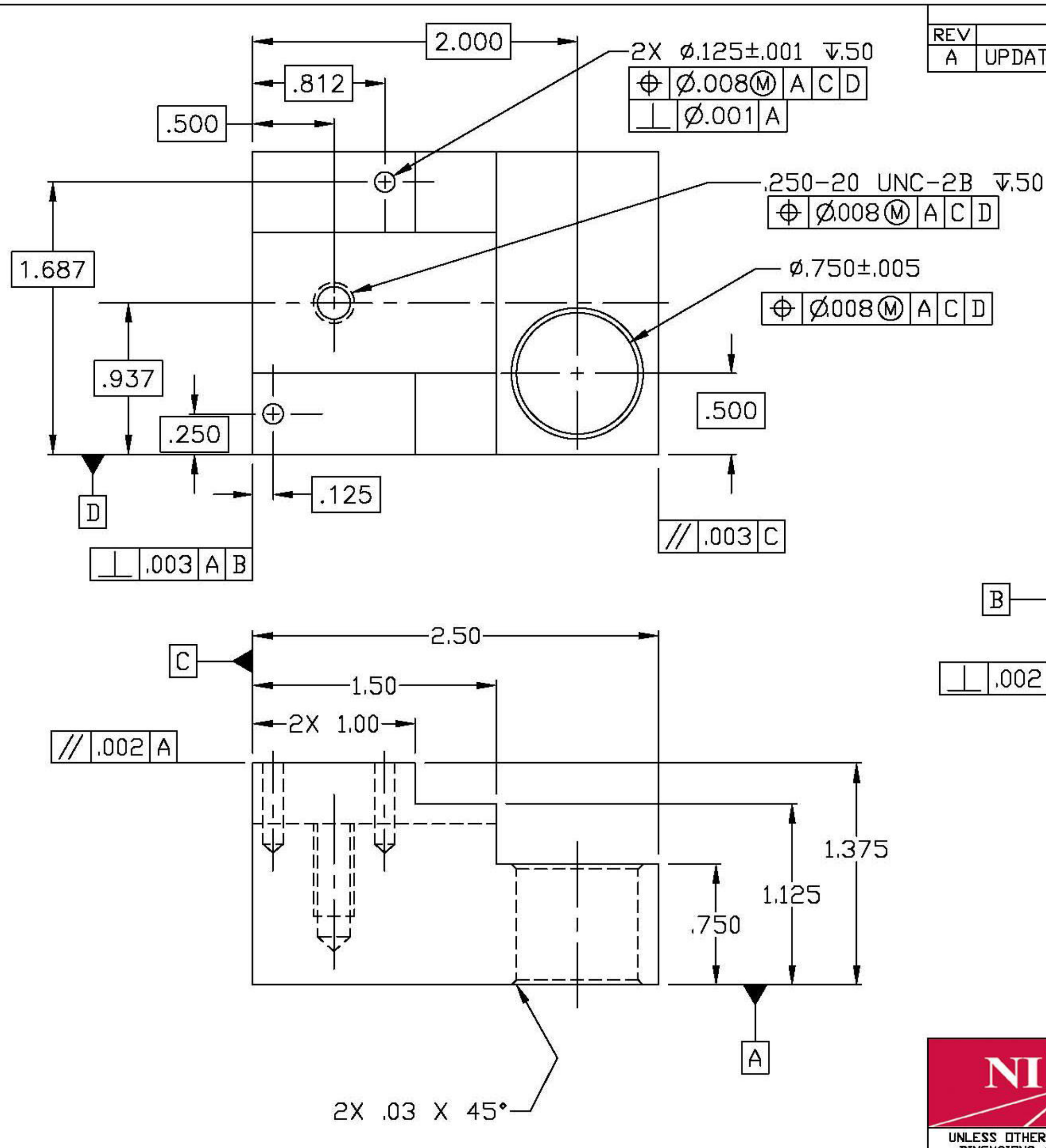
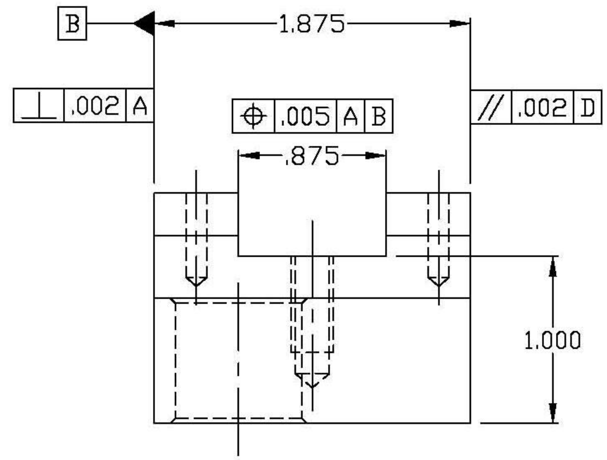
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	UPDATED DRAWING AND TITLE BLOCK	3/7/05	LW





Notes:

1. FINISH ALL OVER 125 MICROINCHES MAX
2. BREAK ALL SHARP EDGES .015" MAX
3. COUNTERSINK ALL HOLES .03" MAX UNLESS SHOWN

DO NOT SCALE DRAWING

NIMS®

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994

TOLERANCES
.X ±.032 .XXX ±.005
.XX ±.015 ANGLES ± 1 DEG.
FRACTIONS ± 1/64

MACHINING SKILLS LEVEL I

Job Duty 2.5 & 2.6
Vertical Milling Operation

DESIGNER	DK	8/1/01	MATERIAL COLD ROLL STEEL OR MILD STEEL
DWG CHK			
DWG APPD			

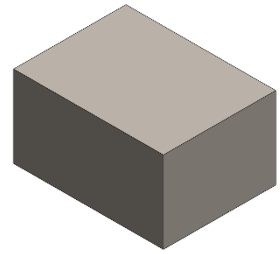
SCALE FULL | DWG.#98301 I | SHEET 1 OF 1

NIMS PROCEDURAL REQUIREMENTS

1. SUBMIT THIS PRINT AND WORKPIECE ALONG WITH THE PERFORMANCE AFFIDAVIT FOR EVALUATION

<u>NIMS Step Block General Procedure</u>

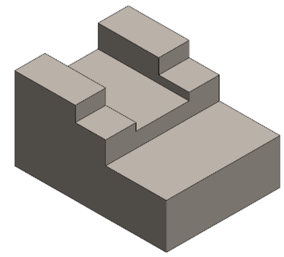
1) Cut a piece of 1.5” X 2” mild steel stock to a length of 2.625” on the bandsaw.
<u>Tools used</u>: Combination square



2) Tram the milling machine head within .0005” per 6”.
<u>Tools used</u>: Tramming plate, .0005”-reading test indicator, Indicol holder

3) Square the stock and rough the overall dimensions to .030” oversize (*ie* 1.405” X 1.905” X 2.530”).
<u>Tools used</u>: SECO Octomill, HSS end mill, dial caliper, parallels, brass pin

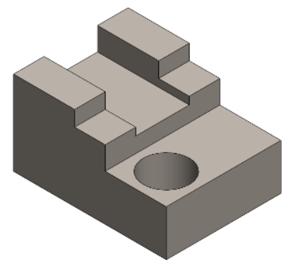
4) Rough the steps and slot to .030” oversize on all linear dimensions.



a. *bottom step:* 1.530” from Datum C and .780” from Datum A
b. *top step:* 1.030” from Datum C and 1.155” from Datum A
c. *slot:* .75” wide and 1.030” from Datum A

<u>Tools used</u>: Weldon-style end mill holder, HSS roughing end mill, dial caliper, drill chuck, edgefinder (to find part center to cut slot), parallels

5) Pre-drill the large hole.
<u>Tools used</u>: Drill chuck, edgefinder, #4 center drill, 11/16” drill, parallels (max 1/8” thick)



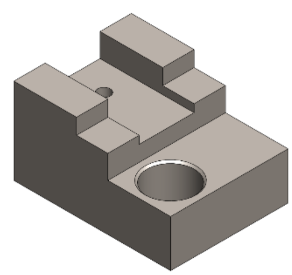
6) Finish all outside surfaces in the proper sequence to establish final sizes and GD&T controls.

a. Datum feature A
b. Datum feature C
c. Datum feature D
d. Side opposite datum feature C
e. Side opposite datum feature D

<u>Tools used</u>: R8 collet, flycutter with brazed carbide tool, .0005”-reading test indicator, Indicol holder, outside micrometers, parallels

7) Finish steps and top surface (side opposite datum feature A) to establish final sizes.
<u>Tools used</u>: R8 collet, 1/2" solid carbide end mill, outside micrometers, parallels

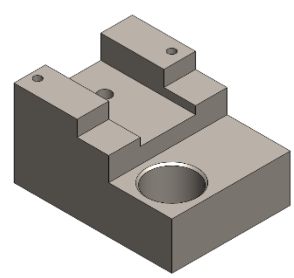
8) Finish slot to establish final sizes and position.
<u>Tools used</u>: R8 collet, 1/2" solid carbide end mill, outside micrometers, adjustable parallel (to measure slot width), parallels



9) Bore large hole to establish final size and position.
<u>Tools used</u>: Drill chuck, edgefinder, offset boring head, indexable carbide boring bar, outside micrometers, telescoping gage, R8 collet, 7/8” X 90° countersink, parallels (max 1/32” thick)

10) Drill and tap ¼-20 threaded hole.

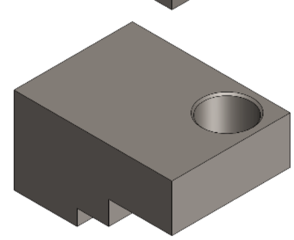
- Drill .75”-.875” deep
- Tap .50” deep minimum



<u>Tools used</u>: Albrecht-brand precision drill chuck, edgefinder, #4 center drill, #8 stub drill, ½” X 90° countersink, ¼-20 plug tap, ¼-20 bottoming tap, tap wrench, spring-loaded tap guide, ¼-20 UNC 2B Go/NoGo gage, parallels

11) Drill and ream 2X small holes.

- Drill .625” deep minimum
- Ream .50” deep



<u>Tools used</u>: Albrecht-brand precision drill chuck, edgefinder, #1 or #2 center drill, #32 stub drill, ½” X 90° countersink, .1250” reamer, pin gages, parallels

12) Countersink backside of large hole.
<u>Tools used</u>: .0005”-reading test indicator, Indicol holder, R8 collet, 7/8” X 90° countersink, parallels

PROJECT PLANNING WORKSHEET

OPERATION	TOOLS	CS/RPM
.		

Points Earned	
Total Points Possible	30

NIMS STEP BLOCK

INSPECTION REPORT

____
Student Name

Linear Dimensions

1) Overall Length: 2.50 +/- .015 ______
2) Overall Width: 1.875 +/- .005 ______
3) Overall Height: 1.375 +/- .005 ______
4) Step 1 Length: 1.50 +/- .015 ______
5) Step 1 Height: .750 +/- .005 ______
6) Step 2 Length: 1.00 +/- .015 ______
7) Step 2 Height: 1.125 +/- .005 ______
8) Slot Width: .875 +/- .005 ______
9) Slot Height: 1.000 +/- .005 ______

Holes

1) Bore: ⌀.750 +/- .005 ______
2) Bore: .03 X 45° Chamfers (2X) ☐
3) Pin Hole 1: ⌀.125 +/- .001 ______
4) Pin Hole 1: ↧.50 +/- .015 ______
5) Pin Hole 2: ⌀.125 +/- .001 ______
6) Pin Hole 2: ↧.50 +/- .015 ______
7) Threaded Hole: Verified w/ Go/No Go Gage ☐
8) Threaded Hole: ↧.50 Minimum (*Ten Turns) ☐

Geometric Dimensioning and Tolerancing

1) Slot: True Position within .005 with respect to Datums A, B ______
2) Bore: True Position within ⌀.008 (at MMC) with respect to Datums A, C, D ______
3) Pin Hole 1: True Position within ⌀.008 (at MMC) with respect to Datums A, C, D ______
4) Pin Hole 1: Perpendicular within ⌀.001 to Datum A ______

5) Pin Hole 2: True Position within ⌀.008 (at MMC) with respect to Datums A, C, D ______
6) Pin Hole 2: Perpendicular within ⌀.001 to Datum A ______
7) Threaded Hole: True Position within ⌀.008 (at MMC) with respect to Datums A, C, D
   *Based on minor diameter of threads. ______
8) Datum Feature C: Perpendicular within .003 to Datums A, B ______
9) Datum Feature D: Perpendicular within .002 to Datum A ______
10) Surfaces Opposite Datum Feature A: Parallel within .002 to Datum A ______
11) Surface Opposite Datum Feature C: Parallel within .003 to Datum C ______
12) Surface Opposite Datum Feature D: Parallel within .002 to Datum D ______

Overall Appearance

Clean, Edges Broken .015 Max, Finish 125 µIN Max ☐

ROUGHING END MILLS

Speed and Feed Data

Material	SFM	Chip Load per Tooth			
		1/8”	1/4”	1/2”	1”
Aluminum Alloys	125-250	.0010	.0020	.0025	.0030
Magnesium	125-250	.0010	.0020	.0025	.0030
Copper	75-100	.0008	.0015	.0030	.0060
Brass	85-110	.0008	.0015	.0030	.0060
Bronze	75-100	.0008	.0015	.0030	.0060
Cast Iron	100-125	.0008	.0015	.0025	.0050
Cast Steel	75-100	.0008	.0015	.0025	.0050
Malleable Iron	80-120	.0008	.0015	.0025	.0050
Stainless Steel					
Free Machining	75-90	.0005	.0007	.0012	.0020
Other	50-75	.0005	.0007	.0012	.0020
Steel					
Annealed	100-125	.0010	.0020	.0040	.0060
Rc 18-24	75-100	.0070	.0012	.0030	.0050
Rc 25-37	40-75	.0005	.0010	.0020	.0040
Titanium					
Up to Rc 30	40-75	.0005	.0012	.0025	.0050
Rc 30+	20-25	.0005	.0010	.0020	.0035
High Temp Alloys					
Austenitic	12-20	*	.0007	.0015	.0030
Ferritic	50-75	.0004	.0007	.0020	.0050
Nickel Base	20-25	.0004	.0007	.0015	.0030
Cobalt Base	8-15	*	.0007	.0015	.0030

LIST OF SYMBOLS		
F	=	NUMBER OF FLUTES
D	=	DIAMETER OF CUTTER
R.P.M.	=	REVOLUTIONS PER MINUTE
S.F.M.	=	SURFACE FEET PER MINUTE
I.P.M.	=	FEED RATE: INCHES PER MINUTE
I.P.R.	=	FEED RATE: INCHES PER REVOLUTION

MACHINING FORMULAS

$$\text{S.F.M.} = 0.262 \times D \times \text{R.P.M.}$$

$$\text{R.P.M.} = \frac{3.82 \times \text{S.F.M.}}{D}$$

$$\text{I.P.R.} = \frac{\text{I.P.M.}}{\text{R.P.M.}} \quad \text{or} \quad \text{CHIP LOAD} \times F$$

$$\text{I.P.M.} = \text{R.P.M.} \times \text{I.P.R.}$$

$$\text{CHIP LOAD} = \frac{\text{I.P.M.}}{\text{R.P.M.} \times F} \quad \text{or} \quad \frac{\text{I.P.R.}}{F}$$

CARBIDE END MILLS

Speed and Feed Data - Applications in Various Materials

Material	SFM	Chip Load per Tooth			
		1/8"	1/4"	1/2"	1"
Aluminum Alloys	600-1200	.0010	.0020	.0040	.0080
Brass	200-350	.0010	.0020	.0030	.0050
Bronze	200-350	.0010	.0020	.0030	.0050
Carbon Steel	100-600	.0010	.0015	.0030	.0060
Cast Iron	80-350	.0010	.0015	.0030	.0060
Cast Steel	200-350	.0005	.0010	.0020	.0040
Cobalt Base Alloys	20-80	.0005	.0008	.0010	.0020
Copper	350-900	.0010	.0020	.0030	.0060
Die Steel	50-300	.0005	.0010	.0020	.0040
Graphite	600-1000	.0020	.0050	.0080	.0100
Inconel/Monel	30-50	.0005	.0010	.0015	.0030
Magnesium	900-1300	.0010	.0020	.0040	.0080
Malleable Iron	200-500	.0005	.0010	.0030	.0070
Nickel Base Alloys	50-100	.0002	.0008	.0010	.0020
Plastic	600-1200	.0010	.0030	.0060	.0100
Stainless Steel - Free Machining	100-300	.0005	.0010	.0020	.0030
Stainless Steel - Other	50-250	.0005	.0010	.0020	.0030
Steel - Annealed	100-350	.0010	.0020	.0030	.0050
Steel - Rc 18-24	100-500	.0004	.0008	.0015	.0045
Steel - Rc 25-37	25-120	.0003	.0005	.0010	.0030
Titanium	100-200	.0005	.0008	.0015	.0030

Set-up Instructions | Standard and Micro Adjusting Boring Heads

Adjusting Standard Adjusting Boring Heads (see figure B2)

1. Loosen the locking screw (6).
2. Turn the dial screw (3) clockwise to increase the diameter, and turn it counterclockwise to decrease the diameter.
3. Tighten the locking screw (6).

IMPORTANT: Do not loosen the gib screws (5). It can cause poor performance when making diameter adjustments.

NOTE: To machine a smaller bore diameter, turn the dial screw (3) counterclockwise one full turn minimum to remove any backlash, and then adjust to small size.

No.	Part
1	Bar holder
2	Boring head body
3	Dial screw
4	Bar holder set screws
5	Gib screws
6	Locking screw

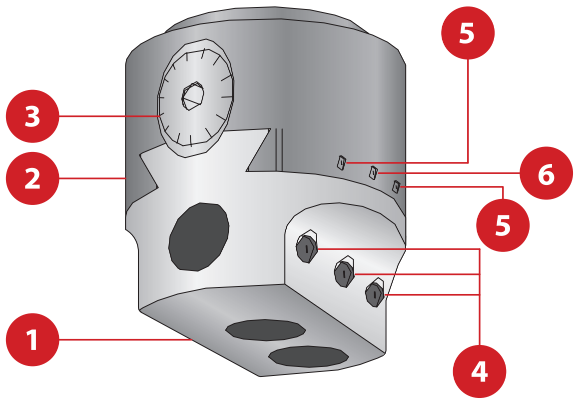


Figure B2

Adjusting Micro Adjusting Setting Boring Heads (see figure B3)

Before setting the micro adjusting boring head to the bore diameter, you need to set the micro adjusting dial (7) to the minimum bore diameter.

1. Turn the micro adjusting dial (7) clockwise until the dial screw bottoms out on the bottom of the dial screw bore.
2. Note the graduation line on the dial face closest to the reference line, then turn the micro adjusting dial (7) counterclockwise 3-1/4 turns.
3. Reverse direction and line the graduation line noted in Step 2 with the reference line.
4. The micro adjusting dial is now set so you have 0.006" on diameter of adjustment.

Adjusting micro adjusting setting boring heads is just as easy as adjusting standard boring heads. First, you adjust the boring head using the 0.001" adjustment (3), and then you make your final adjustment with the 0.00005" adjustment (7).

1. Loosen the locking screw (6).
2. Turn the dial screw (3) clockwise to increase the diameter and counterclockwise to decrease the diameter.
3. Tighten the locking screw (6).
4. Turn the 0.00005" dial screw (7) clockwise to increase the diameter and counterclockwise to decrease the diameter. Locking of the 0.00005" dial screw (7) is **not** required.

NOTE: The micro adjusting dial screws only have a total range of 0.006" (0.15mm) on diameter.

No.	Part
1	Insert holder
2	Boring head body
3	Dial screw
4	Gib screws
5	Locking screw
6	Micro adjusting dial screw

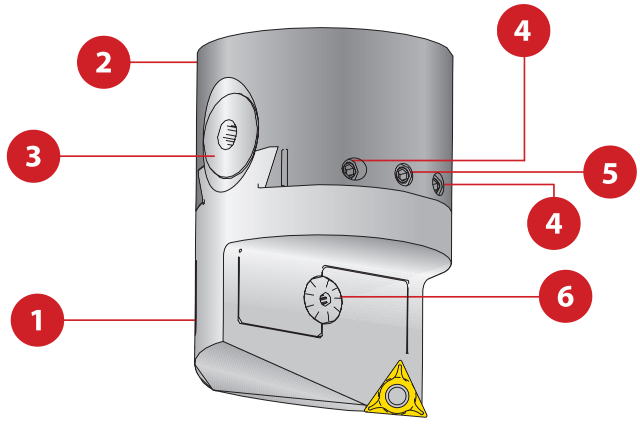


Figure B3

Recommended Cutting Data | Imperial (inch)

Finish Boring

ISO	Material	Hardness (BHN)	Cri-Bore® | CBER® | CB Style		
			SFM		Feed (IPR)
			Uncoated Inserts	Coated Inserts	
P	**Free Machining Steel** 1118, 1215, 12L14, etc.	100 - 250	350 - 700	450 - 800	0.003 - 0.005
P	**Low Carbon Steel** 1010, 1020, 1025, 1522, 1144, etc.	85 -275	350 - 700	450 - 800	0.002 - 0.004
P	**Medium Carbon Steel** 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 325	400 - 700	500 - 800	0.002 - 0.004
P	**Alloy Steel** 4140, 5140, 8640, etc.	125 - 375	300 - 600	400 - 700	0.002 - 0.004
P	**High Strength Alloy** 4340, 4330V, 300M, etc.	225 - 400	300 - 600	350 - 650	0.002 - 0.004
P	**Tool Steel** H-13, H-21, A-4, O-2, 5-3, etc.	150 - 250	300 - 600	300 - 700	0.002 - 0.004
S	**High Temp Alloy** Hastelloy B, Inconel 600, etc.	140 - 310	100 - 250	150 - 300	0.002 - 0.004
M	**Stainless Steel 400 Series** 1010, 1020, 1025, 1522, 1144, etc.	185 - 350	350 - 600	400 - 650	0.002 - 0.004
M	**Stainless Steel 300 Series** 1010, 1020, 1025, 1522, 1144, etc.	135 - 275	350 - 600	400 - 650	0.002 - 0.004
M	**Super Duplex Stainless Steel** 1010, 1020, 1025, 1522, 1144, etc.	135 - 275	350 - 600	400 - 650	0.002 - 0.004
K	**Nodular, Grey, Ductile Cast Iron**	120 - 320	400 - 600	500 - 700	0.002 - 0.004
N	**Cast Aluminum**	30 - 180	750 - 1000	800 - 1100	0.002 - 0.004
N	**Wrought Aluminum**	30 - 180	750 - 1000	750 - 1000	0.002 - 0.004
N	**Brass**	100	700 - 950	750 - 1000	0.002 - 0.004

NOTICE: The modular boring system's configuration, including the length of boring bar, boring head off set, and amount of extensions and/or reducers, may all affect performance of boring systems. All of these factors may increase imbalance of the modular boring system. Imbalance at excessive RPM will cause vibration in the machine tool, which can cause damage to the machine tool; in particular the spindle. This vibration may occur at spindle speeds above 1000 RPM. If vibration is present, reduce spindle speed.