18	4	5,5	8	11	16	22	12	18	25	36	50	71
over 6300 to 10000	3,5	5	7	10	14	20	4,5	6	9	12	18	25	14	20	28	40	56	80

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 10 to 50	3	4	6	8	11	16	3,5	5,5	8	11	16	22	2,5	3,5	5	7	9	14
over 50 to 125	4	5	7	10	14	20	4,5	6	9	12	18	25	3	4	5,5	8	11	16
over 125 to 280	4,5	6	8	12	16	22	5	7	10	14	20	28	3,5	4,5	6	9	12	18
over 280 to 560	5	7	10	14	18	28	5,5	8	11	16	22	32	3,5	5	7	10	14	20
over 560 to 1000	6	8	11	16	20	28	6	9	12	18	25	36	4	5,5	8	11	16	22
over 1000 to 1600	6	9	12	18	22	32	7	10	14	20	28	40	4,5	6	9	12	18	25
over 1600 to 2500	7	9	14	20	25	36	8	11	16	22	32	45	5	7	10	14	18	25
over 2500 to 4000	7	10	14	20	28	40	8	12	16	22	32	45	5,5	7	10	14	20	28
over 4000 to 6300	8	11	16	22	32	45	9	12	18	25	36	50	5,5	7	11	14	22	28
over 6300 to 10000	9	12	18	25	32	50	10	14	20	28	40	56	6	8	12	16	22	32

Normal module from 6 to 10 mm

Tolerances in µm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	20	28	40	63	100	160
$f_{H\alpha}$	12	18	25	40	63	100
F_f	22	32	45	71	110	180

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 10 to 50	12	18	25	40	63	110	16	22	32	50	80	140	32	45	71	110	180	280
over 50 to 125	14	20	28	45	71	110	18	25	36	56	90	140	45	63	90	140	220	360
over 125 to 280	14	20	28	45	71	125	18	25	36	56	90	160	56	71	100	160	250	400
over 280 to 560	16	22	32	50	80	125	20	28	40	63	100	160	63	80	110	180	280	450
over 560 to 1000	16	25	32	56	90	140	20	28	40	71	110	180	71	90	125	200	320	500
over 1000 to 1600	18	25	36	56	90	140	22	32	45	71	110	180	71	100	140	220	360	560
over 1600 to 2500	20	28	40	63	100	160	25	36	50	80	125	200	80	110	160	250	400	630
over 2500 to 4000	22	32	45	71	110	180	28	36	50	80	140	220	90	125	180	280	450	710
over 4000 to 6300	25	32	50	80	125	200	32	45	63	100	160	250	100	140	200	320	500	800
over 6300 to 10000	28	36	56	90	140	220	32	50	71	110	180	280	110	160	220	360	560	900

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 10 to 50	22	32	45	71	110	180	32	40	63	80	125	160	18	25	36	50	71	100
over 50 to 125	28	40	56	90	140	220	36	50	71	100	140	200	22	32	45	63	80	110
over 125 to 280	32	45	63	100	160	250	40	56	80	110	160	220	25	36	50	71	90	125
over 280 to 560	36	50	71	110	180	280	45	63	90	125	180	250	28	40	56	80	110	140
over 560 to 1000	40	56	80	125	200	320	50	71	100	140	200	280	32	45	63	80	125	160
over 1000 to 1600	45	63	90	140	220	360	56	80	110	160	220	320	34	50	63	90	125	180
over 1600 to 2500	50	71	100	160	250	400	63	90	125	160	250	320	36	50	71	100	140	200
over 2500 to 4000	56	80	110	180	280	450	63	90	125	180	250	360	40	56	80	110	160	220
over 4000 to 6300	63	90	125	200	320	500	71	100	140	200	280	400	40	56	80	125	160	250
over 6300 to 10000	71	100	140	220	360	560	80	110	160	220	320	450	45	63	90	125	180	250

Normal module from 10 to 16 mm

Tolerances in µm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	3	4,5	6	9	12	18
$f_{H\alpha}$	2	3	4	6	8	12
F_f	4	5,5	8	11	16	22

Reference circle diameter d in mm	Deviation																	
	f_p, f_{pe}						f_u						F_p					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 50 to 125	2,5	3	4,5	6	9	12	3	4	5,5	8	11	16	6	9	12	18	25	32
over 125 to 280	2,5	3,5	4,5	6	9	12	3	4,5	5,5	8	11	16	7	10	14	20	28	40
over 280 to 560	2,5	3,5	5	7	10	14	3	4,5	6	9	12	18	8	12	16	22	32	45
over 560 to 1000	2,5	4	5	7	10	14	3	5	6	9	12	18	10	14	18	25	36	50
over 1000 to 1600	3	4	5,5	8	11	16	4	5	7	10	14	20	11	16	20	28	40	56
over 1600 to 2500	3	4	6	8	12	16	4	5	7	10	16	20	12	16	22	32	45	63
over 2500 to 4000	3,5	4,5	7	9	12	18	4,5	5,5	8	11	16	22	14	18	25	36	50	71
over 4000 to 6300	3,5	5	7	10	14	20	4,5	6	9	12	18	25	14	18	28	36	56	71
over 6300 to 10000	4	5,5	8	11	16	22	5	7	10	14	20	28	14	20	28	40	56	80

Reference circle diameter d in mm	Deviation																	
	$F_{p\,z/8}$						F_r						R_s					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 50 to 125	4	5	8	11	16	22	5	7	10	14	20	28	3	4,5	6	9	12	18
over 125 to 280	5	6	9	14	18	25	5,5	8	11	16	22	32	3,5	5	7	10	14	20
over 280 to 560	5	7	10	16	20	28	6	9	12	18	25	36	4	6	8	11	16	22
over 560 to 1000	6	8	12	18	22	32	7	10	14	20	28	40	4,5	6	9	12	18	25
over 1000 to 1600	7	9	14	18	25	36	8	11	16	22	32	45	5	7	10	14	20	28
over 1600 to 2500	7	10	14	20	28	40	8	12	16	25	32	45	5,5	8	11	14	20	28
over 2500 to 4000	8	11	16	22	32	45	9	12	18	25	36	50	6	8	12	16	22	32
over 4000 to 6300	8	12	16	25	32	45	10	14	20	28	40	56	6	8	12	16	22	32
over 6300 to 10000	9	12	18	25	36	50	11	16	22	32	45	63	6	9	12	18	25	36

Normal module from 10 to 16 mm

Tolerances in µm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	25	36	50	80	125	200
$f_{H\alpha}$	16	22	32	50	80	125
F_f	28	40	56	90	140	250

Reference circle diameter d in mm	Deviation																	
	f_p, f_{pe}						f_u						F_p					
	Gear tooth quality																	
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 50 to 125	18	25	32	56	90	140	22	32	40	63	110	140	45	63	90	140	220	360
over 125 to 280	18	25	36	56	90	140	22	32	45	71	110	180	56	80	110	180	280	450
over 280 to 560	20	28	36	56	90	160	25	36	45	71	110	200	63	90	125	200	320	500
over 560 to 1000	20	28	40	63	100	160	25	36	50	80	125	200	71	100	140	220	360	560
over 1000 to 1600	22	32	40	63	110	180	28	36	50	80	140	220	80	110	160	250	400	630
over 1600 to 2500	22	32	45	71	110	180	28	40	56	90	140	220	90	125	180	280	450	710
over 2500 to 4000	25	36	50	80	125	200	32	45	63	100	160	250	100	140	180	320	500	800
over 4000 to 6300	28	40	56	90	140	220	36	50	71	110	180	280	110	140	220	360	560	900
over 6300 to 10000	28	40	63	100	160	250	36	56	80	125	200	320	110	160	220	360	560	900

Reference circle diameter d in mm	Deviation																	
	$F_{p\,z/8}$						F_r						R_s					
	Gear tooth quality																	
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 50 to 125	28	40	56	90	140	250	40	56	80	110	160	220	25	36	50	71	100	140
over 125 to 280	36	50	71	110	180	280	45	63	90	125	180	250	28	40	56	80	110	160
over 280 to 560	40	56	80	125	200	320	50	71	100	140	200	280	32	45	63	90	125	160
over 560 to 1000	45	63	90	140	220	360	56	80	110	160	220	320	36	50	71	100	140	180
over 1000 to 1600	50	71	100	160	250	400	63	90	125	180	250	360	36	56	71	100	140	200
over 1600 to 2500	56	80	110	180	280	450	71	90	140	180	280	360	40	56	80	110	160	220
over 2500 to 4000	63	90	110	200	320	500	71	100	140	200	280	400	45	63	90	125	180	250
over 4000 to 6300	63	90	140	220	320	500	80	110	160	220	320	450	45	63	90	125	180	250
over 6300 to 10000	71	100	140	220	360	550	90	125	180	250	360	500	50	71	100	140	200	280

Normal module from 16 to 25 mm

Tolerances in µm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	4	6	8	12	16	22
$f_{H\alpha}$	3	4	5,5	8	11	16
F_f	5	7	10	14	20	28

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 125 to 280	3	4	6	8	11	16	4	5	8	10	14	20	8	11	16	22	32	40
over 280 to 560	3	4,5	6	8	12	16	4	5,5	8	10	16	20	9	14	18	25	36	45
over 560 to 1000	3	4,5	6	9	12	18	4	5,5	8	11	16	22	10	14	20	28	40	56
over 1000 to 1600	3,5	5	7	9	14	18	4,5	6	9	11	16	22	11	16	22	32	45	56
over 1600 to 2500	3,5	5	7	10	14	20	4,5	6	9	12	18	25	12	18	25	36	50	63
over 2500 to 4000	4	5,5	8	11	14	20	5	7	10	14	18	25	14	20	28	40	56	71
over 4000 to 6300	4	5,5	8	11	16	22	5	7	10	14	20	28	14	20	28	40	56	80
over 6300 to 10000	4,5	6	9	12	18	25	5,5	8	11	16	22	32	16	22	32	45	63	90

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 125 to 280	5	7	10	14	18	28	6	9	12	18	25	36	4	6	8	11	16	22
over 280 to 560	6	8	11	16	22	32	7	10	14	20	28	40	4,5	7	9	12	18	25
over 560 to 1000	6	9	14	18	25	36	8	11	16	22	32	45	5	7	10	14	20	28
over 1000 to 1600	7	10	14	20	28	36	9	12	18	25	36	50	5,5	8	11	16	22	32
over 1600 to 2500	8	11	16	22	28	40	9	14	18	25	36	50	6	8	12	16	22	32
over 2500 to 4000	8	12	18	25	32	45	10	14	20	28	40	56	7	9	12	18	25	36
over 4000 to 6300	9	12	18	25	36	50	11	16	22	32	45	63	7	10	14	18	25	36
over 6300 to 10000	10	14	20	28	40	56	12	16	25	32	50	71	7	10	14	20	28	40

Normal module from 16 to 25 mm

Tolerances in μm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	32	45	63	110	160	250
$f_{H\alpha}$	22	28	40	71	110	180
F_f	40	56	80	125	200	320

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 125 to 280	22	32	45	71	110	180	28	40	56	90	140	220	56	80	110	180	280	450
over 280 to 560	22	32	45	71	110	180	28	40	56	90	140	220	71	90	125	200	320	560
over 560 to 1000	25	36	50	80	125	200	32	45	63	100	160	250	80	110	140	220	360	630
over 1000 to 1600	25	36	50	80	125	200	32	45	63	100	160	250	90	110	160	250	400	710
over 1600 to 2500	28	40	56	80	140	220	36	50	71	110	180	280	90	125	180	280	450	750
over 2500 to 4000	28	40	56	90	140	220	36	50	71	110	180	280	100	140	200	320	500	800
over 4000 to 6300	32	45	63	100	160	250	40	56	80	125	200	320	110	160	220	360	560	900
over 6300 to 10000	32	50	63	110	180	280	40	56	80	125	220	360	125	180	250	360	630	1000

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 125 to 280	36	50	71	110	180	280	50	71	100	140	200	280	32	45	63	90	125	160
over 280 to 560	40	63	80	140	220	320	56	80	110	160	220	320	36	50	71	100	140	180
over 560 to 1000	50	71	90	140	250	360	63	90	125	180	250	360	40	56	80	110	140	200
over 1000 to 1600	56	71	100	160	250	400	71	100	140	200	280	400	40	56	80	110	160	220
over 1600 to 2500	56	80	110	180	280	450	71	100	140	200	280	400	45	63	90	125	180	250
over 2500 to 4000	63	90	125	200	320	500	80	110	160	220	320	450	50	71	100	140	180	280
over 4000 to 6300	71	100	140	220	360	560	90	125	180	250	360	500	50	71	100	140	200	280
over 6300 to 10000	80	110	140	250	400	630	100	140	200	280	360	560	56	80	110	160	200	280

Normal module from 25 to 40 mm

Tolerances in μm

Deviation	Gear tooth quality					
	1	2	3	4	5	6
f_f	6	8	11	16	22	32
$f_{H\alpha}$	4	5,5	8	10	14	20
F_f	7	10	14	20	25	36

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 125 to 280	4	5,5	8	11	15	22	5	7	10	14	20	28	8	12	16	22	32	45
over 280 to 560	4	6	8	11	16	22	5	8	10	14	20	28	10	14	18	28	36	50
over 560 to 1000	4	6	8	12	16	22	5	8	10	16	20	28	11	16	20	32	40	56
over 1000 to 1600	4,5	6	9	12	18	25	5,5	8	11	16	22	32	12	18	25	32	45	63
over 1600 to 2500	4,5	7	9	12	18	25	5,5	9	11	16	22	32	12	18	25	36	50	71
over 2500 to 4000	5	7	10	14	20	25	6	9	12	16	25	32	14	20	28	40	56	80
over 4000 to 6300	5	7	10	14	20	28	6	9	12	18	25	36	16	22	32	45	63	90
over 6300 to 10000	5,5	7	11	14	20	28	7	9	14	18	25	36	16	22	32	45	63	90

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 125 to 280	5	7	10	14	20	28	7	10	14	20	28	40	4,5	7	9	12	18	25
over 280 to 560	6	9	12	16	22	32	8	11	16	22	32	45	5	7	10	14	20	28
over 560 to 1000	7	10	14	18	25	36	9	12	18	25	36	50	5,5	8	11	16	22	32
over 1000 to 1600	8	11	16	20	28	40	10	14	20	28	40	56	6	9	12	18	25	32
over 1600 to 2500	8	12	16	22	32	45	10	14	20	28	40	56	7	9	12	18	25	36
over 2500 to 4000	9	12	18	25	36	50	11	16	22	32	45	63	7	10	14	20	28	40
over 4000 to 6300	9	12	18	25	36	56	12	18	25	36	50	71	7	10	14	20	28	40
over 6300 to 10000	10	14	20	28	40	56	14	18	25	36	50	71	8	12	16	22	32	45

Normal module from 25 to 40 mm

Tolerances in μm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_f	45	63	80	140	220	360
$f_{H\alpha}$	28	40	56	90	140	220
F_f	56	71	100	160	250	400

Reference circle diameter d in mm	Deviation																	
	f_p, f_{pe}						f_u						F_p					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 125 to 280	28	40	56	90	140	250	36	50	71	110	180	320	63	90	125	200	320	500
over 280 to 560	32	45	63	100	160	250	40	56	80	125	200	320	71	100	140	220	360	560
over 560 to 1000	32	45	63	100	160	250	40	56	80	125	200	320	80	110	160	250	400	630
over 1000 to 1600	32	45	63	100	160	280	40	56	80	125	200	360	90	125	180	280	450	750
over 1600 to 2500	36	50	71	110	180	280	45	63	90	140	220	360	100	140	200	320	500	800
over 2500 to 4000	36	50	71	110	180	280	45	63	90	140	220	360	110	160	220	360	560	850
over 4000 to 6300	40	56	71	125	200	320	50	71	100	160	250	400	125	180	220	360	560	1000
over 6300 to 10000	40	56	80	125	200	320	50	71	100	160	250	400	125	180	250	400	630	1000

Reference circle diameter d in mm	Deviation																	
	$F_{p\,z/8}$						F_r						R_s					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 125 to 280	40	56	80	125	200	320	56	80	110	160	220	320	36	50	71	100	140	200
over 280 to 560	45	63	90	140	220	360	63	90	125	180	250	360	40	56	80	110	160	220
over 560 to 1000	50	71	100	160	250	400	71	100	140	200	280	400	45	63	80	125	160	220
over 1000 to 1600	56	80	110	180	280	450	80	110	160	220	320	450	45	63	90	125	180	250
over 1600 to 2500	63	90	125	200	320	500	80	110	160	220	320	450	50	71	100	140	200	280
over 2500 to 4000	71	100	140	220	360	560	90	125	180	250	360	500	56	80	110	140	200	280
over 4000 to 6300	71	100	140	220	360	630	100	140	200	280	400	560	56	80	110	160	220	280
over 6300 to 10000	80	110	160	250	400	630	100	140	200	280	400	560	63	90	110	160	220	320

Normal module from 40 to 70 mm

Tolerances in µm

Deviation	Gear tooth quality	
	5	6
f_f	32	45
$f_{H\alpha}$	22	28
F_f	36	50

Reference circle diameter d in mm	Gear tooth quality	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 125 to 280		6	8	12	16	22	32	7	10	14	20	28	40	9	12	18	25	36	50
over 280 to 560		6	8	12	16	22	32	8	10	14	20	28	40	10	14	20	28	40	56
over 560 to 1000		6	8	12	16	22	32	8	10	14	20	28	40	12	16	22	32	45	63
over 1000 to 1600		6	9	12	16	25	32	8	10	16	22	28	40	14	18	25	36	50	71
over 1600 to 2500		6	9	12	18	25	36	8	12	16	22	32	45	14	20	28	40	56	80
over 2500 to 4000		7	10	14	18	25	36	8	12	16	22	32	45	16	22	32	45	63	80
over 4000 to 6300		7	10	14	20	25	36	9	12	18	25	32	45	18	25	36	45	63	90
over 6300 to 10000		7	10	14	20	28	36	9	12	18	25	36	50	18	25	36	50	71	100

Reference circle diameter d in mm	Gear tooth quality	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
over 125 to 280		6	8	12	16	22	32	8	12	16	25	32	50	6	7	10	14	20	28
over 280 to 560		7	9	12	18	25	36	9	14	18	25	36	50	6	8	12	16	22	32
over 560 to 1000		7	10	14	20	28	40	10	14	20	28	40	56	6	9	12	18	22	32
over 1000 to 1600		8	12	16	22	32	45	11	16	22	32	45	63	7	10	12	18	25	36
over 1600 to 2500		9	12	18	25	36	50	12	16	22	32	45	63	7	10	14	20	28	36
over 2500 to 4000		10	14	20	28	36	50	12	18	25	36	50	71	7	12	16	22	28	40
over 4000 to 6300		10	14	20	28	40	56	14	20	28	40	56	80	8	12	16	22	32	45
over 6300 to 10000		12	16	22	32	45	63	14	20	28	40	56	80	9	14	18	25	36	50

Normal module from 40 to 70 mm

Tolerances in μm

Deviation	Gear tooth quality					
	7	8	9	10	11	12
f_t	63	90	125	200	320	500
$f_{H\alpha}$	40	56	80	125	200	320
F_f	71	100	140	220	360	560

Reference circle diameter d in mm	Deviation f_p, f_{pe}						Deviation f_u						Deviation F_p					
Gear tooth quality	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 125 to 280	45	63	80	140	220	360	56	80	110	180	280	450	71	100	125	200	360	560
over 280 to 560	45	63	90	140	220	360	56	80	110	180	280	450	80	110	160	250	400	630
over 560 to 1000	45	63	90	140	220	360	56	80	110	180	280	450	90	125	180	280	450	710
over 1000 to 1600	45	63	90	140	220	360	56	80	110	180	280	450	100	140	180	320	500	800
over 1600 to 2500	50	63	90	140	250	400	63	80	125	180	320	500	110	140	200	320	560	850
over 2500 to 4000	50	71	100	160	250	400	63	90	125	180	320	500	110	160	220	360	560	900
over 4000 to 6300	50	71	100	160	250	400	63	90	125	220	320	500	125	180	250	400	630	1000
over 6300 to 10000	56	80	110	180	280	450	71	100	140	220	360	560	140	200	280	450	710	1100

Reference circle diameter d in mm	Deviation $F_{p\,z/8}$						Deviation F_r						Deviation R_s					
Gear tooth quality	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
over 125 to 280	45	63	80	140	220	360	71	90	140	180	280	360	40	56	80	110	160	200
over 280 to 560	50	71	100	160	250	400	71	100	140	200	280	400	45	56	90	110	160	220
over 560 to 1000	56	80	110	180	280	450	80	110	160	220	320	450	45	63	90	125	180	250
over 1000 to 1600	63	80	110	200	280	500	90	125	180	250	360	500	50	71	100	140	200	280
over 1600 to 2500	71	90	125	220	320	560	90	125	180	250	360	500	56	80	100	140	200	280
over 2500 to 4000	71	100	140	220	360	560	100	140	200	280	400	560	56	80	110	160	220	320
over 4000 to 6300	80	110	160	250	400	630	110	160	220	320	450	630	63	90	125	180	250	360
over 6300 to 10000	90	125	180	280	450	710	110	160	220	320	450	630	71	100	140	180	250	360

Further Standards and codes

DIN 3962 Part 2	Tolerances for cylindrical gear teeth; tolerances for tooth trace deviations
DIN 3963	Tolerances for cylindrical gear teeth; tolerances for working deviations
DIN 3964	Centre distance allowances and shaft position tolerances of housings for cylindrical gear transmissions
DIN 3999	Symbols for gear teeth
VDI/VDE 2605	Circular pitches and plane angles. Fundamental terms for angle dimensions, angle measurements, angle standards and their errors
VDI/VDE 2612	Profile and tooth trace test for cylindrical gears with involute profile, Part 1 Profile testing, Part 2 Tooth trace testing
VDI/VDE 3336	Cutting cylindrical gears with involute profile, metal-removal processes

Explanations

When the "Gear tooth tolerances" Sub-committee starting revising the DIN Standards on tolerances for cylindrical gear teeth it was faced with the question whether the tolerances contained in ISO 1328 – 1975 could be taken over complete. After a thorough examination the committee came to the conclusion that this would not be expedient for the purposes of German industry.

The DIN gear tooth tolerance system in use so far, the principles of which have not altered, has for the most part proved itself in practice. Only with regard to a few points was a general redefining of tolerances necessary. This applies particularly to the tolerances for single-flank working deviations, tooth trace deviations and, to some extent, for pitch-span deviations.

Apart from this, it has been shown in practice that for the same module the profile deviations do not become larger with increasing diameter (increasing number of teeth). The profile tolerances therefore remain only module-dependent and no longer diameter-dependent.

A general review of the alterations undertaken is given in the Explanations in DIN 3961.

The terms, designations and symbols have been redefined in accordance with DIN 3960, DIN 3998 and DIN 3999. Newly added parameters are the total profile deviation, pitch-span deviation, tooth trace form deviation and tooth trace total deviation.

The numerical specifying of tolerances derives from the equations in DIN 3961. Additional alterations of the tabulated numerical data result from the fact that the module and diameter ranges have been regraded and from the fact that the values in the old DIN Standards calculated from the tolerance equations had for the most part been rounded upwards, whereas in the new Standards they have been rounded up or down to the nearest preferred number.

The diameter range has been enlarged in the upward direction to module m = 70 mm and diameter d = 10 000 mm. Regardless of whether all deviations are measurable, the numerical values in the Tables of DIN 3962 Part 1 and DIN 3963 have been listed completely in the interests of future applications. The module range $m < 1$ mm has been deleted, see in this connection DIN 58 405. The arrangement of the tolerance Standards has been altered so that the tooth trace deviations have been grouped with the individual deviations in DIN 3962 Part 2, whilst DIN 3963 contains only working deviations and DIN 3967 only the system of gear fits.

In the opinion of German industry, the large tolerances for the two-flank working deviation, concentricity deviation and pitch-span deviation and the large amount of spread in their relationship to the other tolerances, which were features objected to in ISO 1328 – 1975, are defined more in keeping with practical requirements in DIN 3962 and DIN 3963.

Literature

Winter, H.; Seifried, A.: Verzahnungsfehler. Statistische Ermittlung natürlicher Zusammenhänge und Normung von Toleranzen. (**Gear tooth errors.** Statistical determination of natural relationships and standardizing of tolerances.) WERKSTATT UND BETRIEB 98 (1965) No. 10, pp. 765–771.

Seifried, A.: Zahnrad-Teilungsfehler. Statistische Ermittlung der Zusammenhänge mit anderen Verzahnungsfehlern. (Gear tooth pitch errors. Statistical determination of relationships with other gear tooth errors.) VDI-Berichte No. 105 (1967), pp. 141–143.

Kagerl, H. G.; Würpel, H.: Fertigungsgerechte Relationen zwischen den geometrischen Abweichungen an Stirnrädern. (Production-oriented relationships between the geometrical deviations on cylindrical gears.) WISSENSCHAFTL. ZEITSCHR. d. TH. Magdeburg 11 (1967) No. 2, pp. 201–210.

Kagerl, H. G.; Dulich, W.: Fertigungsgerechte Relationen Einflankenwälzabweichung/Einflankenwälzsprung – Einzelabweichungen. (Production-oriented relationships single flank working deviation/single flank working error – individual deviations.) FERTIGUNGSTECHNIK UND BETRIEB 21 (1971) No. 8, pp. 455–458.