

Mechanical Engineering Drawing Workshop

Drawing Part 1

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- | | |
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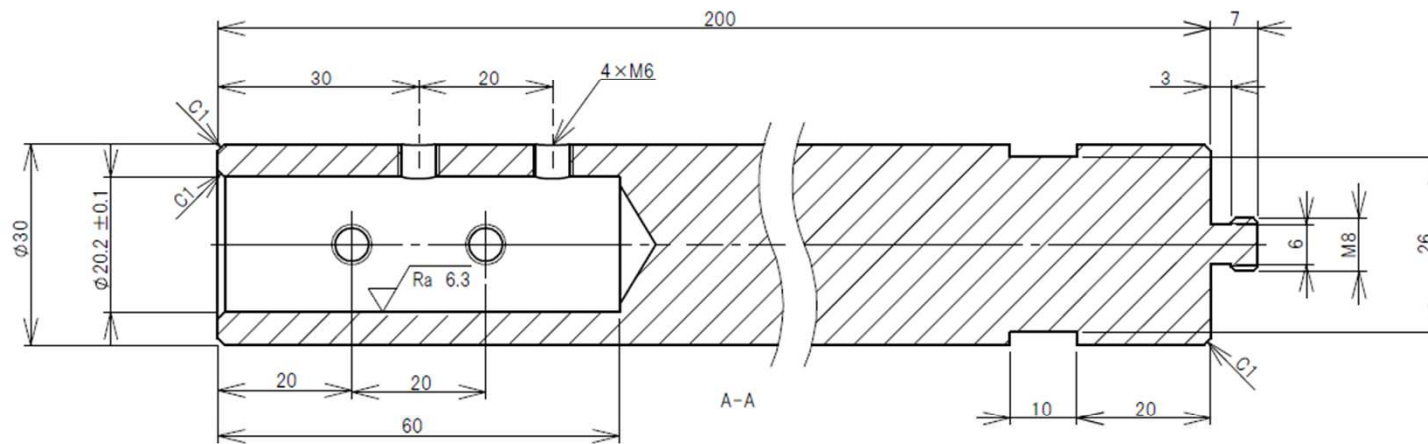
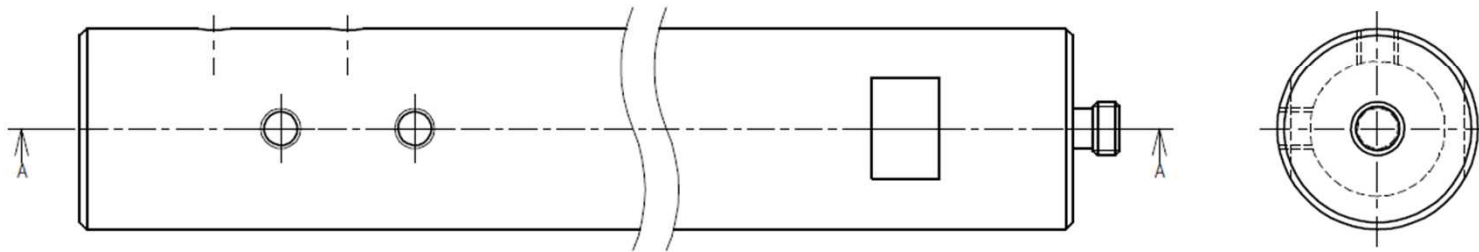
Sample Drawings

Sample 1



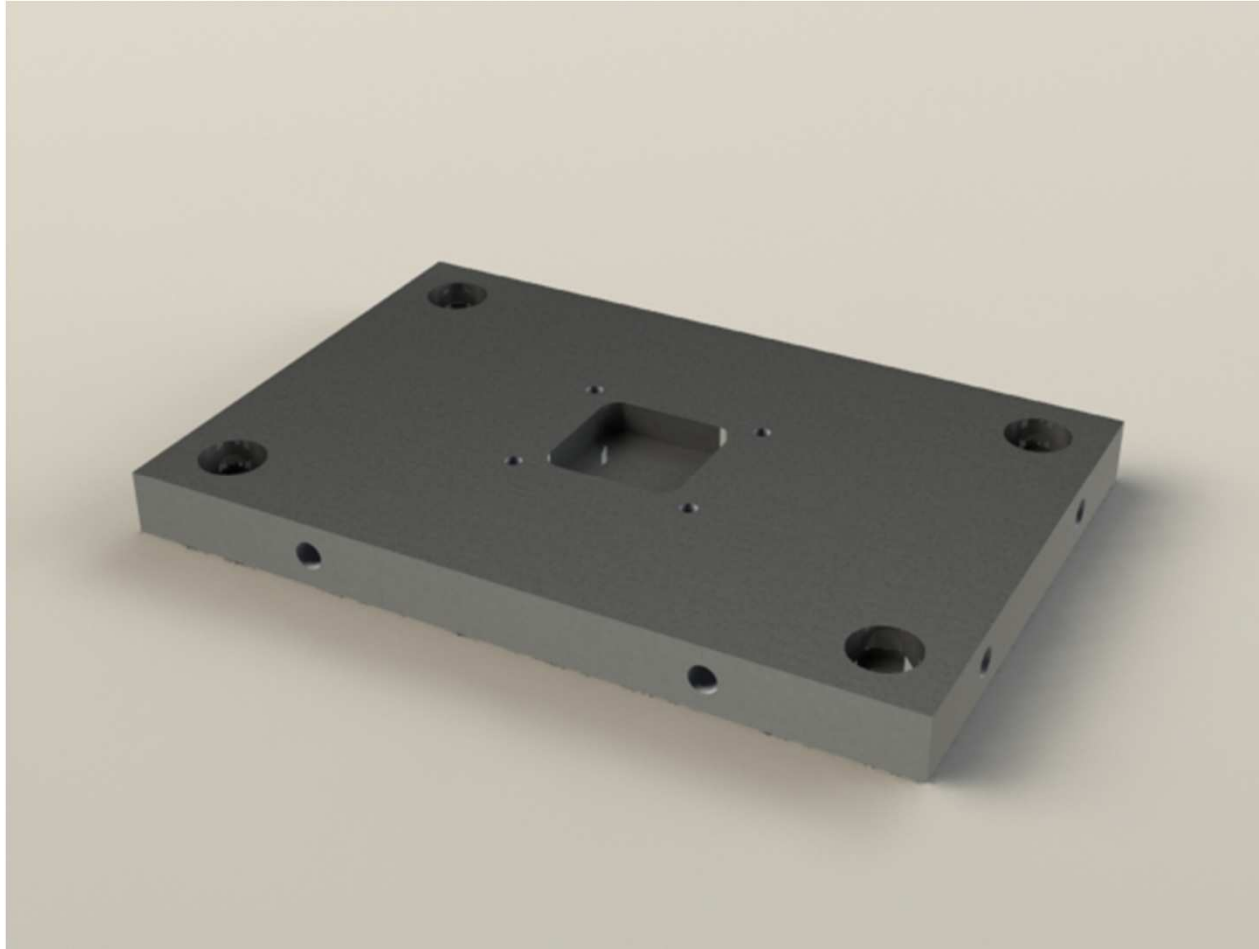
Sample 1

① $\sqrt{Ra\ 25}$ ($\sqrt{Ra\ 6.3}$)

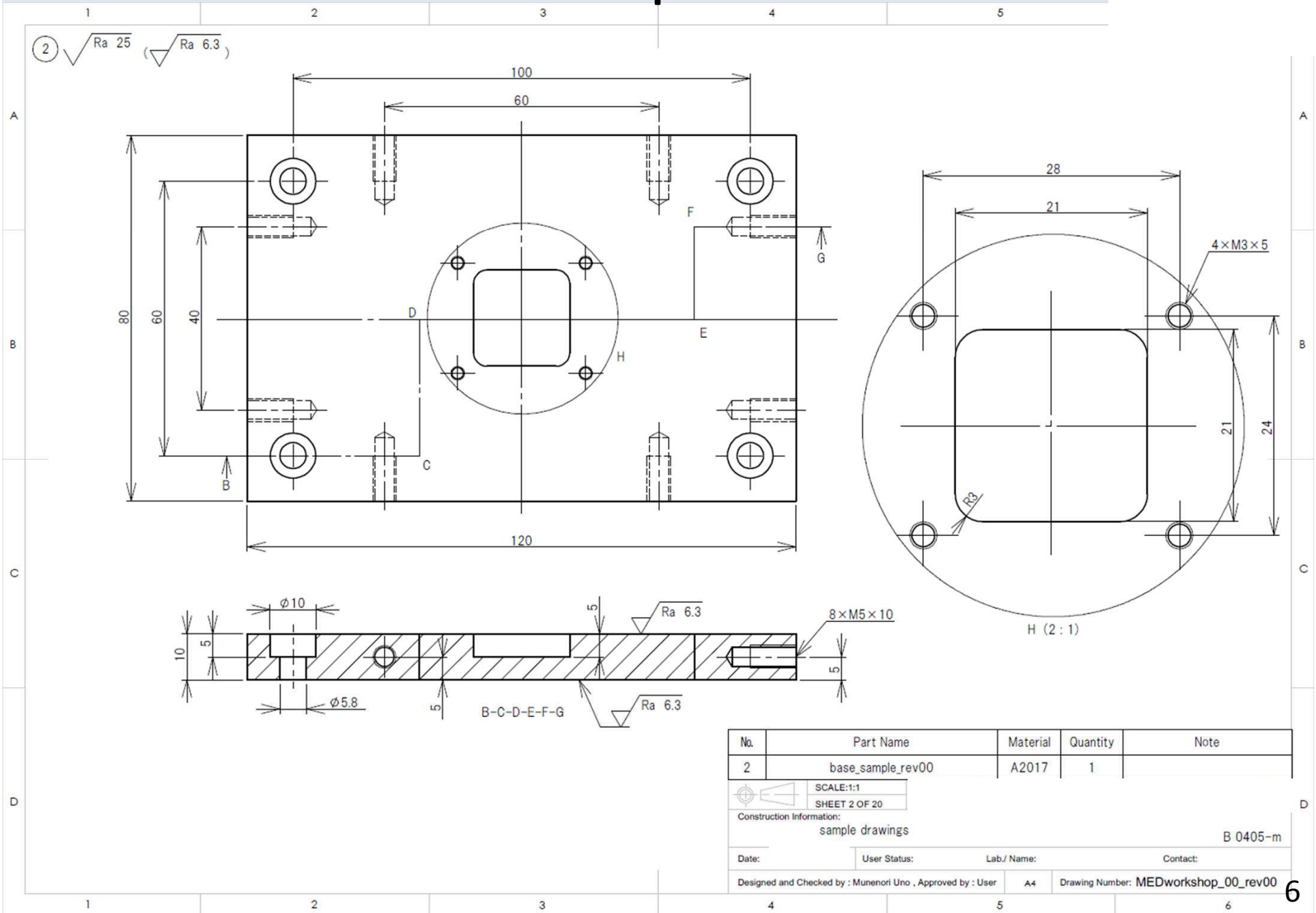


No.	Part Name	Material	Quantity	Note
1	rod_sample_rev00	A2017	1	
SCALE: 1:1 SHEET 1 OF 20 Construction Information: sample drawings 3 0405-m				
Date:	User Status:	Lab./ Name:	Contact:	
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: MEDworkshop_00_rev00	

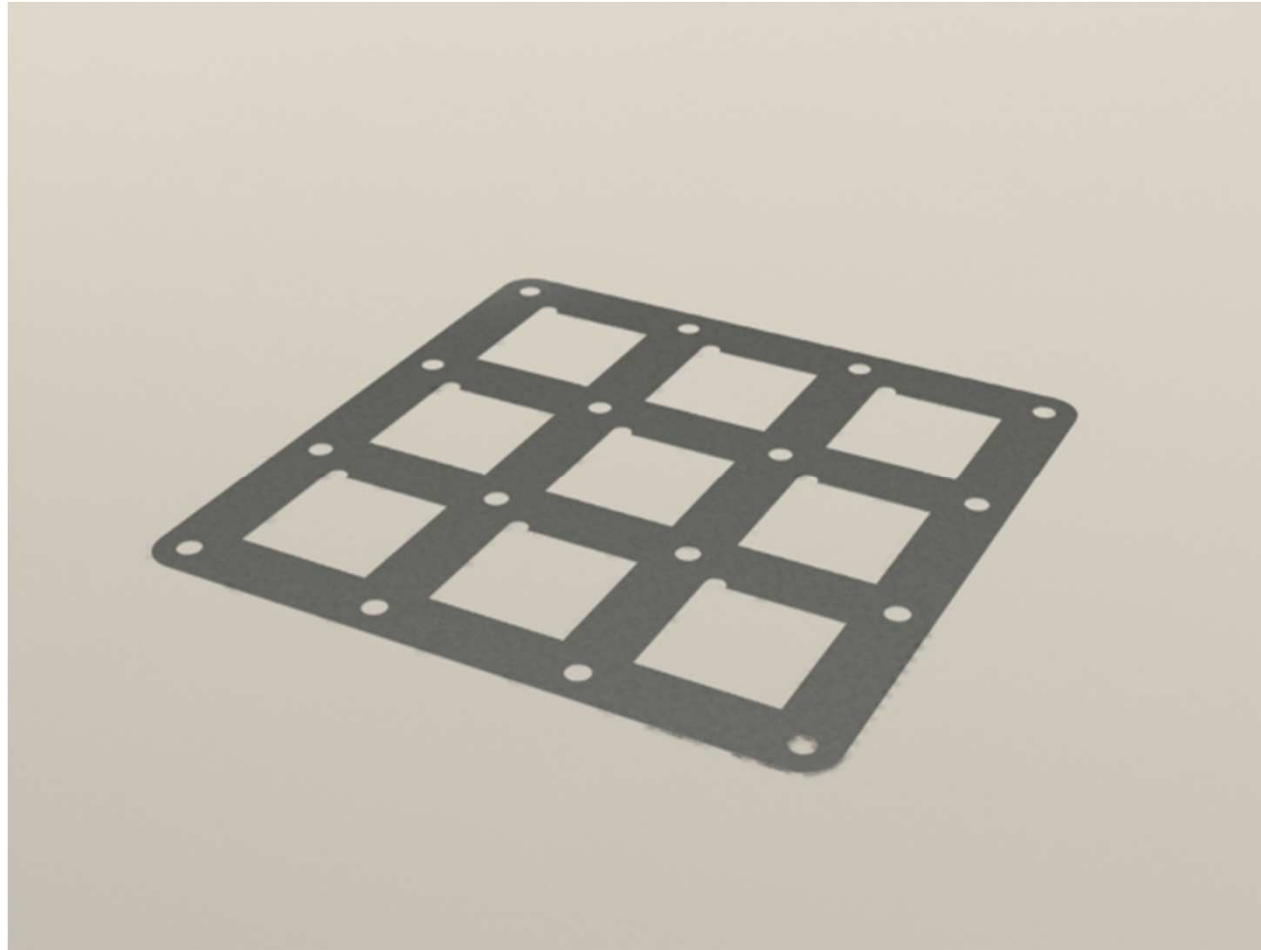
Sample 2



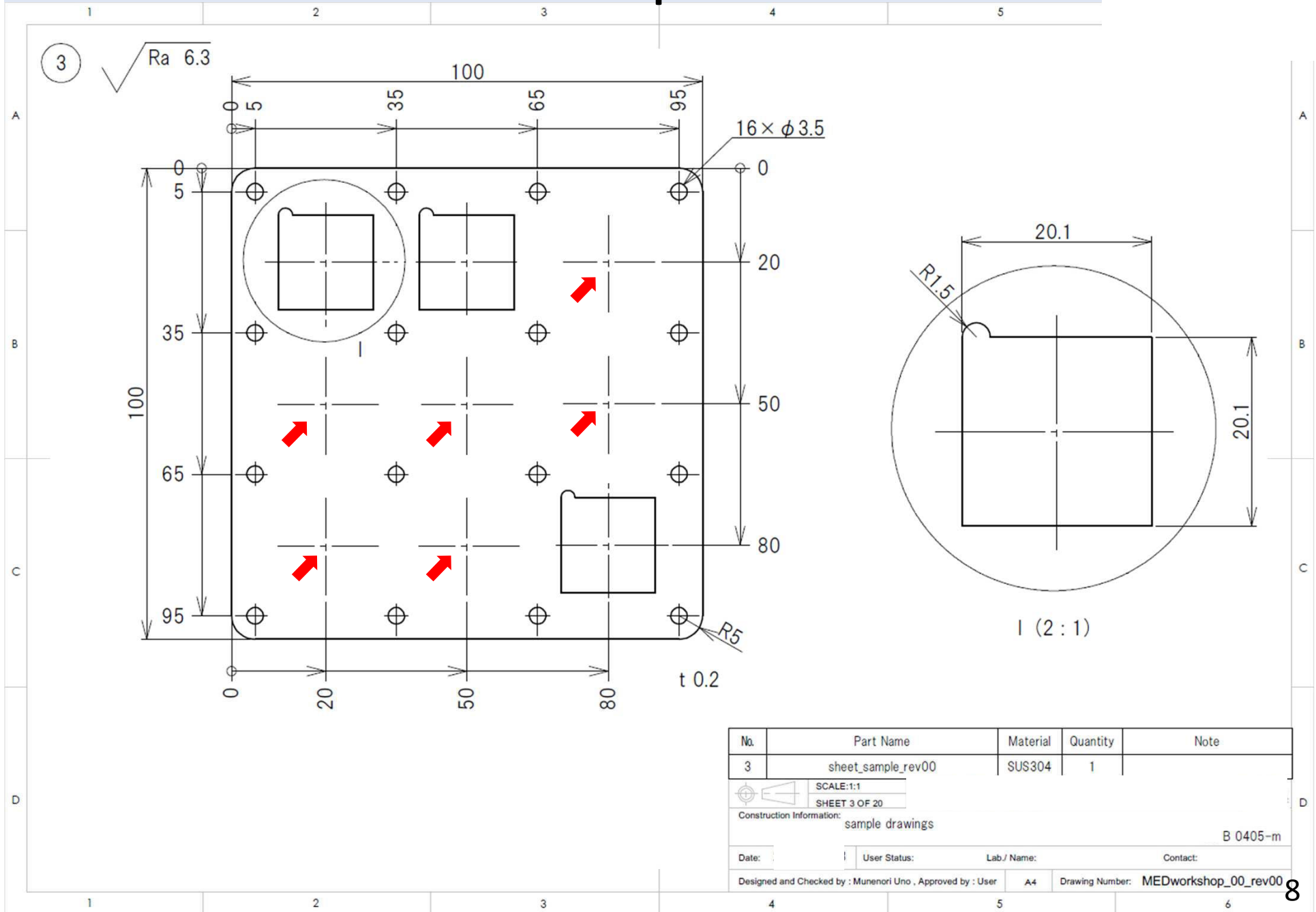
Sample 2



Sample 3



Sample 3

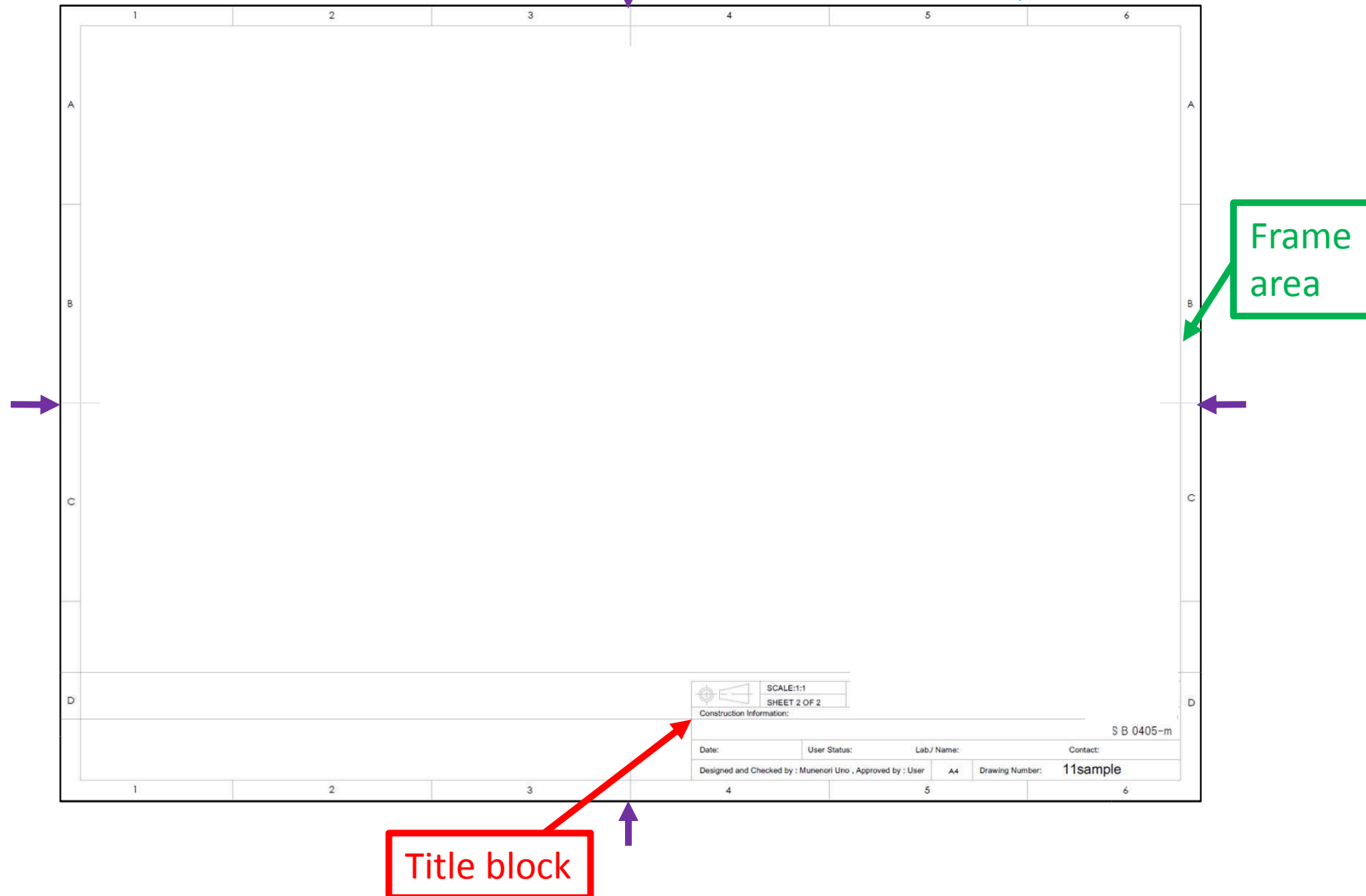


Drawing sheets

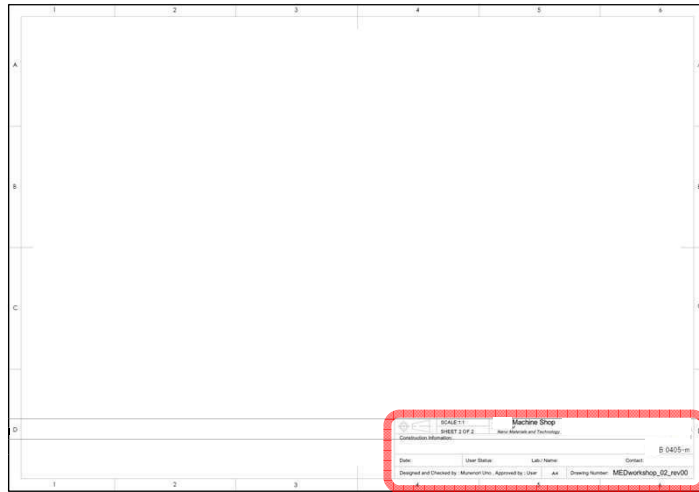
Drawing sheets

Centering mark

Size A0-A4



Drawing sheets



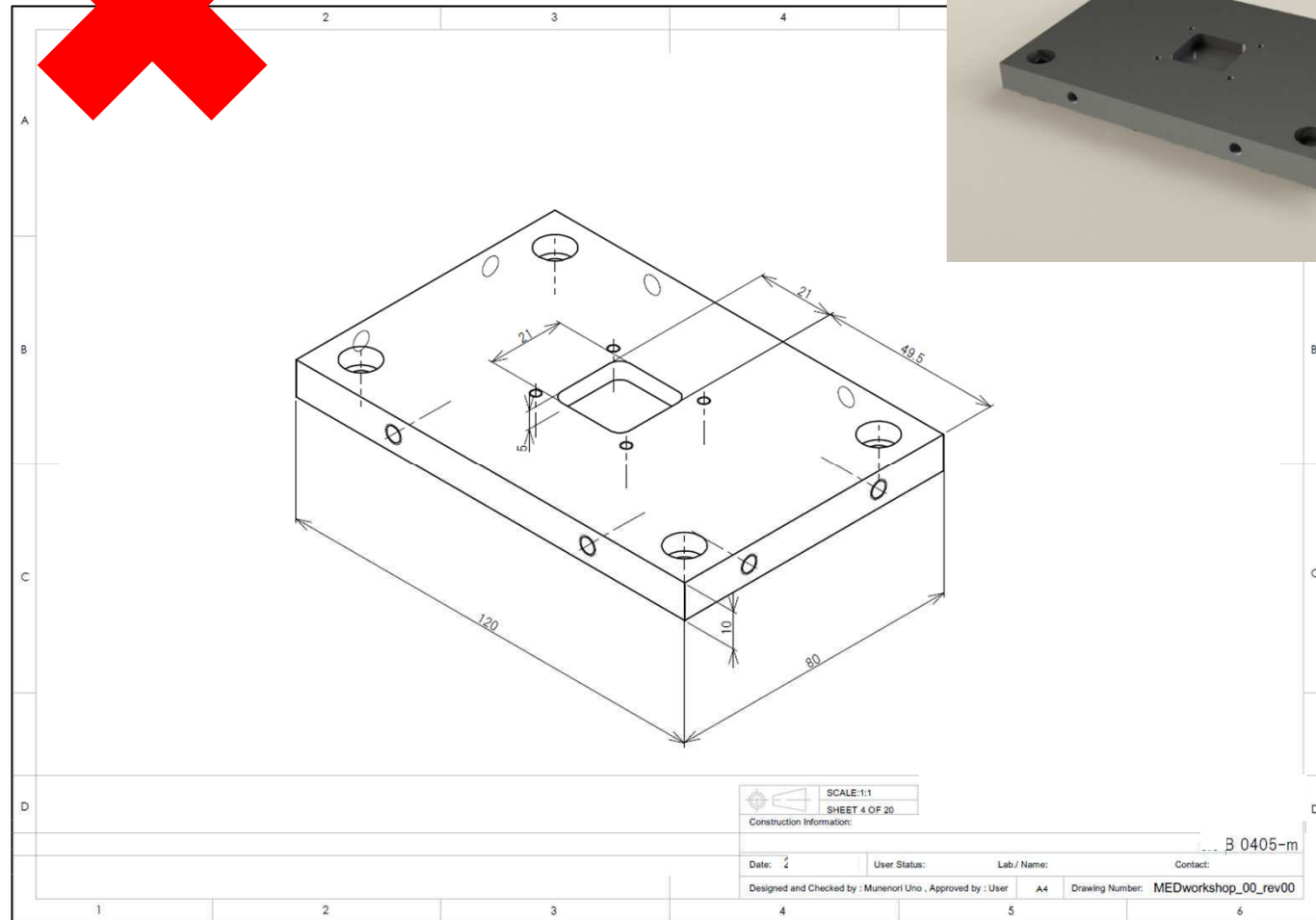
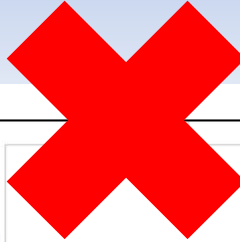
Title block

		SCALE:1:1		Machine Shop	
		SHEET 2 OF 2			
Construction Information:					
B 0405-m					
Date:	User Status:	Lab./ Name:	Contact:		
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 11sample		

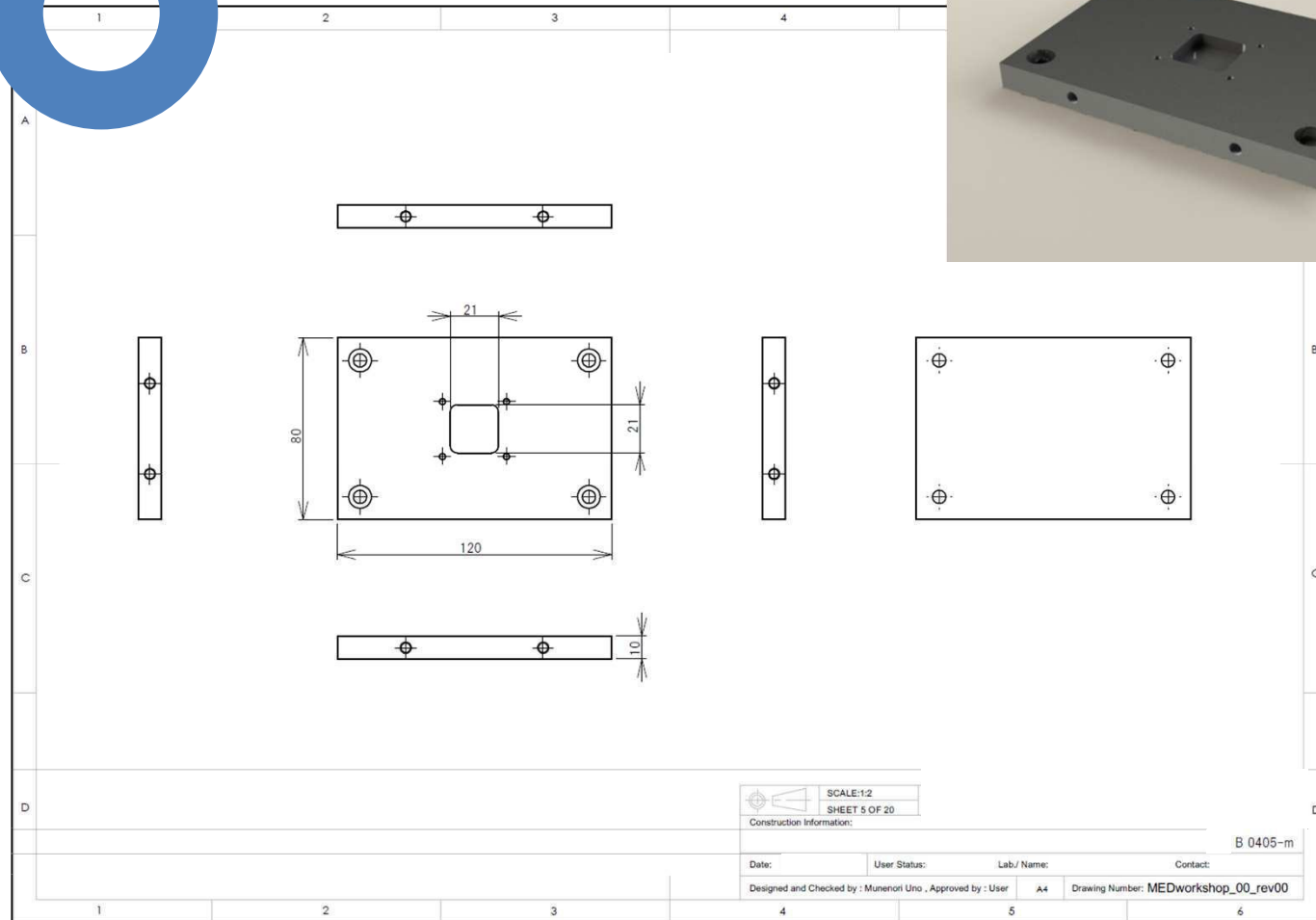
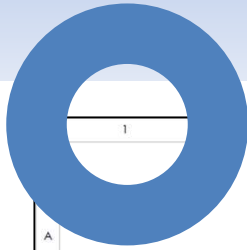
Frame area

Views and projection methods

Views



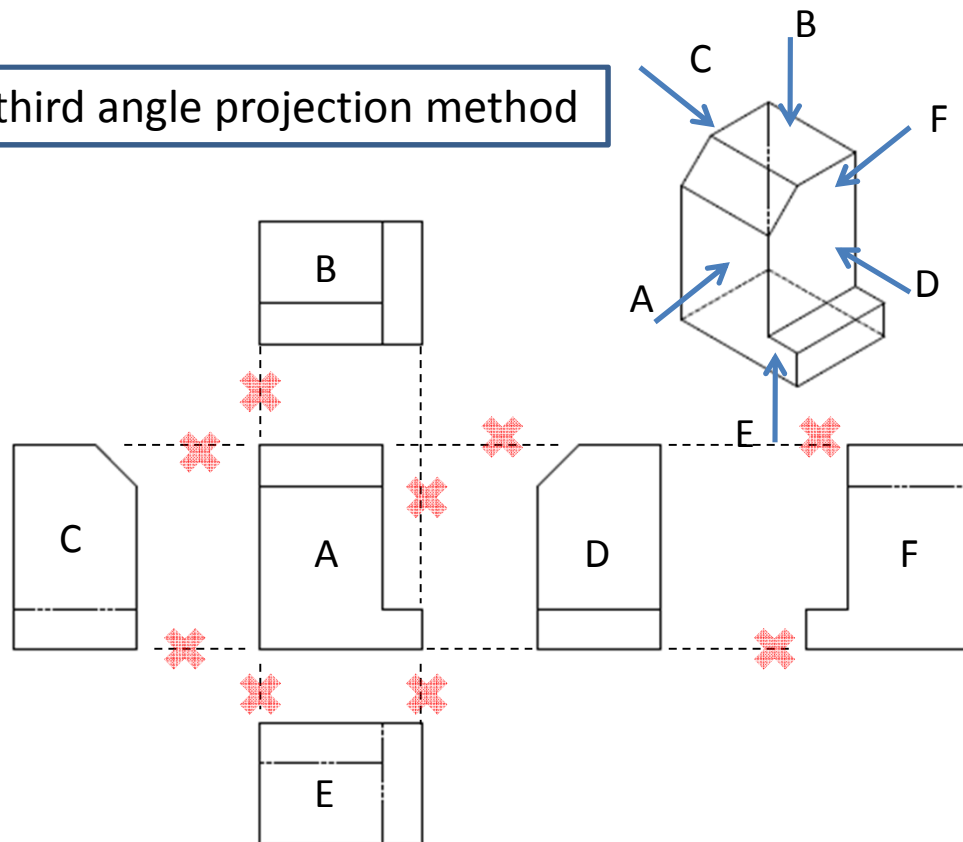
Views



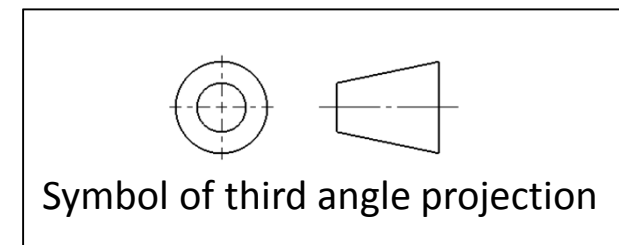
Views

- Orthographic projection

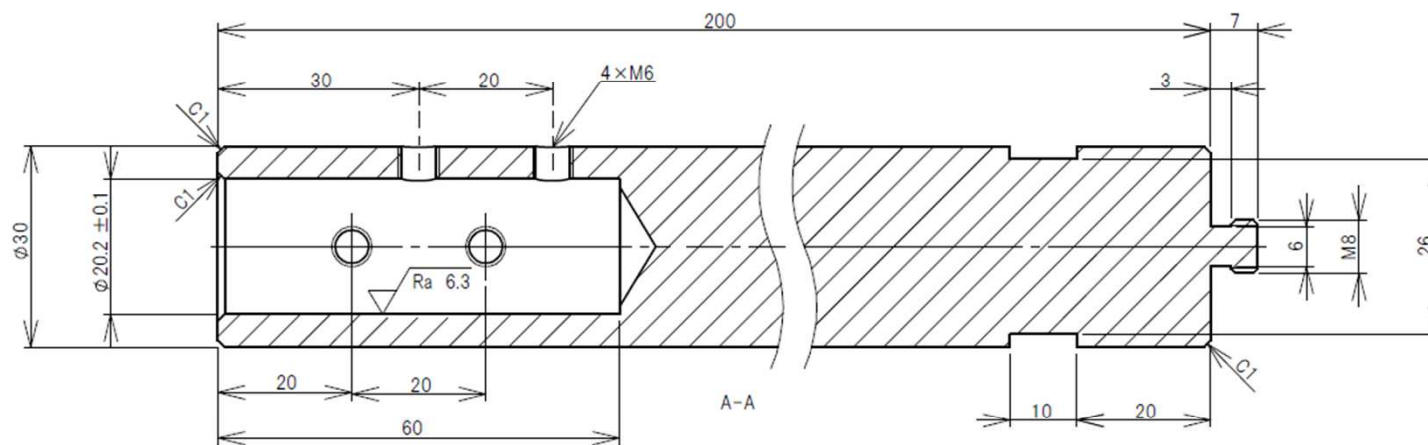
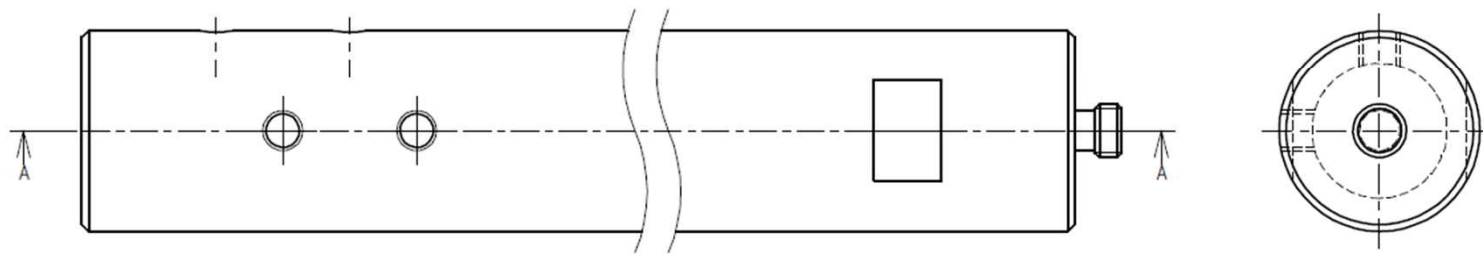
third angle projection method



A:front view(principal view)
B:top view
C:left side view
D:right side view
E:bottom view
F:rear view



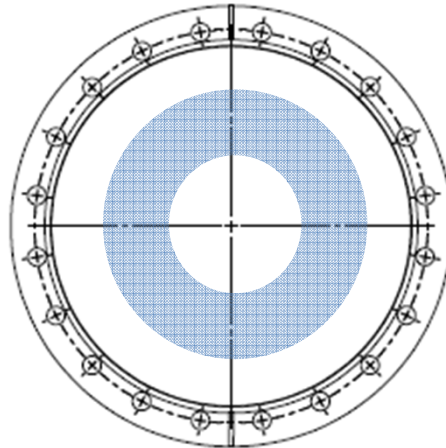
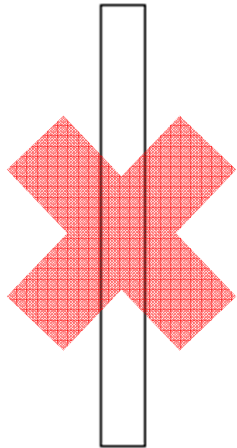
① $\sqrt{Ra\ 25}$ ($\sqrt{Ra\ 6.3}$)



No.	Part Name	Material	Quantity	Note
1	rod_sample_rev00	A2017	1	
SCALE:1:1 SHEET 1 OF 20 Construction Information: sample drawings Date: User Status: Lab./ Name: Contact: Designed and Checked by : Munenori Uno , Approved by : User A4 Drawing Number: MEDworkshop_00_rev00				

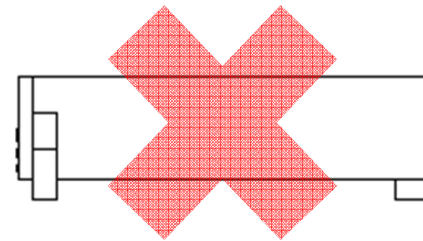
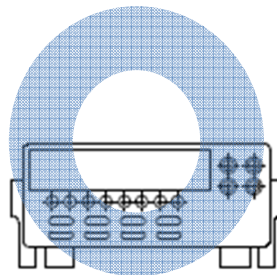
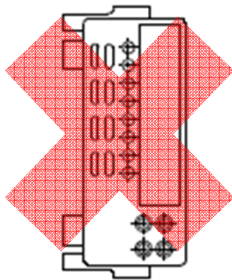
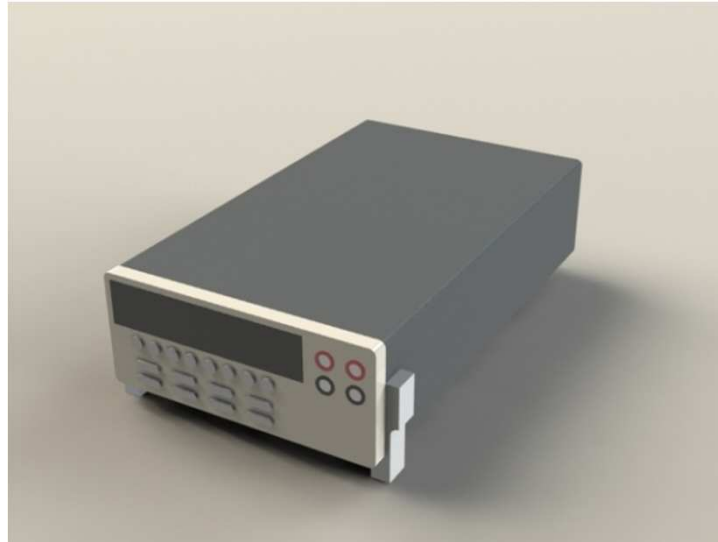
Views

- Principal view 1



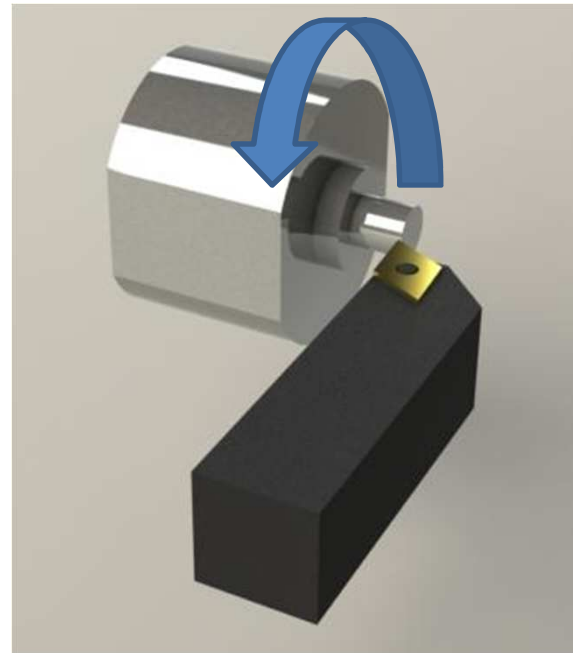
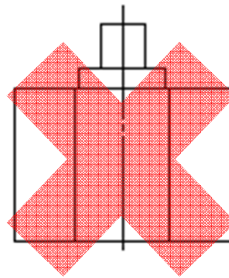
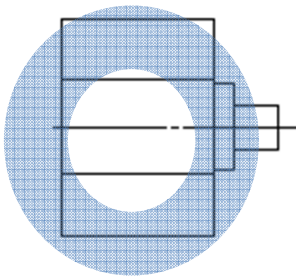
Views

- Principal view 2



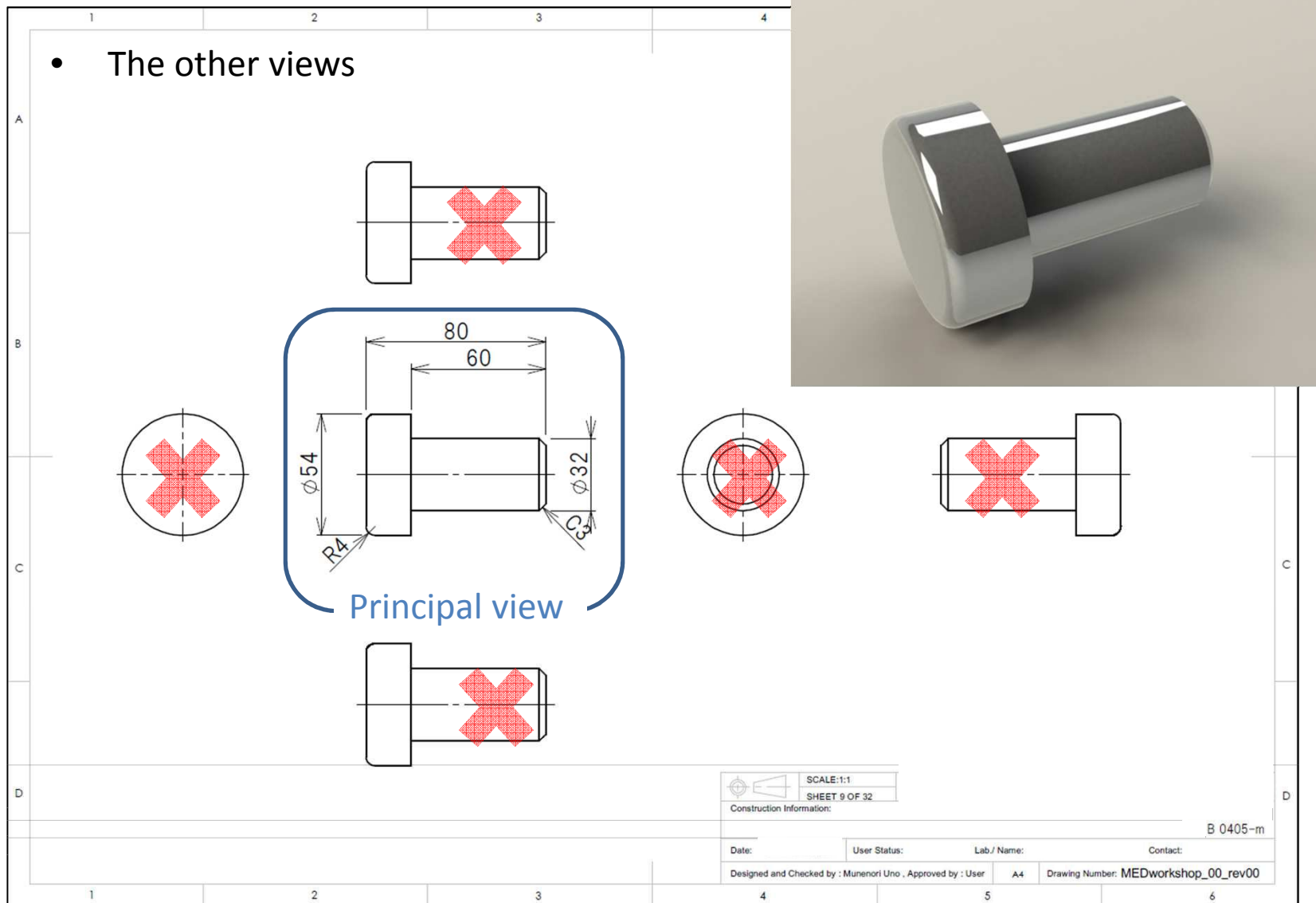
Views

- Principal view 3



Views

- The other views



Line Conventions

Line Conventions

- Kinds of lines (continuity)

Continuous line



Dashed line



Long-dashed dotted line



Long-dashed double-dotted line

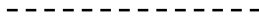


- Kinds of lines (thickness)

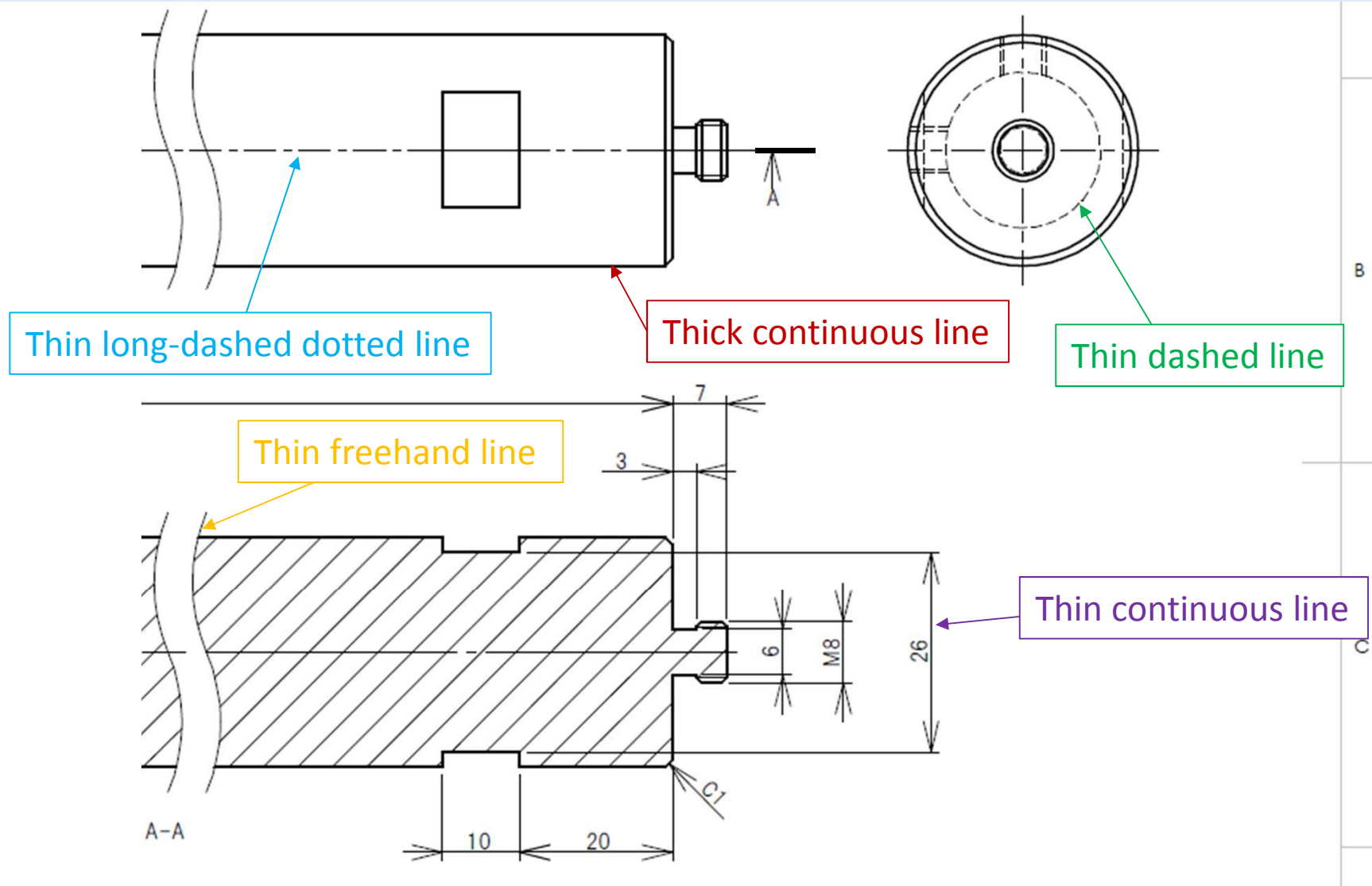
kinds	thickness ratio
Thin line	1
Thick line	2
Extra thick line	4

Line Conventions

- How these lines are used

kinds of lines	
thick continuous line	visible line 
thin continuous line	dimension line projection line leader line 
thin dashed line or thick dashed line	hidden outline  
thin long-dashed dotted line	center line 
thin freehand line	line of limit of partial or interrupted view and section 

Line Conventions



Scales

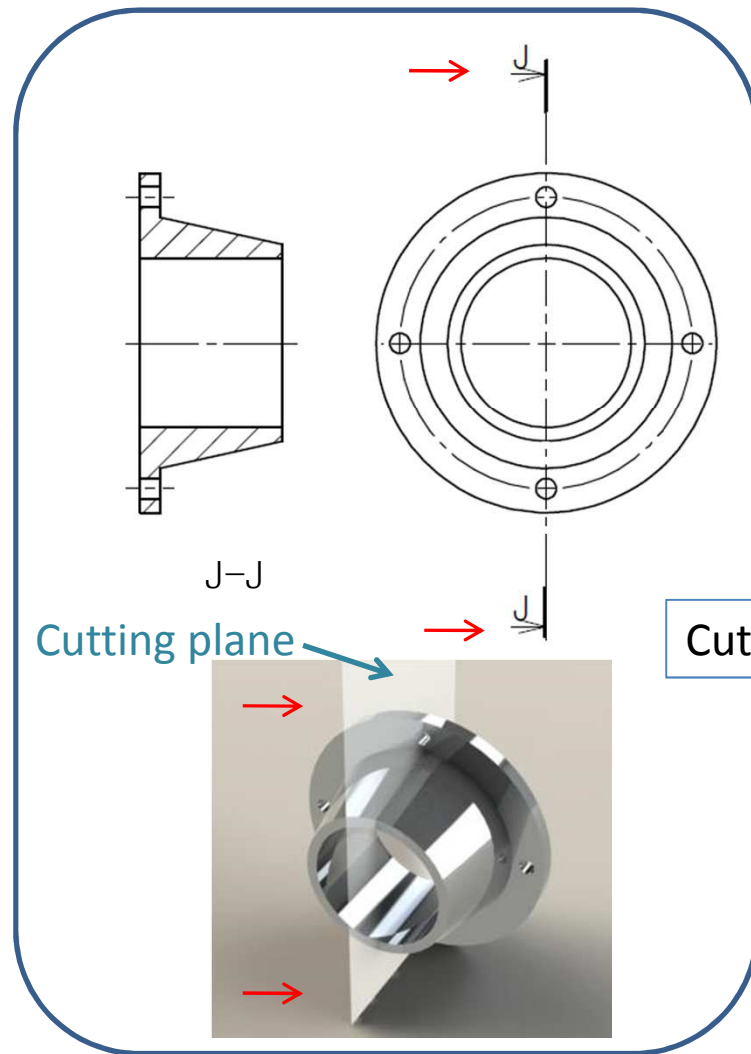
Line Conventions

- Value of scales

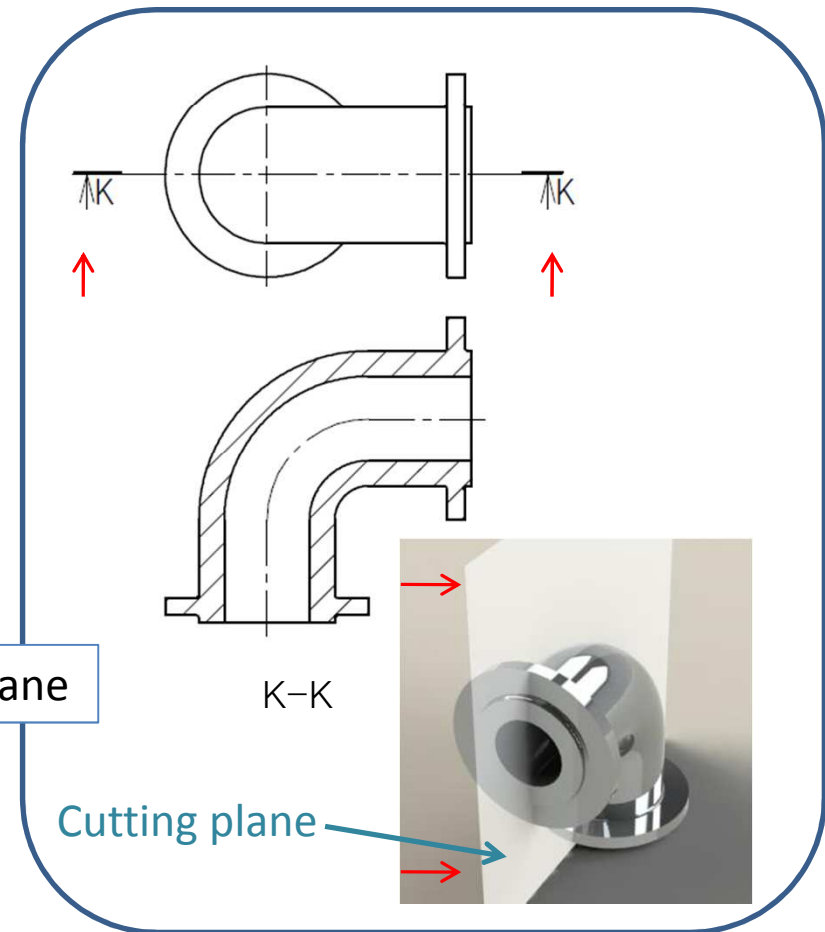
Kinds of scales	endorsed scale		
Enlargement scale	50:1	20:1	10:1
	5:1	2:1	
Full scale	1:1		
Reduction scale	1:2	1:5	1:10
	1:20	1:50	1:100
	1:200	1:500	1:1000
	1:2000	1:5000	1:10000

Sectional views

Dimensions are omitted



Cut by one plane



SCALE:1:1
SHEET 2 OF 2

Construction Information:

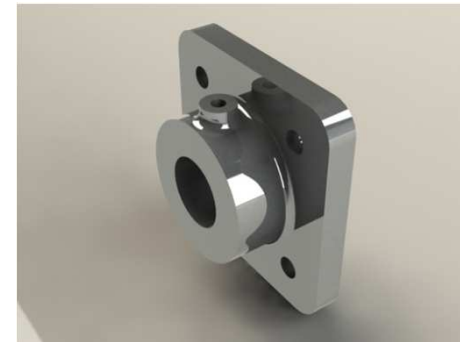
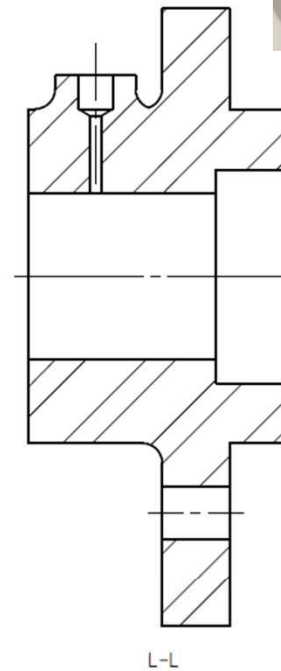
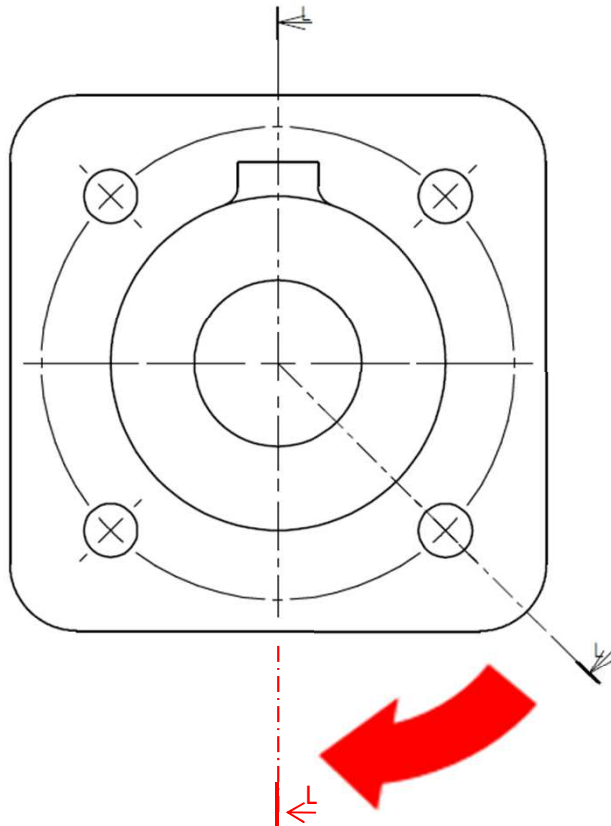
Date: User Status: Lab./ Name: Contact:

Designed and Checked by : Munenori Uno , Approved by : User A4 Drawing Number: 11sample

3 0405-m

Dimensions are omitted

Cut by two planes



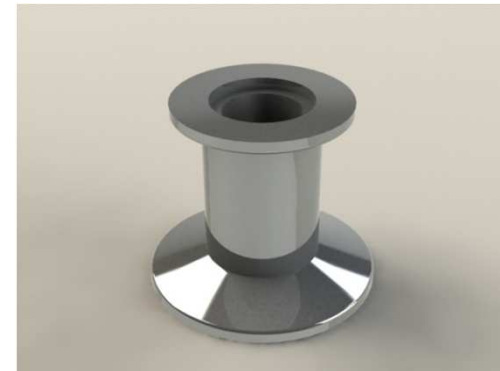
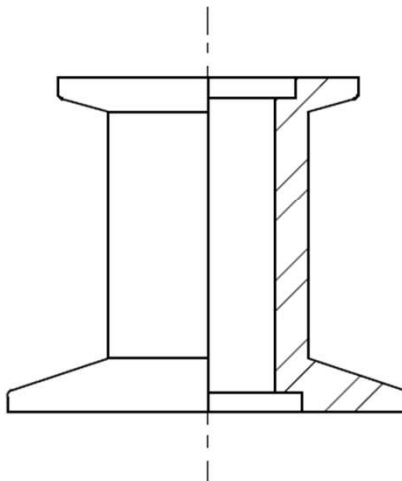
SCALE:1:1
SHEET 2 OF 2
Construction Information:

B 0405-m

Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 11sample

Dimensions are omitted

A section of a symmetrical part



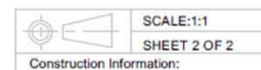
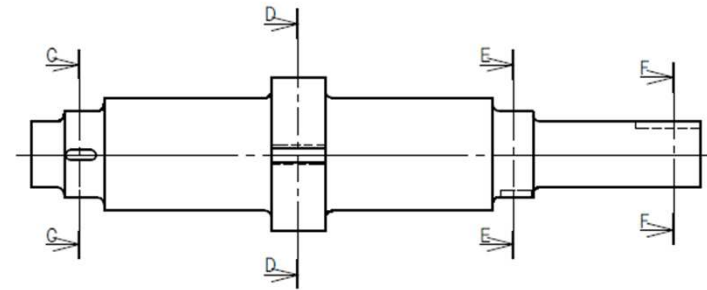
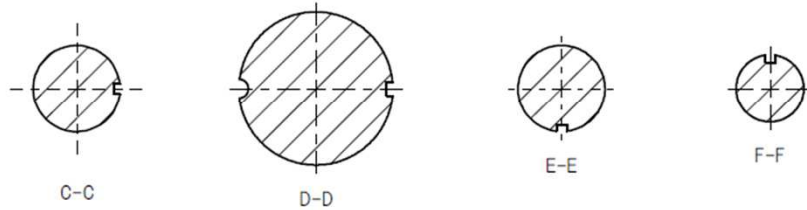
SCALE:1:1
SHEET 2 OF 2

Construction Information:

Date: User Status: Lab./ Name: Contact: B 0405-m
Designed and Checked by : Munenori Uno , Approved by : User A4 Drawing Number: 11sample

Dimensions are omitted

Successive sections



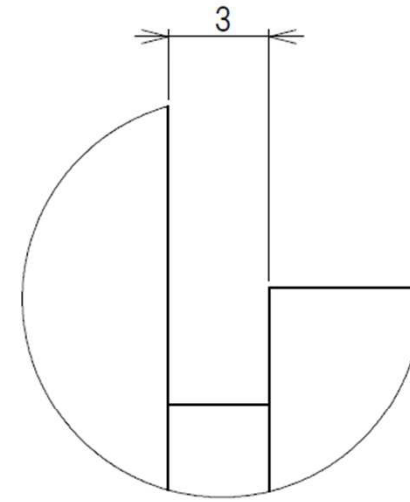
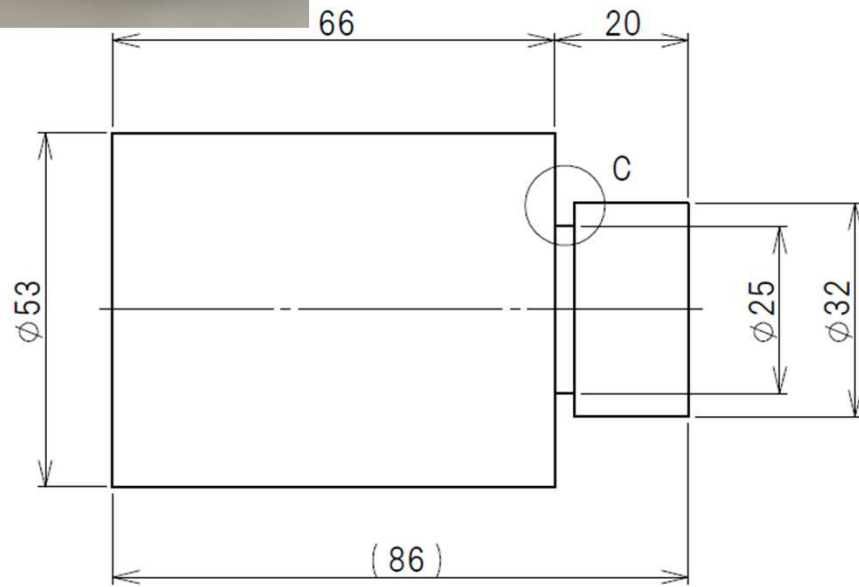
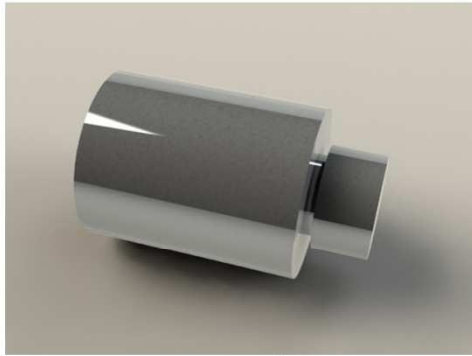
Construction Information:

Date: User Status: Lab./ Name: Contact:

Designed and Checked by : Munenori Uno , Approved by : User A4 Drawing Number: 11sample

B 0405-m

Detail drawings



C (5 : 1)

	SCALE:1:1
	SHEET 2 OF 2

Construction Information:

Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 11sample

3 0405-m

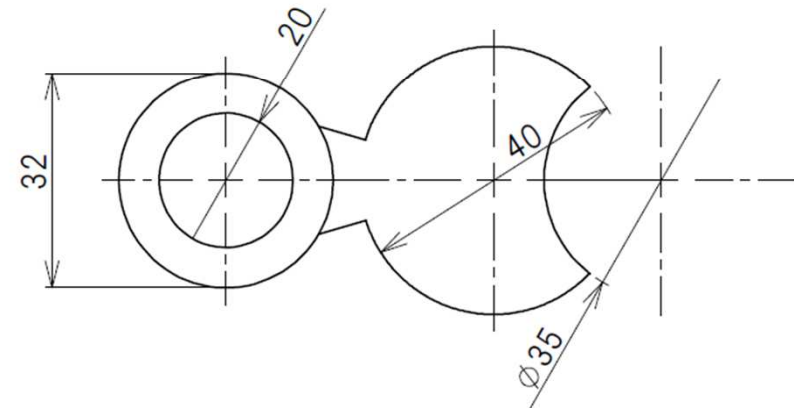
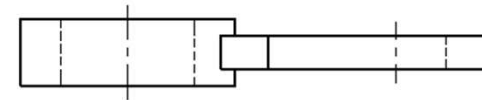
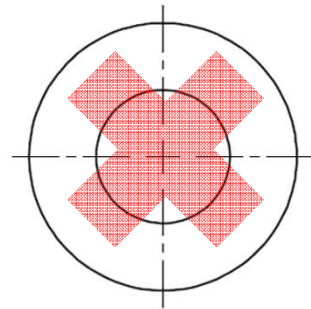
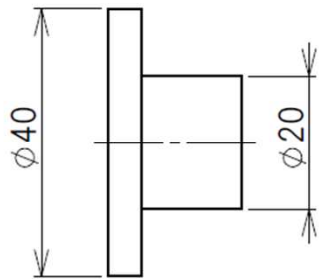
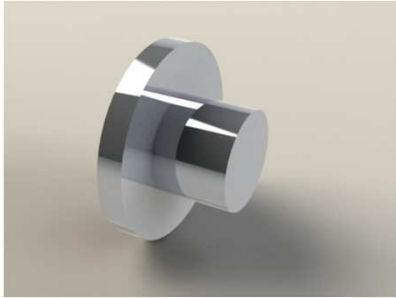
Dimensioning

Dimensioning

- Dimensioning symbols

Description	Symbol	Usage
diameter	ϕ	Put before dimension value of diameter.
radius	R	Put before dimension value of radius.
spherical diameter	S ϕ	Put before dimension value of diameter of sphere.
spherical radius	SR	Put before dimension value of radius of sphere.
square	$\square$	Put before dimension value of square.
thickness of board	t	Put before dimension value of thickness of board.
45 degree chamfers	C	Put before dimension value of 45° chamfers.

Some dimensions are omitted



SCALE:1:1
SHEET 1 OF 29

Construction Information:

B 0405-m

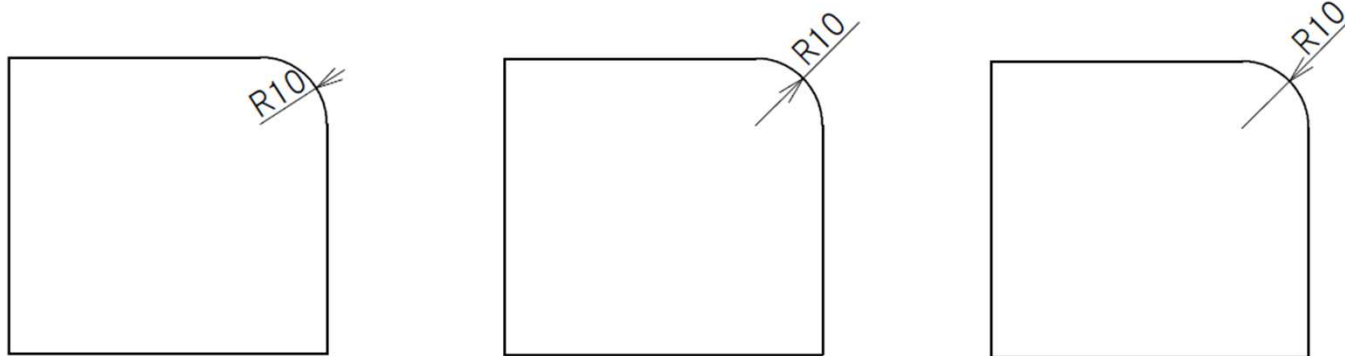
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Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: idrawingpart1_rev00

Dimensioning

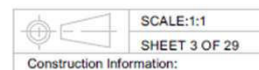
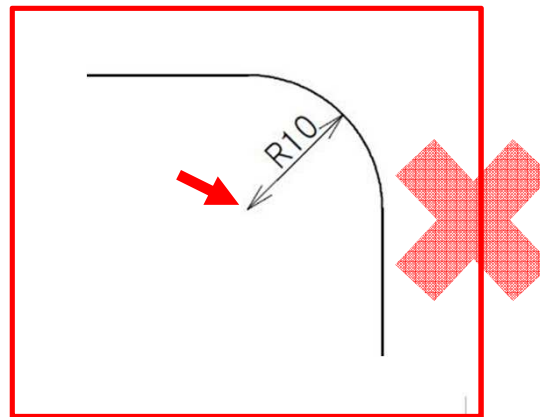
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45 degree chamfers	C	Put before dimension value of 45° chamfers.

Dimensions are omitted



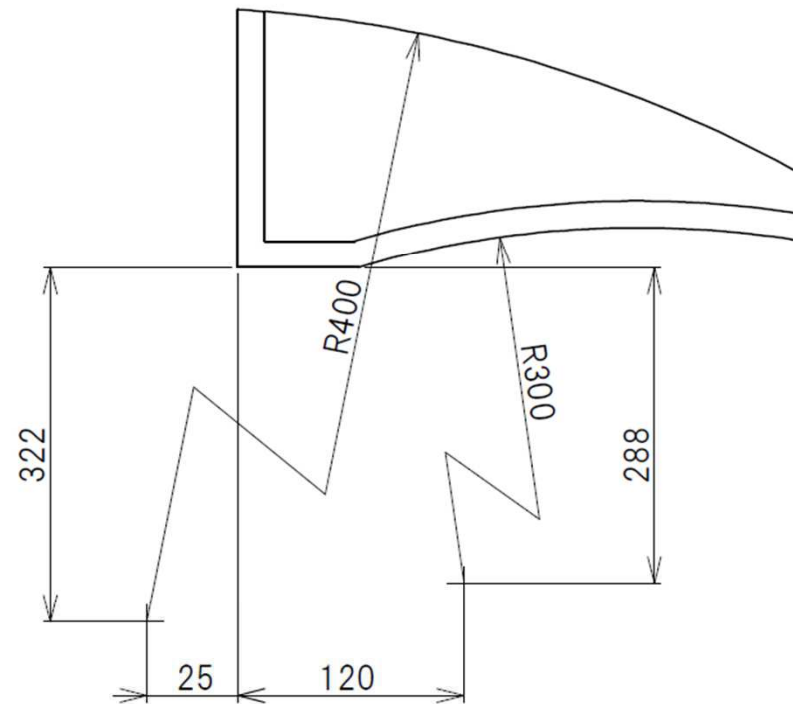
No arrow on the center point.



				B 0405-m			
Date: 2011/02/23		User Status:		Lab/ Name:		Contact:	
Designed and Checked by : Munenori Uno , Approved by : User				A4	Drawing Number: ____drawingpart1_rev00		

B 0405-m

Dimensions are omitted



SCALE:1:2
SHEET 4 OF 29

Construction Information:

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Designed and Checked by : Munenori Uno , Approved by : User	A4	Drawing Number :	rawingpart1_rev00

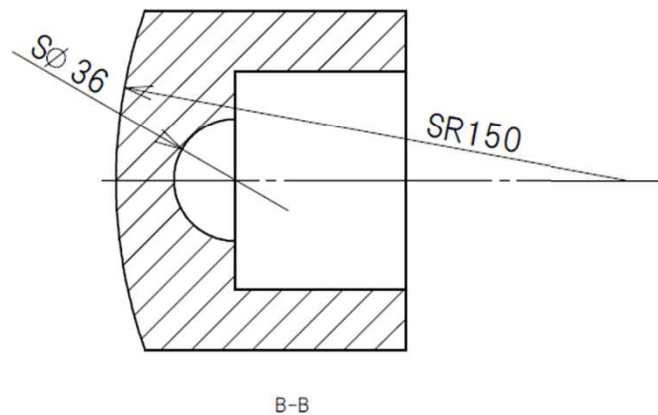
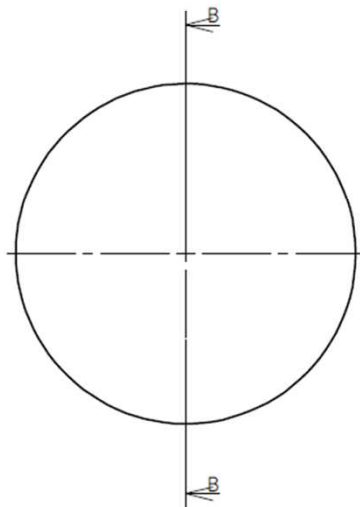
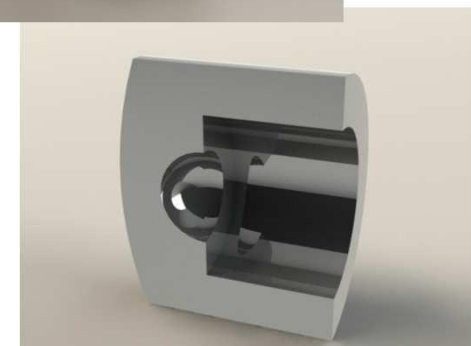
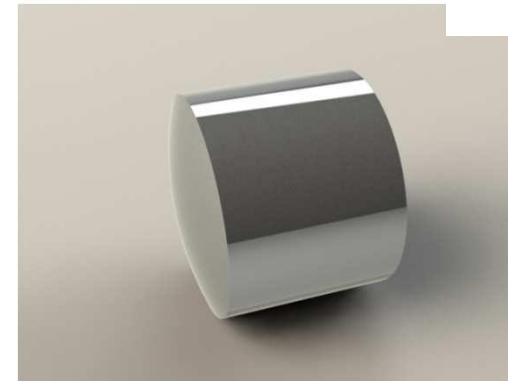
B 0405-m

Dimensioning

- Dimensioning symbols

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45 degree chamfers	C	Put before dimension value of 45° chamfers.

Dimensions are omitted



SCALE:1:1
SHEET 2 OF 2

Construction Information:

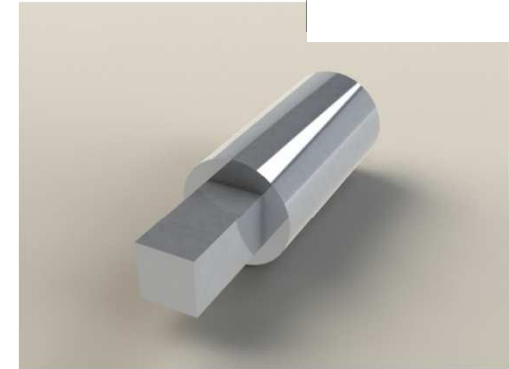
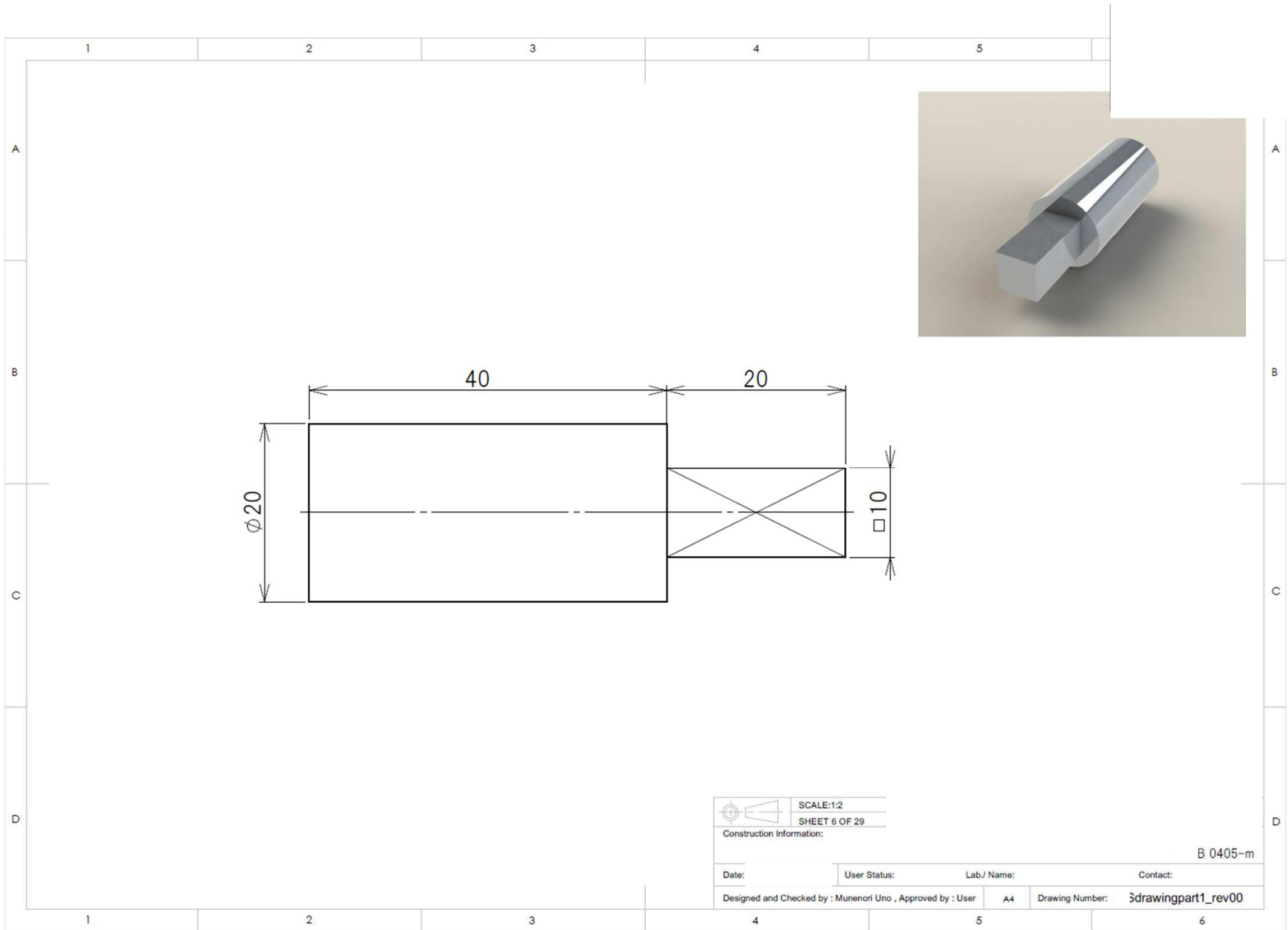
JIS B 0405-m

Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 11sample

Dimensioning

- Dimensioning symbols

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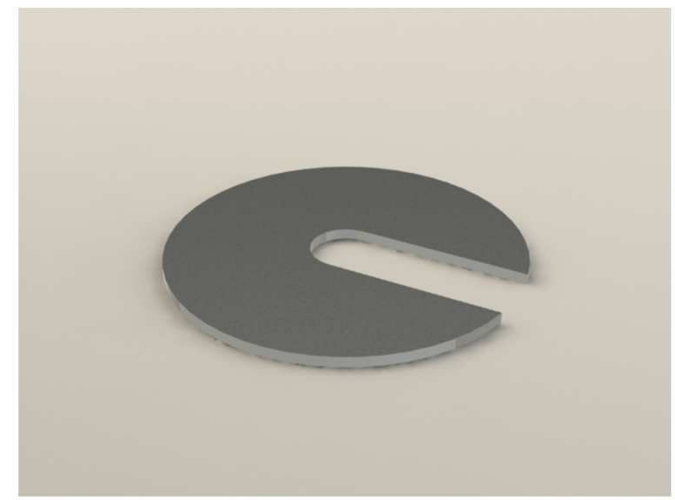
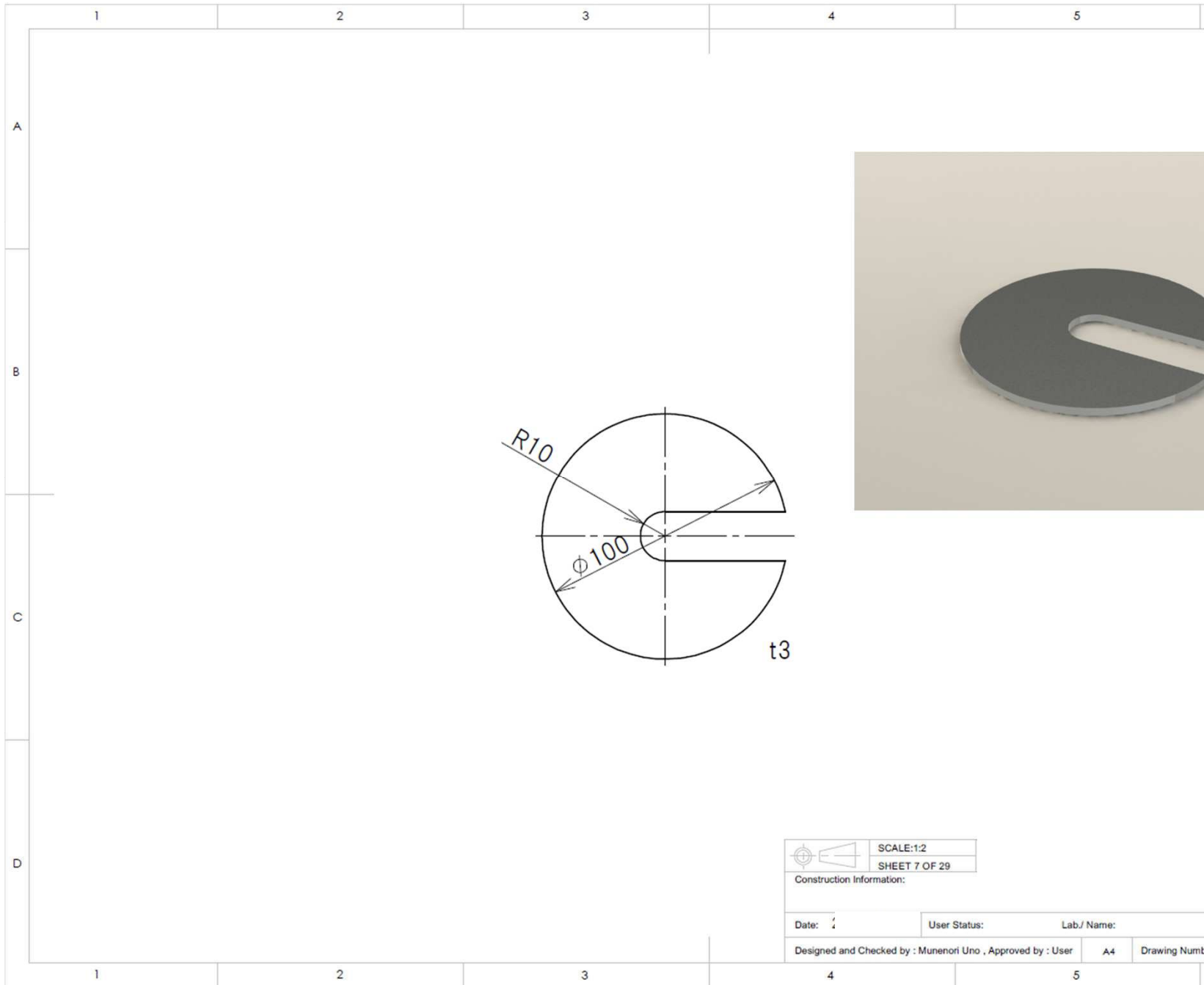
		SCALE:1:2 SHEET 6 OF 29	
Construction Information:			
Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 3drawingpart1_rev00

B 0405-m

Dimensioning

- Dimensioning symbols

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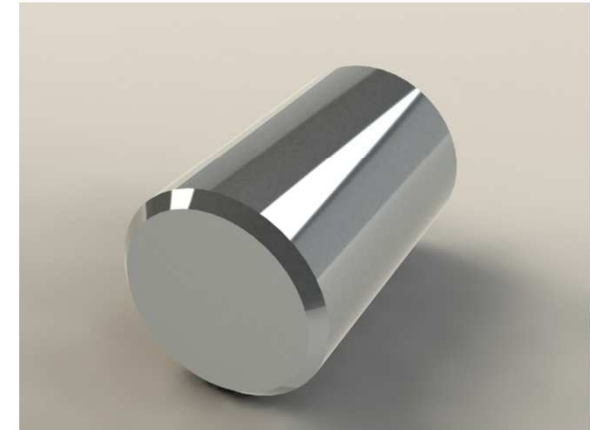
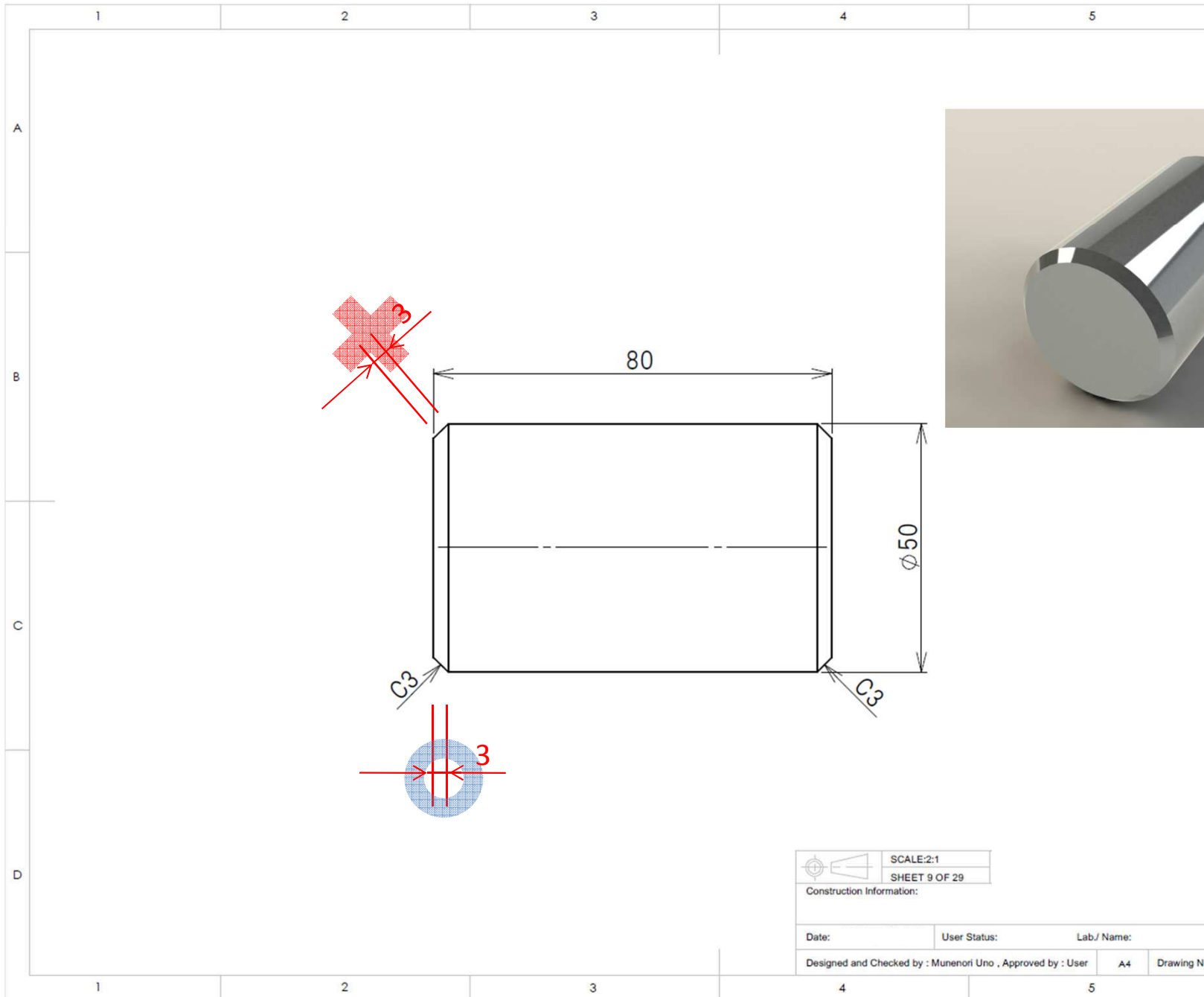
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Date: 1	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 1, drawingpart1_rev00

B 0405-m

Dimensioning

- Dimensioning symbols

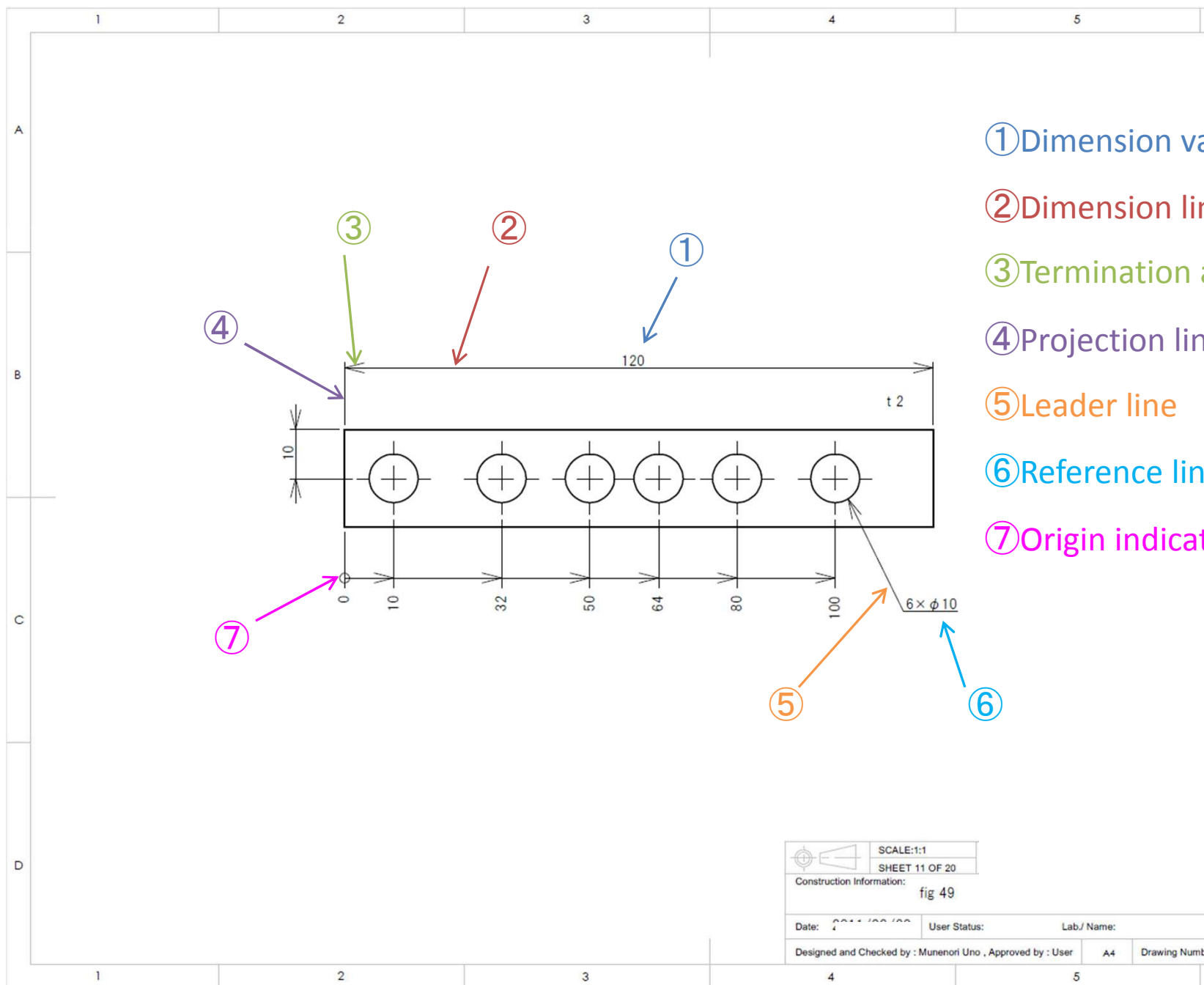
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spherical diameter	S ϕ	Put before dimension value of diameter of sphere.
spherical radius	SR	Put before dimension value of radius of sphere.
square	$\square$	Put before dimension value of square.
thickness of board	t	Put before dimension value of thickness of board.
45 degree chamfers	C	Put before dimension value of 45° chamfers.



B 0405-m

Dimensioning

Elements for dimensioning



① Dimension value

② Dimension line

③ Termination arrow

④ Projection line

⑤ Leader line

⑥ Reference line

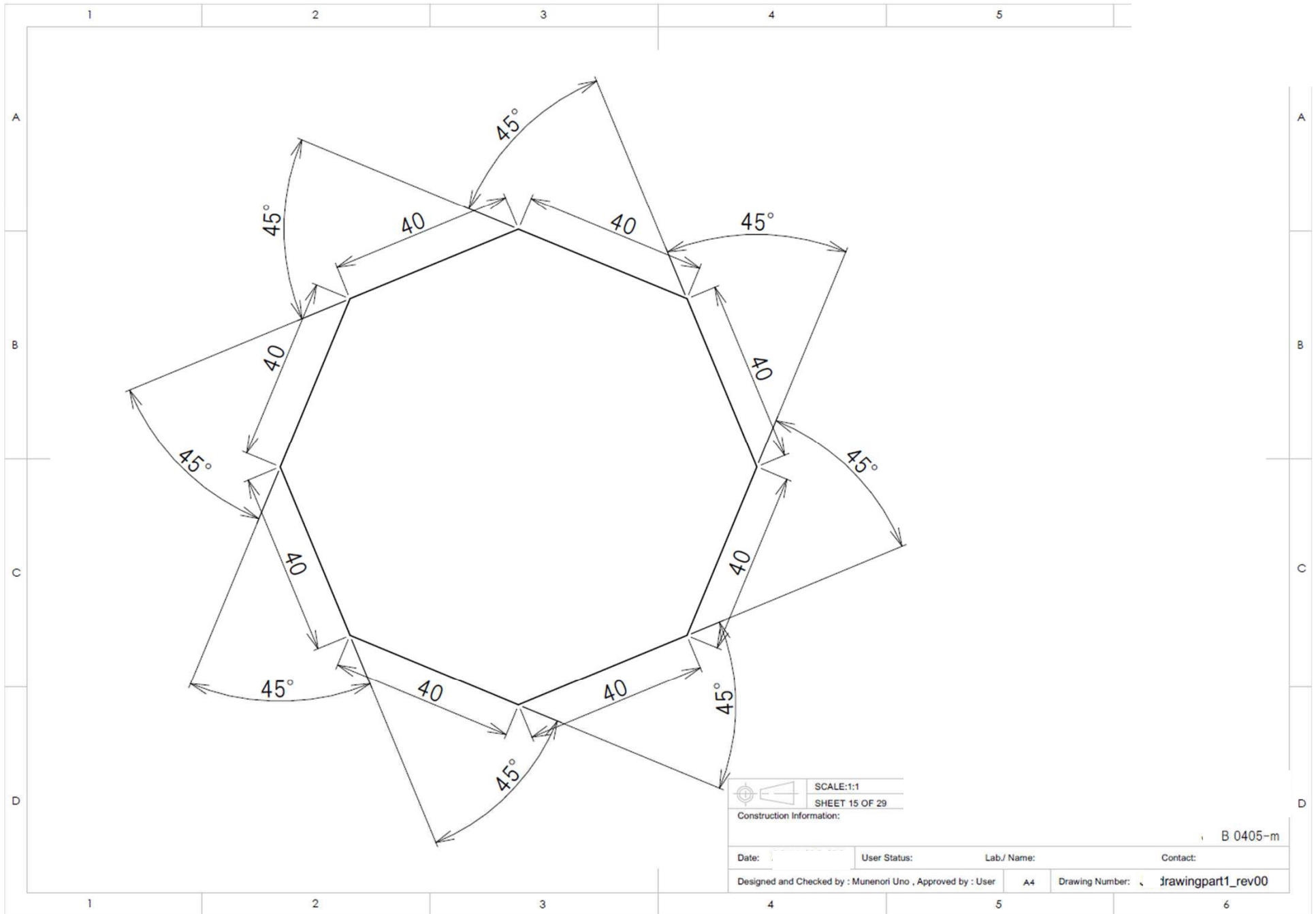
⑦ Origin indicator

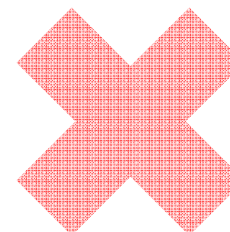
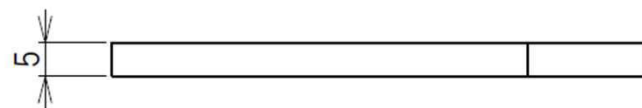
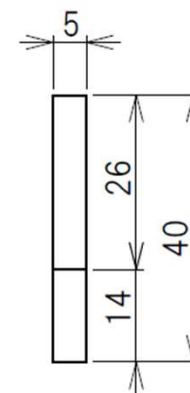
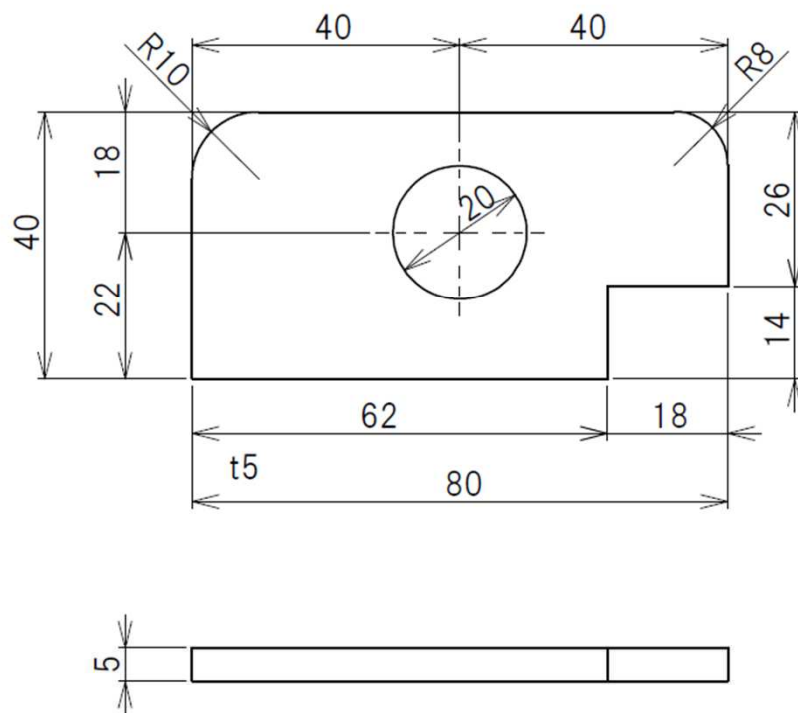
		SCALE:1:1	
		SHEET 11 OF 20	
Construction Information: fig 49			
Date: 2011/08/08	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: MEDworkshop_00_rev00

B 0405-m

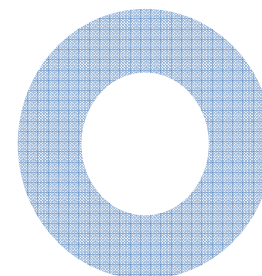
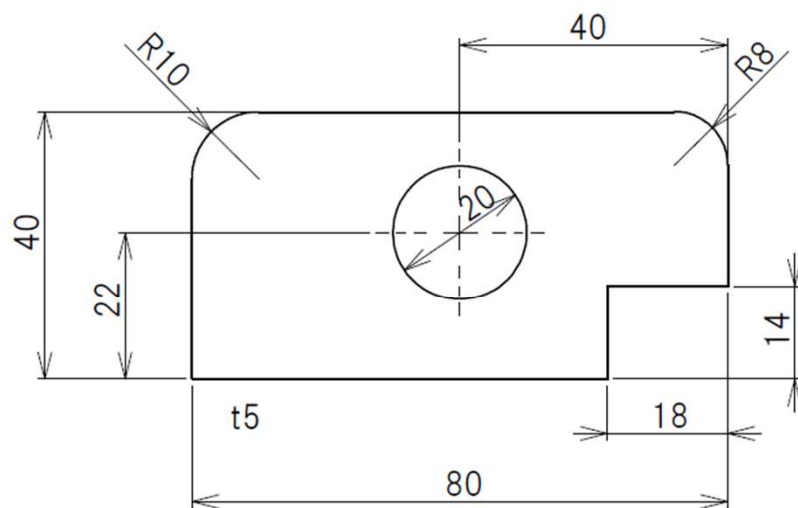
Dimensioning

Rules of dimensioning





		SCALE:1:1	
		SHEET 11 OF 29	
Construction Information:			
B 0405-m			
Date: 4	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: drawingpart1_rev00

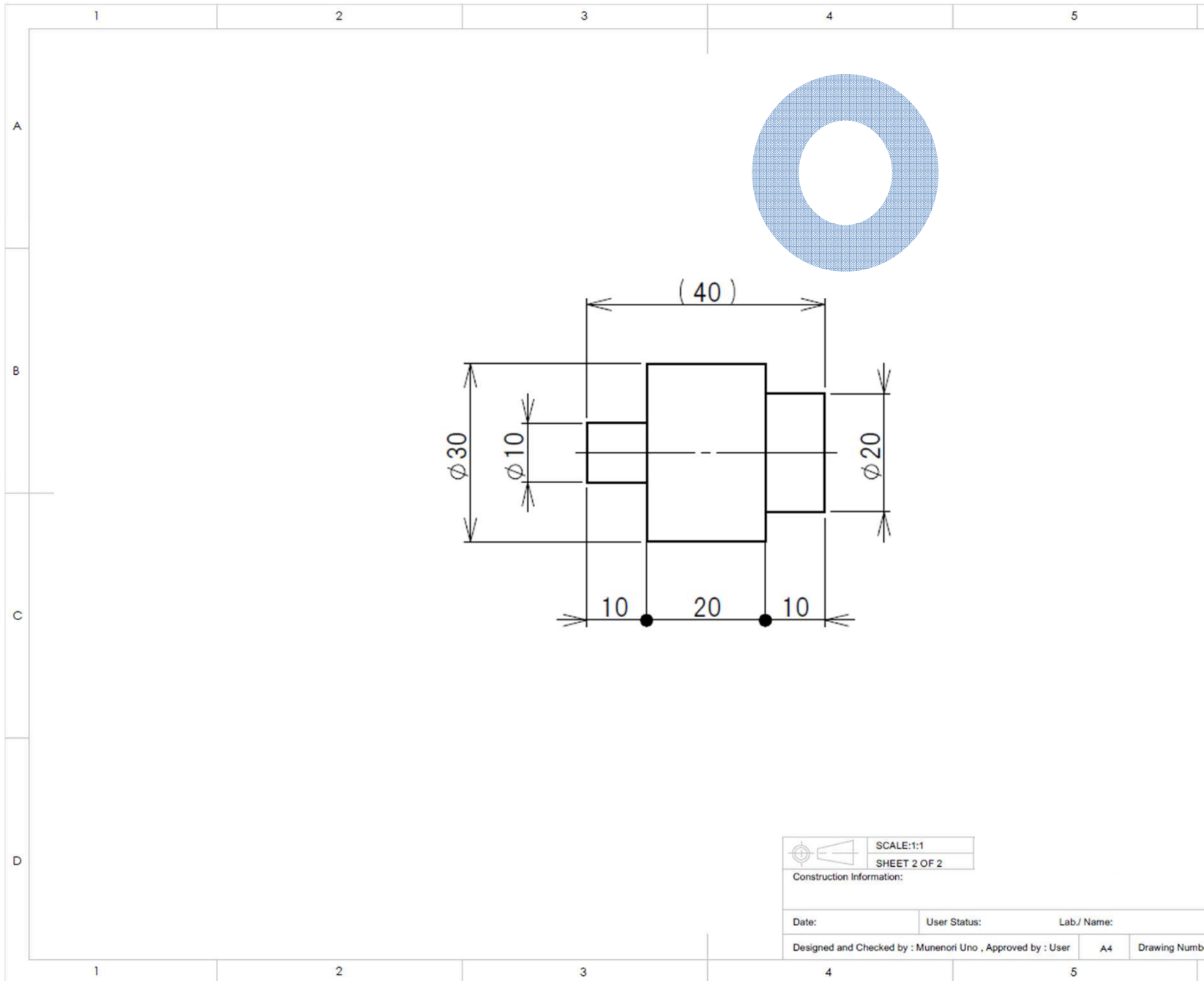


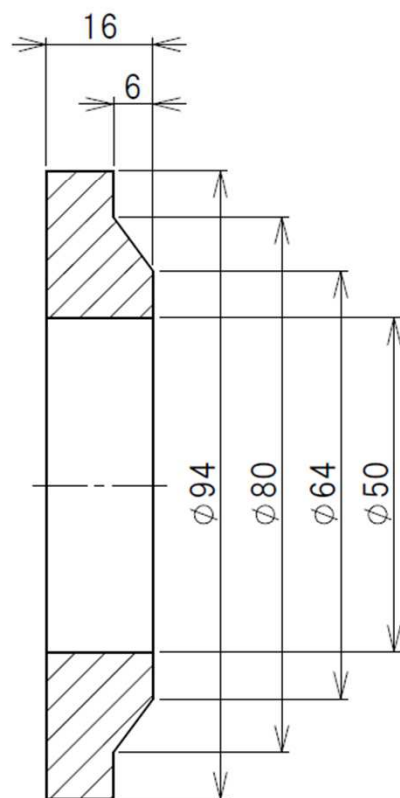
	SCALE:1:1 SHEET 12 OF 30
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Construction Information:

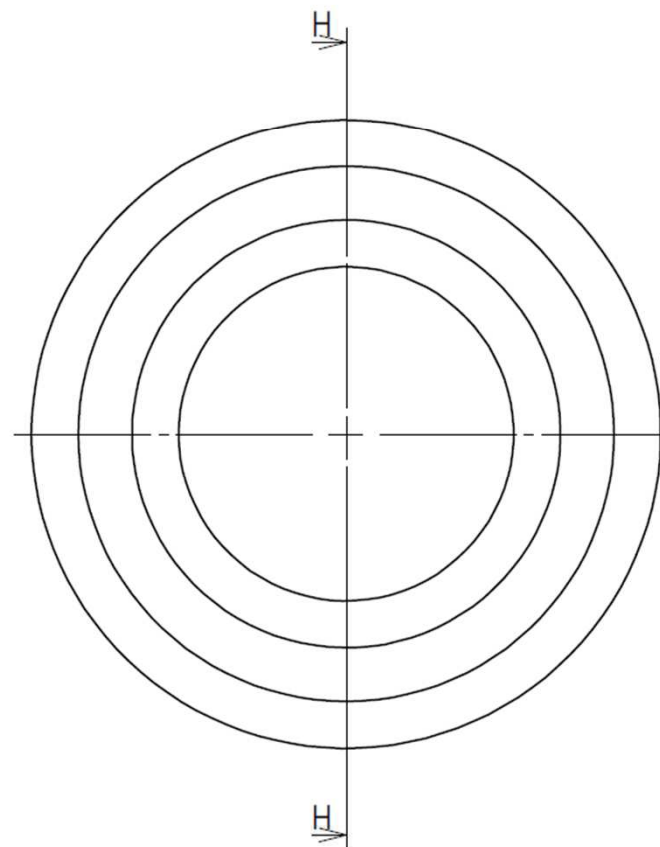
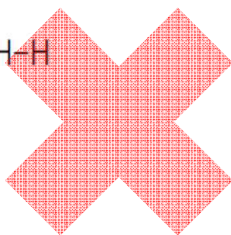
Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User	A4	Drawing Number:	rawingpart1_rev00

B 0405-m





断面図 H-H



SCALE:1:1
SHEET 25 OF 31

Construction Information:

Date:

User Status:

Lab./ Name:

Contact:

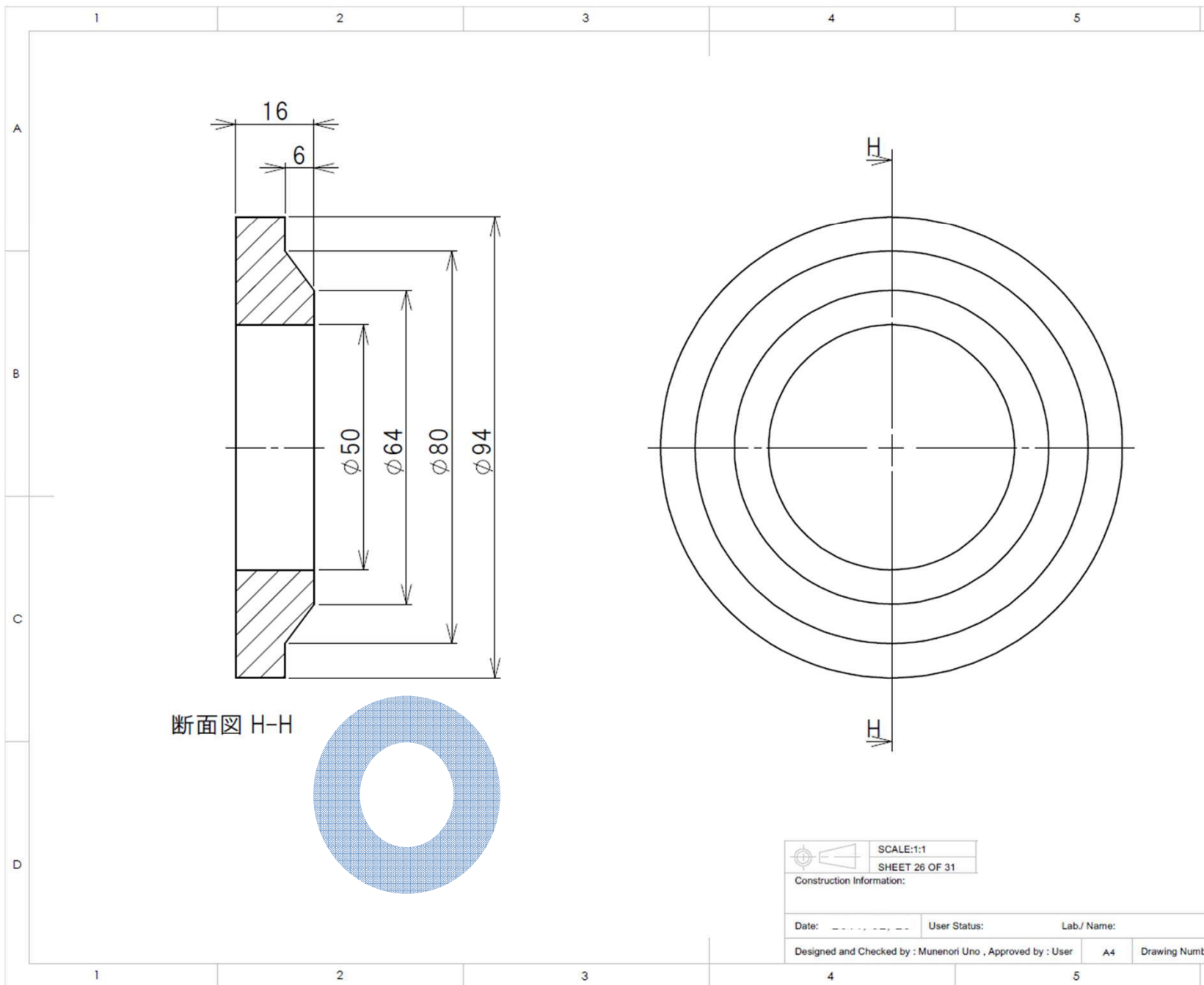
Designed and Checked by : Munenori Uno , Approved by : User

A4

Drawing Number:

rawingpart1_rev00

B 0405-m



SCALE:1:1
SHEET 26 OF 31

Construction Information:

Date: _____

User Status:

Lab./ Name:

Contact:

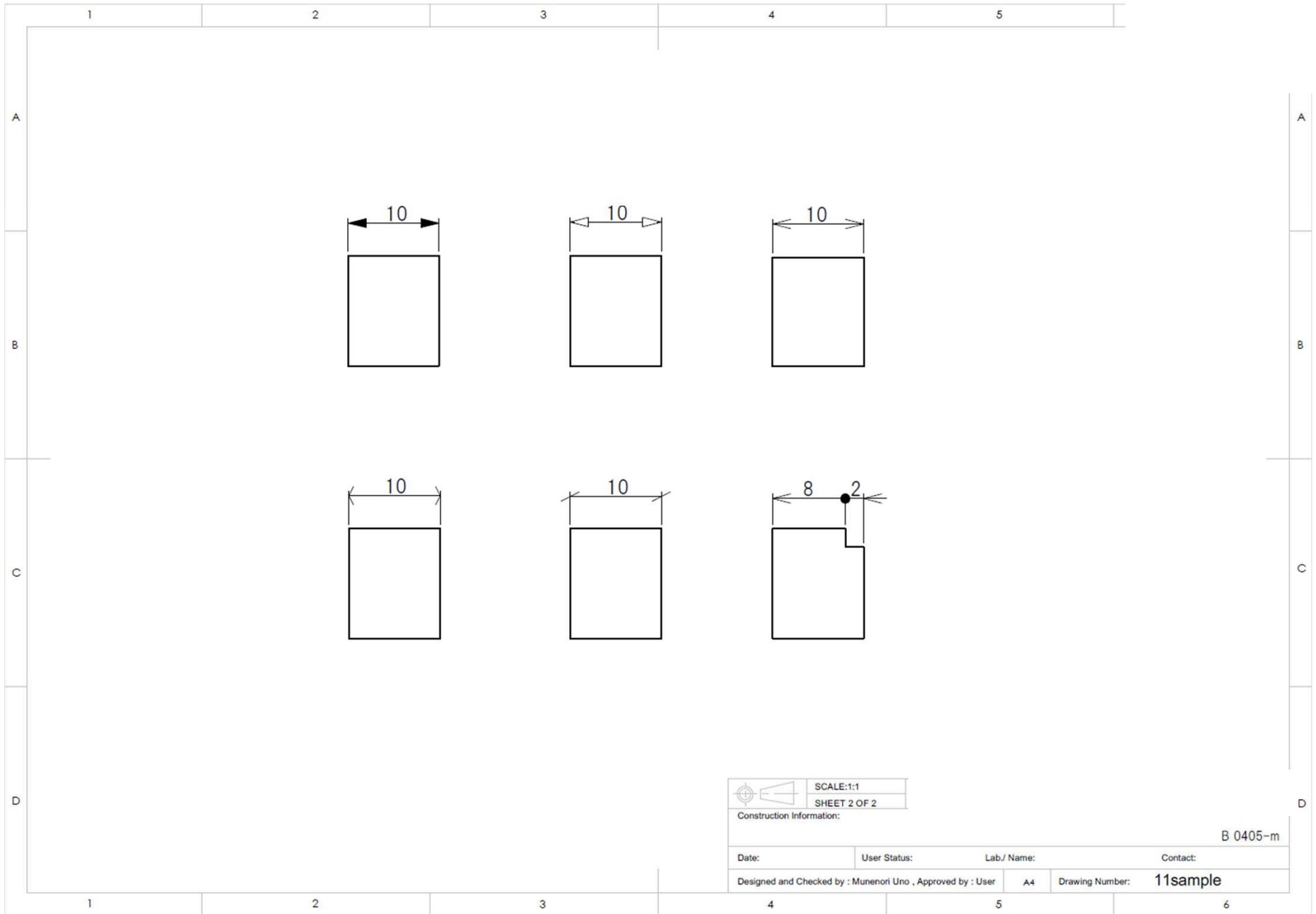
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A4

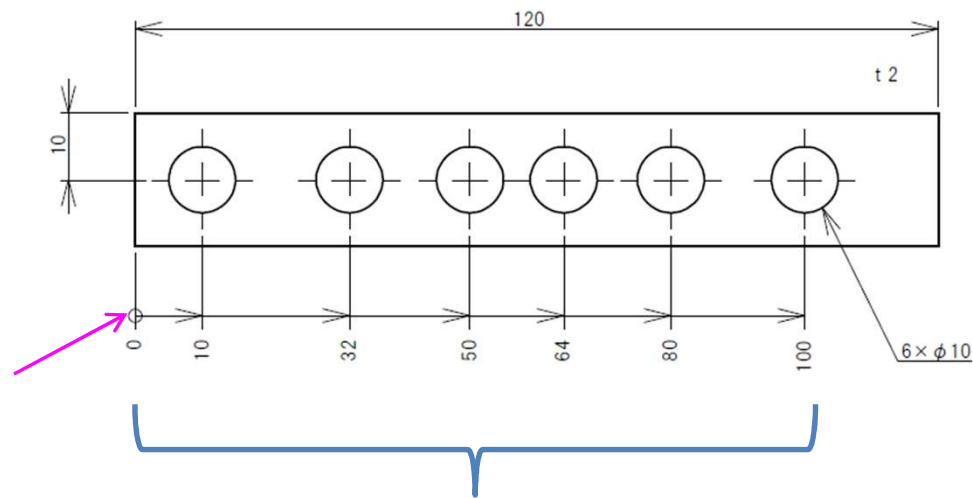
Drawing Number:

lrawingpart1_rev00

... B 0405-m



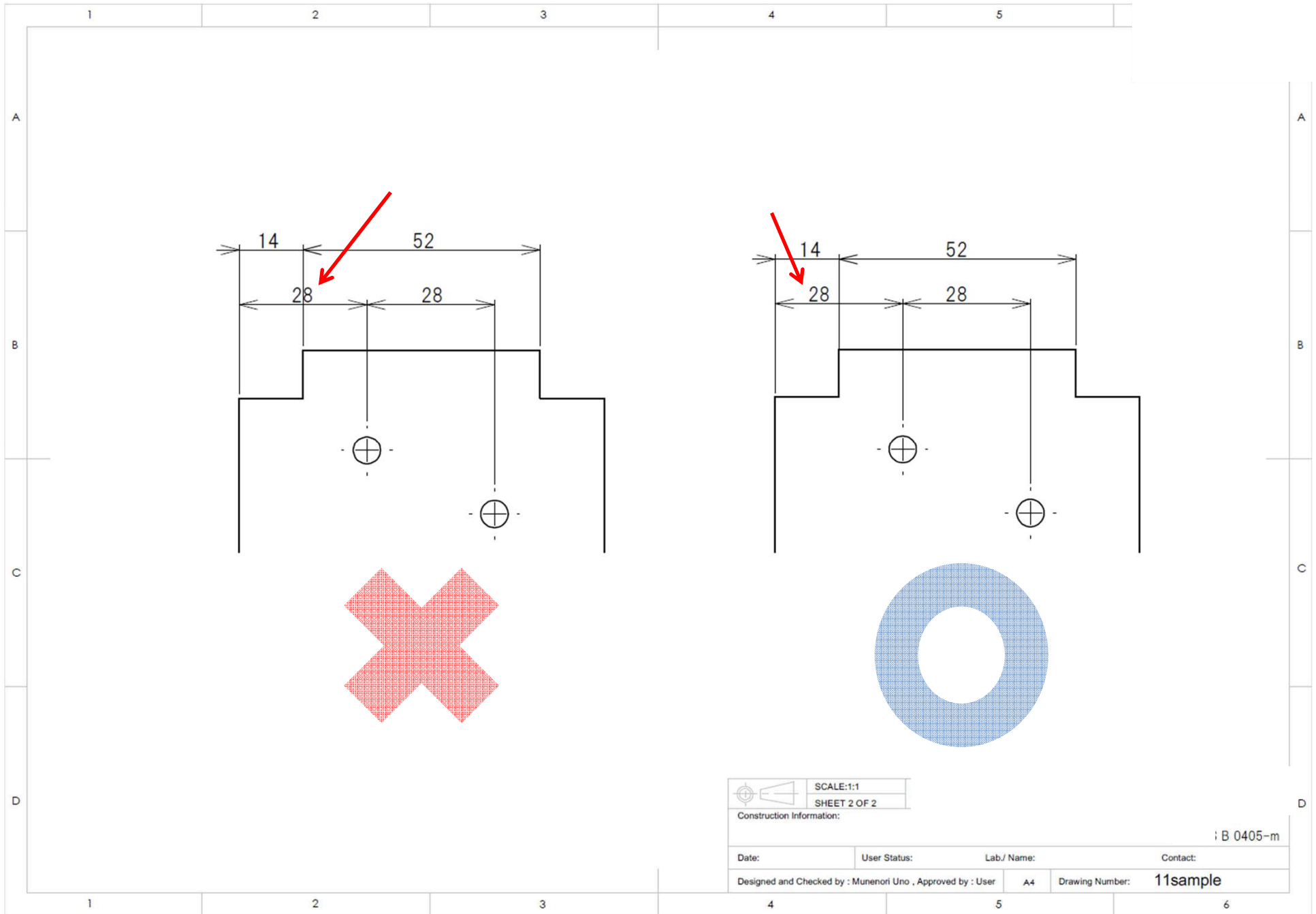
		SCALE:1:1	
		SHEET 2 OF 2	
Construction Information:			
B 0405-m			
Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 11sample



Superimposed running dimensioning

		SCALE:1:1	
		SHEET 11 OF 20	
Construction Information: fig 49			
Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: MEDworkshop_00_rev00

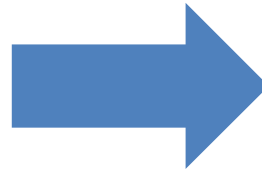
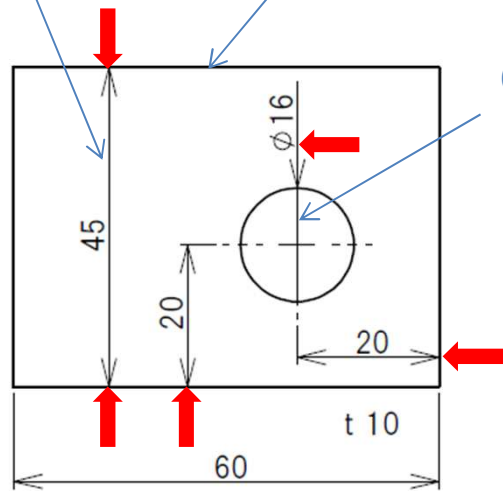
B 0405-m



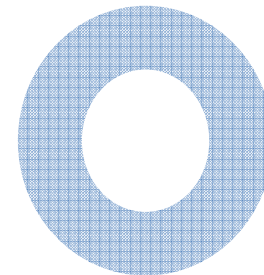
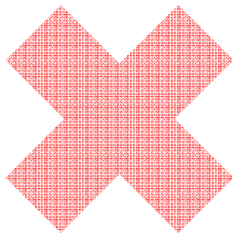
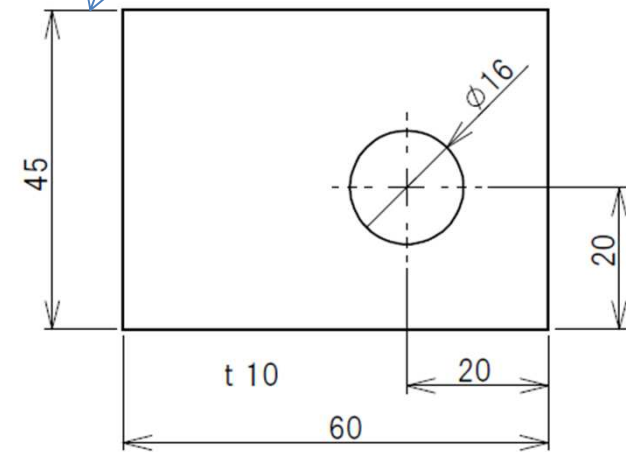
Dimension line

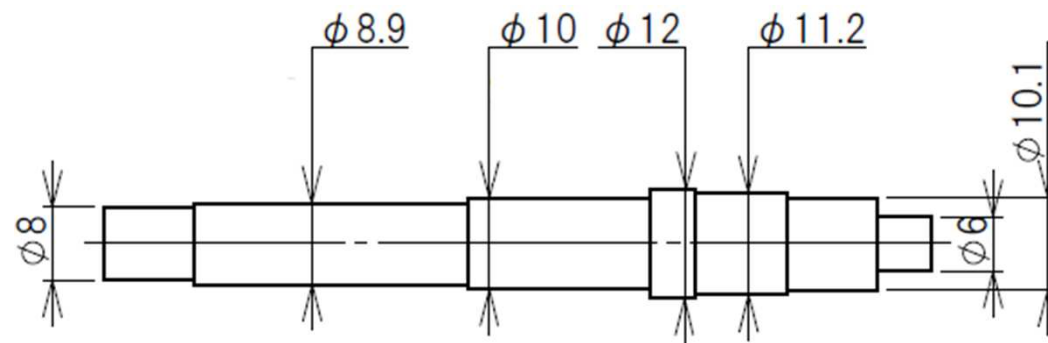
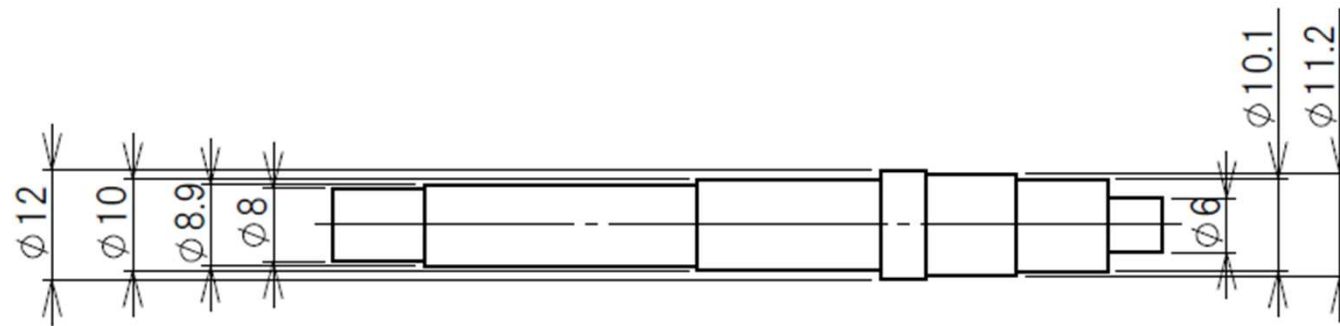
Outline

Center line

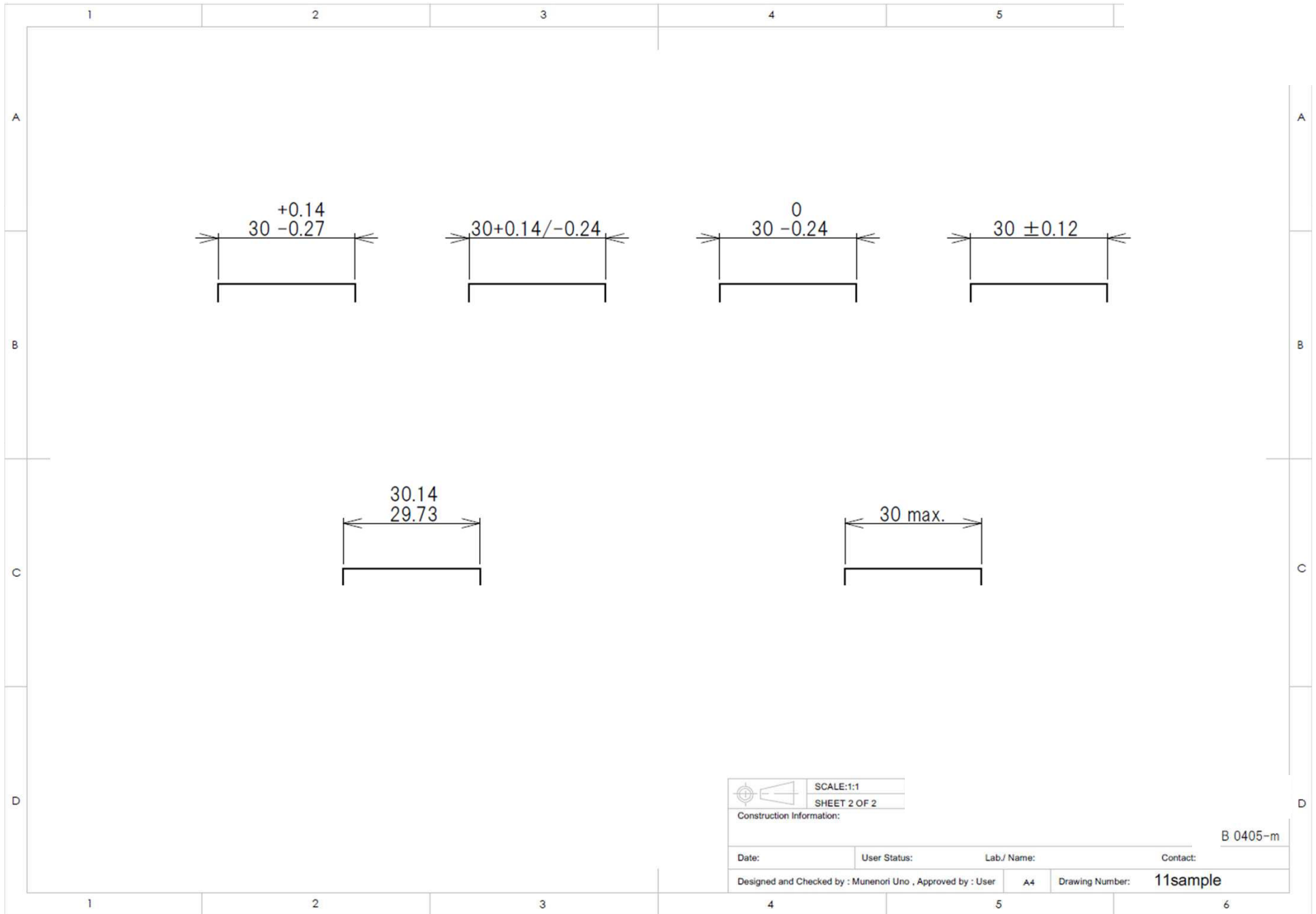


Projection line





Tolerancing of Linear and Angular Dimensions



SCALE:1:1
SHEET 2 OF 2

Construction Information:

Date:	User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number: 11sample

B 0405-m

Mechanical Engineering Drawing Workshop

drawing part 2

Content:

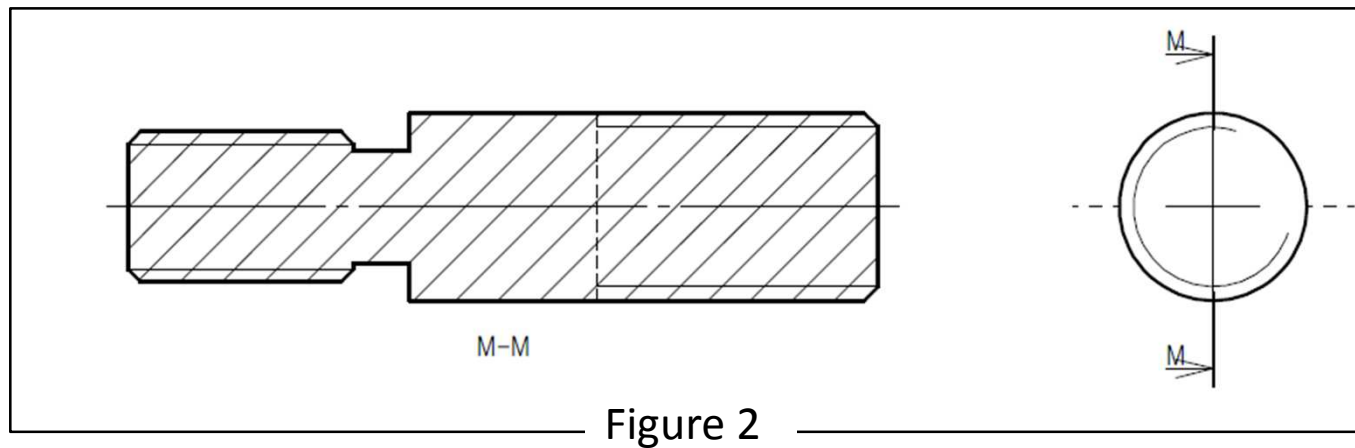
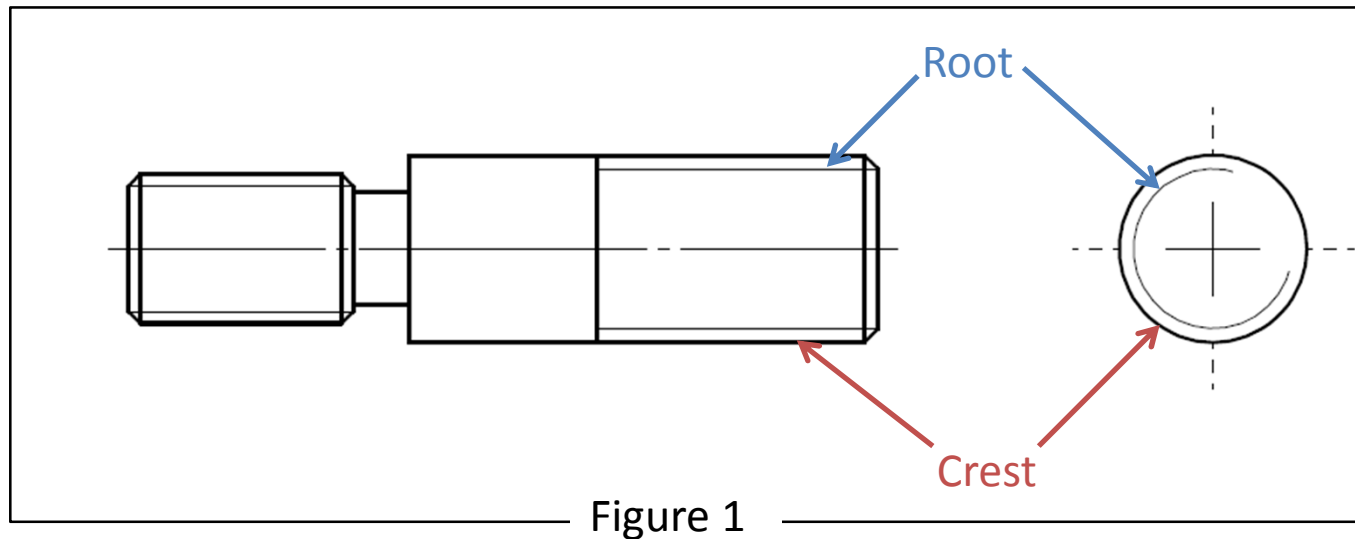
1. Drawing Screw Thread
2. ISO System of Limits and Fits
3. General Tolerances
4. Symbols of Surface Texture

Screw Threads and Threaded Parts

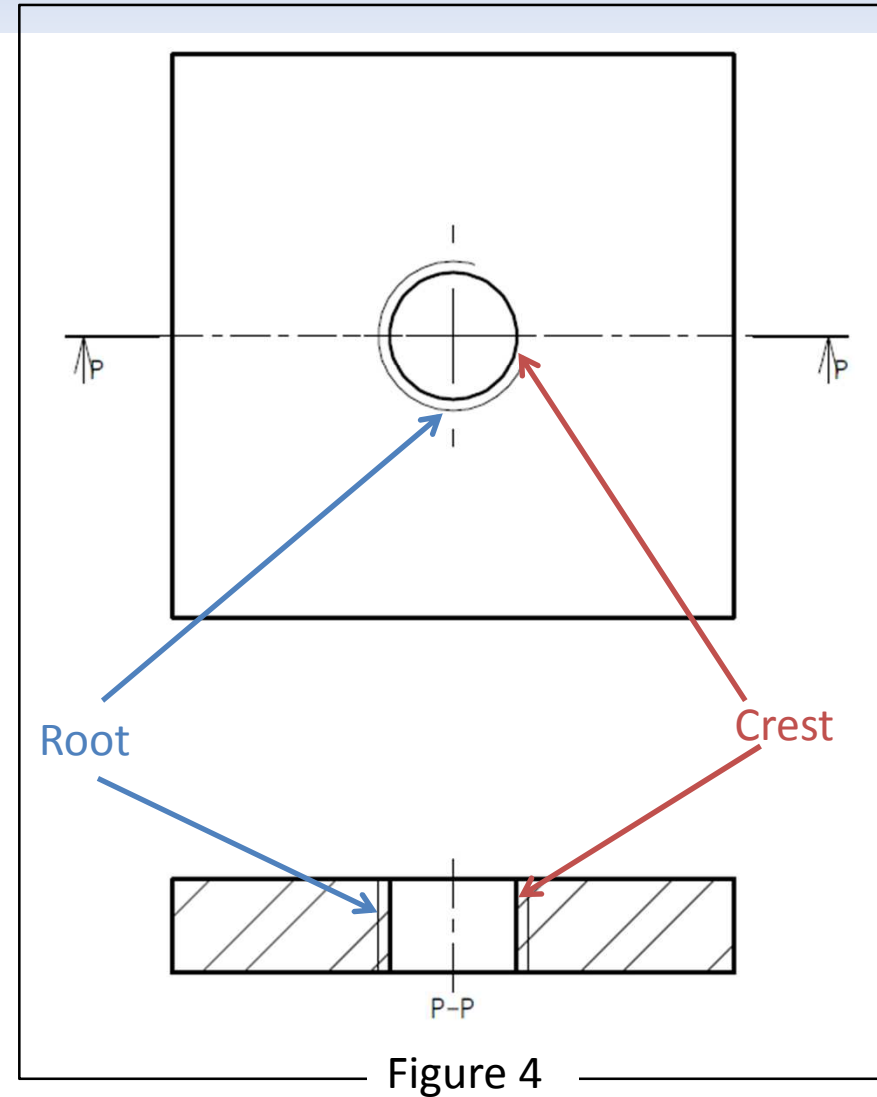
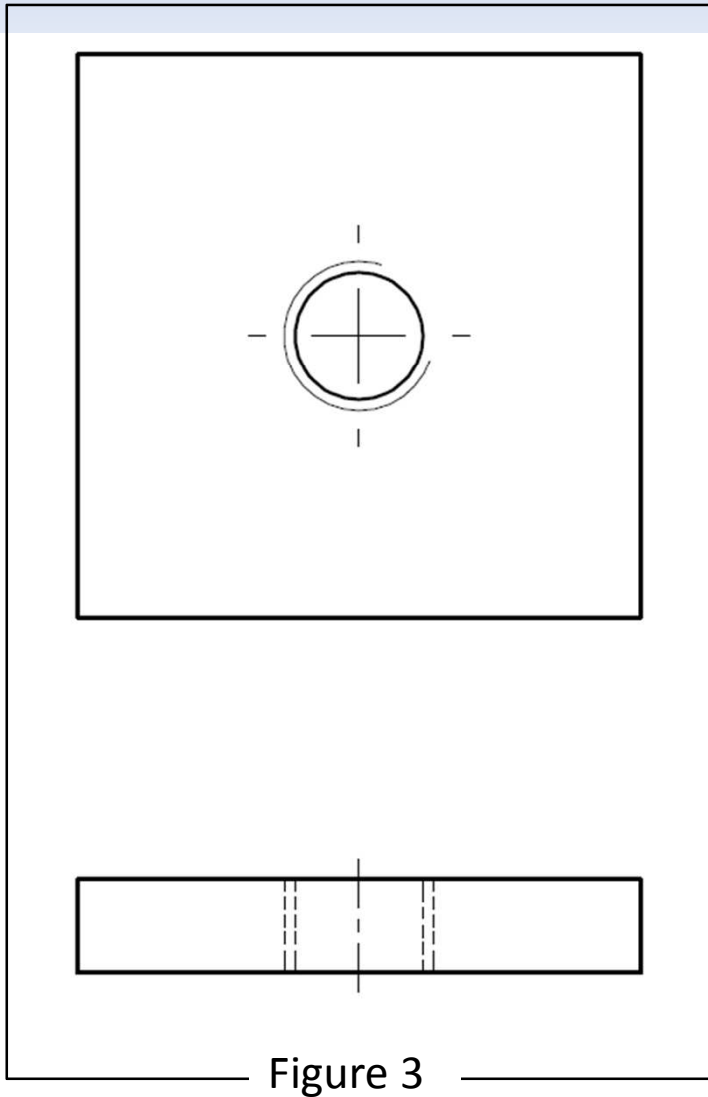
- Part1 : General Conventions

(B0002-1)

Expression



Expression



Expression

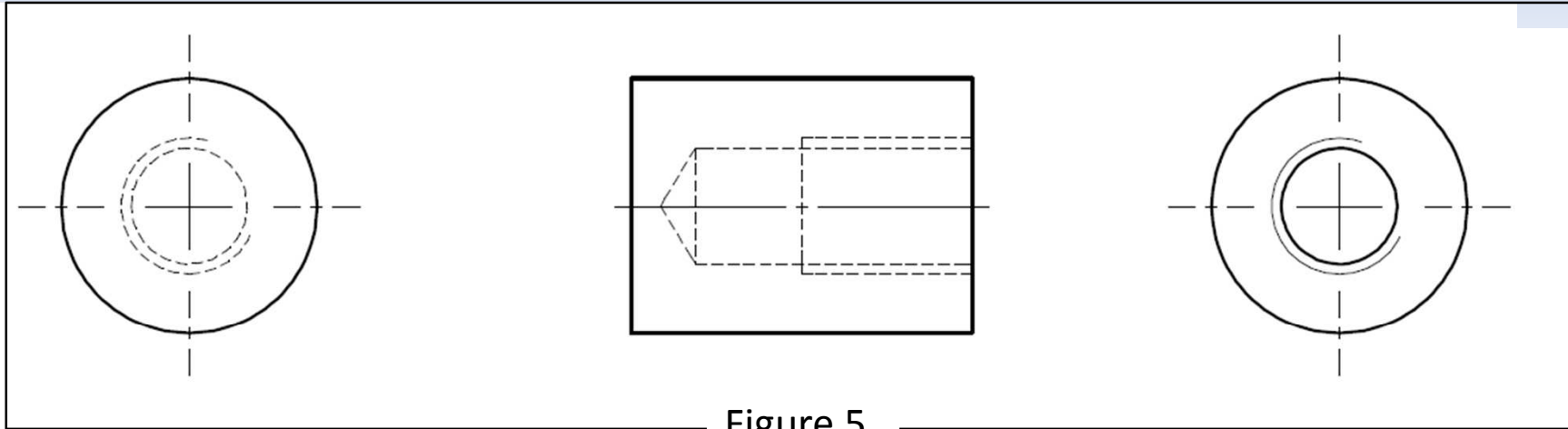


Figure 5

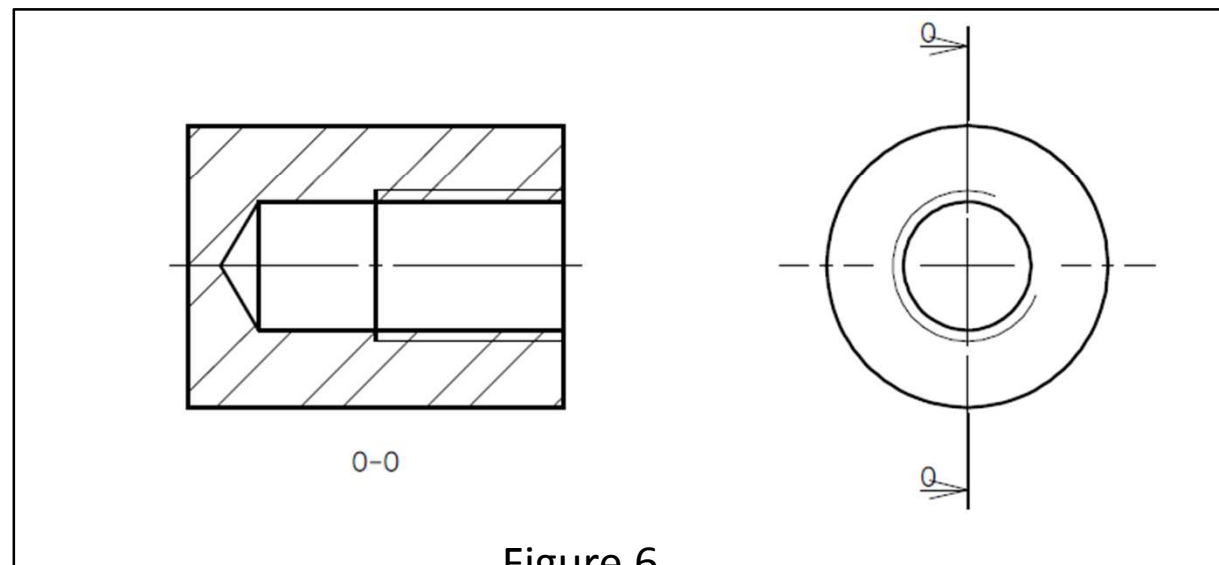


Figure 6

Dimensioning

External thread

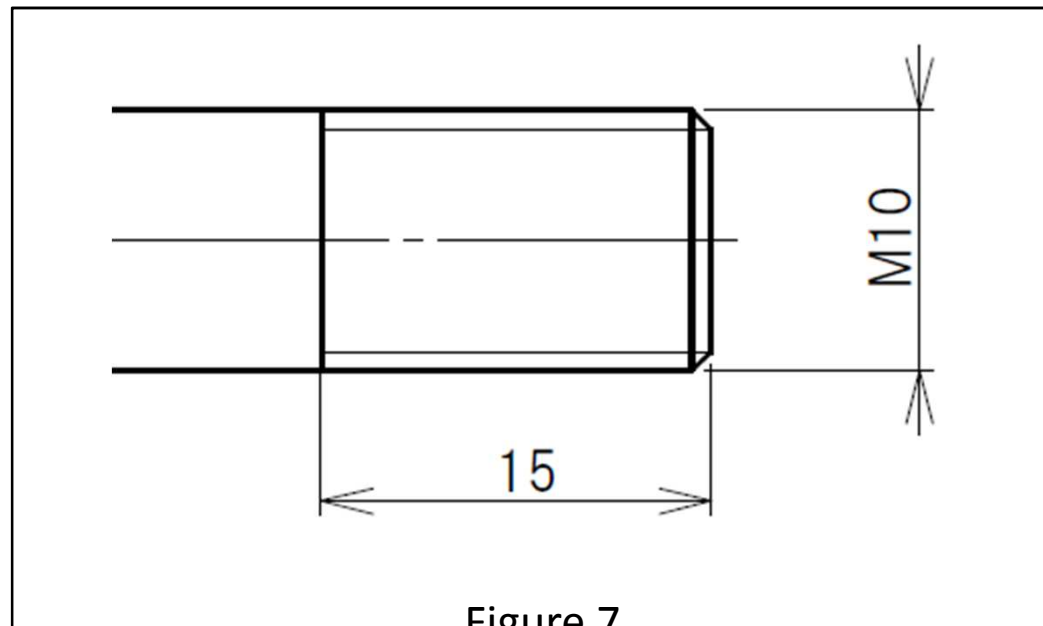
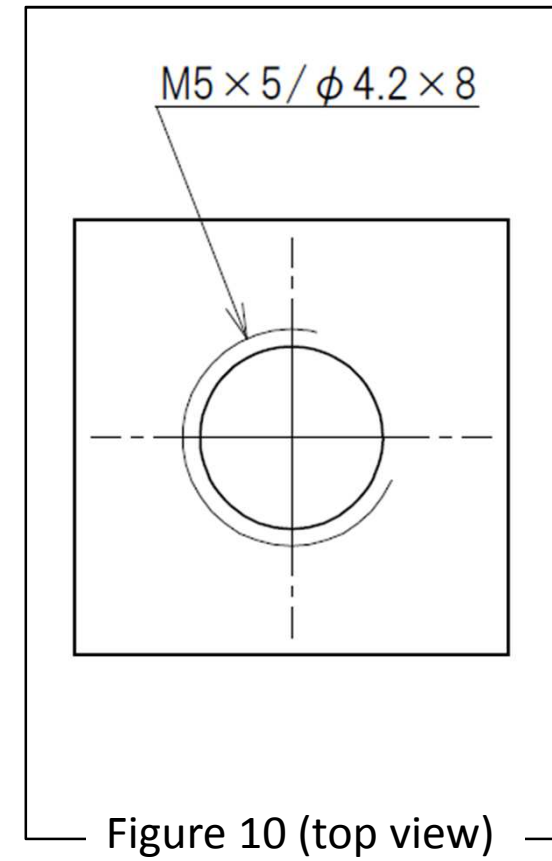
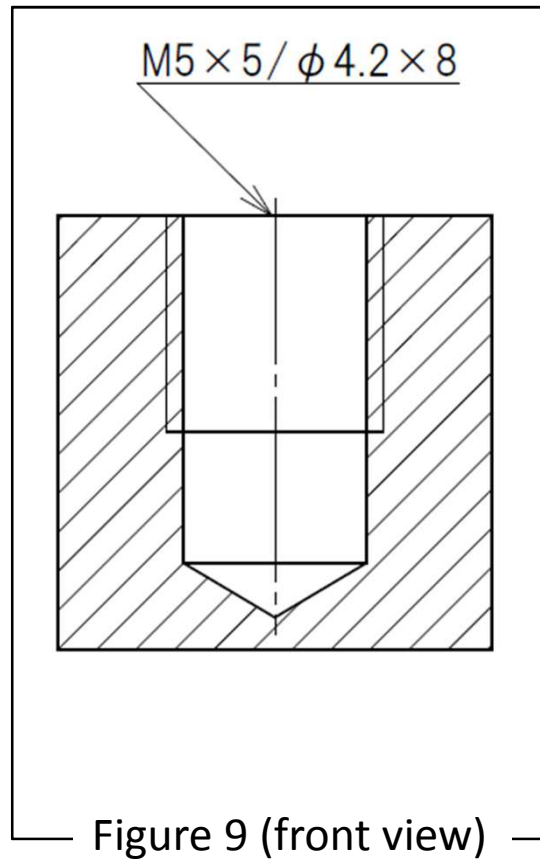
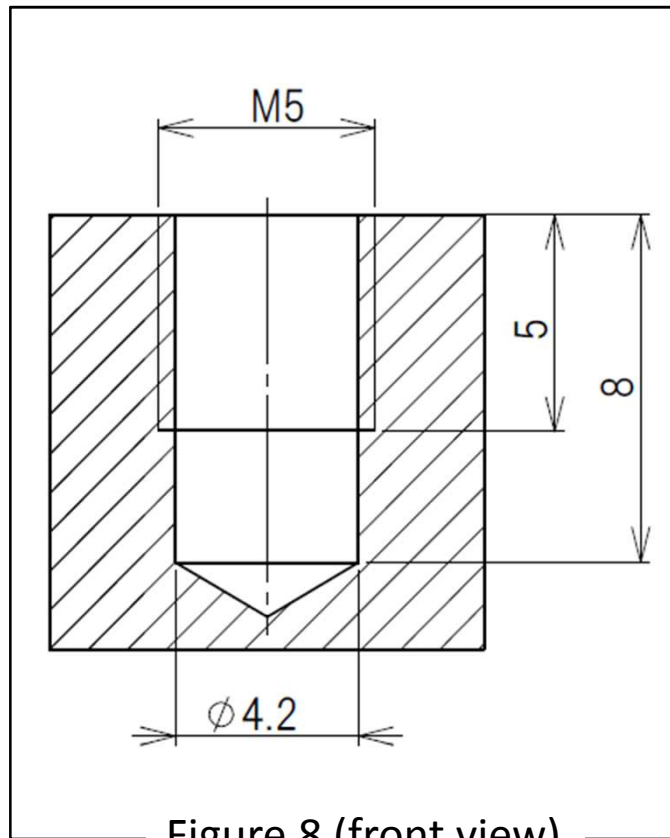


Figure 7

Dimensioning

Internal thread

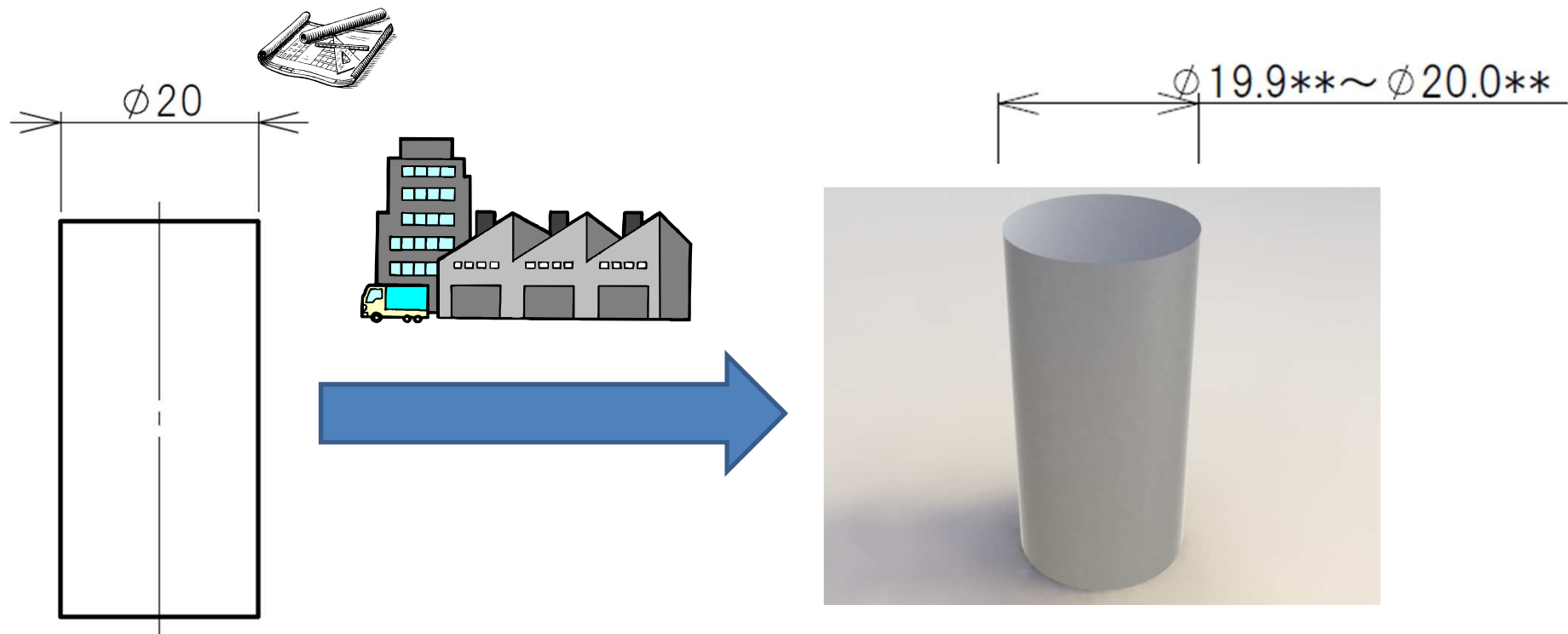


These 3 figures show the same tapped hole.

ISO System of Limits and Fits
-Part1:Bases of Tolerances, Deviations and Fits
(B0401)

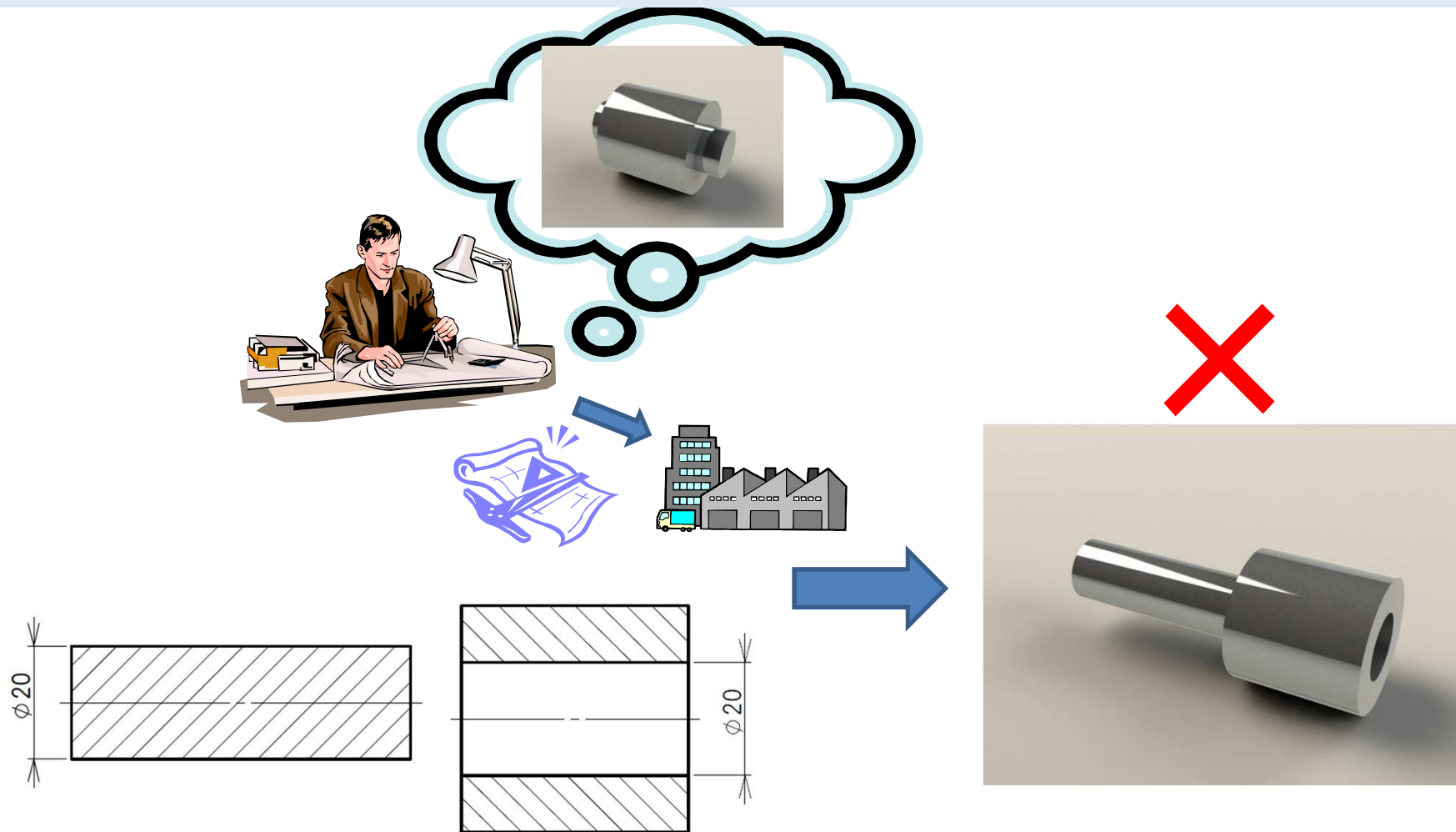
ISO System of Limits and Fits

-Part 1: Bases of Tolerances, Deviations and Fits



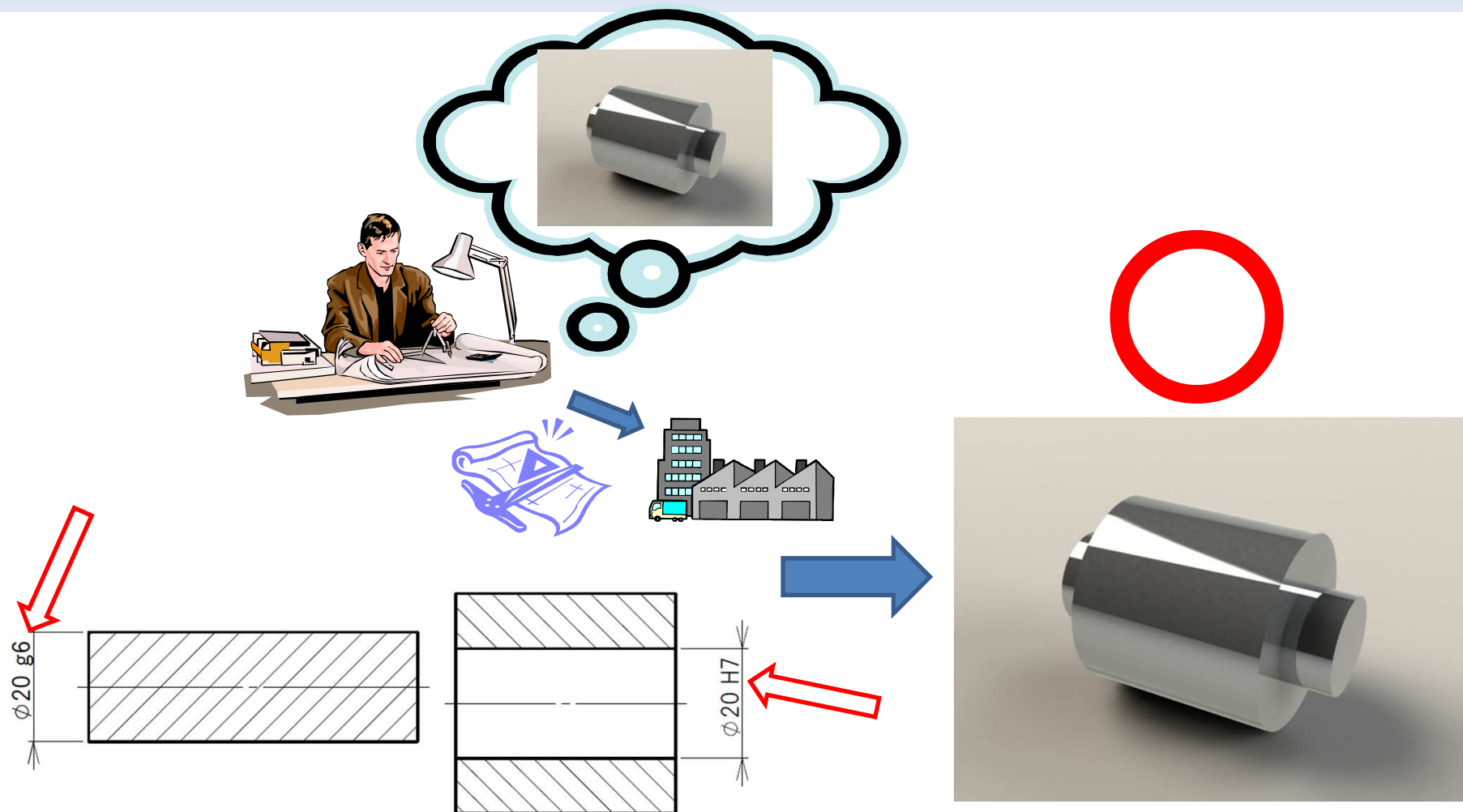
ISO System of Limits and Fits

-Part1:Bases of Tolerances, Deviations and Fits



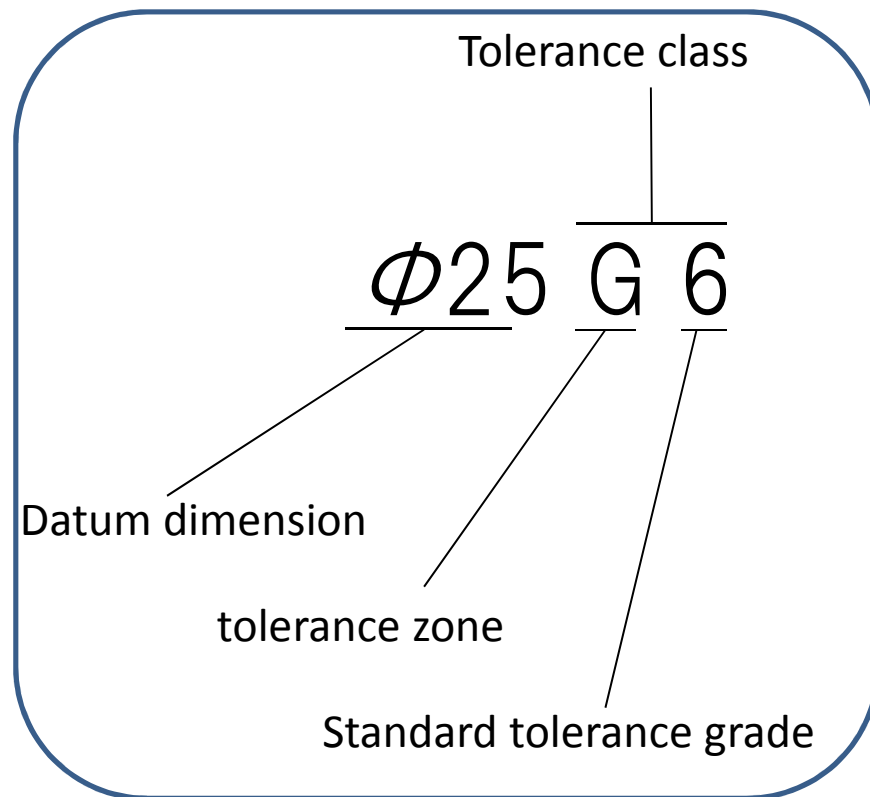
ISO System of Limits and Fits

-Part1:Bases of Tolerances, Deviations and Fits



Hole

- Tolerance class.



=

$$\phi 25 \begin{matrix} +0.020 \\ +0.007 \end{matrix}$$

($\phi 25.007 \sim \phi 25.020$)

Hole (Tolerance Zone)

$\phi 25$ G 6

tolerance zone

tolerance zone

Datum
dimension
(24 ~ 30)

Datum Dimension (mm)		Value of fundamental deviation											(μm)	
		Lower deviation												
		All of the standard tolerance grades												
over	to	A	B	C	CD	D	E	EF	F	FG	G	H	JS	
–	3	+270	+140	+60	+34	+20	+14	+10	+6	+4	+2	0	+standard tolerance/2	
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													
18	24	+300	+160	+110		+65	+40		+20		+7	0		
24	30													
30	40	+310	+170	+120		+80	+50		+25		+9	0		
40	50	+320	+180	+130										
50	65	+340	+190	+140		+100	+60		+30		+10	0		
65	80	+360	+200	+150										
80	100	+380	+220	+170		+120	+72		+36		+12	0		
100	120	+410	+240	+180										
120	140	+460	+260	+200		+145	+85		+43		+14	0		
140	160	+520	+280	+210										
160	180	+580	+310	+230		+170	+100		+50		+15	0		
180	200	+660	+340	+240										

$\phi 25$

0.007

Tolerance
zone

Size tolerance

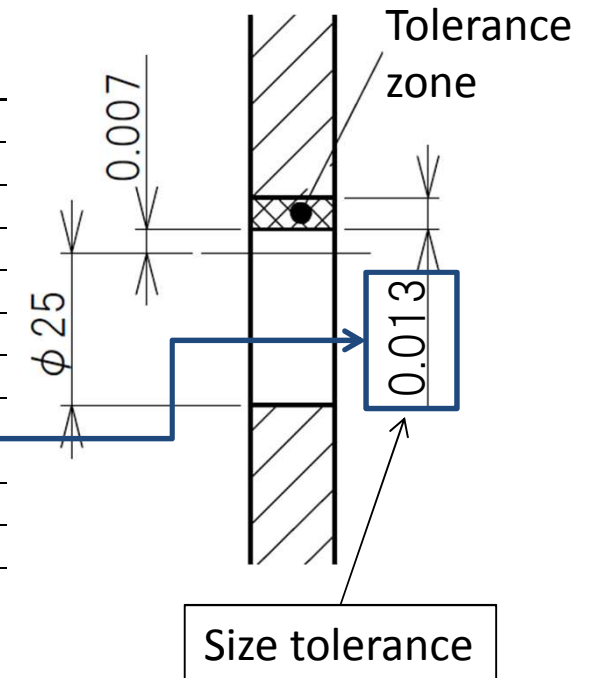
Hole (Size Tolerance)

$\phi 25 \text{ G } 6$

Standard tolerance grade

Datum
dimension
(18~30)

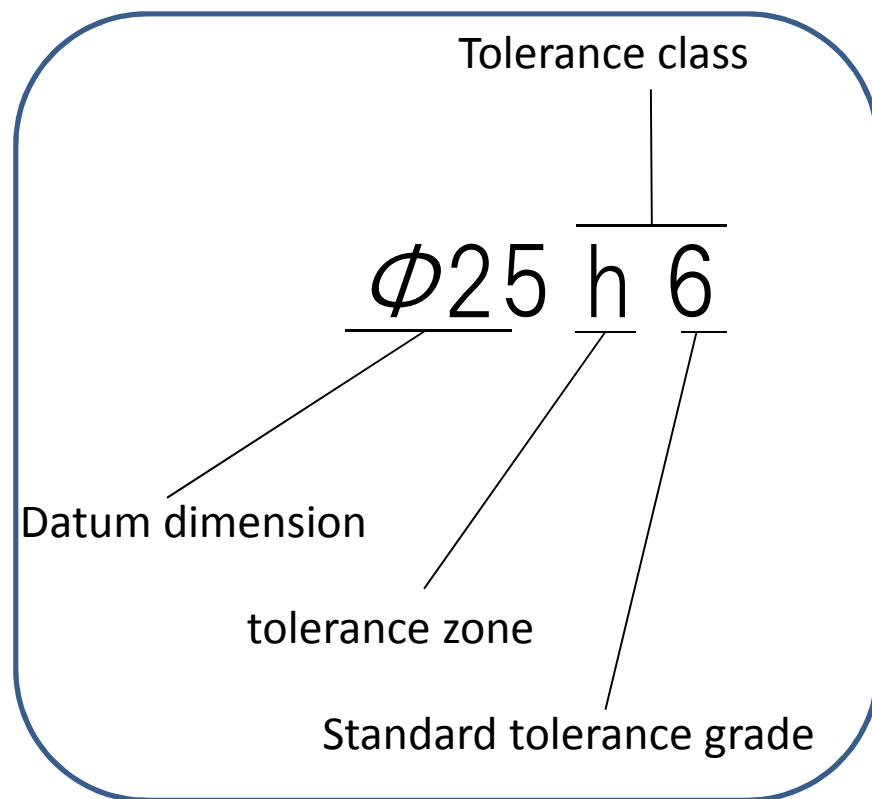
Datum Dimension(mm)		Standard tolerance grade										
over	to	1	2	3	4	5	6	7	8	9	10	11
		Size tolerance (μm)										
-	3	0.8	1.2	2	3	4	6	10	14	25	40	60
3	6	1	1.5	2.5	4	5	8	12	18	30	48	75
6	10	1	1.5	2.5	4	6	9	15	22	36	58	90
10	18	1.2	2	3	5	8	11	18	27	43	70	110
18	30	1.5	2.5	4	6	9	13	21	33	52	84	130
30	50	1.5	2.5	4	7	11	16	25	39	62	100	160
50	80	2	3	5	8	13	19	30	46	74	120	190
80	120	2.5	4	6	10	15	22	35	54	87	140	220



($\phi 25.007 \sim \phi 25.020$)

Shaft

- Tolerance class



=

$$\phi 25^{+0}_{-0.013}$$

($\phi 24.987 \sim \phi 25.000$)

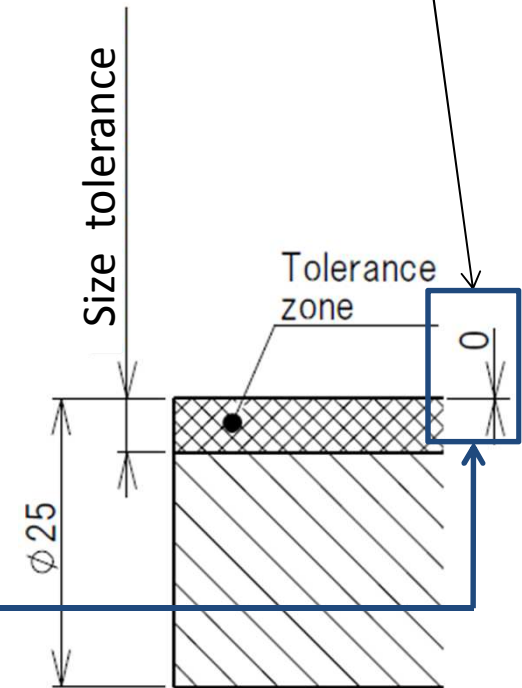
Shaft (Tolerance Zone)

$\phi 25 \text{ h } 6$

tolerance zone

Datum Dimension (mm)		Value of fundamental deviation											(μm)	
		Lower deviation												
		All of the standard tolerance grades												
over	to	a	b	c	cd	d	e	ef	f	fg	g	h	js	
–	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	+standard tolerance/2	
14	18													
18	24	+300	+160	+110		+65	+40		+20		+7	0		
24	30													
30	40	+310	+170	+120		+80	+50		+25		+9	0		
40	50	+320	+180	+130										
50	65	+340	+190	+140		+100	+60		+30		+10	0		
65	80	+360	+200	+150										
80	100	+380	+220	+170		+120	+72		+36		+12	0		
100	120	+410	+240	+180										
120	140	+460	+260	+200		+145	+85		+43		+14	0		
140	160	+520	+280	+210										
160	180	+580	+310	+230		+170	+100		+50		+15	0		
180	200	+660	+340	+240										

Datum
dimension
(24~30)



Shaft (Size Tolerance)

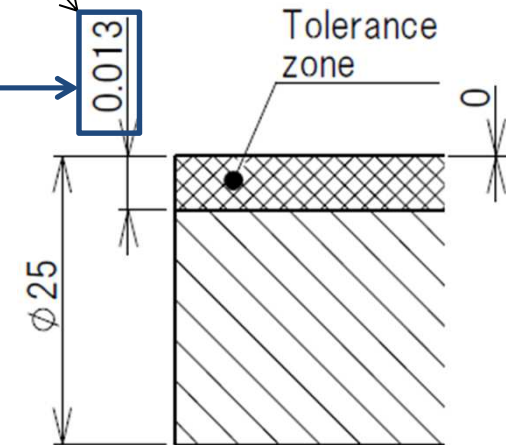
$\phi 25 \text{ h } 6$

Standard tolerance grade

Size tolerance

Datum
dimension
(18~30)

Datum Dimension(mm)		Standard tolerance grade										
over	to	1	2	3	4	5	6	7	8	9	10	11
		Size tolerance (μm)										
-	3	0.8	1.2	2	3	4	6	10	14	25	40	60
3	6	1	1.5	2.5	4	5	8	12	18	30	48	75
6	10	1	1.5	2.5	4	6	9	15	22	36	58	90
10	18	1.2	2	3	5	8	11	18	27	43	70	110
18	30	1.5	2.5	4	6	9	13	21	33	52	84	130
30	50	1.5	2.5	4	7	11	16	25	39	62	100	160
50	80	2	3	5	8	13	19	30	46	74	120	190
80	120	2.5	4	6	10	15	22	35	54	87	140	220



($\phi 24.987 \sim \phi 25.000$)

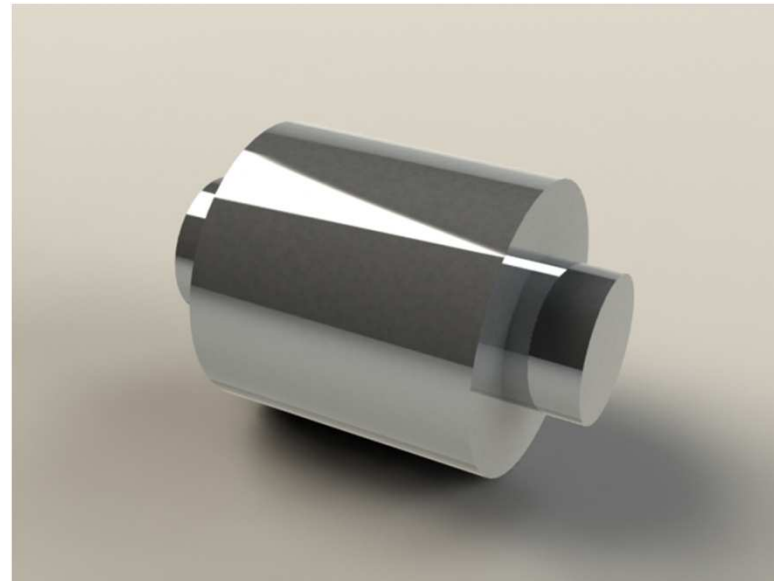
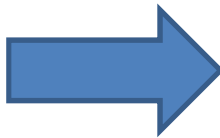
ISO System of Limits and Fits

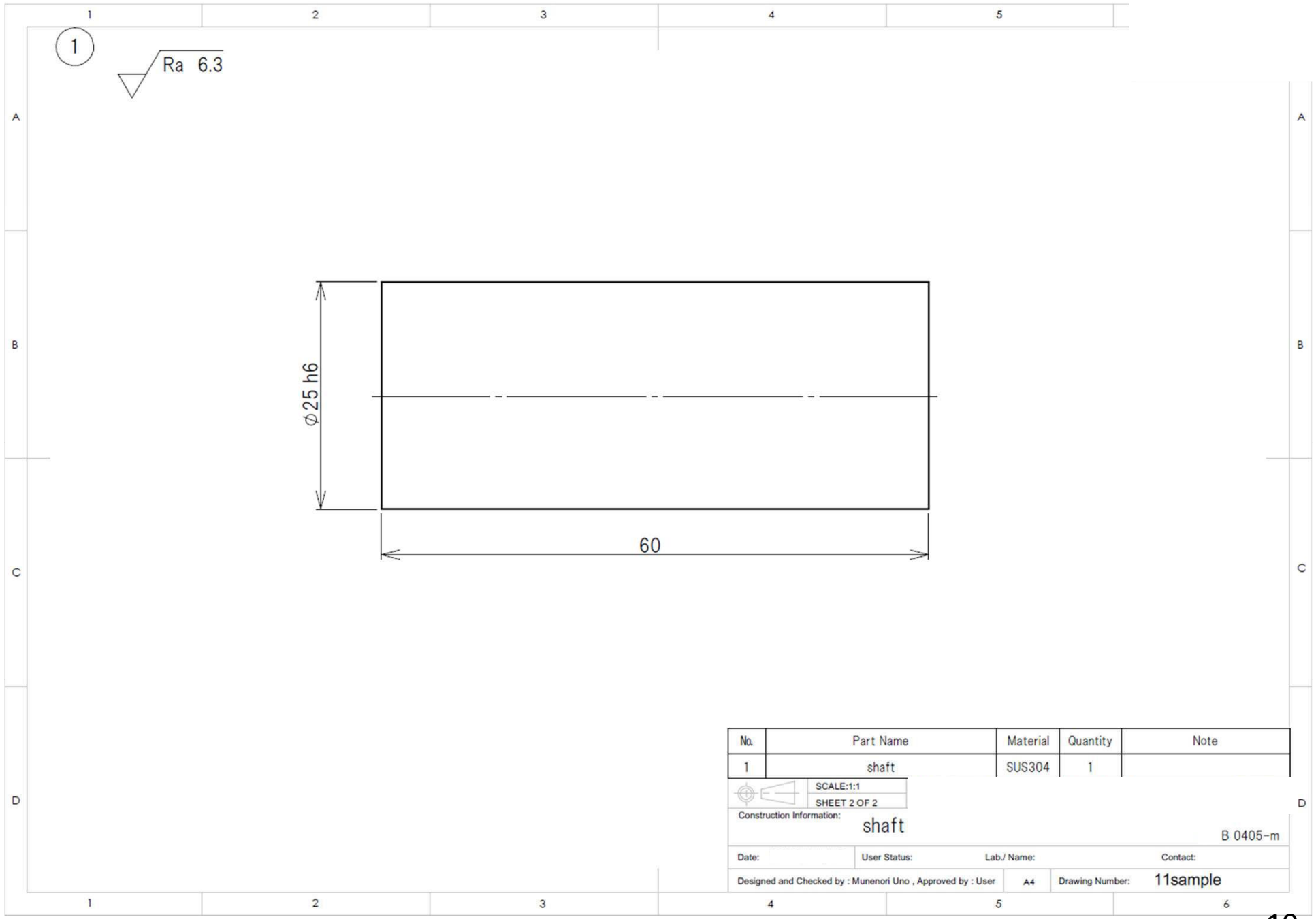
-Part 1: Bases of Tolerances, Deviations and Fits

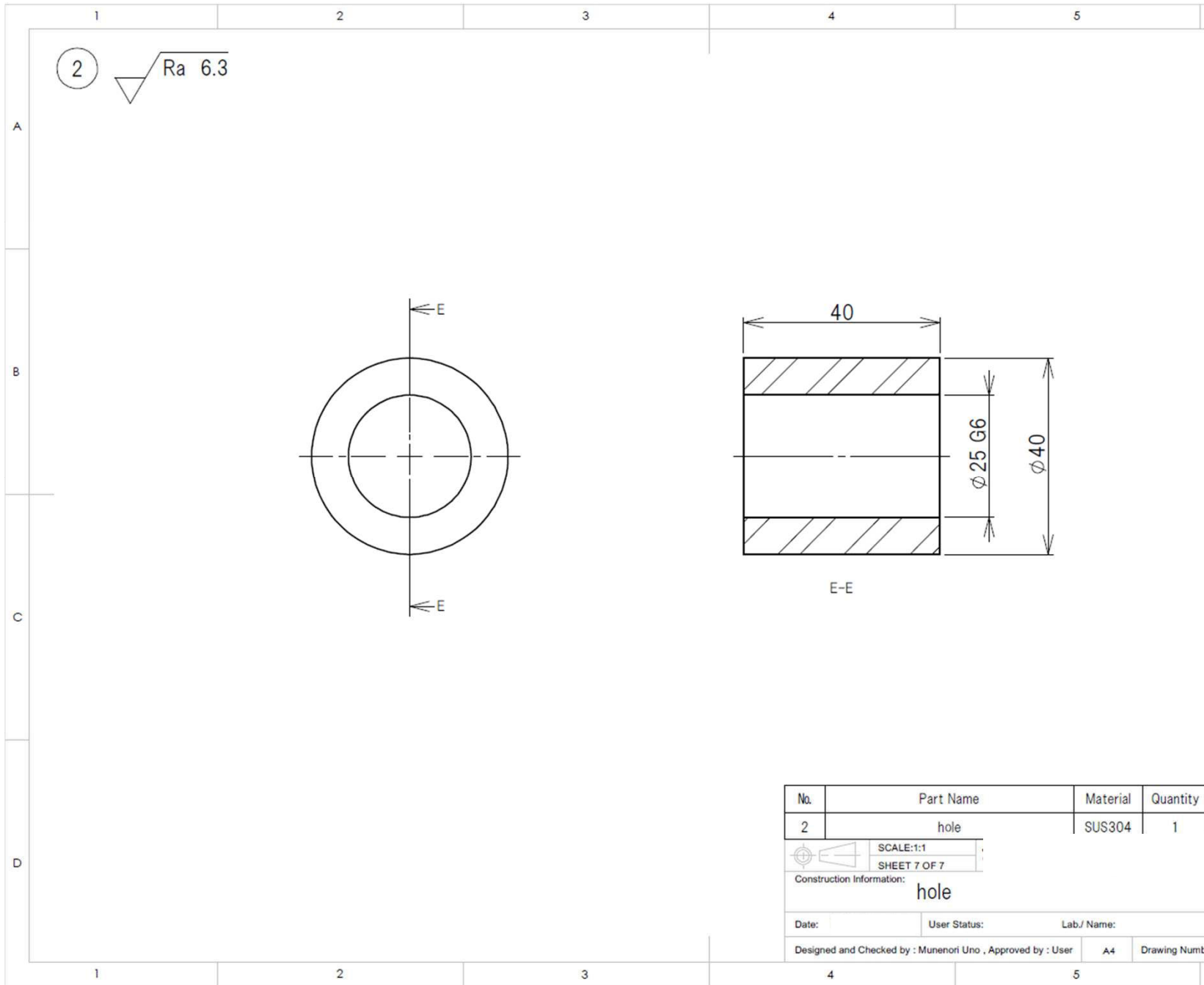
$\phi 25G6$



$\phi 25h6$







No.	Part Name	Material	Quantity	Note
2	hole	SUS304	1	
SCALE:1:1 SHEET 7 OF 7 Construction Information: hole				
Date:	User Status:	Lab./ Name:	Contact:	
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number:	11sample

3 0405-m

Table of General Fit System Combinations

Table 1: Hole basis system of fits

Base hole	Tolerance class of shaft						
	Clearance fit						
H6					g5	h5	
					f6	g6	h6
H7					f6	g6	h6
				e7	f7		h7
H8					f7		h7
				e8	f8		h8
H9			d9	e9			h8
		c9	d9	e9			h9
H10	b9	c9	d9				

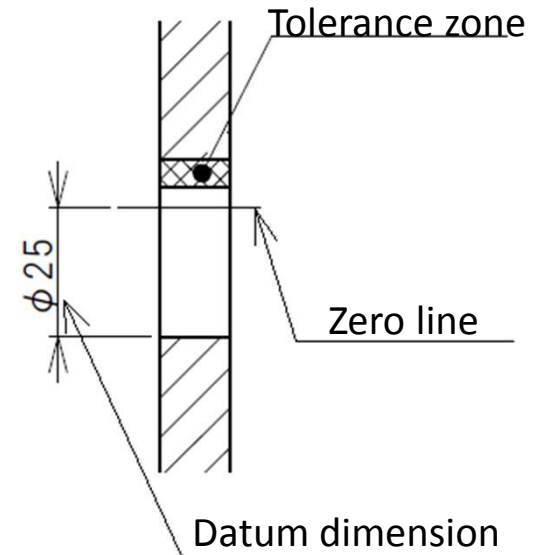


Table 2: Shaft basis system of fits

Base shaft	Tolerance class of hole						
	Clearance fit						
h5							H6
h6					F6	G6	H6
					F7	G7	H7
h7				E7	F7		H7
					F8		H8
h8			D8	E8	F8		H8
			D9	E9			H9
h9			D8	E8			H8
		C9	D9	E9			H9
	B10	C10	D10				

Reference of Fit System Combination

Base hole				Classification
H6	H7	H8	H9	
			c9	Needs sufficient gap. (expansion, tolerance, fitting length)
		d9	d9	
		e8		Rotating parts, or sliding parts. Fitting parts which are often taken apart.
f6	f7	f7 f8		
g5	g6			Need detailed action.
h5 h6	h6	h7 h8	h9	

Table 3

General Tolerances

-Part1:Tolerances for Linear and Angular
Dimensions without Individual Tolerance
Indications
(B0405)

General Tolerances

Standard Tolerance Grade		Datum Dimension						
Symbol	Meaning	from 0.5 to 3	over 3 to 6	over 6 to 30	over 30 to 120	over 120 to 400	over 400 to 1000	over 1000 to 2000
		Limit deviations						
f	fine	± 0.05	± 0.05	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5
m	medium	± 0.1	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2
c	coarse	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2	± 3
v	very coarse	-	± 0.5	± 1	± 1.5	± 2.5	± 4	± 6

Table 4: Permissible dimensional deviation of length without chamfer.

Standard Tolerance Grade		Datum Dimension		
Symbol	Meaning	from 0.5 to 3	over 3 to 6	over 6
		Limit deviations		
f	fine	± 0.2	± 0.5	± 1
m	medium			
c	coarse	± 0.4	± 1	± 2
v	very coarse			

Table 5: Permissible dimensional deviation of length of chamfer .

General Tolerances

Standard Tolerance		Datum Dimension of Shorter Side of Target Angle				
Symbol	Meaning	10 or under	over 10 to 50	over 50 to 120	over 120 to 400	over 400
		Limit Deviations				
f	fine	$\pm 1^\circ$	$\pm 30'$	$\pm 20'$	$\pm 10'$	$\pm 5'$
m	medium					
c	coarse	$\pm 1^\circ 30'$	$\pm 1^\circ$	$\pm 30'$	$\pm 15'$	$\pm 10'$
v	very coarse	$\pm 3^\circ$	$\pm 2^\circ$	$\pm 1^\circ$	$\pm 30'$	$\pm 20'$

Table 6: Deviation Limits of Angle.

Indication on a Drawing

"JIS B 0405-" + standard tolerance grade

No.	Part Name	Material	Quantity	Note
2	hole	SUS304	1	



SCALE:1:1
SHEET 7 OF 7

Construction Information:
hole

Date:	User Status:	Lab./ Name:	Contact:
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Designed and Checked by : Munenori Uno , Approved by : User	A4	Drawing Number:	11sample
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4

5

6

D

Geometrical Product Specifications (GPS)
-Indication of Surface Texture in Technical
Product Specification
(B0031)

Symbols of Surface Texture

- Symbol of basic indication of surface texture

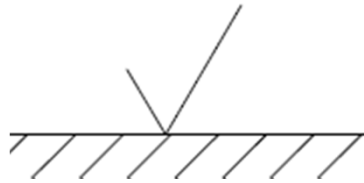


Figure 11: Basic symbol

- Indication about removed process

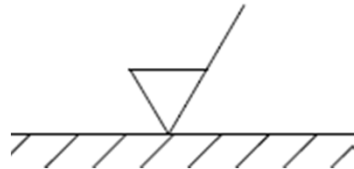


Figure 12: Removal processing is needed.

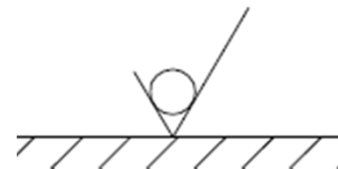


Figure 13: Removal processing is not allowed.

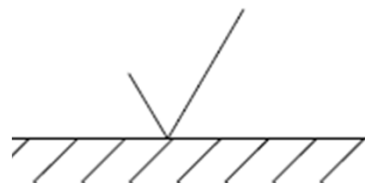


Figure 14: Either is OK.

Symbol of Surface Texture

- Symbol of indication of round surface texture

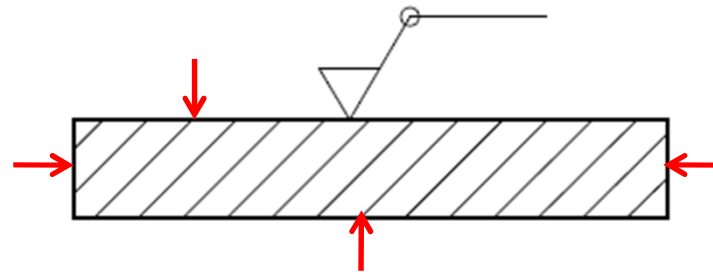


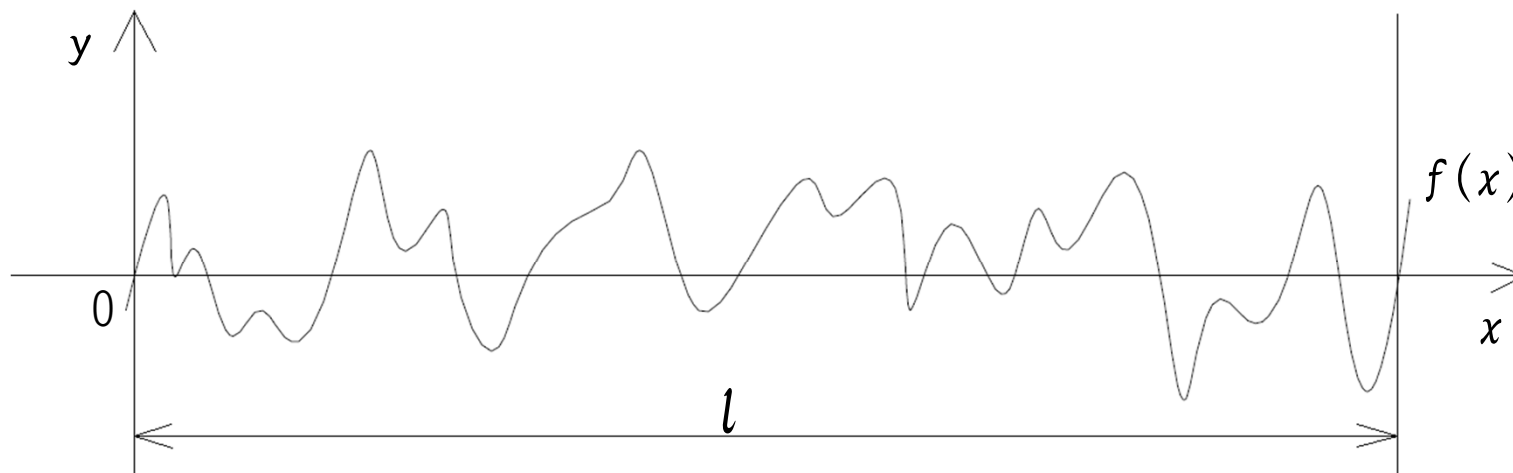
Figure 15: Round surface

Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length

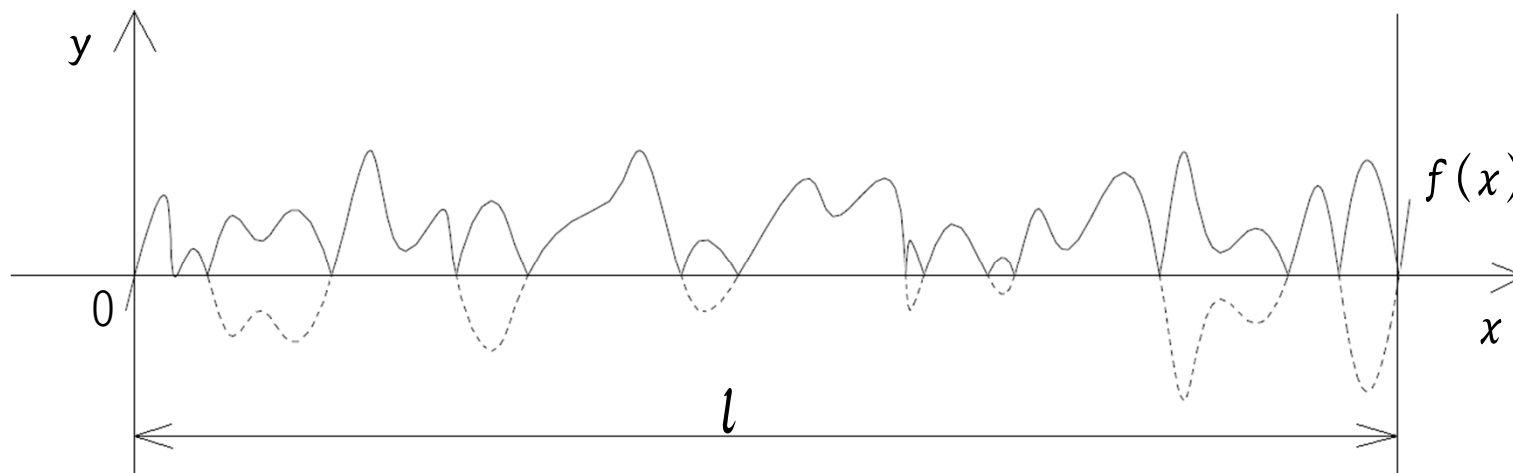


Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length

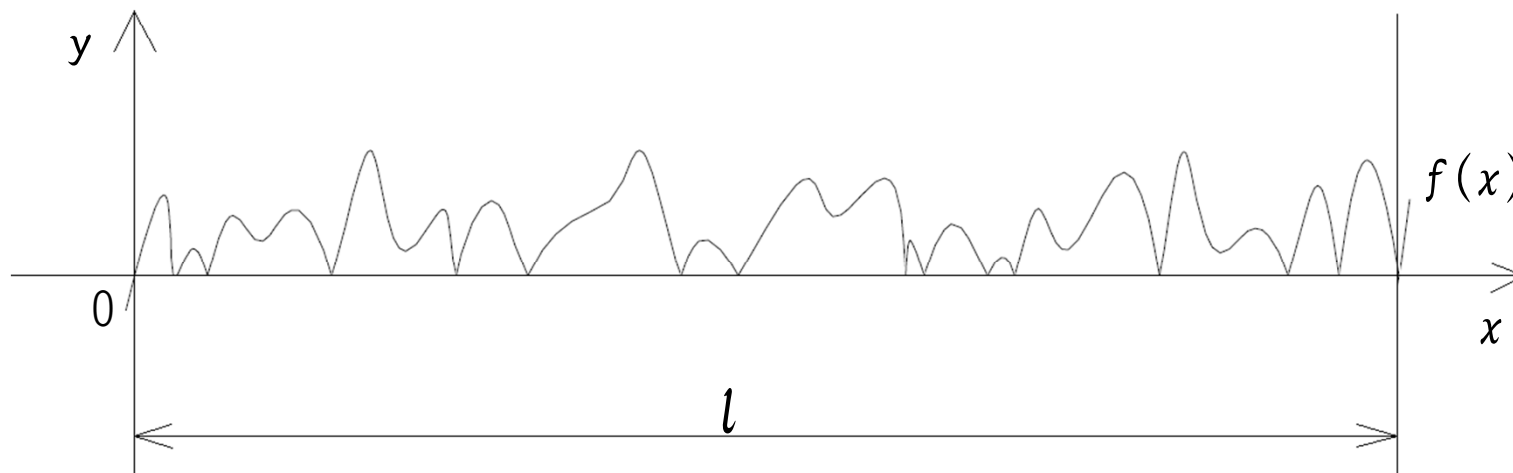


Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length

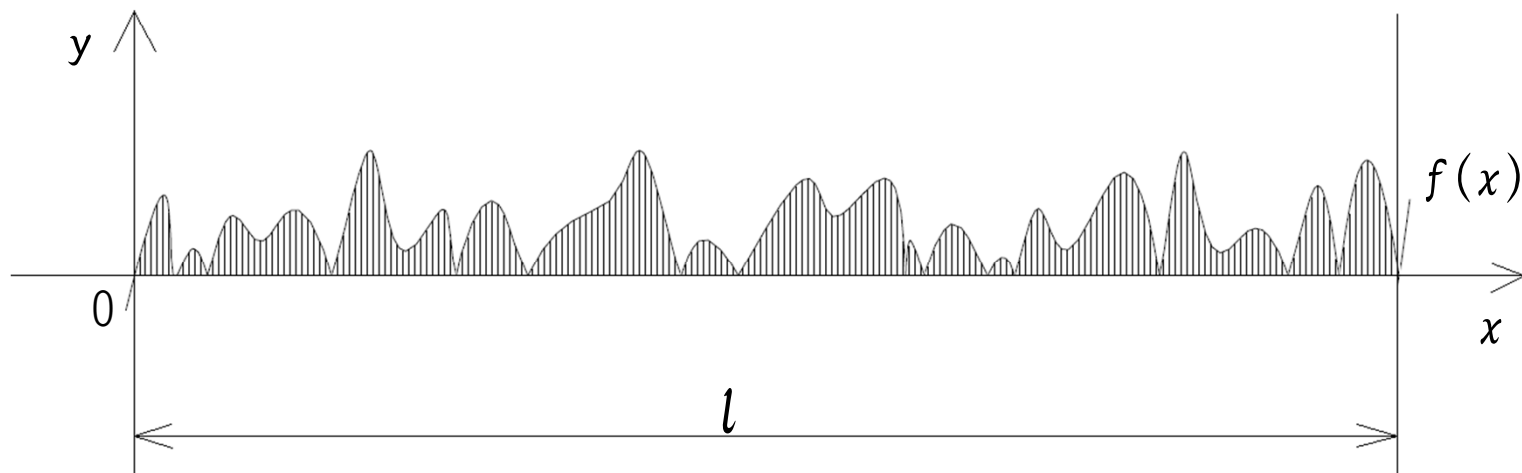


Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length

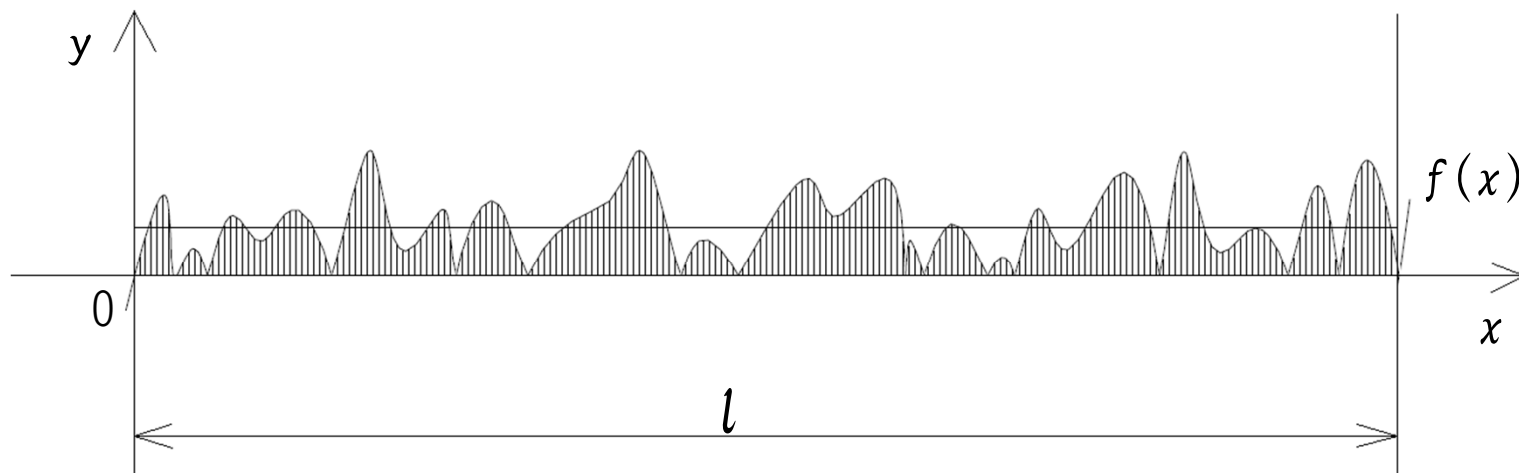


Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length

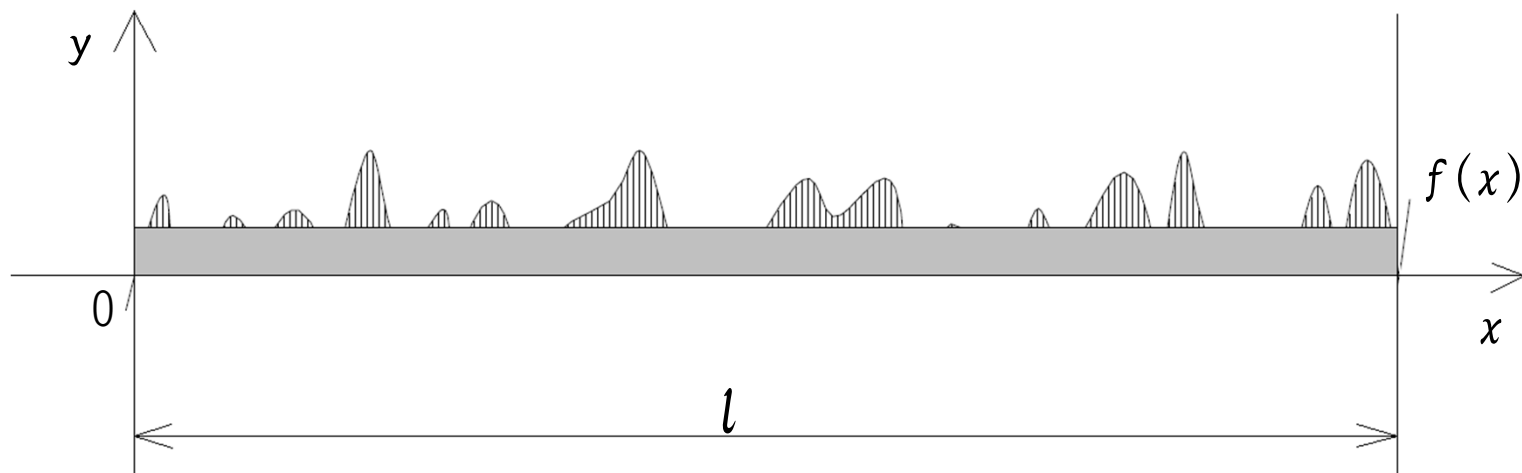


Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length

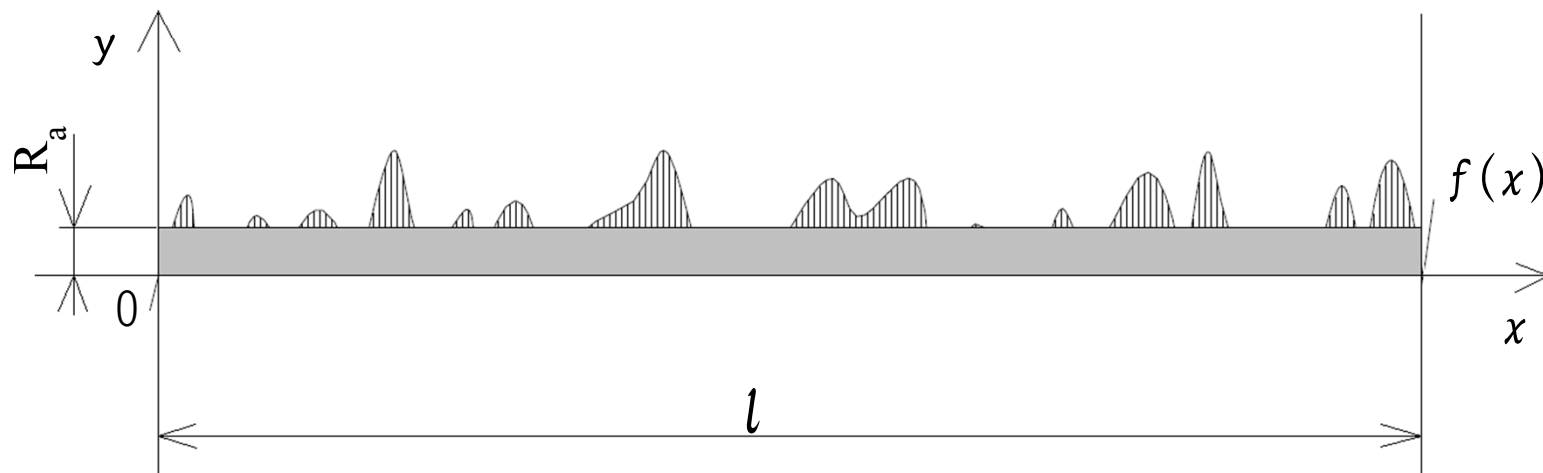


Indication of Surface Texture

Ra: Arithmetic mean deviation

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

$f(x)$: roughness profile l : sampling length



Indication of Surface Texture

μm				
0.008				
0.010				
0.012	0.125	1.25	12.5	125
0.016	0.160	1.60	16.0	160
0.020	0.20	2.0	20	200
0.025	0.25	2.5	25	250
0.032	0.32	3.2	32	320
0.040	0.40	4.0	40	400
0.050	0.50	5.0	50	
0.063	0.63	6.3	63	
0.080	0.80	8.0	80	
0.100	1.00	10.0	100	

Table7: Standard values of “Ra”.

Boldface values have priority over the others.

Indication of Surface Texture

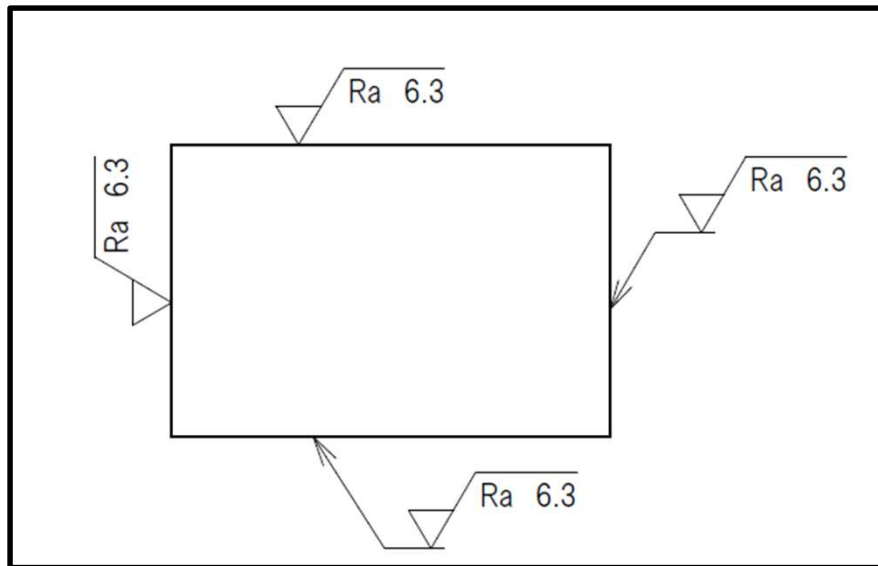


Figure 16: Position

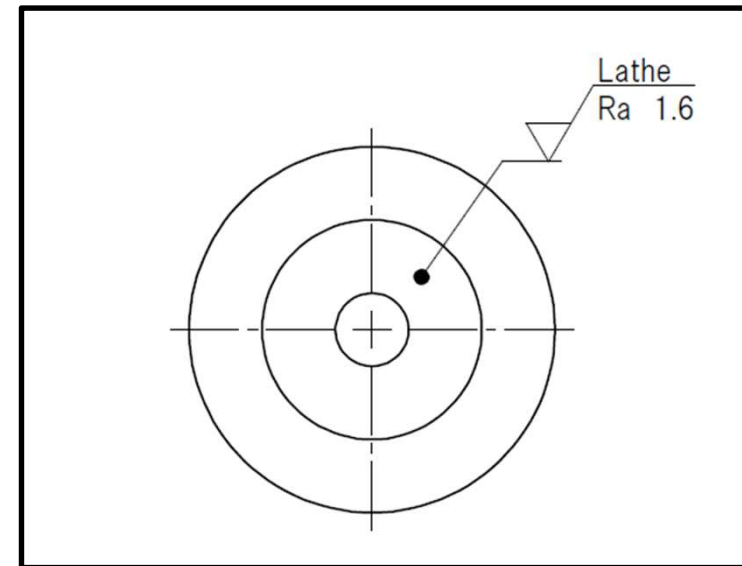
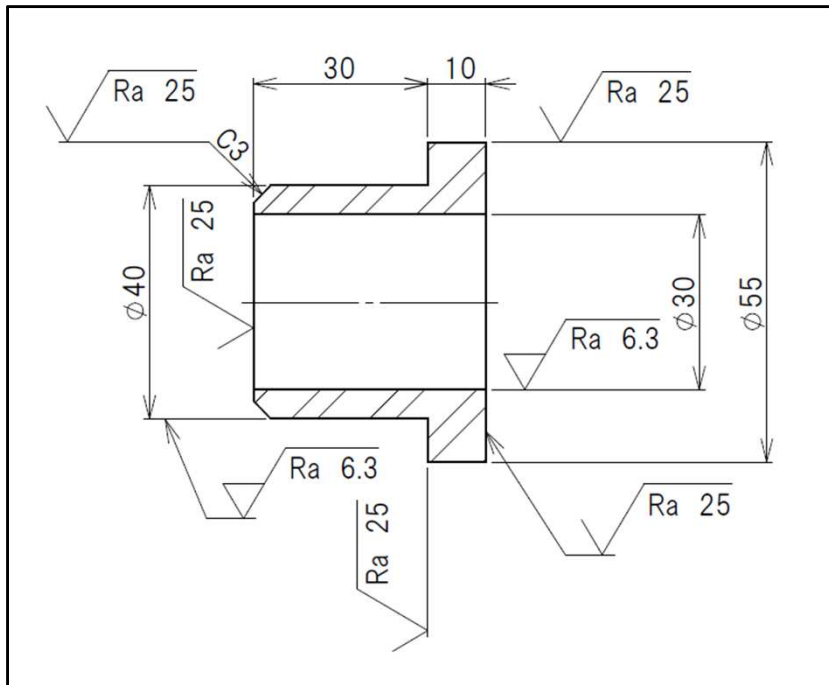
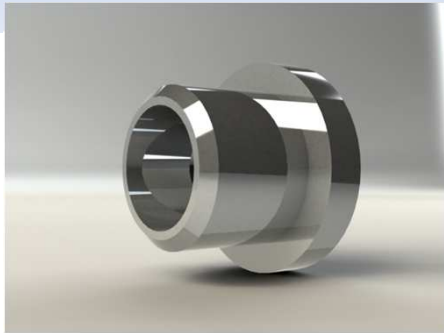


Figure 17: Leader line

Simple Indication of Surface Texture



=

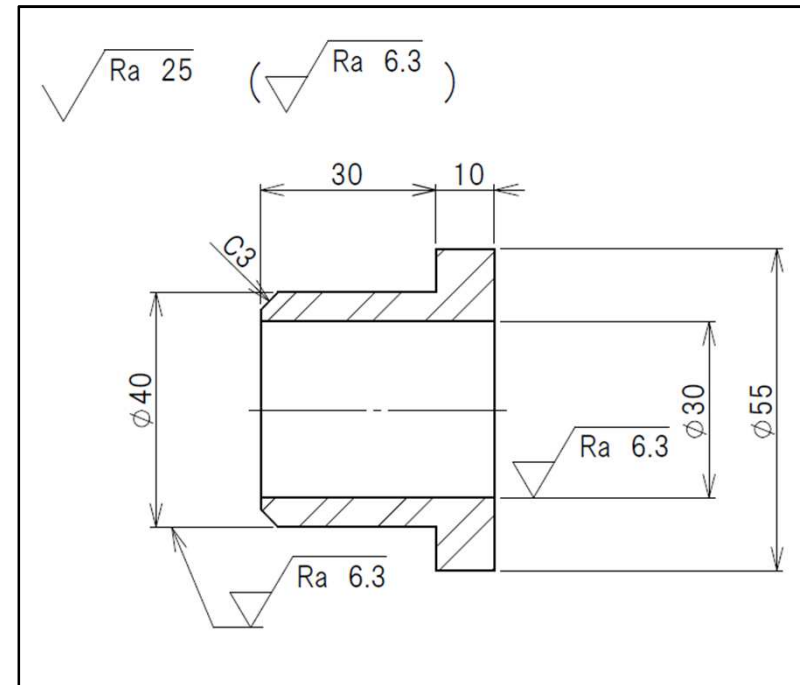


Figure 18: Simple indication of a part of which most of the surfaces in the drawing have the same surface texture.

Reference of Surface Texture

Ra(μ m)	Function	Finishing	
0.05	mirror surface	lapping	
0.1		emery paper	
0.2			
0.4	surface for sliding O-ring	fine machining	
0.8	surface for O-ring flange		electrical discharge machining
1.6			
3.2~6.3			
10	fits	normal machining	
12.5~25			
50			

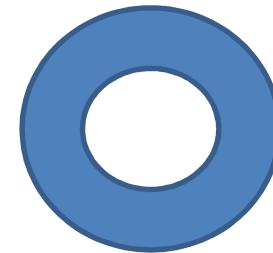
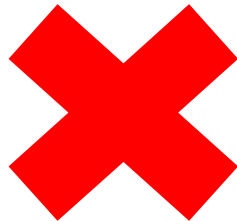
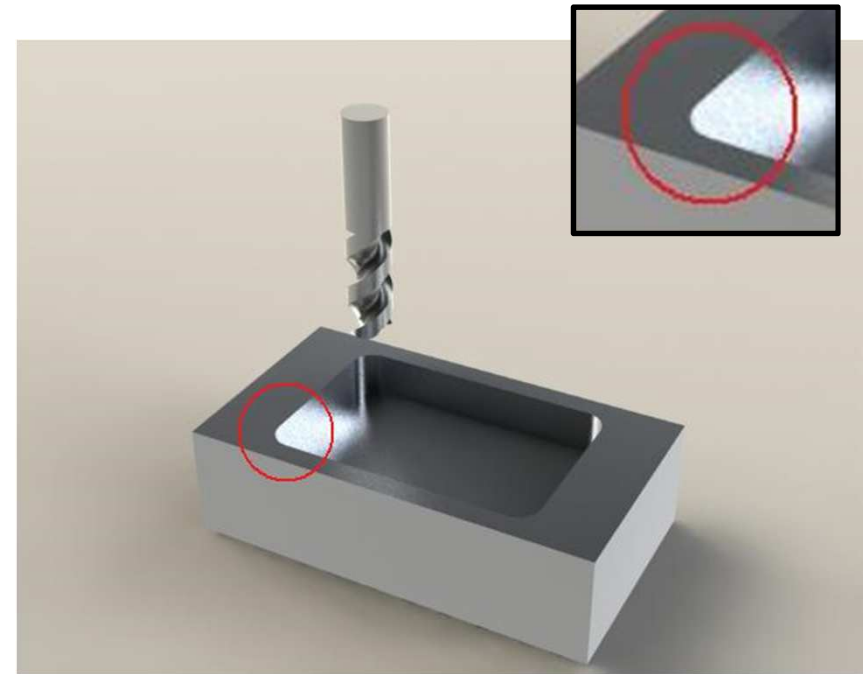
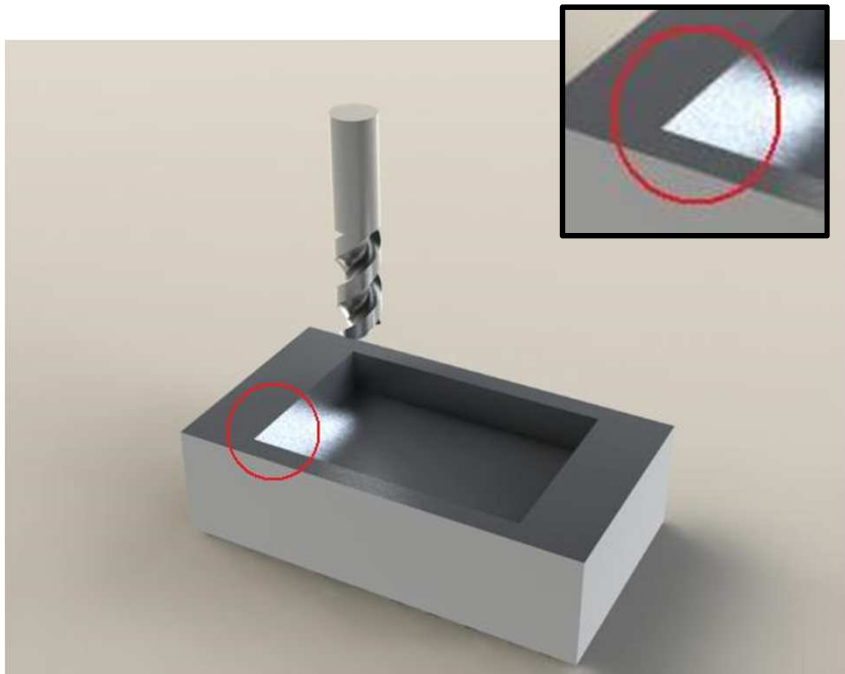
Table 8: Standard numbers of “Ra”.

Mechanical Engineering Drawing Workshop

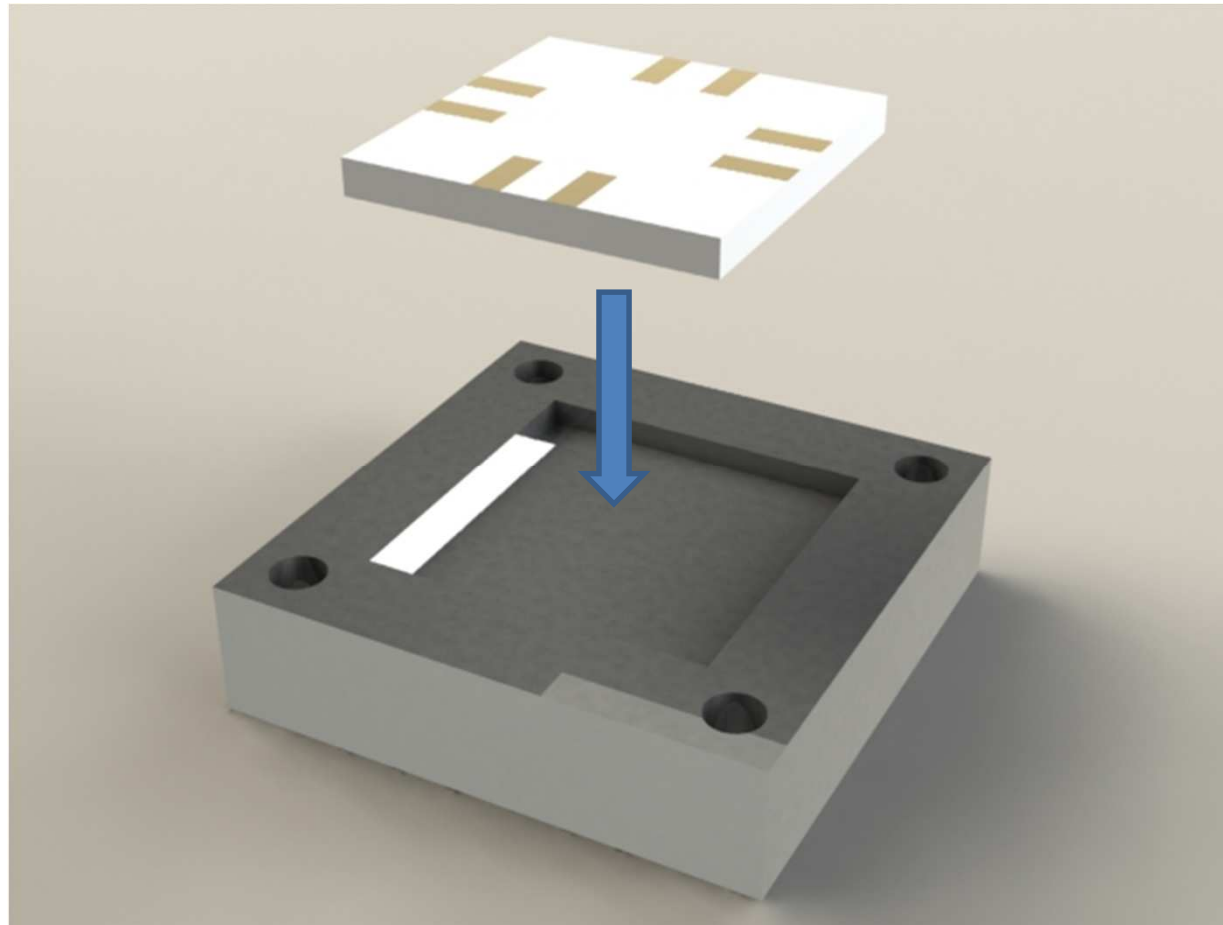
Necessary Knowledge of Actual
Drawing and Design Techniques.

Tips for design

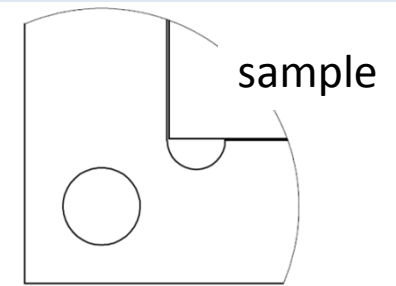
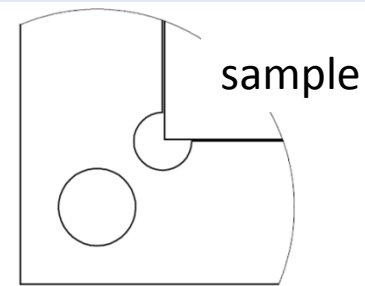
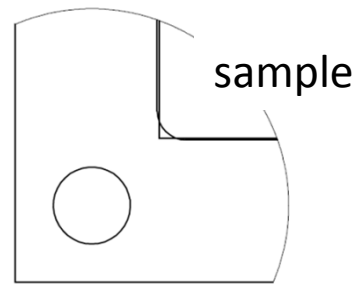
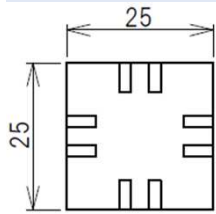
Corner R



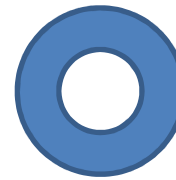
Corner R (sample holder)



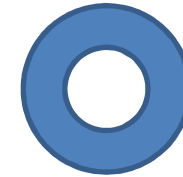
Corner R (sample holder)



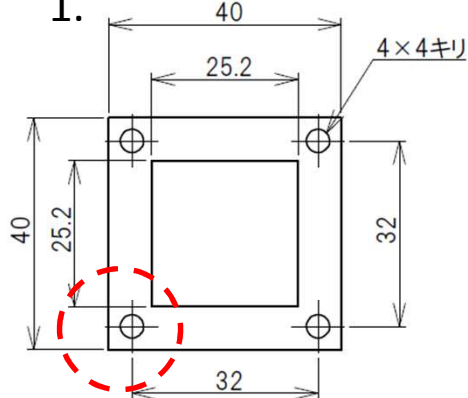
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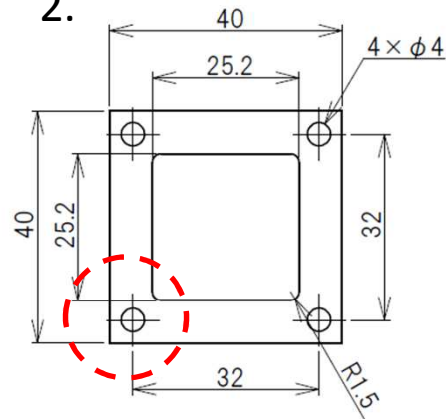
4.



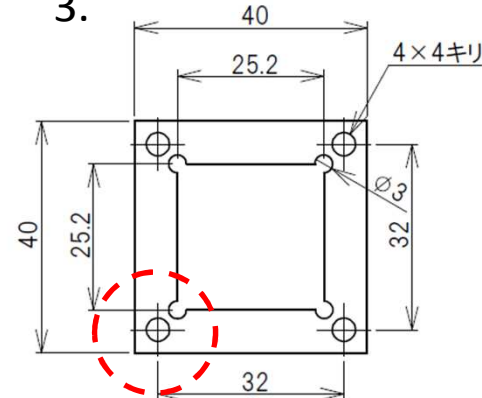
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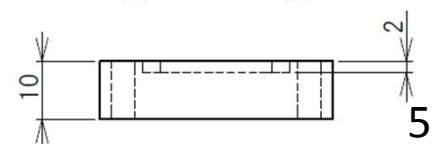
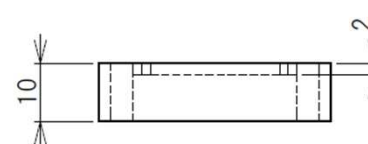
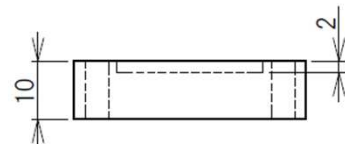
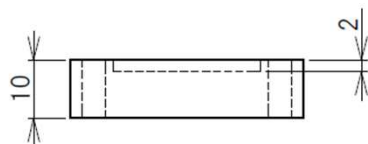
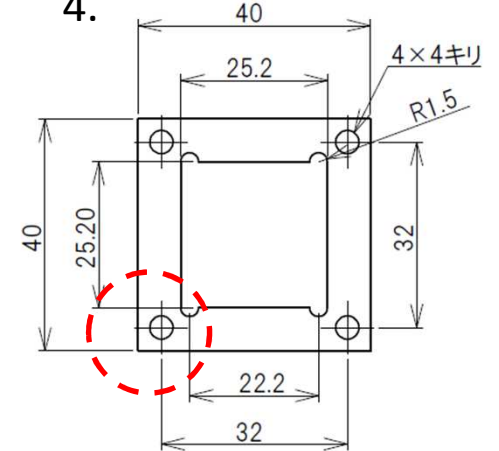
2.



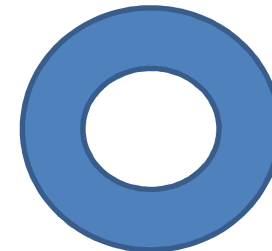
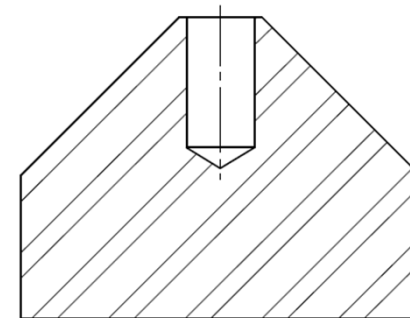
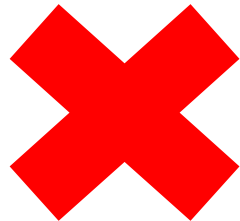
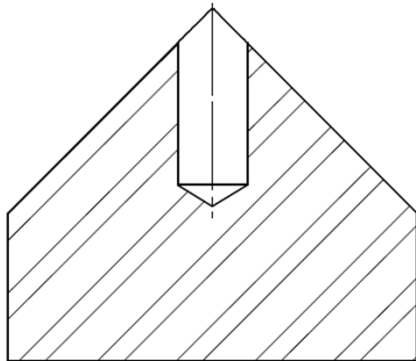
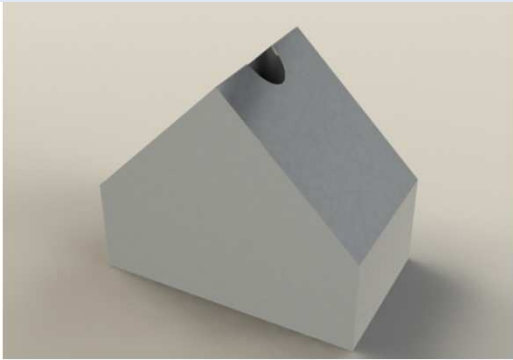
3.



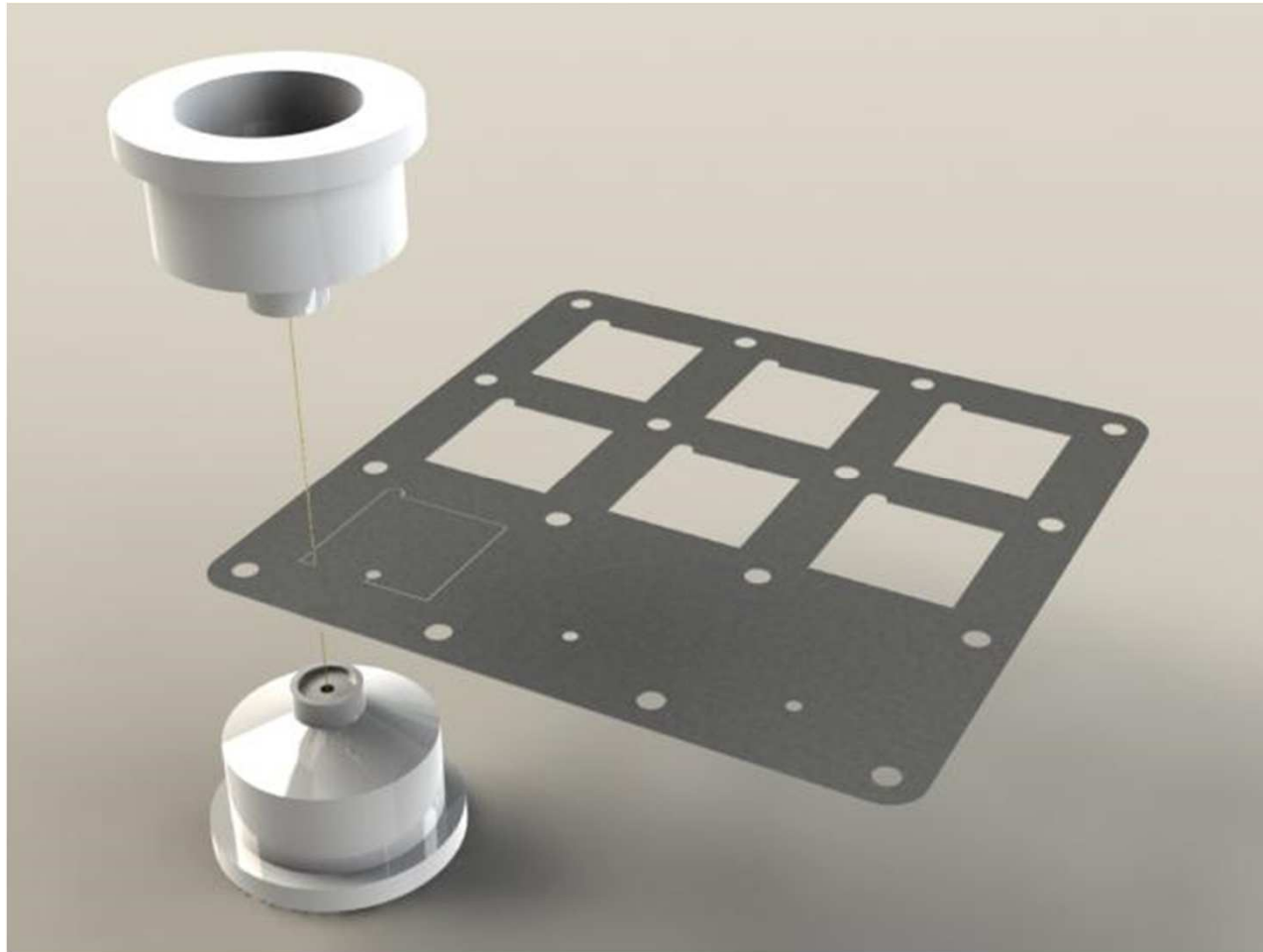
4.



Drilling

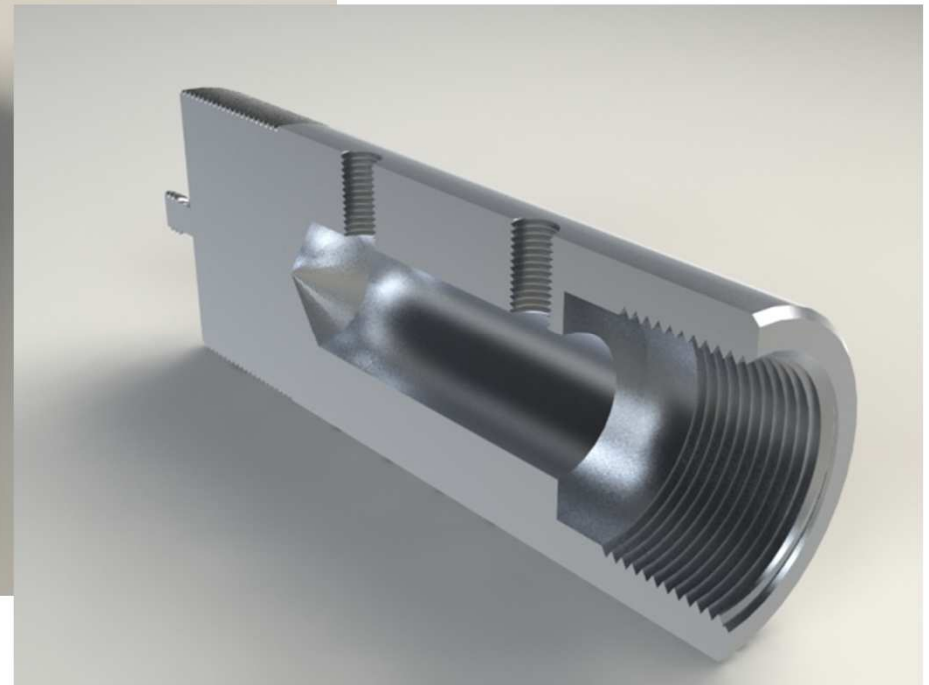
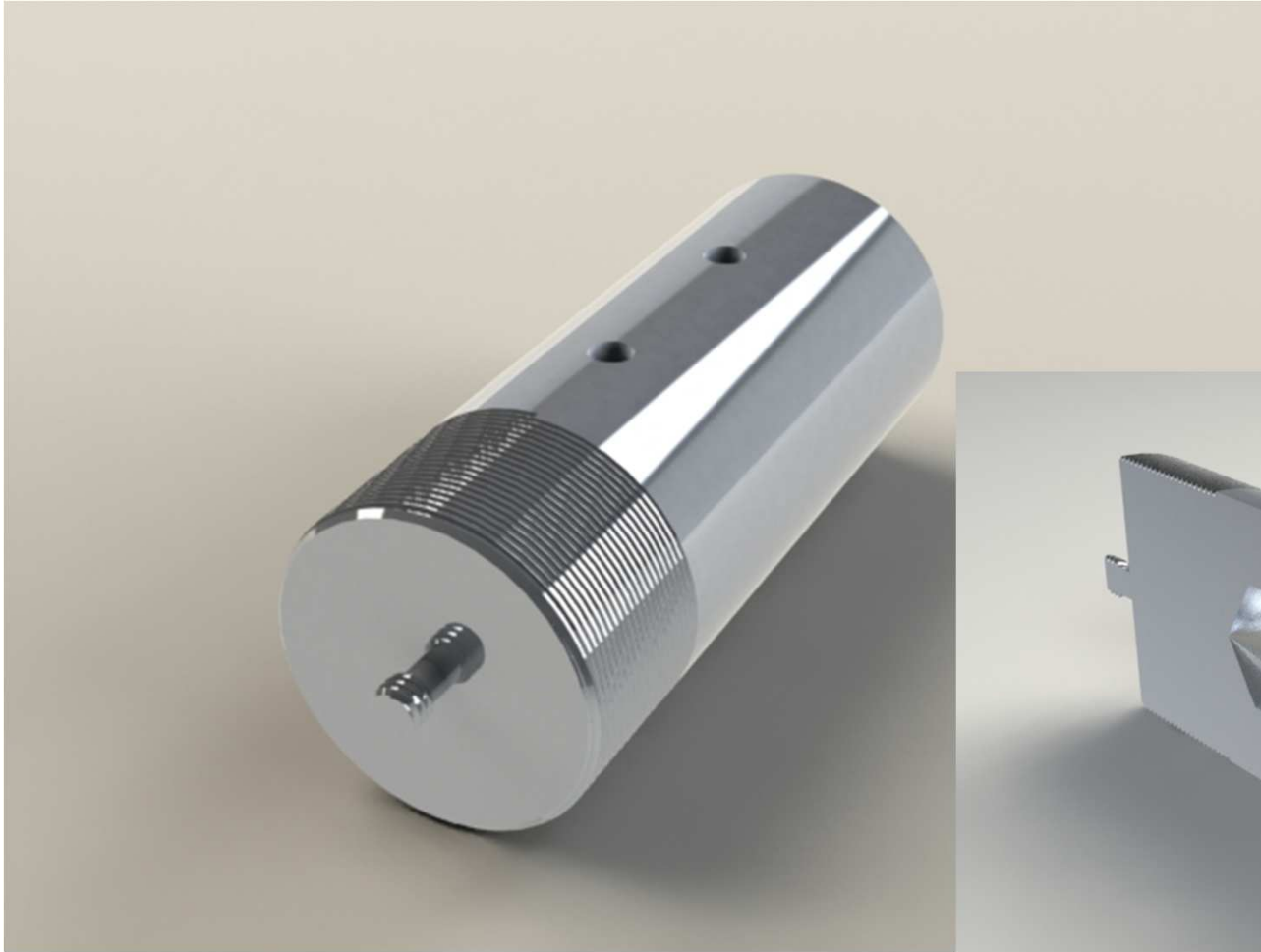


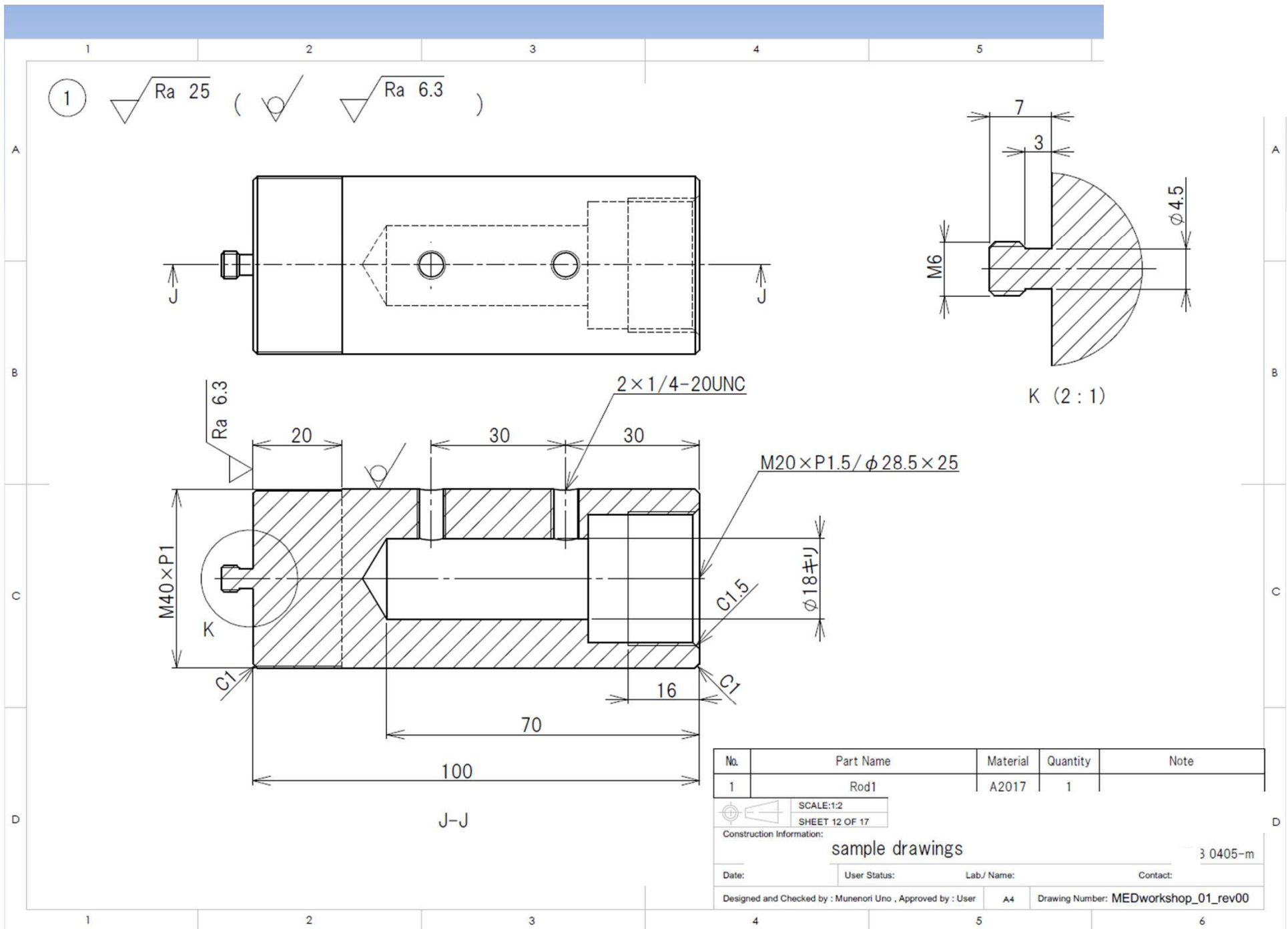
Wire-electrical discharge machining



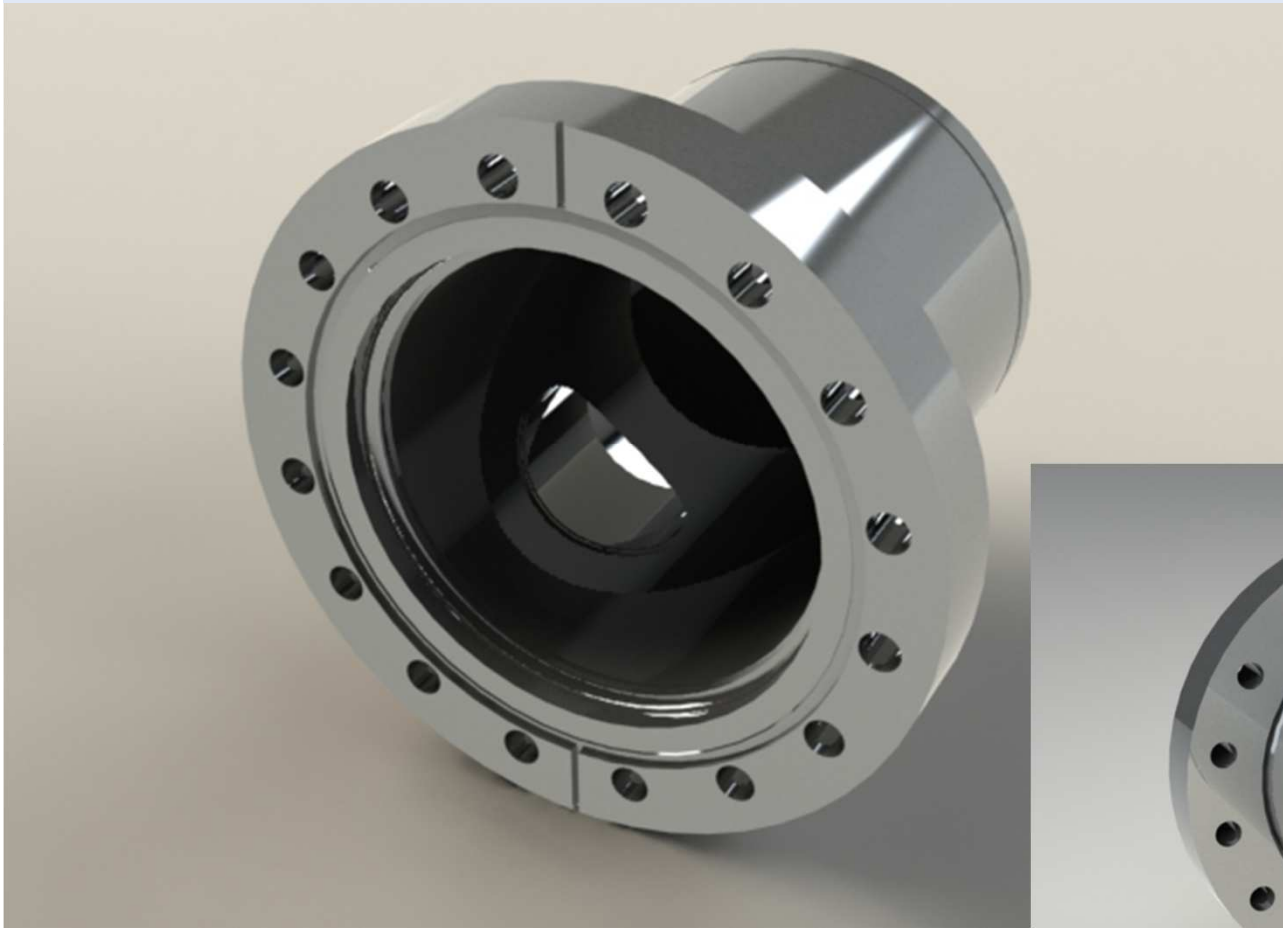
Drawing-samples of major parts

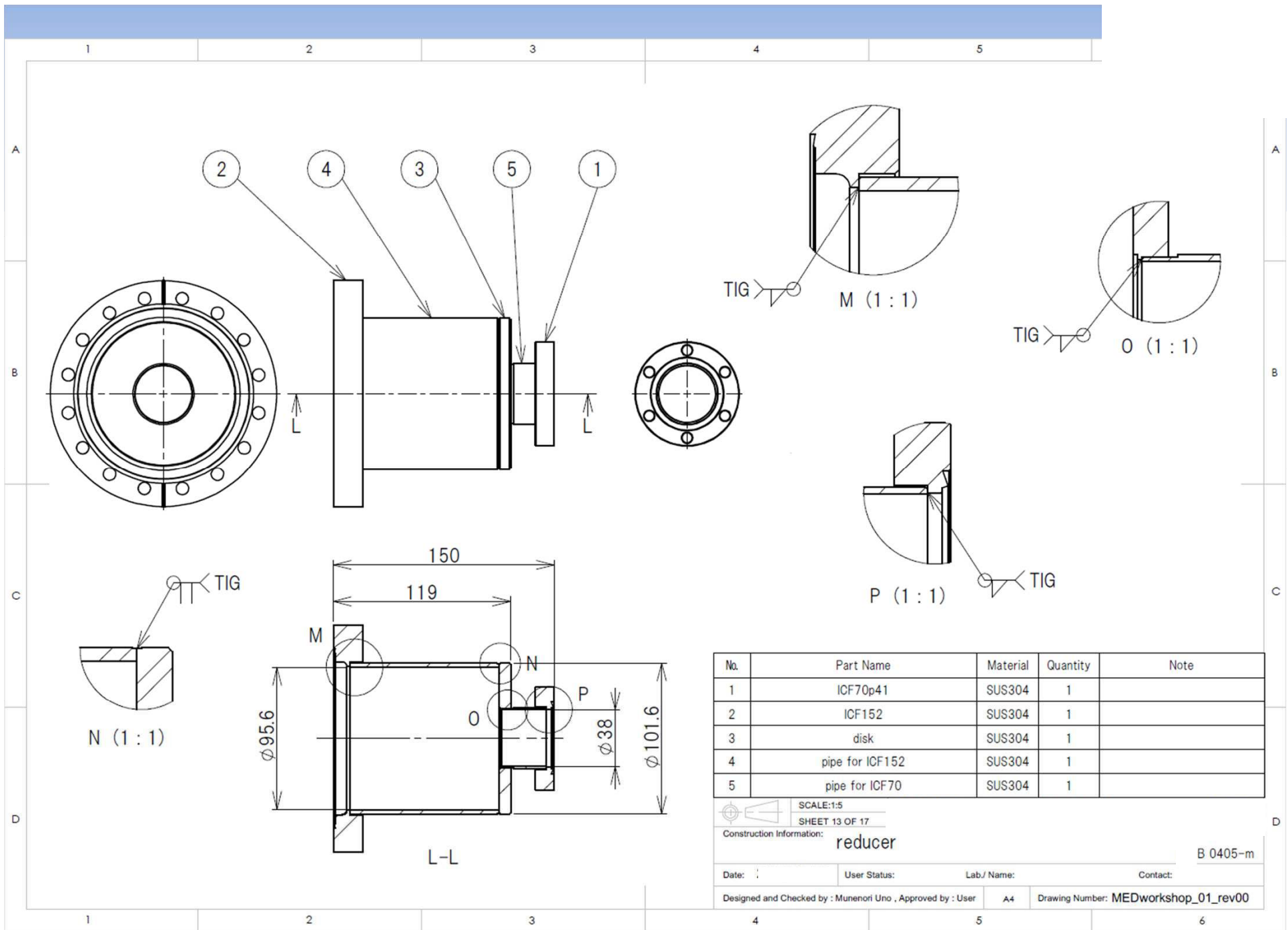
Screw thread



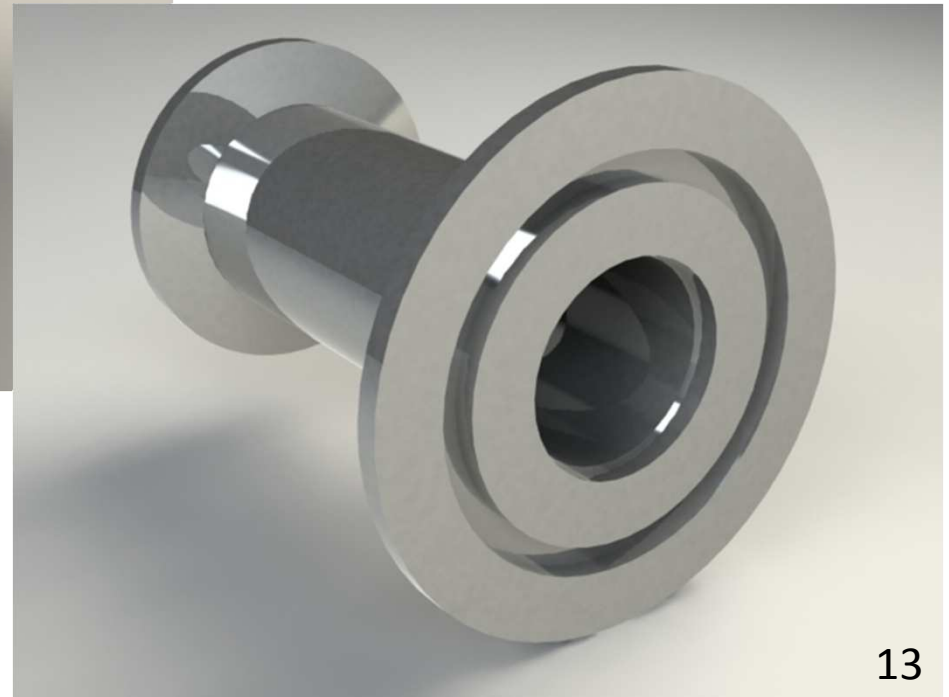
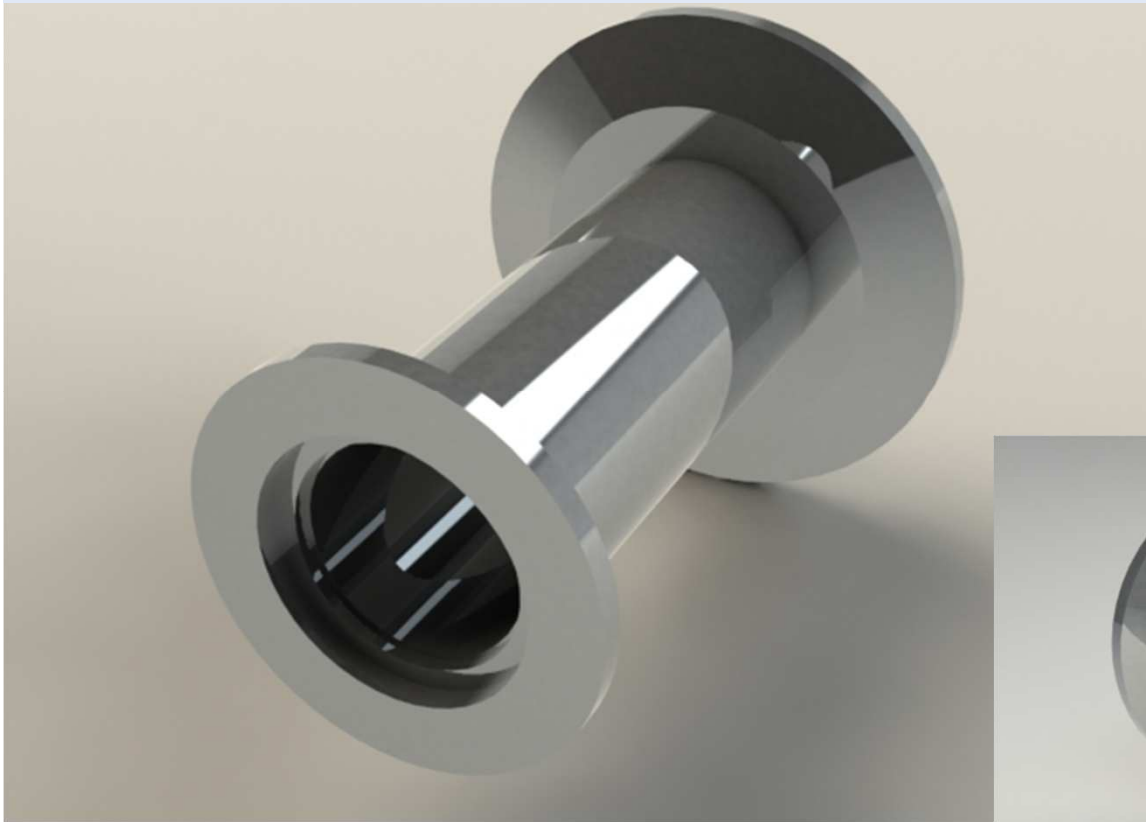


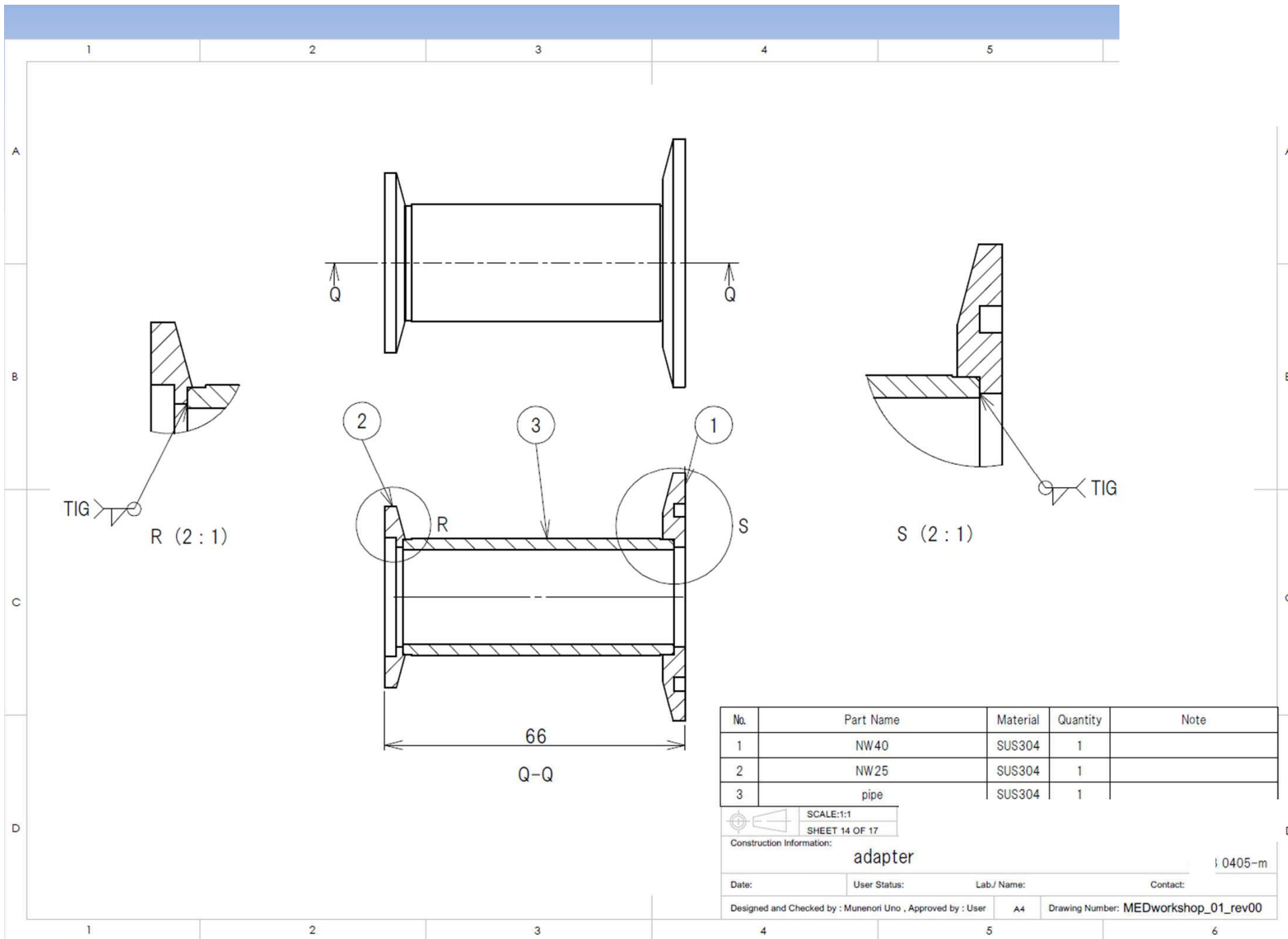
Conflat(CF) metal-seal flange (reducer)



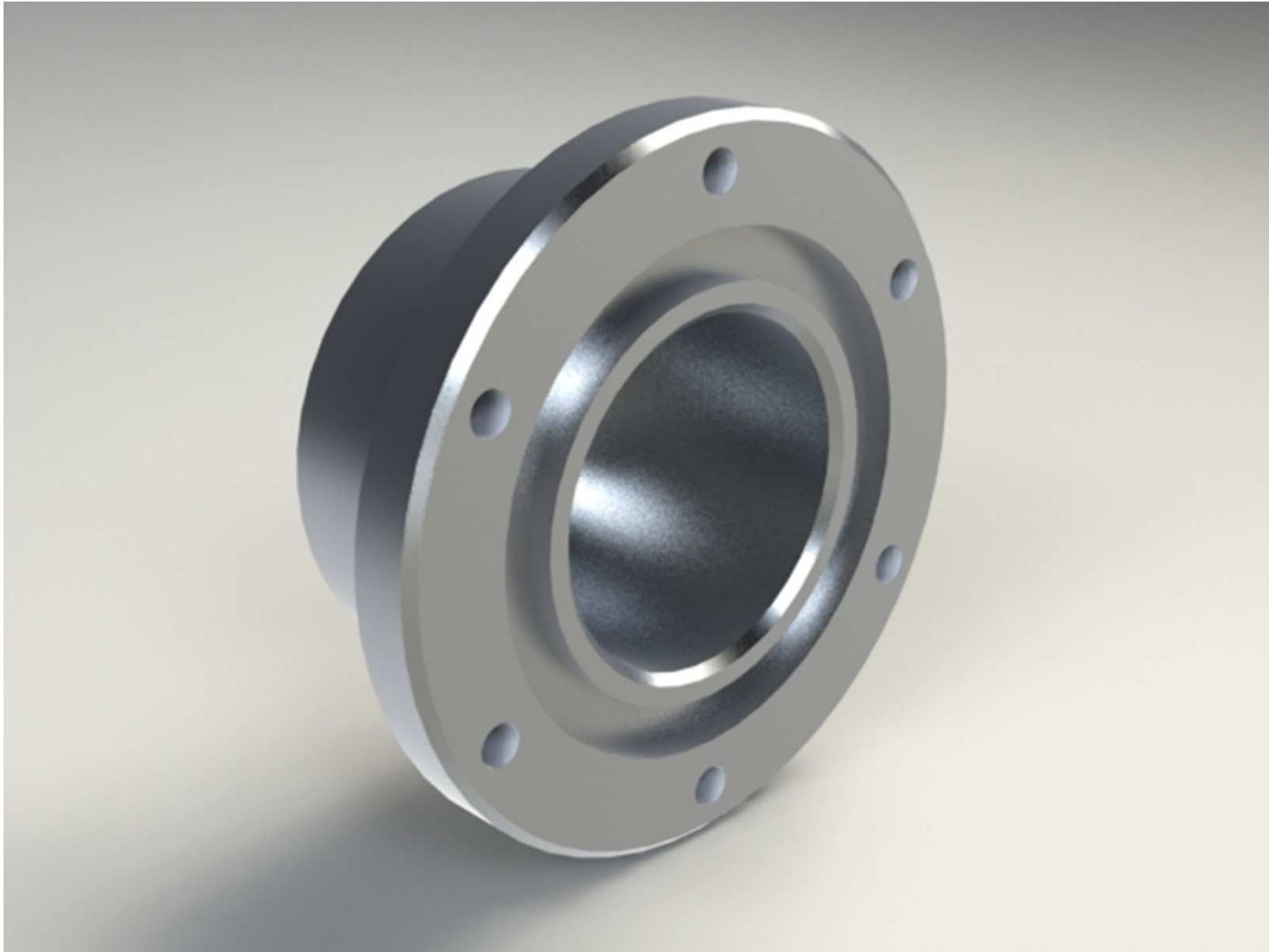


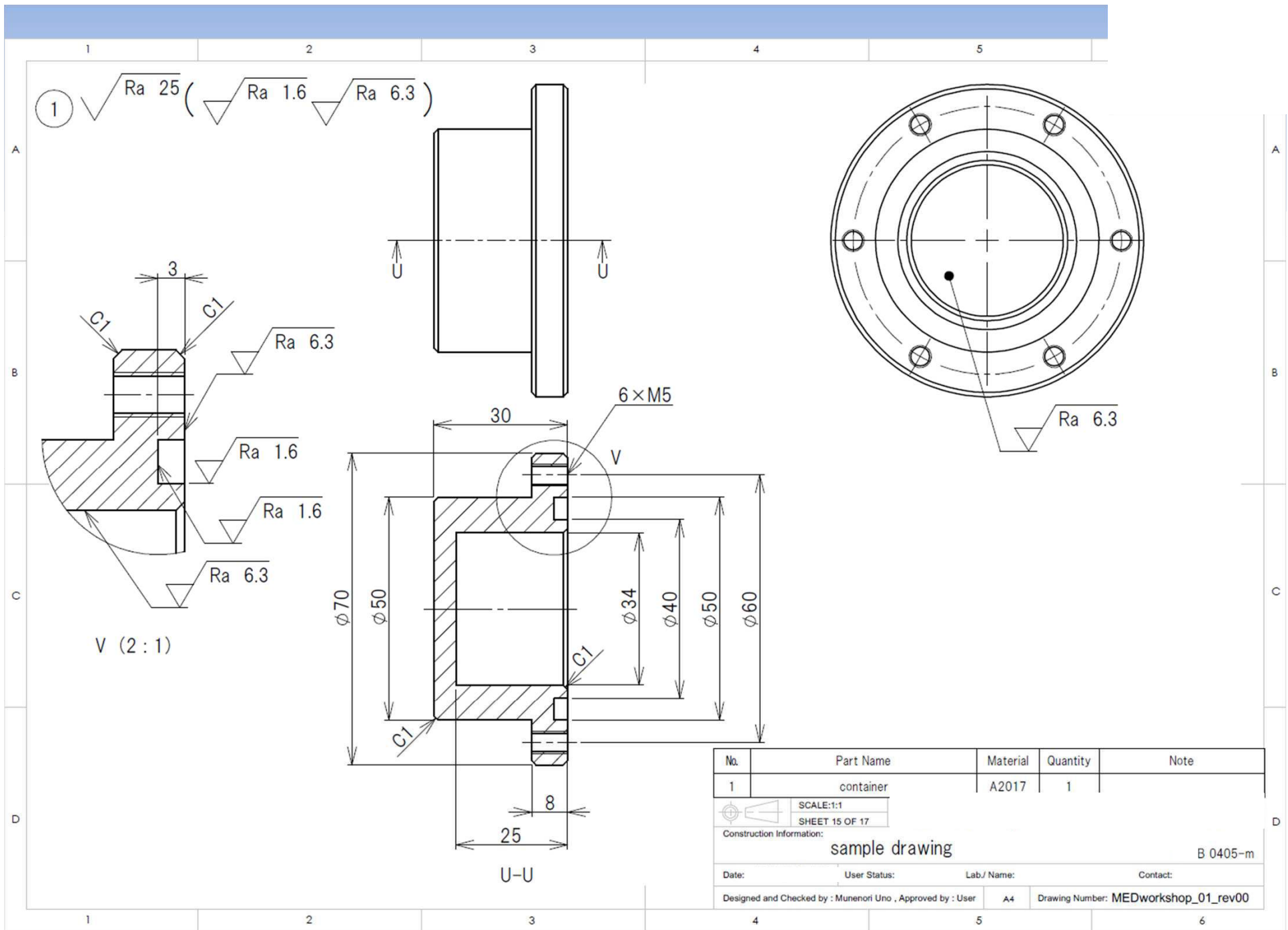
Kwik-flange (KF) (adapter)



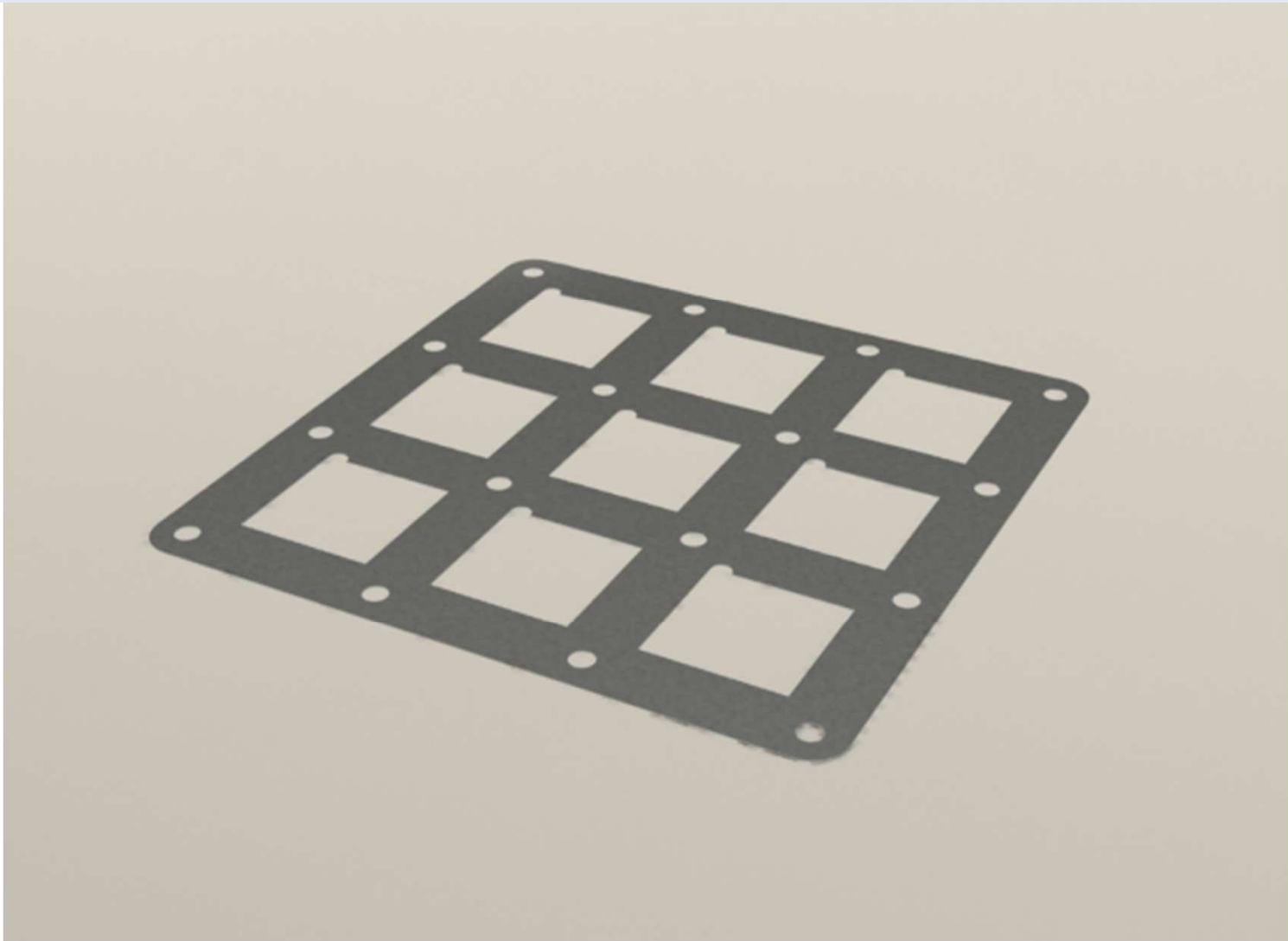


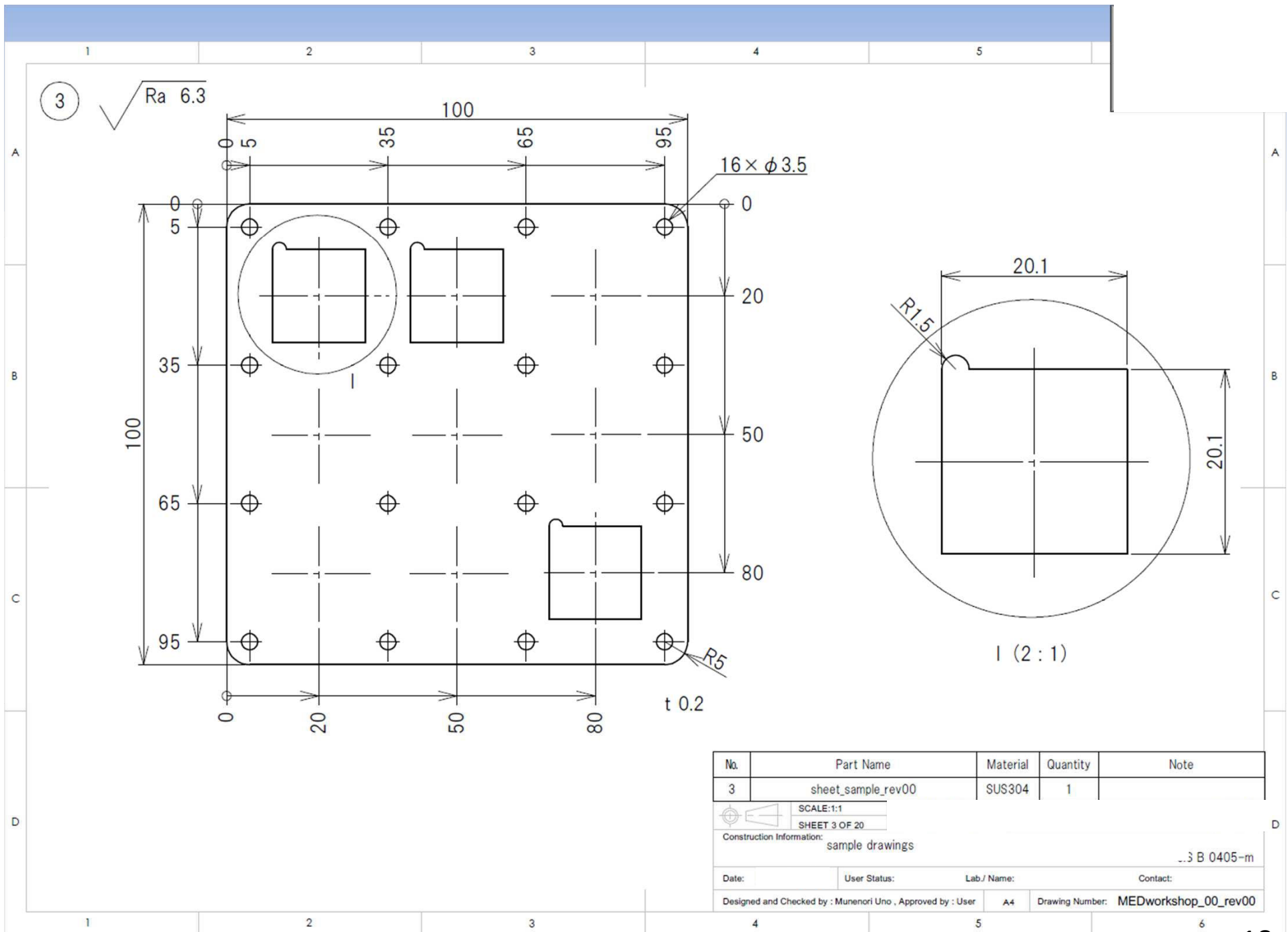
O-ring seal





Mask







Screws

Metric thread and inch thread

Standards	Type of units	Type of pitch
metric coarse thread	metric thread	coarse
metric fine pitch thread		fine
UNC thread	inch thread	coarse
UNF thread		fine

Metric thread:

Triangular screw thread. Diameter and pitch are indicated as mm.
60 degrees thread angle.

Inch thread:

Triangular screw thread. Pitch is indicated as thread/inch.

Coarse thread:

Combination of diameter and pitch is general and used most often.

Fine thread:

This thread type screw is used for special uses.

Metric thread

Name of thread			Pitch										
Priority			Coarse	Fine									
1st	2nd	3rd		3	2	1.5	1.25	1	0.8	0.5	0.35	0.25	0.2
1	–	–	0.25										0.2
–	1.1	–	0.25										0.2
1.2	–	–	0.25										0.2
–	1.4	–	0.3										0.2
1.6	–	–	0.35										0.2
–	1.8	–	0.35										0.2
2	–	–	0.4									0.25	
–	2.2	–	0.45									0.25	
2.5	–	–	0.45								0.35		
3	–	–	0.5								0.35		
–	3.5	–	0.6								0.35		
4	–	–	0.7							0.5			
–	4.5	–	0.75							0.5			
5	–	–	0.8							0.5			
–	–	5.5								0.5			
6	–	–	1						0.8				
–	7	–	1						0.8				
8	–	–	1.25					1	0.8				
–	–	9	1.25					1	0.8				

Metric thread

Name of thread			Pitch										
Priority			Coarse	Fine									
1st	2nd	3rd		3	2	1.5	1.25	1	0.8	0.5	0.35	0.25	0.2
10	–	–	1.5				1.25	1	0.8				
–	–	11	1.5					1	0.8				
12	–	–	1.75			1.5	1.25	1					
–	14	–	2			1.5	1.25	1					
–	–	15				1.5		1					
16	–	–	2			1.5		1					
–	–	17				1.5		1					
–	18	–	2.5		2	1.5		1					
20	–	–	2.5		2	1.5		1					
–	22	–	2.5		2	1.5		1					
24	–	–	3		2	1.5		1					
–	–	25			2	1.5		1					
–	–	26				1.5							
–	27	–	3		2	1.5		1					
–	–	28			2	1.5		1					
30	–	–	3.5	(3)	2	1.5		1					
–	–	32			2	1.5							
–	33	–	3.5	(3)	2	1.5							
–	–	35				1.5							
36	–	–	4	3	2	1.5							
–	–	38				1.5							
–	39	–	4	3	2	1.5							

UNC thread

Name of thread		Thread/inch	Pitch	Diameter
1st priority	2nd priority			
No. 2 - 56 UNC	No. 1 - 64 UNC	64	0.3969	1.854
		56	0.4536	2.184
	No. 3 - 48 UNC	48	0.5292	2.515
No. 4 - 40 UNC		40	0.6350	2.845
No. 5 - 40 UNC		40	0.6350	3.175
No. 6 - 32 UNC		32	0.7938	3.505
No. 8 - 32 UNC	No. 12 - 24 UNC	32	0.7938	4.166
No. 10 - 24 UNC		24	1.0583	4.826
		24	1.0583	5.486
1/4 - 20 UNC		20	1.2700	6.350
5/16 - 18 UNC		18	1.4111	7.938
3/8 - 16 UNC		16	1.5875	9.525
7/16 - 14 UNC		14	1.8143	11.112
1/2 - 13 UNC		13	1.9538	12.700
9/16 - 12 UNC		12	2.1167	14.288
5/8 - 11 UNC		11	2.3091	15.875
3/4 - 10 UNC		10	2.5400	19.050
7/8 - 9 UNC		9	2.8222	22.225

UNC thread

Name of thread		Thread/inch	Pitch	Diameter
1st priority	2nd priority			
1 - 8 UNC		8	3.1750	25.400
1 1/8 - 7 UNC		7	3.6286	28.575
1 1/4 - 7 UNC		7	3.6286	31.750
1 3/8 - 6 UNC		6	4.2333	34.925
1 1/2 - 6 UNC		5	4.2333	38.100
1 3/4 - 5 UNC		4 1/2	5.0800	44.450
2 - 4 1/2 UNC		4 1/2	5.6444	50.800
2 1/4 - 4 1/2 UNC		4	5.6444	57.150
2 1/2 - 4 UNC		4	6.3500	63.500
2 3/4 - 4 UNC		4	6.3500	69.850
3 - 4 UNC		4	6.3500	76.200
3 1/4 - 4 UNC		4	6.3500	82.550
3 1/2 - 4 UNC		4	6.3500	88.900
3 3/4 - 4 UNC		4	6.3500	95.250
4 - 4 UNC		4	6.3500	101.600

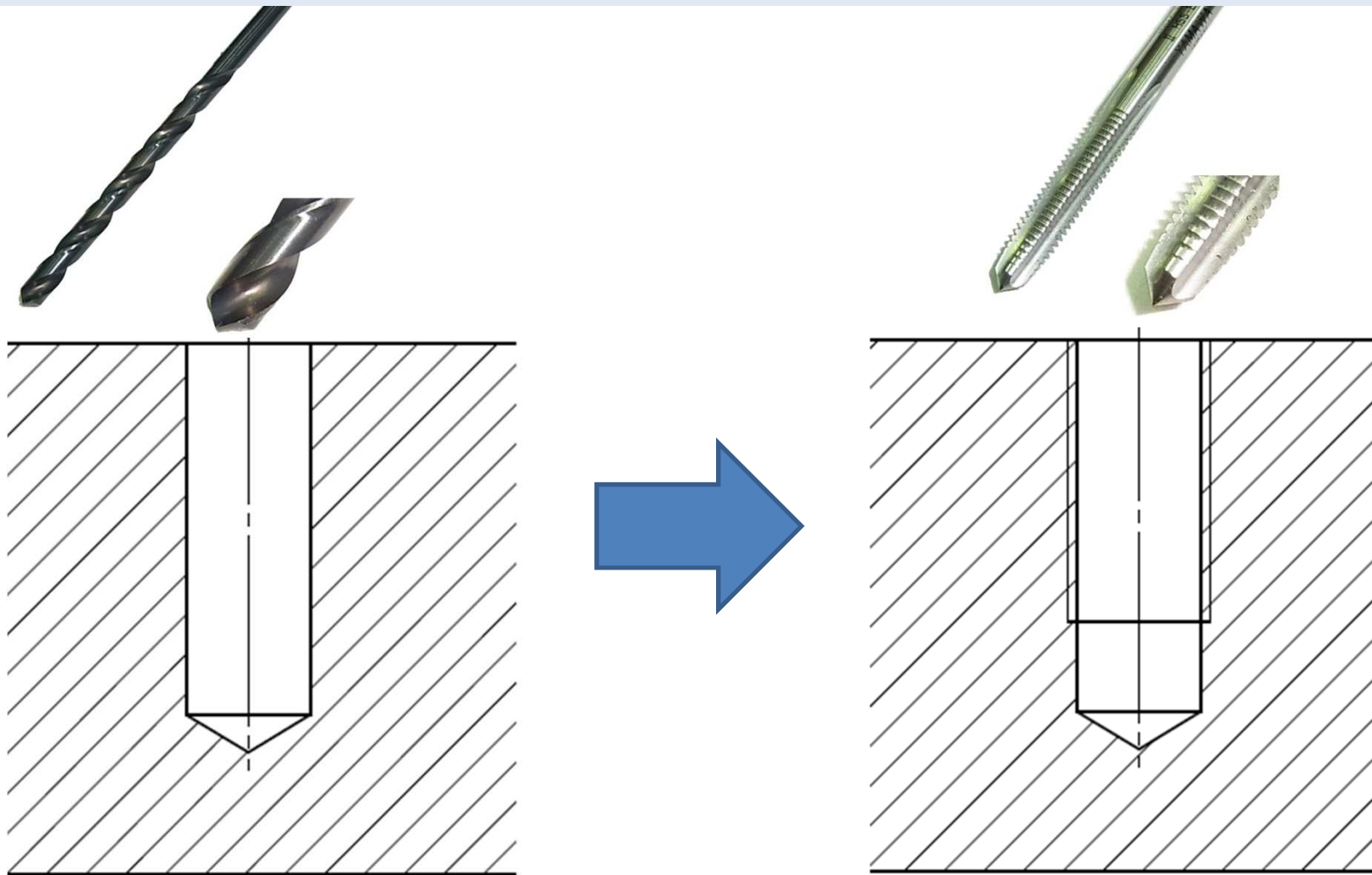
UNF thread

Name of thread		Thread/inch	Pitch	Diameter
1st priority	2nd priority			
No. 0 - 80 UNF	No. 1 - 72 UNF	80	0.3175	1.524
		72	0.3528	1.854
No. 2 - 64 UNF		64	0.3969	2.184
	No. 3 - 56 UNF	56	0.4536	2.515
No. 4 - 48 UNF		48	0.5292	2.845
No. 5 - 44 UNF		44	0.5773	3.175
No. 6 - 40 UNF		40	0.6350	3.505
No. 8 - 36 UNF		36	0.7056	4.166
No. 10 - 32 UNF		32	0.7938	4.826
	No. 12 - 28 UNF	28	0.9071	5.486
1/4 - 28 UNF		28	0.9071	6.350
5/16 - 24 UNF		24	1.0583	7.938

UNF thread

Name of thread		Thread/inch	Pitch	Diameter
1st priority	2nd priority			
No. 0 - 80 UNF	No. 1 - 72 UNF	80	0.3175	1.524
		72	0.3528	1.854
No. 2 - 64 UNF		64	0.3969	2.184
	No. 3 - 56 UNF	56	0.4536	2.515
No. 4 - 48 UNF		48	0.5292	2.845
No. 5 - 44 UNF		44	0.5773	3.175
No. 6 - 40 UNF		40	0.6350	3.505
No. 8 - 36 UNF		36	0.7056	4.166
No. 10 - 32 UNF		32	0.7938	4.826
	No. 12 - 28 UNF	28	0.9071	5.486
1/4 - 28 UNF		28	0.9071	6.350
5/16 - 24 UNF		24	1.0583	7.938

Internal thread



Flanges for vacuum

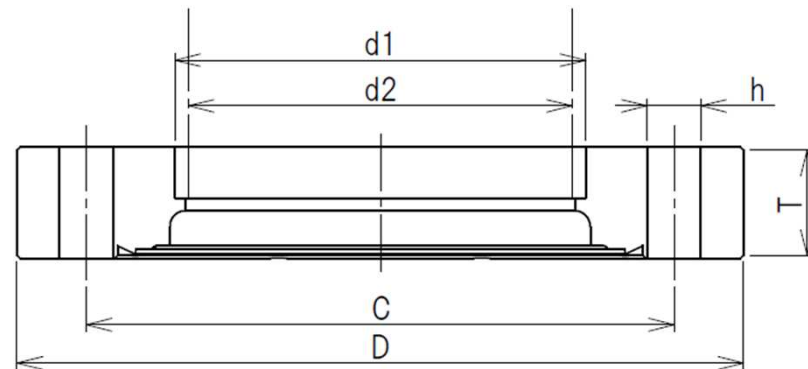
Conflat(CF) metal-seal flange

Conflat metal-seal flange is patented by Varian.

This flange is used for UHV (10^{-6}Pa ~).
Usually, they are called “ICF” + diameter of flange, for example “ICF70”.



Standard of conflat(CF) metal-seal flange



(mm)

Diameter D	Thickness T	Bolt hole			Pipe to weld	
		Quantity	h	C	O.D. d1	I.D. d2
34	7.5	6	4.5	27	19.1	16.7
70	12.7	6	6.7	58.7	41	38
114	17.5	8	8.4	92.2	63.5	60.2
152	20	16	8.4	130.3	101.6	95.6
203	22	20	8.4	181.1	153	147
253	25	24	8.4	231.9	203	197
305	28	32	8.4	284	250	244

JIS flange (VF/VG)

Features

O-ring sealing

There are VG type and VF type flanges.

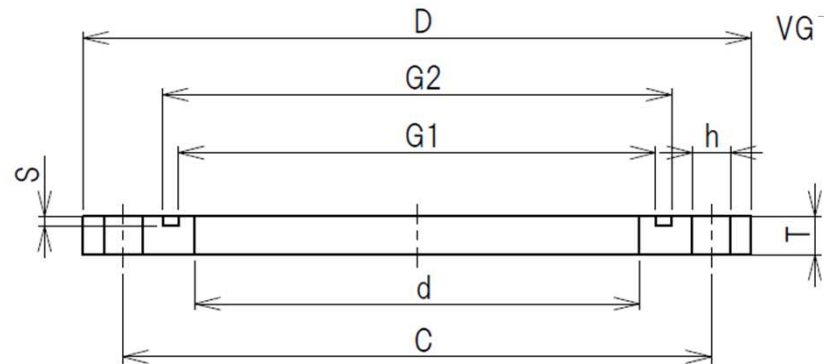
VG has gasket groove. VF has no gasket groove.

Used from low vacuum to high vacuum.

They are called VF70, VG200, etc.



Standard of flange



Name	Diameter D	Thickness T		Bolt holes			Groove			Pipe O.D. d
		Casting	Other	Quantity	Diameter h	P.C.D. C	I.D. G1	O.D. G2	Depth S	
10	70	10	8	4	10	50	24	34	3	17.3
20	80	10	8	4	10	60	34	44	3	27.2
25	90	10	8	4	10	70	40	50	3	34.0
40	105	12	10	4	10	85	55	65	3	48.6
50	120	12	10	4	10	100	73	80	3	60.5
65	145	12	10	4	12	120	85	95	3	76.3
80	160	14	12	4	12	135	100	110	3	89.1
100	185	14	12	8	12	160	120	130	3	114.3
125	210	14	12	8	12	185	150	160	3	139.8
150	235	14	12	8	12	210	175	185	3	165.2
200	300	18	16	8	15	270	225	241	4.5	216.3
250	350	18	16	12	15	320	275	291	4.5	267.4
300	400	18	16	12	15	370	325	341	4.5	318.5
350	450	-	20	12	15	420	380	396	4.5	355.6
400	520	-	20	12	19	480	430	446	4.5	406.4

Tips for actual drawing

Block for item list

- Block for item list

e.g.

Reference number, part name, material, quantity, note etc.

- Title block

e.g.

Drawing number, title, company or group name, client's name, date, scale, projection method, general tolerance etc.

Block for item list

Title block

No.	Part Name	Material	Quantity	Note
1	ICF70p41	SUS304	1	
2	ICF152	SUS304	1	
3	disk	SUS304	1	
4	pipe for ICF152	SUS304	1	
5	pipe for ICF70	SUS304	1	



SCALE:1:5

SHEET 13 OF 17

Construction Information:

reducer

B 0405-m

Date:

User Status:

Lab./ Name:

Contact:

Designed and Checked by : Munenori Uno , Approved by : User

A4

Drawing Number: MEDworkshop_01_rev00

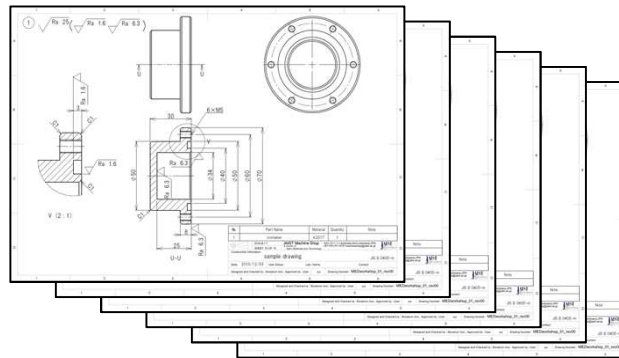
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5

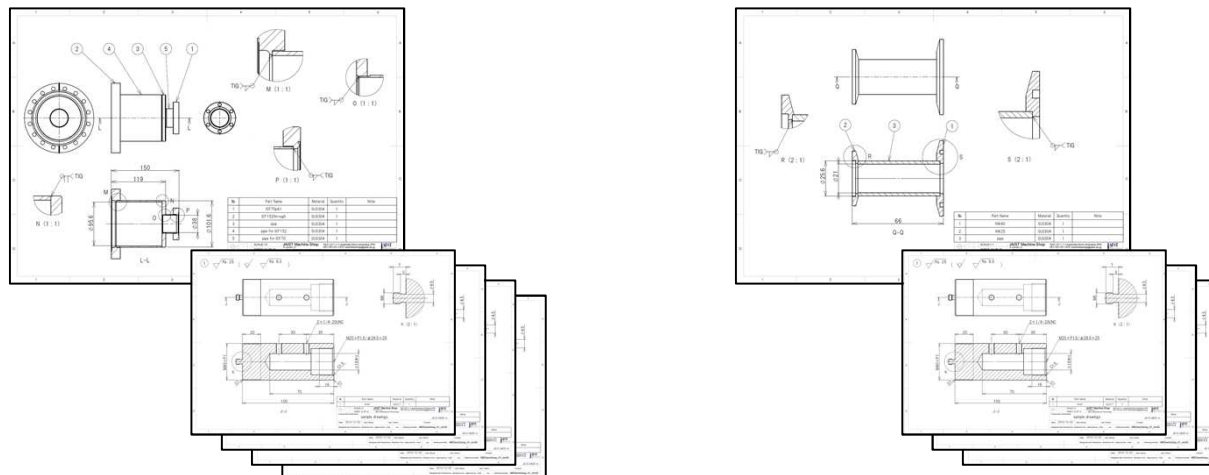
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Part drawing and assembly drawing

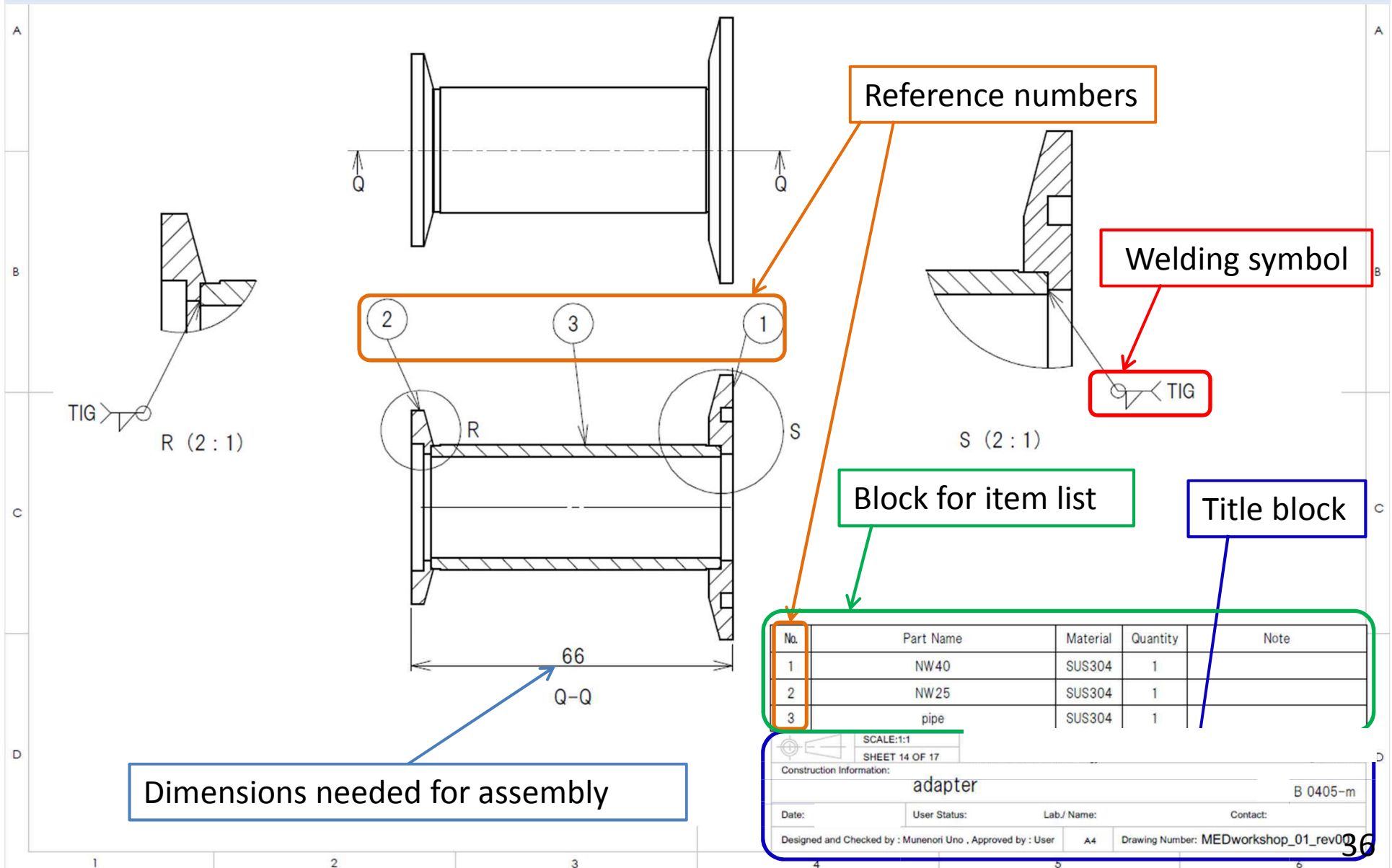
1. Part drawings only



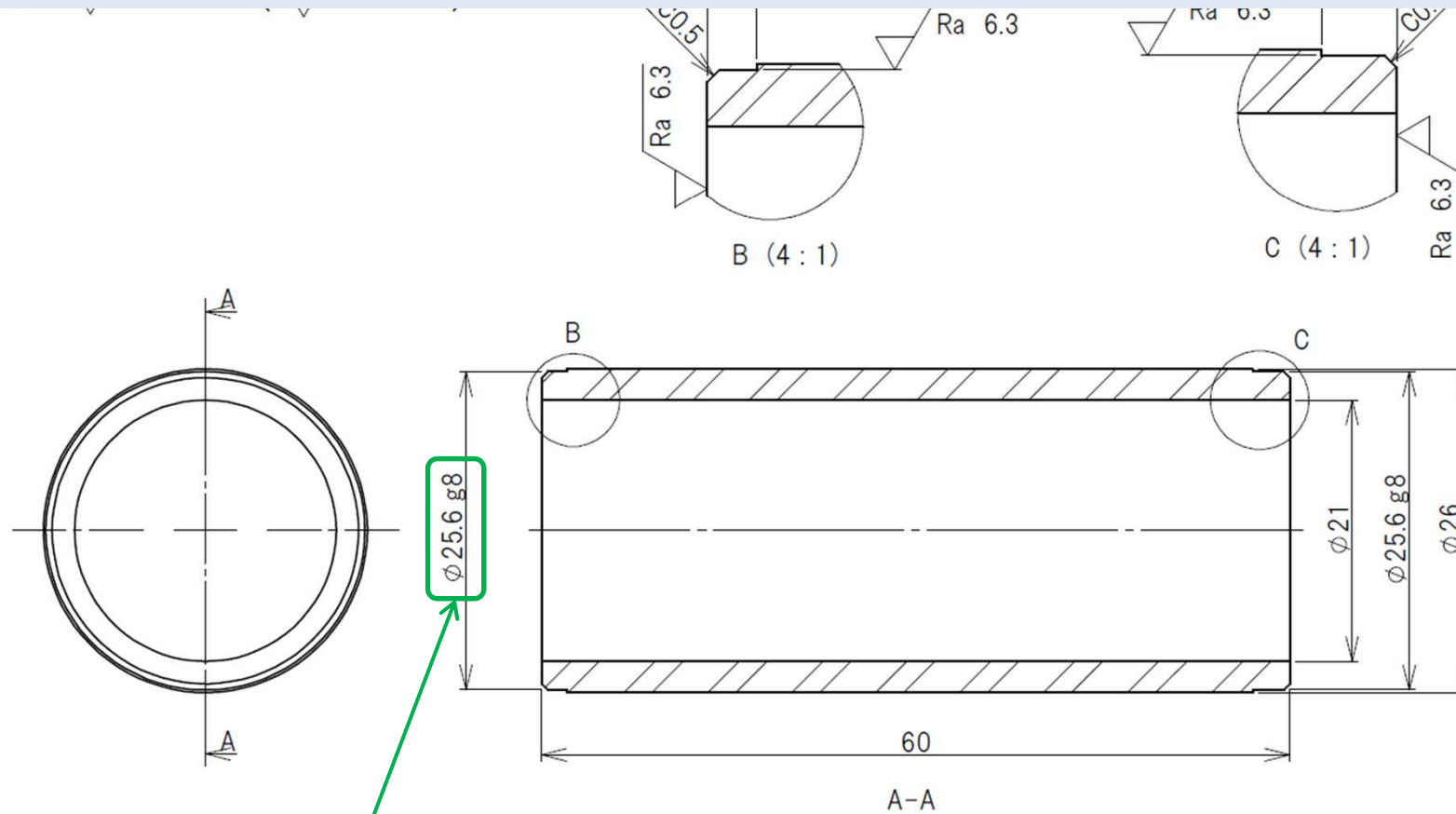
2. Assembly drawings require Part drawings



Assembly drawing



Part drawing



Fit with the flange

No.	Part Name	Material	Quantity	Note
3	pipe	SUS304	1	
 SCALE:1:1 SHEET 2 OF 2 Construction Information: adapter B 0405-m				
Date:		User Status:	Lab./ Name:	Contact:
Designed and Checked by : Munenori Uno , Approved by : User		A4	Drawing Number:	MEDworkshop_02_rev0

Practice

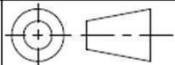


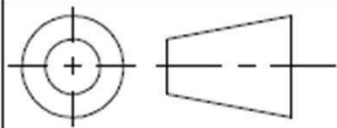




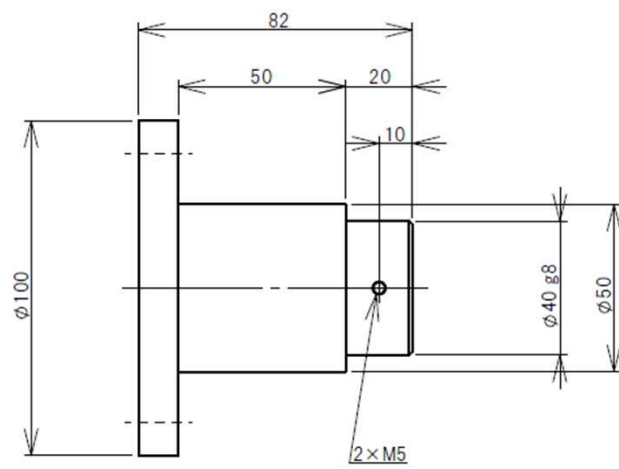
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e-mail:			
drawing title:			
date:	scale:	drawing number:	



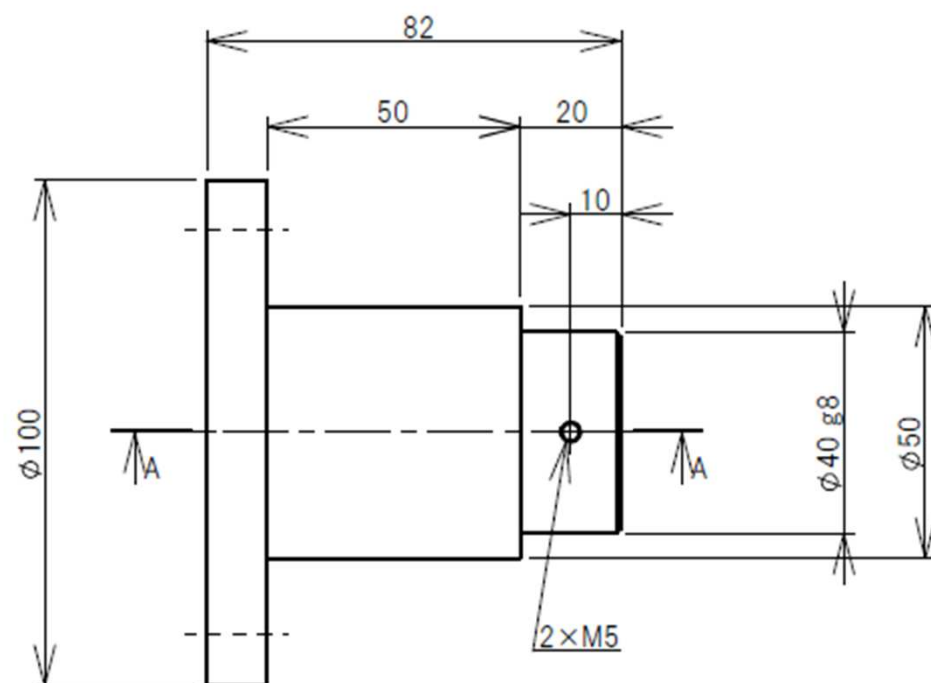
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date:	scale: 1 : 2	drawing number:	

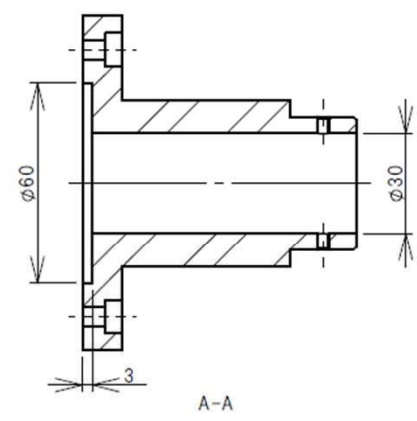
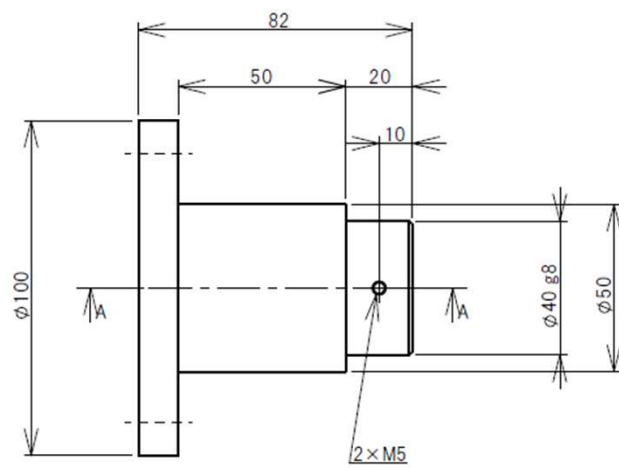
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drawing title: sample drawing			
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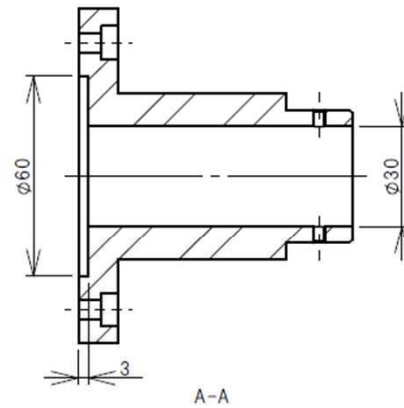
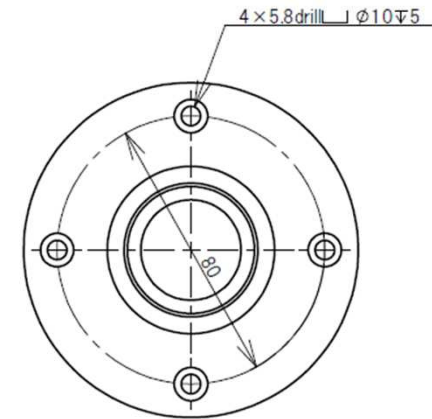
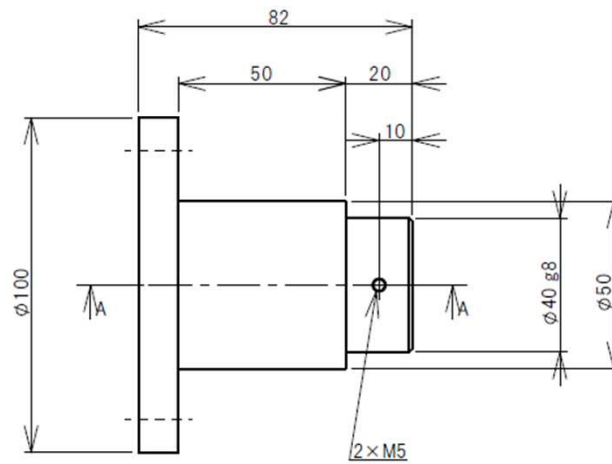


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drawing title: sample drawing			
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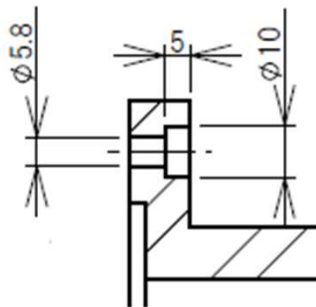




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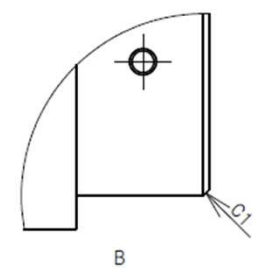
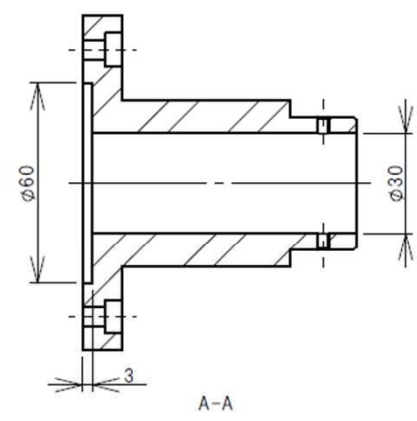
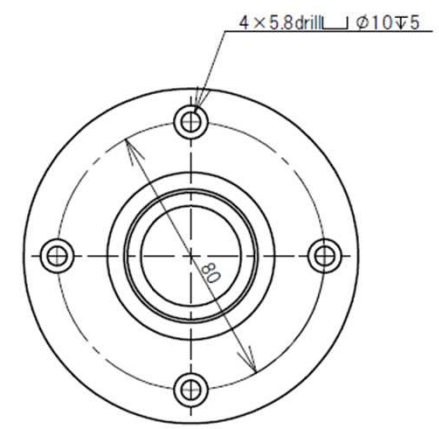
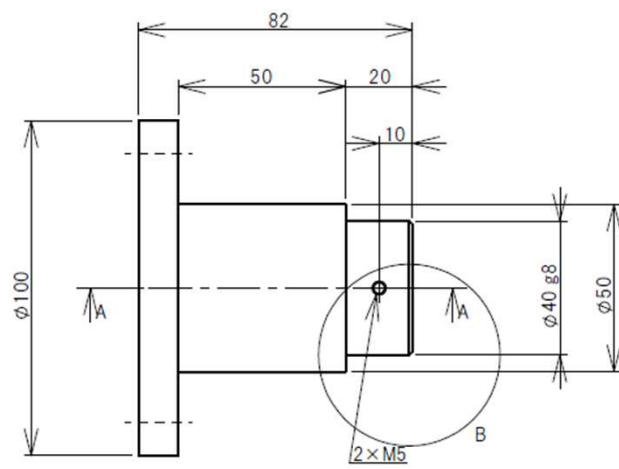
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$\times 4 =$

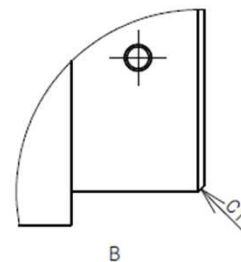
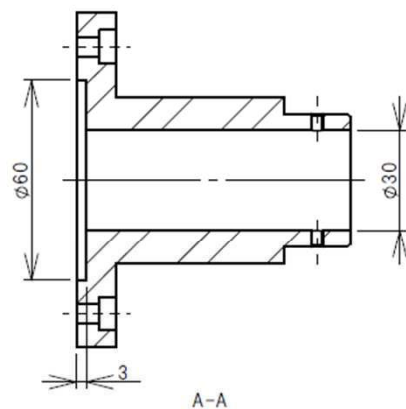
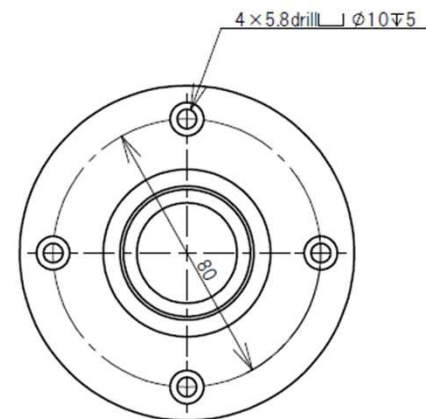
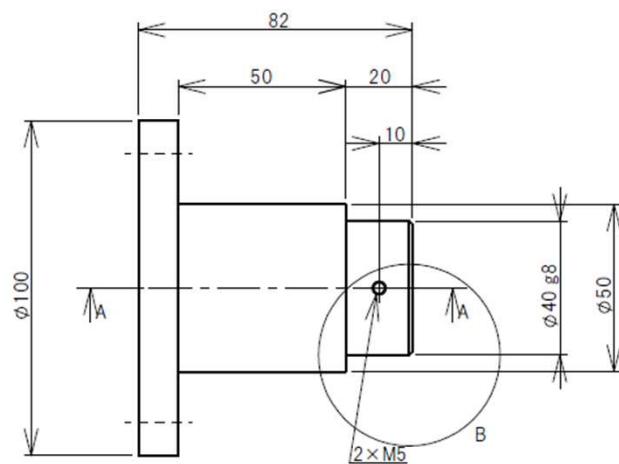


$4 \times 5.8\text{drill} \square \phi 10 \nabla 5$



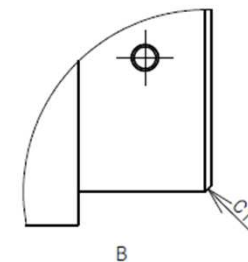
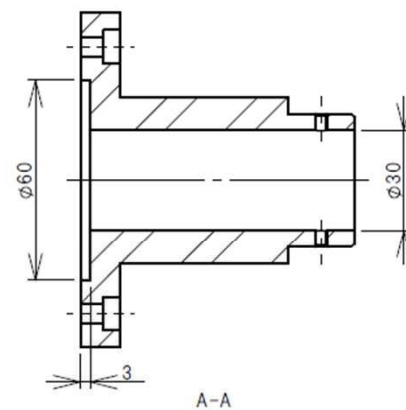
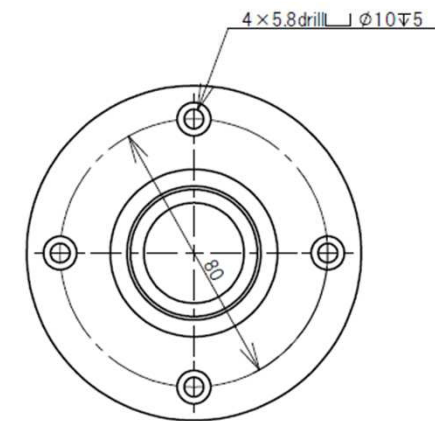
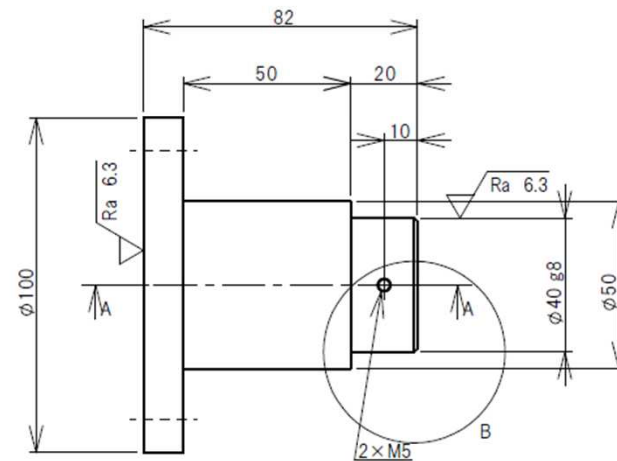
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✓ Ra 25



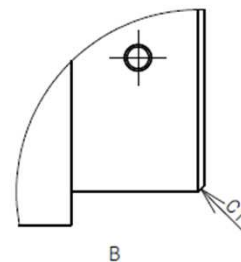
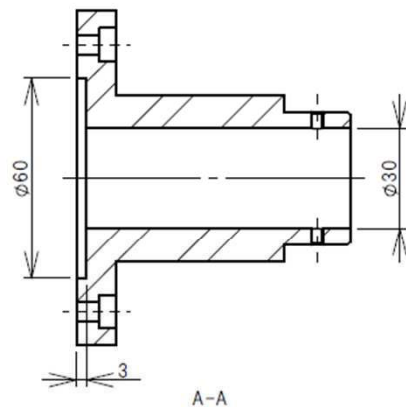
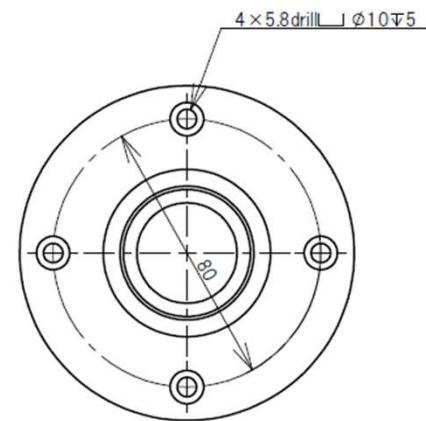
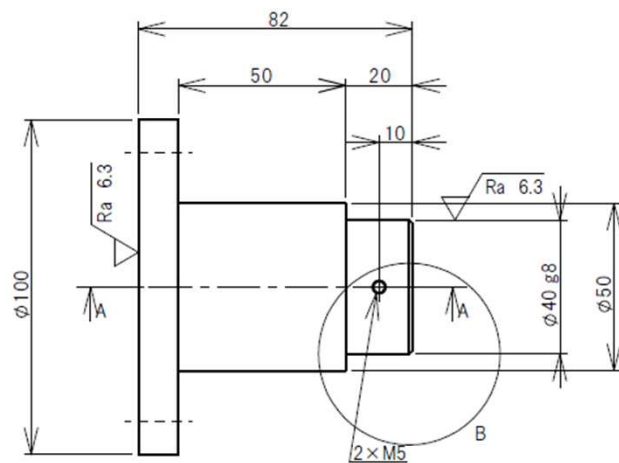
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$\sqrt{Ra\ 25}$ ($\sqrt{Ra\ 6.3}$)



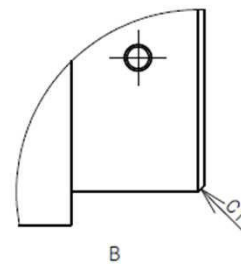
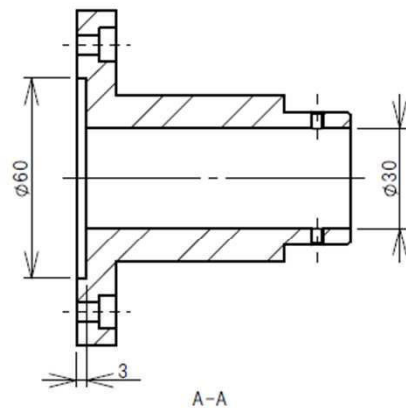
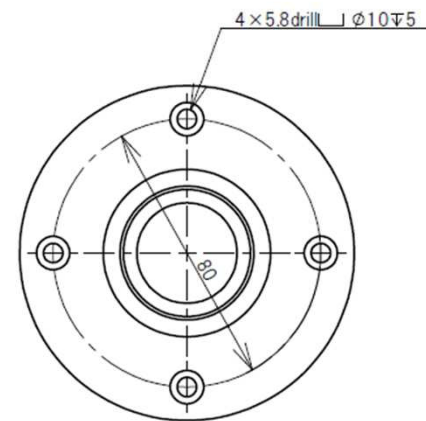
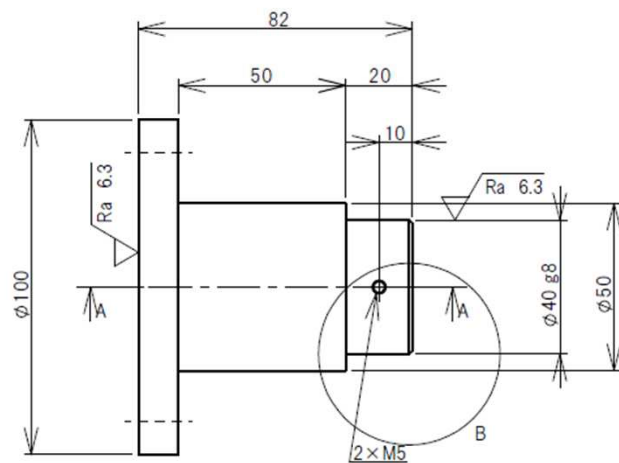
Lab.: Machine	grade: M1	name: Munenori Uno	corporate name: JAIST
drawing title: sample drawing			
date:	scale: 1 : 2	drawing number:	

① $\sqrt{Ra\ 25}$ ($\sqrt{Ra\ 6.3}$)



No.	part name	material	quantity	note
1	sample part	SUS304	1	
Lab.: Machine		grade: M1	name: Munenori Uno	corporate name: JAIST
drawing title: sample drawing				
date:		scale: 1 : 2	drawing number:	

① $\sqrt{Ra\ 25}$ ($\sqrt{Ra\ 6.3}$)



B 0405-m

No.	part name	material	quantity	note
1	sample part	SUS304	1	
Lab.: Machine		grade: M1	name: Munenori Uno	corporate name: JAIST
drawing title: sample drawing				
date:		scale: 1 : 2	drawing number:	