

Table 1.1: degree of precision or grade of tolerance

Tolerance grade	Intended for	Applicable to components or machines
IT 01	Gauges	Slip blocks, Reference gauges
IT 0		
IT 1		High quality gauges
IT 2		
IT 3		
IT 4		
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IT 5	Fits	Ball bearing
IT 6		Grinding, Honing
IT 7		Broaching
IT 8		Center lathe turning
IT 9		Worn automatic lathe
IT 10		Milling
IT 11		Drilling, Rough turning
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IT 12	Not for fits	Light press work
IT 13		Press work
IT 14		Die casting
IT 15		Stamping
IT 16		Sand casting

International Tolerance Grade Selection

Representation of Tolerance

2) Number or Grade

IT01, IT0, IT1,IT16

Tolerance Grade defines range of dimensions (dimensional variation)

There are manufacturing constraints on tolerance grade chosen

Tolerance grade	Manufacturing process and applications	Machine required
IT01, IT0 IT1 to IT5	Super finishing process, such as lapping, diamond boring etc. Use: Gauges	Super finishing machines
IT6	Grinding	Grinding machines
IT7	Precision turning, broaching, honing	Boring machine, honing machine
IT8	Turning, boring and reaming	Lathes, capstan and automats
IT9	Boring	Boring machines
IT10	Milling, slotting, planing, rolling and extrusion	Milling machine, slotting machine, planing machine and extruders
IT11	Drilling, rough turning	Drilling machine, lathes
IT12, IT13, IT14	Metal forming processes	Presses
IT15	Die casting, stamping	Die casting machine, hammer machine
IT16	Sand casting	—

FUNDAMENTAL TOLERANCES OF GRADES 01, 0 AND 1 TO 16

Diameter steps in mm	Values of tolerance in microns (1 micron = 0.001 mm)																		
	Tolerance grades																		
	01	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14*	15*	16*	
To and inc 3	0.3	0.5	0.8	1.2	2	3	4	6	10	14	25	40	60	100	140	250	400	600	
Over 3																			
To and inc 6	0.4	0.6	1	1.5	2.5	4	5	8	12	18	30	48	75	120	180	300	480	750	
Over 6																			
To and inc 10	0.4	0.6	1	1.5	2.5	4	6	9	15	22	36	58	90	150	220	360	580	900	
Over 10																			
To and inc 18	0.5	0.8	1.2	2	3	5	8	11	18	27	43	70	110	180	270	430	700	1100	
Over 18																			
To and inc 30	0.6	1	1.5	2.5	4	6	9	13	21	33	52	84	130	210	330	520	840	1300	
Over 30																			
To and inc 50	0.6	1	1.5	2.5	4	7	11	16	25	39	60	110	160	250	390	620	1000	1600	
Over 50																			
To and inc 80	0.8	1.2	2	3	5	8	13	19	30	46	74	120	190	300	460	740	1200	1900	
Over 80																			
To and inc 120	1	1.5	2.5	4	6	10	15	22	35	54	87	140	220	350	540	870	1400	2200	
Over 120																			
To and inc 180	1.2	2	3.5	5	8	12	18	25	40	63	100	160	250	400	630	1000	1600	2500	
Over 180																			
To and inc 250	2	3	4.5	7	10	14	20	29	46	72	115	185	290	460	720	1150	1850	2900	
Over 250																			
To and inc 315	2.5	4	6	8	12	16	23	32	52	81	130	210	320	520	810	1300	2100	3200	
Over 315																			
To and inc 400	3	5	7	9	13	18	25	36	57	89	140	230	360	570	890	1400	2300	3600	
Over 400																			
To and inc 500	4	6	8	10	15	20	27	40	63	97	155	250	400	630	970	1550	2500	4000	

* Upto 1 mm, Grades 14 to 16 are not provided.

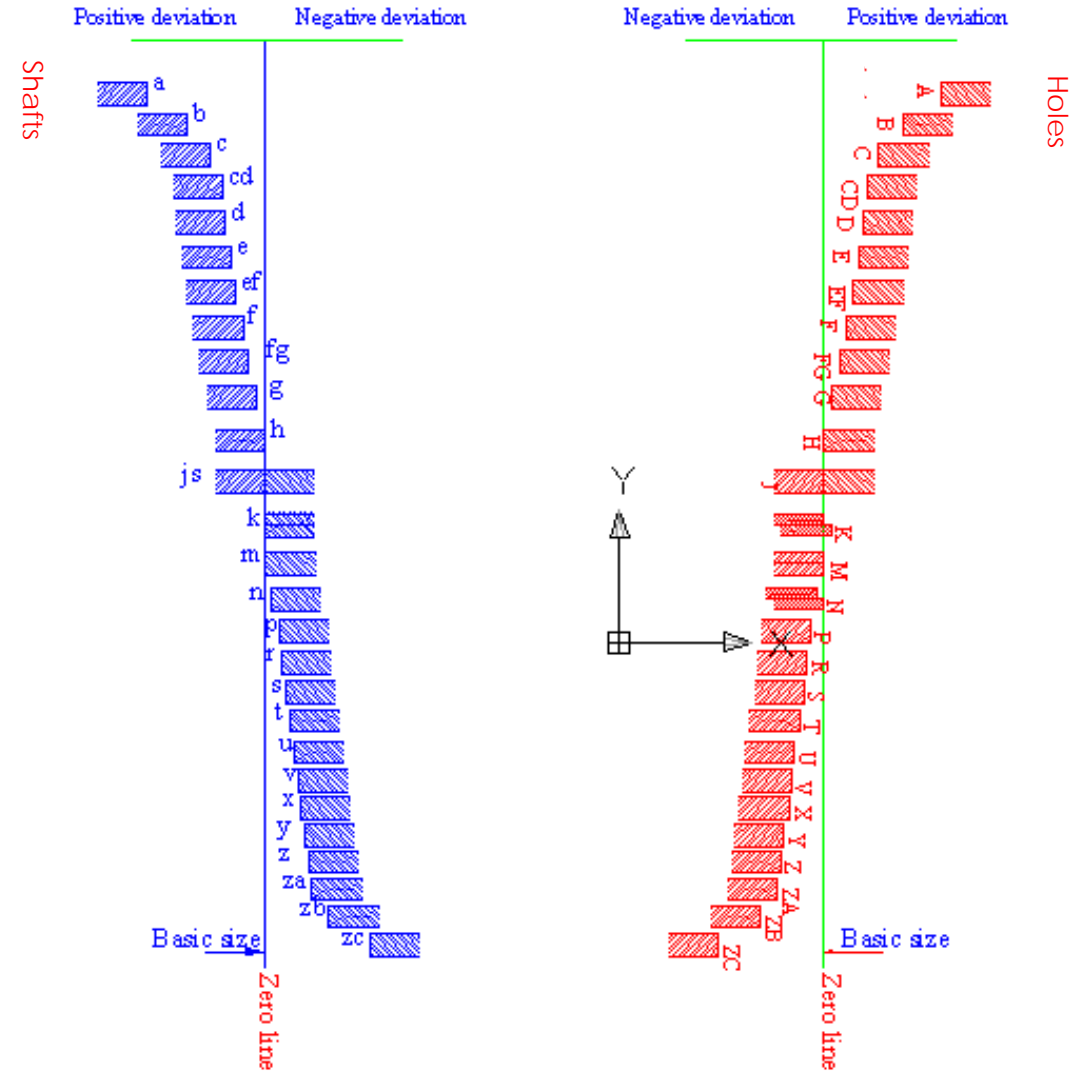


Figure 1.5: Position of the various tolerance zones for a given diameter in the ISO system

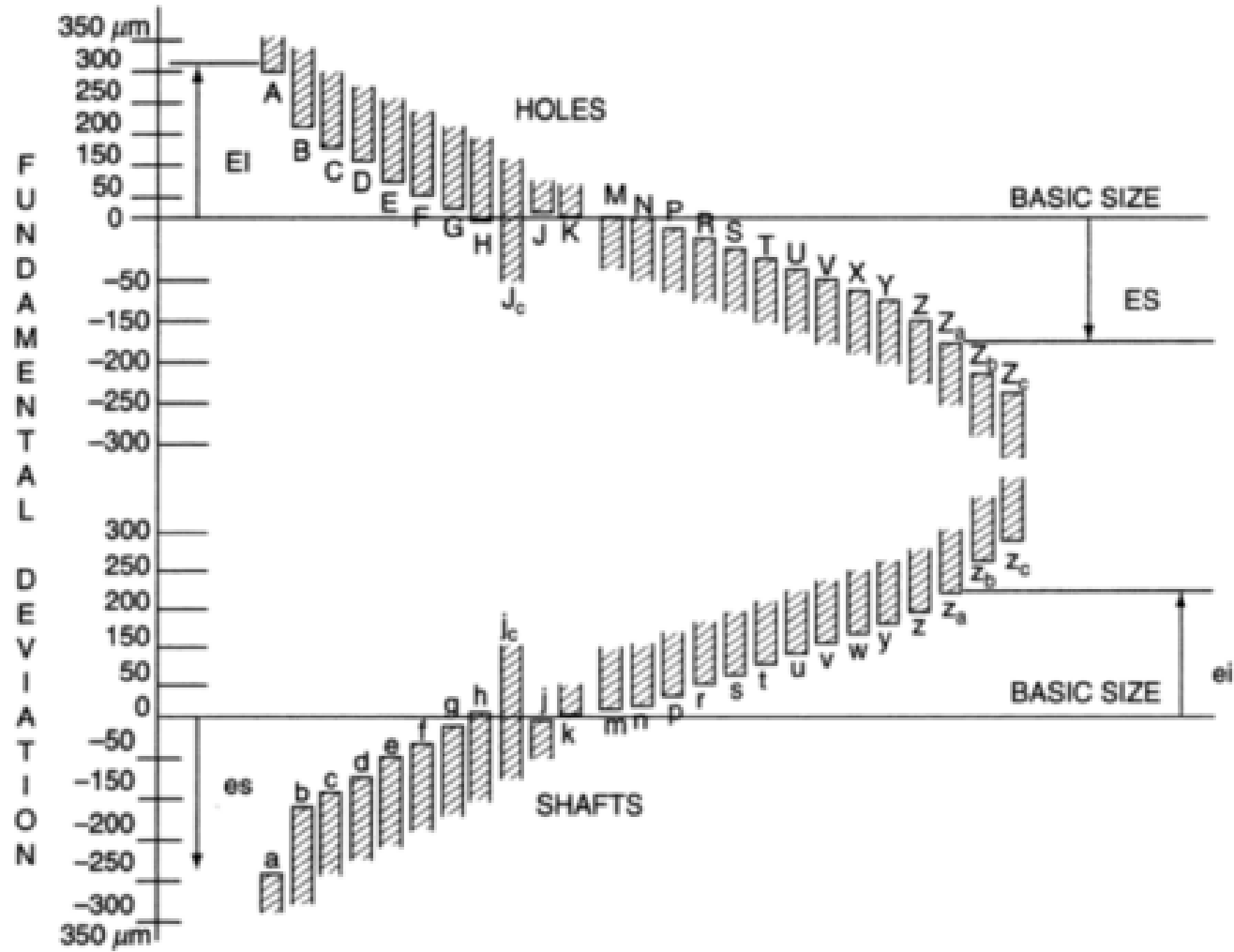


Table for fundamental deviations for shafts

Fundamental deviation		Upper deviation es											Lower deviation ei								
		Letter	a ^a	b ^a	c	cd	d	e	ef	f	fg	g	h	js ^b	j			k			
Grade		01 to 16											5-6	7	8	4-7	≤3 >7				
Nominal sizes																					
Over	To																				
mm	mm																				
-	3	-270	-140	-60	-34	-20	-14	-10	-6	-4	-2	0					-2	-4	-6	0	0
3	6	-270	-140	-70	-46	-30	-20	-14	-10	-6	-4	0					-2	-4	-	+1	0
6	10	-280	-150	-80	-56	-40	-25	-18	-13	-8	-5	0					-2	-5	-	+1	0
10	14	-290	-150	-95	-	-50	-32	-	-16	-	-6	0					-3	-6	-	+1	0
14	18																				
18	24	-300	-160	-110	-	-65	-40	-	-20	-	-7	0					-4	-8	-	+2	0
24	30																				
30	40	-310	-170	-120	-	-80	-50	-	-25	-	-9	0					-6	-10	-	+2	0
40	50	-320	-180	-130																	
50	65	-340	-190	-140	-	-100	-60	-	-30	-	-10	0					-7	-12	-	+2	0
65	80	-360	-200	-150																	
80	100	-380	-220	-170	-	-120	-72	-	-36	-	-12	0					-9	-15	-	+3	0
100	120	-410	-240	-180																	
120	140	-460	-260	-200	-																
140	160	-520	-280	-210	-	-145	-85	-	-43	-	-14	0					-11	-18	-	+3	0
160	180	-580	-310	-230																	
180	200	-660	-340	-240	-																
200	225	-740	-380	-260	-	-170	-100	-	-50	-	-15	0					-13	-21	-	+4	0
225	250	-820	-420	-280																	
250	280	-920	-480	-300	-	-190	-110	-	-56	-	-17	0					-16	-26	-	+4	0
280	315	-1050	-540	-330																	
315	355	-1200	-600	-360	-	-210	-125	-	-62	-	-18	0					-18	-28	-	+4	0
355	400	-1350	-680	-400																	
400	450	-1500	-760	-440	-	-230	-135	-	-68	-	-20	0					-20	-32	-	+5	0
450	500	-1650	-840	-480																	
Grade		6 to 16																			
500	630	-	-	-	-	-260	-145	-	-76	-	-22	0									0
630	800	-	-	-	-	-290	-160	-	-80	-	-24	0									0
800	1000	-	-	-	-	-320	-170	-	-86	-	-26	0									0
1000	1250	-	-	-	-	-350	-195	-	-98	-	-28	0									0
1250	1600	-	-	-	-	-390	-220	-	-110	-	-30	0									0
2000	2500	-	-	-	-	-480	-260	-	-130	-	-34	0									0
2500	3150	-	-	-	-	-520	-290	-	-145	-	-38	0									0

*Not applicable to sizes up to 1 mm.
 **In grades 7 to 11, the two symmetrical deviations ± IT/2 should be rounded if the IT value in micrometres is an odd value by replacing it by the even value immediately below.

Table for fundamental deviations for shafts

Fundamental deviation		Upper deviation <i>ei</i>													
Letter		<i>m</i>	<i>n</i>	<i>p</i>	<i>r</i>	<i>s</i>	<i>t</i>	<i>u</i>	<i>v</i>	<i>x</i>	<i>y</i>	<i>z</i>	<i>za</i>	<i>zb</i>	<i>zc</i>
Grade		01 to 16													
Nominal size															
Over	To														
mm	mm														
-	3	+2	+4	+6	+10	+14	-	+18	-	+20	-	+26	+32	+40	+60
3	6	+4	+8	+12	+15	+19	-	+23	-	+28	-	+35	+42	+50	+80
6	10	+6	+10	+15	+19	+23	-	+28	-	+34	-	+42	+52	+67	+97
10	14	+7	+12	+18	+23	+28	-	+33	-	+40	-	+50	+64	+90	+130
14	18								+39	+45	-	+60	+77	+108	+150
18	24	+8	+15	+22	+28	+35	-	+41	+47	+54	+63	+73	+98	+136	+188
24	30						+41	+48	+55	+64	+75	+88	+118	+160	+218
30	40	+9	+17	+26	+34	+43	+48	+60	+68	+80	+94	+112	+148	+200	+274
40	50						+54	+70	+81	+97	+114	+136	+180	+242	+325
50	65	+11	+20	+32	+41	+53	+66	+87	+102	+122	+144	+172	+226	+300	+405
65	80				+43	+59	+75	+102	+120	+146	+174	+210	+274	+360	+480
80	100	+13	-23	+37	+51	+71	+91	+124	+146	+178	+214	+258	+335	+445	+585
100	120				+54	+79	+104	+144	+172	+210	+254	+310	+400	+525	+690
120	140	+15	+27	+43	+63	+92	+122	+170	+202	+248	+300	+365	+470	+620	+800
140	160				+65	+100	+134	+190	+228	+280	+340	+415	+535	+700	+900
160	180	+17	+31	+50	+68	+108	+146	+210	+252	+310	+380	+465	+600	+780	+1000
180	200				+77	+122	+166	+236	+284	+350	+425	+520	+670	+880	+1150
200	225	+20	+34	+56	+80	+130	+180	+258	+310	+385	+470	+575	+740	+960	+1250
225	250				+84	+140	+196	+284	+340	+425	+520	+640	+820	+1050	+1350
250	280	+21	+37	+62	+94	+158	+218	+315	+385	+475	+580	+710	+920	+1200	+1550
280	315				+98	+170	+240	+350	+425	+525	+650	+790	+1000	+1300	+1700
315	355	+23	+40	+68	+108	+190	+268	+390	+475	+590	+730	+900	+1150	+1500	+1900
355	400				+144	+208	+294	+435	+530	+660	+820	+1000	+1300	+1650	+2100
400	450	+26	+44	+78	+126	+232	+330	+490	+595	+740	+920	+1100	+1450	+1850	+2400
450	500				+132	+252	+360	+540	+660	+820	+1000	+1250	+1600	+2100	+2600
Grade		6 to 16													
500	560	+30	+50	+88	+150	+280	+400	+600							
560	630				+155	+310	+450	+660							
630	710	+34	+56	+100	+175	+340	+500	+740							
710	800				+185	+380	+560	+840							
800	900	+40	+66	+120	+210	+430	+620	+940							
900	1000				+220	+470	+680	+1050							
1000	1120	+44	+78	+140	+250	+520	+780	+1150							
1120	1250				+260	+580	+840	+1300							

Table for fundamental deviations for holes

Fundamental		Lower deviation EI											Upper deviation ES									
Letter	A*	B*	c	CD	D	E	EF	F	FG	G	H	J ^b	J			K		M		N		
Grade	01 to 16											6	7	8	≤8	>8	≤8 ^c	>8	≤8	>8 ^d		
Nominal sizes																						
Over	To	+	+	+	+	+	+	+	+	+	+	+										
mm	mm																					
-	3	270	140	60	34	20	14	10	6	4	2	0										
3	6	270	140	70	46	30	20	14	10	6	4	0										
6	10	280	150	80	56	40	25	18	13	8	5	0										
10	14	290	150	95	-	50	32	-	16	-	6	0										
14	18												6	10	15	-1+Δ	-	-7+Δ	-7	-12+Δ	0	
18	24	300	160	110	-	65	40	-	20	-	7	0										
24	30												8	12	20	-2+Δ	-	-8+Δ	-8	-15+Δ	0	
30	40	310	170	120	-	80	50	-	25	-	9	0										
40	50	320	180	130									10	14	24	-2+Δ	-	-9+Δ	-9	-17+Δ	0	
50	60	340	190	140	-	100	60	-	30	-	10	0										
65	80	360	200	150									13	18	28	-2+Δ	-	-11+Δ	-11	-20+Δ	0	
80	100	380	220	170	-	120	72	-	36	-	12	0										
100	120	410	240	180									16	22	34	-3+Δ	-	-13+Δ	-13	-23+Δ	0	
120	140	460	260	200	-	145	85	-	43	-	14	0										
140	160	520	280	210									18	26	41	-3+Δ	-	-15+Δ	-15	-27+Δ	0	
160	180	580	310	230	-	170	100	-	50	-	15	0										
180	200	660	340	240									22	30	47	-4+Δ	-	-17+Δ	-17	-31+Δ	0	
200	225	740	380	260	-	190	110	-	56	-	17	0										
225	250	820	420	280									25	36	55	-4+Δ	-	-20+Δ	-20	-34+Δ	0	
250	280	920	480	300	-	210	125	-	62	-	18	0										
280	315	1050	540	330									29	39	60	-4+Δ	-	-21+Δ	-21	-37+Δ	0	
315	355	1200	600	360	-	230	135	-	68	-	20	0										
335	400	1350	680	400									33	43	66	-5+Δ	-	-23+Δ	-23	-40+Δ	0	
400	450	1500	760	440	6 to 16																	
450	500	1650	840	480																		
Grade																						
500	630	-	-	-	-	260	145	-	76	-	22	0					0		-26		-44	
630	800	-	-	-	-	290	160	-	80	-	24	0					0		-30		-50	
800	1000	-	-	-	-	320	170	-	86	-	26	0					0		-34		-56	
1000	1250	-	-	-	-	350	195	-	98	-	28	0					0		-40		-66	
1250	1600	-	-	-	-	390	220	-	110	-	30	0					0		-48		-78	
1600	2000	-	-	-	-	430	240	-	120	-	32	0					0		-58		-92	

*Not applicable to sizes up to 1 mm.
^bIn grades 7 to 11, the two symmetrical deviations ± IT/2 should be rounded if the IT value in micrometres in an odd value by replacing it by the even value immediately below.
^cSpecial case: for M6, ES = -9 from 250 to 315 (instead of -11).
^dNot applicable to sizes up to 1 mm.

Table for fundamental deviations for holes

Fundamental deviation		Upper deviation ES											Values for Δ^*							
Letter	P to ZC	P	R	S	T	U	V	X	Y	Z	ZA	ZB							ZC	
Grade	≤ 7	> 7																		
Nominal sizes													Grades:							
Over	To	-	-	-	-	-	-	-	-	-	-	-	-	3	4	5	6	7	8	
mm	mm																			
-	3	6	10	14	-	18	-	20	-	26	32	40	60	0	0	0	0	0	0	
3	6	12	15	19	-	23	-	28	-	35	42	50	80	1	1.5	1	3	4	6	
6	10	15	19	23	-	28	-	34	-	42	52	67	97	1	1.5	2	3	6	7	
10	14	18	23	28	-	33	-	40	-	50	64	90	130	1	2	3	3	7	9	
14	18						39	45	-	60	77	108	150							
18	24	22	28	35	-	41	47	54	63	73	98	136	188	1.5	2	3	4	8	12	
24	30						48	55	64	75	88	118	160							218
30	40	26	34	43	-	48	60	68	80	94	112	148	200	1.5	3	4	5	9	14	
40	50						54	70	81	97	114	136	180							242
50	65	32	41	53	66	87	102	122	144	172	226	300	405	2	3	5	6	11	16	
65	80						102	120	146	174	210	274	360							480
80	100	37	51	71	91	124	146	178	214	258	335	445	585	2	4	5	7	13	19	
100	120						172	210	254	310	400	525	690							
120	140	43	63	92	122	170	202	248	300	365	470	620	800	3	4	6	7	15	23	
140	160						228	280	340	415	535	700	900							
160	180						252	310	380	465	600	780	1000							
180	200	50	77	122	166	266	284	350	425	520	670	880	1150	3	4	6	9	17	26	
200	225						310	385	470	575	740	960	1250							
225	250						340	425	520	640	820	1050	1350							
250	280	56	94	158	218	315	385	475	580	710	920	1200	1550	4	4	7	9	20	29	
280	315						425	525	650	790	1000	1300	1700							
315	355	62	108	190	268	390	475	590	730	900	1150	1500	1800	4	5	7	11	21	32	
355	400						660	820	1000	1300	1650	2100								
400	450	68	126	232	330	490	595	740	920	1100	1450	1850	2400	5	5	7	13	23	34	
450	500						820	1000	1250	1600	2100	2600								
Grade		6 to 16																		
500	560	78	150	280	400	600														
560	630		155	310	450	660														
630	710	88	175	340	500	740														
710	800		185	380	560	840														
800	900	100	210	430	620	940														
900	1000		220	470	680	1050														
1000	1120	120	250	520	780	1150														
1120	1250		260	580	840	1300														

* In determining K, M, N up to Grade 8 and P to ZC up to Grade 7, add the Δ value appropriate to the grade as indicated, e.g. for P7 from 18 to 30, $\Delta = 8$ therefore ES = -14.

Example

Determine which type of fit is presented by **H7/p6**? For basic size of 30 mm determine the dimensions of the hole and the shaft for the given fit. (**Fit: 30 H7/p6**)

Capital H means basic hole system and upper deviation = zero

H7 : Tol Grade 7 mean 21μ variation

p6 : Tol Grade 6 means 13μ variation
(p means upper deviation is 22μ)

Fit: 40 H8/e6

INTERFERENCE FIT

