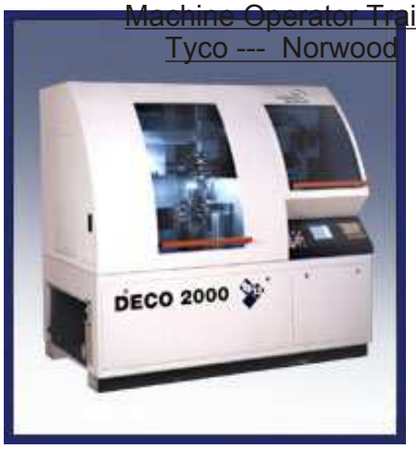
Micrometer Quiz



Machine Operator Training
Tyco Norwood

--- Safety
--- The Decimal Number System
--- 6” Scale
--- Micrometer
--- Blueprint Reading
--- Metric > Inch Conversion
--- Tolerance Calculations
--- The Unified Screw Thread
--- Using The Decimal Equivalent Chart
--- Standard Drill Sets
--- Micro Finishes

Machine Shop Safety

Safety Glasses

Everyone must wear safety glasses in the shop.

Even when you're not working on a machine, you must wear safety glasses.

Clothes and Hair

Check your clothes and hair before you walk into the shop.

If you have long hair tie it up.

If your hair is caught in spinning machinery, it will be pulled out if you're lucky.

If you're unlucky, you will be pulled into the machine.

No Loose baggy clothing. Ex: No Gloves and no Jewelry

Wear appropriate shoes

Always be aware of the oily condition of the floor aroun your machine and

Assigned work area.

No open toe sandals. Wear shoes that give a sure footing. If you are working with heavy objects, steel toes are re commended.

Safe Conduct in the Shop

Be aware of what's going on around you.

Listen to the machine, If something doesn't sound right, turn the machine off.

Do not let someone else talk you into doing something dangerous.

Do not attempt to measure a part that's moving.

Never touch chips or rotating tooling with your hands or fingers when a machine running.

Keep the shop doors closed. Do not let any unauthorized people in the shop.

"No access card, No admittance" is the policy.

Machining

If you do not know how to do something, ASK!

Before starting the Machine:

Study the machine, Know which parts move, which are stationary, and which

are sharp.

Remove wrenches from area's of low machine clearance.

Pull chips at the end of your shift.

Do not use compressed air to blow machines clean. This endangers people's eyes and can force dirt into machine slides.

Never pull or remove chips with your bare hands.

Never operate machinery alone in the shop.

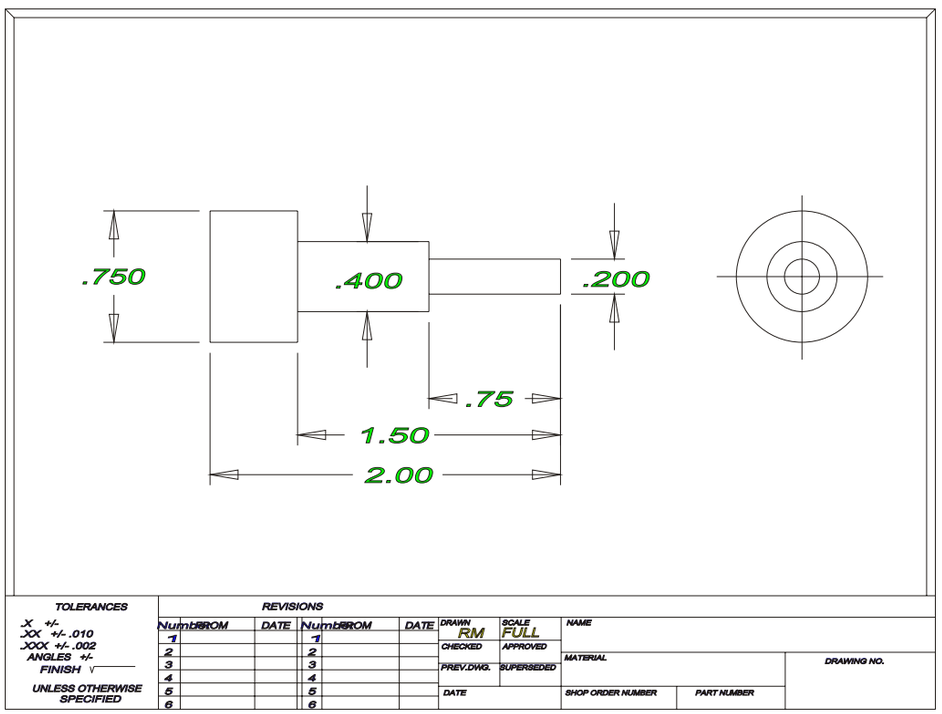
Hazardous Waste

Always follow proper guidlines when disposing of Hazardous Waste.

If your not sure what is proper, ask your team leader for help.

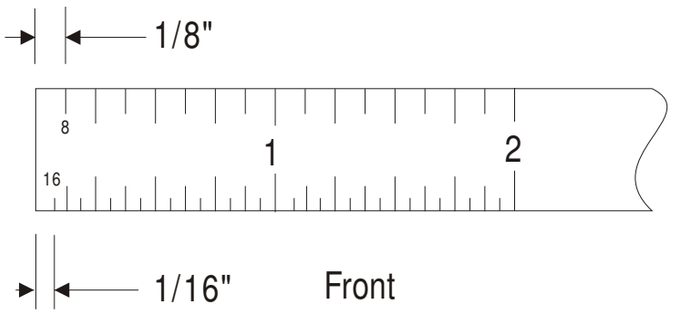
Decimal Numbering System

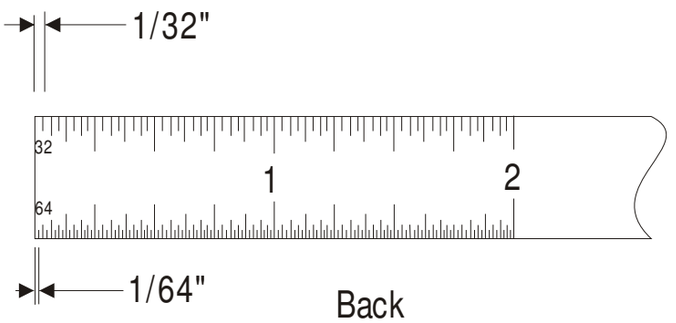
	Whole Numbers							Decimal Numbers						
	Millions	Hundred - Thousands	Ten - Thousands	Thousands	Hundreds	Tens	Ones	.	Tenths	Hundredths	Thousandths	Ten - Thousandths	Hundred - Thousandths	Millionths
1							1	.	0					
1 ½							1	.	5					
1 ¼							1	.	2	5				
1 ¾							1	.	7	5				
½								.	5	0	0			
.110 Thousandths								.	1	1	0			
.111 Thousandths								.	1	1	1			
.112 Thousandths								.	1	1	2			



The Steel Rule

The steel rule is the most common and basic measuring tools found in the machine shop. The rule (sometimes called a scale) is available in many different combinations or sets of division. The most common one used is divided into four increments of measurement by 64ths, 32nds, 16ths, and 8ths as shown below.





Please answer the following questions;

1. How many 64ths are there in one inch? _____

2. How many 32 ths are there in one inch ? _____

3. How many 16 ths are there in 1/4 of an inch ? _____

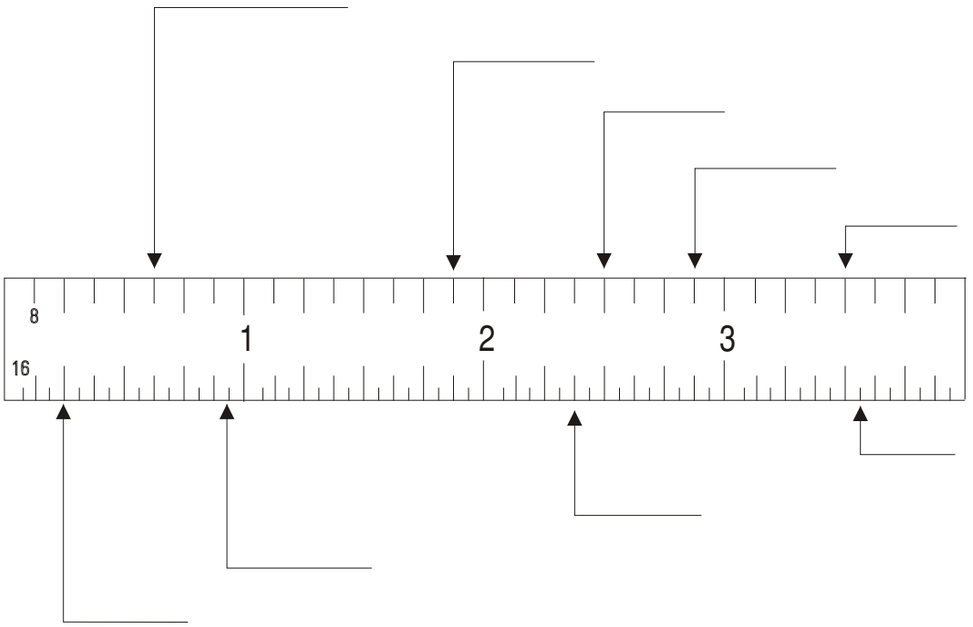
4. How many 8 ths are there in 3/4 of an inch ? _____

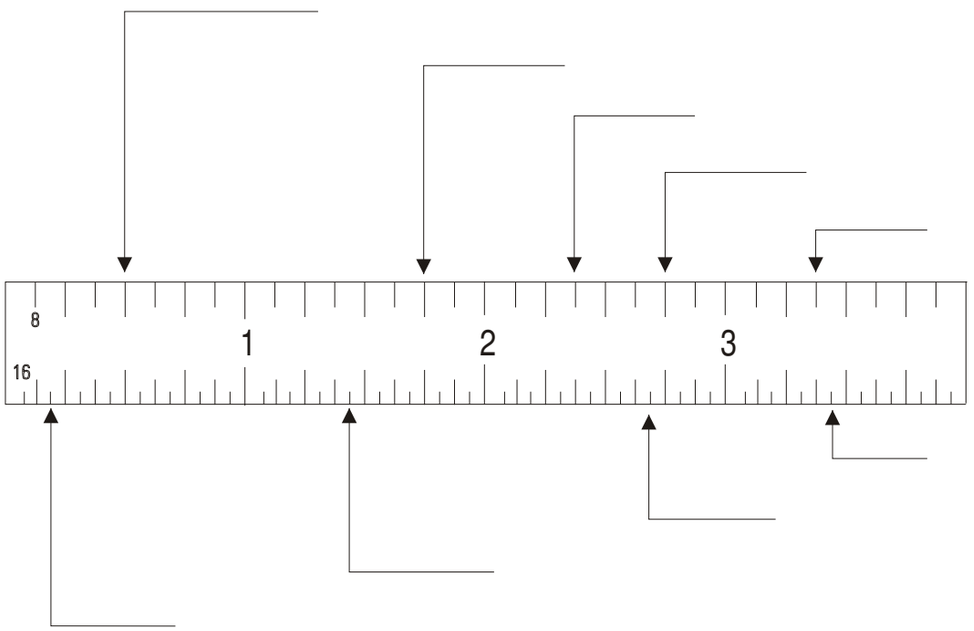
5. How many 64 ths are there in 1 3/4 of an inch ? _____

Reading The Steel Rule

Students Name _____

Please write in the correct scale measurements as indicated below.

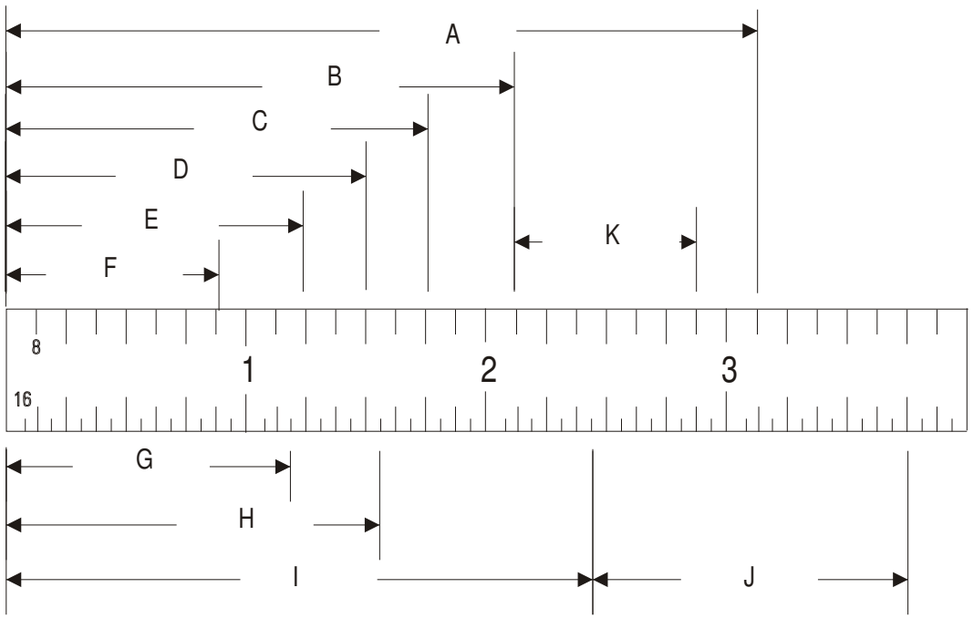




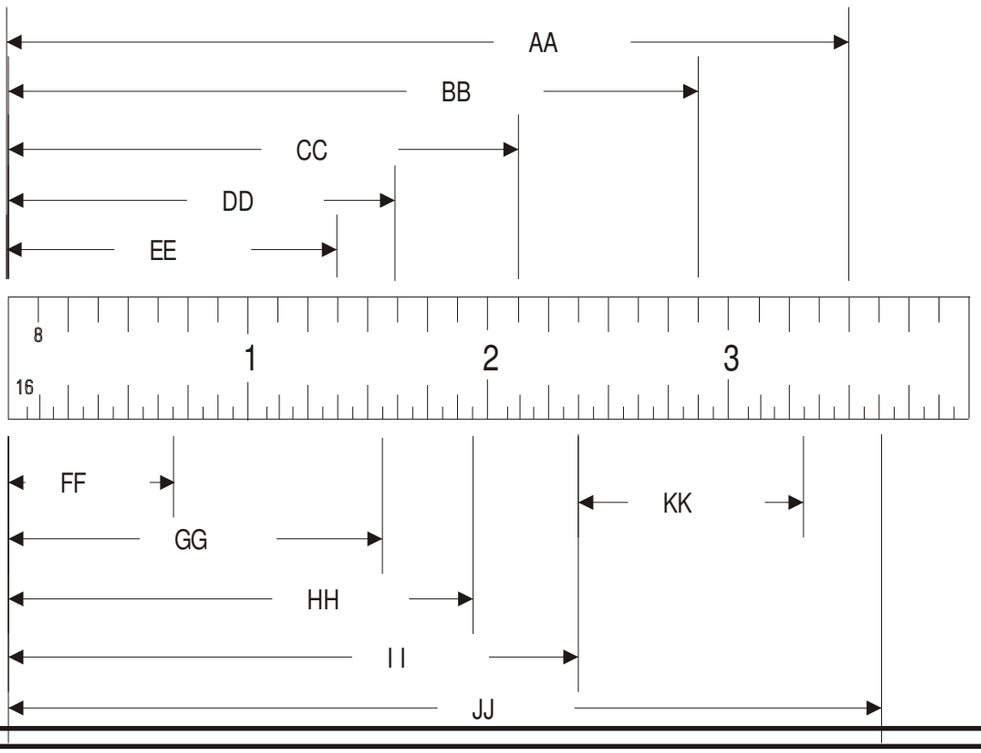
Reading The Steel Rule

Students Name _____

Please write in the correct scale measurements as indicated below.



A =
B =
C =
D =
E =
F =
G =
H =
I =
J =
K =

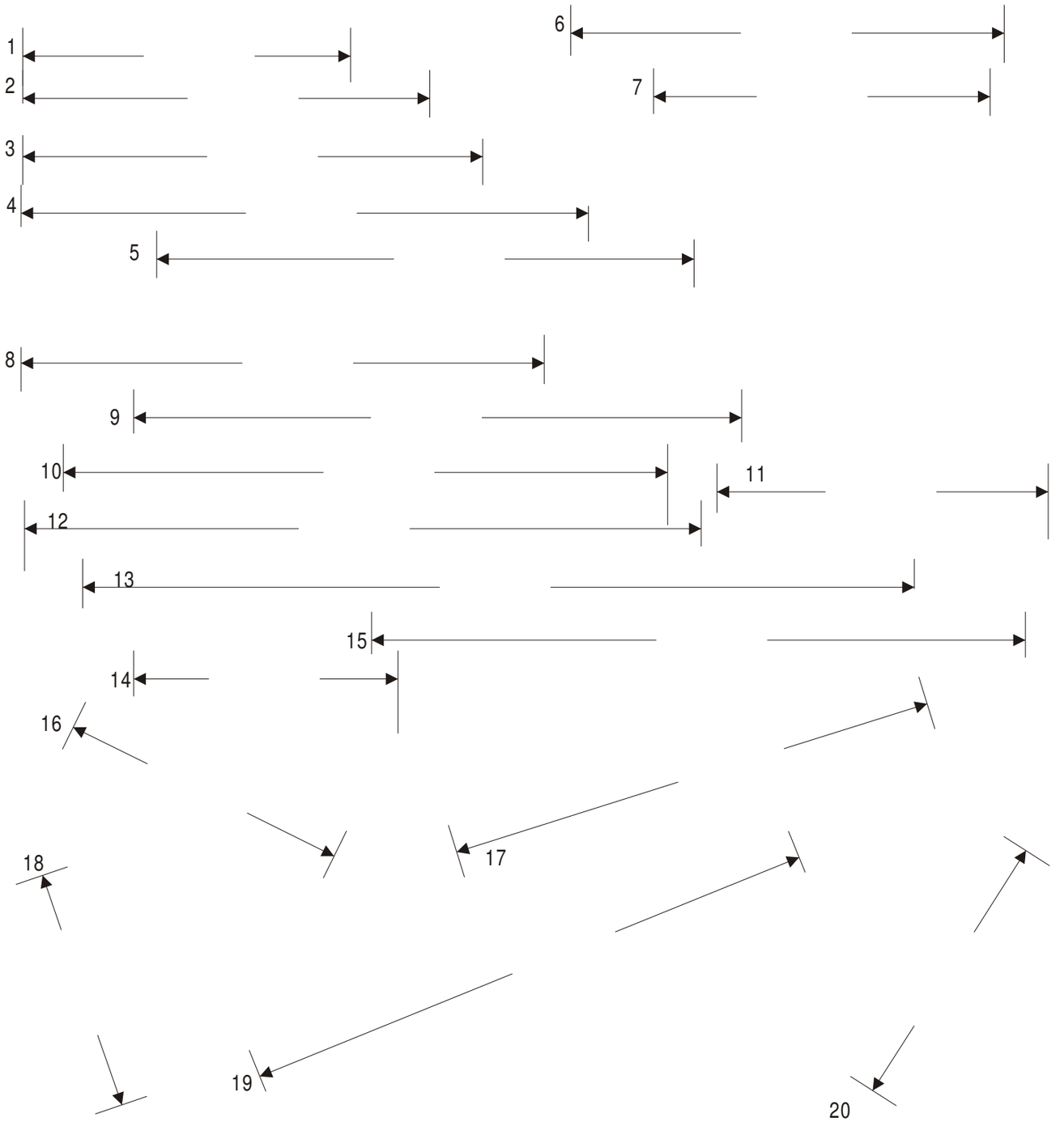


AA =
BB =
CC =
DD =
EE =
FF =
GG =
HH =
II =
JJ =
KK =

Reading The Steel Rule

Students Name _____

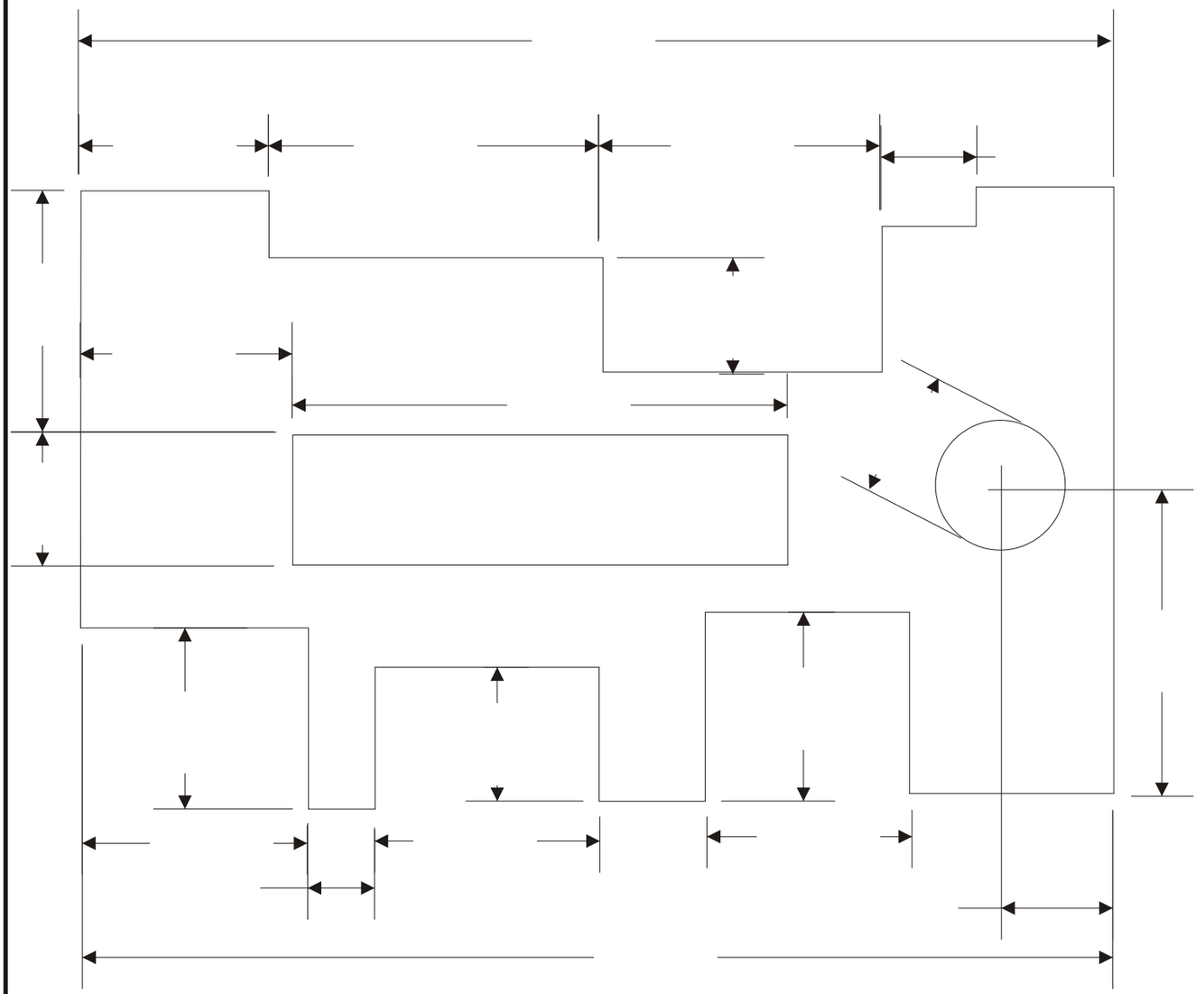
Please write in the correct line length measurements indicated below.
Your answer should be written to the nearest 1/16 " reduced to it's lowest terms.



Reading The Steel Rule

Students Name _____

Please write in the correct measurements between arrowheads as indicated below.
Your answer should be written to the nearest 1/16 " reduced to it's lowest terms.



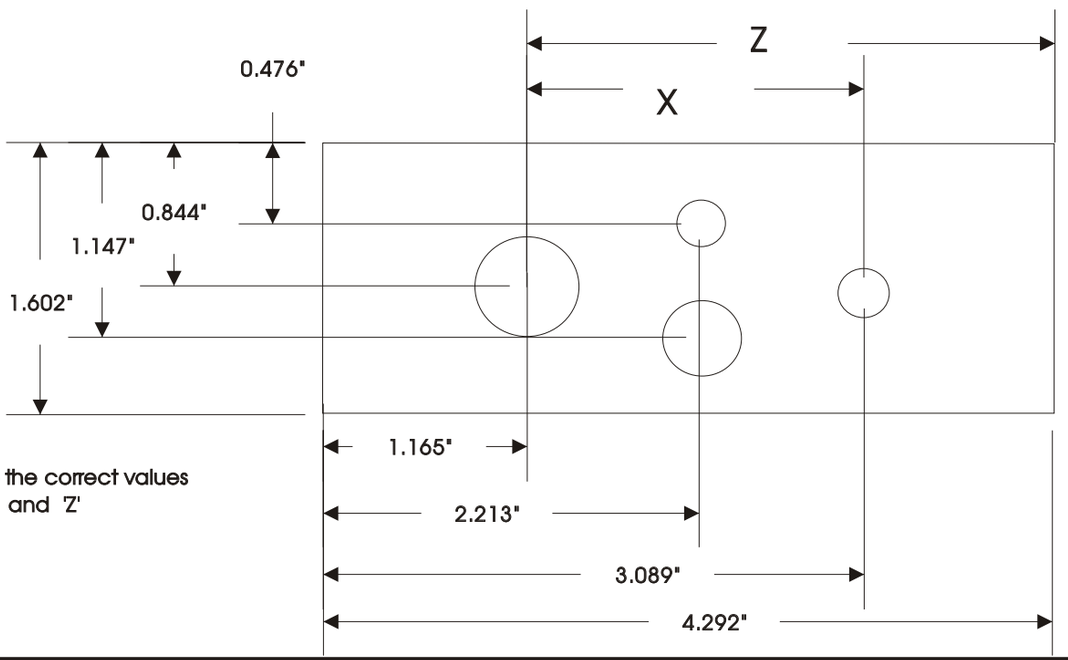
Exercise in Reducing Fractions

1. Reduce the following common fractions to decimals.

¼	7/8	5/8	13/32
3/8	13/16	11/64	13/64
2/3	9/10	1/25	11/16
4/5	3/32	63/64	9/32

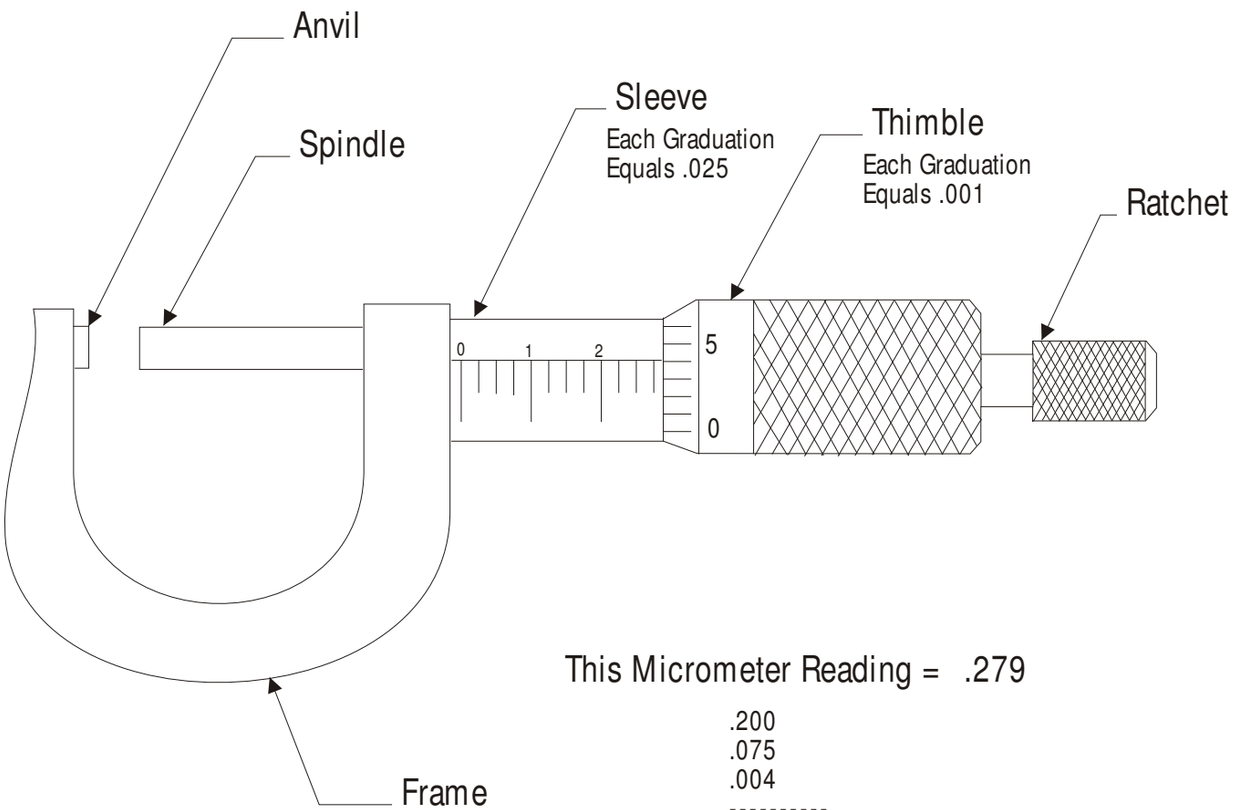
2. Please find the total of the following sets of numbers.

.250	1.125
.375	2.5625
9/32	1 13/32
15/64	.500
.9375	.750
63/64	3 7/32



Please Calculate the correct values for dimension 'X' and 'Z'

The Parts of a Micrometer

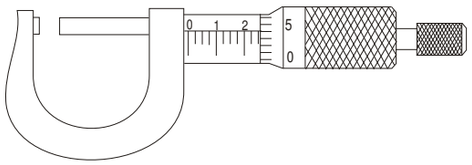


This Micrometer Reading = .279

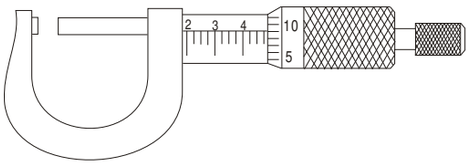
.200
.075
.004

.279

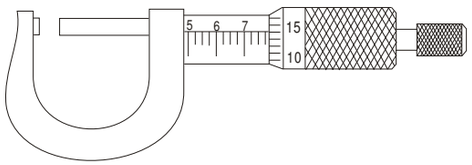
Reading The Micrometer



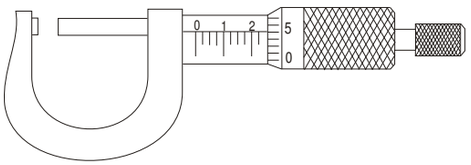
Reading = _____



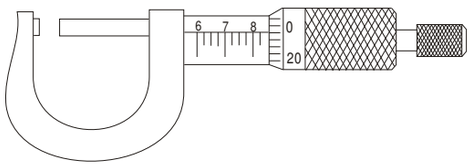
Reading = _____



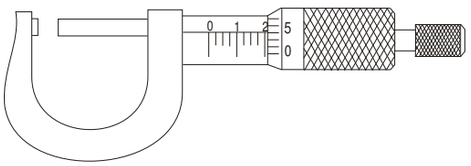
Reading = _____



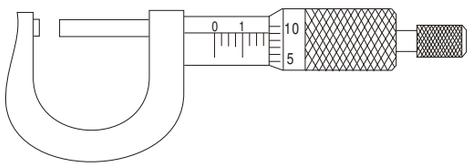
Reading = _____



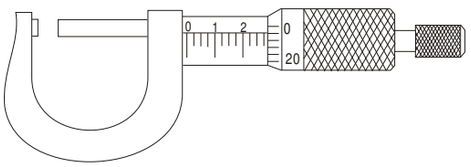
Reading = _____



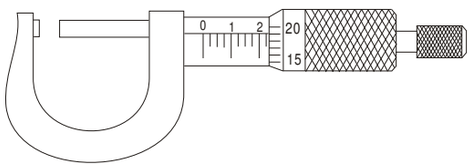
Reading = _____



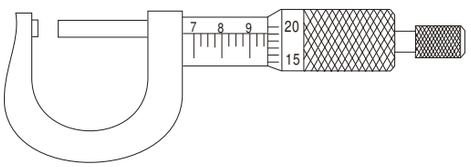
Reading = _____



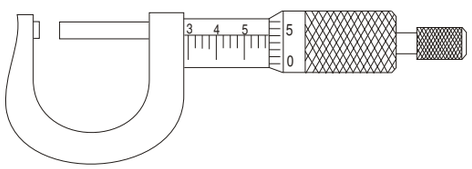
Reading = _____



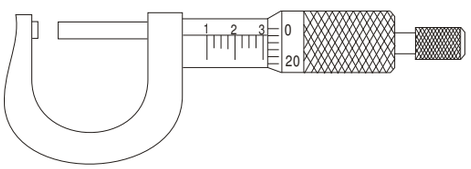
Reading = _____



Reading = _____

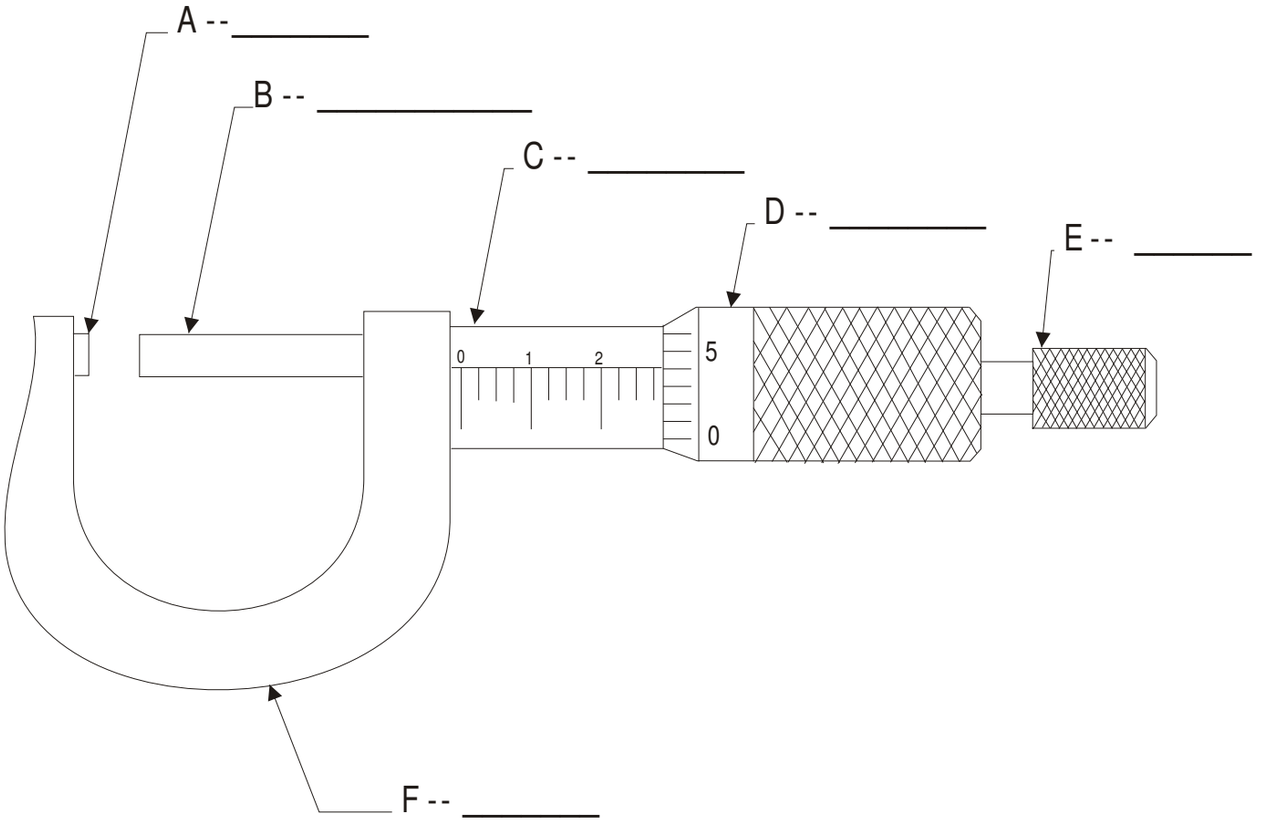


Reading = _____



Reading = _____

1. Please fill-in the correct names of the micrometer in the drawing below.



2. What is the range of any micrometer? _____

3. How many threads per inch are there on item 'B' shown above? _____

4. What is the value of each line on the item marked 'C' in the above drawing? _____

5. What is the value of each numbered line on the item marked 'C' in the above drawing? _____

6. What is the value of each line on the item marked 'D' in the above drawing? _____

Machine Operator Training
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PAGE ONE OF BLUEPRINT READING CURRICULUM

TITLE BLOCK ONLY

NOTES:

1. MAT'L. = STAINLESS STEEL PER ASTM-A484 AND ASTM-A582 TYPE 303
2. UNLESS OTHERWISE SPECIFIED, HOLES, SLOTS, & DIAMETERS, SHALL BE PARALLEL AND CONCENTRIC WITHIN .003 T.I.R.
3. FINISH TO BE 63 UNLESS OTHERWISE SPECIFIED.
4. REMOVE BURRS AND BREAK SHARP CORNERS (.005 RAD. MAX.).

	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE INCHES, AND BEFORE PLATING, ALL ANGLES ARE DEGREES	
	TOLERANCES	
	FRACTIONS ± 1/64 | DECIMALS ± .005 | ANGLES ± 1deg	
	DRAWN DATE	*TITLE*
	CHECKED	
	APPROVED	SIZE | CODE IDENT NO | COND | REV
USED ON		

Machine Operator Training
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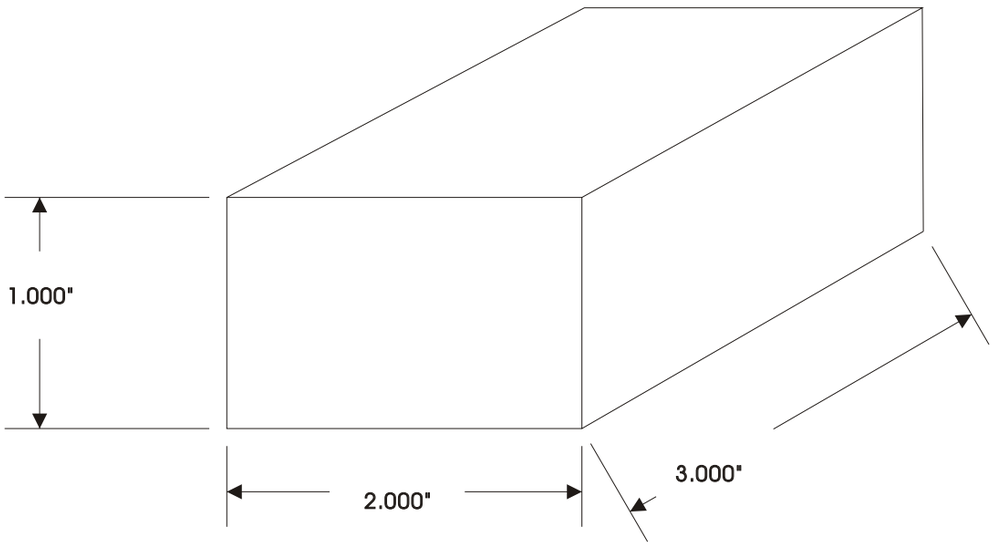
ISOMETRIC VIEW



ISOMETRIC VIEW

ALL SQUARE & RECTANGULAR
BLOCKS HAVE 6 SIDES.

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	DRAWN DATE	*TITLE*
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Machine Operator Training
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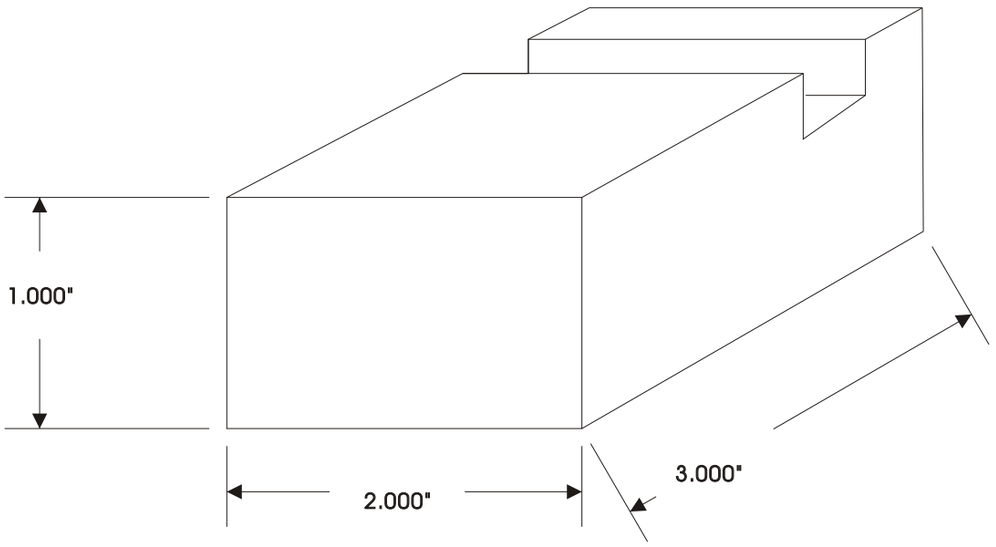
ISOMETRIC VIEW



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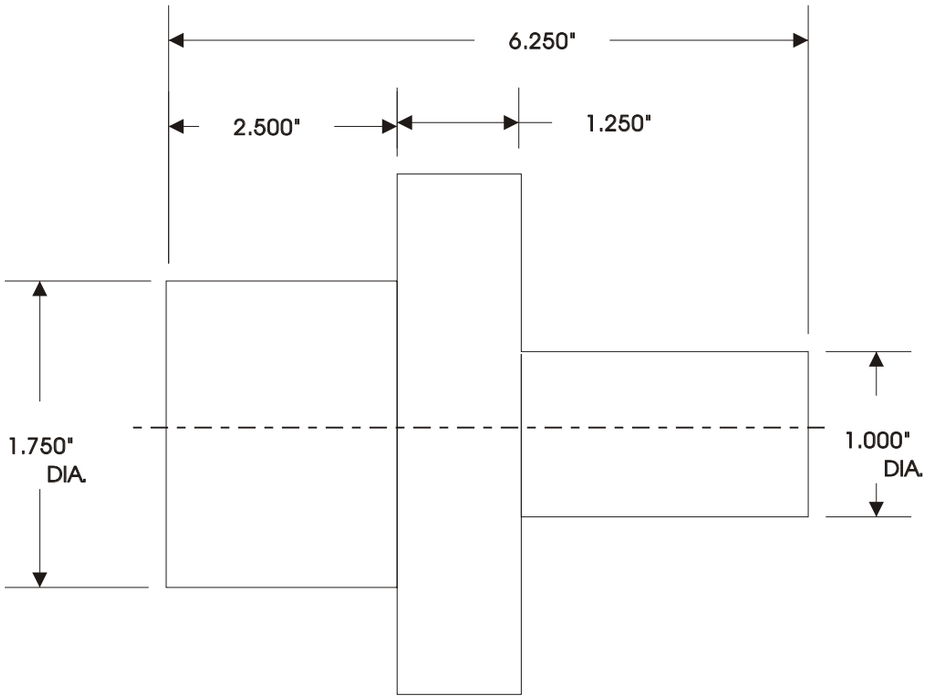
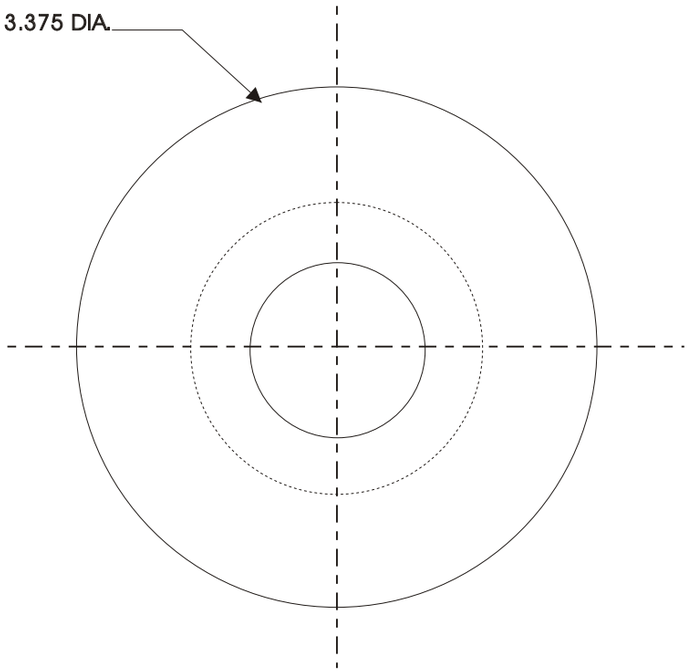
	DRAWN DATE	*TITLE*
	CHECKED	
	APPROVED	SIZE | CODE IDENT NO | COND | REV
USED ON		

Machine Operator Training
Tyco --- Norwood

TYPICAL TWO VIEW DRAWING OF CYLINDRICAL OBJECT





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TOLERANCES

FRACTIONS	DECIMALS	ANGLES
± 1/64	± .005	± 1deg

DRAWN DATE

CHECKED

APPROVED

USED ON

TITLE

SIZE		CODE IDENT NO	COND	REV

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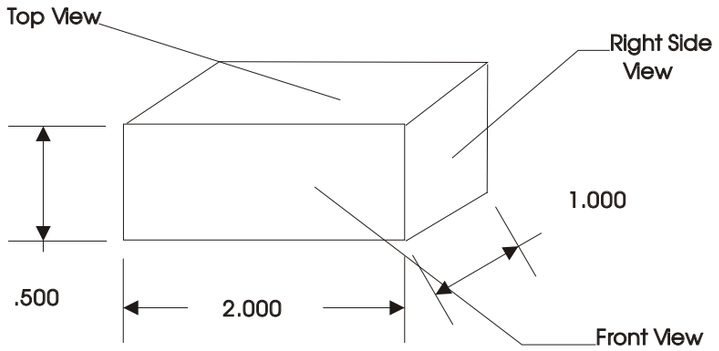
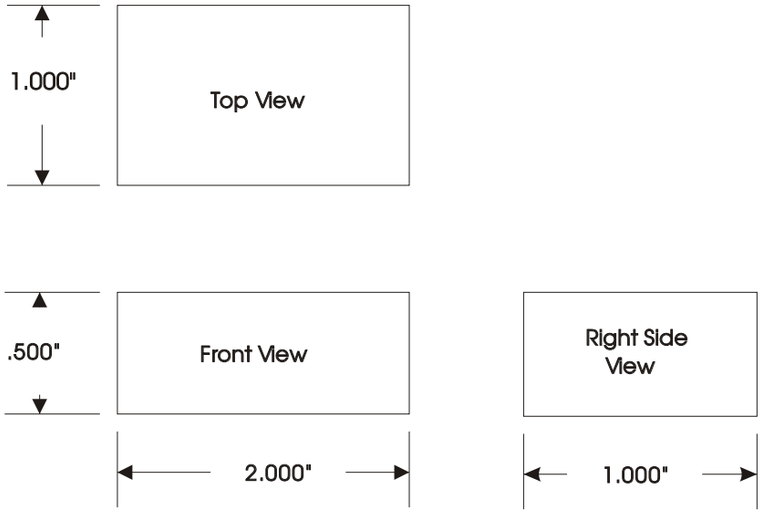
TYPICAL THREE VIEW DRAWING

ISOMETRIC VIEW





ISOMETRIC VIEW

ALL SQUARE & RECTANGULAR BLOCKS HAVE 6 SIDES.

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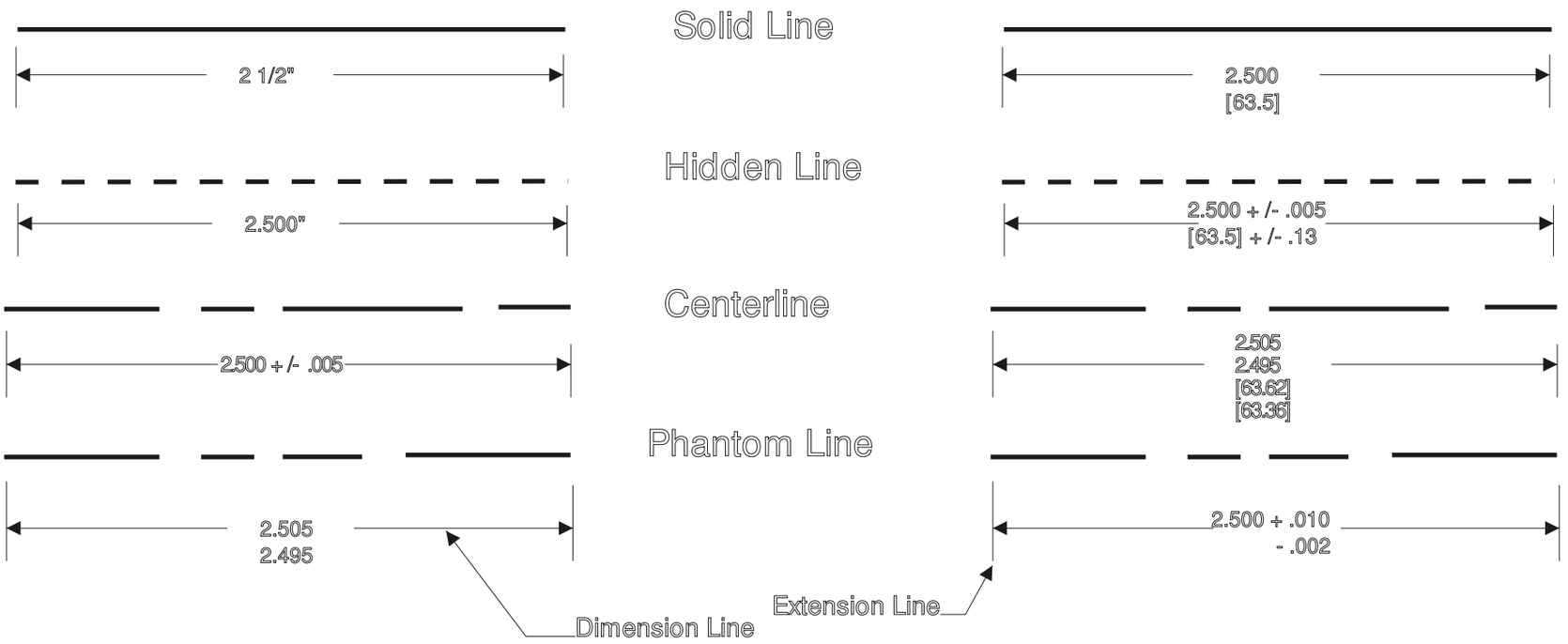
	TOLERANCES	
	FRACTIONS ± 1/64 | DECIMALS ± .005 | ANGLES ± 1deg	
	DRAWN DATE	*TITLE*
	CHECKED	
	APPROVED	SIZE | CODE IDENT NO | COND | REV
USED ON		

Machine Operator Training
Tyco --- Norwood

The Four Basic Line Types

Common Tolerance Types

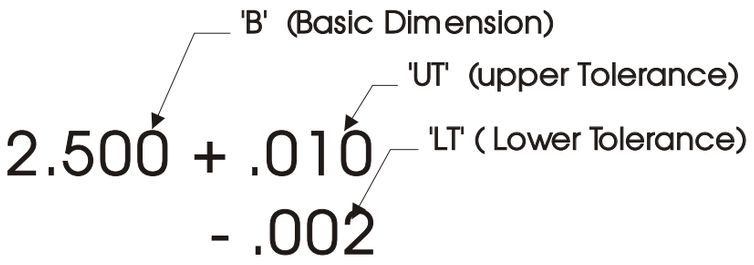


Conversion Factor = .03937
= = = = = = = = = = = = = = =
Metric to Inch = Factor x Dimension
Inch to Metric = Dimension Div. by Factor

	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE INCHES, AND BEFORE PLATING, ALL ANGLES ARE DEGREES	
	TOLERANCES	
	FRACTIONS + - 1/64 | DECIMALS + - .005 | ANGLES + - 1deg	
	DRAWN DATE	*TITLE*
	CHECKED	
	APPROVED	SIZE | CODE IDENT NO | COND | REV
USED ON		

Machine Operator Training
Tyco --- Norwood

Blueprint Reading
Calculating 'Max - Min - Mean' Dimensions



Legend

B = Basic Dimension
UT = Upper Tolerance
LT = Lower Tolerance
Mean = Mean Dimension

Max = B + UT Min = B - LT
Mean = (Max + Min) / 2

Example
2.500 + .010
- .002

Max = B + UT
= 2.500 + .010
Max = 2.510

Min = B - LT
= 2.500 - .002
Min = 2.498

Mean = (Max + Min) /2
= (2.510 + 2.498) /2)
= 5.008 /2
Mean = 2.504

Machine Operator Training
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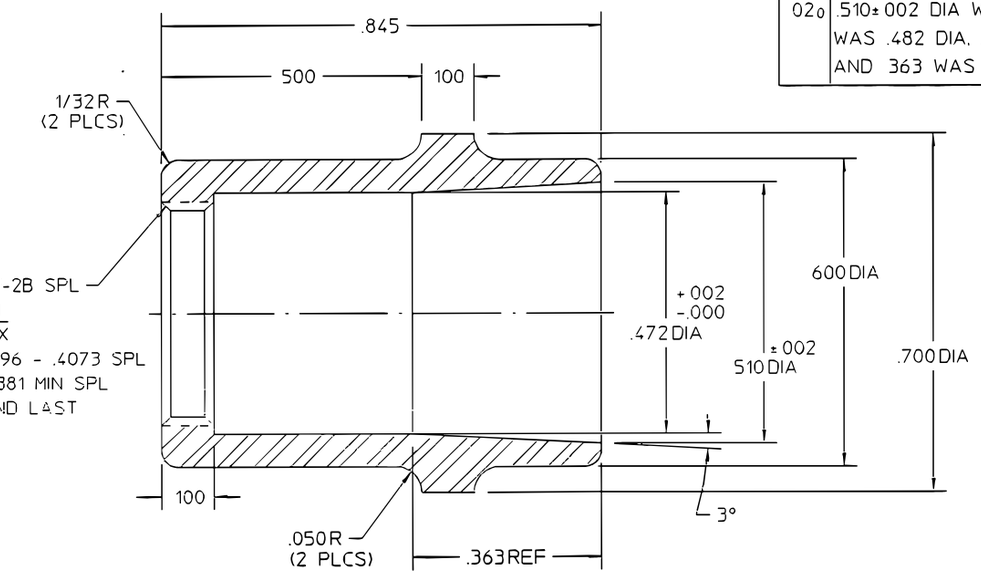
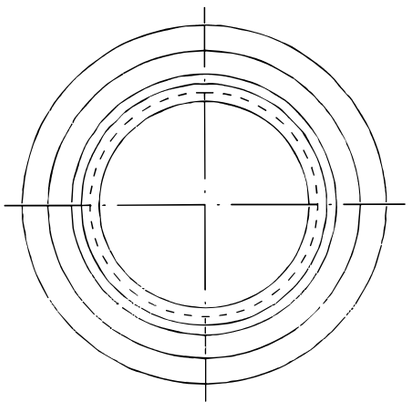
01-0750-0159 / 1.000
RAW MAT'L / LENGTH

REVISIONS			
	DESCRIPTION	DATE	APPROVED
01_0	RELEASED	1-10-91	
01_1	515±.001 DIA AND 3° WERE TBD, .315 REF WAS .236 REF PER ECN 91-0527	6-26-91	
02_0	.510±.002 DIA WAS 515±.001 DIA, .472 DIA WAS .482 DIA, .500 WAS .350, .845 WAS 730 AND .363 WAS .315 PER ECN 91-0765-2	9/30/91	10-3-91





NOTES.
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3. FINISH TO BE 63 UNLESS OTHERWISE SPECIFIED.
4. REMOVE BURRS AND BREAK SHARP CORNERS .005 MAX

[redacted]
+/- 1/64
3782-2316-10
USED ON

DRAWN MC
CHEC
APP'D 1-10-91

Omni Spectra
Omni Spectra, Inc.
Microwave Connector Division

TITLE
OUTER SLEEVE

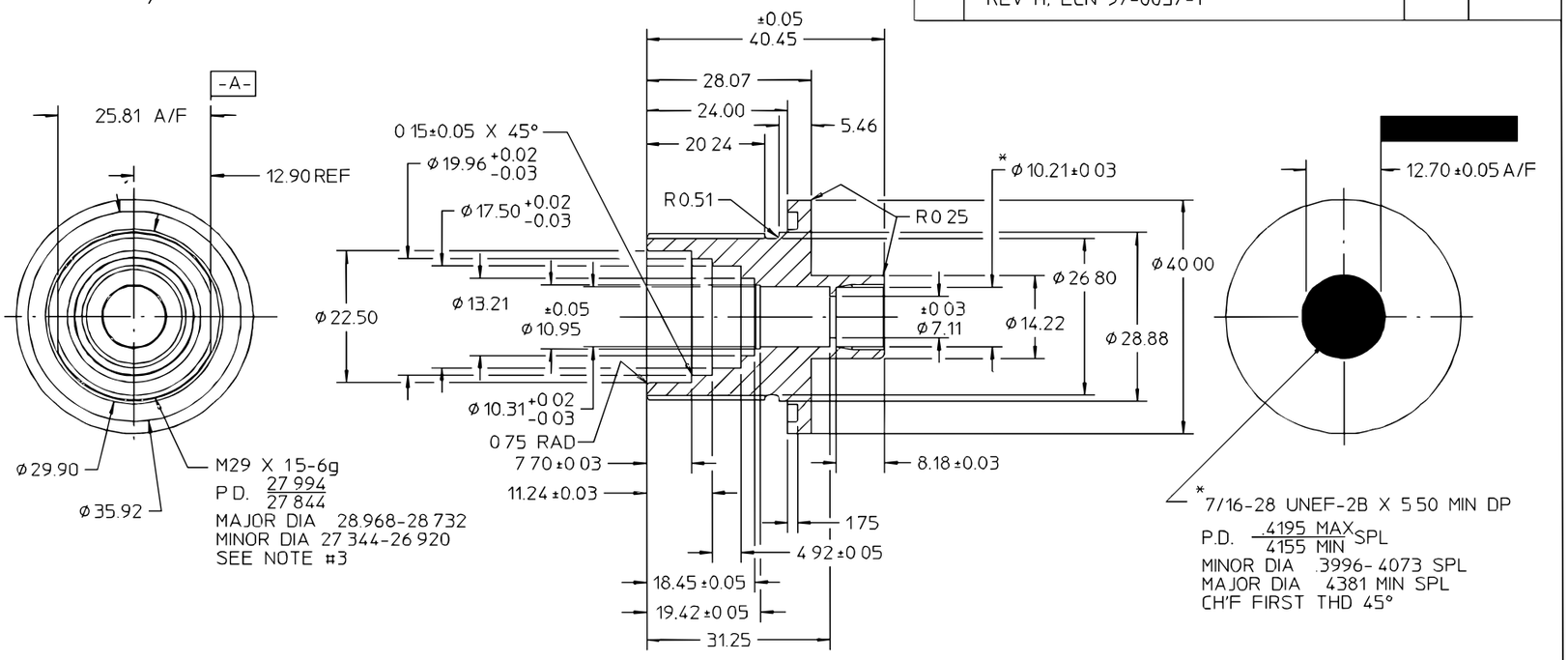
SIZE	CODE IDENT NO.		REV
B	26805	6069-15-01	02_0

SCALE 5:1 PLATING AREA .30582 IN² SHEET 1 OF 1

Machine Operator Training
Tyco --- Norwood

02-1625-0159 / 1.731
RAW MAT'L / LENGTH

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
04_0	UPDATED DWG TO DECIBEL REV G TO REV H, ECN 97-0057-1	KLE 3-3-97	03/03/97



NOTES:
1. MATL HALF HARD BRASS PER ASTM-B-16 OR BS2874 CZ121
2. DIAMETERS MARKED * TO BE CONCENTRIC TO WITHIN 0.05 TO EACH OTHER BUT TO WITHIN 0.10 TO ALL OTHER BORES
3. TRUNCATE THREAD TO 28.50±0.05 DIA

8804-5003-94
USED ON
GROUP CODE

DRAWN BY
CHECKED BY
APP'D BY

Unless otherwise dimensions are i and before platin are degrees

DEC ±0.10 A

M/A-COM an AMP company
M/A-COM, Inc
Waltham, MA 02254

TITLE
HOUSING

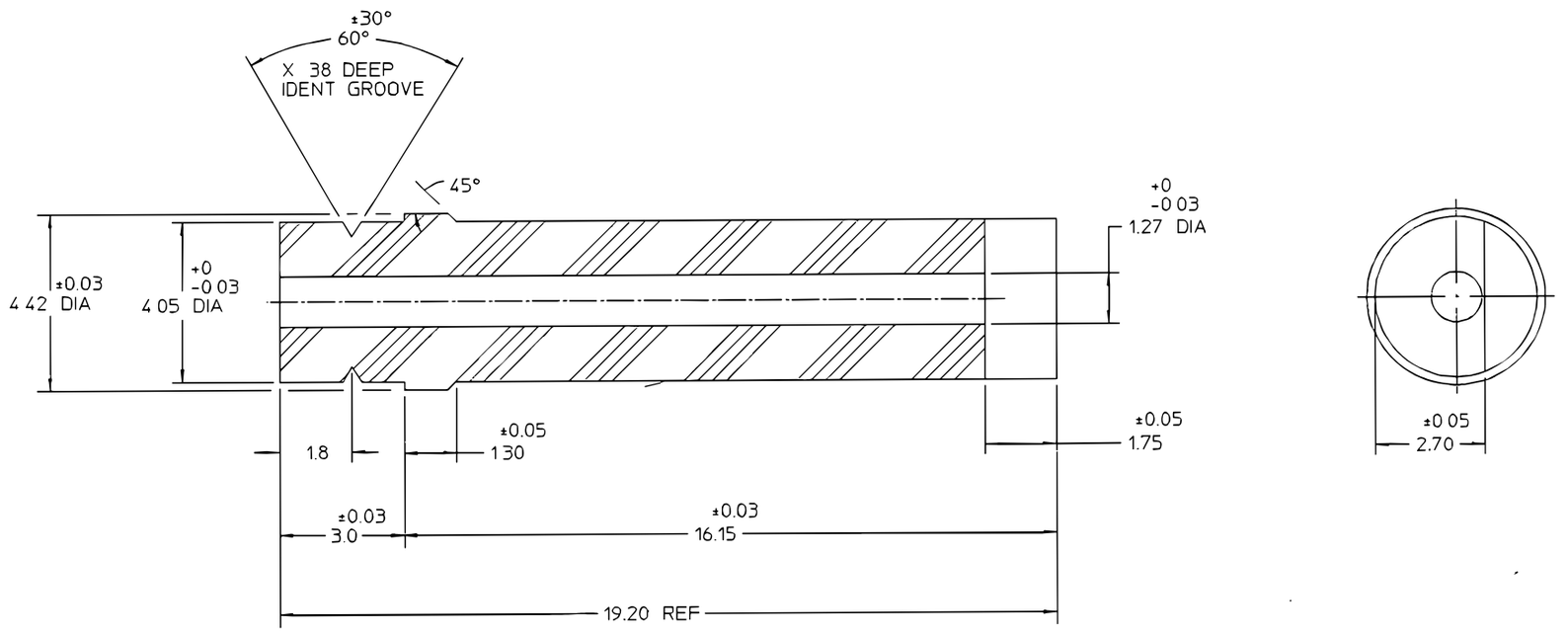
SIZE	CODE IDENT NO		REV
B	26805	0104-03-01	04_0

SCALE 15/1 | PLATING AREA 11.62 sqin | SHEET 1 OF 1

Machine Operator Training
Tyco --- Norwood

04-0187-0159 / 0 786
RAW MAT'L / LENGTH

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
01 0	RELEASED	3/28/97	S. Morley



NOTES:
1. MATL TEFLON PER ASTM-D-1457
2. UNLESS OTHERWISE SPECIFIED HOLES, SLOTS AND DIAMETERS SHALL BE PARALLEL AND CONCENTRIC WITHIN 0.07 T.I.R.
3. REMOVE BURRS AND BREAK SHARP CORNERS 0.13 MAX

2252-5521-09
USED ON
GROUP CODE

DRAWN BY
CHECKED 1/28/97
APP'D BY

Unles
spec
are
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All a
degre

M/A-COM, Inc
Waltham, MA 02254

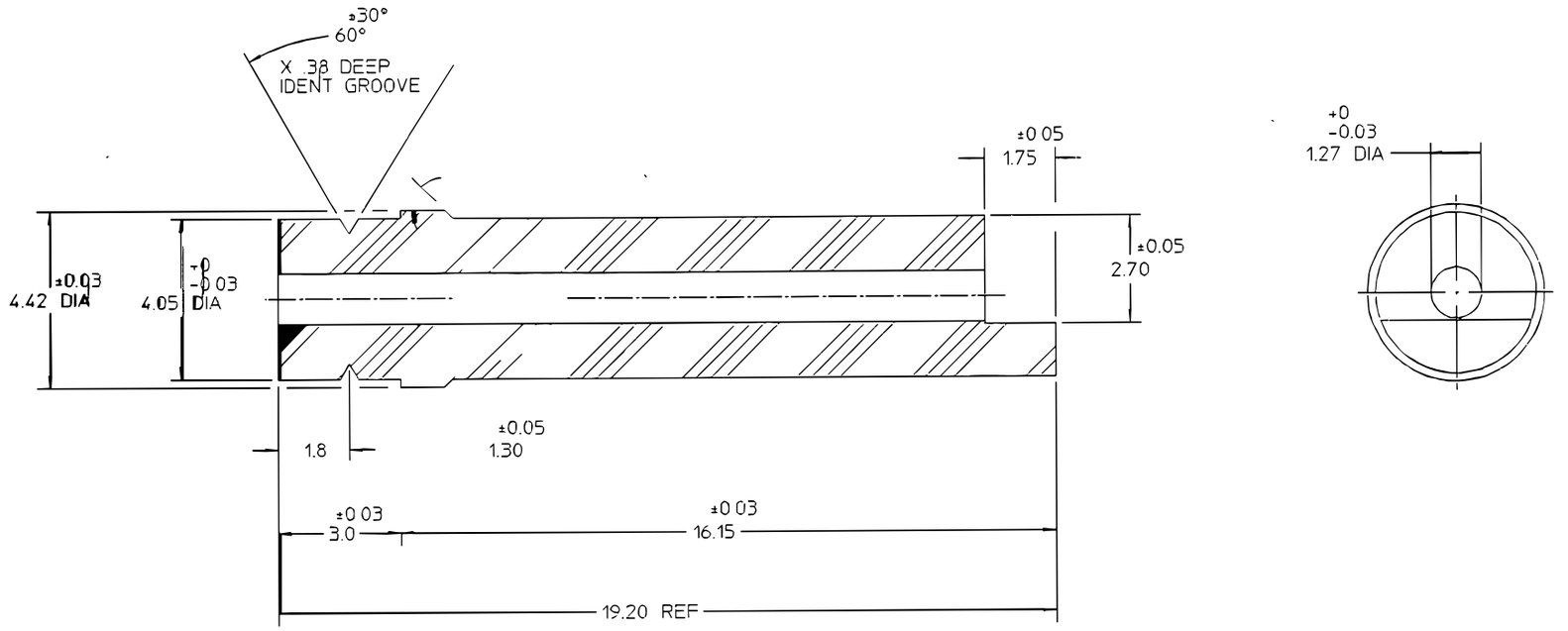
TITLE
DIELECTRIC

SIZE	CODE IDENT NO		REV
B	26805	2212-06-01	01 0
SCALE 10.1	PLATING AREA N/A		SHEET 1 OF 1

Machine Operator Training
Tyco --- Norwood

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
01 0	RELEASED	3/28/97	S. Mordy

04-0187-0159 / 0.786
RAW MAT'L / LENGTH



2252-5531-00 USED ON	These drawings and specifications are the property of M/A-COM Interconnect Division and shall not be reproduced or copied or used in whole or in part as the basis for the manufacture or sale of item(s) without written permission	DRAWN BY S. Mordy DATE 3/28/97 CHECKED BY APP'D BY	M/A-COM, Inc. Waltham, MA 02254 an AMP company	
GROUP CODE		Unless otherwise specified dimensio are in millimeters and before plating All angles are degrees. DEC ±0.13 ANGLES ± 1°	TITLE DIELECTRIC	
			SIZE B / CODE IDENT NO 26805 / 2212-06-01 / REV 01 0	
			SCALE 10 : 1 / PLATING N/A	SHEET 1 OF 1

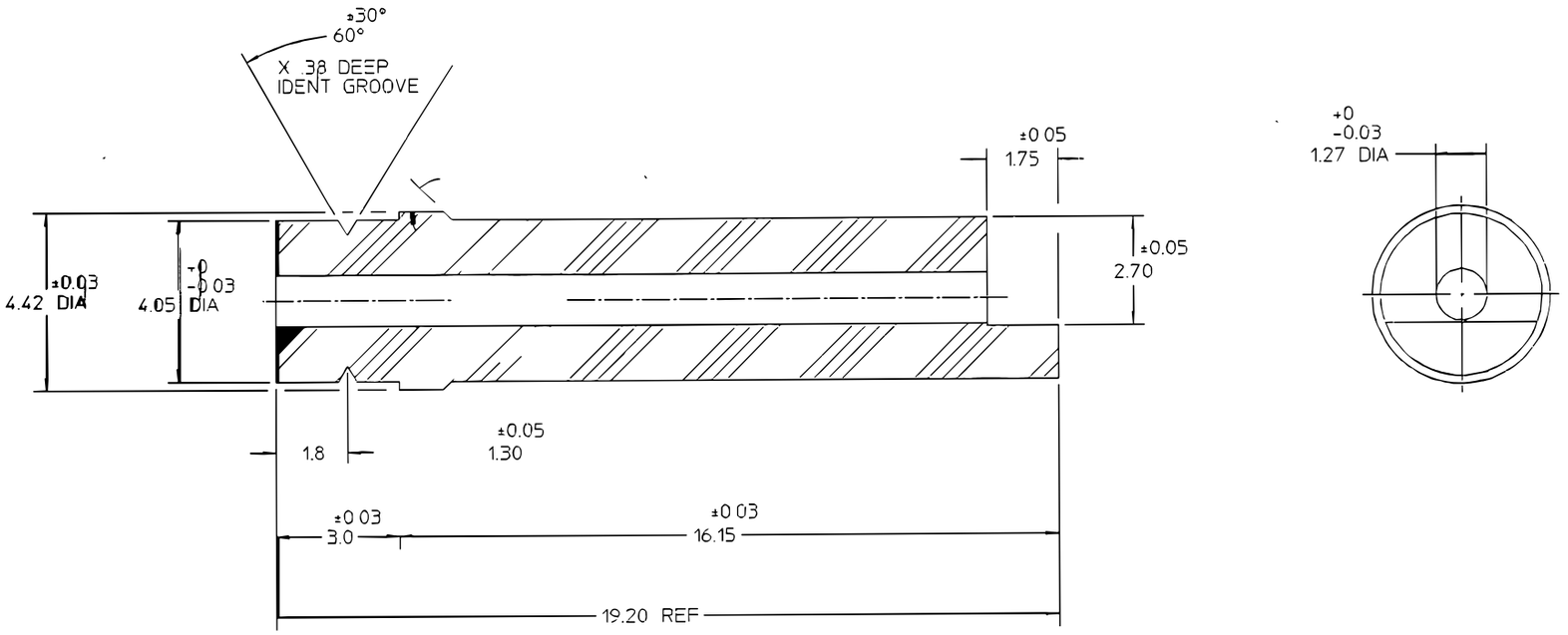
Class Assignment
Converting Metric To Inch
(10 Dimensions)

Calculating
Max
Mean } Dimensions
Min

Machine Operator Training
Tyco --- Norwood

04-0187-0159 / 0.786
RAW MAT'L / LENGTH

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
01 0	RELEASED	3/28/97	S. Mordy



2252-5531-00 USED ON	These drawings and specifications are the property of M/A-COM Interconnect Division and shall not be reproduced or copied or used in whole or in part as the basis for the manufacture or sale of item(s) without written permission	DRAWN BY S. Mordy DATE 3/28/97 CHECKED BY APP'D BY	M/A-COM, Inc. Waltham, MA 02254	
GROUP CODE		Unless otherwise specified dimensions are in millimeters and before plating All angles are degrees. DEC ±0.13 ANGLES ± 1°	TITLE: DIELECTRIC	
			SIZE B / CODE IDENT NO 26805 / 2212-06-01 / REV 01 0	
			SCALE 10 : 1 / PLATING SPEC N/A	SHEET 1 OF 1

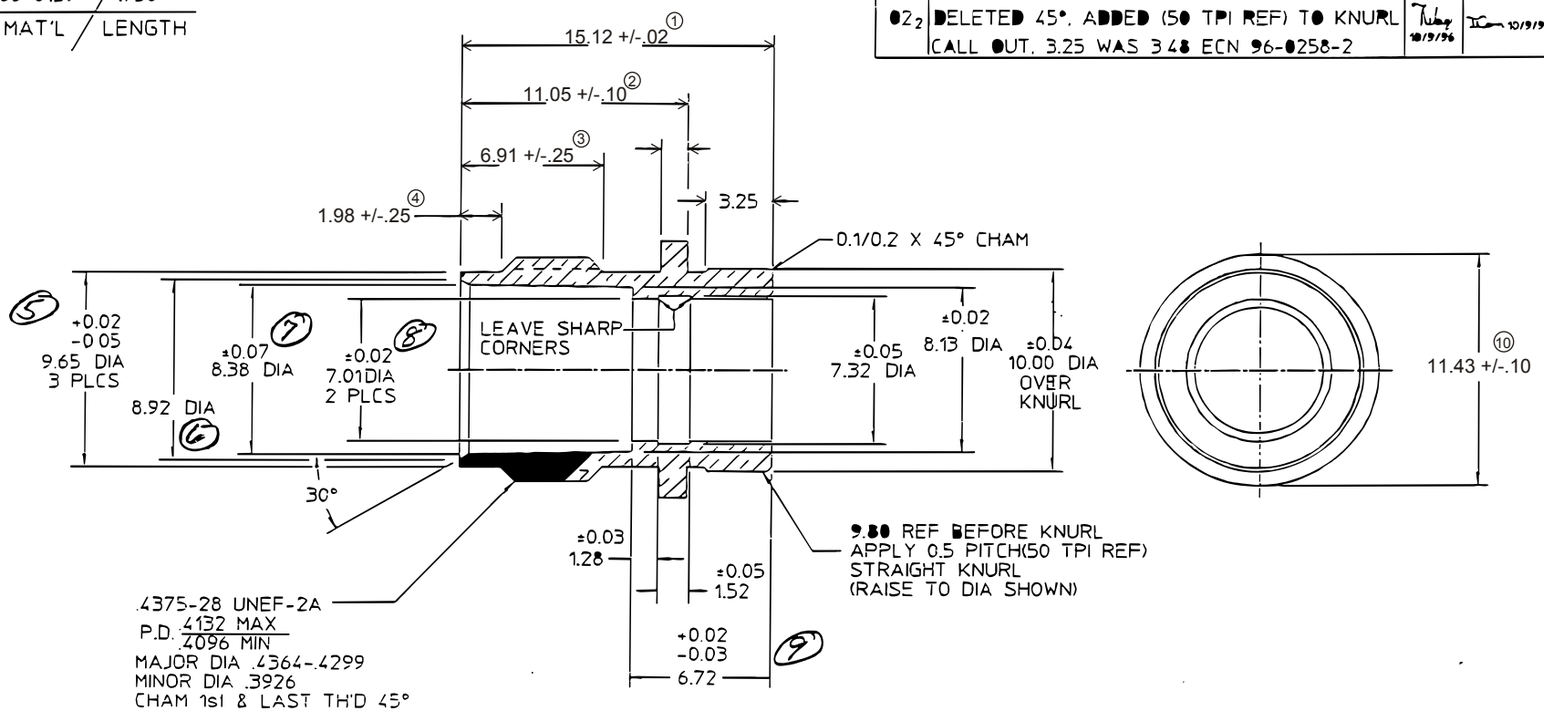
Test
Converting Metric To Inch

Calculating
Max
Mean } Dimensions
Min

Machine Operator Training
Tyco --- Norwood

02-0500-0159 / .750
RAW MAT'L / LENGTH

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
02	DELETED 45°. ADDED (50 TPI REF) TO KNURL CALL OUT. 3.25 WAS 3.48 ECN 96-0258-2	10/9/96	10/9/96



NOTES
1. MATL. HALF HARD BRASS PER ASTM-B-16
2. UNLESS OTHERWISE SPECIFIED HOLES SLOTS AND DIAMETERS SHALL BE PARALLEL AND CONCENTRIC WITHIN 0.10 T.I.R.
3. FINISH TO BE 1.6 UNLESS OTHERWISE SPECIFIED.
4. REMOVE BURRS AND BREAK SHARP CORNERS 0.07 MAX

3158-5044-36
USED ON
GROUP CODE

DRAWN BY [illegible] DATE 12/5/95
CHECKED BY
APP'D BY [illegible] 12/6/95

Unless otherwise specified dimensions are in millimeters, and before plating. All angles are degrees.

DEC ANGLES
±0.13 ± 1°

M/A-COM, Inc.
Waltham, MA 02254

TITLE HOUSING

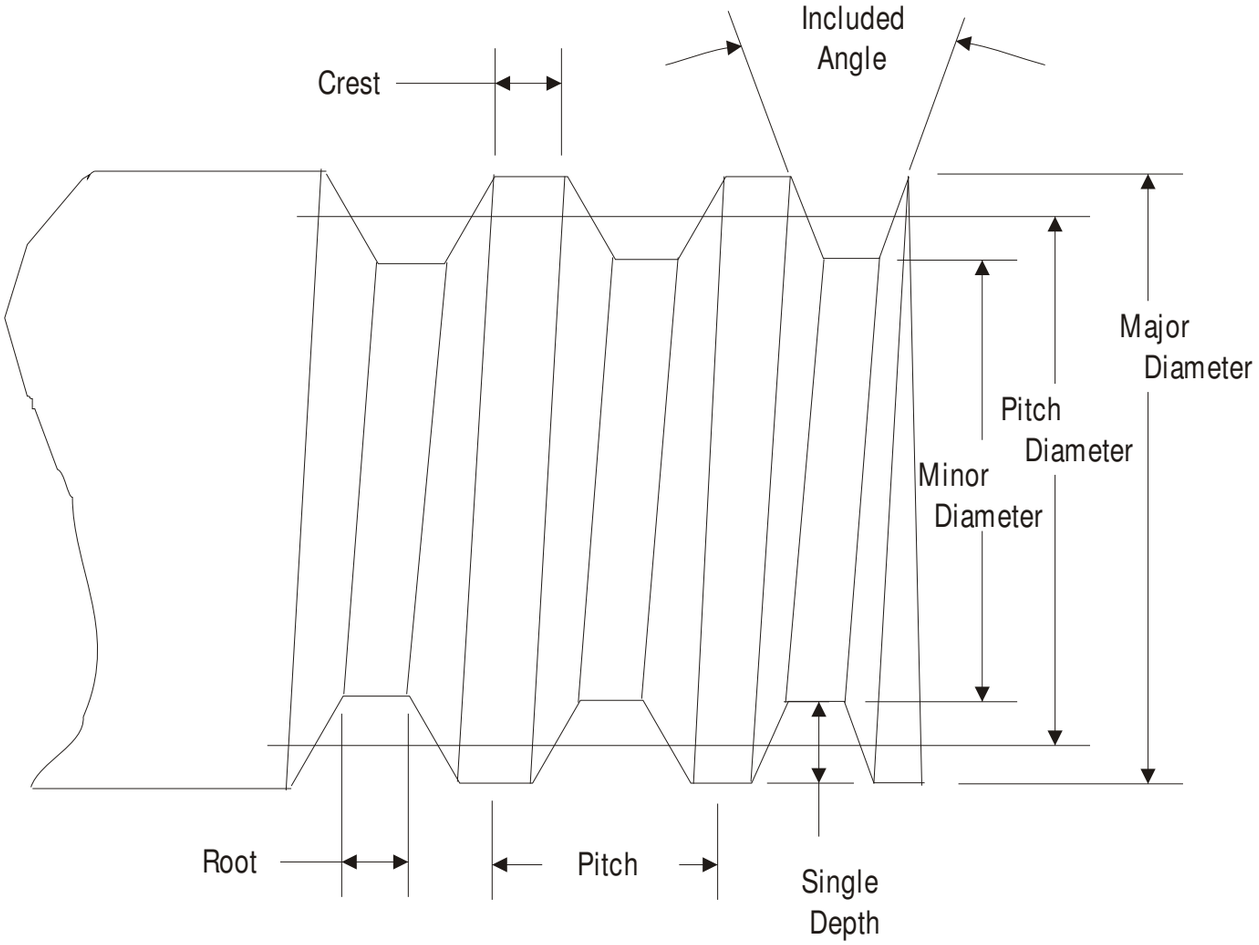
SIZE B | REV

SCALE 5:1 | PLATING AREA 2.000

Threads

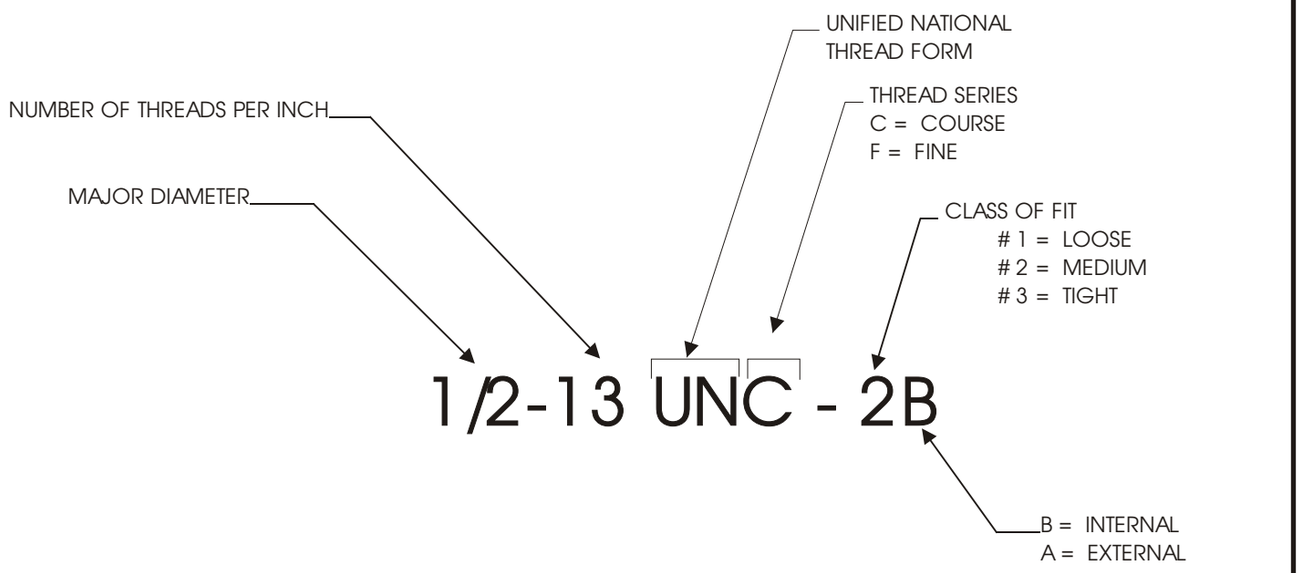
Machine Operator Training
Tyco --- Norwood

Parts of a Screw Thread

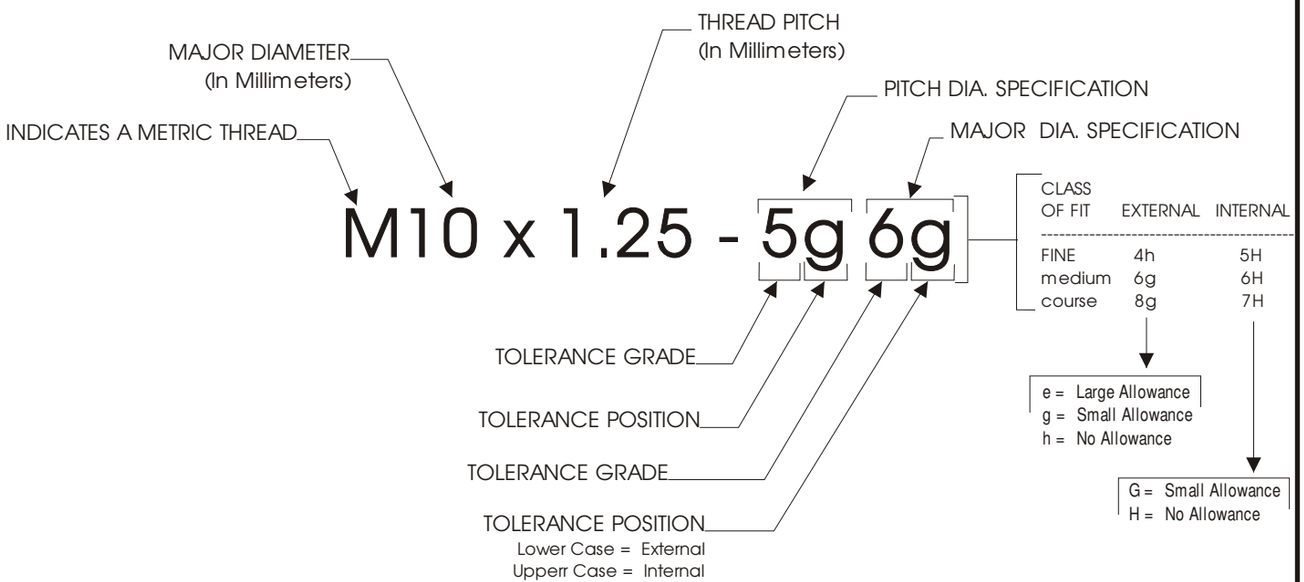


THE TYPICAL THREAD DESIGNATION

The English Format

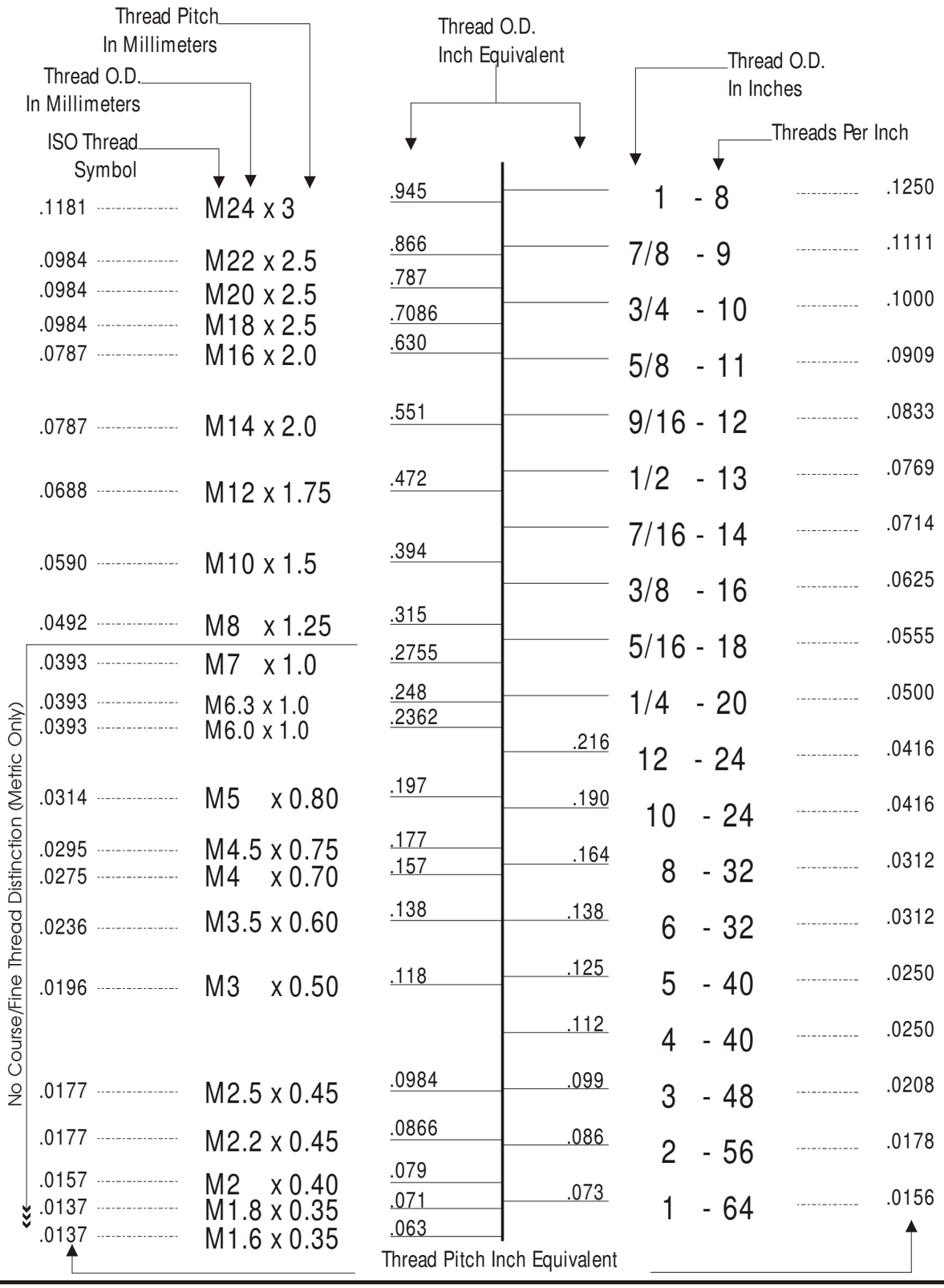


The Metric Format



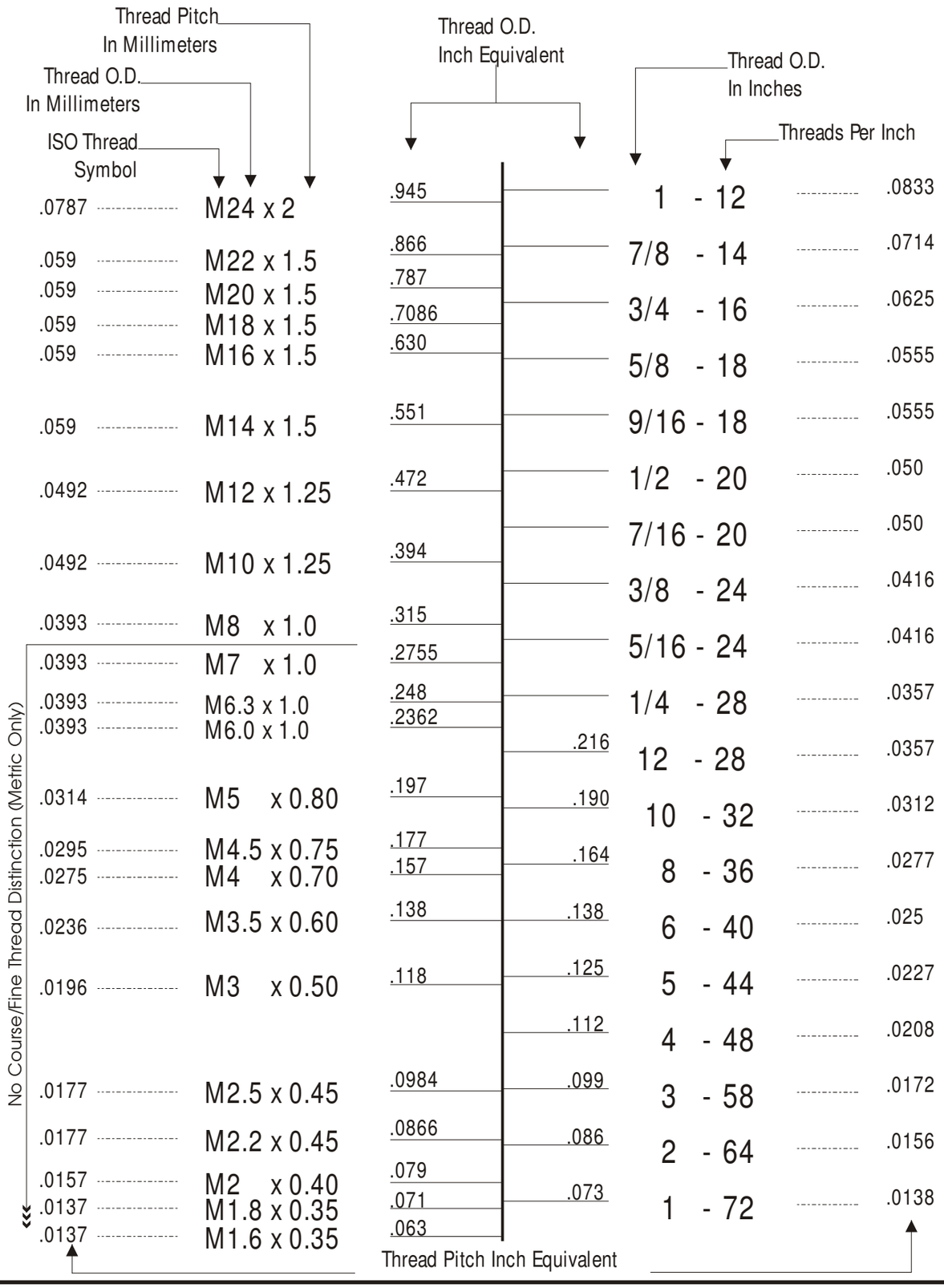
THE TYPICAL THREAD DESIGNATION
Metric/Inch Comparison (Course Threads)

Machine Operator Training
Tyco --- Norwood



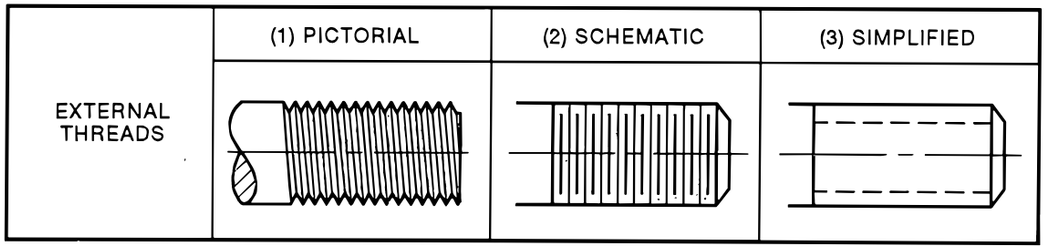
THE TYPICAL THREAD DESIGNATION
Metric/Inch Comparison (Fine Threads)

Machine Operator Training
Tyco --- Norwood

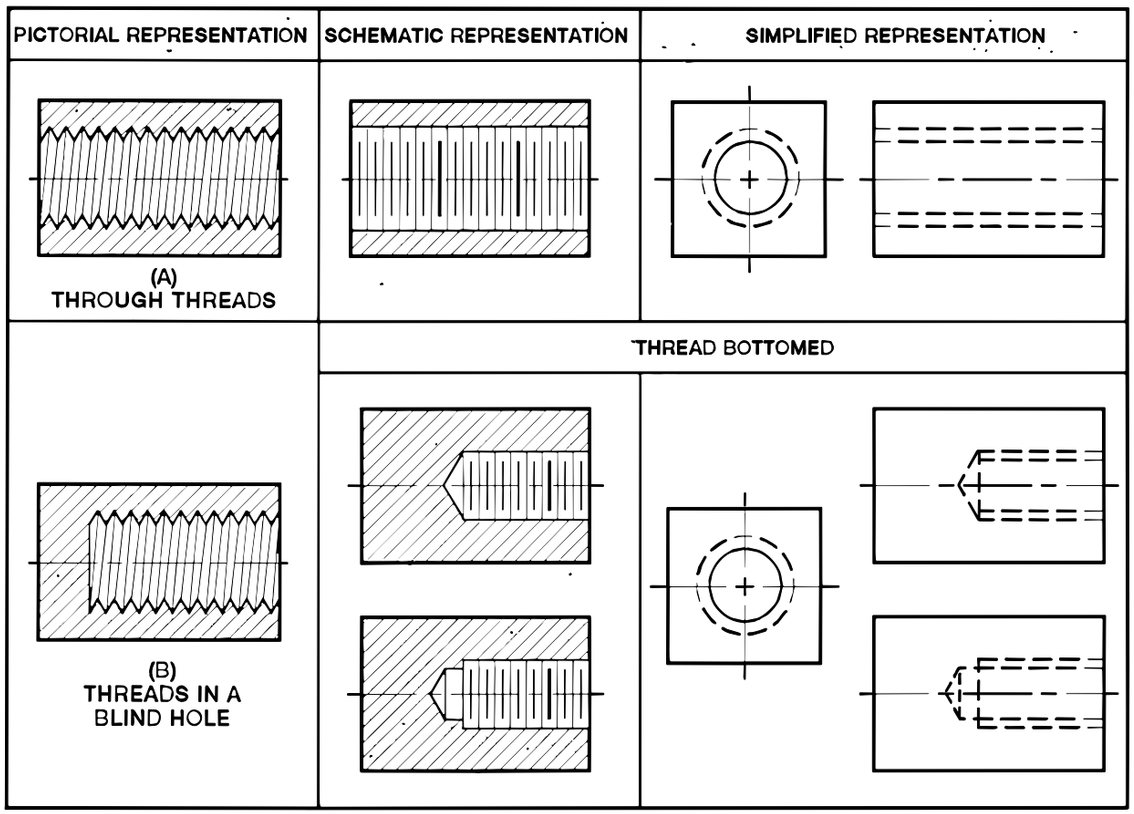


Slyles of Thread Representation

The Following are Three Methods of External Thread Representation



The Following Drawings show Three different methods of Representing Internal Threads, Both Through hole Threads and Blind, Bottom Threaded Holes.



Machine Operator Training
Tyco --- Norwood

DECIMAL EQUIVALENTS & TAP DRILL SIZES

FRACTION OR DRILL SIZE	DECIMAL EQUIVALENT	TAP SIZE
5/16 ----------	.3125	3/8-16
O	.3160	
P	.3230	
21/64 ----------	.3281	
Q	.3320	3/8-24
5/8 -----	.6250	
41/64 ----------	.6406	
21/32 ----------	.6562	3/4-10
43/64 ----------	.6719	
11/16 -----	.6875	3/4-16
FRACTION OR DRILL SIZE	DECIMAL EQUIVALENT	TAP SIZE

Using The Decimal Equivalent Chart

Students Name _____

1. Please give the correct Decimal Equivalent for the following fractions.

1/4 = _____	27/64 = _____	5/32 = _____
1/64 = _____	13/16 = _____	1 1/2" = _____
9/16 = _____	17/32 = _____	31/32 = _____

2. Please give the correct Diameter of the following Drills.

Z _____	# 1 _____	# 60 _____	U _____
# 21 _____	Q _____	F _____	19/32 _____
27/64 _____	1 7/64 _____	# 80 _____	1" _____

3. Please write the correct Drill that corresponds with the following Decimal Equivalents.

.421 _____	.156 _____	.413 _____	.368 _____
.109 _____	.234 _____	.312 _____	.875 _____
.332 _____	.377 _____	.281 _____	.062 _____

THREAD QUIZ # 1

Machine Operator Training
Tyco --- Norwood

A TYPICAL THREAD DESIGNATION
****** 7/8-14 UNC - 2B ******

1. The above Thread Designation indicates how many threads per inch? _____

2. The above Thread Designation indicates what Form of Thread? _____

3. The above thread designation indicates what Series of thread? _____

4. What is the Major Diameter of the above thread? _____

5. In the above thread, what does the 'B' Indicate? _____

6. What does the number '2' indicate in the above thread? _____

7. Name the three common drill sets found in most Machine Shops.

_____ _____ _____

8. Give the decimal equivalents for the following fractions.

3/8 _____ 5/32 _____ 21/32 _____

5/16 _____ 1/16 _____ 31/64 _____

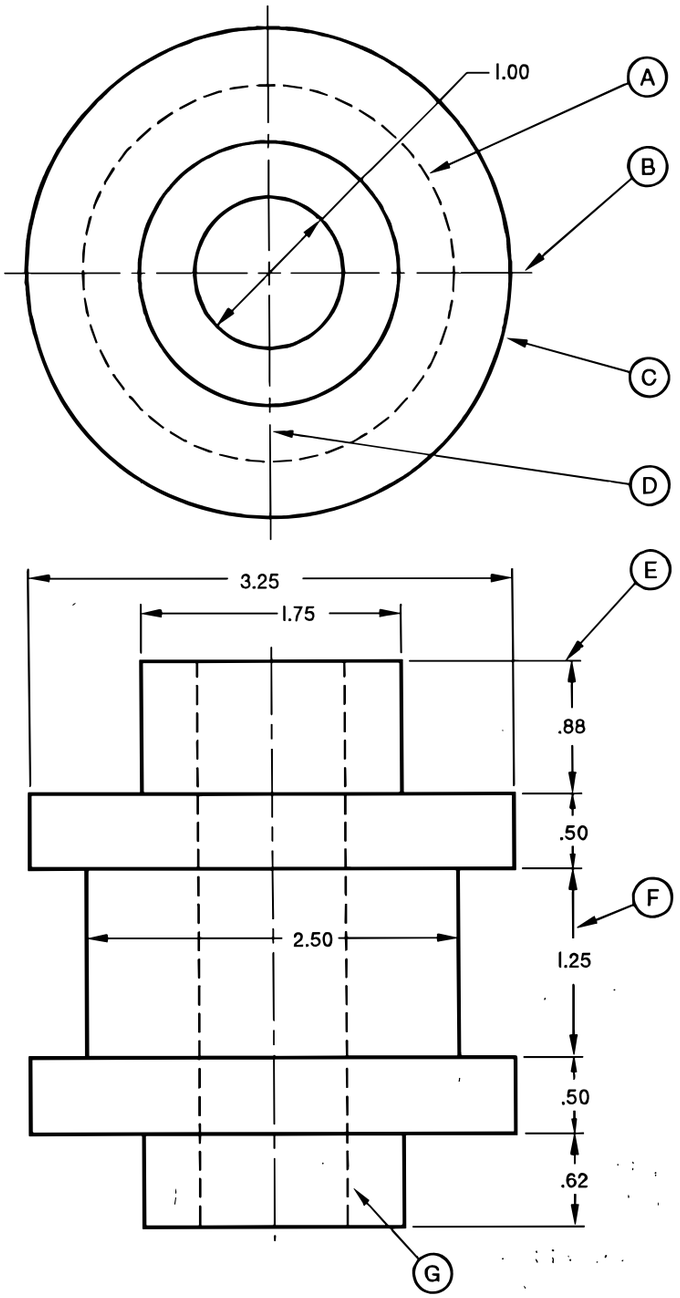
1/64 _____ 57/64 _____ 7/32 _____

1" 21/64 _____

Pleas write the correct diameter of the following Twist Drills.

P _____ K _____ # 4 _____ # 21 _____ F _____

U _____ # 60 _____ # 38 _____ # 55 _____ # 1 _____



NO. REQD 12	
ORDER NO. 45 - 21	
MATL CDS (SAE 1020)	
FLANGED SLEEVE	**BP-8B**

Flanged Sleeve (BP - 8B)

Machine Operator Training
Tyco --- Norwood

_____Student Name _____

1. What is the name of the part ? 1. _____

2. What is the order number ? 2. _____

3. How many pieces are required ? 3. _____

4. What material will be used ? 4. _____

5. Name the two views which are used to represent the Flanged Sleeve. 5. _____

6. Name the kind of line indicated by each of the following encircled letters. 6.

(A) (A) _____

(B) (B) _____

(C) (C) _____

(D) (D) _____

(E) (E) _____

(F) (F) _____

(G) (G) _____

7. What is the outside diameter of both flanges ? 7. _____

8. What is the height (Thickness) of each flange ? 8. _____

9. What is the diameter of the center hole ? 9. _____

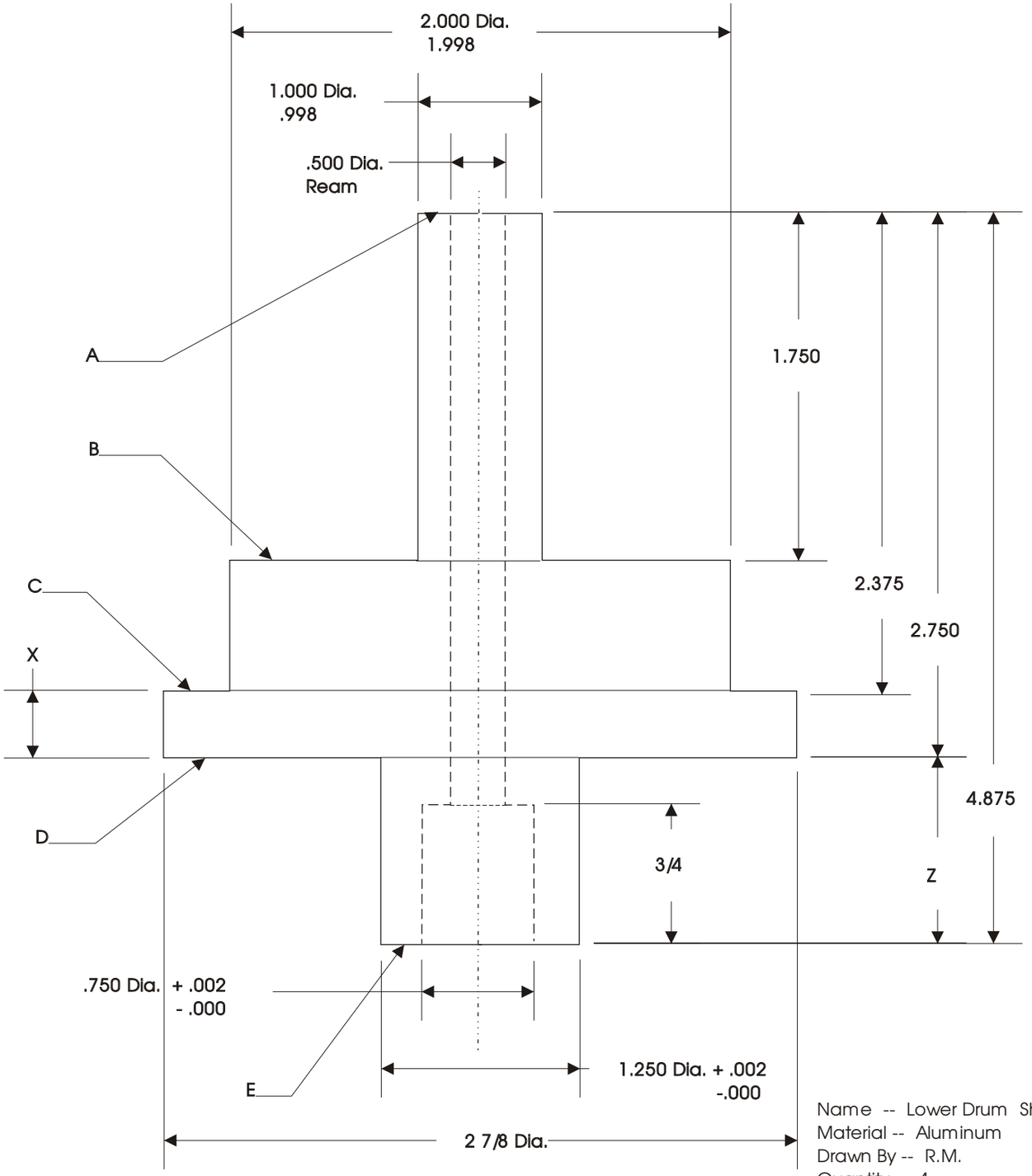
10. Does the hole go all the way through the center of the sleeve ? 10. _____

11. What is the diameter of the hidden circle (A) ? 11. _____

12. Determine the total or overall height of the Flanged Sleeve. 12. _____

Machine Operator Training
Tyco --- Norwood

Class Exercise # 4



Name -- Lower Drum Shaft
Material -- Aluminum
Drawn By -- R.M.
Quantity -- 4
Date -- 9/30/96
Print # -- 655g

Tolerances -- Decimals + /- .005
-- Fractional + /- 1/64
-- Angular + /- 1/2deg.

Lower Drum Shaft

Class Exercise # 4
Questions

Students Name _____

Lower Drum Shaft
---

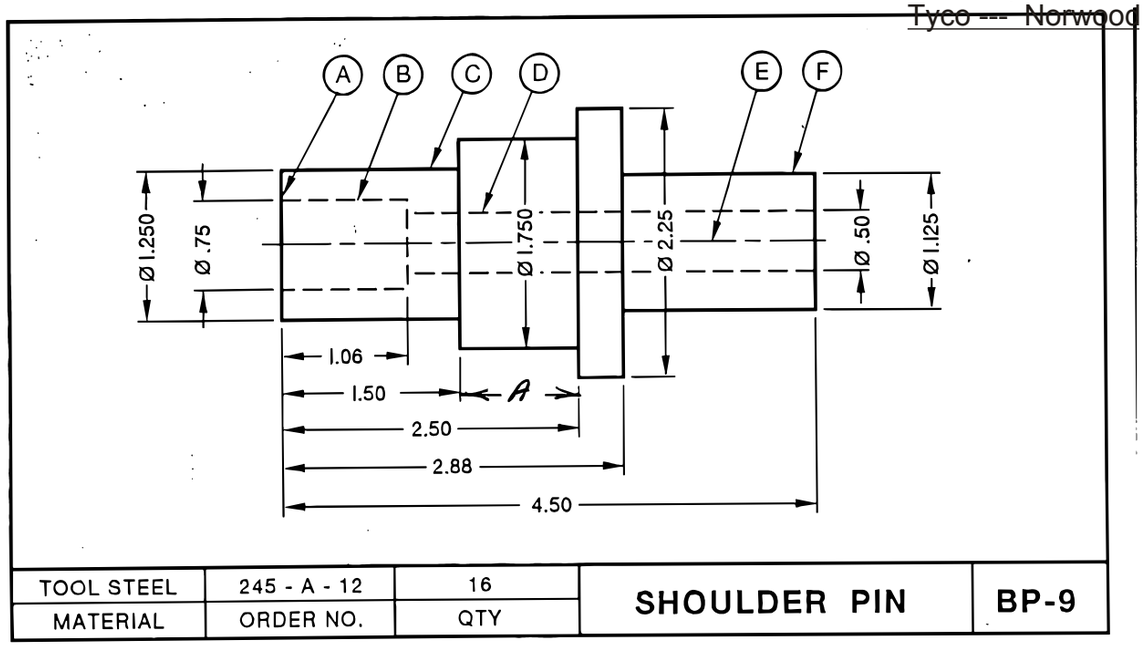
1. What is the name of the part? _____
2. What Material will the part be made from? _____
3. What is the Print number? _____
4. What is the basic shape of the part? _____
5. What is the overall length? _____
6. What is the largest Diameter? _____
7. How many Internal and External diameters does the part have?

_____

8. What is the diameter of the smallest hole? _____
9. What is the diameter of the largest hole?

_____

10. To what Depth is the larger hole bored into the Part? _____
11. What is the length of the reamed hole ? _____
12. What is the length of dimension 'X' ? _____
13. What is the Length of the section that is 1.000 Dia. ? _____
14. What is the correct value for dimension 'Z' ? _____
15. What is the length of the part from face 'A' to shoulder 'C' ? _____
16. What is the length of the part from face 'E' to shoulder 'C' ? _____
17. What amount of Tolerance is permitted on fractional dimensions where tolerance is not specified? _____
18. What amount of tolerance is permitted on decimal dimensions where tolerance is not specified? _____
19. How many diameters are being held within limits of accuracy smaller than + /- .005" ? _____



TOOL STEEL	245 - A - 12	16	SHOULDER PIN	BP-9
MATERIAL	ORDER NO.	QTY		

ASSIGNMENT — UNIT 9

SHOULDER PIN (BP-9)

Student's Name _____

1. Name the view represented on BP-9. 1. _____
2. What is the shape of the Shoulder Pin? 2. _____
3. How many outside diameters are shown? 3. _____
4. What is the largest diameter? 4. _____
5. What diameter is the smallest hole? 5. _____
6. What is the overall length of the pin? 6. _____
7. How deep is the .75" hole? 7. _____
8. PLEASE CALCULATE DIMENSION 'A'. 8. _____
9. What letters represent object lines? 9. _____
10. What kinds of lines are (B) and (D)? 10. _____
11. What letter represents the center line? 11. _____
12. What does the center line indicate about the holes and outside diameters? 12. _____
13. Give the thickness of the Ø 2.25". 13. _____
14. WRITE the order number of the part. 14. _____
15. What material is specified for the pins? 15. _____

Basic Print Calculations

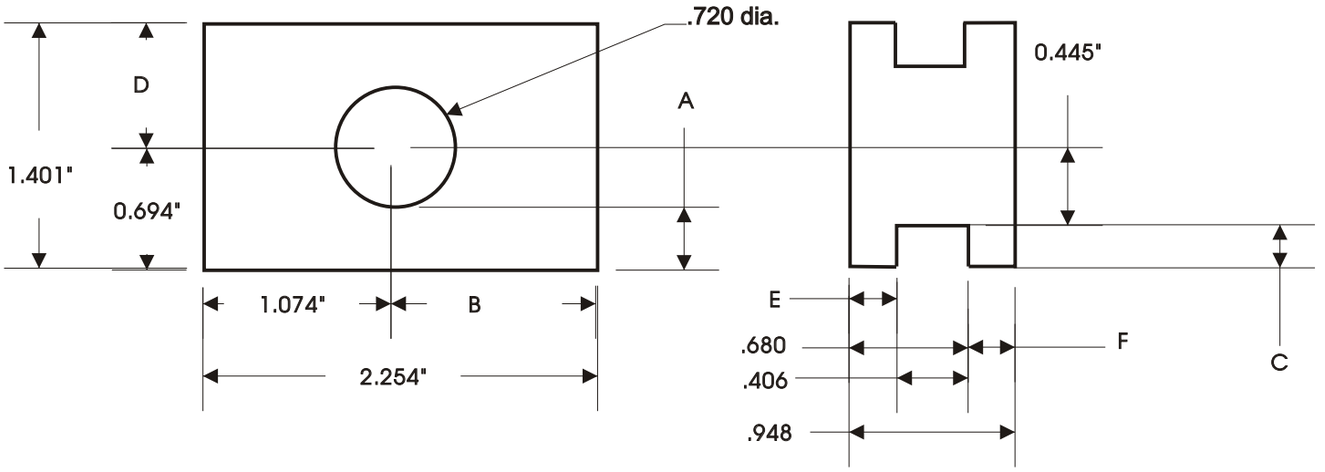
Machine Operator Training
Tyco --- Norwood

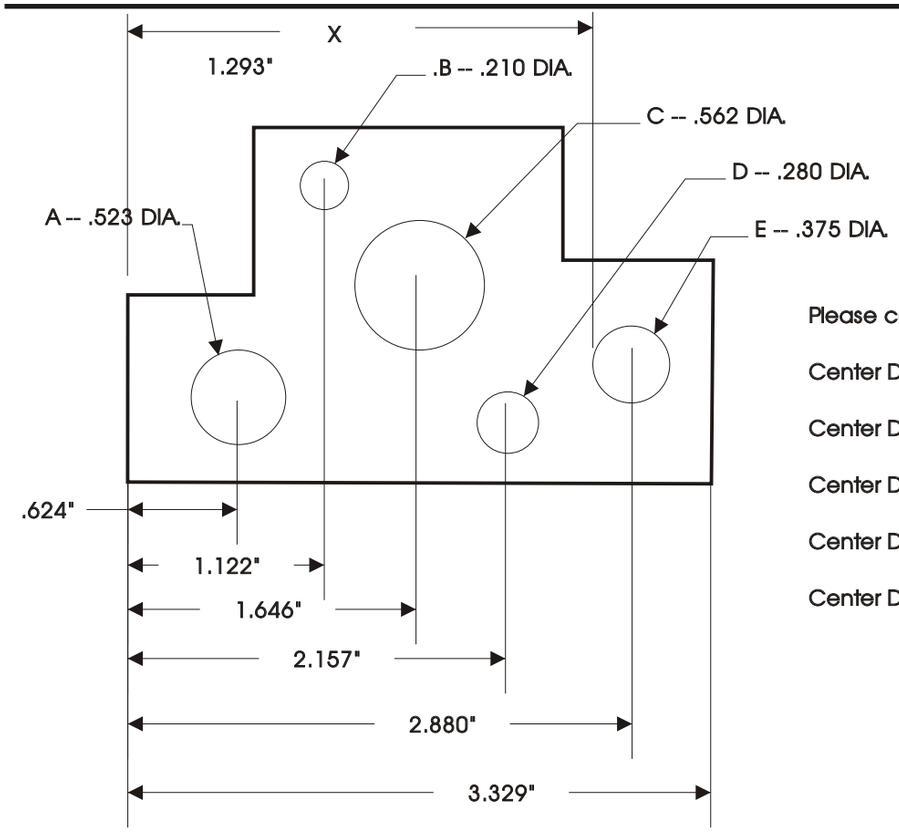
Slove For The Following Dimensions

1. A = _____ 4. D = _____

2. B = _____ 5. E = _____

3. C = _____ 6. F = _____





Please calculate the center distance between;

Center Distance A -- B = _____

Center Distance B -- D = _____

Center Distance C -- E = _____

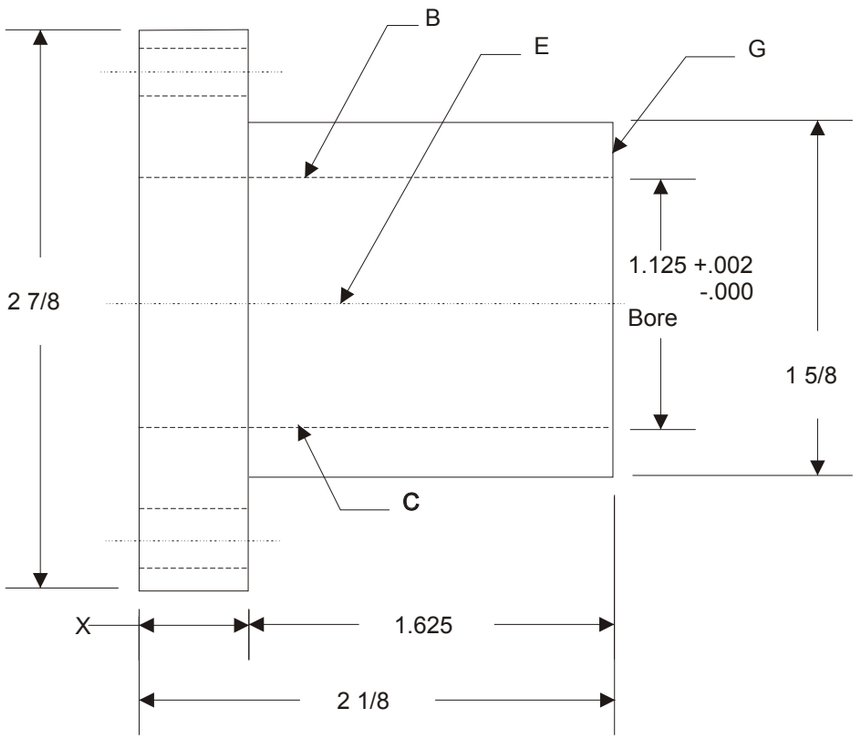
Center Distance A -- E = _____

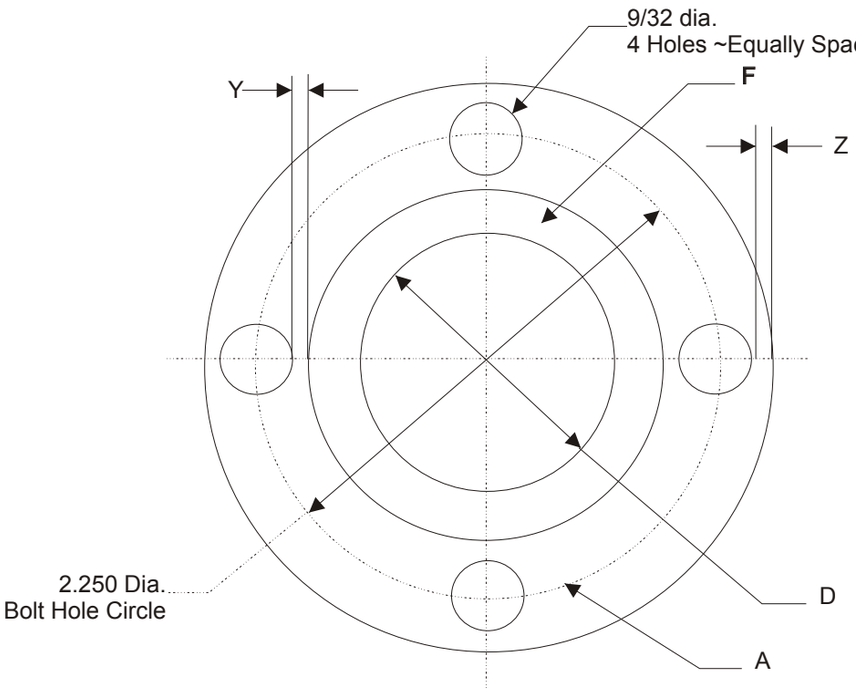
Center Distance C -- D = _____

Distance 'X' = _____

Class Exercise #5

Machine Operator Training
Tyco --- Norwood





6 Required -- Mat'l. = Cast Iron -- Scale = 1:1-

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE INCHES, AND BEFORE PLATING ALL ANGLES ARE DEGREES

TOLERANCES

FRACTIONS	DECIMALS	ANGLES
± 1/64	± .005	± 1deg

DRAWN DATE

CHECKED

APPROVED

USED ON

TITLE Flanged Bushing

SIZE		CODE IDENT NO	COND	REV

Class Exercise # 5
Questions

Machine Operator Training
Tyco --- Norwood

Student Name _____

Flanged Bushing
---

1. How Many drill holes are required? _____
2. What drill size is required for these holes? _____
3. What diameter Bolt Hole Circle are the four 9/32 dia. holes on? _____
4. What type of line is line 'A' ? _____
5. What type of line is line 'E' ? _____
6. What lines in the front view are the projections for diameter 'D' in the right side view ? _____
7. What kind of lines are indicated by letters 'B' and 'C' ? _____
8. What line in the front view represents surface 'F' ? _____
9. What is the overall length of the Bushing?

_____

10. What is the minimum diameter permitted for hole 'D' ? _____
11. What is the maximum diameter hole 'D' can be bored? _____
12. What is the 'mean' diameter for hole 'D' ? _____
13. What is the tolerance allowed on 'unspecified' decimal dimensions? _____
14. What is the outside diameter of the flange? _____
15. What is the correct value for Flange thickness 'X' ? _____
16. What is the Body length of the Bushing? _____
17. What is the maximum measurement allowed for the Body length? _____
18. What is the outside diameter of the Body? _____
19. What is the wall thickness of the main body? _____
20. What is the correct value for distance 'Y' ? _____
21. What is the correct value for distance 'Z' ? _____
22. What is the Max and Min angular dimension allowed

MICRO FINISHES

Machine Operator Training
Tyco --- Norwood

Relation of Surface Roughness to Dimensional Tolerances

There is a distinct relationship between the permissable surface roughness of the part and dimensional tolerance. The measurement of surface roughness involves the determination of the average linear deviation of the actual surface from the nominal surface. Therefore, the requirement for the required measurement of a dimension is that the variation introduced by surface roughness should not exceed the dimensional tolerance. If this is not the case, the measurement of the dimension will be subject to a variation greater than the required tolerance.

When the average roughness height of a surface exceeds 1/8 the dimensional tolerance, the entire tolerance could be taken up by the roughness height.

The following finish symbols show the surface roughness allowed within a given dimensional tolerance.

Symbol	Maximum Surface Roughness Allowed By Dimensional Tolerance Microinch (μ)	Total Dimensional Tolerance Linear Inches	Equivalent Micrometer(μ)	Machining Process
8	8 μ .000 008	.0001"	.20 μ .000 000 2	Lapping
16	16 μ .000 016	.0002"	.40 μ .000 000 4	Honing/Grinding
32	32 μ .000 032	.0003"	.80 μ .000 000 8	Fine Boring/Turning Grinding
63	63 μ .000 063	.0006"	1.6 μ .000 001 6	Med.Boring/Turning Reaming - Milling Broaching
125	μ 125 .000 125	.001"	3.2 μ .000 003 2	Finish End Milling Finish Side Milling
250	μ 250 .000 250	.002"	6.3 μ .000 006 3	End Milling Side Milling
500	μ 500 .000 500	.004"	12.5 μ .000 012 5	Rough Milling Rough Turning
1000	1000 μ .001 000	.008"	25 μ .000 025	Flame/ Torch Cutting

Misc. Notes

ANSI = American National Standards Institute
✓ = Any manufacturing process
✓ = Maching process required
G✓ = Grind R✓ = Ream L✓ = Lap
✓ = Non-Maching process

Lay Symbols

⊥ = Perpendicular
II = Parallel
X = Angular
M = Multi-directional
C = Circular
R = Radial