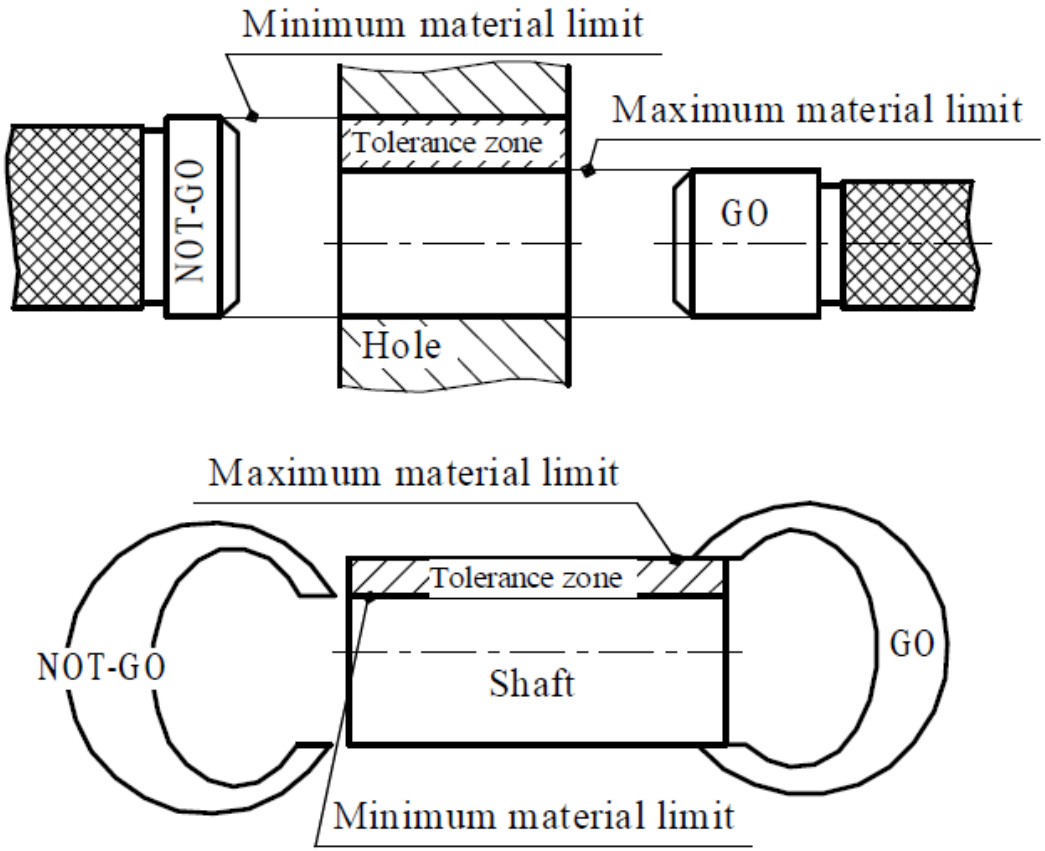
Metrology, standardization and certification

Lecture plan:

1. Basis principles of control.
2. Types of limit gauges.
3. Schemes of tolerance zones for the limit gages.

Basis principles of control

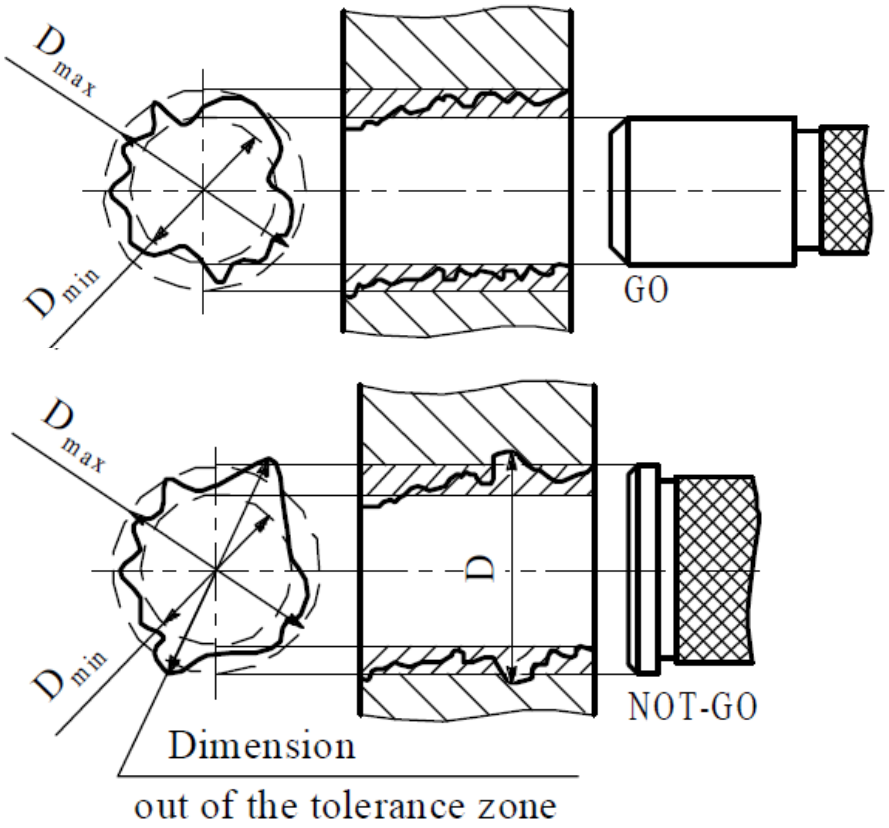
The component dimensional accuracy in mass production is often inspected by the limit gauges due to the simple form and relatively high performance. In practice the limit gauges are applied in inspection of elements made within ***IT6-IT17*** accuracy range.



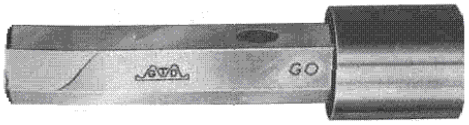
Gauging principle

Basis principles of control

According to the Taylor's principle the ***not-go gauge*** controls only dimension component, but the ***go gauge*** controls form and all the possible geometric deviations.
So, ***not-go gauge*** should be ***shorter*** compared to the component length and the ***go gauge*** should be almost ***the same length*** as the component in order to check the deviations in complex.



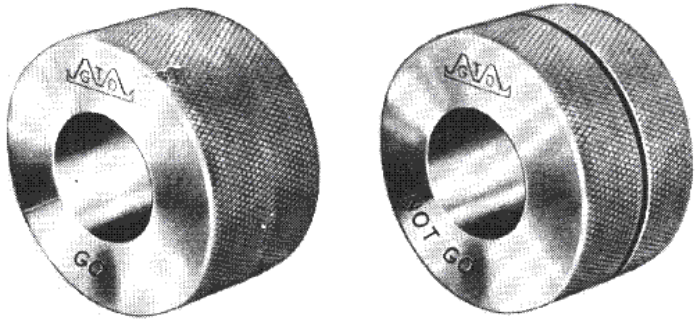
Types of limit gauges



Go plug gauge

Not go plug gauge

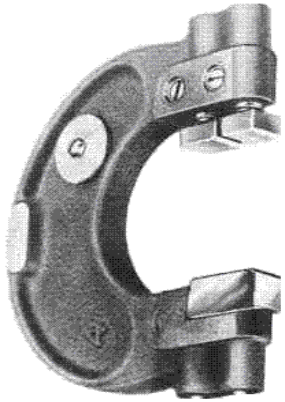
Double sided plug gauge



Ring gauges

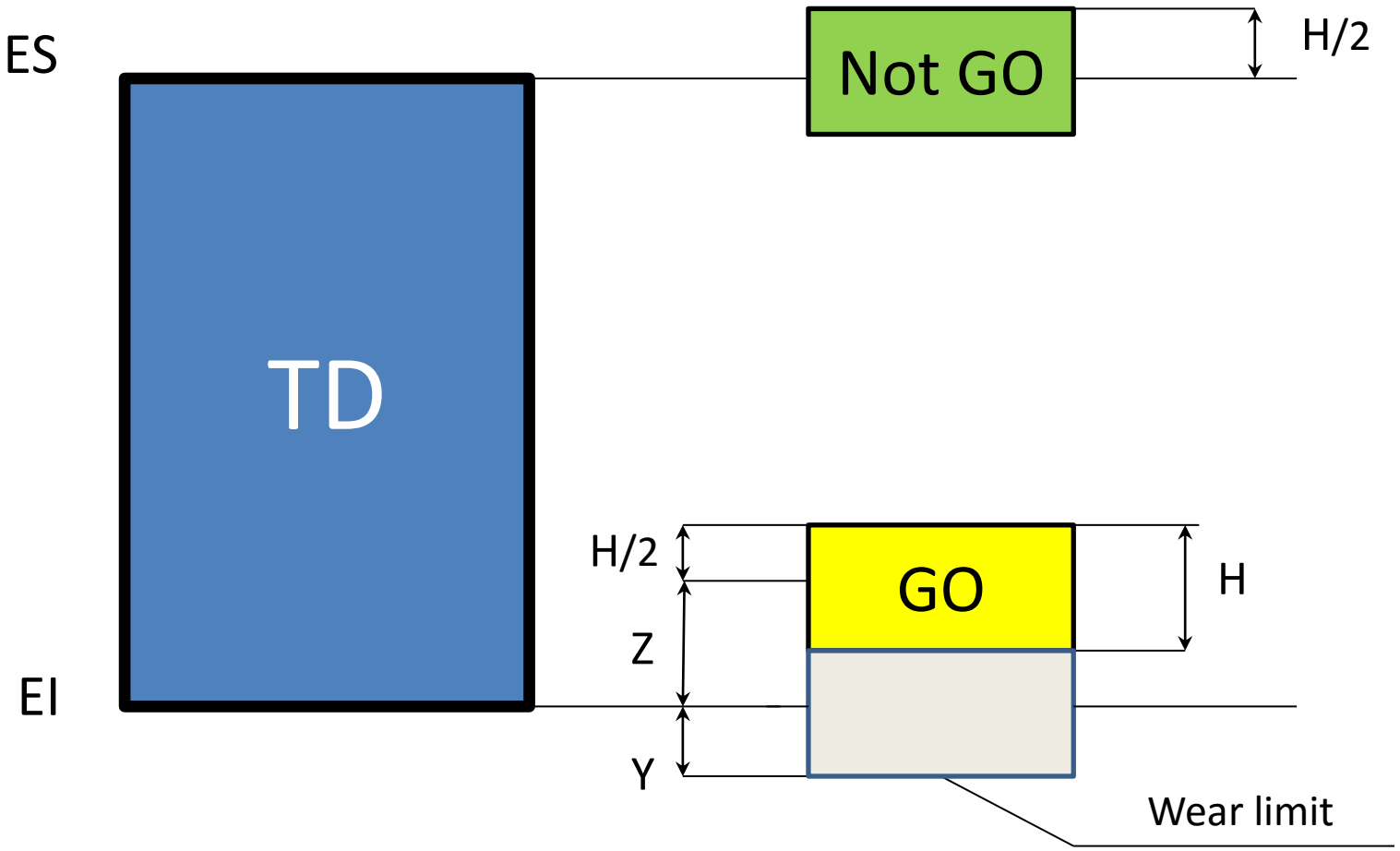
Solid single sided snap gauge;

Solid double sided snap gauge;



Adjustable snap gauge

Scheme of tolerance zones for plug gages

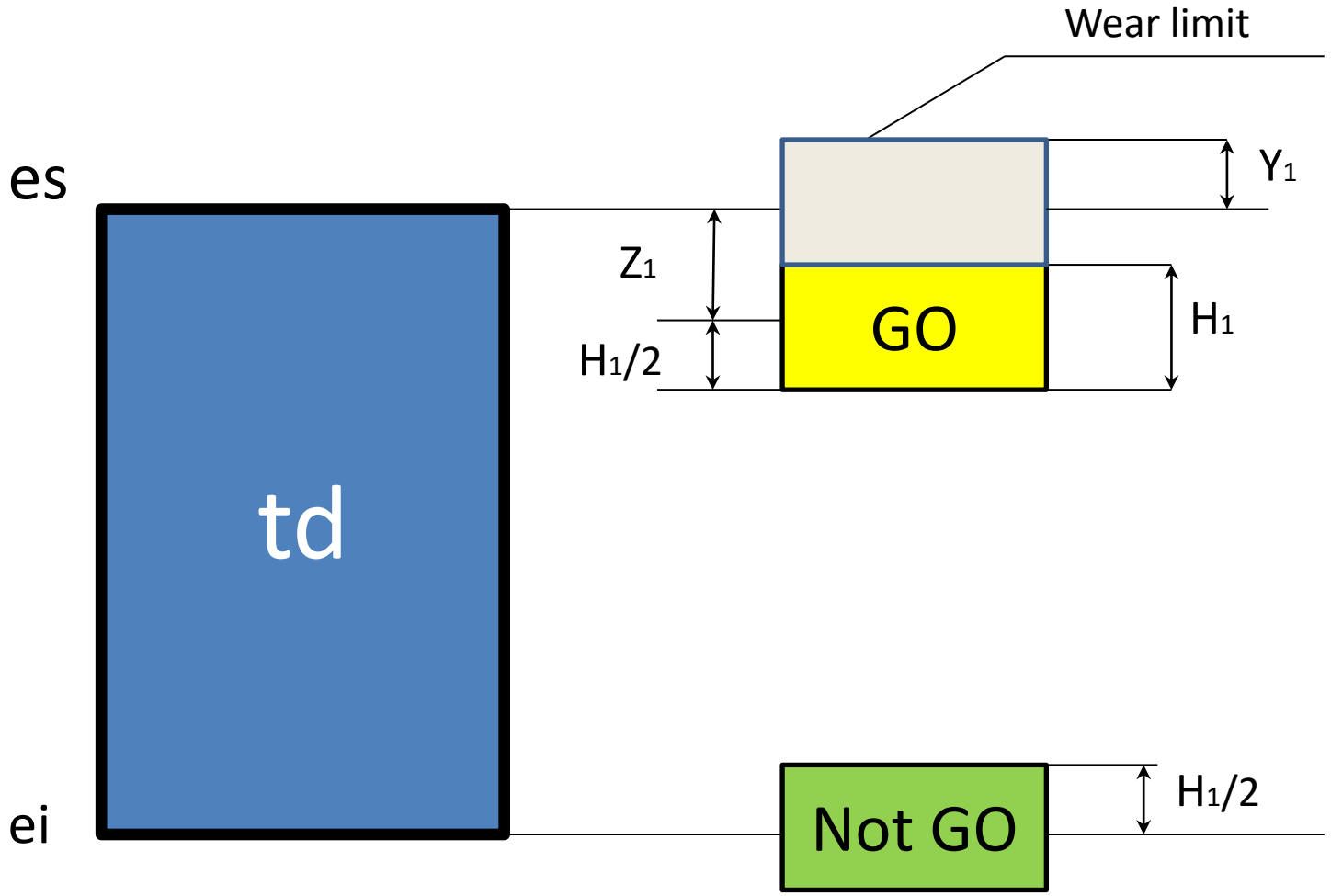


H – plug gauge tolerance

Z – distance from the hole maximum material limit to middle of the go gauge tolerance zone

Y – distance from the hole maximum material limit to wear limit

Scheme of tolerance zones for snap gages



H_1 – snap gauge tolerance

Z_1 - distance from the shaft maximum material limit to middle of the go gauge tolerance zone

Y_1 - distance from the shaft maximum material limit to wear limit

Task 1

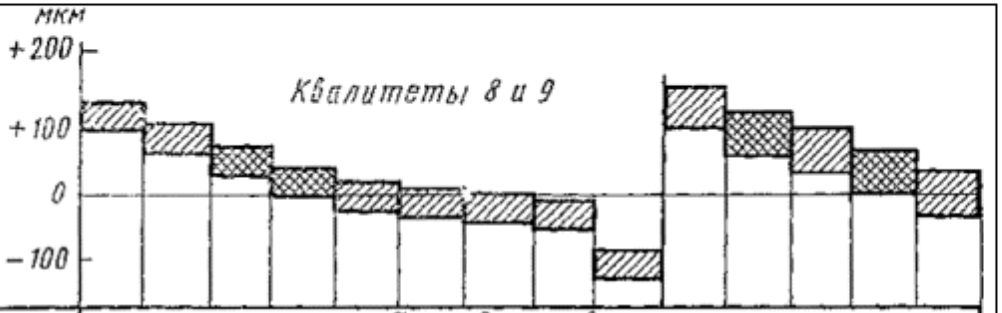
As a result of measuring gauges for the hole control with ∅**111D8** was found that their actual sizes: GO = 111.12 mm, NOT-GO = 111.176 mm.

Requires: draw tolerance zones of working gauges and check hole. Set gauge validity for further use.

DECISION

Determine tolerances for controlled hole in ISO standard:
∅111D8 (es = +174; ei = +120) and calculate his size limits:

Dmin = D + EI; Dmin = 111 + 0,120 = 111,120 mm;
Dmax= D + ES; Dmax= 111 + 0,174 = 111,174 mm.

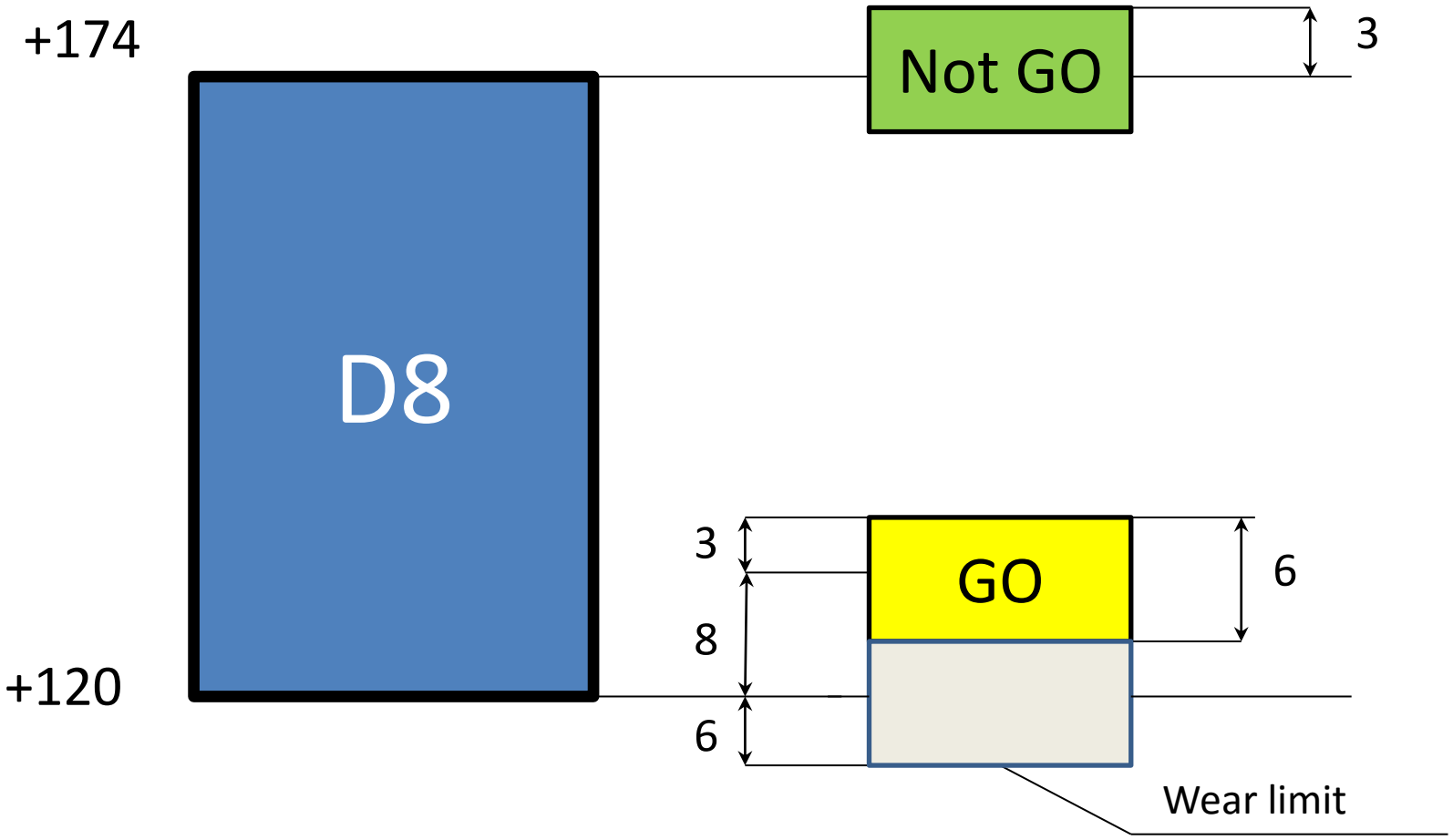


Интервал размеров, мм	Поля допусков													
	D8	E8	F8	H8	J_S8	K8	M8	N8	U8	D9	E9	F9	H9	J_S9*
	Предельные отклонения, мкм													
От 1 до 3	+34 +20	+28 +14	+20 +6	+14 0	+7 −7	0 −14	—	−4 −18	−18 −32	+45 +20	+39 +14	+31 +6	+25 0	+12 −12
Свыше 3 до 6	+48 +30	+38 +20	+28 +10	+18 0	+9 −9	+5 −13	+2 −16	−2 −20	−23 −41	+60 +30	+50 +20	+40 +10	+30 0	+15 −15
Свыше 6 до 10	+62 +40	+47 +25	+35 +13	+22 0	+11 −11	+6 −16	+1 −21	−3 −25	−28 −50	+76 +40	+61 +25	+49 +13	+36 0	+18 −18
Свыше 10 до 14	+77	+59	+43	+27	+13	+8	+2	−3	−33	+93	+75	+59	+43	+21
Свыше 14 до 18	+50	+32	+16	0	−13	−19	−25	−30	−60	+50	+32	+16	0	−21
Свыше 18 до 24	+98	+73	+53	+33	+16	+10	+4	−3	−41 −74	+117	+92	+72	+52	+26
Свыше 24 до 30	+65	+40	+20	0	−16	−23	−29	−36	−48 −81	+65	+40	+20	0	−26
Свыше 30 до 40	+119	+89	+64	+39	+19	+12	+5	−3	−60 −99	+142	+112	+87	+62	+31
Свыше 40 до 50	+80	+50	+25	0	−19	−27	−34	−42	−70 −109	+80	+50	+25	0	−31
Свыше 50 до 65	+146	+106	+76	+46	+23	+14	+5	−4	−87 −133	+174	+134	+104	+74	+37
Свыше 65 до 80	+100	+60	+30	0	−23	−32	−41	−50	−102 −148	+100	+60	+30	0	−37
Свыше 80 до 100	+174	+126	+90	+54	+27	+16	+6	−4	−124 −178	+207	+159	+123	+87	+43
Свыше 100 до 120	+120	+72	+36	0	−27	−38	−48	−58	−144 −198	+120	+72	+36	0	−43
Свыше 120 до 140									−170 −233					

Standard values of parameters for plug gage

Квалитеты допусков изделий	Обозначение размеров и допусков	Интервалы размеров, мм									
		До 3	Св.3 до 6	Св.6 до 10	Св.10 до 18	Св.18 до 30	Св.30 до 50	Св.50 до 80	Св.80 до 120	Св.120 до180	Св.180 до 250
		Размеры и допуски, мкм									
8	Z , Z_1	2	3	3	4	5	6	7	8	9	12
	Y , Y_1	3	3	3	4	4	5	5	6	6	7
	α , α_1	0	0	0	0	0	0	0	0	0	4
	H	2	2,5	2,5	3	4	4	5	6	8	10
	H_1	3	4	4	5	6	7	8	10	12	14
	H_s^*, H_p	1,2	1,5	1,5	2	2,5	2,5	3	4	5	7

Scheme of tolerance zones for the plug gauges



Calculation the limit sizes of plug gauges

Not -GO max = Dmax + H/2; Not -GO max = 111,174 + 0,006/2 = 111,177 mm;

Not -GO min = Dmax - H/2; Not -GO min = 111,174 - 0,006/2 = 111,171 mm.

GO min = Dmin + Z - H/2;
GO min = 111,120 + 0,008 - 0,006/2 = 111,125 mm;
for the new gauge

GO min = Dmin - Y;
GO min = 111,120 - 0,006 = 111,114 mm;
for the gauge which is in operation

GO max = Dmin + Z + H/2;
GO max = 111,120 + 0,008 + 0,006/2 = 111,131 mm.

Validity of the plug gauges

Not-GO min $<$ Not-GO(actual) $<$ Not-GO max

$$111{,}171 < 111{,}176 < 111{,}177$$

condition is met

GO min $<$ GO(actual) $<$ GO max

$$111{,}125 < 111{,}120 < 111{,}131$$

The condition is not met for the new plug gauge

$$111{,}114 < 111{,}120 < 111{,}131$$

The condition is met for the plug gauge in service

Task 2

As a result of the measuring gauges for the shaft control with ∅18g6 was found that its actual sizes: GO= 17.955 mm , Not-GO = 17.983 mm.

Requires: draw tolerance zones of working gauges and check shaft. Set gauge validity for further use.

DECISION

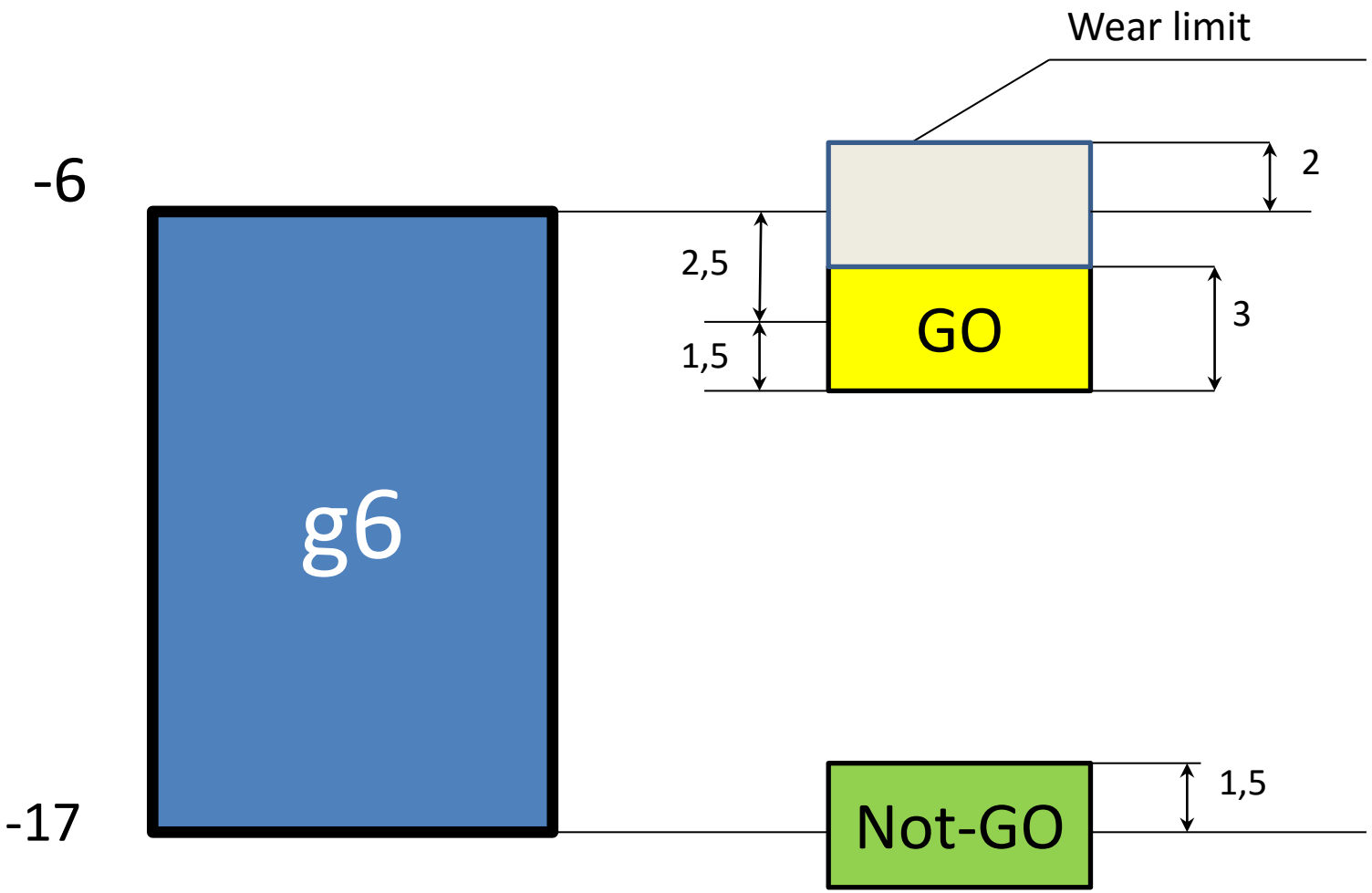
Determine tolerances for controlled hole in ISO standard:
∅18g6 (es = -6; ei = -17) and calculate his size limits:

dmin = d + ei; dmin = 18 + (-0,006) = 17,994 mm;
dmax= d + es; dmax= 18 + (-0,017) = 17,923 mm.

Интервал размеров, мм	Поля допусков										
	f6	g6	h6	j_s6	k6	m6	n6	p6	r6	s6	t6
	Предельные отклонения, мкм										
От 1 до 3	−6 −11	−2 −8	0 −6	+3,0 −3,0	+6 0	+8 +2	+10 +4	+12 +6	+16 +10	+20 +14	—
Свыше 3 до 6	−10 −18	−4 −12	0 −8	+4,0 −4,0	+9 +1	+12 +4	+16 +8	+20 +12	+23 +15	+27 +19	—
Свыше 6 до 10	−13 −22	−5 −14	0 −9	+4,5 −4,5	+10 +1	+15 +6	+19 +10	+24 +15	+28 +19	+32 +23	—
Свыше 10 до 14	−16	−6	0	+5,5	+12	+18	+23	+29	+34	+39	—
Свыше 14 до 18	−27	−17	−11	−5,5	+1	+7	+12	+18	+23	+28	
Свыше 18 до 24	−20	−7	0	+6,5	+15	+21	+28	+35	+41	+48	—
Свыше 24 до 30	−33	−20	−13	−6,5	+2	+8	+15	+22	+28	+35	+54 +41
Свыше 30 до 40	−25	−9	0	+8,0	+18	+25	+33	+42	+50	+59	+64 +48
Свыше 40 до 50	−41	−25	−16	−8,0	+2	+9	+17	+26	+34	+43	+70 +54
Свыше 50 до 65	−30	−10	0	+9,5	+21	+30	+39	+51	+60 +41	+72 +53	+85 +66
Свыше 65 до 80	−49	−29	−19	−9,5	+2	+11	+20	+32	+62 +43	+78 +59	+94 +75
Свыше 80 до 100	−36	−12	0	+11,0	+25	+35	+45	+59	+73 +51	+93 +71	+113 +91
Свыше 100 до 120	−58	−34	−22	−11,0	+3	+13	+23	+37	+76 +54	+101 +79	+126 +104

Квалитеты допусков изделий	Обозначение размеров и допусков	Интервалы размеров, мм									
		До 3	Св.3 до 6	Св.6 до 10	Св.10 до 18	Св.18 до 30	Св.30 до 50	Св.50 до 80	Св.80 до 120	Св.120 до180	Св.180 до 250
		Размеры и допуски, мкм									
6	Z	1	1,5	1,5	2	2	2,5	2,5	3	4	5
	Y	1	1	1	1,5	1,5	2	2	3	3	4
	α , α_1	0	0	0	0	0	0	0	0	0	2
	Z_1	1,5	2	2	2,5	3	3,5	4	5	6	7
	Y_1	1,5	1,5	1,5	2	3	3	3	4	4	5
	H , H_s	1,2	1,5	1,5	2	2,5	2,5	3	4	5	7
	H_1	2	2,5	2,5	3	4	4	5	6	8	10
	H_p	0,8	1	1	1,2	1,5	1,5	2	2,5	3,5	4,5

Scheme of tolerance zones for snap gages



Calculation the limit sizes of snap gauges

Not-GO max = dmin + H1/2; Not-GO max = 17,983 + 0,003/2 = 17,9845 mm;

Not-GO min = dmin - H1/2; Not-GO min = 17,983 - 0,003/2 = 17,9815 mm.

GO min = dmax - Z1 - H1/2;
GO min = 17,994 - 0,0025 - 0,003/2 = 17,990 mm.

GO max = dmax - Z1 + H1/2;
GO max = 17,994 - 0,0025 + 0,003/2 = 17,993 mm;
for the new gauge

GO max = dmax + Y1;
GO max = 17,994 + 0,002 = 17,996 mm;
for the gauge which is in operation

Validity of the snap gauges

Not-GO min $<$ Not-GO(actual) $<$ Not-GO max

$17{,}9815 < 17{,}983 < 17{,}9845$

condition is met

GO min $<$ GO(actual) $<$ GO max

$17{,}990 < 17{,}955 < 17{,}993$

The condition is not met for the new snap gauge

$17{,}990 < 17{,}955 < 17{,}996$

The condition is met for the plug gauge in service

Thank you for attention