

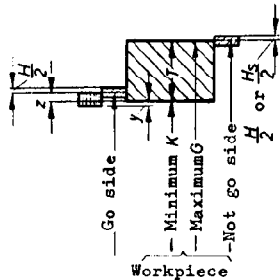
Plain Workshop and Inspection Gauges
Manufacturing Tolerances and Permissible Wear

Arbeits- und Prüflöhren für Längenmaße;
Herstellertoleranzen und zulässige Abnutzung

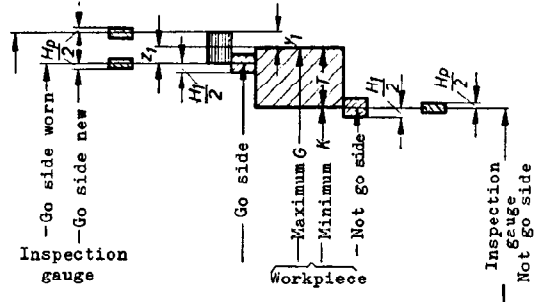
Dimensions in μm

Gauges for internal dimensions (holes)

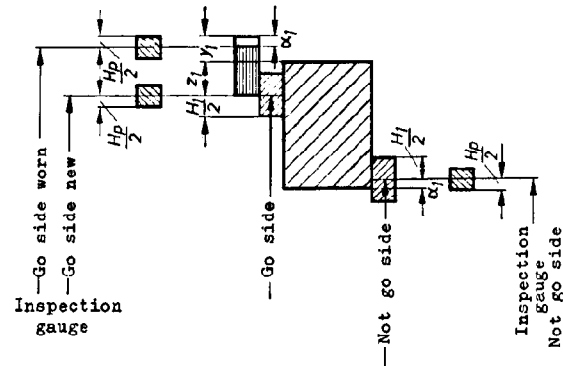
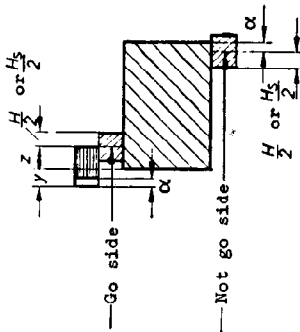
Nominal size
range up to
180 mm



Gauges for external dimensions (shafts)



Nominal size
range over
180 mm



Manufacturing tolerances
Inspection
gauge

Perm.wear
Workshop
gauge

Perm.wear
Workshop
gauge

Tolerance on workpiece
Internal
dimension

Tolerance on workpiece
External
dimension

Illustrated for quality 5 to 8;
for quality 9 onwards y and y_1
are equal to 0
For meaning of symbols, see
page 3



Formulae for determining gauge dimensions

Gauges for	Side of gauge	Nominal size range								
		up to 180 mm				over 180 mm				
		Design size	Manufacturing tolerance	Design size	Manufacturing tolerance	Design size	Manufacturing tolerance	Design size	Manufacturing tolerance	
Internal dimension	Not go	G	$\pm \frac{H}{2}$ or $\pm \frac{H_s}{2}$	not defined	not defined	$G - \alpha$	$\pm \frac{H_s}{2}$ (or $\pm \frac{H}{2}$)	not defined	not defined	
		Go	new			$K + z$	$\pm \frac{H}{2}$			$K + z$
	worn		$K - y$			-	$K - y + \alpha$			-
External dimension	Go	worn	$G + y_1$	$G + y_1$	$\pm \frac{H_p}{2}$	$G + y_1 - \alpha_1$	-	$G + y_1 - \alpha_1$	$\pm \frac{H_p}{2}$	
		new	$G - z_1$	$G - z_1$	$\pm \frac{H_p}{2}$	$G - z_1$	$\pm \frac{H_1}{2}$	$G - z_1$	$\pm \frac{H_p}{2}$	
	Not go	K	$\pm \frac{H_1}{2}$	K	$\pm \frac{H_p}{2}$	$K + \alpha_1$	$\pm \frac{H_1}{2}$	$K + \alpha_1$	$\pm \frac{H_p}{2}$	

¹⁾ $H/2$ applies only if spherical end measuring rods are not used.
For ISA system of fits, introduction, gauges, see DIN 7150 Sheet 2

Continued on pages 2 to 5
Explanations on page 6

No guarantee can be given in respect of this translation
In all cases the latest German-language version of this standard shall be taken as authoritative

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Gauges for internal dimensions (holes)

Nominal size range mm	Symbol	Quality of workpiece according to ISO tolerance group										
		6	7	8	9	10	11	12	13	14	15	16
from 1 to 3	T	6	10	14	25	40	60	100	140	250	400	600
	H/2	0,6	1		1		2		5		5	
	y	1	1,5	3	0		0		0		0	
	z	1	1,5	2	5		10		20		40	
over 3 to 6	T	8	12	18	30	48	75	120	180	300	480	750
	H/2	0,75	1,25		1,25		2,5		6		6	
	y	1	1,5	3	0		0		0		0	
	z	1,5	2	3	6		12		24		48	
over 6 to 10	T	9	15	22	36	58	90	150	220	360	580	900
	H/2	0,75	1,25		1,25		3		7,5		7,5	
	H _s /2	0,75	0,75		0,75		2		4,5		4,5	
	y	1	1,5	3	0		0		0		0	
	z	1,5	2	3	7		14		28		56	
over 10 to 18	T	11	18	27	43	70	110	180	270	430	700	1100
	H/2	1	1,5		1,5		4		9		9	
	H _s /2	1	1		1		2,5		5,5		5,5	
	y	1,5	2	4	0		0		0		0	
	z	2	2,5	4	8		16		32		64	
over 18 to 30	T	13	21	33	52	84	130	210	330	520	840	1300
	H/2	1,25	2		2		4,5		10,5		10,5	
	H _s /2	1,25	1,25		1,25		3		6,5		6,5	
	y	1,5	3	4	0		0		0		0	
	z	2	3	5	9		19		36		72	
over 30 to 50	T	16	25	39	62	100	160	250	390	620	1000	1600
	H/2	1,25	2		2		5,5		12,5		12,5	
	H _s /2	1,25	1,25		1,25		3,5		8		8	
	y	2	3	5	0		0		0		0	
	z	2,5	3,5	6	11		22		42		80	
over 50 to 80	T	19	30	46	74	120	190	300	460	740	1200	1900
	H/2	1,5	2,5		2,5		6,5		15		15	
	H _s /2	1,5	1,5		1,5		4		9,5		9,5	
	y	2	3	5	0		0		0		0	
	z	2,5	4	7	13		25		48		90	
over 80 to 120	T	22	35	54	87	140	220	350	540	870	1400	2200
	H/2	2	3		3		7,5		17,5		17,5	
	H _s /2	2	2		2		5		11		11	
	y	3	4	6	0		0		0		0	
	z	3	5	8	15		28		54		100	
over 120 to 180	T	25	40	63	100	160	250	400	630	1000	1600	2500
	H/2	2,5	4		4		9		20		20	
	H _s /2	2,5	2,5		2,5		6		12,5		12,5	
	y	3	4	6	0		0		0		0	
	z	4	6	9	18		32		60		110	

Gauges for internal dimensions (holes) (continued)

Nominal size range mm	Symbol	Quality of workpiece according to ISO tolerance group										
		6	7	8	9	10	11	12	13	14	15	16
over 180 to 250	T	29	46	72	115	185	290	460	720	1150	1850	2900
	H/2	3,5	5		5		10		23		23	
	H _s /2	3,5	3,5		3,5		7		14,5		14,5	
	y	4	6	7	0		0		0		0	
	z	5	7	12	21	24	40	45	80	100	170	210
	α	2	3	4	4	7	10	15	25	45	70	110
over 250 to 315	T	32	52	81	130	210	320	520	810	1300	2100	3200
	H/2	4	6		6		11,5		26		26	
	H _s /2	4	4		4		8		16		16	
	y	5	7	9	0		0		0		0	
	z	6	8	14	24	27	45	50	90	110	190	240
	α	3	4	6	6	9	15	20	35	55	90	140
over 315 to 400	T	36	57	89	140	230	360	570	890	1400	2300	3600
	H/2	4,5	6,5		6,5		12,5		28,5		28,5	
	H _s /2	4,5	4,5		4,5		9		18		18	
	y	6	8	9	0		0		0		0	
	z	7	10	16	28	32	50	65	100	125	210	280
	α	4	6	7	7	11	15	30	45	70	110	180
over 400 to 500	T	40	63	97	155	250	400	630	970	1550	2500	4000
	H/2	5	7,5		7,5		13,5		31,5		31,5	
	H _s /2	5	5		5		10		20		20	
	y	7	9	11	0		0		0		0	
	z	8	11	18	32	37	55	70	110	145	240	320
	α	5	7	9	9	14	20	35	55	90	140	220

Gauge dimensions for workpieces whose tolerances "T" are not contained in the above Table are evaluated by the data given for the next larger "T" in the same nominal size range.

Worked example²⁾

Gauge dimensions for gauge 25 G 9

The workpiece allowances are $\left. \begin{array}{l} + 0.162 \\ + 0.110 \end{array} \right\}$ see DIN 7161

The size limits for the workpiece are therefore

$$G = 25.000 + 0.162 = 25.162 \text{ mm}$$

$$K = 25.000 + 0.110 = 25.110 \text{ mm}$$

for a workshop gauge these values give the following:

$$\text{Not go side} = G \pm \frac{H}{2} = 25.162 \pm 0.02 \text{ mm}$$

$$\text{Go side new} = (K + z) \pm \frac{H}{2} = (25.110 + 0.009) \pm 0.02 \\ = 25.119 \pm 0.02 \text{ mm}$$

$$\text{Go side worn} = K - y = 25.110 - 0 \\ = 25.110 \text{ mm}$$

Meaning of symbols used

- G = Maximum of workpiece
H = Manufacturing tolerance of workshop gauges for internal dimensions (excluding spherical end measuring rods)
H_s = Manufacturing tolerance of spherical end measuring rods
H₁ = Manufacturing tolerance of workshop gauges for external dimensions
H_p = Manufacturing tolerance of inspection gauges
K = Minimum of workpiece
T = Tolerance on workpiece (T = G - K)
y and y₁ = Quantity specifying wear limit
z and z₁ = Quantity specifying design size of go side
α and α₁ = Safety allowance for metrological uncertainty

²⁾ For gauge dimensions and manufacturing tolerances for ISO fit sizes from 1 to 500 mm nominal for workshop plug gauges and spherical end measuring rods, to be evaluated from the gauge allowances, see DIN 7164

Gauges for external dimensions (shafts)

Nominal size range mm	Symbol	Quality of workpiece according to ISO tolerance group											
		5	6	7	8	9	10	11	12	13	14	15	16
from 1 to 3	T	4	6	10	14	25	40	60	100	140	250	400	600
	$H_1/2$	0,6	1	1,5	1,5	2	5	5					
	$H_p/2$	0,4	0,4	0,6	0,6	0,6	1	1					
	y_1	1	1,5	3	0	0	0	0					
	z_1	1	1,5	2	5	10	20	40					
over 3 to 6	T	5	8	12	18	30	48	75	120	180	300	480	750
	$H_1/2$	0,75	1,25	2	2	2,5	6	6					
	$H_p/2$	0,5	0,5	0,75	0,75	0,75	1,25	1,25					
	y_1	1	1,5	3	0	0	0	0					
	z_1	1	2	3	6	12	24	48					
over 6 to 10	T	6	9	15	22	36	58	90	150	220	360	580	900
	$H_1/2$	0,75	1,25	2	2	3	7,5	7,5					
	$H_p/2$	0,5	0,5	0,75	0,75	0,75	1,25	1,25					
	y_1	1	1,5	3	0	0	0	0					
	z_1	1	2	3	7	14	28	56					
over 10 to 18	T	8	11	18	27	43	70	110	180	270	430	700	1100
	$H_1/2$	1	1,5	2,5	2,5	4	9	9					
	$H_p/2$	0,6	0,6	1	1	1	1,5	1,5					
	y_1	1,5	2	4	0	0	0	0					
	z_1	1,5	2,5	4	8	16	32	64					
over 18 to 30	T	9	13	21	33	52	84	130	210	330	520	840	1300
	$H_1/2$	1,25	2	3	3	4,5	10,5	10,5					
	$H_p/2$	0,75	0,75	1,25	1,25	1,25	2	2					
	y_1	2	3	4	0	0	0	0					
	z_1	1,5	3	5	9	19	36	72					
over 30 to 50	T	11	16	25	39	62	100	160	250	390	620	1000	1600
	$H_1/2$	1,25	2	3,5	3,5	5,5	12,5	12,5					
	$H_p/2$	0,75	0,75	1,25	1,25	1,25	2	2					
	y_1	2	3	5	0	0	0	0					
	z_1	2	3,5	6	11	22	42	80					
over 50 to 80	T	13	19	30	46	74	120	190	300	460	740	1200	1900
	$H_1/2$	1,5	2,5	4	4	6,5	15	15					
	$H_p/2$	1	1	1,5	1,5	1,5	2,5	2,5					
	y_1	2	3	5	0	0	0	0					
	z_1	2	4	7	13	25	48	90					
over 80 to 120	T	15	22	35	54	87	140	220	350	540	870	1400	2200
	$H_1/2$	2	3	5	5	7,5	17,5	17,5					
	$H_p/2$	1,25	1,25	2	2	2	3	3					
	y_1	3	4	6	0	0	0	0					
	z_1	2,5	5	8	15	28	54	100					

Gauges for external dimensions (shafts) (continued)

Nominal size range mm	Symbol	Quality of workpiece according to ISO tolerance group											
		5	6	7	8	9	10	11	12	13	14	15	16
over 120 to 180	T	18	25	40	63	100	160	250	400	630	1000	1600	2500
	$H_1/2$	2,5	4	6	6	9	20	20					
	$H_p/2$	1,75	1,75	2,5	2,5	2,5	4	4					
	y_1	3	4	6	0	0	0	0					
	z_1	3	6	9	18	32	60	110					
over 180 to 250	T	20	29	46	72	115	185	290	460	720	1150	1850	2900
	$H_1/2$	3,5	5	7	7	10	23	23					
	$H_p/2$	2,25	2,25	3,5	3,5	3,5	5	5					
	y_1	3	5	6	7	0	0	0					
	z_1	4	7	12	21	24	40	45	80	100	170	210	
	α_1	1	2	3	4	4	7	10	15	25	45	70	110
over 250 to 315	T	23	32	52	81	130	210	320	520	810	1300	2100	3200
	$H_1/2$	4	6	8	8	11,5	26	26					
	$H_p/2$	3	3	4	4	4	6	6					
	y_1	3	6	7	9	0	0	0					
	z_1	5	8	14	24	27	45	50	90	110	190	240	
over 315 to 400	T	25	36	57	89	140	230	360	570	890	1400	2300	3600
	$H_1/2$	4,5	6,5	9	9	12,5	28,5	28,5					
	$H_p/2$	3,5	3,5	4,5	4,5	4,5	6,5	6,5					
	y_1	4	6	8	9	0	0	0					
	z_1	6	10	16	28	32	50	65	100	125	210	280	
	α_1	2,5	4	6	7	7	11	15	30	45	70	110	180
over 400 to 500	T	27	40	63	97	155	250	400	630	970	1550	2500	4000
	$H_1/2$	5	7,5	10	10	13,5	31,5	31,5					
	$H_p/2$	4	4	5	5	5	7,5	7,5					
	y_1	4	7	9	11	0	0	0					
	z_1	7	11	18	32	37	55	70	110	145	240	320	
α_1	3	5	7	9	9	14	20	35	55	90	140	220	

Gauge dimensions for workpieces whose tolerances " μ " are not contained in the above Table are evaluated by the data given for the next larger " μ " in the same nominal size range.

Worked example³⁾

Gauge dimensions for gauge 270 - 0.05

The workpiece allowances are:

$$G = 270.000 \text{ mm}$$

$$K = 270 - 0.05 = 269.950 \text{ mm}$$

for a workshop gauge these values give the following:

$$\begin{aligned} \text{Go side worn} &= G + y_1 - \alpha_1 = 270.000 + 0.007 - 0.004 \\ &= \underline{270.003 \text{ mm}} \end{aligned}$$

$$\begin{aligned} \text{Go side new} &= (G - z_1) \pm \frac{H_1}{2} = (270.000 - 0.008) \pm 0.006 \\ &= \underline{269.992 \pm 0.006 \text{ mm}} \end{aligned}$$

$$\begin{aligned} \text{Not go side} &= (K + \alpha_1) \pm \frac{H_1}{2} = (269.950 + 0.004) \pm 0.006 \\ &= \underline{269.954 \pm 0.006 \text{ mm}} \end{aligned}$$

³⁾ For gauge dimensions and manufacturing tolerances for ISO fit sizes from 1 to 500 mm nominal for workshop gap gauges and inspection gauges, to be evaluated from the gauge allowances, see DIN 7163

Explanations

DIN 7162 is used for determining gauge dimensions. In the case of gauges for internal dimensions the tabulated values apply to workpiece qualities from IT 6 to IT 16, and in the case of external dimensions to workpiece qualities from IT 5 to IT 16. The present issue takes account of ISO tolerances according to ISO Recommendation ISO/R 286 - 1962. Compared with the October 1936 issue of DIN 7162 some alterations have been made to gauge dimensions as a result of modification of certain basic tolerances (see DIN 7151, Issue of November 1964) and of certain basic allowances (see DIN 7152, Issue of July 1965). For the fixed gauges affected by these changes the new ISO values are compared with the previous ISA values in the Tables below.

Nominal size range mm		Basic tolerance IT				Basic allowance on tolerance zone position or tolerance zone																	
		IT				f	g	i		n	p	r	s	x	z	zb	zc	F	G	J			
		5	6	7	12			5a.	7	8										6	7	8	
from 1	ISO	4	6	10	100	-6	-2	-2	-4	-6	+4	+6	+10	+14	+20	+26		+60	+6	+2	+2	+4	+6
to 3	ISA	5	7	9	90	-7	-3	-1	-2	-7	+6	+9	+12	+15	+22	+28	-	+50	+7	+9	+3	+3	+7
over 3	ISO	-	-	-	-	-	-	-2	-4	-	-	-	-	-	-	-	+50	+80	-	-	+5	+6	+10
to 6	ISA	-	-	-	-	-	-	-1	-3	-	-	-	-	-	-	-	+53	+69	-	-	+4	+5	+9

Nominal size range mm		Basic allowance on tolerance zone position or tolerance zone																				
		M		N		P		R		S		U		X	Z	ZA		ZB		ZC		
		6 a.	8	8	9 to	6 a.	7 from 8	from 8	from 8	6 a.	7 from 8	6 a.	7 from 8	from 8	from 8	6 a.	7	6	7	6	7	
from 1	ISO	-2	-2	-4	-4	-6	-6	-10	-14	-14	-18	-20	-26	-32	-40	-40	-60	-60				
to 3	ISA	0	+3	-1	0	-7	-9	-12	-13	-15	-16	-22	-28	-30	-38	-38	-48	-48				
over 3	ISO	-	-	-	-	-	-	-	-	-	-	-	-	-	-47	-46	-77	-76				
to 6	ISA	-	-	-	-	-	-	-	-	-	-	-	-	-	-58	-61	-74	-77				

According to ISO, in the nominal size range over 6 and up to 10 the basic allowances are as follows: for zb +67 instead of +70 previously, for ZB 6 -64 instead of -76 previously, for ZB 7 -61 instead of -79 previously and for ZC 7 -91 instead of -93 previously. In the range over 400 and up to 450 the basic allowance 2400 instead of 2350 μm applies to zc for all qualities and to ZC from and including quality 8 and in the range over 450 and up to 500 the basic allowance 2100 instead of 2050 μm applies to zb for all qualities and to ZB from and including quality 8.

The gauge manufacturing tolerances H, H_g, H_i and H_p are correlated with workpiece tolerances. The correlation adopted in the ISA system of fits (see DIN 7150 Sheet 2, Issue of July 1938x) has been retained. In the qualities used for gauge manufacture the ISO basic tolerances have undergone extensive changes compared with the ISA values. These changes are shown in the Table below on the right.

Workpiece tolerance T	Order of magnitude of gauge manufacturing tolerance IT for			
	H	H _g	H _p	H _i
IT 5	-	-	1	2
IT 6	2	2	1	3
IT 7	3	2	1	3
IT 8 to IT 10	3	2	2	4
IT 11 to IT 12	5	4	2	5
IT 13 to IT 16	7	6	3	7

Nominal size range mm		Gauge manufacturing tolerance ± $\frac{IT}{2}$ of						
		IT 1	IT 2	IT 3	IT 4	IT 5	IT 6	IT 7
from 1	ISO	0,4	0,6	1	1,5	2	3	5
to 3	ISA	0,75	1	1,5	2	2,5	3,5	4,5
over 3	ISO	0,5	0,75	1,25	-	-	-	-
to 10	ISA	0,75	1	1,5	-	-	-	-
over 10	ISO	0,6	-	-	-	-	-	-
to 18	ISA	0,75	-	-	-	-	-	-
over 18	ISO	-	1,25	-	-	-	-	-
to 30	ISA	-	1	-	-	-	-	-
over 30	ISO	0,75	1,25	-	-	-	-	-
to 50	ISA	1	1,5	-	-	-	-	-
over 80	ISO	1,25	-	-	-	-	-	-
to 120	ISA	1,5	-	-	-	-	-	-
over 120	ISO	1,75	-	-	-	-	-	-
to 180	ISA	2	-	-	-	-	-	-
over 180	ISO	2,25	-	-	-	-	-	-
to 250	ISA	2,5	-	-	-	-	-	-