



## GUIDELINES FOR TOOL DESIGN AND REWORK

How to use this manual:

The purpose of this manual is to provide the tool fabricator with the guidelines needed to design a new tool or rework an existing tool for DAI Ceramics Inc. (DAI).

DAI is willing to work with the fabricator to exclude certain requirements, in the instance that tooling cost is the primary consideration.

## **TABLE OF CONTENTS**

<b>1. Tool Qualification Process</b>	<b>1</b>
1.1 Quote Tool Build	1
1.2 Tool Build Letter	1
1.3 Concept Development	1
1.4 Approval of Tool Design	1
1.5 Fabrication	1
1.6 Shipment	1
1.7 Qualify Tool and Process	1
1.8 Rework	1
<b>2. Important Tool Requirements</b>	<b>2</b>
2.1 Drawings	2
2.2 Paperwork	2
2.3 Construction	2
2.4 Shipment and Storage	3
2.5 Material and Construction	3
2.6 Cavity Block Inserts	3
2.7 Return and Ejector Systems	4
2.8 Safety	4
2.9 Vents	5
<b>3. Machine Specific Requirements</b>	<b>6</b>
3.1 LP2	6
3.2 Newbury (N30)	7
3.3 Mercia (M35)	8
3.4 Newbury (N75)	9
3.5 Mercia (M150)	10
3.6 Newbury (N150)	11
3.7 Newbury (N200)	12
<b>4. Water Line Specifications</b>	<b>13</b>
4.1 Requirement	13
4.2 Chill Pins	14
<b>5. Feed Plate Design</b>	<b>15</b>
5.1 Feed Plates	15
5.2 Sprue and Feed Channel	16
<b>6. Cavity Finish Requirements</b>	<b>17</b>
6.1 Polish	17
6.2 Draft	17
<b>7. Tooling Identification</b>	<b>18</b>
7.1 Tool Information Stamping	18
7.2 DAI Shop Order Number Stamping	18
7.3 Chrome Fixtures	18

<b>8. CNC Fixture</b>	
8.1 CNC fixture basic dimensions	<b>18</b>
<b>9. Communications</b>	<b>19</b>

## **1. Tool Qualification Process**

The following steps are necessary for all tools fabricated for use at DAI Ceramics, Inc. (DAI). Omitting any of these steps, without notifying DAI in writing prior to omission may result in the return of the tool to the fabricator(s) for appropriate correction action.

### **1.1 Quote Tool Build**

After reviewing a rough dimensional sketch of the part, DAI will generate a tool quote request with exceptions to this manual. The exceptions will exclude certain design requirements based on whether the tool is prototype, medium, or full production category.

### **1.2 Tool Build Letter**

This is the document containing general build instructions to the fabricator(s), i.e. core shrink factors, number of cavities per tool, DAI approved exceptions to the tool manual, etc.

### **1.3 Concept Development**

This mandates a degree of idea exchange with DAI Engineering, Manufacturing, and Management.

### **1.4 Approval of Tool Design**

Before the tool is constructed, concept drawings should be sent to DAI. DAI shall then approve the build parameters prior to start of tool fabrication.

### **1.5 Fabrication**

The tool should be fabricated according to the build letter exceptions and instructions of this manual. Follow the important requirements for all tools (Section 2), machine specific requirements (Sections 3), and peripheral installation guidelines (Sections 4-7).

### **1.6 Shipment**

The tool should be protected to prevent damage to cavity and to any external workings of the tool (ejector lever, limit switches, etc.) See Section 2.4 of this manual. Layout/inspection reports, core drawings, EMD charts, and IGES files are required at tool delivery.

### **1.7 Qualify Tool and Process**

This is accomplished by DAI Engineering and Manufacturing personnel with a degree of fabricator involvement to resolve any outstanding tooling issues.

### **1.8 Rework**

Any rework performed should remain within the guidelines of Sections 2-7, unless the fabricator(s) performing the rework have received written acknowledgement from DAI.

## **2. Important Tool Requirements**

The following requirements apply to all tools manufactured for DAI Ceramics Incorporated (DAI), including individual machine requirements (Section 3).

### **2.1 Drawings**

- 2.1.1 Prior to fabricating the tool, the fabricator(s) should get DAI approval of concept drawings that show overall cavity dimensions and arrangement, and fired core drawings showing all fired core dimensions.
- 2.1.2 Five sets of final core drawings should arrive with the tool. If requested by DAI in the build letter, a full set of EMD charts including core prints, and IGES files should be supplied with the tool.

### **2.2 Paperwork**

- 2.2.1 Shippers showing the shipper, receiver, and contents of package.
- 2.2.2 Ship layout and inspection reports with the tool.
- 2.2.3 Written operating instructions may be required by DAI for segmented tools requiring several steps to operate. In the past, DAI has found this documentation helpful in protecting the integrity of the tool.

### **2.3 Construction**

- 2.3.1 Shrink factors from the build instruction letter should be used to fabricate the proper size cavity.
- 2.3.2 Cavity tolerance should not go less than  $\pm 0.001$ " of the print tolerance or 10% of casting drawing.
- 2.3.3 No negative draft and/or undercut is permitted.
- 2.3.4 Multi-cavity tools require unique identification markers for each cavity, using dots or numbers. They should be visible on the parts in the core print area, so as not to affect pattern fit.
- 2.3.5 Water lines may not be required for all tools. If they are, install on both halves of the tool. See Section 7.0 in this manual.
- 2.3.6 Two sets of hardened, flat face feed plates are required with each tool. See Section 8.0 for important design parameters (bolt pattern on face, size, etc.). Feed plates must be identified with DAI S/O #

- 2.3.7 Die runners must extend a minimum of 0.250” beyond the feed plate pocket before entering the core cavity. The runner must have a 0.030” corner radius minimum at the point of entry into the core cavity.
- 2.3.8 Depending on mold size, tool vender to determine quantity and diameter size of dowel pins . Dowel pins to be captured 1.750” before any other part of the tool meets. Taper on the pins should extend no more than 0.375” from the top of the pin.
- 2.3.9 When cutting mounting slots, they should be 0.500” depth by 0.500” height, with a 0.500” thick ledge.
- 2.3.10 Approximately 2/3 of the cavity should be cut into the bottom half of the tool. This ensures the part will remain in the bottom half of the tool for extraction. (**Not for diameters**)
- 2.3.11 A keyway or camber lock is required to prevent leading to trailing edge movement of the cavity blocks when needed.

## **2.4 Shipment and Storage**

- 2.4.1 A minimum of two socket head, cap screw, storage bolts.
- 2.4.2 Storage bolts should be located on opposite end of the tool.

## **2.5 Material and Conditioning**

- 2.5.1 Material for construction is specified in DAI’s tool build letter.
- 2.5.2 DAI may use mild steels and aluminum on certain hardware tool types.
- 2.5.3 No lamination construction is permitted, unless approved by DAI in writing.
- 2.5.4 When using D2 material, cavities are to be hardened to 58-60 Rockwell.

## **2.6 Cavity Block Inserts**

- 2.6.1 Cavity block inserts and feed plates should have 0.002” pre-loading.
- 2.6.2 A keyway or camber lock is required to prevent leading to trailing edge movement of the cavity inserts.
- 2.6.3 A “Chrome Plating” fixture must be supplied to hold the ejector pins flush with the cavity while chroming. Include all bolts and hardware to fasten the plate.

## **2.7 Return and Ejector System**

### **2.7.1 Cam ejector systems need to be authorized in writing by DAI.**

2.7.2 A normally open circuit should be the design for limit switches to prevent damage when slides or ejectors are out.

2.7.3 Lever operated ejector systems are preferred.

2.7.4 Ejector levers and slides should be located on the operator side (east end of the tool), or if approved by DAI, opposite the runner (south end of the tool). The location of the lever affects the efficiency of operation and some safety functions of the press.

2.7.5 Regular and reverse ejector systems should completely release the part from the cavity.

2.7.6 Placement and quantity of ejector and return pins require DAI Engineering and Manufacturing input, before fabrication.

2.7.7 Return pin pads must be fabricated into the mold, for mold bases that have Rockwell hardness less than the pins. (i.e. aluminum tools)

## **2.8 Safety**

2.81. All outside corners of tool to be broken for handling safety.

## **2.9 Vents**

2.9.1 Do not install vents, until written instruction has been received with the purchase order.

2.9.2 Cut vents into bottom half of mold. This allows for proper cleaning during operation of mold.

2.9.3 Do not position on core shape

2.9.4 Do not position on corners.

2.9.5 As a general rule vents are cut 0.125" - .250" wide and 0.003" – 0.005" deep.

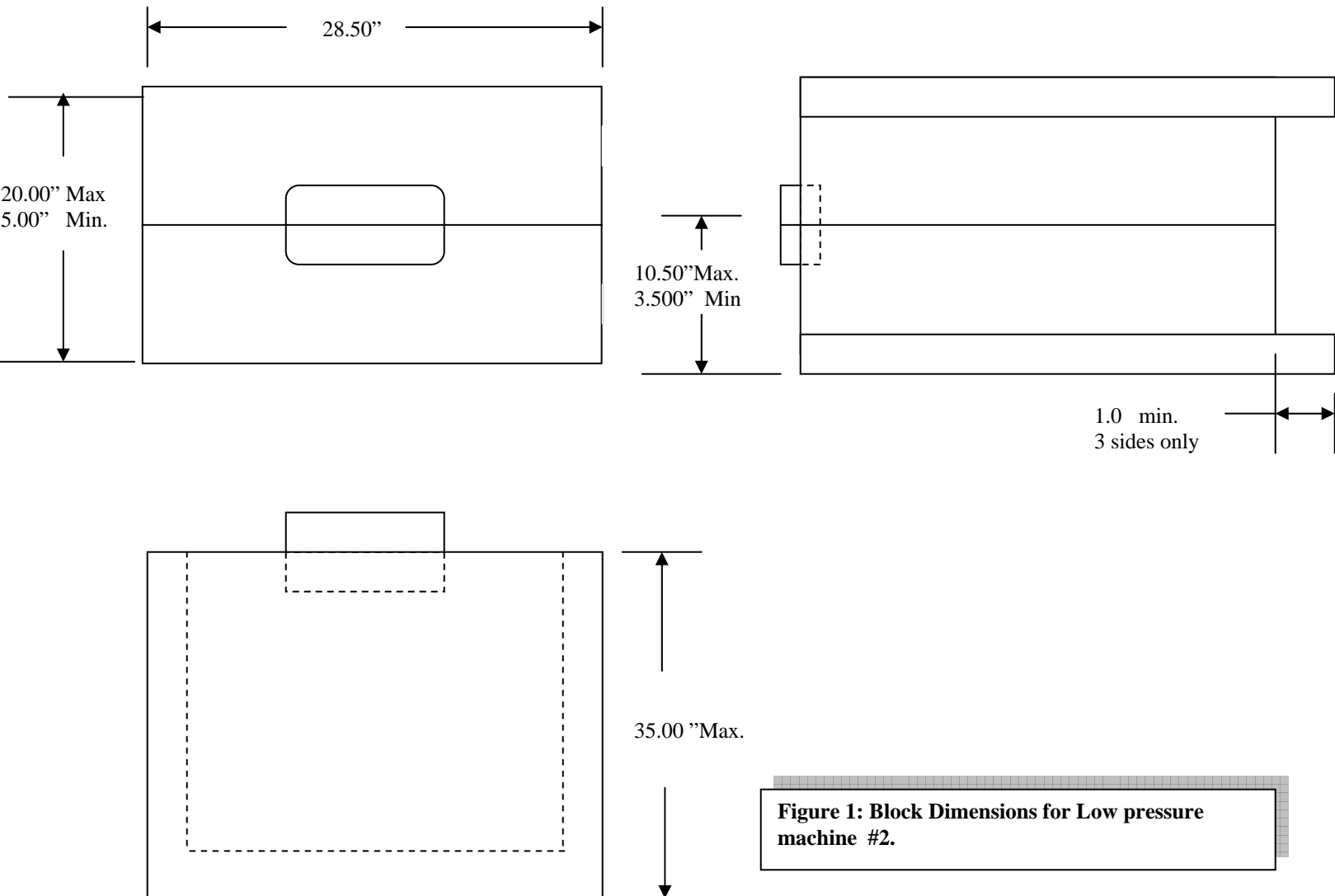
**2.10 VERY IMPORTANT: Internal cavity detail “Flashing” (Ribs, Pedestals Etc.) Should be flashed Approximately .002 to prevent “peening and “mushrooming” of surface before and after chrome.**

### 3. Machine Specific Requirements

This section is meant to show different tool design requirement for different injection machines used at DAI Ceramics, Inc. The fabricator should refer to Section 2 for the important tool requirements for all machines.

#### 3.1 LP 2

3.1.1 Feed Plates should be 1" thick and pocketed 3/4" into block.



### 3.2 Newbury (N30)

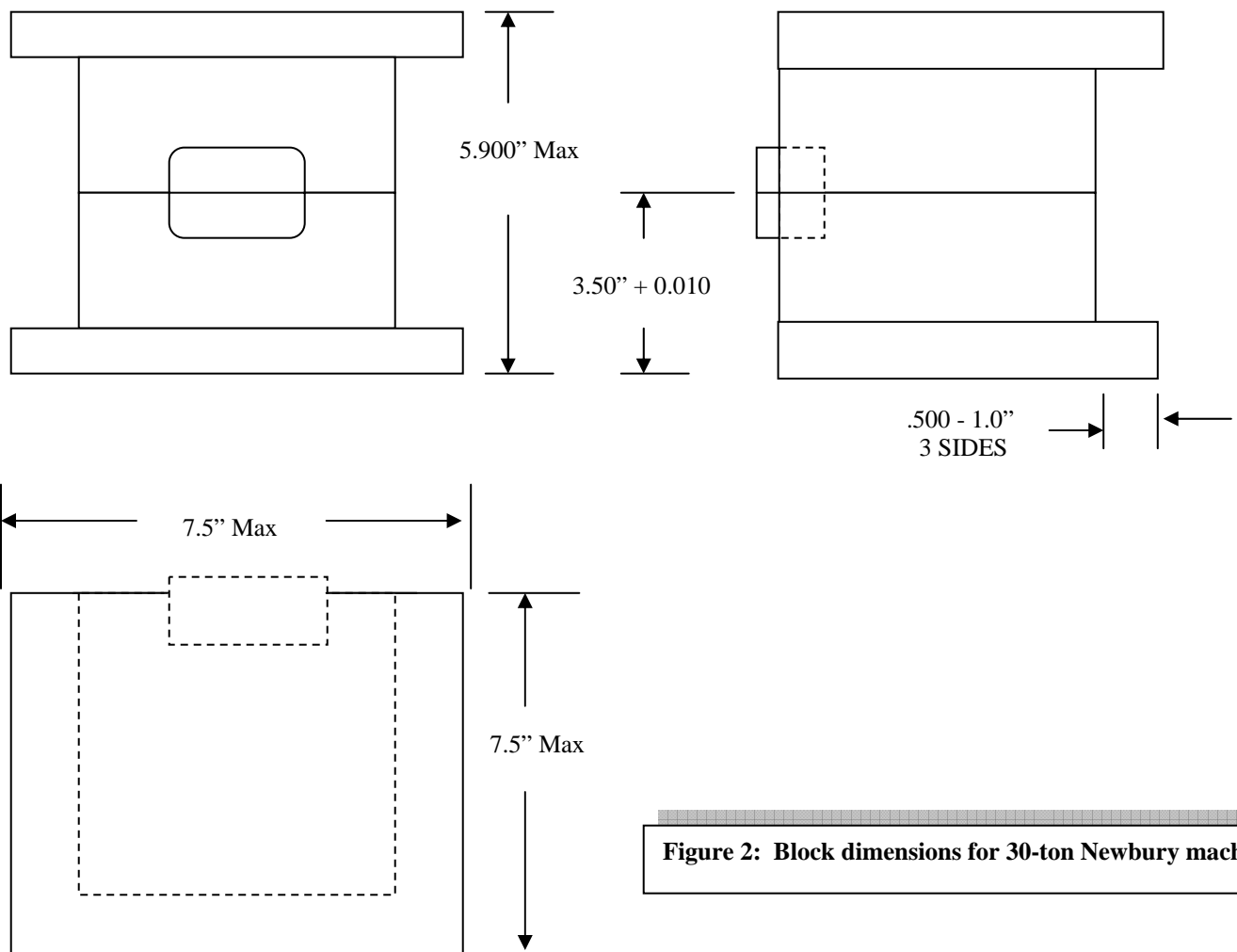
3.2.1 Sprue center line **H**eight 3.5"  $\pm 0.010$ ".

3.2.2 Maximum tool **H**eight should be 5.900

3.2.3 Minimum tool **W**idth is 4.0", and **D**epth is 4.0".

3.2.4 Maximum tool **W**idth is 7.5", and **D**epth is 7.5".

3.2.5 Feed plates should be 1" thick and pocketed  $\frac{3}{4}$ " into block.



### 3.3 Mercia (M35)

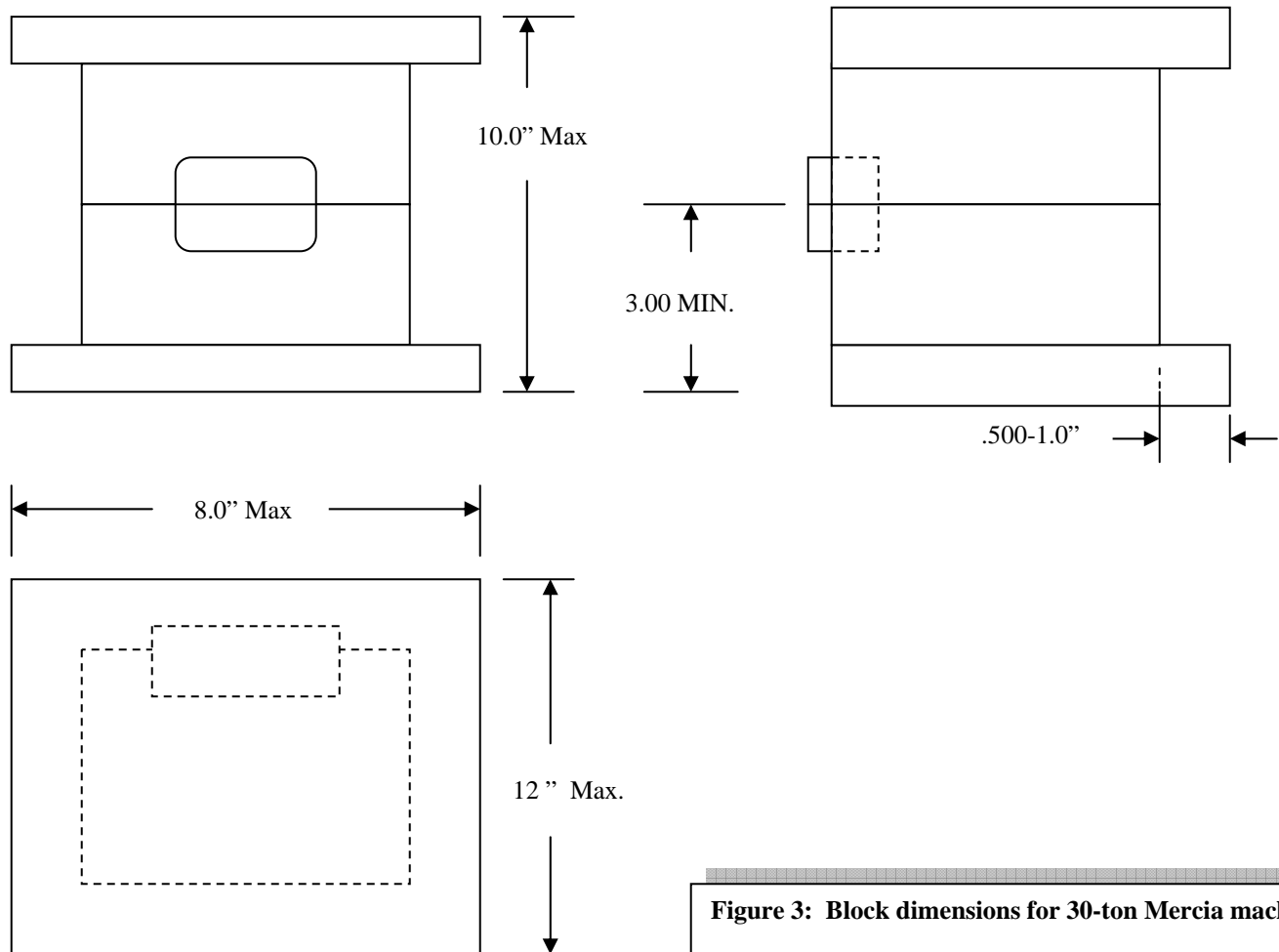
3.3.1 Sprue center line **H**eight 3.00 MINIMUM Other sprue heights may be an option.

3.3.2 Maximum tool **H**eight is 10.0". Other tool heights may be an option.

3.3.3 Minimum tool **W**idth is 4.0", and **D**epth is 4.0".

3.3.4 Maximum tool **W**idth is 8.0", and **D**epth is 12.0".

3.3.5 Feed plates should be 1" thick and pocketed  $\frac{3}{4}$ " into block.



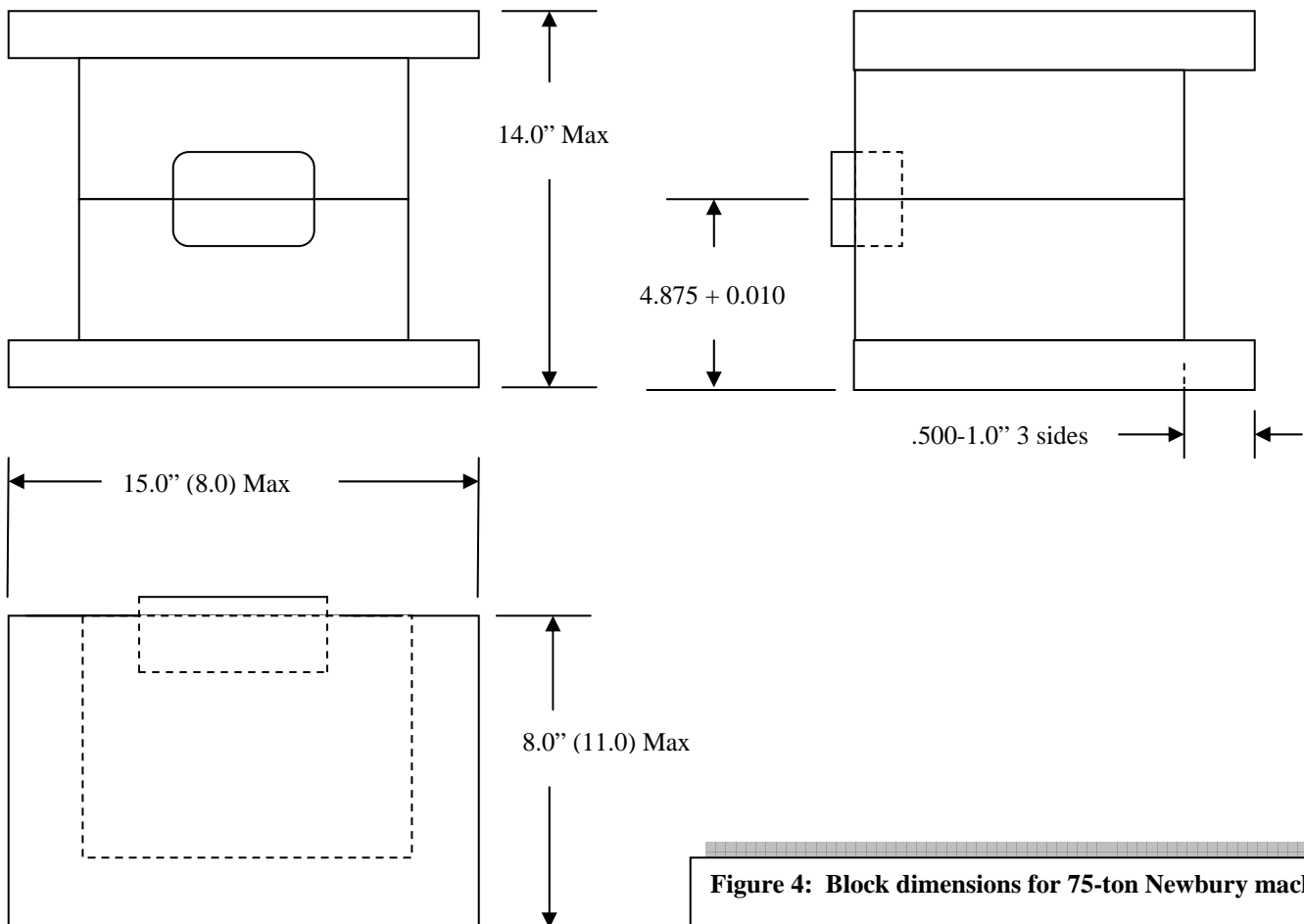
### 3.4 Newbury (N75)

3.4.1 Sprue center line Height 4.875" +/-0.010".

3.4.2 Minimum tool Height is 8.0", Width is 6.5", and Depth is 6.5".

3.4.3 Maximum tool Height is 14.0", Width is 15.0", and Depth is 11.0".

3.4.4 Feed plates should be 1" thick and pocketed 3/4" into block.



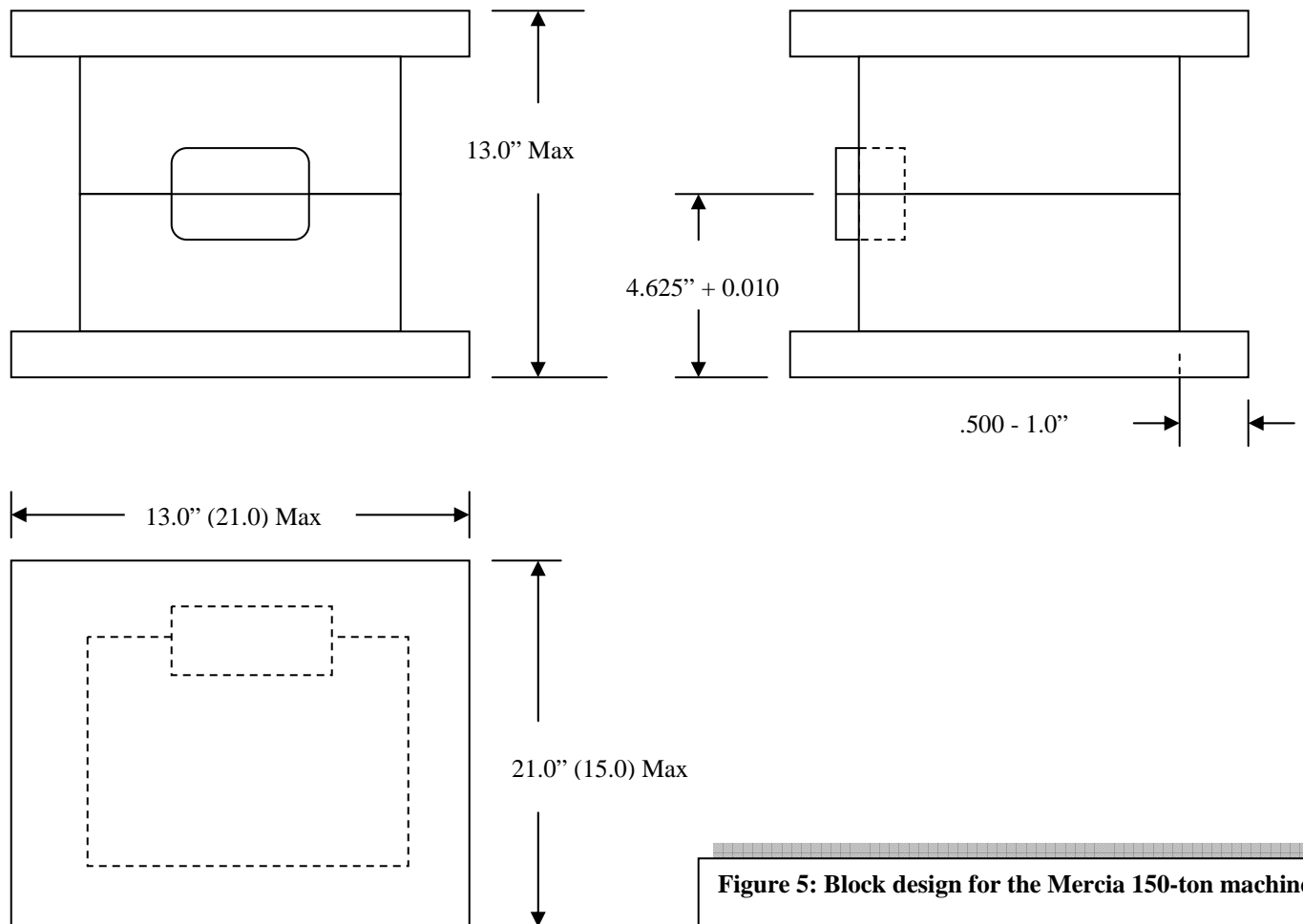
### 3.5 Mercia (M150)

3.5.1 Sprue center line **H**eight  $4.625 \pm 0.010$ ".

3.5.2 Minimum tool **H**eight is 8.5", **W**idth is 6.5", and **D**ePTH is 6.5".

3.5.3 Maximum tool **H**eight is 13.0", **W**idth is 13.0", and **D**ePTH is 21.0".

3.5.4 Feed plates should be 1" thick and pocketed  $\frac{3}{4}$ " into block.



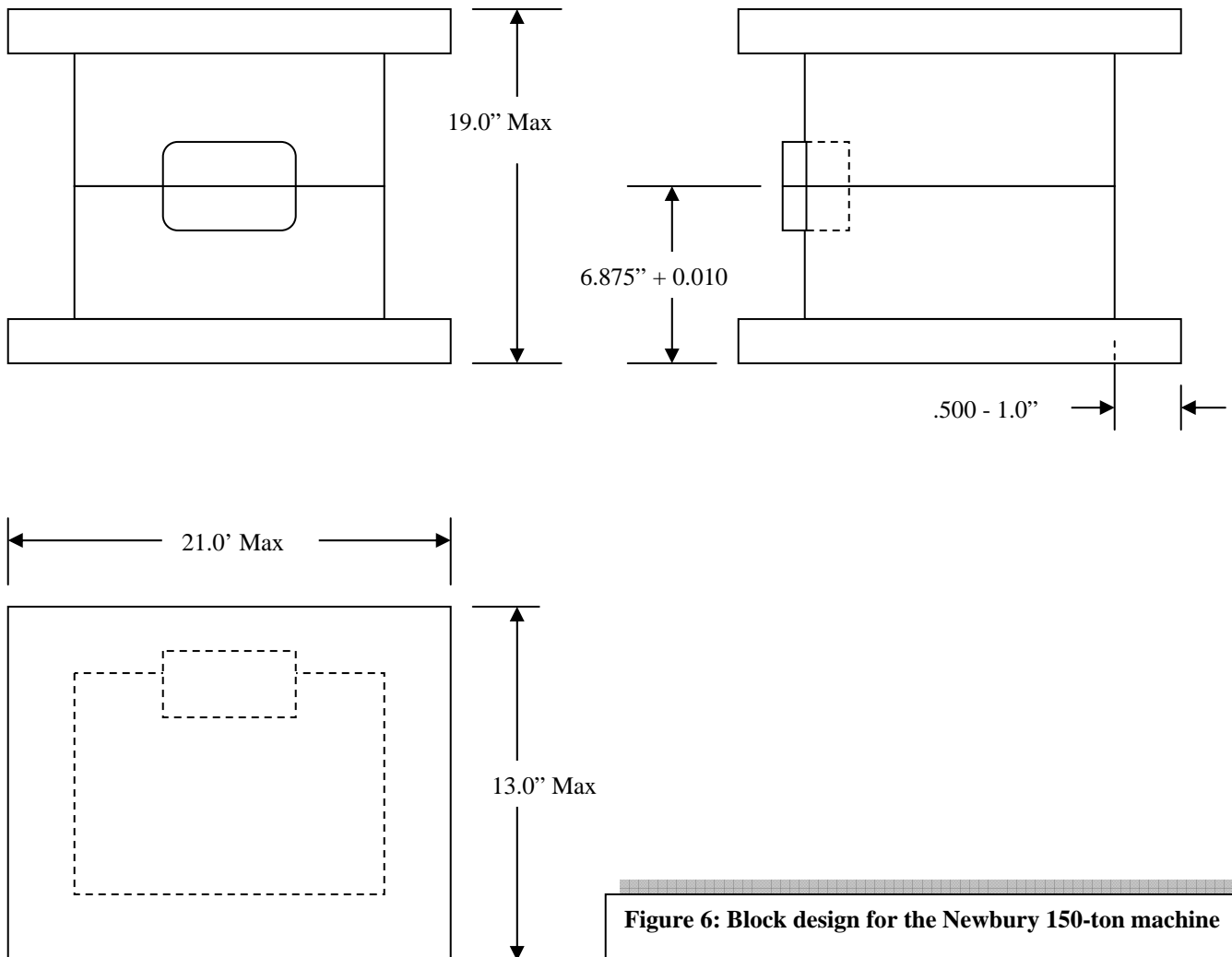
### 3.6 Newbury (N150) (#14 machine)

3.6.1 Sprue center line Height 6.875 +/-0.010".

3.6.2 Minimum tool Height is 10.0", Width is 6.5", and Depth is 6.5".

3.6.3 Maximum tool Height is 19.0", Width is 21.0", and Depth is 13.0".

3.6.4 Feed plates should be 1" thick and pocketed 3/4" into block.



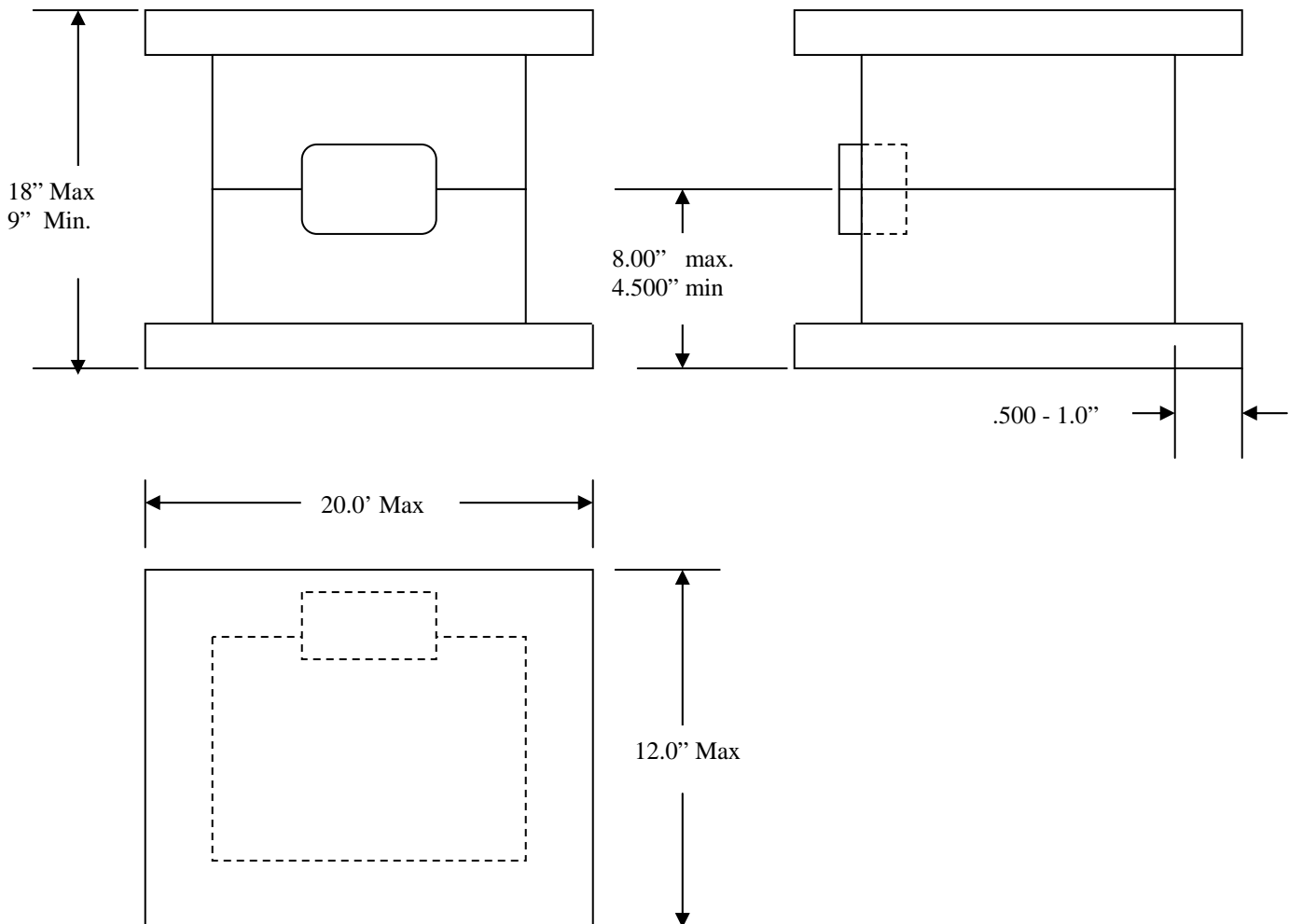
**3.7 Newbury (N200) #16 machine.**

3.7.1 Sprue center line **H**eight

3.7.2 Minimum tool **H**eight is , **W**idth is 6.5", and **D**ePTH is .

3.7.3 Maximum tool **H**eight is , **W**idth is , and **D**ePTH is .

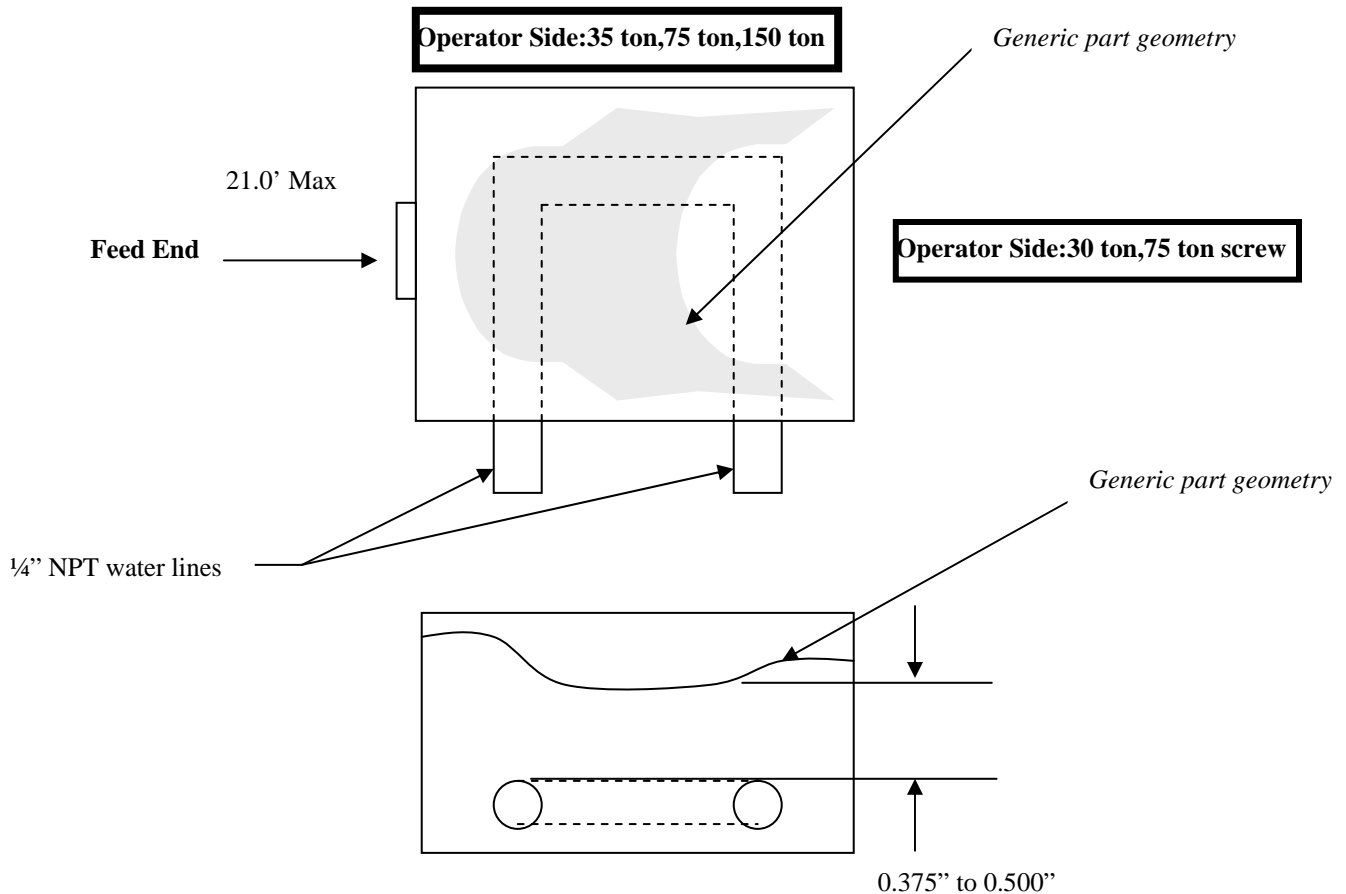
Feed plates should be 1" thick and pocketed 3/4" into



## 4. Water Line Specifications

### 4.1 Requirements

- 4.1.1 Minimize the vertical distance between the deepest point of the cavity(s) and the cooling channels. Wall thickness from cavity(s) must be within the range of 0.375" to 0.5". With cavity blocks, maintain this same thickness range from the insert area.
- 4.1.2 Minimize the horizontal distance between the channels and the perimeter of the cavity(s). This can be accomplished by centering the channels between the tangent to the cavity(s) perimeter and the center of the cavity. Wall thickness from cavity(s) must be within the range of 0.375" to 0.5". With cavity blocks, maintain this same thickness range from the insert area (Figure 7).
- 4.1.3 Hook-ups are to be threaded with 1/4" NPT.
- 4.1.4 Should be contained in the cavity blocks.
- 4.1.5 Horizontal spacing of no less than 1 1/2", between supply and return lines.



**Figure 7: Cut-out of an arbitrary tool showing water line installation relative to part center**

## **4.2 Chill Pins**

- 4.2.1 Bubble or cascade/Freon tubes should be used in all chill pins.
- 4.2.2 When chill pins end at the feed, they should be tapered to a cone for diameters and a blade for airfoil cross-sections. This reduces the pin deflection induced by material injection force.

## 5. Feed Plate Design

5.1 Feed Plates must be stamped with DAI S/O number.

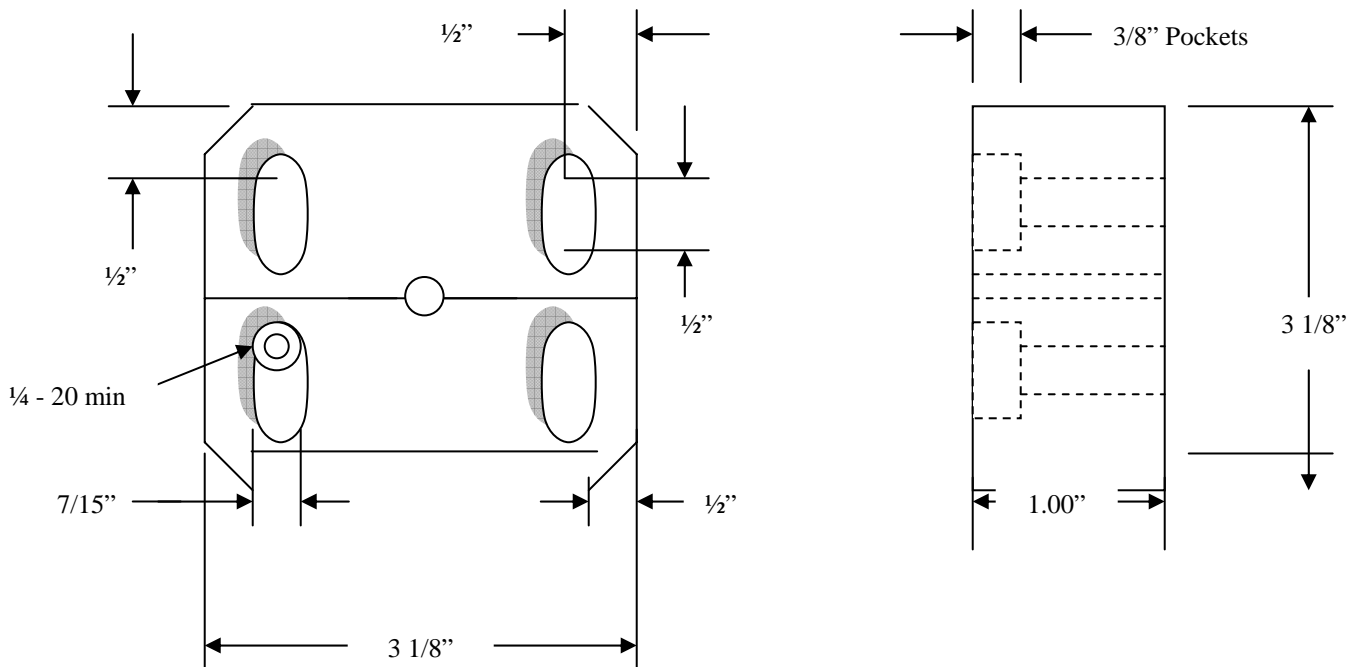
5.1.1 Two sets of feed plates should be included with the mold.

5.1.2 Fastening bolts are to be a minimum  $\frac{1}{4}$ " – 20 shcs.

5.1.3 Pocketed and pre-loaded fastening holes are required (Figure 8)

5.1.4 No portion of the forming cavity is to be located in the feeder plates.

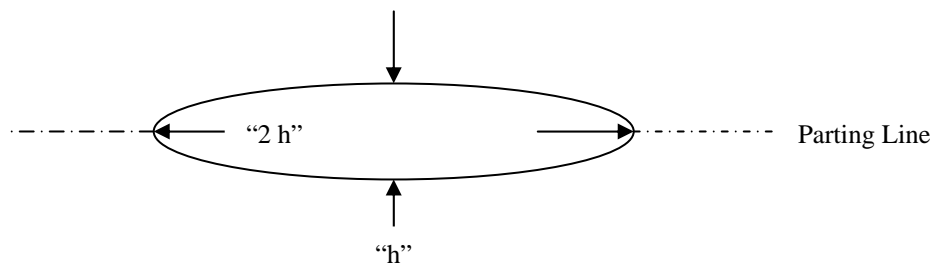
5.1.5 Material is to be D-2 or CPM 10V (A-11), hardened to a minimum of 55-60 Rockwell.



**Figure 8: Feed plate bolt pattern and plate specifications**

## 5.2 Sprue and Feed Channel

- 5.2.1 Sprue diameter should be as required.
- 5.2.2 Sprue length should not exceed 1.00”.
- 5.2.3 The feed should enter the cavity at the thickest section.
- 5.2.4 The entire feed channel should be polished to the same quality as the cavity. Tool marks and undercutting in the sprue and feed channel are not acceptable.
- 5.2.5 The ingate should be circular in cross-section. For the cases where an elliptical cross-section may be preferred, use the following guidelines . . .



**Figure 9: Dimensional relationship for an elliptical feed**

## **6. Cavity Finish Requirements**

### **6.1 Polish**

6.1.1 Cavity area is to be diamond polished to 5-10 RMS.

6.1.2 All undercuts, regardless of cause, must be polished out.

### **6.2 Draft**

6.2.1 All draw surfaces must have a minimum of  $1/2^\circ$  draft. Note: DAI must be notified if the draft angle will violate the blue print prior to cutting.

6.2.2 All pedestals are to be targeted at 0.002" above nominal at the base and 0.002" below nominal at the parting surface.

## **7. Tooling Identification**

### **7.1 Tool Information Stamping**

All tools are to have the following stamped on the top surface with 1/8" characters or larger. Any information specific to DAI Ceramics, Inc. (DAI) will be supplied on the purchase order or build letter:

1. Prime Customer Name and Part Number
2. Foundry's Name and Part Number
3. DAI Shop Number
4. Core Material
5. Core Shrink Factor
6. Tool Shop Name and I.D. Number
7. Completion Date for Tool Fabrication
8. Weight of Tool

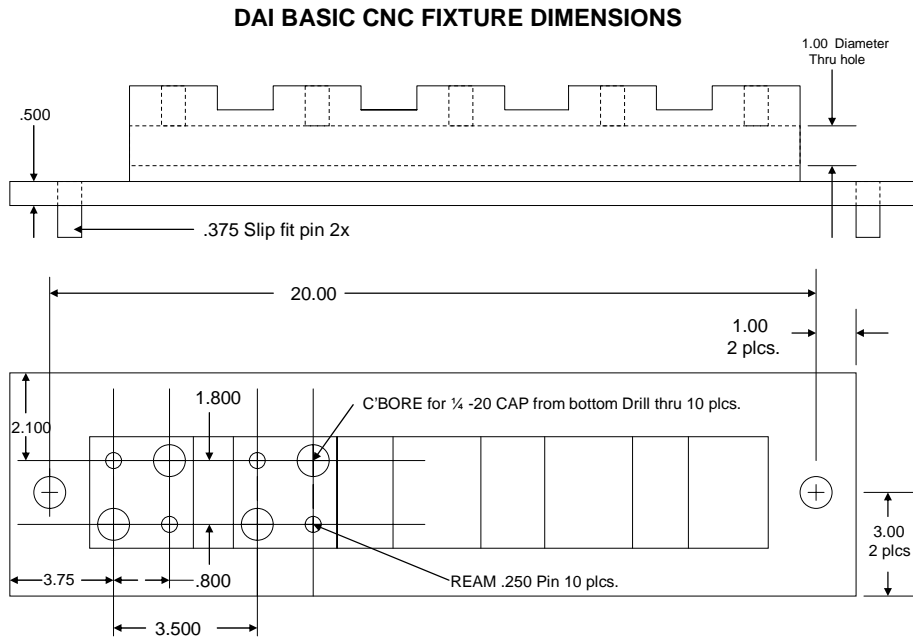
### **7.2 DAI Shop Order Number Stamping**

The DAI shop order number **must** be stamped on at least on side of the bolster plates or on the ledge above the mounting slots. This helps DAI personnel to quickly locate the tool when in storage.

### **7.3 Chrome Fixtures**

Chrome fixtures must be marked with DAI S/O number.

## 8. CNC Fixture construction



## **9. Communications**

**DAI CERAMICS, INC.  
38240 Airport Parkway  
Willoughby, Ohio 44094**

**Phone: (440) 946-6964**

**Fax: (440) 951-2106**

**Email: [sales@daiceramics.com](mailto:sales@daiceramics.com)**

