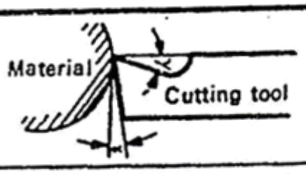
LAMPIRAN

Standard values for cutting speeds—angles—specific cutting force



Values given apply to dry cutting, using high-speed steel tools at a cutting speed V_{60} (tool life 60 min); tungston carbide tools at a cutting speed V_{40} (tool life 40 min). Setting angle $\lambda=45°$, nose angle $\epsilon=90°$, front clearance $\lambda=5\ldots8°$. Front clearance $\lambda=10\ldots25°$ for soft materials.

Values of specific cutting force (pressure), tangential to the work surface are applicable for depth of cut four to eight times of the feed.

Material	Strength in kgf/mm²	Cutting tool	Side clearance $\alpha°$	Side rake $\gamma°$	Feed s in mm per revolution: 0.1	0.2	0.4	0.8	1.6	3.2	0.1	0.2	0.4	0.8
					Cuttting speed V m/min						Specific cutting force K_s, kgf/mm² chip section			
Plain carbon structural steel St 34, St 37, St 42	up to 45	HSS	8	14	280	60	45	34	25	19	360	260	190	136
		TCT¹	5	10		236	200	170	67	56				
St 50, St 63	50... 70	HSS	8	14	240	44	32	24	18	14	410	225	215	154
		TCT	5	10		205	175	145	50	42				
St 78	70... 85	HSS	8	14	200	32	24	18	13	10	440	315	230	164
		TCT	5	10		170	132	106	34	27				
Cast steel	50... 75	HSS	8	10	118	34	25	19	14	11	360	260	190	136
		TCT	5	6		100	85	71	24	20				
Alloy steels	85...100	HSS	8	10	150	24	17	12	8.5	(6)	500	360	260	185
		TCT	5	6		118	95	75	24	20				
Mn-steel, Cr-Ni-steel, Cr-Mo steel	100...140	HSS	8	6	95	16	11	8	(5-6)	13	530	380	275	200
		TCT	5	6		75	60	50	16					
Other steel alloys	140...180	HSS	8	6	60	9.5	6	32	10	8	570	410	300	215
		TCT	5	6		48	38							
Tool steel	150...180	HSS	8	6	50	40	32	27	8.5	6.7	570	410	300	215
		TCT	5	6										
Austenitic-steel Manganese steel		HSS			40	32	25	20	6.7	5.3	660	480	350	252
		TCT	5	6										
Cast iron Grade 15	BHN ...200	HSS	8	0	140	48	27	18	14	9.5	190	136	100	72
		TCT	5	0		118	95	80	67					
Cast iron Grade 25	BHN 200...250	HSS	8	0	106	32	18	13	9.5	6.3	290	208	150	108
		TCT	5	0		90	75	63	53					
Malleable Cast iron		HSS	8	10	106	43	28	20	13	9	240	175	125	92
		TCT	5	10		90	75	63	53					
Copper alloys Brass	BHN 80...120	HSS	8	0	600	125	85	56	36		160	115	85	60
		TCT	5	6		530	450	400	355					
Tin bronze		HSS	8	0	500	85	63	48	34	24	140	100	70	52
		TCT	5	6		450	375	335	300					
Cast bronze		HSS	8	0	355	63	53	43	36	28	340	245	180	128
		TCT	5	6		280	236	200	180					
Light alloys Pure aluminium		HSS	12	30	400	300	200	118	75		105	76	55	40
		TCT	12	30	1320	1120	950	850	710					
Al-alloys (11...13% S:)		HSS	12	18	100	67	45	30			140	100	70	52
		TCT	12	18	224	190	160	140	118					
Piston alloys		HSS	12	14	25	22	20	18	17		125	90	65	48
		TCT	12	14										
Magnesium-alloys		HSS	8	6	1000	900	800	750	710		58	42	30	22
		TCT	5	6	1800	1500	1250	1060	900					
Synthetic and moulded materials Ebonite (Hard rubber)		HSS	12	10	300	280	250	224	200		48	35	25	18
		TCT	12	10										
Moulded plastic, Bakelite		HSS	12	14	280	212	170	132	100		48	35	25	18
		TCT	12	14										

¹TCT: Tungston carbide tipped tools
Cutting speeds given apply to the hard TCT grades

Tabel 1.7 TOLERANSI MENURUT ISO

Satuan dalam μm

*) Dibagi dalam beberapa tingkatan

Lubang

Ukuran dasar	G7	H6	JS6	K6	G7	H7	JS7	K7	M7	P7	E8	H8	H9	P9
>3 - 6	+16 +4	+8 0	±4	+2 -6	+16 +4	+12 0	±6	+3 -9	0 -12	-8 -20	+38 +20	+18 0	+30 0	-12 -42
>6 - 10	+20 +5	+9 0	±4,5	+2 -7	+20 +5	+15 0	±7,5	+5 -10	0 -15	-9 -24	+47 +25	+22 0	+36 0	-15 -51
>10 - 18	+24 +6	+11 0	±5,5	+2 -9	+24 +6	+18 0	±9	+6 -12	0 -18	-11 -29	+59 +32	+27 0	+43 0	-18 -61
>18 - 30	+28 +7	+13 0	±6,5	+2 -11	+28 +7	+21 0	±10,5	+6 -15	0 -21	-14 -35	+73 +40	+33 0	+52 0	-22 -74
>30 - 50	+34 +9	+16 0	±8	+3 -13	+34 +9	+25 0	±12,5	+7 -18	0 -25	-17 -42	+89 +50	+39 0	+62 0	-26 -88
>50 - 80	+40 +10	+19 0	±9,5	+4 -15	+40 +10	+30 0	±15	+9 -21	0 -30	-21 -51	+106 +60	+46 0	+74 0	-32 -106
>80 - 120	+47 +12	+22 0	±11	+4 -18	+47 +12	+35 0	±17,5	+10 -25	0 -35	-24 -59	+126 +72	+54 0	+87 0	-37 -124
>120 - 180	+54 +14	+25 0	±12,5	+4 -21	+54 +14	+40 0	±20	+12 -28	0 -40	-28 -68	+148 +85	+63 0	+100 0	-43 -143

Poros

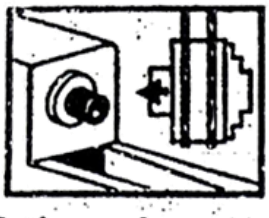
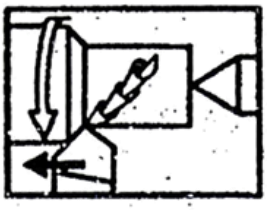
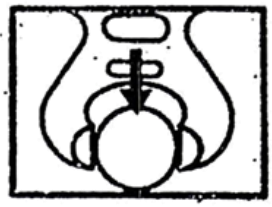
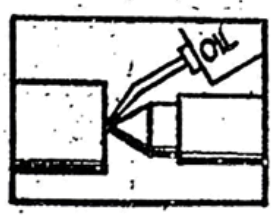
Ukuran dasar	n6	h5	js5	k5	g6	h6	js6	k6	m6	p6	s6	f7	e8	h9
> 3 - 6	+16 +8	0 -5	±2,5	+6 +1	-4 -12	0 -8	±4	+9 +1	+12 +4	+20 +12	+27 +19	-10 -22	-20 -38	0 -30
> 6 - 10	+19 +10	0 -6	±3	+7 +1	-5 -14	0 -9	±4,5	+10 +1	+15 +6	+24 +15	+32 +23	-13 -28	-25 -47	0 -36
> 10 - 18	+23 +12	0 -8	±4	+9 +1	-6 -17	0 -11	±5,5	+12 +1	+18 +7	+29 +18	+39 +28	-16 -34	-32 -59	0 -43
> 18 - 30	+28 +15	0 -9	±4,5	+11 +2	-7 -20	0 -13	±6,5	+15 +2	+21 +8	+35 +22	+48 +35	-20 -41	-40 -73	0 -52
> 30 - 50	+33 +17	0 -11	±5,5	+13 +2	-9 -25	0 -16	±8	+18 +2	+25 +9	+42 +26	+59 +43	-25 -50	-50 -89	0 -62
> 50 - 80	+39 +20	0 -13	±6,5	+15 +2	-10 -29	0 -19	±9,5	+21 +2	+30 +11	+51 +32	*)	-30 -60	-60 -106	0 -74
> 80 - 120	+45 +23	0 -15	±7,5	+18 +3	-12 -34	0 -22	±11	+25 +3	+35 +13	+59 +37		-36 -71	-72 -126	0 -87
>120 - 180	+52 +27	0 -18	±9	+21 +3	-14 -39	0 -25	±12,5	+28 +3	+40 +15	+68 +43		-43 -83	-85 -148	0 -100

NILAI TOLERANSI KEKASARAN PERMUKAAN

Kelas kekasaran	Harga C.L.A (μm)	Harga Ra (μm)	Toleransi	Panjang sampel (mm)
N1	1	0.0025	0.02 – 0.04	0.08
N2	2	0.05	0.04 – 0.08	
N3	4	0.0	0.08 – 0.15	0.25
N4	8	0.2	0.15 – 0.3	
N5	16	0.4	0.3 – 0.6	
N6	32	0.8	0.6 – 1.2	
N7	63	1.6	1.2 – 2.4	
N8	125	3.2	2.4 – 4.8	0.8
N9	250	6.3	4.8 – 9.6	
N10	500	12.5	9.6 – 18.75	2.5
N11	1000	25.0	18.75 – 37.5	
N12	2000	50.0	37.5 – 75.0	8

Calculating the machining time

To enable proper estimation of the time required for operating machine tools, the following distinctions are made

Setting time	Machining time t_m	Auxiliary time t_a	Delay time
			
Setting up the machine: Getting tools, study of drawings	Actual time in which the tool is cutting	Clamping job, setting the tool, measuring, checking	Lubricant machine trouble shooting or repair work, short breaks

Longitudinal turning

rpm known

l = length to be turned

s_r = feed mm/rev

n = rpm

Feed per minute:

$$s = s_r \times n$$

$$t_m = \frac{l}{s_r \times n} \text{ (min)}$$

Example:

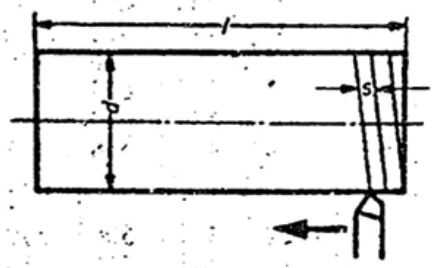
l = 600 mm

s_r = 0.5 mm/rev

n = 50 rpm

$$t_m = \frac{600 \text{ mm}}{0.5 \text{ mm/rev} \times 50 \text{ rpm}}$$

$$= 24 \text{ min}$$



$$\text{Machining time} = \frac{\text{length to be turned}}{\text{feed per minute}}$$

Note: The rpm calculated will be different from the rpm available with a particular machine.

rpm unknown

d = diameter (m)

v = cutting speed m/min

s_r = feed mm/rev

l = length to be turned

$$n = \frac{v}{\pi \times d}$$

$$t_m = \frac{l \times \pi \times d}{s_r \times v} \text{ (min)}$$

Example:

d = 0.125 m

v = 20 m/min

s_r = 0.5 mm/rev

l = 600 mm

$$t_m = \frac{600 \text{ mm} \times 3.14 \times 0.125 \text{ m}}{0.5 \text{ mm/rev} \times 20 \text{ m/min}}$$

$$= 23.5 \text{ min}$$

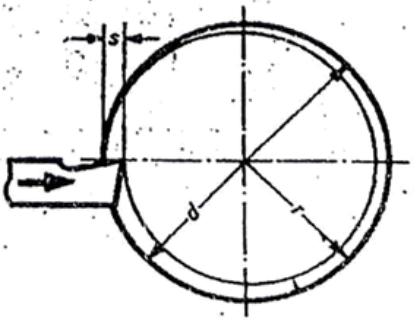
Facing

$$n = \frac{v}{\pi \times d}$$

$$t_m = \frac{r}{s_r \times n}$$

In order to obtain a uniform cutting speed, the rpm should be varied. For a constant rpm an average cutting speed should be considered.

For facing the radius r can be considered, as the length to be turned



Example:

d = 0.250 m

v = 20 m/min

s_r = 0.5 mm/rev

$$n = \frac{v}{\pi \times d} = \frac{20 \text{ m/min}}{3.14 \times 0.25 \text{ m}}$$

$$= 25 \text{ rpm}$$

$$t_m = \frac{r}{s_r \times n} = \frac{125 \text{ mm}}{0.5 \text{ mm} \times 25 \text{ rpm}}$$

$$= 10 \text{ min}$$

Feed rate s based on the permissible quantity V' of chips produced

Permissible chip removal V' cm³/kW min	Depth of cut a mm	s with a machine drive power $P=1$ kW								
		Width b of cut in mm								
		40	50	60	80	100	120	140	160	180
8	3	66	53	44	33	26	22	19	16	15
	5	40	32	27	20	16	13	11	10	9
	8	25	20	16	12	10	8	7	6	5.5
10	3	83	66	55	41	33	27	23	20	18
	5	50	40	33	25	20	16	14	12	11
	8	31	25	21	15	12.5	10	9	8	7
12	3	100	80	67	50	40	33	29	25	22
	5	60	48	40	30	24	20	17	15	13
	8	37	30	25	19	15	12	10	9	8
15	3	125	100	84	62	50	42	36	31	28
	5	75	60	50	37	30	25	21	19	16
	8	47	37	31	21	19	15	13	11	10
22	3	184	146	121	92	73	61	52	46	41
	5	110	88	73	55	44	37	31	27	24
	8	69	55	46	34	27	23	19	17	15
28	3	230	185	155	116	94	78	67	58	52
	5	140	110	93	70	56	47	40	35	31
	8	87	70	58	44	35	29	25	22	19
60	3	500	400	335	250	200	165	142	125	110
	5	300	240	200	150	120	100	86	75	67
	8	185	150	125	94	75	62	53	47	42
75	3	625	500	415	310	250	205	178	156	140
	5	375	300	250	185	150	125	105	94	83
	8	235	185	155	115	94	78	67	58	52

* Calculated values shown in the table are to be multiplied by the factors 2.5 or 5 in case the machine drive power P is 2.5 or 5 kW respectively.

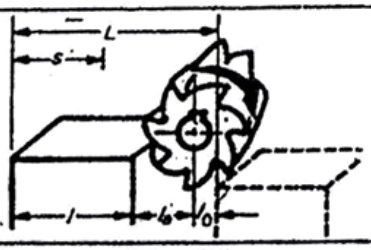
Estimation of machining time

$$\text{Machining time} = \frac{\text{Total length of travel}}{\text{Rate of feed}}$$

$$t_m = \frac{L}{s}$$

The total length of travel depends on the length of the workpiece, the size of cutter used and the method of milling employed.

Travel L

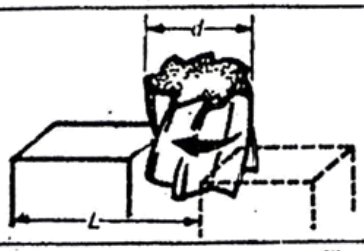


Slab milling

Roughing and finishing cutters

L = length of workpiece + approach + over travel

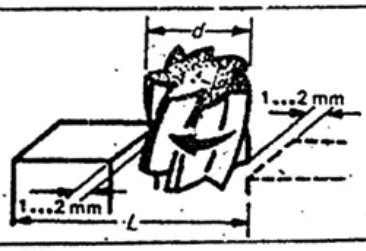
$L = l + l_a + l_o$



Face milling

Roughing cut

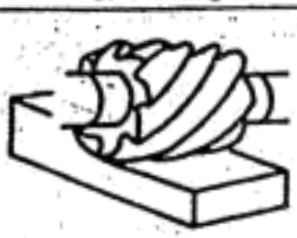
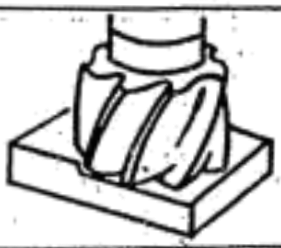
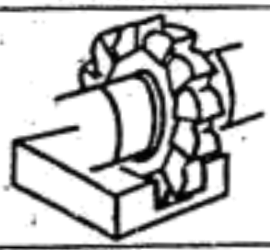
$L = l + \frac{d}{2} + 2$

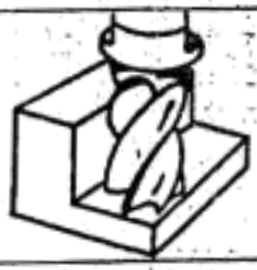
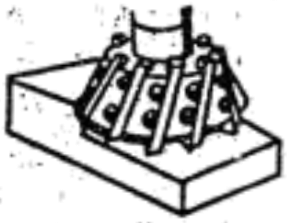
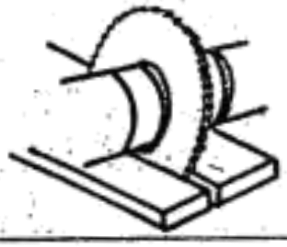


Finish cut

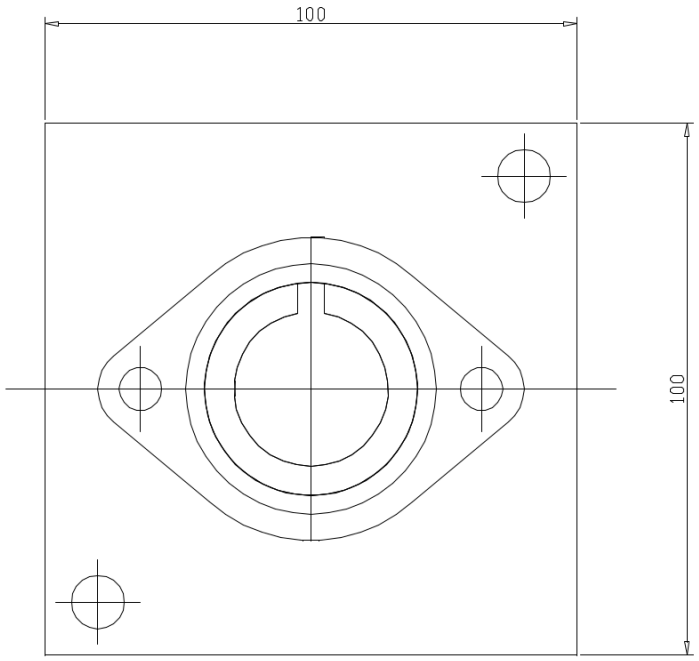
$L = l + d + 4$

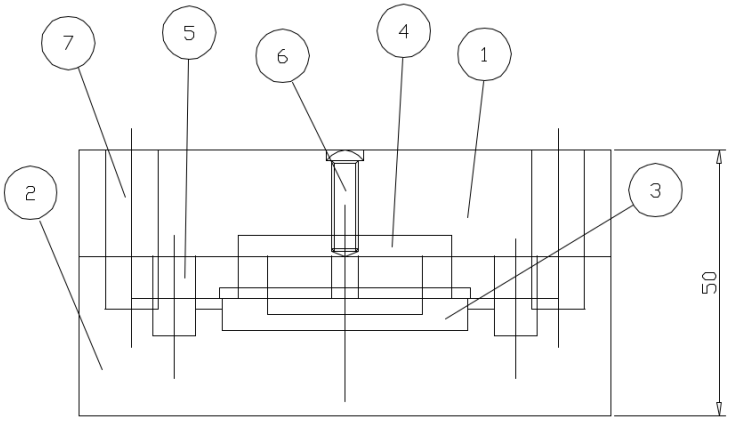
Suggested cutting speed and feed*

	Slab milling				Shell-end mill				Site and face-mill			
												
Width of cut b	b=100 mm				b=70 mm				b=20 mm			
	Roughing ▽		Finishing ▽▽		Roughing ▽		Finishing ▽▽		Roughing ▽		Finishing ▽▽	
Depth of cut a	a=5 mm		a=0.5 mm		a=5 mm		a=0.5 mm		a=10 mm			
	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min
Carbon steel up to 63 kgf/mm²	17	100	22	60	17	100	22	70	18	100	22	40
Alloy steel annealed up to 78 kgf/mm²	14	80	18	50	14	90	18	55	14	80	18	30
Alloy steel heat treated up to 100 kgf/mm²	10	50	14	36	10	55	14	42	12	50	14	25
Gray cast iron up to HB 180	12	120	18	60	12	140	18	70	14	120	18	40
Brass (Cu Zn 40)	35	70	35	50	36	190	55	150	36	150	55	75
Light alloy	200	200	250	100	200	250	250	110	200	200	250	100

	End milling cutter				Inserted tooth face milling cutter				Circular saw			
												
Width of cut b	b=25 mm				b=180 mm				b=2.5 mm			
	Roughing ▽		Finishing ▽▽		Roughing ▽		Finishing ▽▽		Roughing ▽			
Depth of cut a	a=5mm		a=0.5 mm		a=5 mm		a=0.5 mm		a=10 mm			
	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min	Cutting speed v m/min	Feed s' mm/min		
Carbon steel up to 63 kgf/mm²	17	50	22	120	20	65	30	50	45	50		
Alloy steel annealed up to 78 kgf/mm²	15	40	19	100	16	36	23	40	35	40		
Alloy steel heat treated up to 100 kgf/mm²	13	20	17	65	14	20	18	30	25	30		
Grey cast iron up to HB 180	15	80	19	120	16	100	24	90	35	50		
Brass (Cu Zn 40)	35	80	55	120	50	200	60	120	350	200		
Light alloys	160	90	180	120	250	250	300	90	320	180		

* Values to be adjusted against available machine power (refer page 109).

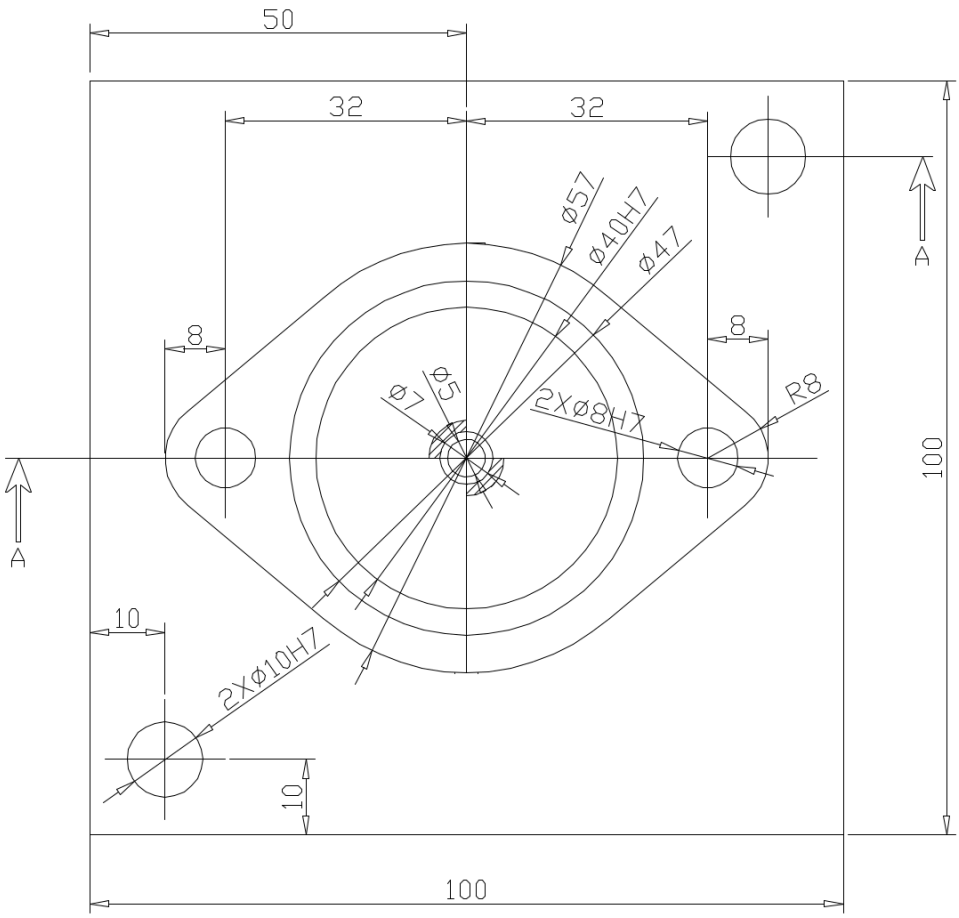


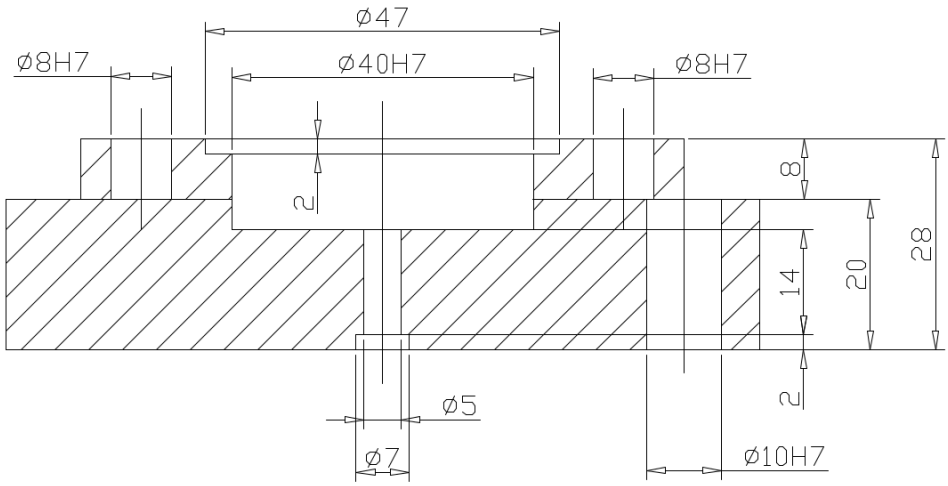


		2	POROS ø 10	7	AL	ø30X40	DIBUAT
		1	BAUT M5X0,75	6	ISO	ø5X17	DIBELI
		2	POROS ø 8	5	Al	ø30X20	DIBUAT
		1	INTI ATAS	4	Al	ø40X15	DIBUAT
		1	INTI BAWAH	3	Al	ø48X20	DIBUAT
		1	CETAKAN BAWAH	2	Al	100X100X35	DIBUAT
		1	CETAKAN ATAS	1	Al	100X100X35	DIBUAT
JUMLAH			NAMA BAGIAN	NO.BAG	BAHAN	UKURAN	KET.

III	II	I	PERUBAHAN:				
			KOMPONEN CETAKAN KARET GASKET POMPA AIR SHIMIZU	SKALA: 1 : 1	DIGAMBAR:	22.5.19	DONI A.
					DIPERIKSA:		PB.1&2.
			POLITEKNIK NEGERI SRIWIJAYA	DRAME NO: 1/5/22/6MA			

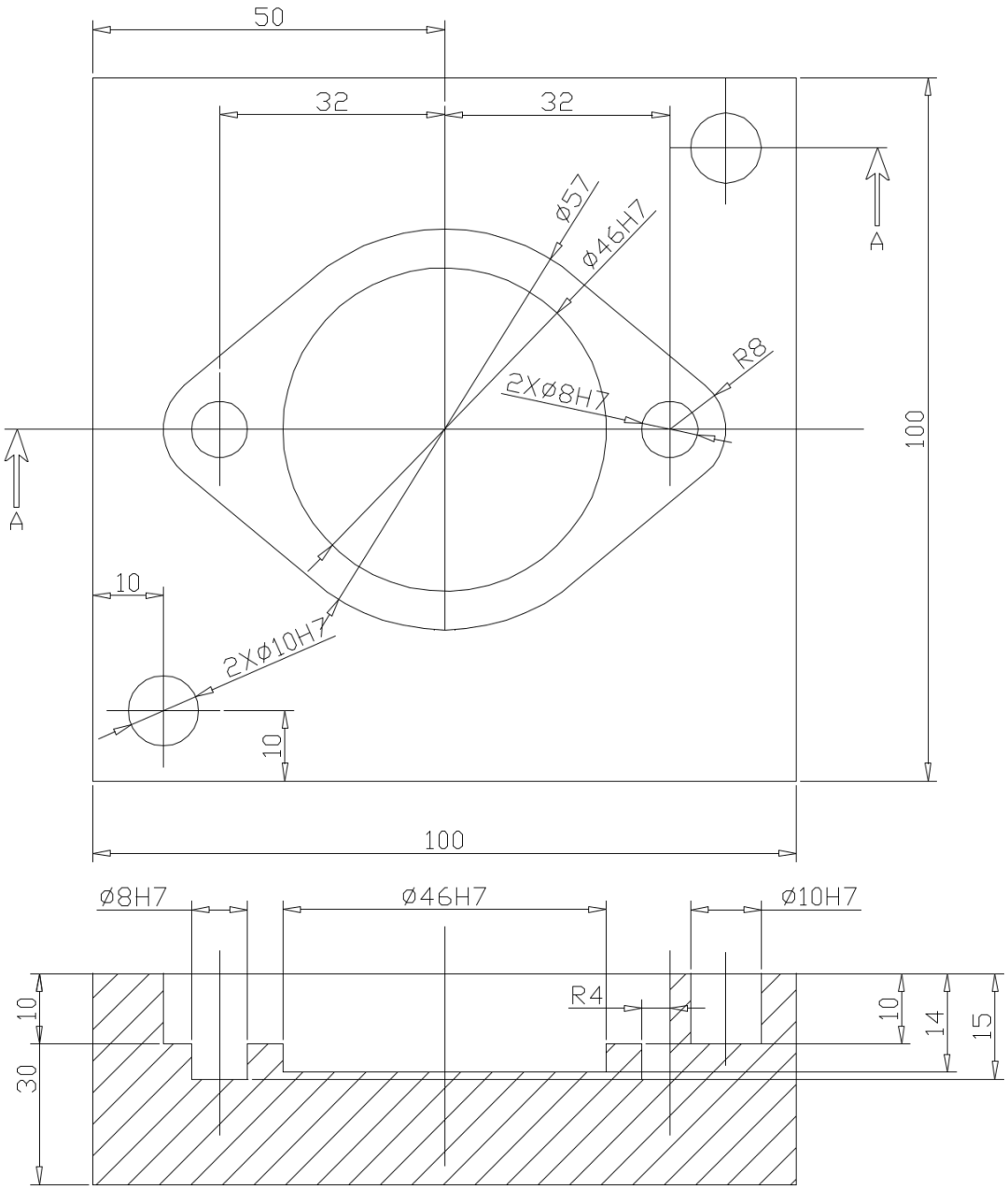
NO. 1 TOL. ± 0,2 N8 MILLING





		1	CETAKAN ATAS	1	Al	100X100X35	DIBUAT
JUMLAH			NAMA BAGIAN	NO.BAG	BAHAN	UKURAN	KET.
III	II	I	PERUBAHAN :				
			KOMPONEN CETAKAN KARET GASKET POMPA AIR SHIMIZU		SKALA: 1 : 1	DIGAMBAR: 22.5.19 DONI A.	DIPERIKSA: PB.1&2.
			POLITEKNIK NEGERI SRIWIJAYA			DRAME NO: 1/5/22/6MA	

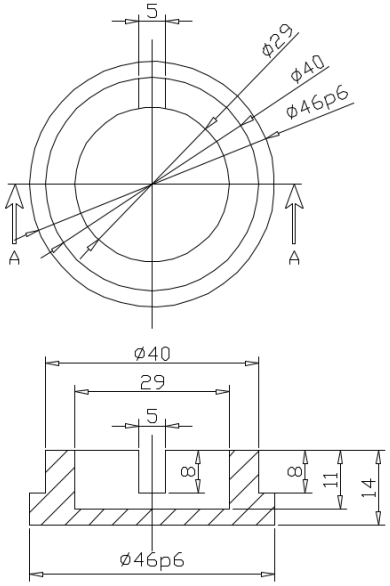
NO. 2 TOL. ± 0,2 N8 MILLING



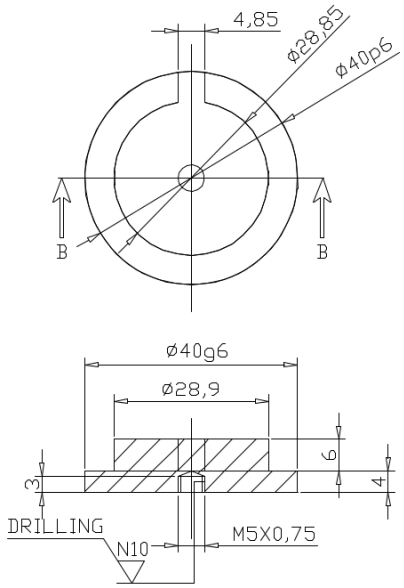
		1	CETAKAN BAWAH	2	Al	100X100X35	DIBUAT
JUMLAH			NAMA BAGIAN	NO.BAG	BAHAN	UKURAN	KET.
III	II	I	PERUBAHAN:				

KOMPONEN CETAKAN KARET GASKET POMPA AIR SHIMIZU	SKALA: 1 : 1	DIGAMBAR: 22.5.19	DONI A.
		DIPERIKSA:	PB.1&2
POLITEKNIK NEGERI SRIWIJAYA	DRAME NO: 1/5/22/6MA		

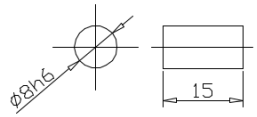
NO.3 TOL.±0,2 N6 TURNING



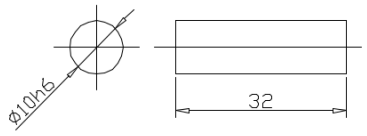
NO.4 TOL.±0,05 N6 TURNING (N10)



NO.5 TOL.±0,2 N6 TURNING



NO.7 TOL.±0,2 N6 TURNING



		2	POROS ø10	7	Al	ø30X40	DIBUAT
		2	POROS ø8	5	Al	ø30X20	DIBUAT
		1	INTI ATAS	4	Al	ø40X15	DIBUAT
		1	INTI BAWAH	3	Al	ø48X20	DIBUAT
JUMLAH			NAMA BAGIAN	NO.BAG	BAHAN	UKURAN	KET.
III	II	I	PERUBAHAN:				

KOMPONEN CETAKAN KARET GASKET POMPA AIR SHIMIZU	SKALA: 1 : 1	DIGAMBAR:	22.5.19 DONI A.
		DIPERIKSA:	PB.1&2.
POLITEKNIK NEGERI SRIWIJAYA	DRAME NO: 1/5/22/6MA		