



# **UNIT C: MANUFACTURING PROCESSES**

**OBJECTIVE: D403.02**

**EXPLAIN THE ANSI STANDARDS OF APPLYING ANNOTATIONS TO A DRAWING THAT BEST DESCRIBES THE MANUFACTURING PROCESS.**



# MANUFACTURING ANNOTATIONS

## 2 Types of Manufacturing Notes

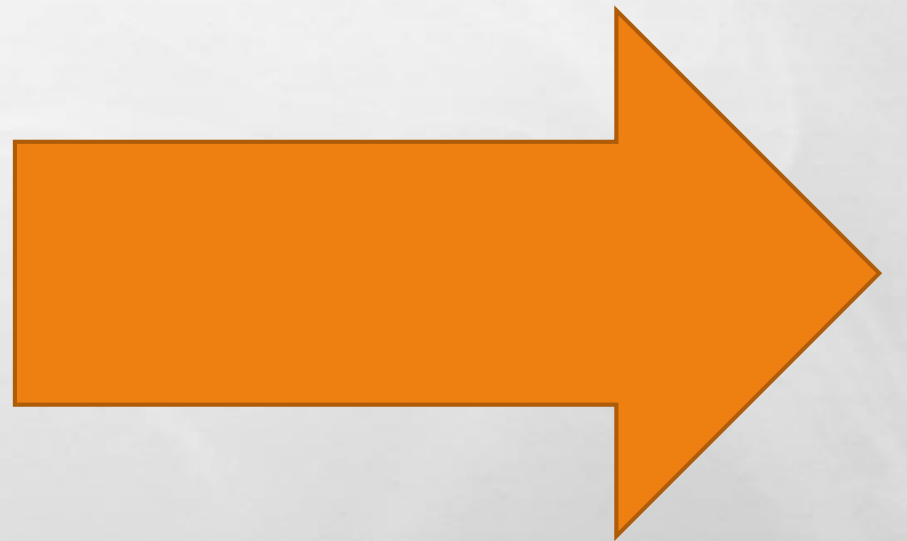
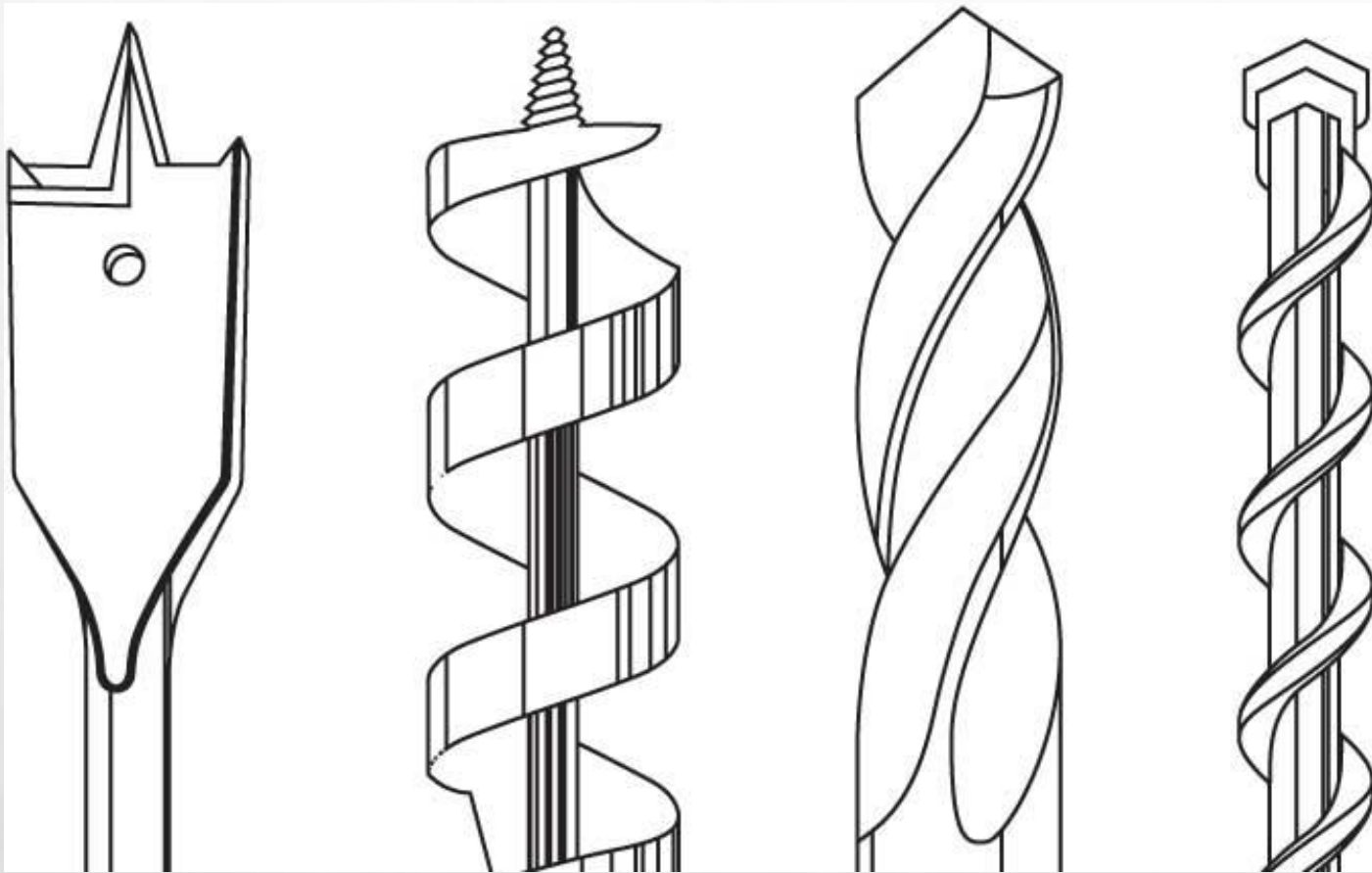
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### GENERAL NOTES

- APPLIES TO GENERAL INFORMATION ABOUT THE PART AS A WHOLE.
- *EXAMPLE:*  
**FILLET & ROUNDS ARE TO BE R. 125 (FINISH ALL OVER).**

### LOCAL NOTES

- NOTE CONNECTED TO A LEADER POINTING TO THE APPROPRIATE AREA APPLYING TO A SPECIFIC MACHINING OPERATION.



# DRILLING TERMINOLOGY & Callouts

# **DRILL**

**IS THE PROCESS USED TO CUT A  
CYLINDRICAL HOLE WITH A DRILL  
PRESS AND DRILL BIT.**

# **BORING**

**ENLARGES THE HOLE SLIGHTLY  
AND MAKING IT ROUNDER AND  
STRAIGHTER.**

# **REAM**

**TO ENLARGE A HOLE TO A MORE  
ACCURATE SIZE AND SURFACE  
QUALITY.**

# MACHINED HOLES *BY THEIR PROFILES*

Through

Blind

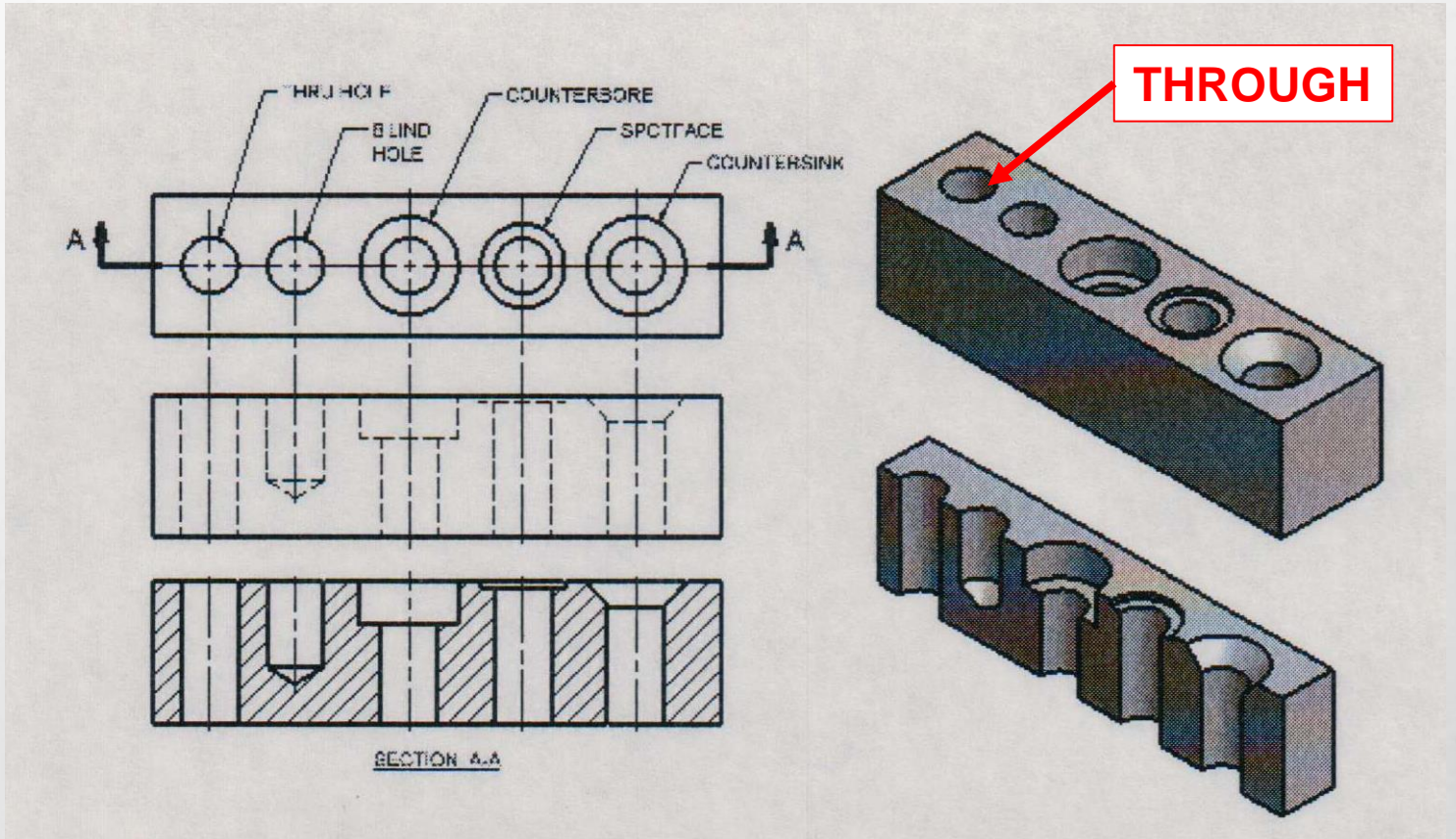
Counterbore

Countersink

Spotface

# THROUGH

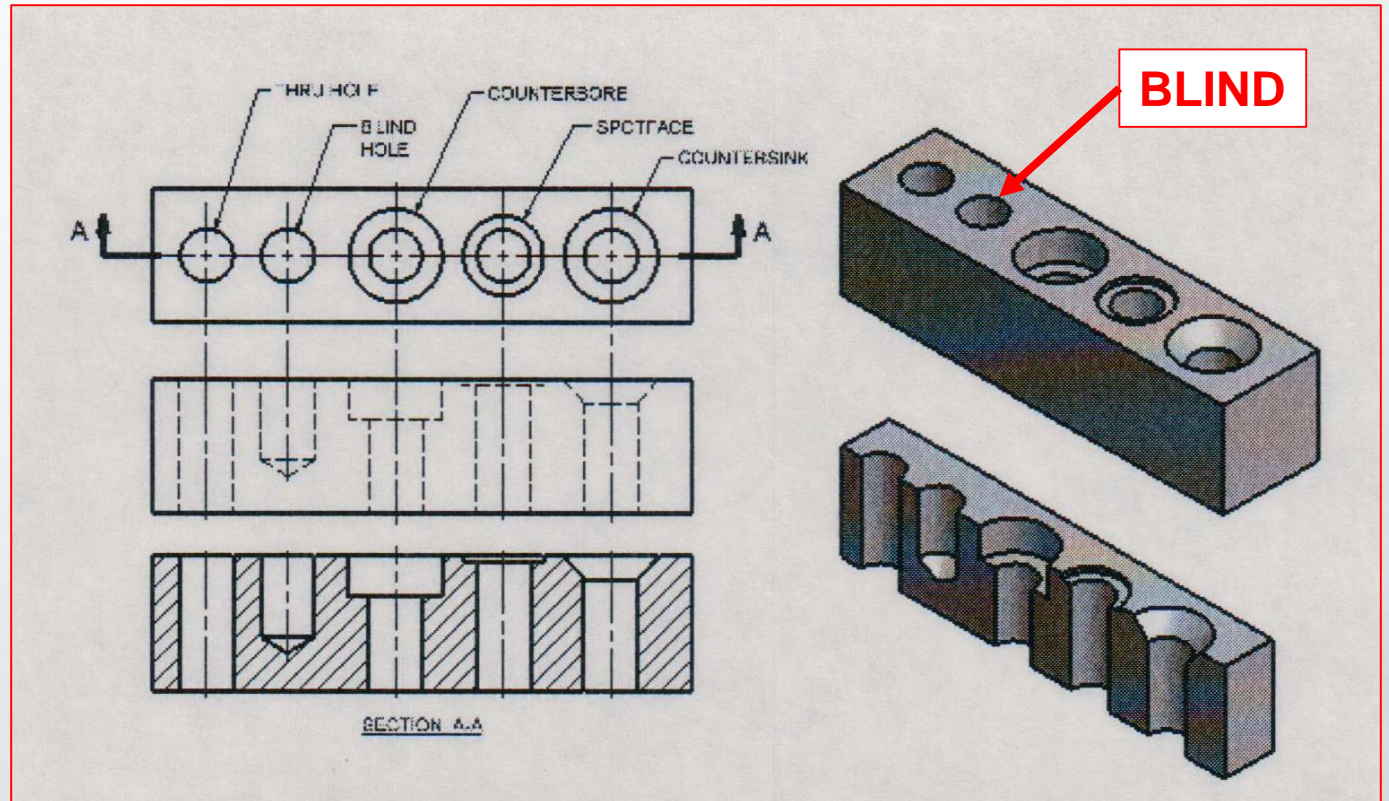
**A THROUGH HOLE IS ONE THAT  
PASSES ALL THE WAY THROUGH  
THE OBJECT.**





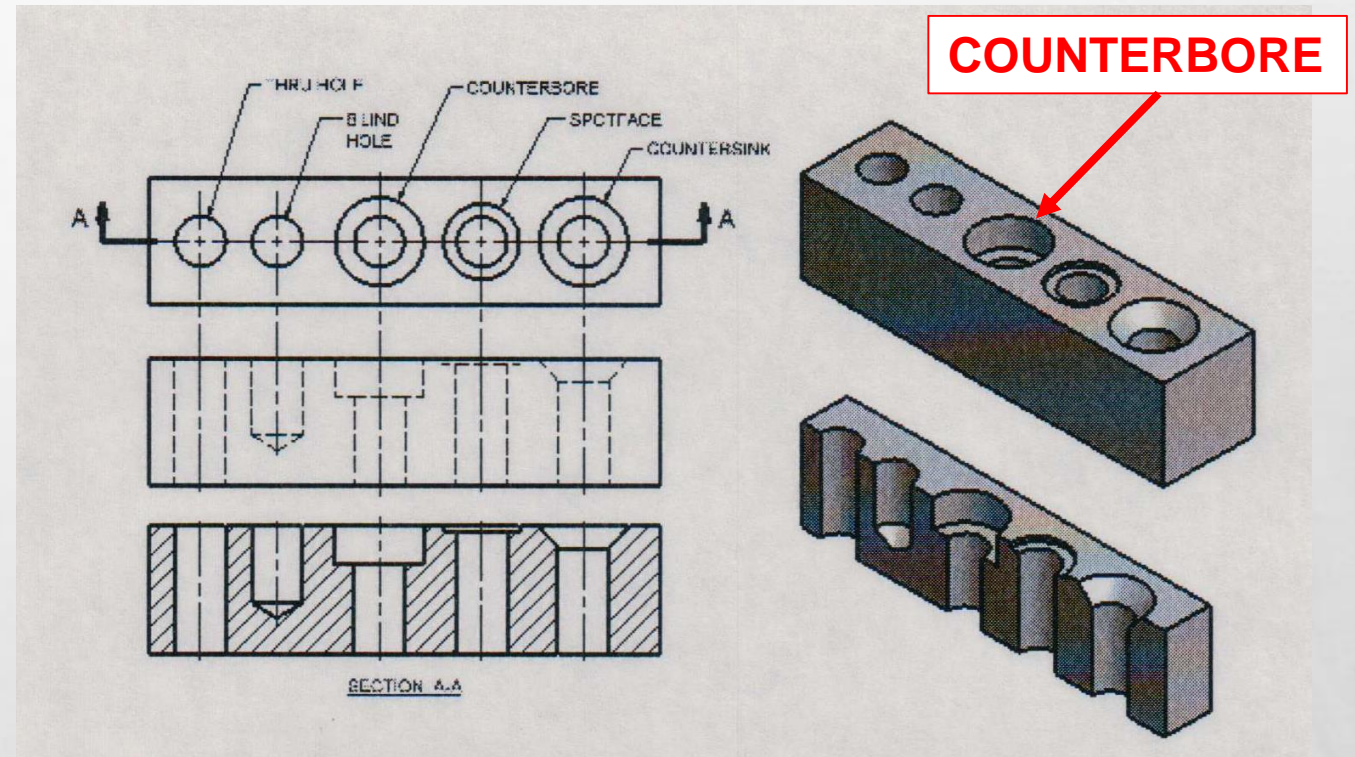
# BLIND

**A BLIND HOLE CUTS INTO BUT DOES NOT PASS COMPLETELY THROUGH THE OBJECT.**



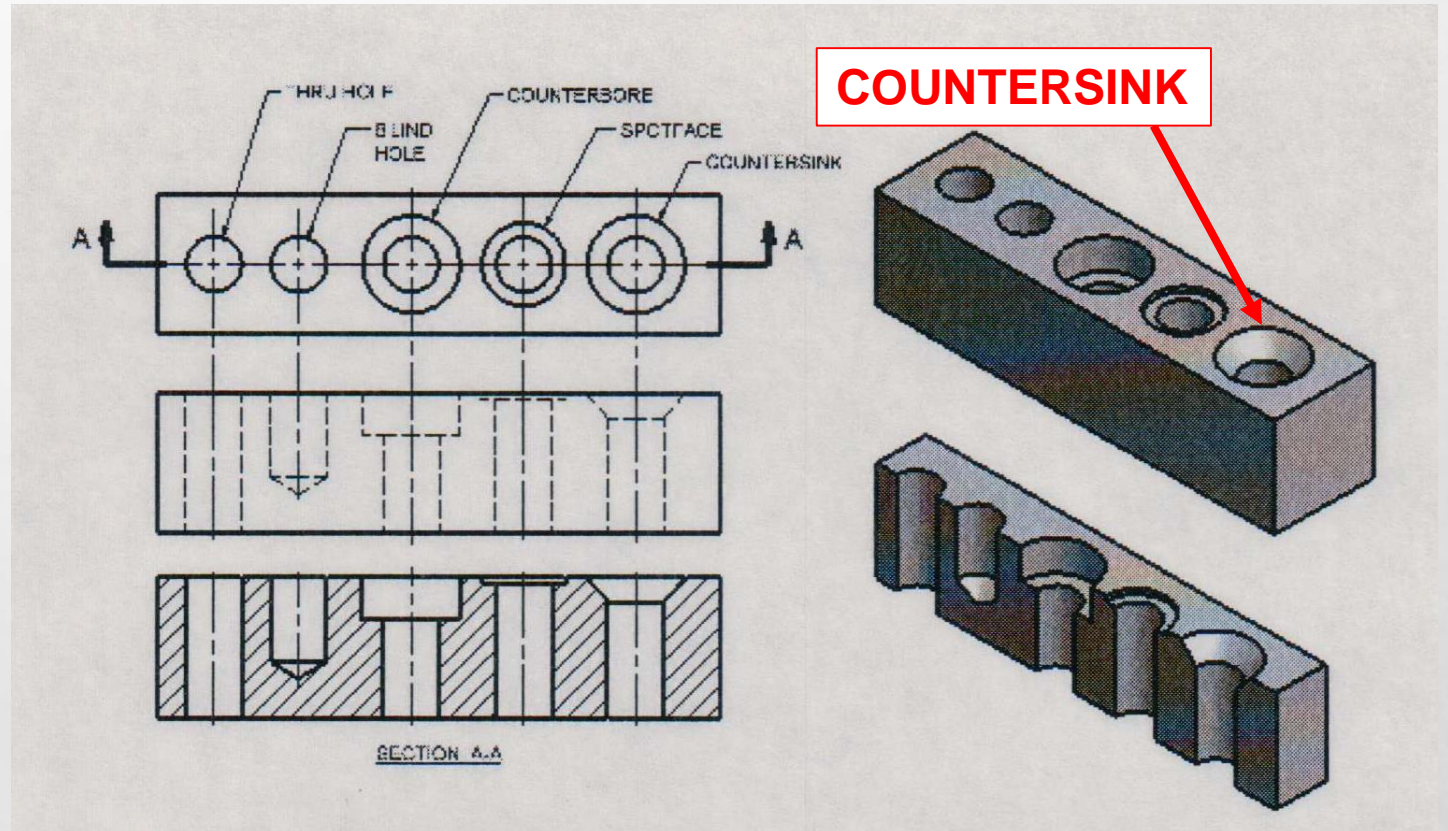
# COUNTERBORE

**TO ENLARGE THE END OF A DRILL HOLE TO A SPECIFIC DIAMETER AND DEPTH IN ORDER TO RECESS A MATING PART.**



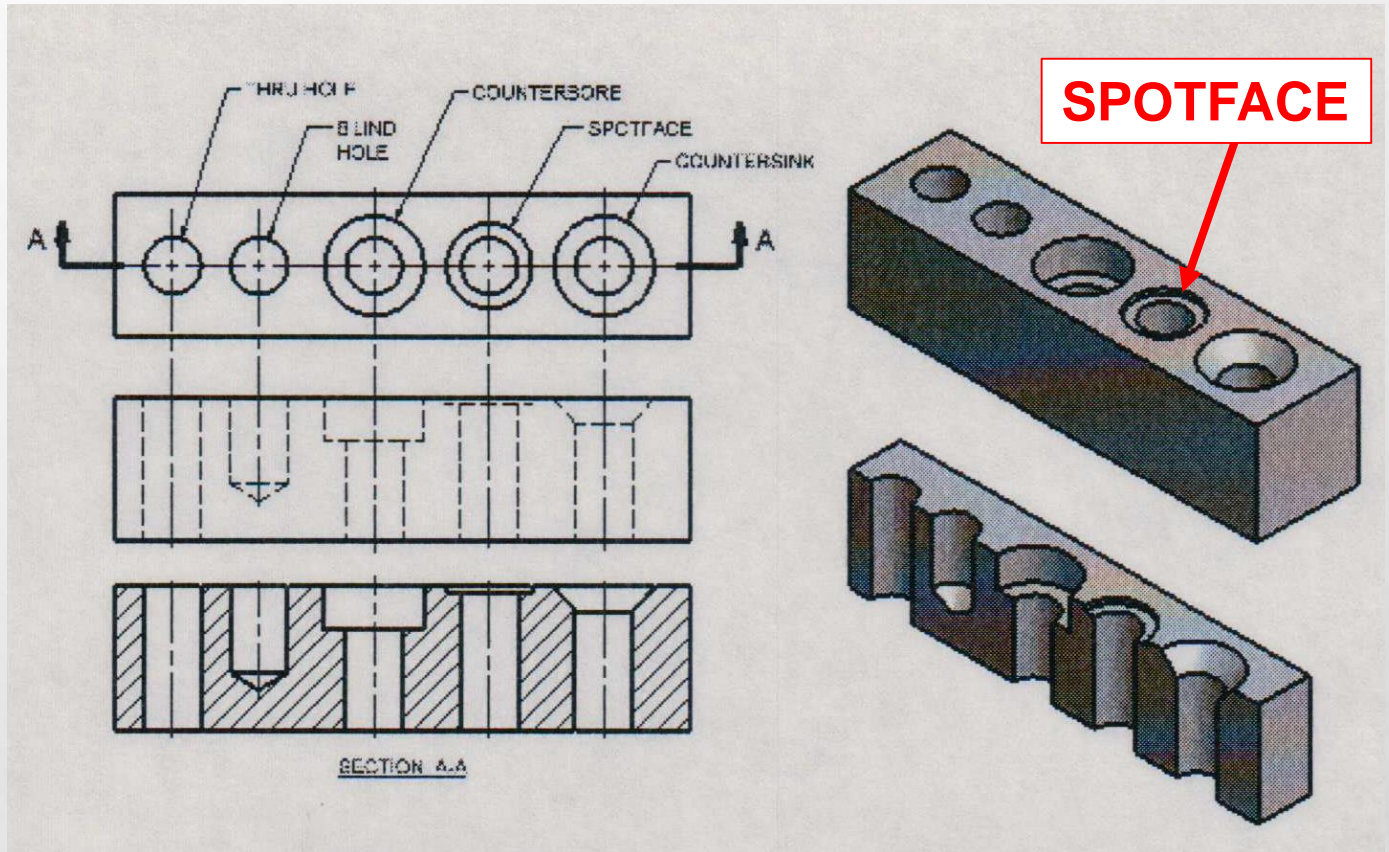
# COUNTERSINK

**TO RECESS A HOLE WITH A CONICALLY (CONE) SHAPED TOOL TO PROVIDE A SEAT FOR FLAT HEAD SCREWS.**



# SPOTFACE

**THE CUTTING OF A SHALLOW COUNTERBORE, USUALLY ABOUT .0625 DEEP (DEPTH SYMBOL IS OMITTED). THE SPOTFACE DEPTH DOES NOT NEED TO BE SPECIFIED. *THE SPOTFACE PROVIDES AN ACCURATE BEARING SURFACE FOR THE UNDERSIDE OF A BOLT HEAD.***



# STANDARDS FOR ANNOTATIONS

## *& Symbols when identifying hole callouts*

**A.**

NOTES SHOULD ALWAYS BE  
LETTERED HORIZONTALLY ON THE  
DRAWING PAPER.

**B.**

ALWAYS ATTACH LEADERS AT THE  
FRONT OF THE FIRST WORD OF A  
NOTE, OR AFTER THE LAST WORD.

**C.**

WHEN SIZING A DRILL HOLE THE  
ARROWHEAD OF THE LEADER  
SHOULD POINT TOWARDS THE  
CENTER OF THE CIRCLE.

WHEN THE CIRCULAR VIEW OF  
THE HOLE HAS 2 OR MORE  
CONCENTRIC CIRCLES, AS FOR A  
COUNTERBORE, THE ARROWHEAD  
SHOULD TOUCH THE MOST OUTER  
CIRCLE.

**D.**

**FRACTIONAL SIZE DRILLS ARE AVAILABLE DRILL SIZES OF 1/16" DIAMETER TO 3-1/2" DIAMETER.**

**IT IS COMMON PRACTICE (AS RECOMMENDED BY ANSI) TO GIVE THE DRILL SIZE IN DECIMAL-INCH SIZE FOR ALL DIAMETERS.**

**E.**

**FOR NUMBERED OR LETTER-SIZE DRILLS IT IS RECOMMENDED THAT THE DECIMAL SIZE BE GIVEN IN PARENTHESES.**

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**EXAMPLE:**

**#25 (.1495) DRILL, E (.250) DRILL**

**F.**

**METRIC DRILLS ARE USUALLY LISTED SEPARATELY WITH A DECIMAL-MILLIMETER VALUE.**

**THE WORD "DRILL" MAY BE OMITTED FROM THE NOTE.**

**G.**

REPETITIVE DRILL HOLES WITH THE SAME DIAMETER ARE SPECIFIED BY THE USE OF AN "X" FOLLOWING THE NUMBER OF TIMES THE HOLE IS REQUIRED.

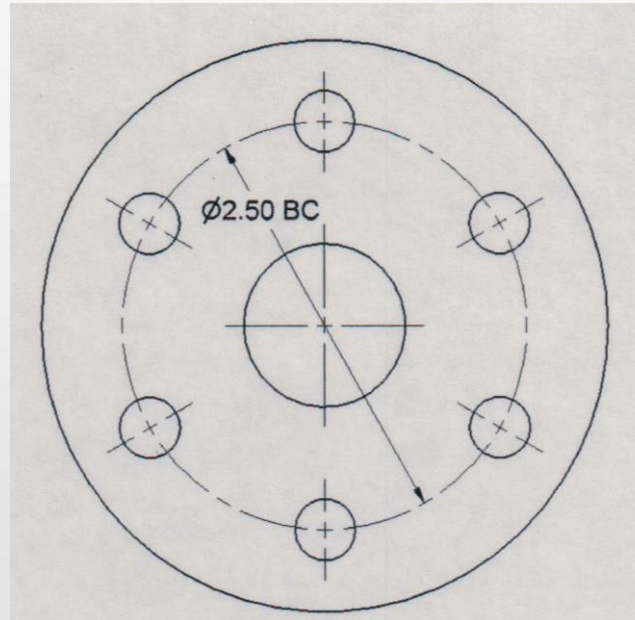
EXAMPLE:

4X D.375

(FOUR HOLES WITH A DIAMETER OF .375)

**H.**

HOLES EQUALLY SPACED ABOUT A COMMON CENTER ARE LOCATED BY GIVING THE CENTER OF THE HOLES AND DIAMETER OF THE BOLT CIRCLE (BC).



Counterbore Example:	$\phi .375$ $\perp \phi .75 \times .375$
Countersink Example:	$\phi .500$ $\sphericalangle \phi .75 \times .82$
Spotface Example:	$\phi .250$ $\perp \phi 1.00$

**I.**

THE ORDER OF THE DRILL CALLOUT CORRESPONDS TO THE ORDER OF PROCEDURE IN THE SHOP IN PRODUCING THE HOLE.

THE SMALLER DRILLED HOLE IS GIVEN FIRST, THEN THE COUNTERBORE DIAMETER, FOLLOWED BY THE DEPTH.

# SURFACE TEXTURE

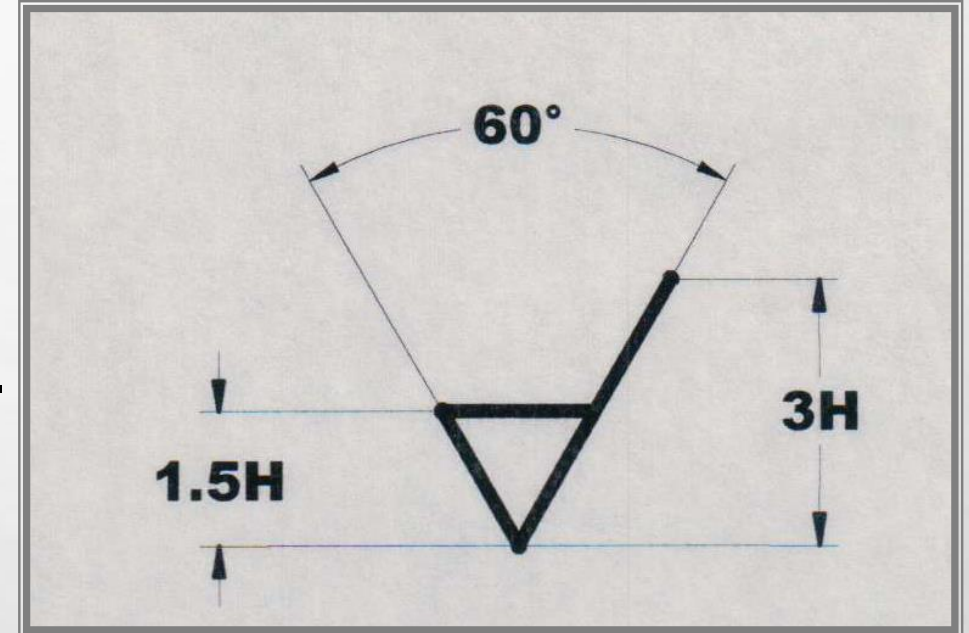
*Symbols*

1. USED TO INDICATE THAT A SURFACE IS TO BE MACHINED, OR FINISHED.

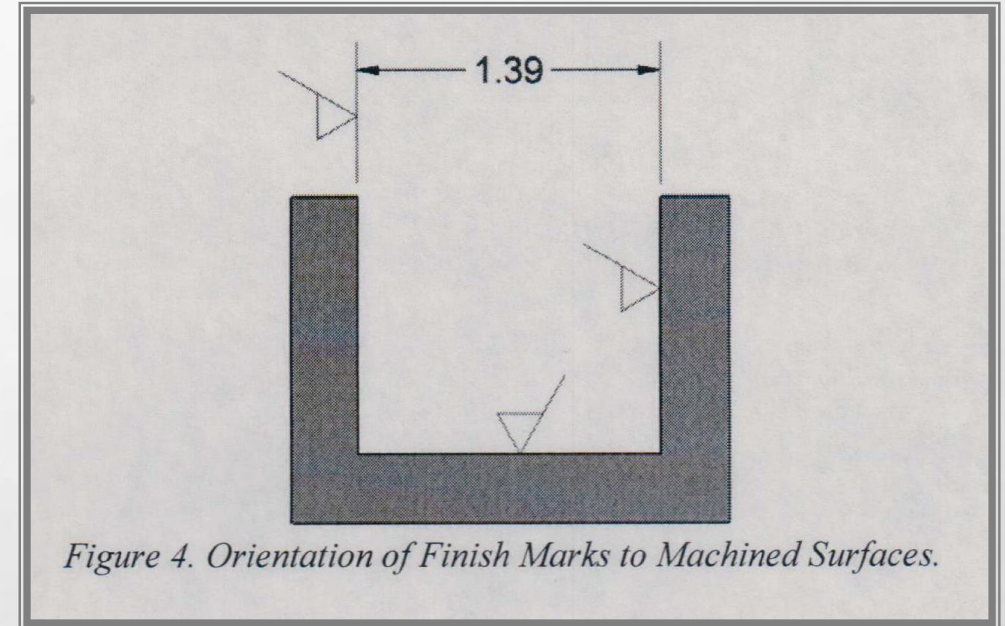


**2.** IT IS NOT NECESSARY TO  
SHOW THE FINISH MARKS FOR  
MACHINING PROCESSES SUCH AS  
DRILLING, REAMING, BORING, ETC.

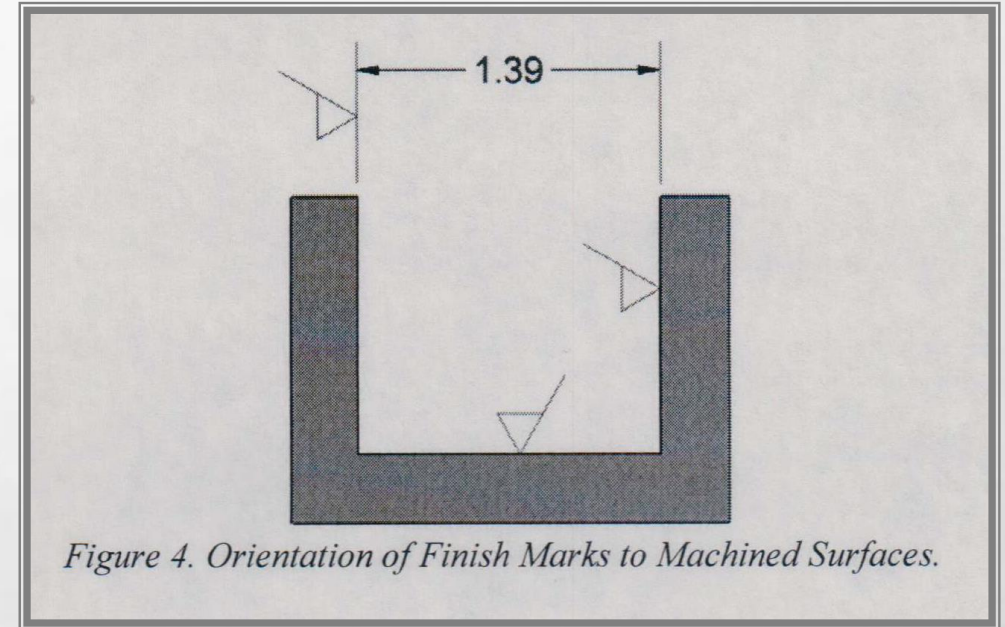
**3.** THE CHECK MARK SYMBOL IS THE PREFERRED SYMBOL BY ANSI.




**4.** THE POINT OF THE VERTEX OF THE FINISH MARK SHOULD BE DIRECTED INWARD TOWARD THE BODY OF THE PART. SUCH AS THAT OF A CUTTING TOOL.



**5.** THE FINISH MARK SYMBOL SHOULD BE POSITIONED TO READ FROM THE BOTTOM OF THE SHEET OR FROM THE RIGHT SIDE OF THE SHEET.





6. THE FINISH MARK IS ONLY SHOWN ON THE EDGE VIEW OF A FINISHED SURFACE AND IS REPEATED IN ANY OTHER VIEW IN WHICH THE SURFACE APPEARS AS A LINE, EVEN IF THE LINE IS A HIDDEN LINE.

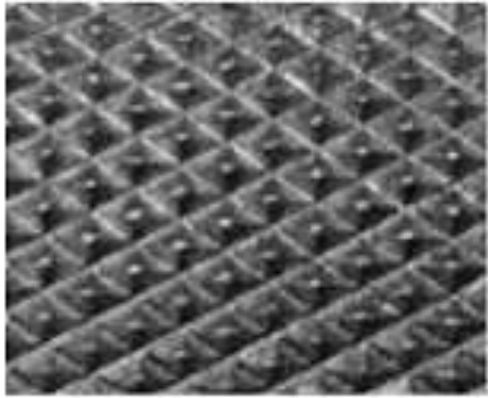
7. IF A PART IS TO BE FINISHED ALL OVER,  
FINISH MARKS ARE OMITTED AND A  
GENERAL NOTE SUCH AS “**FINISH ALL OVER**”  
OR “**FAO**” SHOULD BE PLACED IN THE  
LOWER PORTION OF THE SHEET, NEXT TO  
THE TITLE BLOCK.

# KNURLING

- A ROUGHENED SURFACE COMMONLY FOUND ON THUMBSCREWS AND HANDLES OF VARIOUS KINDS TO PROVIDE A BETTER GRIP.
  - ALSO CAN BE CREATED TO PROVIDE A PRESS FIT BETWEEN 2 PARTS.
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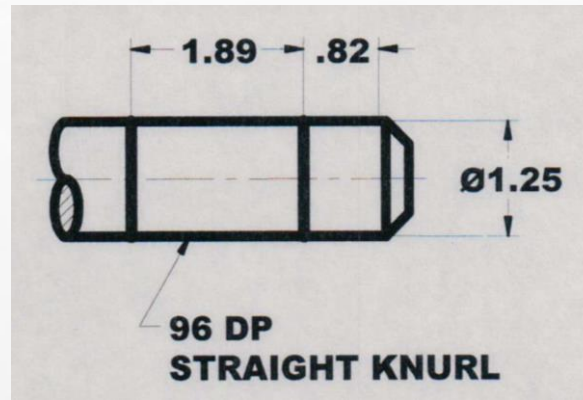
## *Types of Knurls*

- **Diamond** – *crossing diagonal grooves*
  - **Straight** – *parallel grooves*
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## Handgrip Knurls

FOR HANDGRIP KNURLS, ONLY THE **PITCH** OF THE KNURL (SOMETIMES LISTED AS FINE, MEDIUM, OR COARSE), THE **TYPE** OF KNURL (DIAMOND OR STRAIGHT), AND THE **LENGTH** OF THE KNURL AREA ARE REQUIRED.



## Press Fit Type

FOR A PRESS FIT TYPE KNURL, THE **TOLERANCE DIAMETER** OF THE CLASS OF FIT IS GIVEN BEFORE THE ACTUAL KNURLING NOTE.

THE MOST COMMONLY USED DIAMETRICAL PITCHES (DP) ARE 64 DP (COARSE), 96 DP (MEDIUM), 128 DP (FINE), AND 160 DP (EXTRA FINE).

## Knurl Symbols

A KNURL SYMBOL (HATCHING PATTERN) **DOES NOT** HAVE TO BE SHOWN ON THE DRAWING WHEN A LOCAL NOTE IS APPLIED.

# DIMENSIONING OF KNURLS

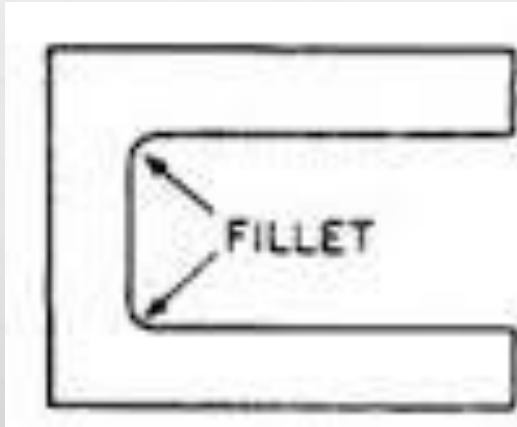


# FILLETS & ROUNDS

*The purpose of fillets and rounds is to add strength and protection from sharp edges.*

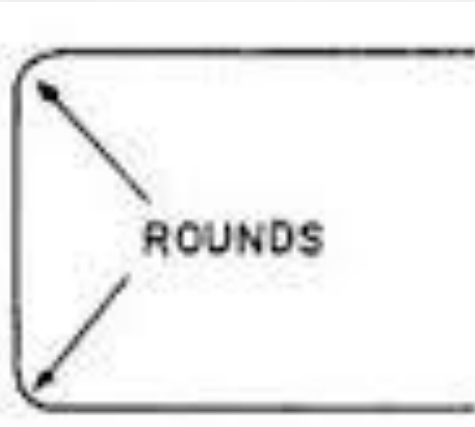
## FILLET

A ROUNDED INTERIOR CORNER



## ROUND

A ROUNDED EXTERIOR CORNER



**THE PRESENCE OF THE  
CURVED SURFACE IS  
INDICATED ONLY  
WHERE THEY APPEAR  
AS ARCS.**

**Fillets and rounds are normally found on cast, forged, and plastic parts.**