SURFACE QUALITY

(Surface Texture)

There are two principal reasons for surface finish control:

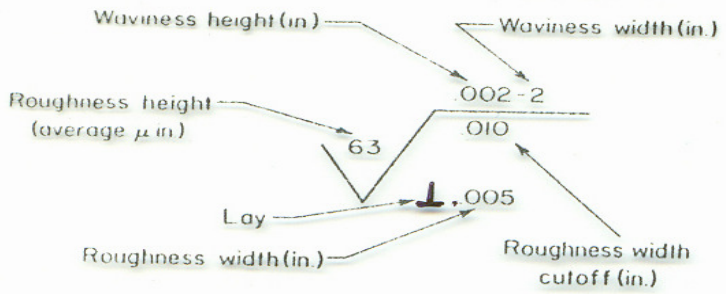
1. To reduce friction
2. To control wear

Surface texture. This term refers to repetitive or random deviations from the nominal surface, which form the pattern of the surface. Included are roughness, waviness, lay, and flaws

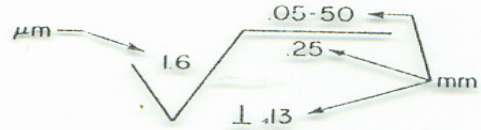
Whenever a film of lubricant must be maintained between two moving parts, the surface irregularities must be small enough so that they will not penetrate the oil film under the most severe operating conditions. Bearings, journals, cylinder boxes, piston pins, bushings, pad bearings, helical and worm gears, seal surfaces, machine ways, and so forth, are the types of items for which this condition must be fulfilled.

Surface finish is also important to the wear of certain pieces that are subject to dry friction, such as machine tool bits, threading dies, stamping dies, rolls, clutch plates, and brake drums.

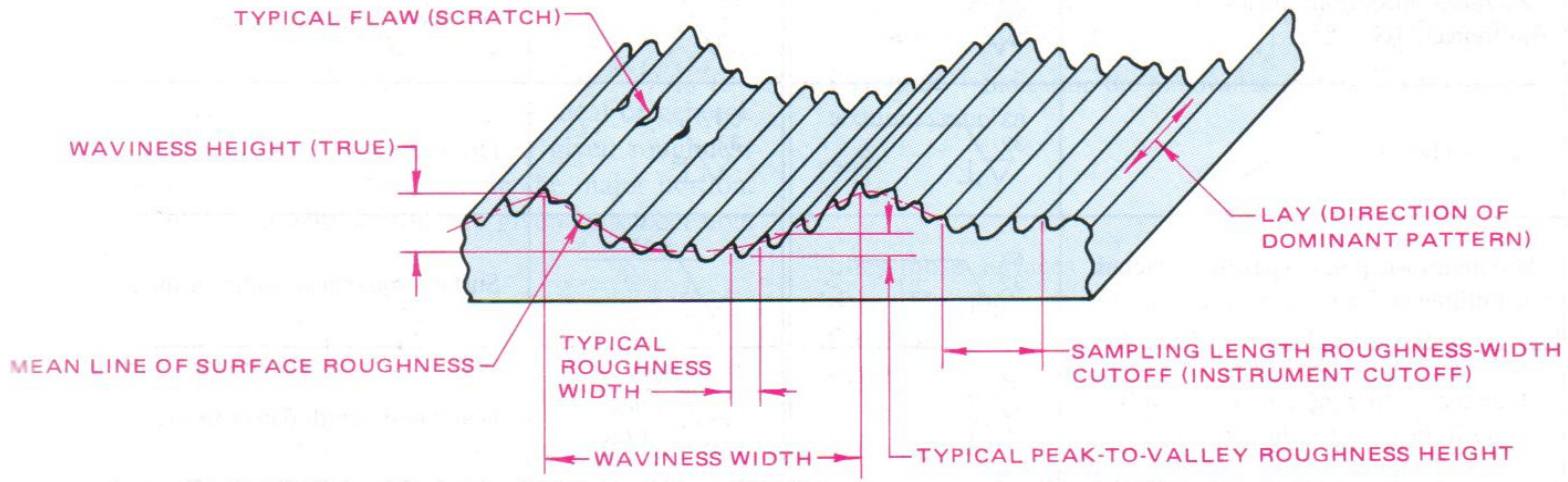
SURFACE QUALITY SYMBOL



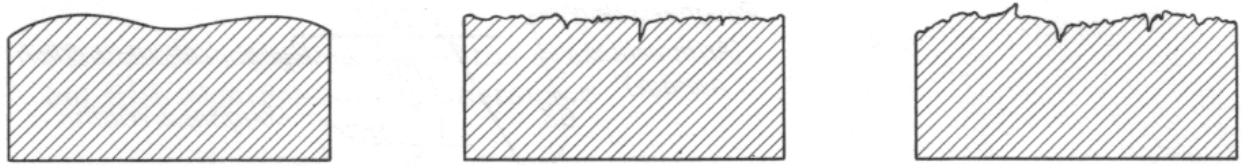
DECIMAL INCH SYMBOL



METRIC SYMBOL



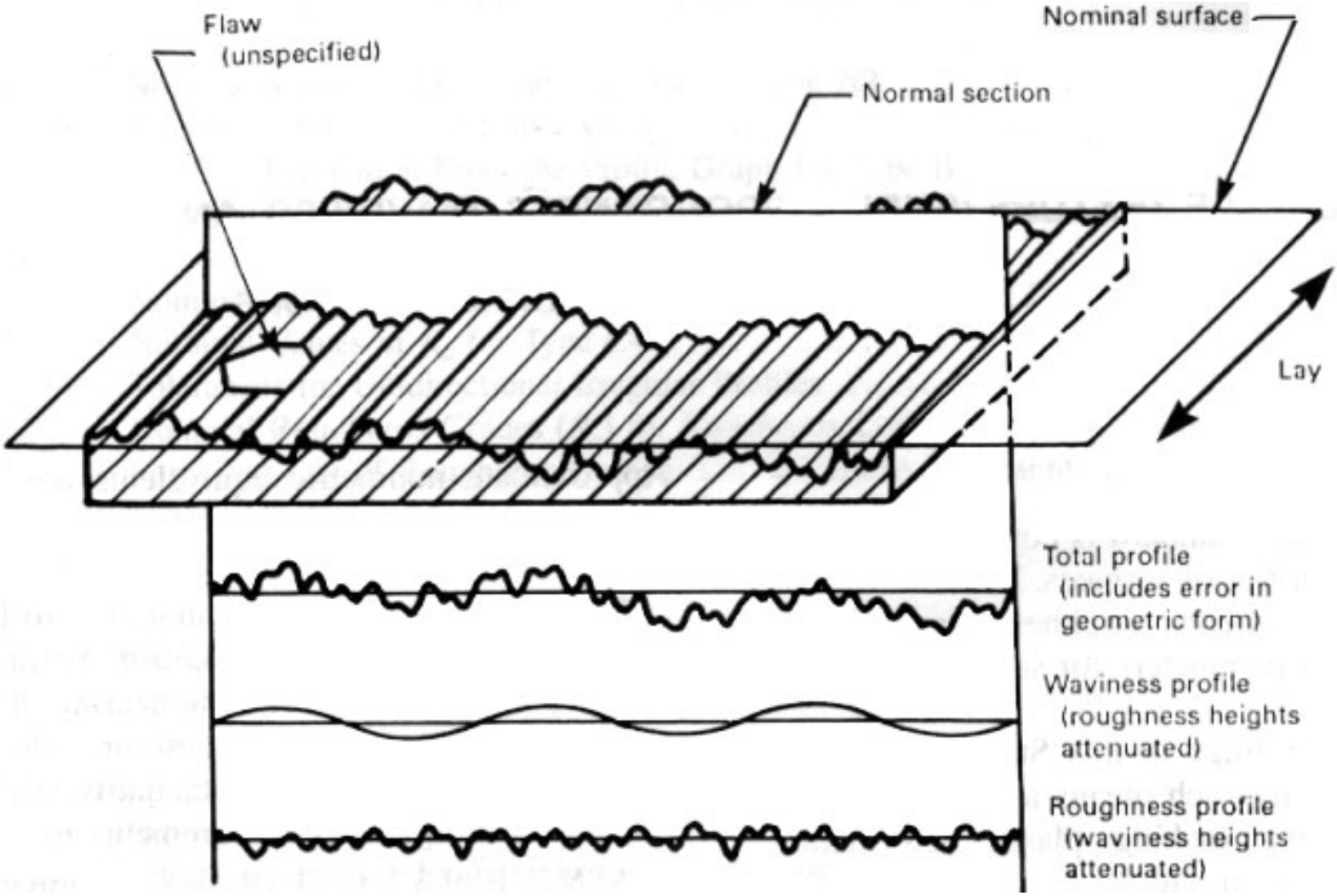
Surface texture characteristics.



WAVINESS

ROUGHNESS

COMBINED WAVINESS AND ROUGHNESS


Flaw
(unspecified)
Nominal surface
Normal section
Lay
Total profile
(includes error in
geometric form)
Waviness profile
(roughness heights
attenuated)
Roughness profile
(waviness heights
attenuated)

Roughness. Roughness is the relatively finely spaced surface irregularities that are produced by the cutting action of tool edges and abrasive grains on surfaces that are machined.

Roughness height. Roughness height is the average (arithmetical) deviation from the mean line of the profile. It is expressed in micrometer

Roughness width. Roughness width is the distance between successive peaks or ridges, which constitute the predominant pattern of roughness. Roughness width is measured in millimeter

Roughness width cutoff. This term indicates the greatest spacing of repetitive surface irregularities to be included in the measurement of average roughness height. It is measured in mm.

Waviness. Waviness is the surface undulations that are of much greater magnitude than the roughness irregularities. Waviness may result from machine or work deflections, vibrations, warping, strains, or similar causes.

Waviness height. Waviness height is the peak-to-valley distanc It is rated in mm.

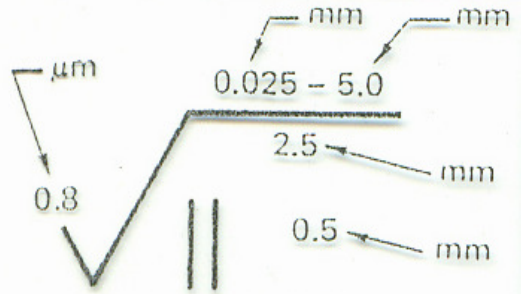
Waviness width. Waviness width (rated in mm) is the spacing of successive wave valleys or wave peaks

Flaws. Flaws are irregularities, such as cracks, checks, blowholes, scratches, and so forth, that occur at one place or at relatively infrequent or widely varying intervals on the surface

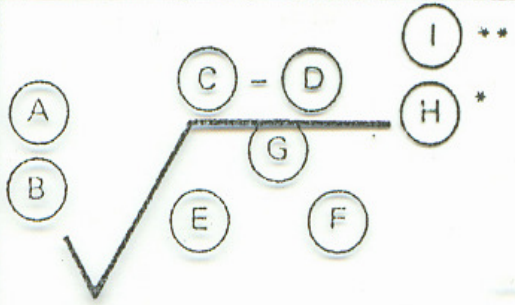
Lay. Lay is the predominant direction of the tool marks of the surface pattern

Designation of Surface Characteristics

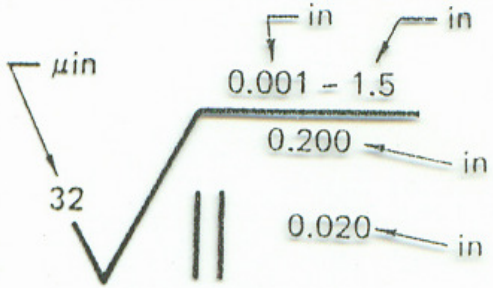
A surface whose finish is to be specified should be marked with the finish mark having the general form of a check mark ($\surd$) so that the point of the symbol shall be on the line representing the surface, on the extension line, or on a leader pointing to the surface. Good practice dictates that the long leg and the extension shall be to the right as the drawing is read.



SI METRIC UNITS OF MEASUREMENT (EXAMPLE)

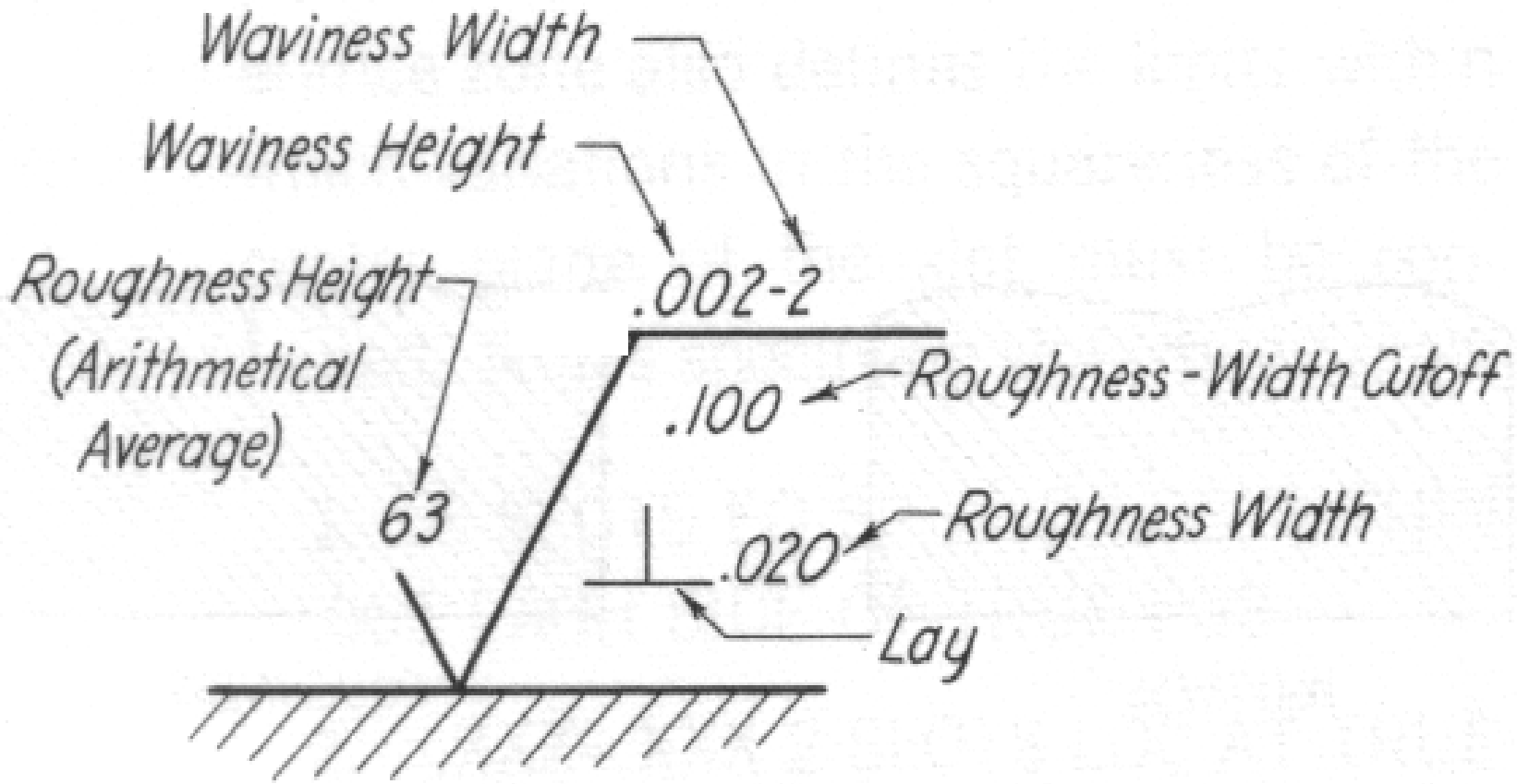


LOCATION OF RATING AND SYMBOLS



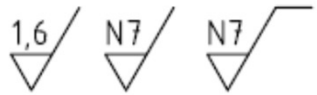
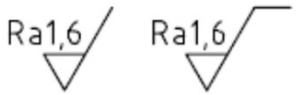
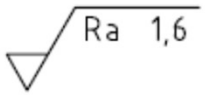
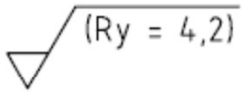
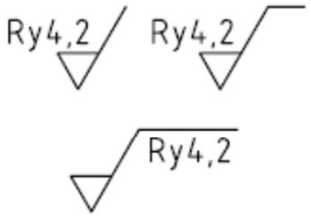
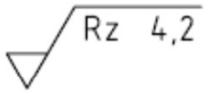
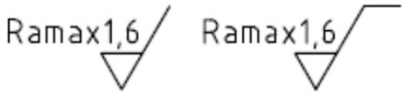
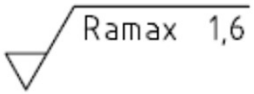
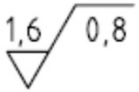
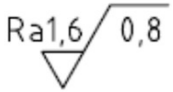
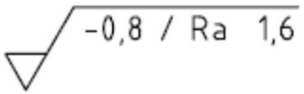
CUSTOMARY INCH UNITS OF MEASUREMENT (EXAMPLE)

CHARACTERISTIC	MEASUREMENT UNIT	
	SI METRIC	CUSTOMARY INCH
(A) MAXIMUM/(AVERAGE) ROUGHNESS HEIGHT RATING	µm	µin.
(B) MINIMUM AVERAGE ROUGHNESS HEIGHT	µm	µin.
(C) MAXIMUM WAVINESS HEIGHT VALUE	mm	in.
(D) WAVINESS WIDTH	mm	in.
(E) LAY DIRECTION SYMBOL		
(F) SURFACE ROUGHNESS WIDTH	mm	in.
(G) SURFACE ROUGHNESS WIDTH CUTOFF	mm	in.
(H) * CONTACT (BEARING) AREA, WHERE REQUIRED	%	%
(I) **MANUFACTURING PROCESS, WHERE REQUIRED		



Surface texture symbol.

Table I.1 — Evolution of drawing indications of surface texture requirements

	Editions of ISO 1302			Example illustrating main issue
	1971 (recommendation) [a] 1974 (1st edition) [a] 1978 (2nd edition) [a]	1992 (3rd edition) [b]	2001 (4th edition) [c]	
a)				*Ra* only — "16 %-rule"
b)				Parameter other than only *Ra* — "16 %-rule"
c)	[d]	 [e]		"Max-rule"
d)				*Ra* plus sampling length

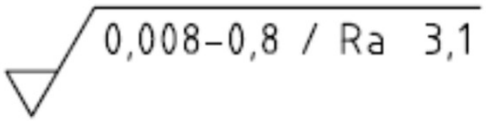
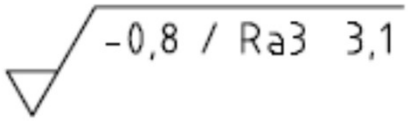
16% rule

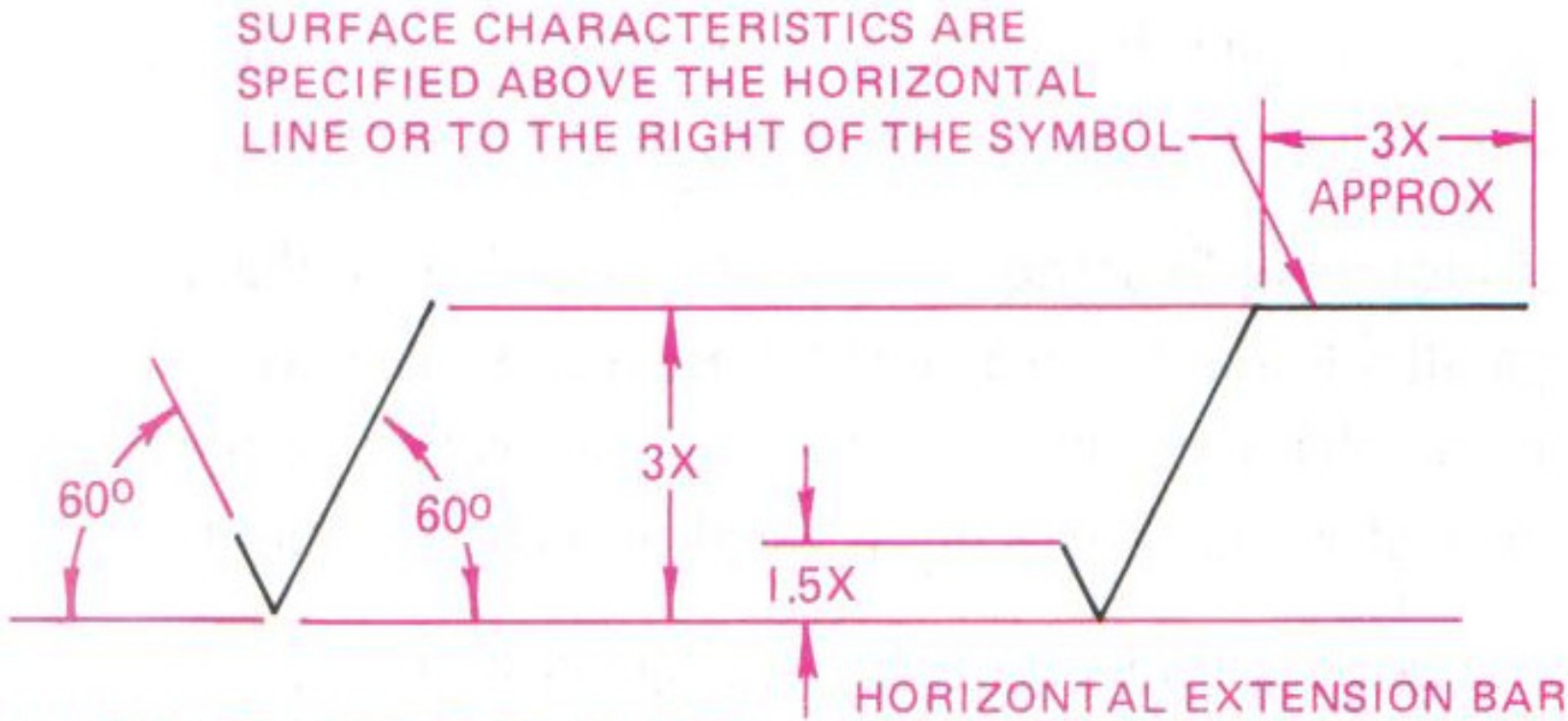
All roughness parameters without the "max" suffix represent the mean value measured within the five sampling lengths:

16% of the measured values may exceed the limit.

Step-by-step method:

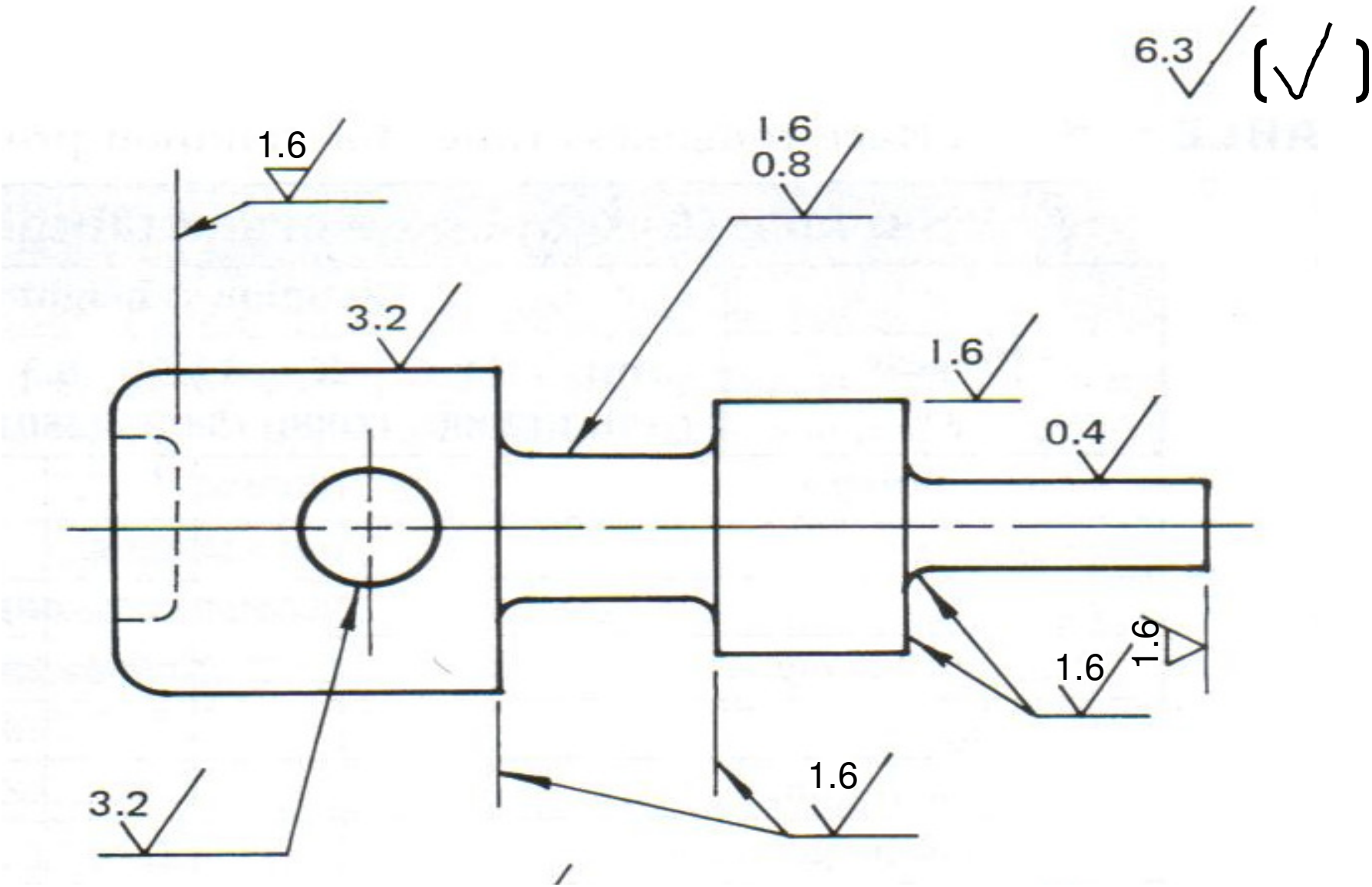
1. If the first measured value is below 70% of the limit, this is considered to comply.
2. Failing this, take two additional measurements at other points on the surface; if all three measured values are below the limit, this is considered to comply.
3. Failing this, take nine additional measurements at other points on the surface; if a total of not more than two measured values are greater than the limit, this is considered to comply.

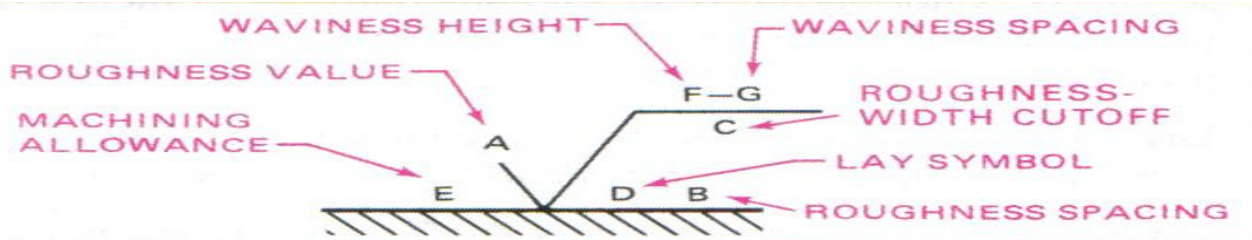
	The process shall remove material, unilateral upper specification limit, transmission band 0,008-0,8 mm, R-profile, arithmetic mean deviation 3,1 µm, evaluation length of 5 sampling lengths (default), “16 %-rule” (default).
	The process shall remove material, unilateral upper specification limit, transmission band: sampling length 0,8 mm (λs default 0,002 5 mm) according to ISO 3274, R-profile, arithmetic mean deviation 3,1 µm, evaluation length of three sampling lengths (default), “16 %-rule” (default).

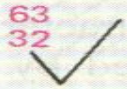
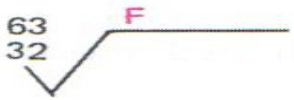
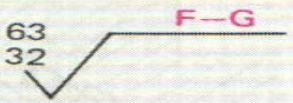
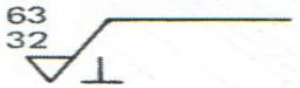
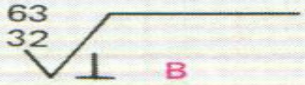


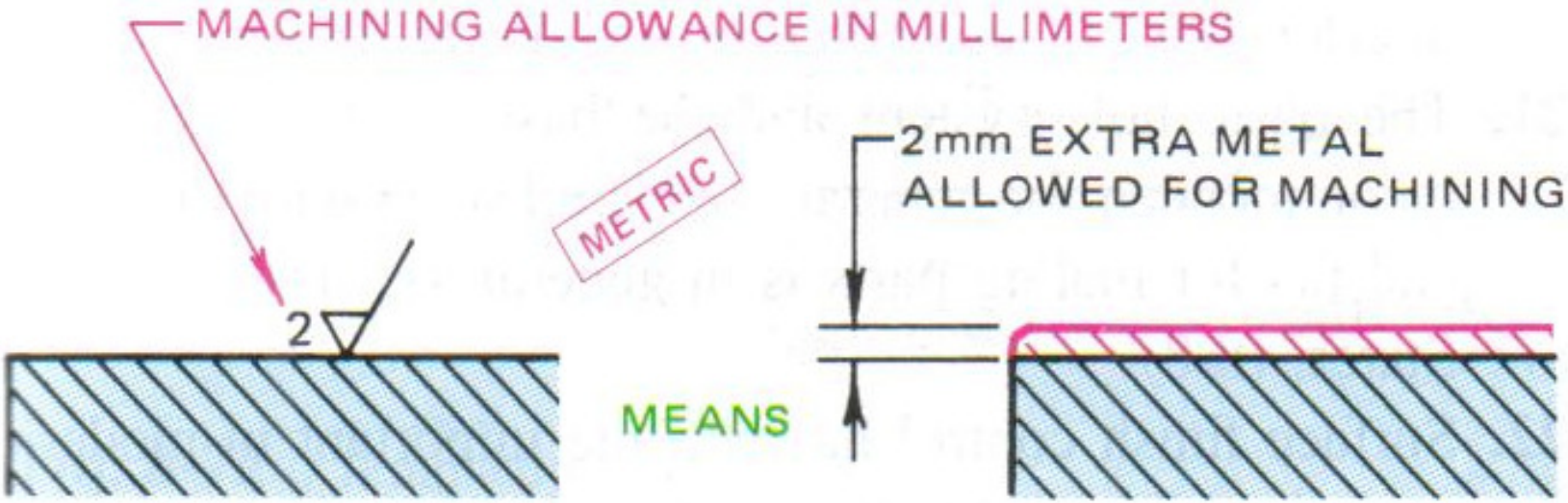
(A) USED WHEN SURFACE MAY BE PRODUCED BY ANY METHOD EXCEPT WHEN A BAR OR CIRCLE IS SPECIFIED

(B) USED WHEN ANY SURFACE CHARACTERISTICS ARE SPECIFIED

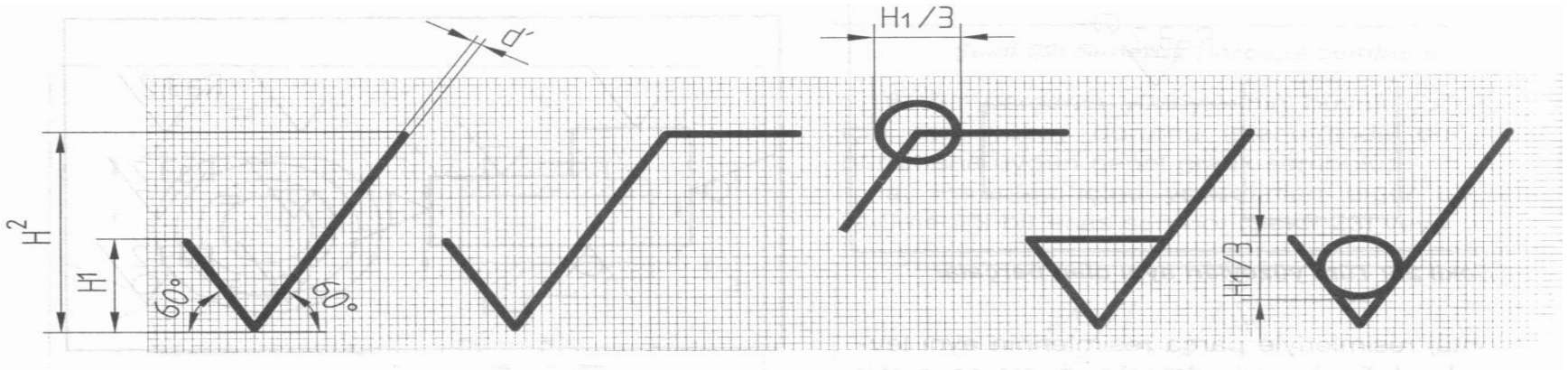

6.3
1.6
1.6
0.8
3.2
1.6
0.4
1.6
1.6
3.2
1.6

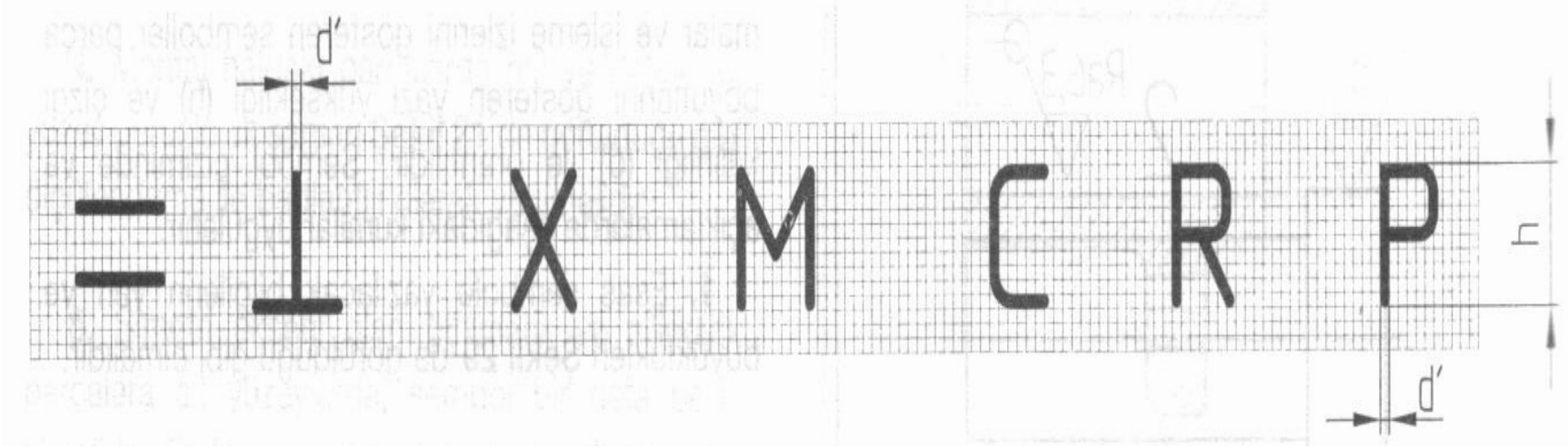


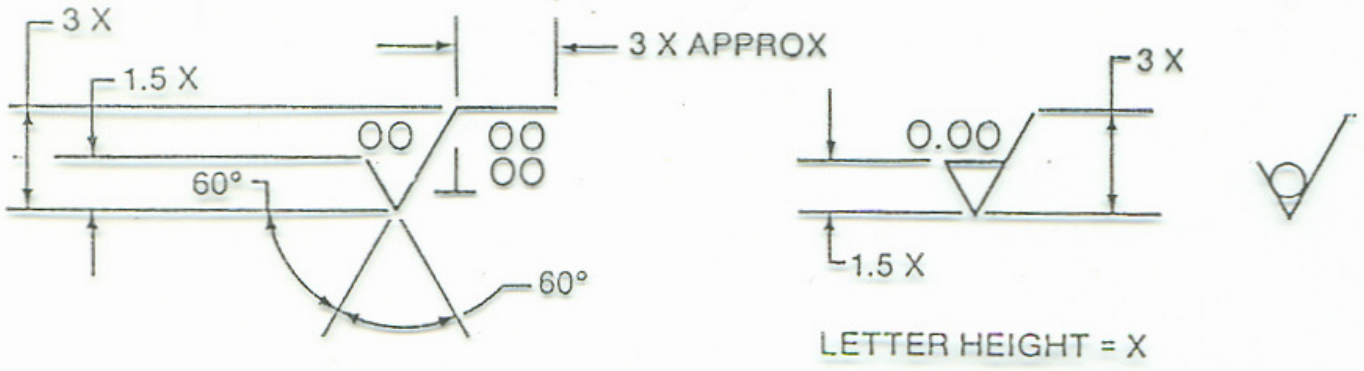
Basic surface texture symbol	
Roughness-height rating in microinches or micrometers and N series roughness numbers	
Maximum and minimum roughness height in microinches or micrometers	
Waviness height in inches or millimeters (F)	
Waviness spacing in inches or millimeters (G)	
Lay symbol (D)	
Maximum roughness spacing in inches or millimeters (B)	
Roughness sampling length or cutoff rating in inches or millimeters (C)	



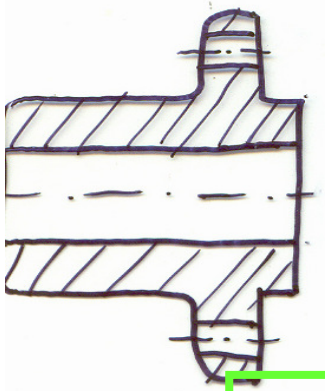
Indication of machining allowance.


H2
H1
60°
60°
d'
H1/3
H1/3

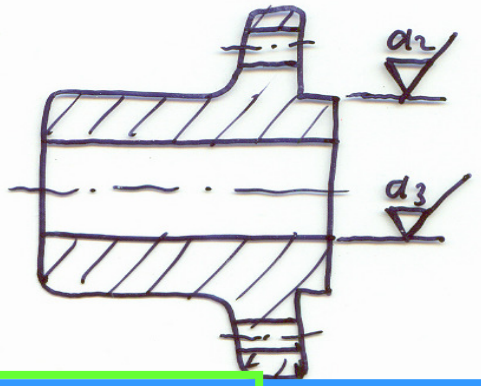

d'
X
M
C
R
P
h
d'

Symbol	Meaning
(a) 	Basic Surface Texture Symbol. Surface may be produced by any method except when the bar or circle, (b) or (d), is specified.
(b) 	Material Removal By Machining Is Required. The horizontal bar indicates that material removal by machining is required to produce the surface and that material must be provided for that purpose.
(c) 	Material Removal Allowance. The number indicates the amount of stock to be removed by machining in millimeters (or inches). Tolerances may be added to the basic value shown or in a general note.
(d) 	Material Removal Prohibited. The circle in the vee indicates that the surface must be produced by processes such as casting, forging, hot finishing, cold finishing, die casting, powder metallurgy or injection molding without subsequent removal of material.
(e) 	Surface Texture Symbol. To be used when any surface characteristics are specified above the horizontal line or to the right of the symbol. Surface may be produced by any method except when the bar or circle, (b) or (d), is specified.
(f) 	

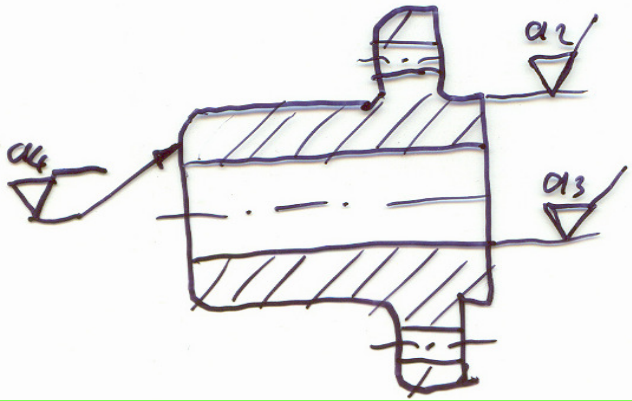
a
All Surfaces



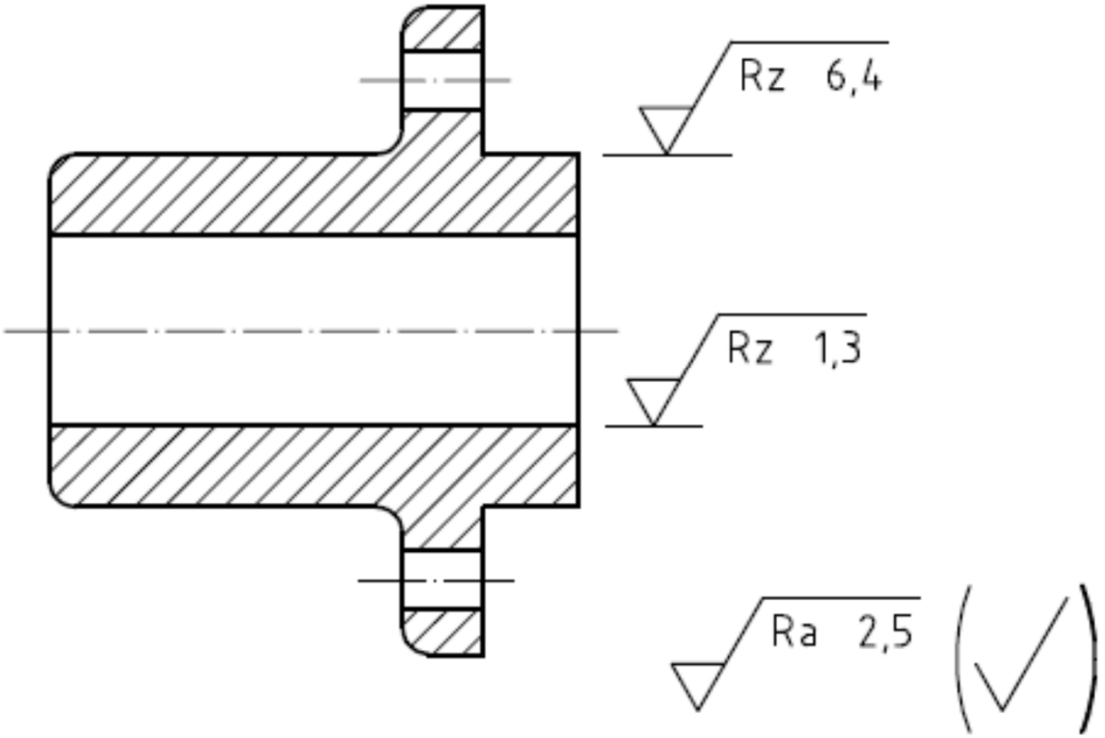
a_1 (a_2 , a_3)

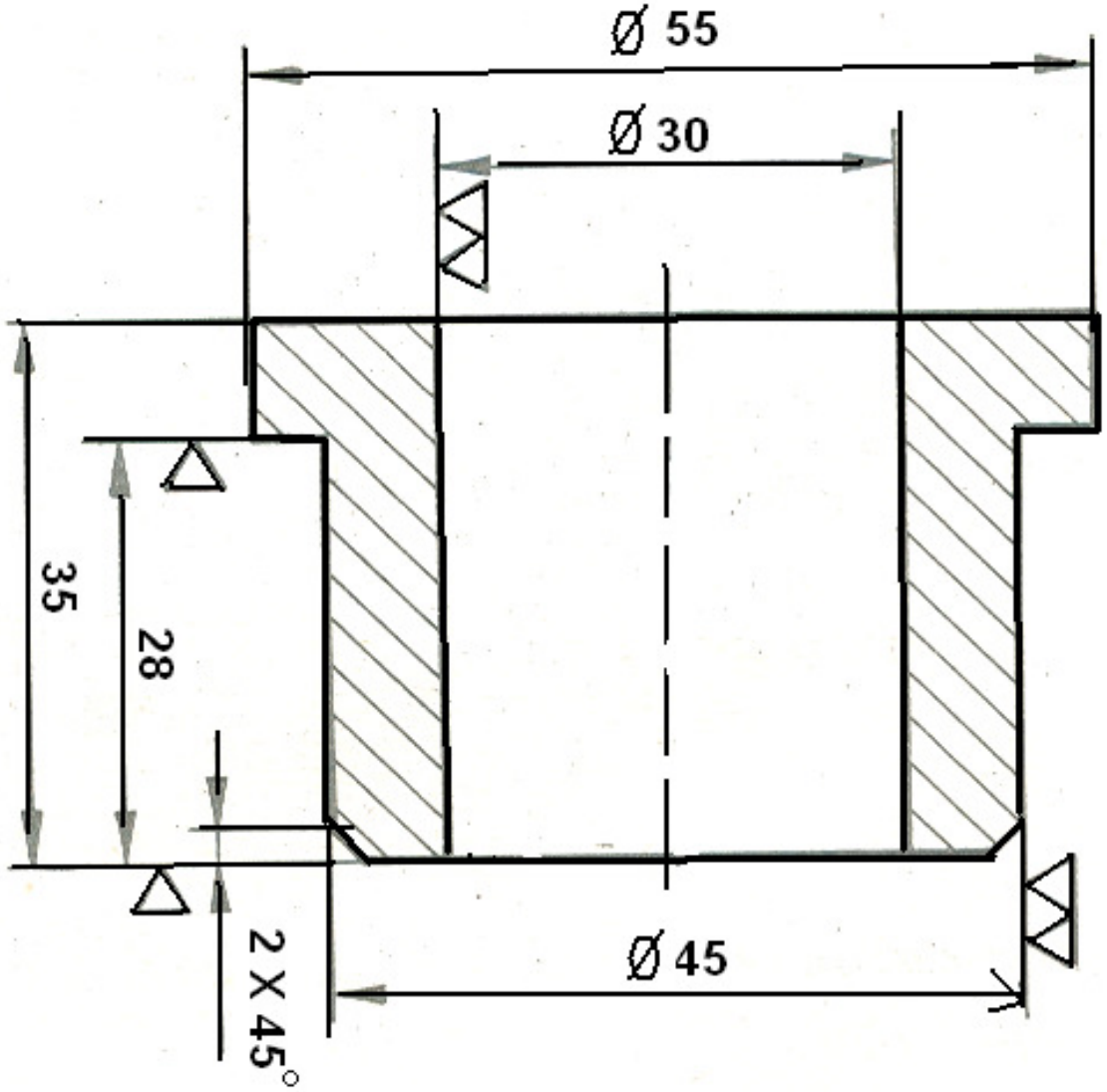


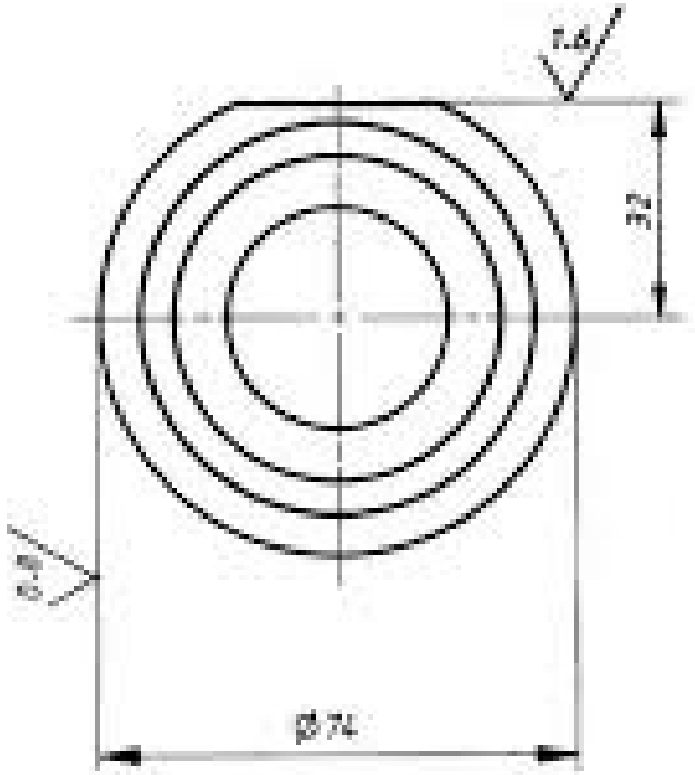
a_1 ($\surd$)



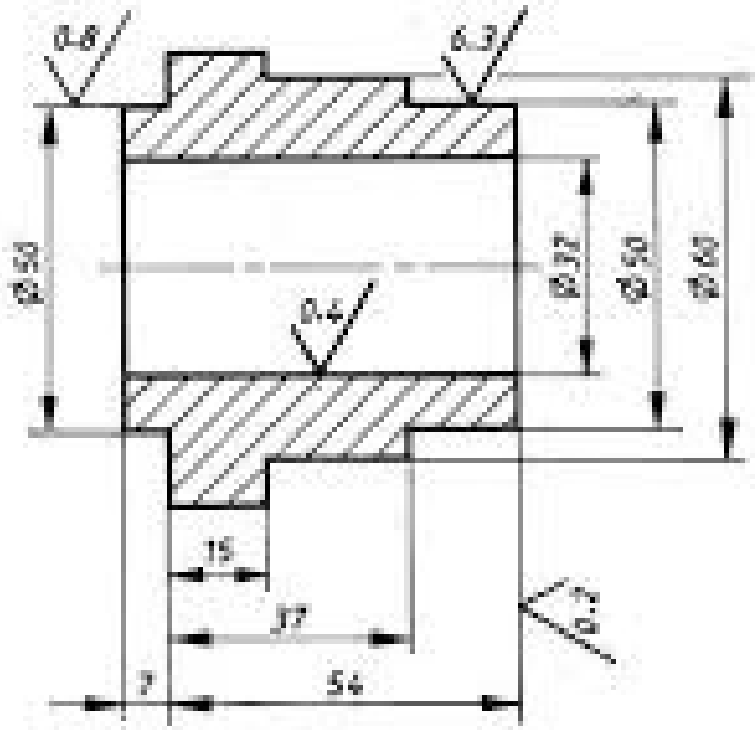
ISO 1302- 2002




Ø 55
Ø 30
35
28
2 X 45°
Ø 45



All Dimensions in mm



All Surface Roughness in μm

PREFERRED SERIES OF ROUGHNESS AVERAGE VALUES

MICROMETERS		Symbol	MICROINCHES		Symbol
μm	μin	(ISO 1302)	μm	μin	
0.012	0.5		1.25	50	
0.025*	1*	N1	1.60*	63*	N7
0.050*	2*	N2	2.0	80	
0.075	3		2.5	100	
0.10*	4*	N3	3.2*	125*	N8
0.125	5		4.0	160	
0.15	6		5.0	200	
0.20*	8*	N4	6.3*	250*	N9
0.25	10		8.0	320	
0.32	13		10.0	400	
0.40*	16*	N5	12.5*	500*	N10
0.50	20		15	600	
0.63	25		20	800	
0.80*	32*	N6	25*	1000*	N11
1.00	40		50*		N12

40~400 ▽

*Recommended

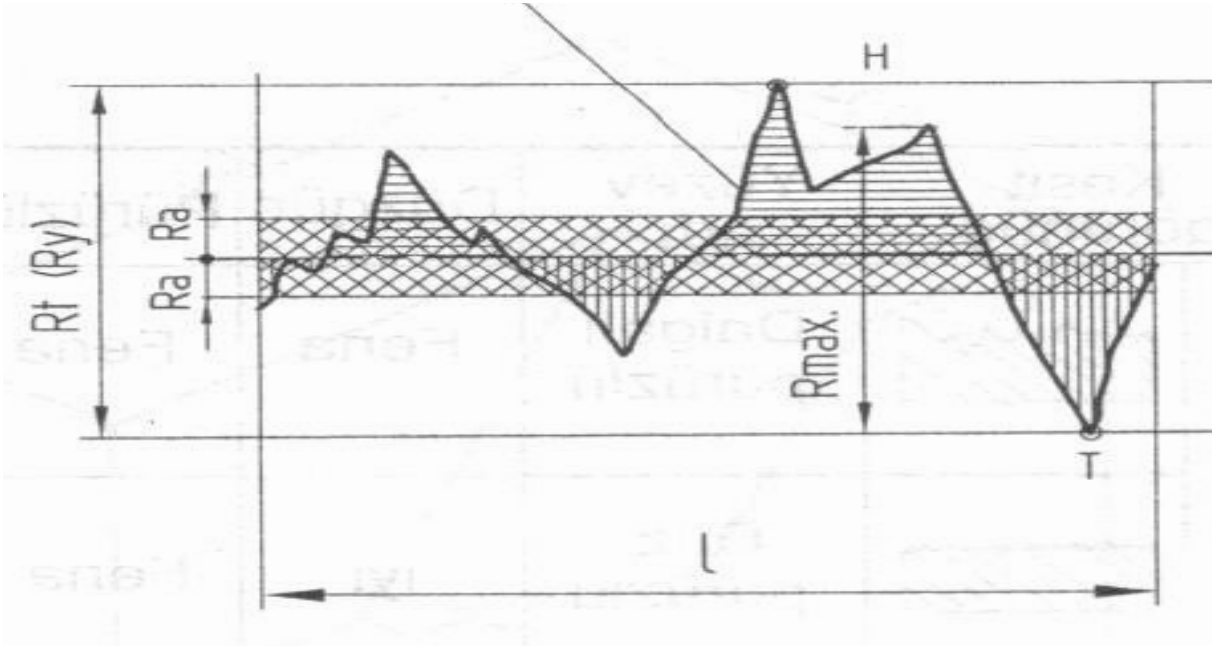
Recommended Roughness-Height Values		N Series of Roughness Grade Numbers
Microinches μ in.	Micrometers μm	
2000	50	N 12
1000	25	N 11
500	12.5	N 10
250	6.3	N 9
125	3.2	N 8
63	1.6	N 7
32	0.8	N 6
16	0.4	N 5
8	0.2	N 4
4	0.1	N 3
2	0.05	N 2
1	0.025	N 1

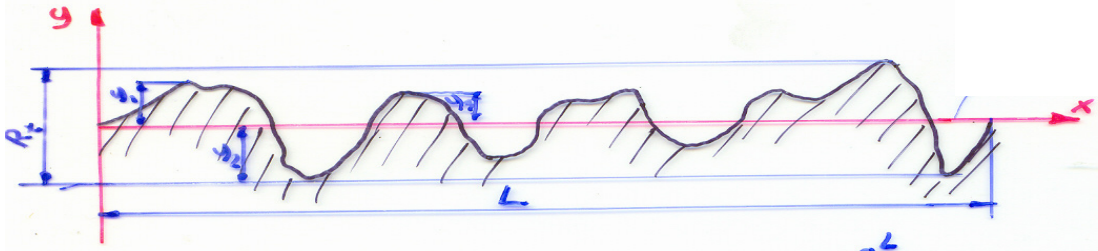
Process	Roughness height rating micrometers, μm (microinches, μ in.) aa													
	(μm)	50	25	12.5	6.3	3.2	1.6	0.8	0.4	0.2	0.1	0.05	0.025	0.012
	(μ in.)	(2000)	(1000)	(500)	(250)	(125)	(63)	(32)	(16)	(8)	(4)	(2)	(1)	(0.5)
Typical application		Very rough surface Equiv to sand casting.	Rough surface. Rarely used.	Coarse finish. Equiv to rolled surfaces and forgings.	Medium finish commonly used. Reasonable appear.	Good for close fits. Unsuitable for fast rotating members.	Used on shafts and bearings with light loads and moderate speeds.	Used on high speed-shafts and bearings.	Used on precision gage and instrument work. Costly.	Refined finish. Costly to produce.	Super finish costly. Seldom used.			

Rt: Max. Roughness Height

Ra: Arithmetical average of roghness height

Rz: Average of 5 regions





L: Roughness - width cut-off (Roughness measuring sampling length)

Mean Roughness Height (mean deviation) : $R_a = \frac{\int_0^L |y| dx}{L}$

$$R_a \approx \frac{|y_1| + |y_2| + |y_3| + \cdots + |y_n|}{n} \quad [\mu m]$$

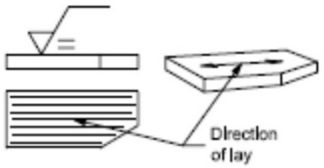
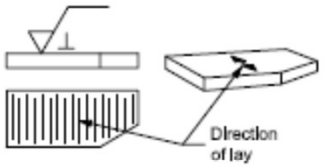
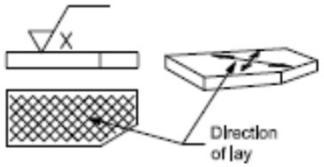
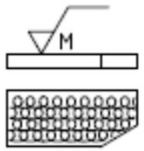
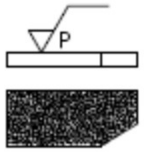
n = # of samplings (measures)

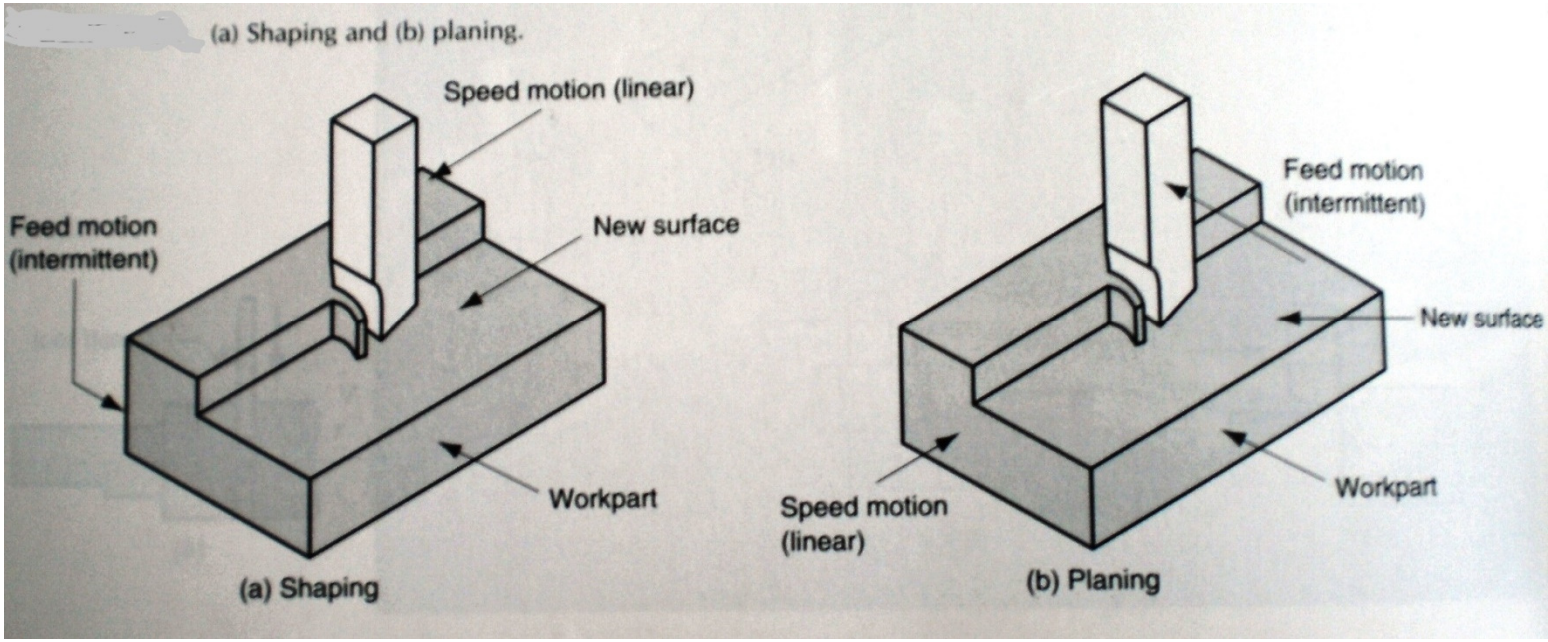
Ra [μm]	L [mm] Lapping, superfinish, Grinding	Turning, Drilling	Milling	Shaping, Planning
0.025	0.25			
0.05	0.25			
0.1	0.25			
0.2	0.25			
0.4	0.8	0.8	0.8	0.8
0.8	0.8	0.8	0.8	0.8
1.6	0.8	0.8	2.5	2.5
3.2	2.5	2.5	2.5	2.5
6.3		2.5	8	8
12.3		2.5	8	8
25				

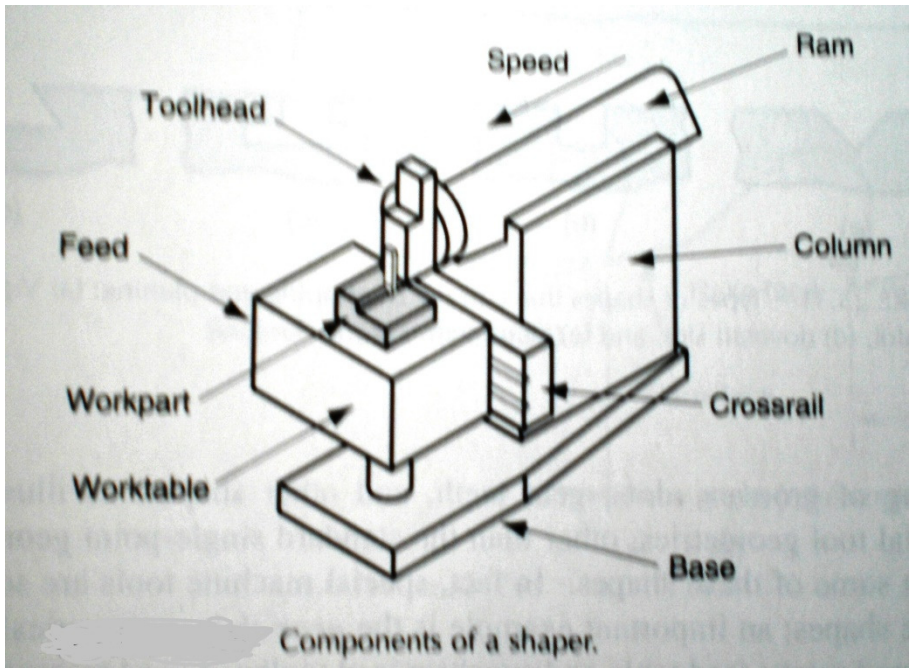
Recommended Roughness Values for Some Applications

- **Slide Bearing** → House 0.8–1.6; → Shaft surface 0.2–0.8
- **Cylindrical Holes**
  - Hydraulic Cylinders 0.2
  - Engine Cylinders 0.4
  - O-Ring Applications 0.4
  - Gear Hubs 0.8–1.6
- **Drilled Hole** 3.2
- **Reamed Hole** 0.8
- **Shafts**
  - Gear fits 0.8–1.6
  - Cam shafts 0.4
  - High speed - low feed turning 0.8–1.6
  - Coarse Turning 6.3
- **Fits**
  - Loose Fits → tolerance ≤ 0.025 mm → 1.6 (max.); → tolerance > 0.025 mm → 3.2 (min.)
  - Transition Fits 0.8 (max.)
  - Interference Fits 0.8–1.6
- **Key Seats (ways)** 1.6–3.2
- **Sliding Surface** 0.4–0.8
- **Breaking Surface** 0.4
- **Disk Clutches** 0.4
- **Threads**
  - by rolling 0.2
  - by milling 1.6
  - by Grinding 0.4
  - by tapping 3.2
- **Gears**
  - Teeth surface → $m \geq 2.5$ → 1.6; → $m < 2.5$ → 0.8
  - Rim surface 3.2
  - Chain Gears 3.2
- **Calibration gages (master gages)** 0.025–0.1
- **Measuring gages** 0.2

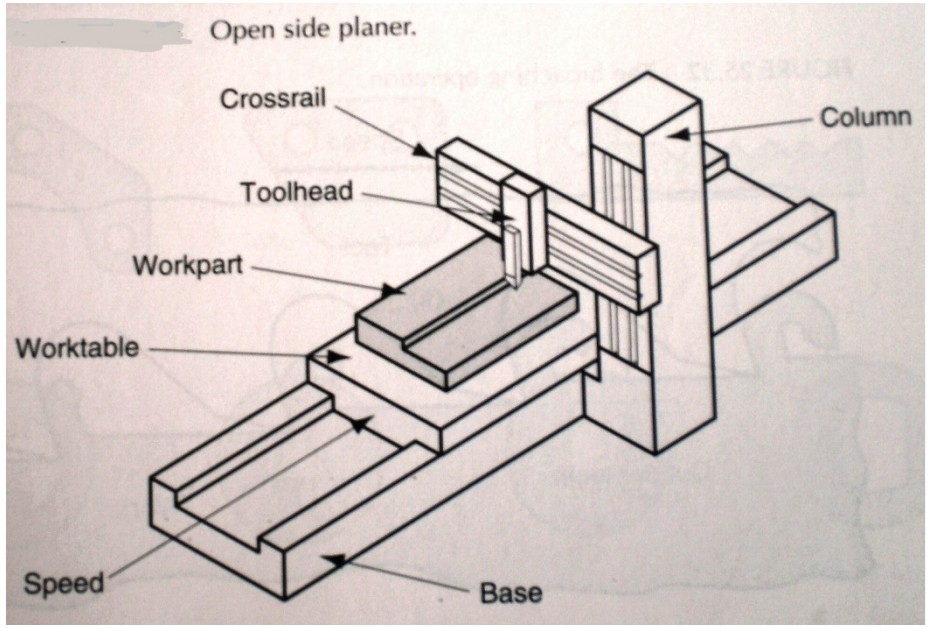
Table 2 — Indication of surface lay

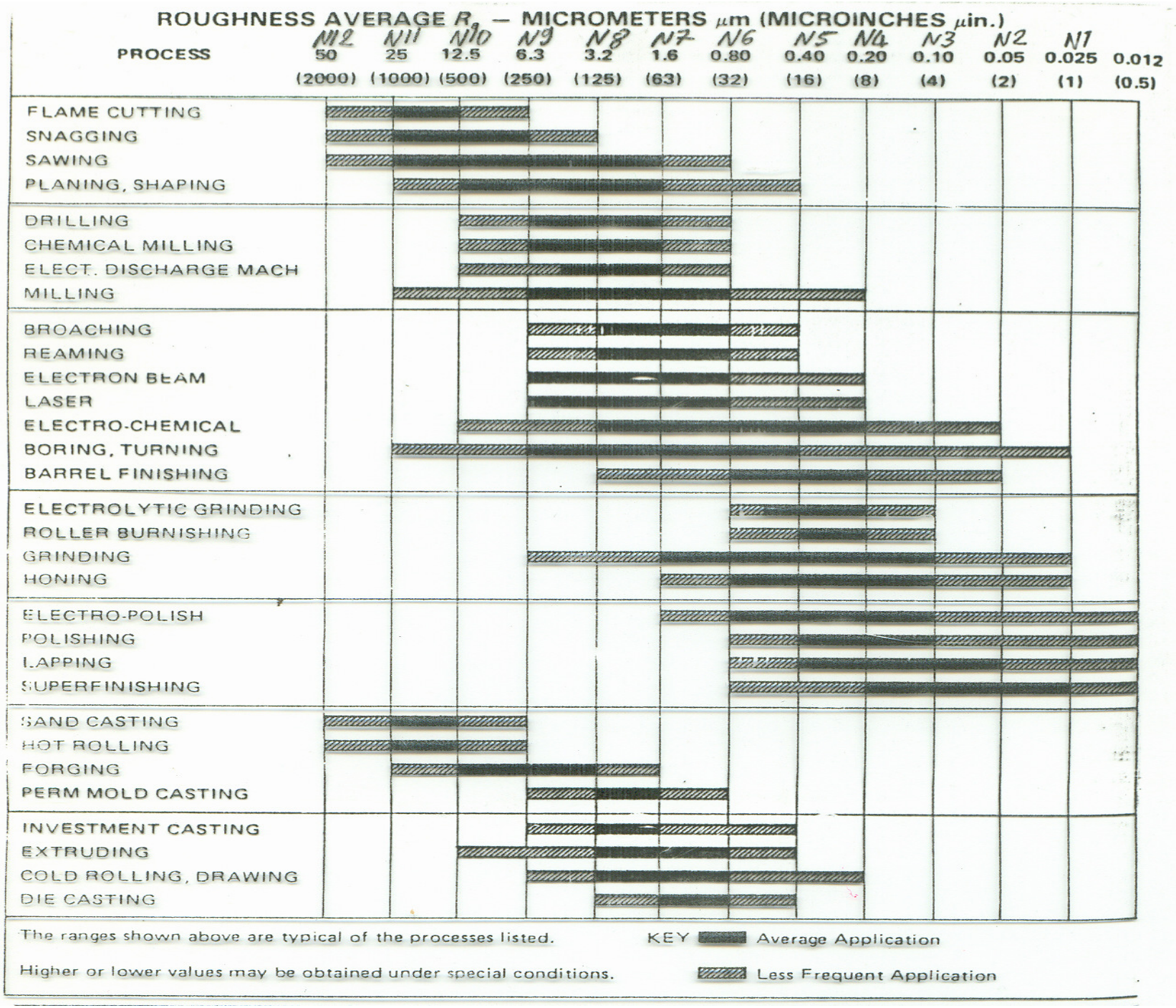
Graphical symbol	Interpretation and example	
=	Parallel to plane of projection of view in which symbol is used	
⊥	Perpendicular to plane of projection of view in which symbol is used	
X	Crossed in two oblique directions relative to plane of projection of view in which symbol is used	
M	Multi-directional	
C	Approx. circular relative to centre of surface to which symbol applies	
R	Approx. radial relative to centre of surface to which symbol applies	
P	Lay is particulate, non-directional, or protuberant	
If it is necessary to specify a surface pattern which is not clearly defined by these symbols, this shall be achieved by the addition of a suitable note to the drawing.		





Components of a shaper.




ROUGHNESS AVERAGE R_a — MICROMETERS μm (MICROINCHES μin.)
PROCESS
N12 50 (2000)
N11 25 (1000)
N10 12.5 (500)
N9 6.3 (250)
N8 3.2 (125)
N7 1.6 (63)
N6 0.80 (32)
N5 0.40 (16)
N4 0.20 (8)
N3 0.10 (4)
N2 0.05 (2)
N1 0.025 (1)
0.012 (0.5)
FLAME CUTTING
SNAGGING
SAWING
PLANING, SHAPING
DRILLING
CHEMICAL MILLING
ELECT. DISCHARGE MACH
MILLING
BROACHING
REAMING
ELECTRON BEAM
LASER
ELECTRO-CHEMICAL
BORING, TURNING
BARREL FINISHING
ELECTROLYTIC GRINDING
ROLLER BURNISHING
GRINDING
HONING
ELECTRO-POLISH
POLISHING
LAPPING
SUPERFINISHING
SAND CASTING
HOT ROLLING
FORGING
PERM MOLD CASTING
INVESTMENT CASTING
EXTRUDING
COLD ROLLING, DRAWING
DIE CASTING
The ranges shown above are typical of the processes listed.
Higher or lower values may be obtained under special conditions.
KEY
Average Application
Less Frequent Application

Typical surface roughness-height applications.

Microinches AA Rating	Micrometers AA Rating	Application
1000	25.2	Rough, low-grade surface resulting from sand casting, torch or saw cutting, chipping, or rough forging. Machine operations are not required as appearance is not objectionable. This surface, rarely specified, is suitable for unmachined clearance areas on rough construction items.
500	12.5	Rough, low-grade surface resulting from heavy cuts and coarse feeds in milling, turning, shaping, boring, and rough filing, disc grinding, and snagging. It is suitable for clearance areas on machinery, jigs, and fixtures. Sand casting or rough forging produces this surface.
250	6.3	Coarse production surfaces, for unimportant clearance and clean-up operations, resulting from coarse surface grind, rough file, disc grind, rapid feeds in turning, milling, shaping, drilling, boring, grinding, etc., Where tool marks are not objectionable. The natural surfaces of forgings, permanent mold castings, extrusions, and rolled surfaces also produce this roughness. It can be produced economically and is used on parts where stress requirements, appearance, and conditions of operations and design permit.
125	3.2	The roughest surface recommended for parts subject to loads, vibration, and high stress. It is also permitted for bearing surfaces when motion is slow and loads light or infrequent. It is a medium commercial machine finish produced by relatively high speeds and fine feeds taking light cuts with sharp tools. It may be economically produced on lathes, milling machines, shapers, grinders, etc., Or on permanent mold castings, die castings, extrusions, and rolled surfaces.
63	1.6	A good machine finish produced under controlled conditions using relatively high speeds and fine feeds to take light cuts with sharp cutters. It may be specified for close fits and used for all stressed parts, except fast-rotating shafts, axles, and parts subject to severe vibration or extreme tension. It is satisfactory for bearing surfaces when motion is slow and loads light or infrequent. It may also be obtained on extrusions, rolled surfaces, die castings, and permanent mold castings when rigidly controlled.
32	0.8	A high-grade machine finish requiring close control when produced by lathes, shapers, milling machines, etc., But relatively easy to produce by centerless, cylindrical, or surface grinders. Also, extruding, rolling, or die casting may produce a comparable surface when rigidly controlled. This surface may be specified in parts where stress concentration is present. It is used for bearings when motion is not continuous and loads are light. When finer finishes are specified, production costs rise rapidly; therefore, such finishes must be analyzed carefully.
16	0.4	A high-quality surface produced by fine cylindrical grinding, emery buffing, coarse honing, or lapping. It is specified where smoothness is of primary importance, such as rapidly rotating shaft bearings, heavily loaded bearings, and extreme tension members.
8	0.2	A fine surface produced by honing, lapping, or buffing. It is specified where packings and rings must slide across the direction of the surface grain, maintaining or withstanding pressures, or for interior honed surfaces of hydraulic cylinders. It may also be required in precision gages and instrument work, or sensitive-value surfaces, or on rapidly rotating shafts and on bearings where lubrication is not dependable.
4	0.1	A costly refined surface produced by honing, lapping, and buffing. It is specified only when the requirements of design make it mandatory. It is required in instrument work, gage work, and where packings and rings must slide across the direction of surface grain, such as on chrome-plated piston rods, etc., Where lubrication is not dependable.
2 1	0.05 0.025	Costly refined surfaces produced only by the finest of modern honing, lapping, buffing, and superfinishing equipment. These surfaces may have a satin or highly polished appearance depending on the finishing operation and material. These surfaces are specified only when design requirements make it mandatory. They are specified on fine or sensitive instrument parts or other laboratory items, and certain gage surfaces, such as precision gage blocks.

Profilometer is a measuring instrument used to measure a surface's profile, in order to quantify its roughness. Vertical resolution is usually in the nanometre level, though lateral resolution is usually poorer.

- Contact profilometers

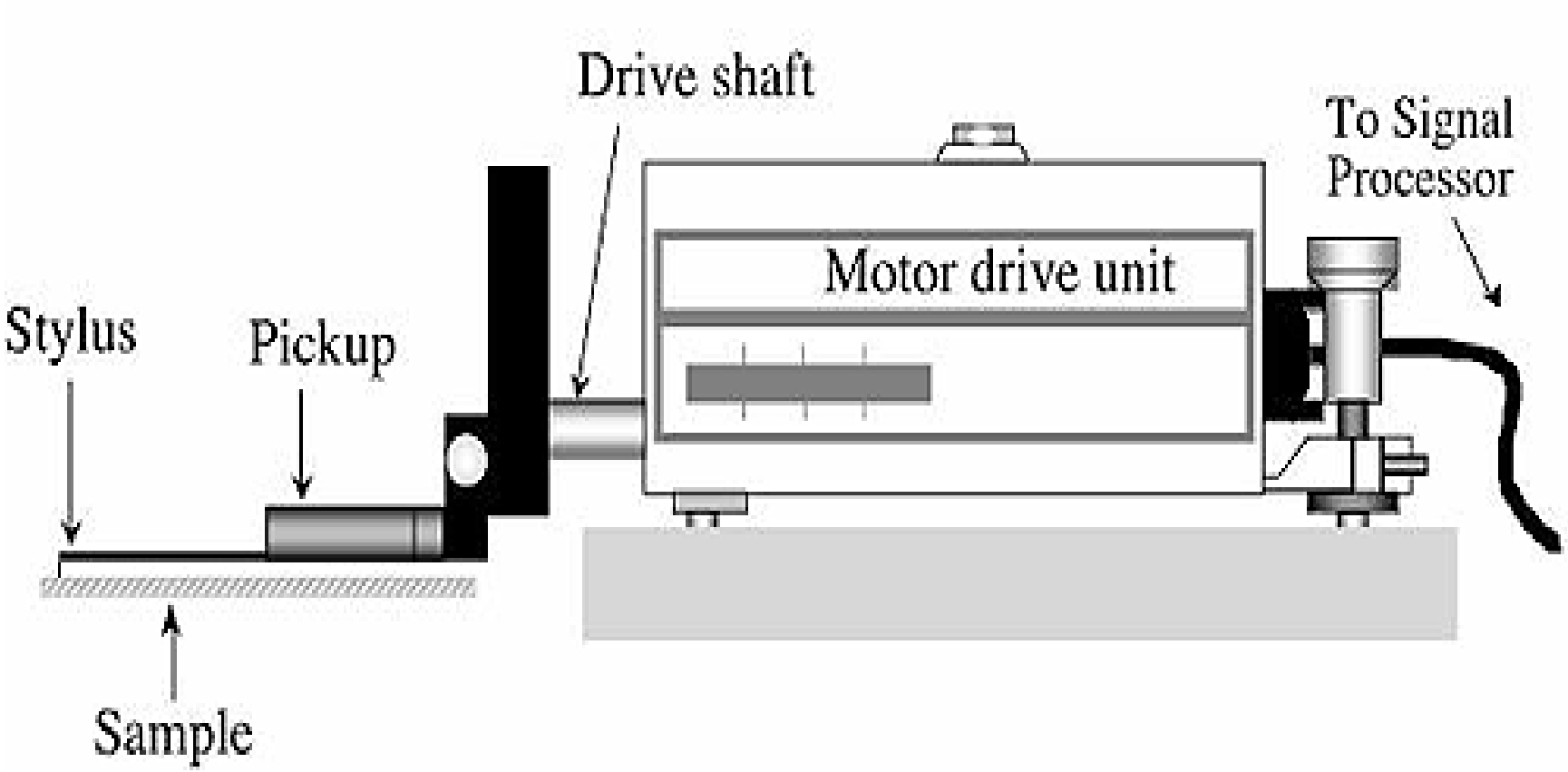
A diamond stylus is moved vertically in contact with a sample and then moved laterally across the sample for a specified distance and specified contact force. A profilometer can measure small surface variations in vertical stylus displacement as a function of position. A typical profilometer can measure small vertical features ranging in height from 10 nanometres to 1 millimetre. The height position of the diamond stylus generates an analog signal which is converted into a digital signal stored, analyzed and displayed. The radius of diamond stylus ranges from 20 nanometres to 25 µm, and the horizontal resolution is controlled by the scan speed and data signal sampling rate. The stylus tracking force can range from less than 1 to 50 milligrams.

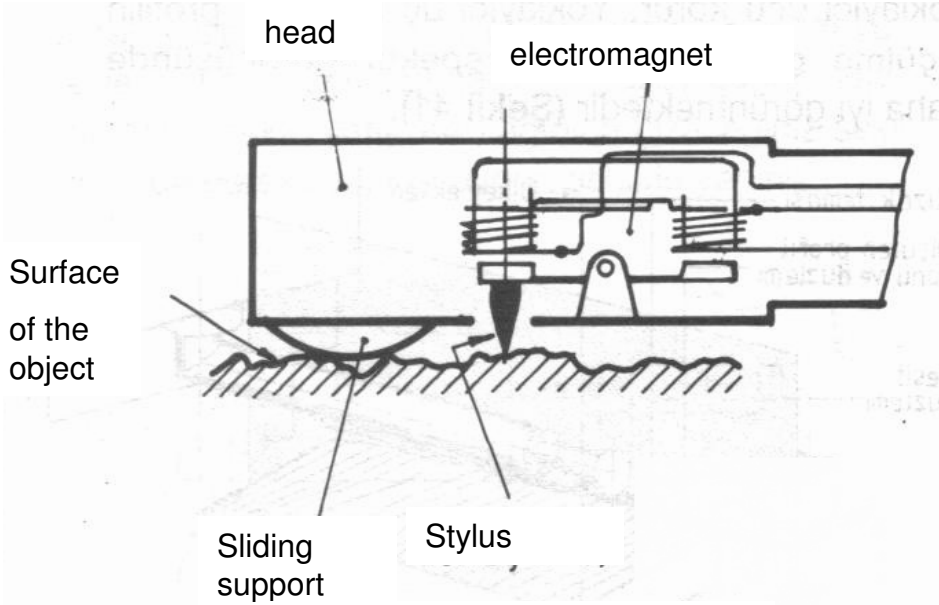
- Non-contact profilometers

An optical profilometer is a non-contact method for providing much of the same information as a stylus based profilometer. There are many different techniques which are currently being employed, such as laser triangulation (triangulation sensor), confocal microscopy and digital holography.

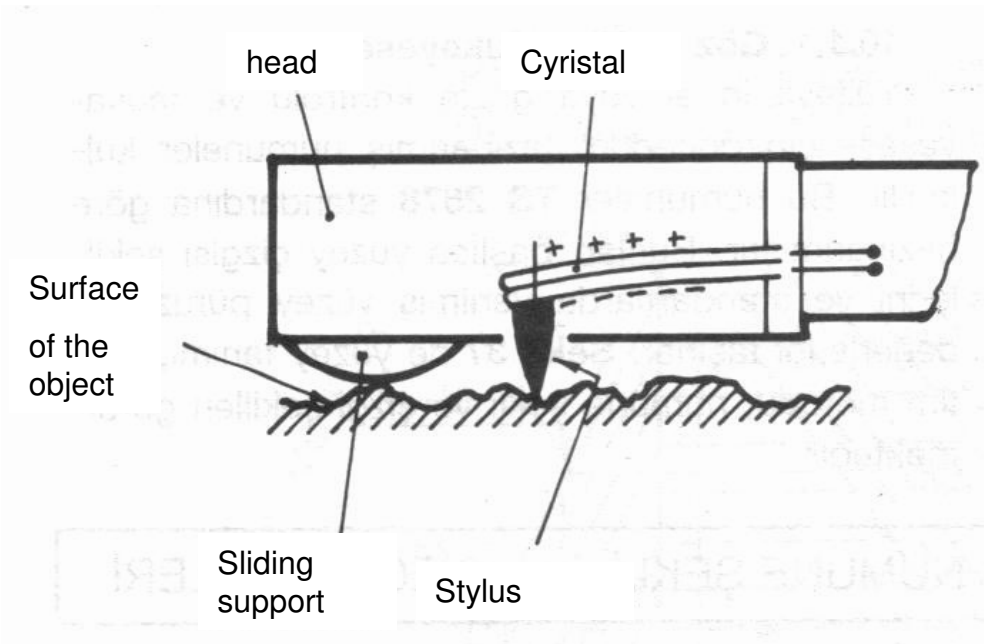
Master Specimens

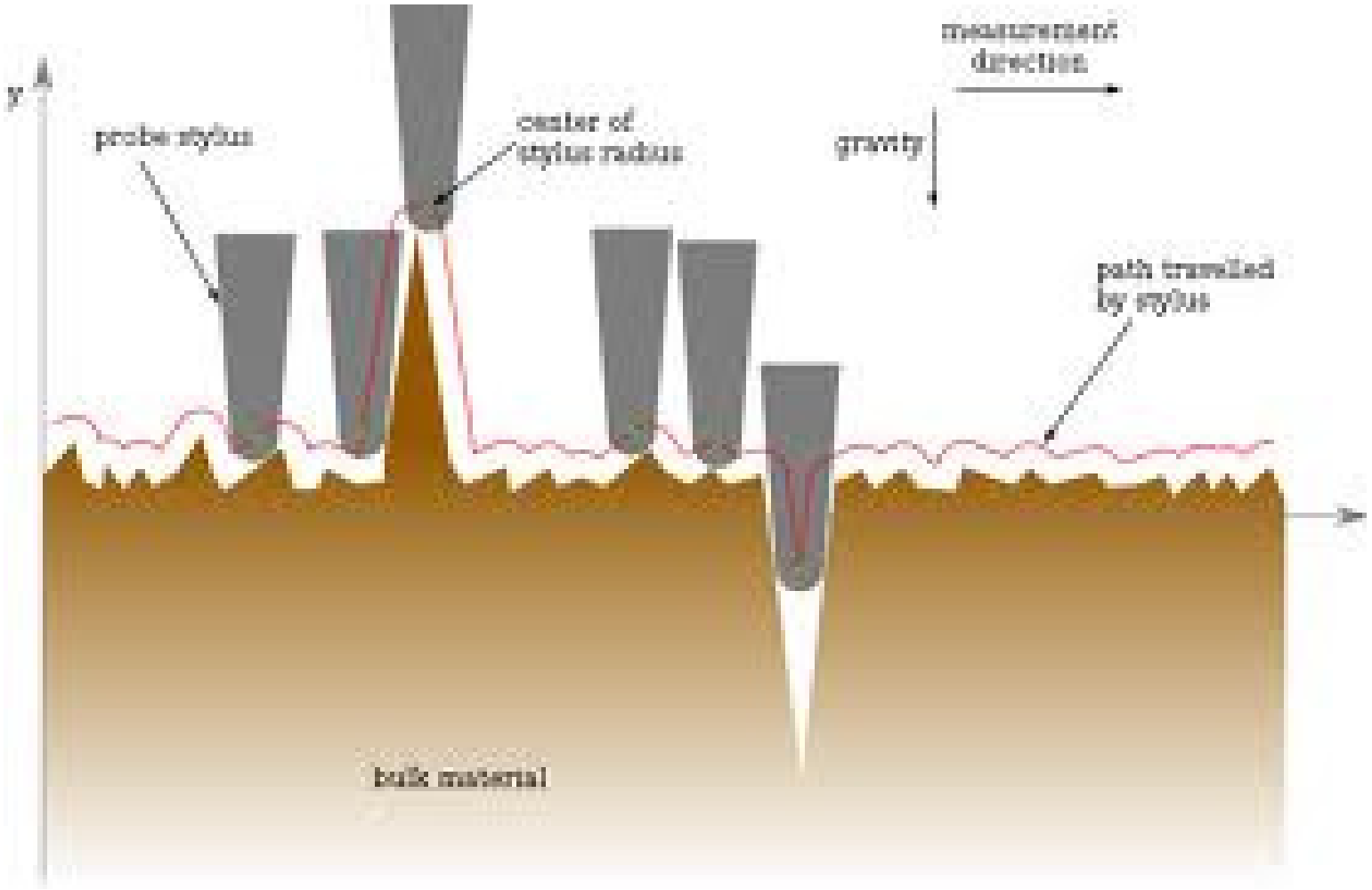
Profilometer

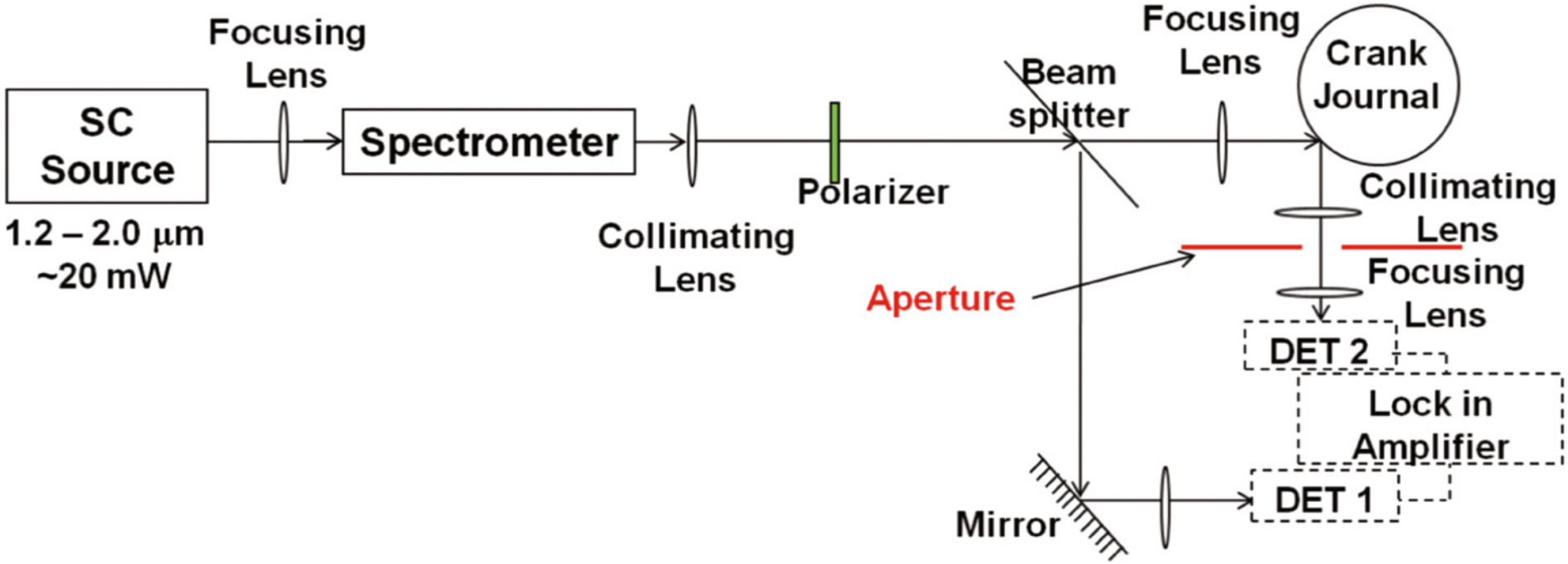

Drive shaft
To Signal Processor
Motor drive unit
Stylus
Pickup
Sample



Probe of a Contact Profilometer




y
probe stylus
center of
stylus radius
measurement
direction
gravity
path traveled
by stylus
bulk material

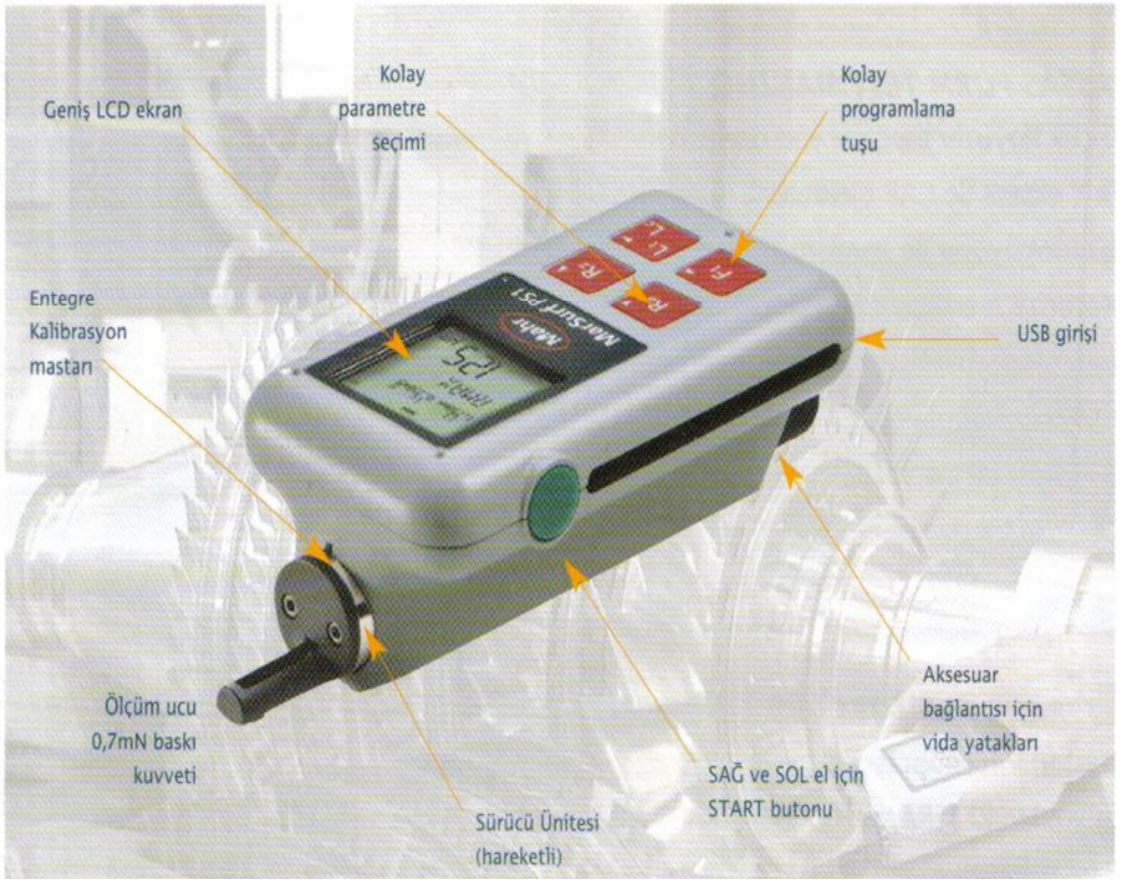


Optical Rougness Tester

PORTATİF YÜZEY PÜRÜZLÜLÜK OLÇUM SISTEMLERI

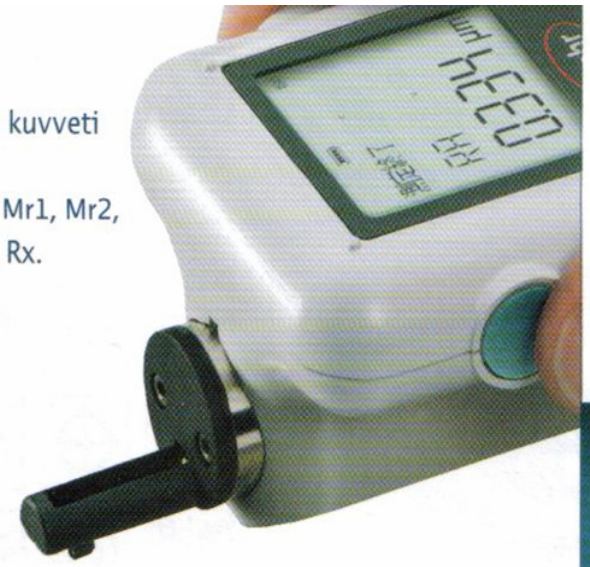
Marsurf PS1 Portatif Pürüzlülük Ölçme Ekipmanı

- Kolay kullanım
- Hızlı ölçüm sonuçları
- Yükseklik ayar ayakları
- Entegre kalibrasyon mastarı
- USB kablo bağlantısı
- Şarj edilebilir pil ve şarj adaptörü
- Taşıma çantası
- Pikap koruyucusu
- Opsiyonel uç seçenekleri
- Ölçme standine bağlanabilir
- Yazıcıya bağlanabilir



Teknik Özellikler:

Birim	:	mm / inch çevrimli
Pikap	:	2µm uç radyuslu ölçüm ucu, 0,7mN baskı kuvveti
		350µm ölçüme kursu
Parametreler	:	Ra, Rp, Rz (Ry), Rmax, Rpm, Rpk, Rk, Rvk, Mr1, Mr2,
		A1, A2, Vo, Rt, R3z, RPc, Rmr, RSm, R, Ar, Rx.
Çözünürlük	:	32nm profil çözünürlüğü
Filtre	:	DIN EN ISO 11562 (Gauss);
		DIN EN ISO 13565; DIN EN ISO 3274
Kesme boyu	:	0,25 - 0,8 - 2,5mm (otomatik seçim)
Tarama boyu	:	1,75 - 5,6 - 17,5mm (ISO)
	:	1 - 2 - 4 - 8 - 16mm (CNOMO)
Kalibrasyon	:	Dinamik kalibrasyon
Bellek	:	15 profil; 20.000 ölçüm sonucu
Güvenlik	:	Ayarları saklama ve şifre ile koruma
Diğer işlevler	:	Saat/tarih ayarı
Boyutlar	:	140x50x70mm; 400gr
Bağlantı	:	USB ve RS232 çıkışı



Patentli Tarama ucu

Üretim hattında portatif ve Seri ölçümlerde kullanıma uygundur.

Ölçüm standı (opsiyonel)

Yükseklik ayakları (standart)

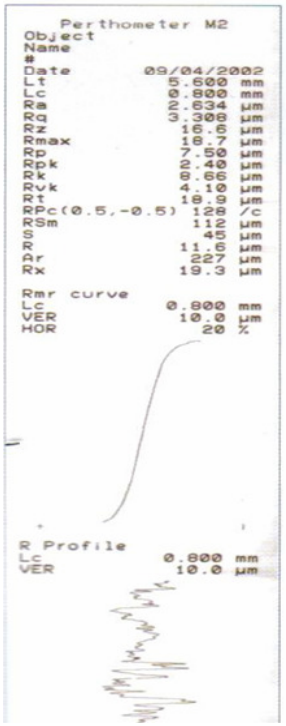
Geniş LCD ekran, hassas sonuçlar

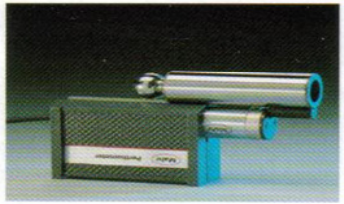
Yazıcı (opsiyonel)

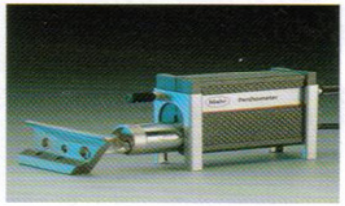
Taşıma çantası (standart)

Marsurf Perthometer M Serisi Portatif Pürüzlülük Ölçüm Ekipmanları

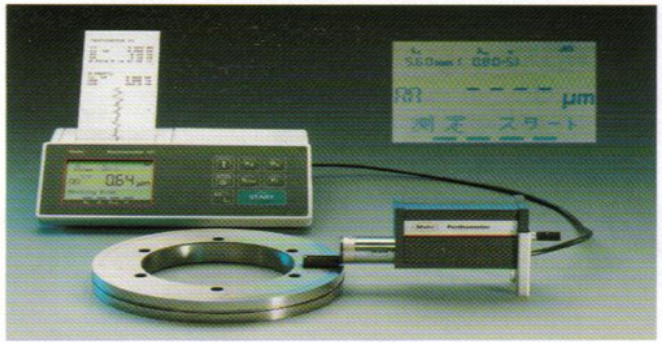
- DIN ISO, CNOMO parametrelerinin seri ölçümleri
- Otomatik ve dinamik kalibrasyon özelliği
- Otomatik tarama boyu seçimi
- 1,75 / 5,6 /17,5mm tarama boyu
- Profil çözünürlüğü 0,012µm
- Entegre termal yazıcı
- İç ve dış çap ölçümleri
- Bellek kartı ile sonuçların saklanması
- RS232 bağlantısı ile data transferi
- Özel çantası içinde komple set
- Stend ile kullanma opsiyonu ve geniş aksesuar seçeneği
- Türkçe kullanma kitapçığı





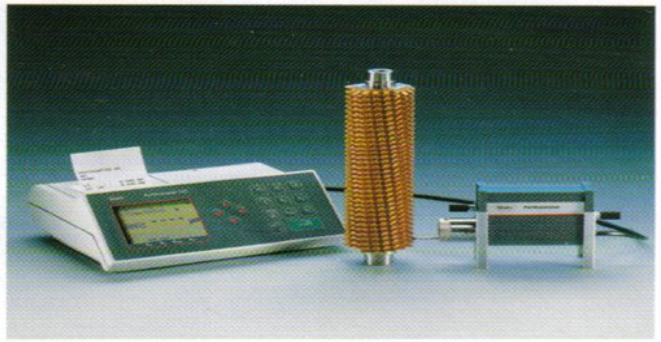


Perthometer M1



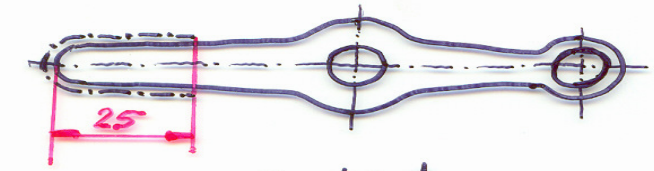
4 temel parametre
Ra / Rmax / R2 / Rpc

Perthometer M2

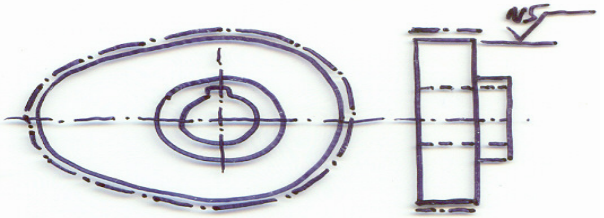


DIN-ISO-JIS ve
CNOMO parametreleri

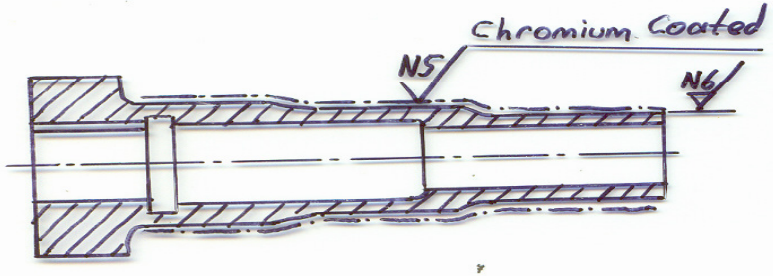
Hardened
RC = 60 ± 4
Ht = 1 ± 0.2

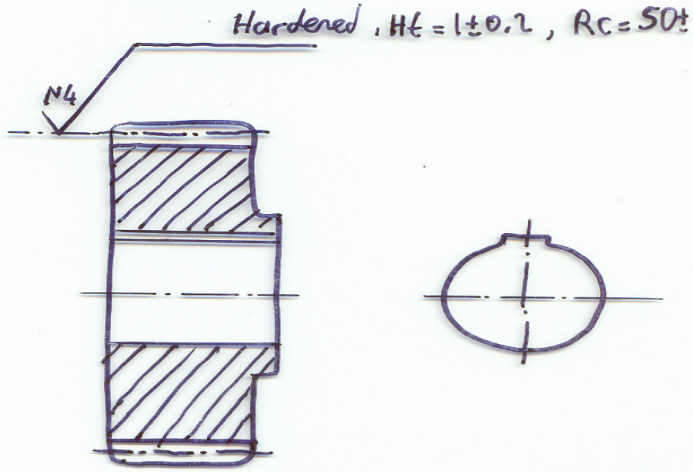


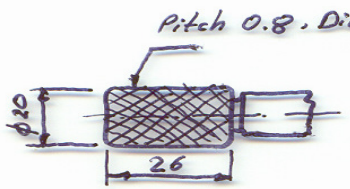
Hardened
Ht = 1 ± 0.2
RC = 38 ± 0.8

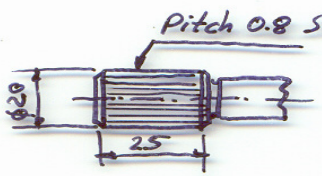


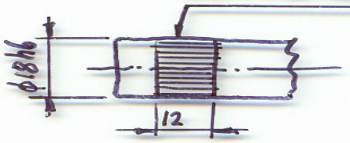
Hardened
Ht = 2 ± 0.5
RC = 40 ± 2









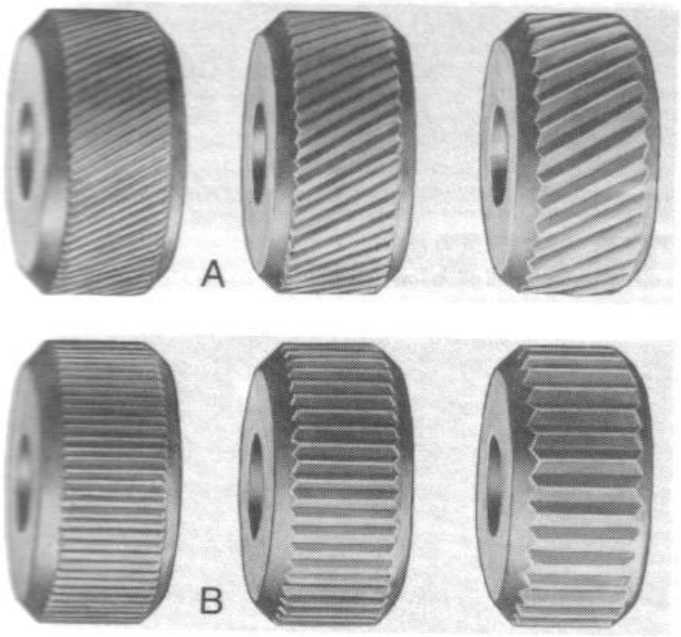


standard Pitch Value

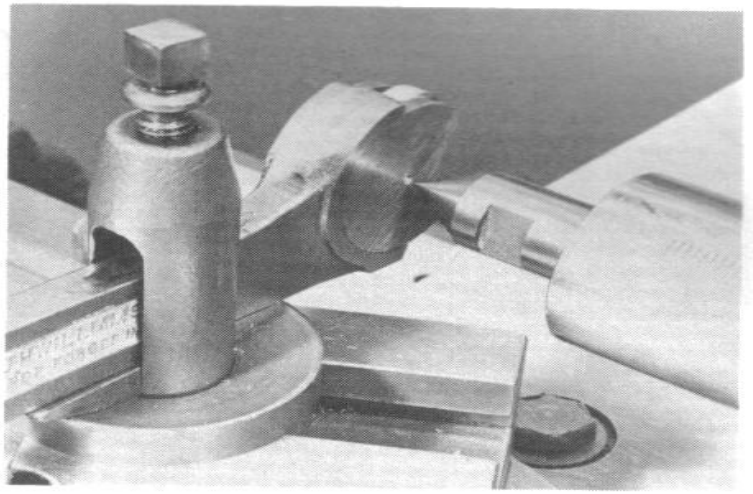
straight Knurl	0.5	0.6	0.8	1	1.2	1.6	2
Diamond Knurl	—	0.6	0.8	1	1.2	1.6	2

KNURLING

Knurling is a process of impressing diamond-shaped or straight indentations on the surface of work. The purposes of knurling are to improve the appearance of the work and to provide a better grip. It is done by forcing a knurling tool containing a set of hardened cylindrical patterned rolls against the surface of revolving work. Diamond and straight pattern rolls in three styles—fine, medium, and coarse-



Diamond- and straight-pattern fine, medium, and coarse knurling rolls. (*Courtesy J. H. Williams & Co.*)

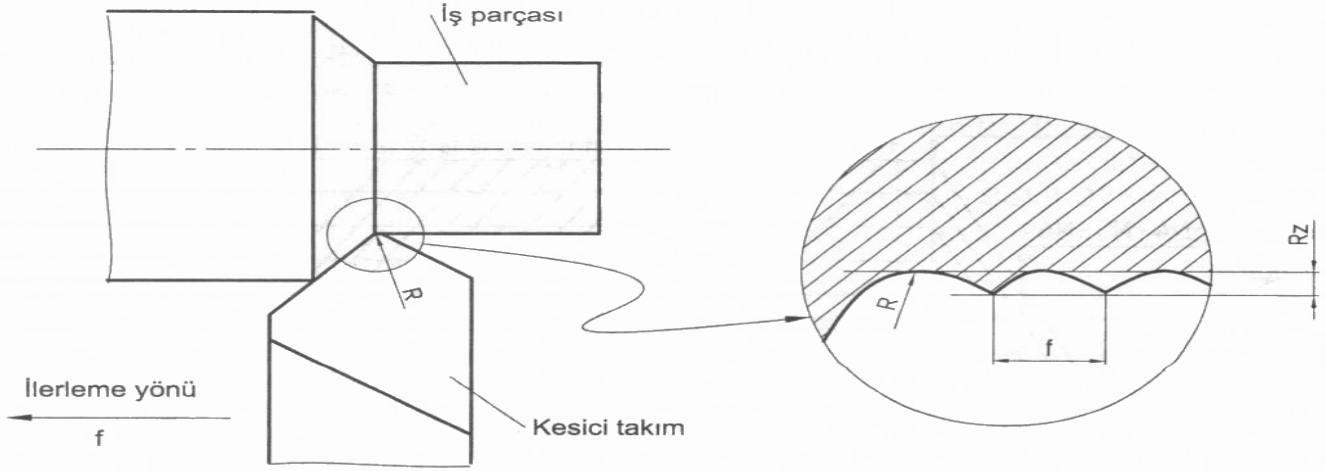


Aligning the center of the floating head with the lathe center point. (*Courtesy Kostel Enterprises Ltd.*)

A knurling tool with one set of rolls in a self-centering head.

$$Rt \approx Tolerance/3$$

$$Rz \approx Tolerance/2$$



Kesici takım uç kavisi ve yüzey pürüzlülüğüne göre; 1 devirdeki ilerleme (f) mm

Talaş cinsi / Ortalama pürüz yüksekliği μm / Ortalama pürüzlülük değeri μm / Yüzey sınıf numarası / Kesici takım uç kavisi	Kaba talaş		Orta talaş		İnce talaş	
	Rz = 100	Rz = 63	Rz = 25	Rz = 16	Rz = 6,3	Rz = 4
	Ra = 25	Ra = 12,5	Ra = 6,3	Ra = 3,2	Ra = 1,6	Ra = 0,8
	N11	N10	N9	N8	N7	N6
0,4 mm	0,57	0,45	0,28	0,2	0,14	0,1
0,8	0,80	0,63	0,43	0,3	0,2	0,16
1,2	1	0,8	0,5	0,4	0,25	0,2
1,6	1,13	0,9	0,6	0,45	0,3	0,23
2,4	1,4	1,3	0,7	0,55	0,35	0,28

$$Rz = \frac{f^2}{0{,}008.R}\ \mu m \qquad Ra = \frac{f^2}{(0{,}032 - 0{,}040).R}\ \mu m$$

Rz> 25 =0,032
Rz<16 =0,040

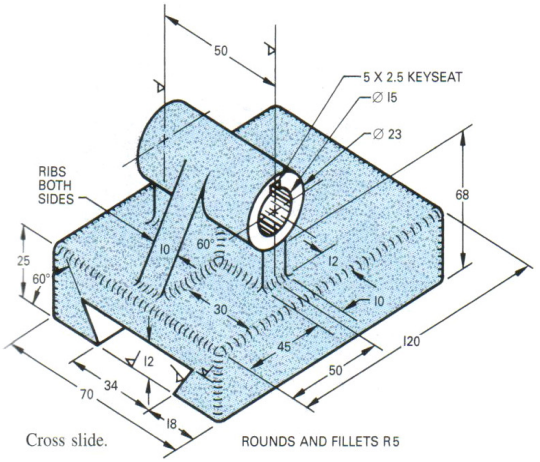
Talaşlı üretimde kesici takım ve pürüzlülük ilişkileri

MECH 114
Home Exercises

1)

Make a working drawing of the cross slide shown in Fig. Scale 1:1. The following information is to be added to the drawing:

- The dovetail slot is to have a maximum roughness value of 3.2 μm and a machining allowance of 2mm.
- The ends of the shaft support are to have maximum and minimum roughness values of 1.6 and 0.8 μm and a machining allowance of 2 mm.
- The hole is to have an H8 tolerance.

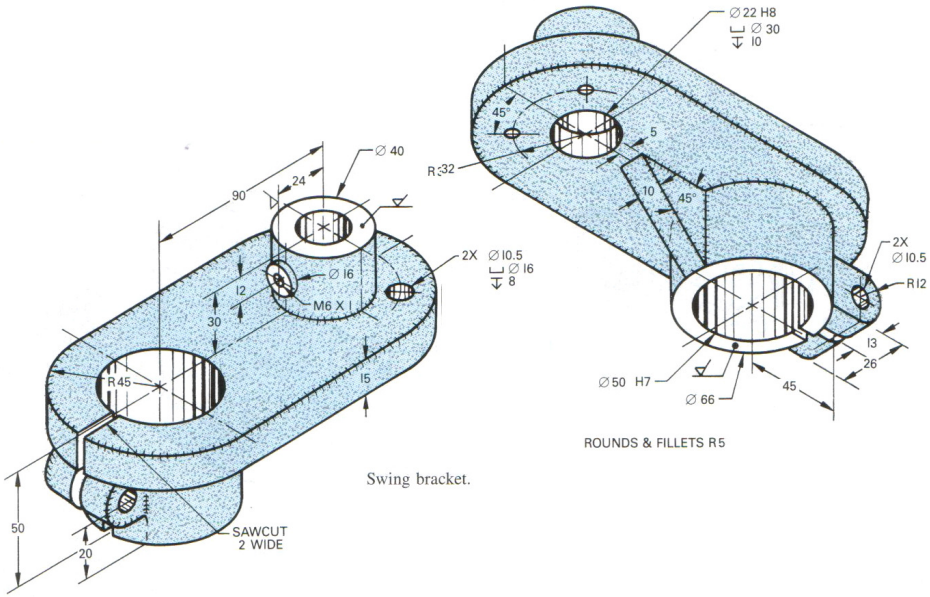


Cross slide.

2)

Draw the necessary views, show the dimensions, surface quality symbols, geometrical tolerances. (Scale:1:1), Object Name: Swing Bracket, Material: GG 30,

Unless otherwise specified, surface finish to be 63 μin (1.6 μm) with a machining allowance of .06 in. (2 mm).



Swing bracket.