

according to DIN ISO 21771:2014

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Project	Gear pair	Remark
00001.01.21 [3STG360]	002 [AV=250 (INT)]	teste

	Gear 1	Gear 2
	PIN250E	ENG250D

1 INPUT DATA

1.1 Centre distance	a_w	250,000	mm
1.2 Allowance DIN EN ISO 286-1:2019	$Aa_w e/i$	js7 0,023 / -0,023	mm
1.3 Limit values for a_w	$a_w e/i$	250,023 / 249,977	mm
1.4 Number of teeth	z	15	63
1.5 Normal pressure angle	α_n	25,000 [25° 00' 00"]	°
1.6 Helix angle	β	8,000 [08° 00' 00"]	°
1.7 Required transmission ratio	u_{req}	4,134	
1.8 Normal module 6.2 - none none:0	m_n	6,200	mm
1.9 Tooth inclination direction	z_r	Left	Right
1.10 Gear Tooth Working Flank	a_f	Left - L	
1.11 Gear accuracy ISO 1328-1:1995	Q	6	6
1.12 Facewidth	b	95,000	88,000 mm
1.13 Allowance for grinding (per flank)	$q [q^*]$	0,160 [0,026] 25PRM5 WSST	0,160 [0,026] 25PRM5 WSST
1.14 Cutting tool - Profile		09.05.0056:2020	09.05.0056:2020

2 GENERAL OUTPUT DATA

2.1 Exact transmission ratio	u_{exa}	4,200 [1,597%]	
2.2 Minimum number of teeth without undercut	z_c	11,198	
2.3 Usable facewidth	b_w	88,000	mm
2.4 Relation	b_w/a_w	0,352	

3 GEAR CUTTING TOOL DATA

3.2 Drawing number		-	-
3.3 Pressure angle of the tool	α_{p0}	25,000	25,000 °
3.4 Addendum of tool	$h_{aP0} [h_{aP0}^*]$	7,440 [1,200]	7,440 [1,200] mm
3.5 Dedendum	$h_{fP0} [h_{fP0}^*]$	7,440 [1,200]	7,440 [1,200] mm
3.6 Tooth thickness	$s_{P0} [s_{P0}^*]$	9,739 [1,571]	9,739 [1,571] mm
3.7 Fillet radius on head of tool	$\rho_{aP0} [\rho_{aP0}^*]$	2,336 [0,377]	2,336 [0,377] mm
3.8 Fillet radius on root of tool	$\rho_{rP0} [\rho_{rP0}^*]$	1,240 [0,200]	1,240 [0,200] mm
3.9 Reference addendum of tooth gear head	$h_{aP} [h_{aP}^*]$	6,200 [1,000]	6,200 [1,000] mm
3.10 Protuberance	$\rho_{rP0} [\rho_{rP0}^*]$	0,240 [0,039]	0,240 [0,039] mm
3.11 Protuberance hight	h_{prP0}	2,634 [0,425]	2,634 [0,425] mm
3.12 Protuberance angle	$[h_{prP0}^*]$	12,000	12,000 °
3.13 Tooth thickness of tool on protuberance	$s_{prP0} [s_{prP0}^*]$	4,904 [0,791]	4,904 [0,791] mm
3.14 Chamfer at the bottom of the tooth	α_{kP0}	0,000	0,000 °
3.15 Depth of dedendum form	$h_{fFP0} [h_{fFP0}^*]$	0,000 [0,000]	0,000 [0,000] mm
3.16 Addendum chamfer	$h_k [h_k^*]$	0,000 [0,000]	0,000 [0,000] mm

4 ANGLES

4.1 Transverse pressure angle at pitch diameter	α_t	25,215 [25° 12' 55"]	°
4.2 Tip transverse pressure angle	α_{at}	36,518	30,062 °
4.3 Normal working pressure angle at pitch diameter	α_{wn}	27,673 [27° 40' 24"]	°
4.4 Transverse working pressure angle at pitch diameter	α_{wt}	27,916 [27° 54' 56"]	°
4.5 Limit values for α_{wt}	$\alpha_{wt\ e/i}$	27,926 / 27,906	°
4.6 Tip diameter helix angle	β_a	8,990	8,358 °
4.7 Working diameter helix angle	β_w	8,188 [08° 11' 17"]	°
4.8 Base diameter helix angle	β_b	7,246 [07° 14' 46"]	°

5 MODULES, PITCHES, ...

5.1 Transverse module	m_t	6,261	mm
5.2 Axial module	m_x	44,549	mm
5.3 Modul on base diameter	m_b	5,664	mm
5.4 Transverse pitch	p_t	19,669	mm
5.5 Normal pitch	p_n	19,478	mm
5.6 Transverse pitch on base diameter	p_{bt}	17,795	mm
5.7 Normal pitch on base diameter	p_{bn}	17,653	mm
5.8 Transverse base pitch on the path of contact	p_{et}	17,795	mm
5.9 Normal base pitch on the path of contact	p_{en}	17,653	mm
5.10 Lead	p_z	2.099,315	8.817,121 mm
5.11 Axial pitch	p_x	139,954	mm

6 DIAMETERS, ...

6.1 Reference diameter	d	93,914	394,439 mm
6.2 Base diameter	d_b	84,965	356,854 mm
6.3 Working pitch diameter	d_w	96,154	403,846 mm
6.4 Limit values for d_w	$d_w\ e/i$	96,163 / 96,145	403,883 / 403,809 mm
6.5 Tip diameter	d_a	105,722	412,317 mm
6.6 Allowance DIN EN ISO 286-1:2019	$Ad_a\ e/i$	h5 0,000 / -0,015	h5 0,000 / -0,027 mm
6.7 Limit values for d_a	$d_a\ e/i$	105,722 / 105,707	412,317 / 412,290 mm
6.8 Active tip diameter	d_{Na}	105,722	412,317 mm
6.9 Limit values for d_{Na}	$d_{Na\ e/i}$	105,722 / 105,707	412,317 / 412,290 mm
6.10 Active root diameter (SAP diameter)	d_{Nf}	89,317	395,784 mm
6.11 Limit values for d_{Nf}	$d_{Nf\ e/i}$	89,364 / 89,287	395,837 / 395,741 mm
6.12 Tip form diameter	d_{Fa}	105,722	412,317 mm
6.13 Limit values for d_{Fa}	$d_{Fa\ e/i}$	105,722 / 105,707	412,317 / 412,290 mm
6.14 Root form diameter	d_{Ff}	85,728	388,543 mm
6.15 Limit values for d_{Ff}	$d_{Ff\ e/i}$	85,682 / 85,656	388,285 / 388,166 mm
6.16 Root diameter	d_f	79,034	385,629 mm
6.17 Limit values for d_f	$d_f\ e/i$	78,884 / 78,798	385,350 / 385,221 mm
6.18 V-circle diameter	d_v	93,914	400,509 mm
6.19 Tip alteration coefficient	k	-0,0477	
6.20 Tip alteration	k^*m_n	-0,2960	-0,2960 mm
6.21 Theoretical tip clearance	$c\ [c^*]$	4,325 [0,698]	4,325 [0,698] mm
6.22 Limit values for c	$c\ e/i$	4,559 / 4,441	4,479 / 4,377 mm

7 PROFILE SHIFT, ...

7.1 Theoretical center distance	a_d	244,176	mm
7.2 Sum of coefficient of profile shift	ΣX	0,98705	
7.3 Division of sum of profile shift coefficients		Same tooth-root stress	
7.4 Profile shift coefficient	x	0,00000	0,48954
7.5 Addendum modification factor at undercut limit	x_{min}	-0,39212	-4,79078
7.6 Virtual number of teeth for profile modification calculations	Z_{nx}	15,392	64,648
7.7 Generating profile shift coefficient	$x_{E\ e/i}$	-0,01210 / -0,01900	0,46710 / 0,45670

8 TOOTH DIMENSIONS

8.1 Addendum	h_a	5,904	8,939 mm
8.2 Limit values for h_a	$h_{a\ e/i}$	5,904 / 5,897	8,939 / 8,926 mm
8.3 Dedendum	h_f	7,440	4,405 mm
8.4 Limit values for h_f	$h_{f\ e/i}$	7,515 / 7,558	4,544 / 4,609 mm
8.5 Tooth depth	h	13,344	13,344 mm
8.6 Tooth thickness half angle	ψ	12,032	3,667 °
8.7 Tooth space half angle	η	12,032	2,063 °
8.8 Transverse space width	e_t	9,835	6,976 mm
8.9 Normal space width	e_n	9,739	6,908 mm
8.10 Transverse tooth thickness	s_t	9,835	12,693 mm
8.11 Normal tooth thickness	s_n	9,739	12,570 mm
8.12 Limit values for s_n	$s_{n\ e/i}$	9,669 / 9,629	12,440 / 12,380 mm
8.13 Normal tooth thickness / m_n	s_n^*	1,571	2,027 mm
8.14 Tip tooth thickness half angle	ψ_a	3,667	1,031 °
8.15 Tip tooth space half angle	η_a	20,283	4,698 °
8.16 Tip transverse space width	e_{at}	18,714	16,904 mm
8.17 Tip normal space width	e_{an}	18,532	16,740 mm
8.18 Transverse top land thickness	s_{at}	3,428	3,656 mm
8.19 Tooth top land thickness	s_{an}	3,386	3,618 mm
8.20 Condition $s_{an}/m_n > 0.2$	s_{an}/m_n	0,525	0,549
8.21 Limit values for s_{an}	$s_{an\ e/i}$	3,312 / 3,252	3,486 / 3,403 mm
8.22 Tooth thickness at tip form diameter	s_{Fan}	3,386	3,618 mm
8.23 Limit values for s_{Fan}	$s_{Fan\ e/i}$	3,312 / 3,253	3,486 / 3,403 mm
8.24 Normal space width on diameter d_f	e_{fn}	0,000	2,954 mm
8.25 Limit values for e_{fn}	$e_{fn\ e/i}$	0,000 / 0,000	2,959 / 2,962 mm

9 DIMENSIONAL CONTROL - s_c , s_{Yn}

9.1 Circle of curvature of the ellipse in normal section	d_n	95,769	402,229 mm
9.2 Tooth thickness half angle	ψ	667,725	205,119 °
9.3 Cord tooth thickness without backlash	s_c	9,722	12,568 mm
9.4 Limit values for s_c	$s_{c\ e/i}$	9,652 / 9,612	12,438 / 12,378 mm
9.5 Reference chordal addendum for s_c	h_c	6,151	9,037 mm
9.6 Limit values for h_c	$h_{c\ e/i}$	6,151 / 6,144	9,037 / 9,024 mm
9.7 Y-circle diameter	d_Y	93,000	394,000 mm
9.8 Reference chordal addendum for s_Y	h_Y	6,628	9,260 mm
9.9 Limit values for h_Y	$h_{Y\ e/i}$	6,628 / 6,620	9,260 / 9,246 mm
9.10 Normal tooth thickness at Y-cylinder	s_{Yn}	10,059	12,760 mm
9.11 Limit values for s_{Yn}	$s_{Yn\ e/i}$	9,989 / 9,949	12,630 / 12,570 mm
9.12 Measure with machining allowance for s_{Yn}	s_{Ynfre}	10,339	12,950 mm
9.13 Limit values for s_{Ynfre}	$s_{Ynfre\ e/i}$	10,339 / 10,349	12,950 / 10,349 mm

10 DIMENSIONAL CONTROL - W_k

10.1 Tooth thickness tolerance DIN EN 10027-1:2017		cd 25	cd 25
10.2 Normal tooth thickness tolerance	T_{sn}	0,040	0,060 mm
10.3 Upper tooth thickness allowances	A_{sne}	-0,070	-0,130 mm
10.4 Normal tooth thickness deviation	$A_{sn\ e/i}$	-0,070 / -0,110	-0,130 / -0,190 mm
10.5 Number of teeth for span measurement	k [calc]	3,000 [3,138]	10,000 [10,620]
10.6 Number of teeth for tooth width calculations	Z_{nW}	15,413	64,734
10.7 Nominal base tangent length over k	W_k	46,728	181,172 mm
10.8 Allowances	$AW_{k\ e/i}$	-0,063 / -0,100	-0,118 / -0,172 mm
10.9 Limit values for W_k	$W_{k\ e/i}$	46,665 / 46,628	181,054 / 181,000 mm
10.10 Minimum width for the measurement	$b_{F\ min}$	7,919	27,277 mm
10.11 Measuring diameter (med)	$d_{MWk\ m}$	96,749	399,492 mm
10.12 Possible condition for $d_{MWk\ m}$		102,594 > d > 87,714	409,189 > d > 394,309 mm
10.13 Allowance for grinding (per flank)	q	0,160	0,160 mm
10.14 Base tangent length over k, with machining allowance	$W_{k\ fre}$	46,985	181,374 mm
10.15 Limit values for $W_{k\ fre}$	$W_{k\ fre\ e/i}$	46,985 / 46,995	181,374 / 181,384 mm
10.16 Allowances	$AW_{k\ e/i}$	0,000 / 0,010	0,000 / 0,010 mm

11 DIMENSIONAL CONTROL - M_{rK} , M_{dK}

11.1 Pin/Ball diameter	D_M [calc]	12,000 [11,320]	12,000 [11,320] mm
11.2 Nominal dimension over one ball	M_{rK}	56,261	209,580 mm
11.3 Allowances	$AM_{rK\ e/i}$	-0,060 / -0,095	-0,124 / -0,181 mm
11.4 Limit values for M_{rK}	$M_{rK\ e/i}$	56,201 / 56,167	209,456 / 209,399 mm
11.5 Diameter of the measure circle	d_M	94,697	401,564 mm
11.6 Limit values for d_M	$d_{M\ e/i}$	94,598 / 94,541	401,328 / 401,220 mm
11.7 Diameter of the measure circle	$d_{M\ med}$	94,570	401,274 mm
11.8 Nominal dimension over two balls	M_{dK}	111,972	419,033 mm
11.9 Allowances	$AM_{dK\ e/i}$	-0,120 / -0,189	-0,247 / -0,361 mm
11.10 Limit values for M_{dK}	$M_{dK\ e/i}$	111,852 / 111,783	418,786 / 418,672 mm
11.11 Dimension over two balls with machining allowance	M_{dKfre}	112,461	419,456 mm
11.12 Allowances	$AM_{dKfre\ e/i}$	0,000 / 0,019	0,000 / 0,021 mm
11.13 Limit values for M_{dKfre}	$M_{dKfre\ e/i}$	112,461 / 112,461	419,456 / 419,456 mm
11.14 Nominal dimension over two rolls	M_{dR}	112,523	419,160 mm
11.15 Allowances	$AM_{dK\ e/i}$	-0,120 / -0,189	-0,247 / -0,361 mm
11.16 Limit values for M_{dK}	$M_{dK\ e/i}$	112,403 / 112,334	418,913 / 418,799 mm
11.17 Dimension over two rolls with machining allowance	M_{dRfre}	112,461	419,456 mm
11.18 Allowances	$AM_{dRfre\ e/i}$	0,000 / 0,019	0,000 / 0,021 mm
11.19 Limit values for M_{dRfre}	$M_{dRfre\ e/i}$	112,461 / 112,480	419,456 / 419,477 mm

12 BACKLASH

12.1 Sum of allowances of tooth thickness on the transverse section	$\Sigma A_{st\ e/i}$	-0,202 / -0,303	mm
12.2 Center distance center with zero backlash	$a_{bl0\ e/i}$	249,805 / 249,707	mm
12.3 Transverse gearing backlash	$j_{tw\ max/min}$	0,335 / 0,183	mm
12.4 Backlash modification through centre distance tolerance	$\Delta j_{ja\ e/i}$	0,025 / -0,025	mm
12.5 Transverse gearing backlash - Angle	$\varphi_w\ max/min$	0,0950 / 0,0518	0,3989 / 0,2175 °
12.6 Transverse gearing backlash - Angle	$\varphi_w\ max/min$	00° 05' 42" / 00° 03' 06" 00° 23' 56" / 00° 13' 03"	
12.7 Radial gearing backlash	$j_{rw\ max/min}$	0,316 / 0,172	mm
12.8 Normal gearing backlash	$j_{nw\ max/min}$	0,300 / 0,164	mm

13 INVOLUTE

13.1 Pitch angle of the involute	ξ	26,980	26,980 °
13.2 Radius of curvature of the involute	ρ	20,005	84,020 mm
13.3 Pitch angle of the involute on W-cylinder	ξ_w	30,357	30,357 °
13.4 Radius of curvature of the involute on diameter d_w	ρ_w	22,508	94,534 mm
13.5 Tip pitch angle of the involute	ξ_a	42,425	33,162 °
13.6 Radius of curvature of the involute on diameter d_a	ρ_a	31,457	103,272 mm
13.7 Involute reserve	eR_F	1,854 / 1,802	3,836 / 3,728 mm

14 GEAR MESH

14.1 Length of addendum path contact	g_a	8,948	8,738 mm
14.2 Length of contact path	g_α	17,686	mm
14.3 Limit values for g_α	$g_{\alpha e/i}$	17,735 / 17,587	mm
14.4 Transverse contact ratio	ϵ_α	0,994	
14.5 Limit values for ϵ_α	$\epsilon_{\alpha e/i}$	0,997 / 0,988	
14.6 Overlap ratio	ϵ_β	0,629	
14.7 Total contact ratio	ϵ_γ	1,623	
14.8 Limit values for ϵ_γ	$\epsilon_{\gamma e/i}$	1,625 / 1,617	
14.9 Maximum length of contact path	l_{max}	88,708	mm
14.10 Length of the useful involute	l_{inv}	9,433	13,338 mm
14.11 Sliding factor at tooth tip	K_{ga}	0,230	0,225
14.12 Sliding factor at tooth root	K_{gf}	-0,225	-0,230
14.13 Sliding speed at the addendum	v_{ga}	0,835 (0,00895)	0,816 (0,00874) m/s
14.14 Shaft speed	n	720,000	171,429 min ⁻¹
14.15 Tangential velocity at pitch diameter	v_t	3,541	m/s
14.16 Specific sliding at tip diameter	ζ_a	0,352	0,440
14.17 Specific sliding at root diameter	ζ_f	-0,786	-0,544
14.18 Radius of curvature of the tooth flank	T_1T_2	117,043	mm
14.19 Limit values for T_1T_2	$T_1T_2 e/i$	117,092 / 116,993	mm
14.20 Radius of curvature of the tooth flank	T_1A, T_2A	13,770	103,272 mm
14.21 Limit values for T_1A, T_2A	$T_1A, T_2A e/i$	13,721 / 13,846	103,272 / 103,245 mm
14.22 Radius of curvature of the tooth flank	T_1B, T_2B	13,661	103,381 mm
14.23 Limit values for T_1B, T_2B	$T_1B, T_2B e/i$	13,661 / 13,649	103,332 / 103,443 mm
14.24 Radius of curvature of the tooth flank	T_1C, T_2C	22,508	94,534 mm
14.25 Limit values for T_1C, T_2C	$T_1C, T_2C e/i$	22,518 / 22,499	94,574 / 94,495 mm
14.26 Radius of curvature of the tooth flank	T_1D, T_2D	31,565	85,477 mm
14.27 Limit values for T_1D, T_2D	$T_1D, T_2D e/i$	31,516 / 31,642	85,477 / 85,450 mm
14.28 Radius of curvature of the tooth flank	T_1E, T_2E	31,457	85,586 mm
14.29 Limit values for T_1E, T_2E	$T_1E, T_2E e/i$	31,457 / 31,444	85,537 / 85,648 mm

15 ALLOWABLE DEVIATIONS ON TEETH AS PER DIN 3961:1978

15.1 Individual pitch deviation	f_p	10,000	11,000 μm
15.2 Normal base pitch deviation	f_{pe}	10,000	11,000 μm
15.3 Individual profile form deviation	f_f	14,000	14,000 μm
15.4 Profile angle deviation	$f_{H\alpha}$	9,000	9,000 μm
15.5 Total profile deviation	F_f	16,000	16,000 μm
15.6 Pitch deviation	f_u	12,000	14,000 μm
15.7 Total pitch deviation	F_p	32,000	45,000 μm
15.8 Cumulative pitch deviation total	$F_{pk/8}$	20,000	28,000 μm
15.9 Runout deviation	F_r	25,000	32,000 μm
15.10 Tooth thickness variation	R_s	16,000	20,000 μm
15.11 Tooth trace total deviation	F_β	16,000	16,000 μm
15.12 Tooth trace angel deviation	$F_{H\beta}$	10,000	10,000 μm
15.13 Tooth trace form deviation	$f_{\beta f}$	11,000	11,000 μm
15.14 Two-flank working deviation	F_i''	28,000	36,000 μm
15.15 Two-flank working error	f_i''	12,000	16,000 μm
15.16 Single-flank working deviation	F_i'	36,000	50,000 μm
15.17 Single-flank working error	f_i'	18,000	20,000 μm
15.18 Maximum value for axis skew $L_G=237.500$ mm	$f_{\Sigma\beta}$	20,000	μm
15.19 Maximum value for axis inclination	$f_{\Sigma\delta}$	40,000	μm