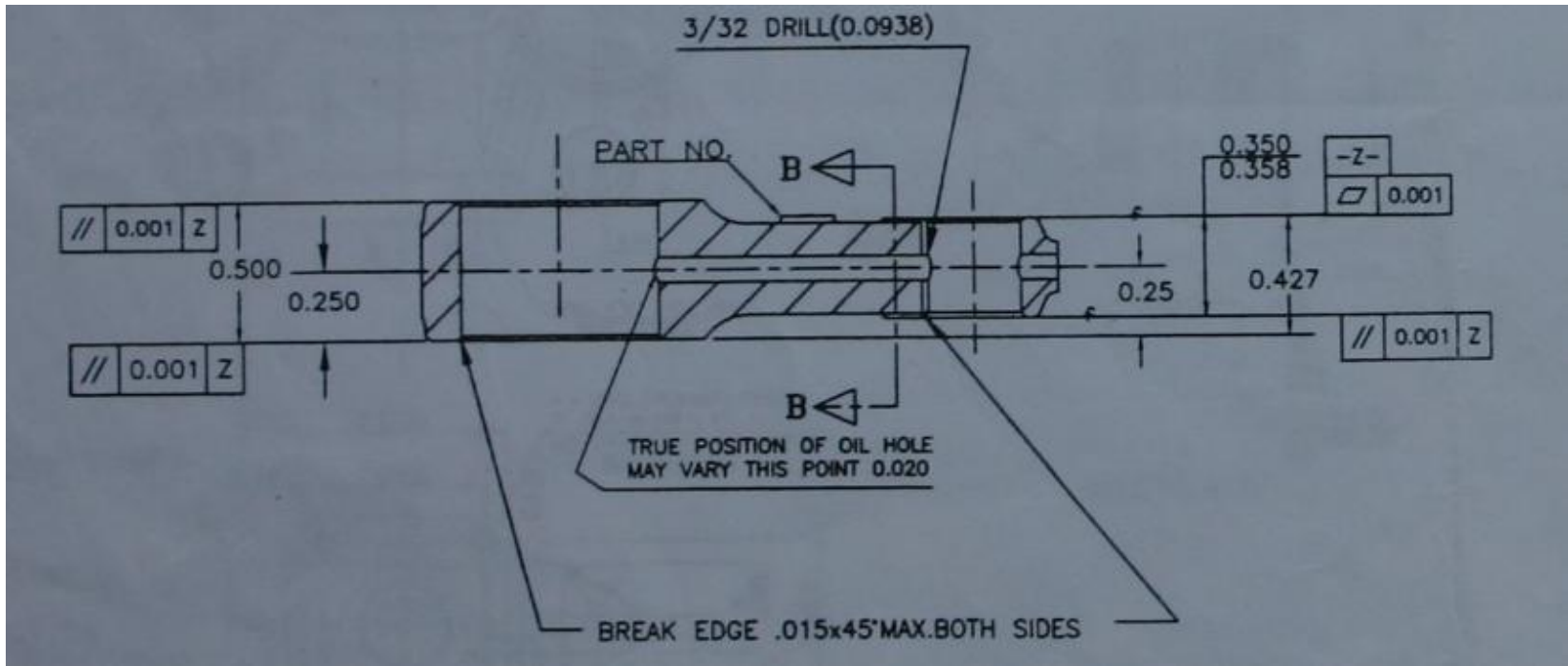# Surface Finish

- An engineering component may be cast, forged, drawn, welded or stamped, etc.

- All the surfaces may not have functional requirements and need not be equally finished

- Some surfaces (owing to their functional requirements) need additional machining that needs to be recorded on the drawing

3/32 DRILL(0.0938)

PART NO.

B

0.350
0.358

-Z-

$\square$ 0.001

// 0.001 Z

0.500

0.250

// 0.001 Z

B

TRUE POSITION OF OIL HOLE
MAY VARY THIS POINT 0.020

0.25

0.427

// 0.001 Z

BREAK EDGE .015x45°MAX.BOTH SIDES

Fig. 8.1 *Tappet in guide*

Labels visible in the figure:

FITTING STRIPS

φ63

φ3

φ50

φ70

φ80

30

30

12

SNUG φ6 .10 LONG

FITTING STRIPS

φ70

φ75

33

φ6 8 DEEP

Screw

M8

Nut

φ28

26

20

6

18

54

Body

Bush

φ22

φ14

R6

1x45°

φ26

6

Valve

68

36

8

a

10

R5

3

18

6.3

20

R5

3.2

8

36

φ22
H7

54

R6

6.3

6.3

6

φ28

42

6.3

3.2

φ14H8

φ22
p6

6.3

6

M8

26

16

3.2

φ14
e8

68

1x45°

φ26

6

6.3

b

Surface Roughness

The geometrical characteristics of a surface include,

      1. Macro-deviations,

      2. Surface waviness, and

      3. Micro-irregularities.

The surface roughness is evaluated by the height, R_t and mean roughness index R_a of the micro-irregularities.
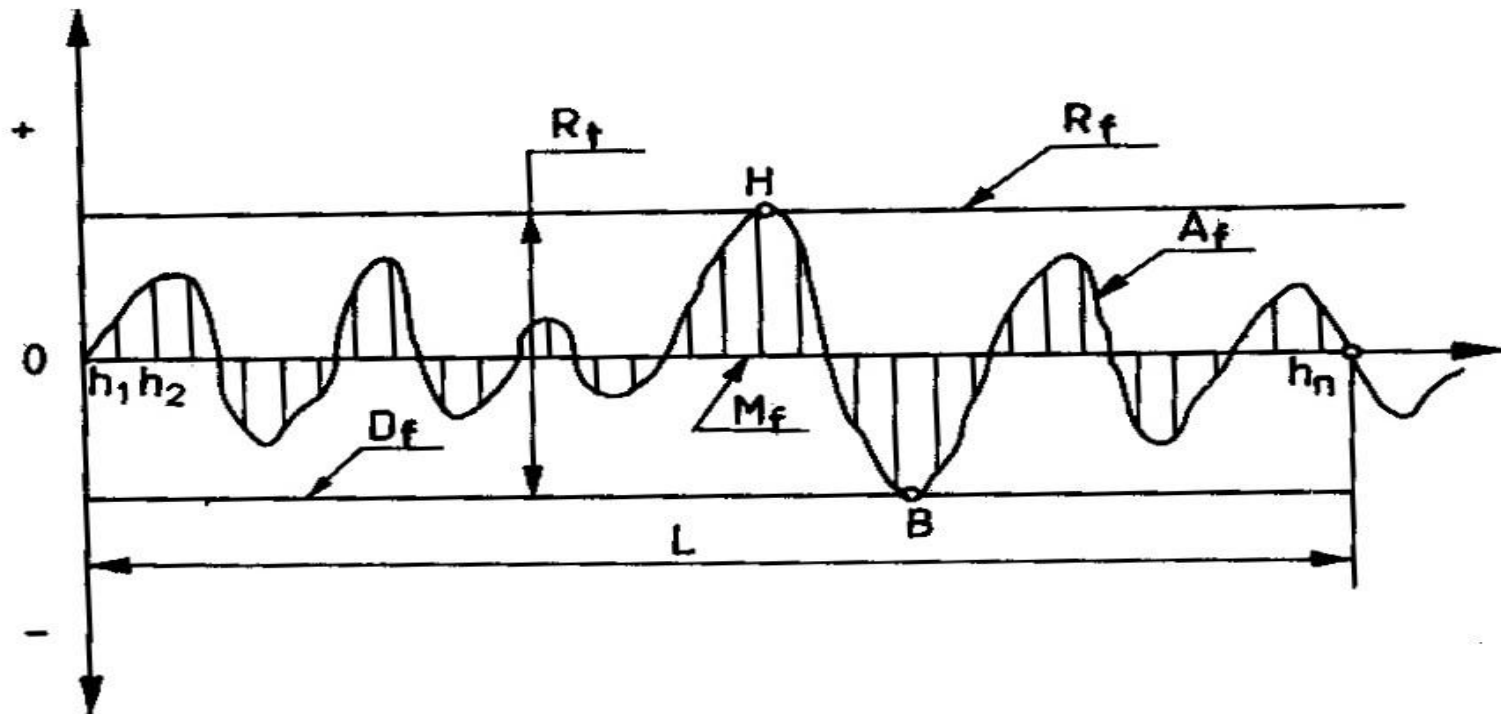
Surface roughness number

Represents the average departure of the surface from perfection over a prescribed sampling length, (usually selected as 0.8 mm)

Surface roughness number (R_a) is expressed in microns.

$$R_a = (h_1 + h_2 + \text{------} + h_n)/n$$

The measurements are usually made along a line, running at right angle to the general direction of tool marks on the surface.

- Actual profile, A_f
  - It is the profile of the actual surface obtained by finishing operation.

- Reference profile, R_f
  - It is the profile to which the irregularities of the surface is referred to. it passes through the highest point of the actual profile.

- Datum profile, D_f
  - It is the profile, parallel to the reference profile .it passes through the lowest point B of the actual profile

- Mean Profile, M_f
  - It is that profile, within the sampling length chosen (L) such that the sum of the material-filled areas enclosed above it by the actual profile is equal to the sum of the material void area enclosed below it by the profile.

- Peak to valley height, R_t
  - It is the distance from the datum profile to the reference profile.

- Mean roughness index, R_a
  - It is the arithmetic mean of the absolute value of the highest h_i between the actual and mean profile.

  - $R_a = 1/L \int_{x=0}^{x=L} |h_i| \, dx$, where L is sampling length

Surface Roughness expected from manufacturing processes

Sl. No.	Manufacturing Process	R_a in µm
1	Sand casting	5 [▨] 50
2	Permanent mould casting	0.8 [▨] 6.3
3	Die casting	0.8 [▨] 3.2
4	High pressure casting	0.32 [▨] 2
5	Hot rolling	2.5 [▨] 50
6	Forging	1.6 [▨] 28
7	Extrusion	0.16 [▨] 5
8	Flame cutting Sawing & Chipping	6.3 [▨] 100
9	Radial cut-off sawing	[▨] 6.3
10	Hand grinding	6.3 [▨] 25
11	Disc grinding	1.6 [▨] 25
12	Filing	0.25 [▨] 25
13	Planing	1.6 [▨] 50

Scale (R_a in µm): 0.012, 0.025, 0.050, 0.10, 0.20, 0.40, 0.80, 1.6, 3.2, 6.3, 12.5, 25, 50, 100, 200

Surface Roughness expected from manufacturing processes

No.	Process	Range (μm Ra)
14	Shaping	1.6 – 25
15	Drilling	1.6 – 20
16	Turning & Milling	0.32 – 25
17	Boring	0.4 – 6.3
18	Reaming	0.4 – 3.2
19	Broaching	0.4 – 3.2
20	Hobbing	0.4 – 3.2
21	Surface grinding	0.063 – 5
22	Cylindrical grinding	0.063 – 5
23	Honing	0.025 – 0.4
24	Lapping	0.012 – 0.16
25	Polishing	0.04 – 0.16
26	Burnishing	0.04 – 0.8
27	Super finishing	0.016 – 0.32

Measurement of roughness

The roughness may be measured, using any of the following :

1. Straight edge
2. Surface gauge
3. Optical flat
4. Tool marker's microscope
5. Profilometer
6. Profilograph
7. Talysurf

INDICATION OF SURFACE TEXTURE

The **basic symbol** consists of two legs of **unequal** length inclined at approximately **60'** to the line representing the considered surface
The symbol must be represented by thin line
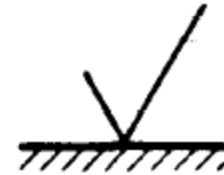
If the removal of material by **machining** is required, a bar is added to the basic symbol,

If the **removal of material is not permitted**, a circle is added to the basic symbol.

When **special surface characteristics** have to be indicated, a line is added to the longer arm of any of the above symbols,
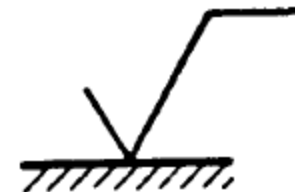
Basic symbol : only be used alone when its meaning is explained by a note

Indication of Surface Roughness

The value or **values** defining the principal criterion of **roughness**
are added to the symbols

a- surface roughness value
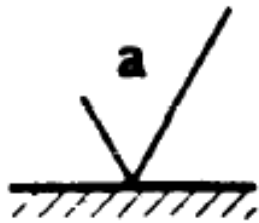
Roughness **a** obtained by
any production process
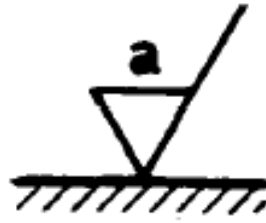
Roughness **a** obtained by
removal of material by
machining
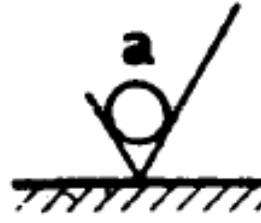
Roughness **a** shall be
obtained without removal
of any material

If it is necessary to impose **maximum**
and **minimum limits** of the principal criterion
of surface roughness, both values shall be
shown
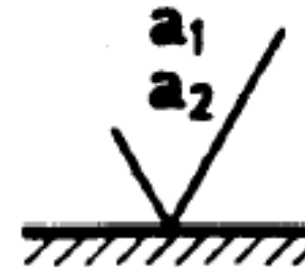
maximum limit (a_1) ;minimum limit (a_2).

If it is required that the required **surface texture** be produced by one **particular production method**, this method shall be indicated in plain language on an extension of the longer arm of the symbol

milled

a
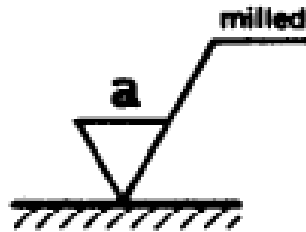
Indication of machining allowance where it is necessary to specify the value of the machining allowance, this shall be indicated on the **left of the symbols**. This value shall be expressed in **millimeters**.

5
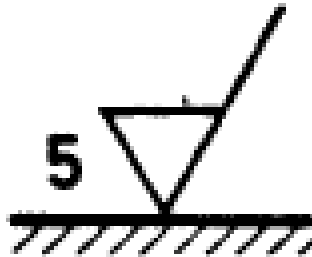
Generally to indicate the surface roughness, the symbol is used instead of value. The relation is given in following table.

Roughness Values R_a μm (1)	Roughness Grade Numbers (2)
50	N 12
25	N 11
12.5	N 10
6.3	N 9
3.2	N 8
1.6	N 7
0.8	N 6
0.4	N 5
0.2	N 4
0.1	N 3
0.05	N 2
0.025	N 1

Machining Symbols

	Symbol		
	Removal of Material by machining is		
	optional	obligatory	prohibited
14.6.2.1	3.2 ✓ or N8 ✓	3.2 ▽ or N8 ▽	3.2 ⌥ or N8 ⌥
14.6.2.2	6.3 / N9 / 1.6 ✓ / N7 ✓ or	6.3 / N9 1.6 ▽ / N7 ▽ or	6.3 / N9 1.6 ⌥ / N7 ⌥ or
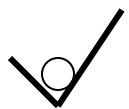
⌥ This symbol may also be used in a drawing, relating to a production process , to indicate that a surface is to be left in the state ,resulting from a preceding manufacturing process, whether this state was achieved by removal of material or otherwise

Position of the Specifications of the Surface Texture in the Symbol - The specifications Of surface texture shall be placed relative to the symbol as shown in figure.
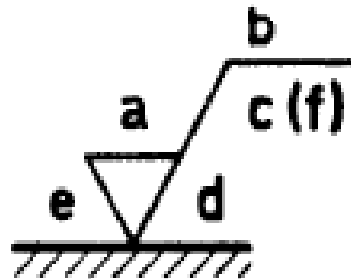
a = Roughness value Ra in micrometres
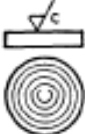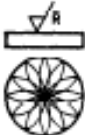   or
   = Roughness grade number N1 to N12.
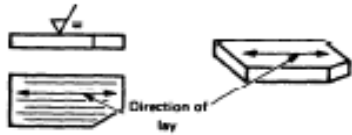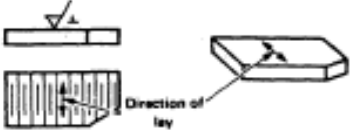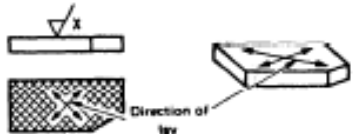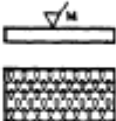
b = Production method, treatment or coating
c = Sampling length
d = Direction of lay
e = Machining allowance
f = Other roughness values (in brackets).

| symbol	Interpretation	
=	Parallel to the plane of projection of the view in which the symbol is used	
⊥	Perpendicular to the plane of projection of the view in which the symbol is used	
X	Crossed in two slant direction relative to the plane of projection of the view in which the symbol is used	
M	Multidirectional	
C	Approximately circular relative to the centre of the surface to which the symbol is applied	
R	Approximately radial relative to the centre of the surface to which the symbol is applied	

Symbols with Additional Indications.

Symbol	Meaning
milled ▽	Production method: milled.
√ 2.5	Sampling length: 2.5 mm
▽ ⊥	Direction of lay: perpendicular to the plane of projection of the view.
2 ▽	Machining allowance: 2 mm
√ $(R_t = 0.4)$	Indication (in brackets) of a criterion of roughness other than that used for R_a for example $R_t = 0.4$ μm

If it is necessary to define **surface texture both before and after treatment**, this shall be explained in a suitable note or in accordance with figure ⟶
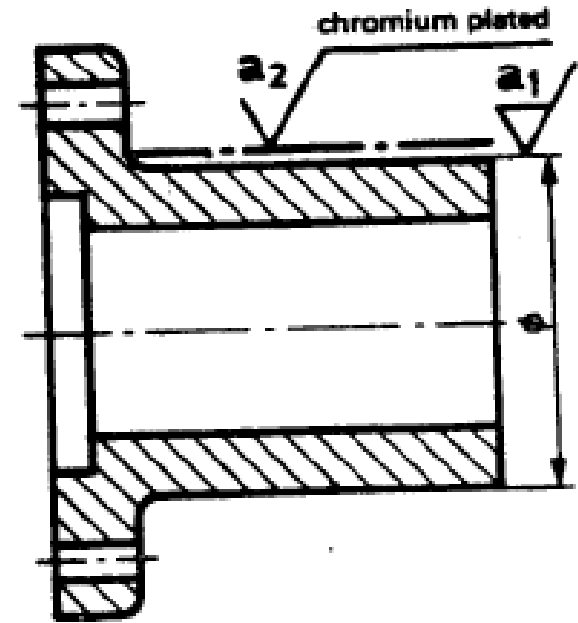
The **direction of lay** is the direction of the predominant surface pattern, ordinarily determined by the production method employed.

If it is necessary to control the direction of lay, it is specified by a symbol added to the surface texture symbol
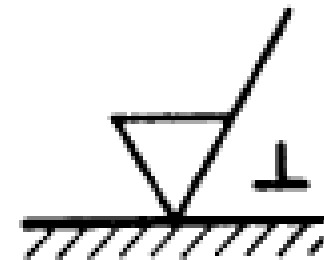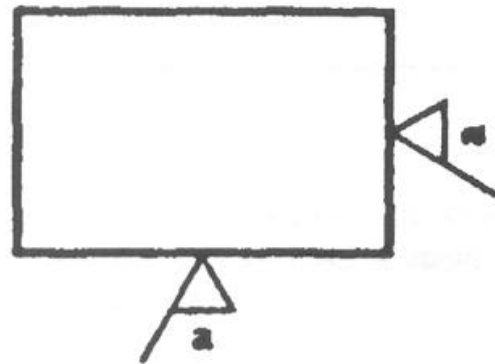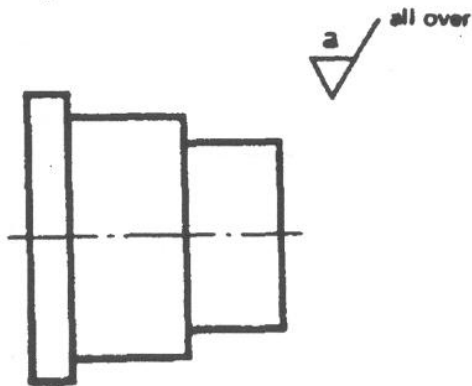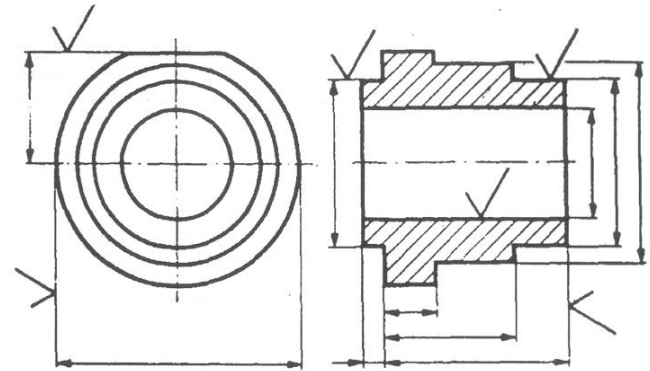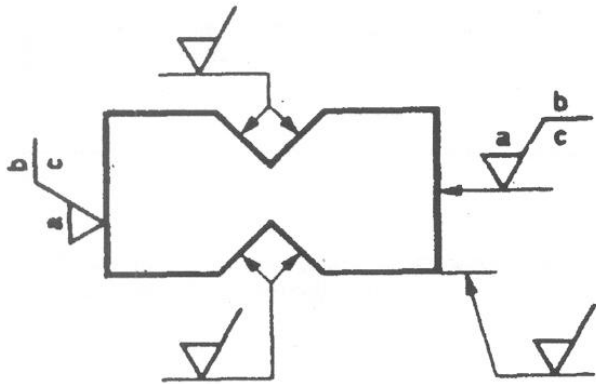
Ways to represent roughness

FIG. 14.24   FIG. 14.25
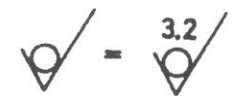
FIG. 14.26

Surface finish grade is shown

N6

OTHERS LETTER 1·5 mm.

Letter size - ★ AFE 3·4 mm

Detail X
5:1

N11

N9

N9

1·25
Ra

0·010

0·3 μ Ra MAX.

A

4·50

N6

N12

⊥ 0·2 A

1·7

0·6
Ra
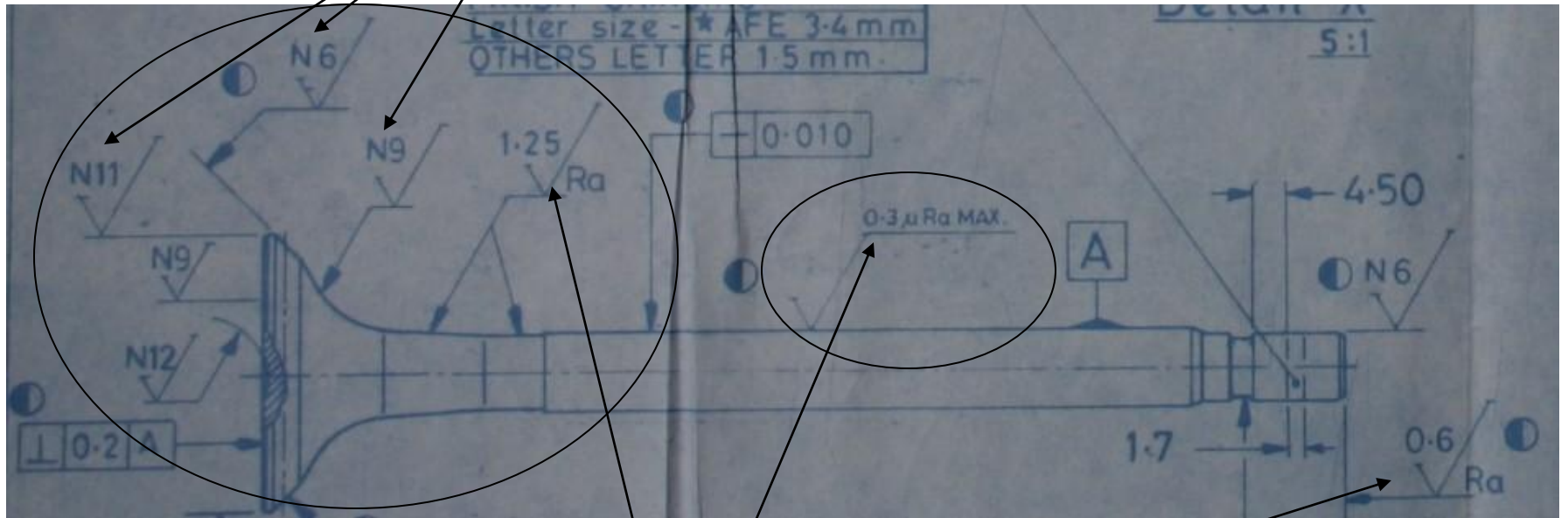
Surface finish value is shown

1X45°
TYP.

75

2

60°

Ø50

Ø37

60°

Ø30

1X45° TYP.

R1,6

78,846 ±0.002

Ø24

3X15°

14

14

30 +0.005 -0

Ø17

118

215

2X45°

Ø18

16

1 TRUE RUNNING 0.005

HARDENED & TEMPERED 58—62R.C

DEBURR SHARP EDGES

REST 6.3

Separate note is written

Surface finish grades specified