Dynisco

LMM
Laboratory Mixing Molder

INSTRUCTION MANUAL

P/N 14213700
Rev. 4.0

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GENERAL EQUIPMENT SPECIFICATIONS

This page is a record of your equipment specifications. This information is found on the stamped nameplate of your instrument. Please fill in the blanks below when you receive your Dynisco unit.

When contacting the sales or service department to order parts or obtain information, refer to this page. This will allow us to respond quickly and accurately to your request.

MODEL NO. _____

SERIAL NO. _____

WIRING DIAGRAM (See drawings at back of manual)

MAIN FUSE_____Amperes

SINGLE PHAZE_____ Volts AC

MODEL_____LMM_____

TYPE__Laboratory Mixing Molder_

Dynisco Polymer Test - Product Warranty

Dynisco Polymer Test warrants to the original buyer only, that all products and services furnished hereunder shall be free from defects in material and workmanship. This warranty is subject to the following terms and conditions.

1. This warranty shall remain in effect for a period of one (1) year from date of start-up or fifteen (15) months from date of shipment whichever is earlier; provided however that notice of any such defect is reported to Dynisco Polymer Test within thirty (30) days following its discovery.
2. Parts that normally contact the material under test shall have a warranty period of three (3) months from start-up or five (5) months from date of shipment whichever comes first; provided however that notice of any such defect is reported to Dynisco Polymer Test within then (10) days following its discovery.
3. This warranty not applicable to the fiber optic image bundle. This item to be warranted for thirty days, and not to exceed the OEM warranty.
4. The start-up date for parts sold as "spare parts" will be considered the date of shipment for purposes of this warrantee only.
5. Consumables such as heat elements, light sources, infrared sources, printer ribbons and the like shall be considered expendable and will only be warranted to be functional at time of shipment.
6. In the event any material or workmanship shall be determined defective by Dynisco Polymer Test, Dynisco Polymer Test's liability hereunder is limited to the repair or replacement, at Dynisco Polymer Test's option, of the defective part. Dynisco Polymer Test shall have NO liability for the costs of removing, returning, or reinstalling any repaired or replaced part or component.
7. Dynisco Polymer Test shall have no liability whatsoever for any defects which directly or indirectly arise out of or result from accident, abuse, improper use, vandalism, unauthorized repairs, or similar deviations from normal use under Dynisco Polymer Test control.
8. This warranty shall be void and of no effect if the products covered hereby are:
    A. Installed or moved and reinstalled without the presence of Dynisco Polymer Test's personnel at start-up.
    B. Not maintained in strict accordance with Dynisco Polymer Test's published maintenance procedures.
    C. Altered or modified in any way without Dynisco Polymer Test's authorization.

Except as provided above, Dynisco Polymer Test makes no other warranties, expressed or implied, including without limitation, warranties of merchantability, or of fitness for a particular purpose.

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1.0 INTRODUCTION

The LMM Laboratory Mixing Molder is equipped with an LED Temperature Controller; direct drive, rotor control used for mixing of the polymer melt; illuminated power, heater and rotor switches; a rotating control box; simple on/off valve; a mold clamping mechanism; and a 2 or 4 cubic centimeter (cc) capacity interchangeable cup.

Note: New Installations Only

Drive must have "Red Gearbox Breather Plug" removed before operating instrument. Motor is located under top mounted instrument cover of "LMM". Remove cover for access and replace when completed.

1.1 Component Identification List

Before operating the LMM Molder, you should first familiarize yourself with the various parts of the instrument, their function and control. The following list is used with **(Figure 1).**

NUMBER	COMPONENT NAME	FUNCTIONS
1	Power Switches	Turn power on and off for the heater and motor.
2	LED Temperature Controller	Indicates and controls the temperature of the stator cup block.
3	Rotor Switch	Turns power on and off.
4	Rotor	Supplies rotation for mixing and axial motion for injection.
5	Support Columns	Support the unit.
6	Stator Cup	Material container for mixing and injection (2cc or 4cc available).
7	Stator Cup Heat Block	Provides the heat for mixing and injection.
8	Valve	Opens and closes exit from cup.
9	Mold	Forms the specimen.
10	Injection Lever	Raises and lowers rotor for injection.

11	"C" Clamp	Used to hold mold pieces together.
12	"C" Clamp Assembly	Includes "C" clamp and and mold.
13	Orifice	Hole in bottom of stator cup.
14	Mold Pilot	Located at top of clamping screw, used as a guide for the mold.
15	Clamping Screw	Holds "C" clamp assembly in place.
16	Heater Switch	Turns on heat to stator cup
17	Operating Instructions	Briefly describes operating procedure.
18	Direct Drive Motor	Drives the rotor.

Figure 1
LMM

2.0 OPERATION

1. Plug the **LMM** Molder into the specified electrical source. For those units being operated in the United States and Canada, the standard electric is 120 VAC, 60 Hz, 1 Phase, 10 Amps. Check the tag at the rear of the instrument for the proper power requirements.

2. Turn on the power.

3. To set operating temperature, (1) on the temperature controller (2) press the **UP** or **DOWN** arrow key until the desired set temperature is displayed on the digital display. Press enter key to store temperature setting in memory. Approximately one half hour is required for unit to stabilize at the set temperature. During this warm-up period, the **ROTOR** (4) should be lowered into the **STATOR CUP** (6).

4. Insert the desired (9) mold into the "C" Clamp (11) and tighten.

5. Insert the (9) mold and "C" Clamp assembly (12) between the **CLAMPING ASSEMBLY** and the **EXTRUDER ORIFICE** (13). Be sure that the (9) mold is facing up and the surfaces are flat and in full contact. Also, check that the larger hole at the bottom of the mold fits into the **MOLD PILOT** (14) at the top of the **CLAMPING SCREW** (15). This mold pilot will insure placement of the mold directly under the orifice (13). Tighten the clamping screw and allow approximately 3 to 5 minutes for the mold to heat up before injecting.

6. Raise the (4) rotor by rotating the **INJECTION LEVER** (10) clockwise.

7. Insert a small quantity of polymer material into the stator cup (6). Make sure that the **VALVE** (8) is closed (pushed all the way in).

8. Lower the (4) rotor by turning the (9) injection lever counterclockwise and press down on the polymer material.

9. Turn on the **ROTOR SWITCH** (3). This rotating will help mix the polymer material.

10. Raise and lower the (4) rotor using the (10) injection lever several times to impart radial mixing.

11. Once the polymer material has melted and has been sufficiently mixed (a liquid dripping action can be observed as the rotor is lifted) if it is ready for injection into the desired mold shape.

12. Open the (8) valve by pulling "outward" on the valve handle and quickly push the (4) rotor down into the cup using the injection lever. Close the valve by pushing the valve handle in prior to releasing on the injection lever.

13. After molding, loosen the clamping screw and remove the (12 "C" Clamp assembly containing the mold. **CAUTION**: the mold will be **HOT** and may require use of heat resistant gloves.

14. Press down on (10) injection lever and extrude out any excess material that remains in the (6) stator cup. Remove with tweezers or other suitable tool.

15. Open mold and remove specimen. **NOTE**: Mold release and /or a quenching bath may be used to allow for ease of specimen removal.

3.0 LMM VARIABLE SPEED CONTROL

The variable speed control is mounted on the front panel. The corresponding speed settings are as follows:

POTENTIOMETER READING	REVOLUTIONS PER MINUTE
20	15
30	30
40	40
50	50
60	65
70	70
80	85
90	100
100	120

4.0 TEMPERATURE CONTROLLERS

4.1 Front Panel Features

The front panel features on the LMM controller are described below **(Figure 2).**

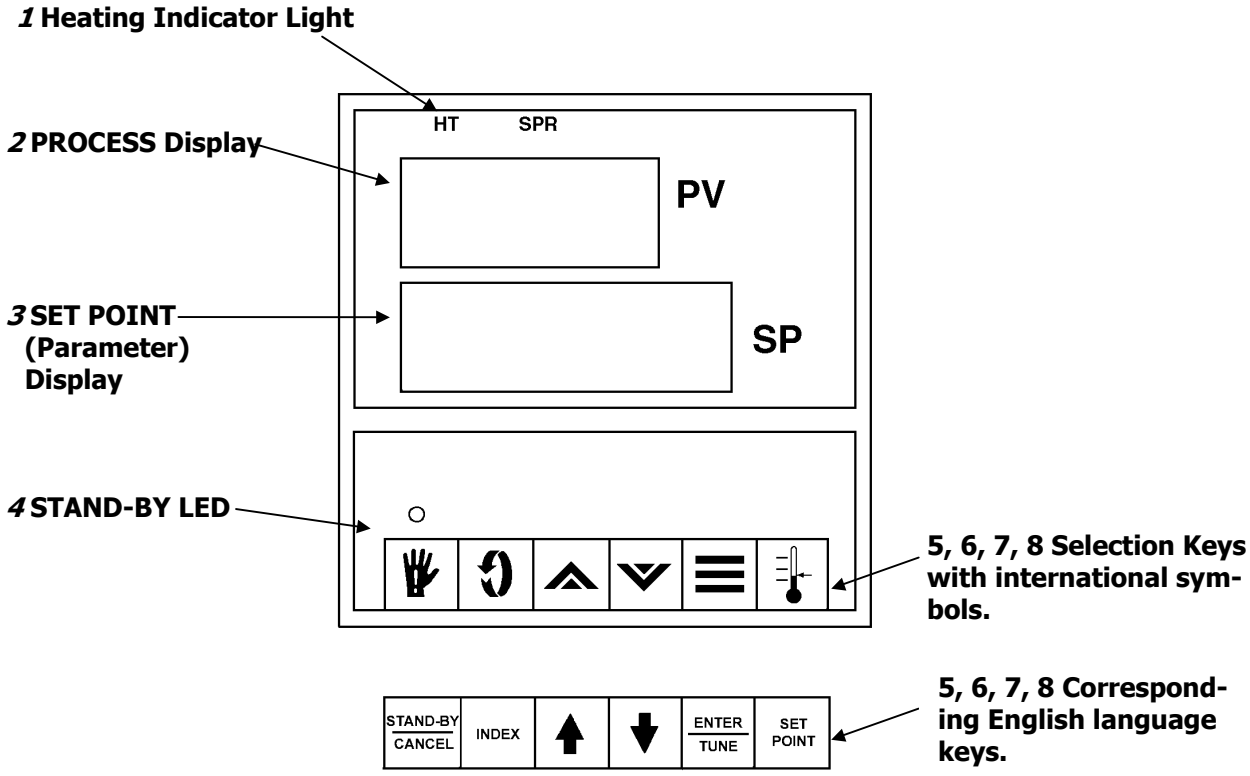

Figure 2
LMM Controller Front Panel

1 HT: Lights when heating is initiated

2 The process temperature or parameter code is viewed on the upper display

3 The temperature set point or parameter setting is viewed on the lower display.

4 STAND-BY LED: Light when the STAND-BY key is pressed to

5 Set point key: Used to select the temperature set point

6 ENTER/TUNE key: Used to enter a selected value into non-volatile memory. Also used to auto-tune the controller when used in the correct sequence.

7 Up and down arrow keys.

8 STAND-BY/CANCEL key: Used to disable outputs and put the controller into idle (stand-by) mode. The stand-by position also allows access to auto-tuning. If the key is pressed during auto-tuning, the controller will cancel the procedure and return to the stand-by mode.

4.2 Controller Operation

Selecting the Set Point:

To select a new set point, press the up or down arrow keys until the desired temperature appears in the lower display. Press ENTER to store the new set point in memory. Allow 15 minutes for the process temperature to stabilize.

NOTE! **If power is interrupted to the controller before the ENTER key is not pressed to set the store the new set point in memory, the old set point will be displayed.**

Set Point High Limit:

The controller's set point high limit is factory-set to 400 °C. The A1 indicator light will stay on while the heater is operating within the process temperature limit. If the set point is set above 400 °C and the process temperature exceeds the set point, the indicator light and heater will shut off.

Tuning the Controller:

See **Appendix A** for instructions on tuning the controller.

Troubleshooting:

The following table will help you troubleshoot any problems that may occur with the LMM controller. Please contact Dynisco Customer Service to obtain repair and maintenance services by a factory-trained service representative.

Problem	***Possible Cause***
The display fails to light up.	No power or blown fuse.
The process display shows (– – – –) or HHHH.	The thermocouple needs repair or replacement.
The process display shows LLLL or counts down when the temperature is rising.	The thermocouple may be reversed.
The temperature display is incorrect by approximately 30%.	The wrong thermocouple type is connected or the internal range jumper is in the wrong position. Check the controller's serial tag for the sensor type then check the probe.
No heat.	Incorrect heater wiring or output module.
The display blinks or entered values change.	Electromagnetic Interference (EMI). To eliminate high-voltage spikes, the sensor and controller wiring may need to be separated from noisy power lines. Heated devices may need grounding or coils and contacts may need to be suppressed.

5.0 CLEANING AND MAINTENANCE

If the polymer material being used is in plentiful supply, the old material may be "purged" from the (6) cup by simple extruding the material rather than molding. Do this by following steps 1 through 15 without installing a mold. This normally takes approximately two grams.

If the polymer material being used is not in plentiful supply, the interior of the (6) cup and exterior of the (4) rotor should be scraped clean with a soft brass tool and the small amount of material remaining in the exit of the (6) cup pushed out with an appropriate size wire.

CAUTION: Never turn on motor, rotate the rotor, operate the injection lever or the valve unless the instrument is free of polymer material or unless the instrument is heated above the softening point of any polymer material that may be left in the instrument. Also, the rotor should be removed from the stator cup while the unit is still hot.

5.1 PROCEDURE TO CHANGE MIXING CUP

Note: Make certain instrument is cold, the rotor is backed out of the cup and the valve moves freely.

1. Use the 1/8" allen wrench to remove the set screw (5 - 40 thread) that holds the valve. The set screw is located on the underside of the cup cross member assembly.

2. Pull the valve forward to remove from the cup.

3. Use the 5/32" allen wrench to remove the two cap screws (10 – 24) from the bottom of the cup cross member assembly that holds the cup in position.

4. Lift the cup from the well.

5. Use the 0.050" allen wrench to loosen the set screw (4 – 40 thread) that holds the thermocouple in the cup, and remove the thermocouple.

6. Loosen the band heater clamping screw, then remove the cup from the band heater.

Note: Prior to replacing the cup using these steps in reverse order, remove the rotor using the following procedure.

5.2 PROCEDURE TO REMOVE THE ROTOR

1. Follow the instructions for removing the cup prior to removing the rotor.

2. Remove the chrome plated hole plug located on the left side of the motor cover housing (see Figure 1). In line with the hold is the motor/rotor coupling connecting the motor shaft and rotor shaft. The lower 10 – 32" set screw secures the rotor shaft to this coupling. Manually rotate the rotor to line up the lower coupling set screw with this hole.

3. Use a 3/32" allen wrench to loosen the set screw.

4. Drop the rotor down through the cup hole in the cross member.

5. To reassemble, make sure that the flat surface on the rotor shaft end is located behind the set screw. Push the rotor upward to seat it against the coupling, and tighten the set screw.

APPENDIX A: TUNING THE LMM CONTROLLER

AUTO-TUNING:

Whenever you install a new programmed controller or heater in the LMM Laboratory Mixing Molder®, or want the optimal PID (Proportional Integral Derivative) settings at the most-used temperature set point, you will need to auto-tune both the header and rotor controllers simultaneously. Auto-tuning will automatically calculate the values for Rate/Reset (**-rt-**), Heat Gain (**-HG-**), and Cool Gain (**-CG**-) on both controllers. The following procedure will guide you through the auto-tuning process.

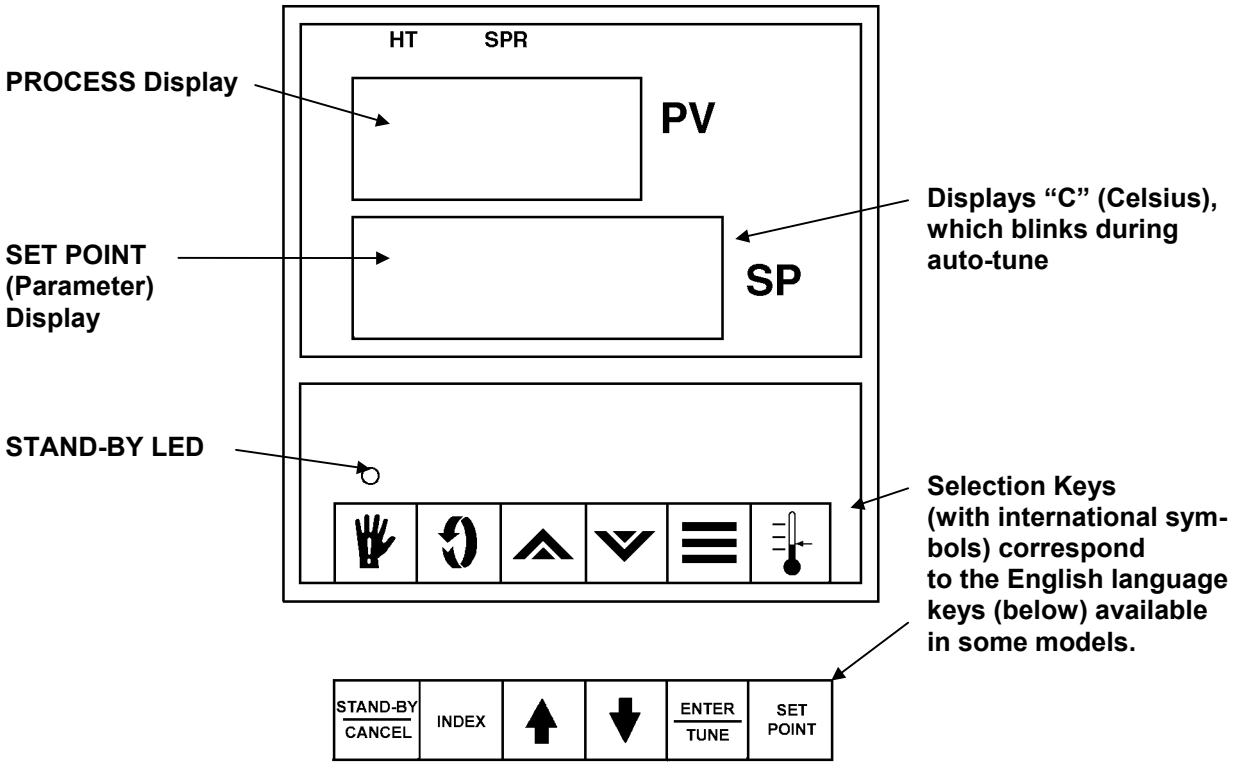

Figure 3
LMM Controller Front Panel

NOTE! **The auto-tuning process must always be started at room (ambient) temperature to ensure effective settings.**

1. Turn on the LMM's MAIN POWER switch.
2. Select the required temperature on the SET POINT display (see the figure above) with the up or down arrows and press ENTER. (Pressing and holding either arrow key for longer than five seconds increases the scrolling speed.)

NOTE! **The set point you select must be at least 38 °C above room (ambient) temperature to ensure effective settings. The header controller should also be set at least 15 °C higher than the rotor controller.**

3. Press the STAND-BY key. The LED above the key will light and the instrument will be placed in idle mode.

AUTO-TUNING*: (continued)*

4. Press the INDEX key until the code for parameter #9 (Access Code), **-cd-**, appears in the PROCESS display. Select configuration code **14** in the SET POINT display with the up or down arrows and press ENTER.
5. Press the INDEX key until the code for parameter #10 (Auto-Tune Damping), -**At-**, appears in the PROCESS display. Dynisco recommends selecting the High Damping option for the optimal PID settings for your instrument. Use the up or down arrows to select the code for this option, **02** in the SET POINT display, and press ENTER.
6. To start auto-tuning, press the ENTER/TUNE key. The displays will return to process and set point displayed. The **C** digit, next to the set point temperature, will blink while tuning is in process. (You can stop the auto-tune at any time by pressing STAND-BY/CANCEL.)
7. When auto-tuning is complete, the **C** digit will stop blinking.
8. Press the STAND-BY key, then press the INDEX key until parameter #9, **-cd-**, appears in the PROCESS display. Select **01** in the SET POINT display by pressing the down arrow and then ENTER. (This code will allow changes to the set point only; all other parameters will be displayed with **lock** when you attempt to select them with the INDEX key.)

FINE TUNING (OPTIONAL):

Auto-tuning Rate/Reset (**-rt-**), Heat Gain (**-HG-**), and Cool Gain (**-CG-**) will be adequate for a majority of users. If you want to customize the PID settings for special test requirements, this section will guide you through manually fine-tuning these parameters.

It is important to note that the best rate time, **-rt-**, is one-eighth (1/8) the time in seconds of one cycle. (A cycle is the time in seconds between the controller's two consecutive picks of temperature overshoot.) For a faster response decrease the value of **-rt-**; for a slower response increase its value. High values of **-rt-** are recommended for systems with poor coupling between the heater and the sensor, or systems that have multiple lags. In addition, the **-HG-** and **-CG-** values must be kept the same, even if no cooling is used. Lower these to half their previous value if you want to lower the temperature overshoot. (Low values are recommended for systems with poor coupling between the header and the sensor.)

You can adjust all three parameters while the instrument is heating up, but remember that the start-up and running parameters will usually be different. Therefore, you will need to adjust both **-HG/-CG**- and **-rt-** ±25% to strike a balance between good start-up and running settings. You may need to spend some time trying different combinations of these parameter values before finding the best setting.

The LMM will not operate properly if some of the initial control parameters are altered; for this reason please consult Dynisco before attempting any such changes. We do not recommend altering any of the control parameters unless you have extensive experience in PID programming.

9. Press the INDEX key until **-rt-**, **-HG-**, or **-CG-** appears in the PROCESS display.
10. Enter the required parameter setting using the up or down arrows. (For **-rt-** the range is 1 to 255 seconds; for **-HG-** and **-CG-**, 1 to 400 seconds.)
11. Press the ENTER key.

APPENDIX B: LMM MOLDS, 2CC AND 4CC CUP CAPACITY

The following molds are available for the LMM with 2cc or 4cc cup capacity:

14116200	Disc	0.08" x 0.63" Dia (2.03mm x 16.0mm Dia)
14162700	Cylindrical Dumbell	0.18" Dia x 0.81" (4.57mm Dia x 20.6mm)
14162800	Flat Dumbell	0.03" x 1.0" (0.76mm x 25.4mm)
14162900	Flat Dumbell (D1708)	0.03" x 1.5" (0.76mm x 38.1mm)
14272700	Flat Dumbell (D1708)	0.06" x 1.5" (1.52mm x 38.1mm)
14163000	Rectangular	0.06" x 1.5 x 0.5" (1.52mm x 3.8.1mm x 1.27mm)
14163100	Rectangular	0.12" x 2.0" x 0.12" (3.05mm x 50.8mm x 3.05mm)

The drawings for each of the above molds can be found in figures 4-10.

APPENDIX C: LMM MOLDS, 4CC CUP CAPACITY ONLY

The following molds are available for the LMM with 4cc cup capacity only:

14163200	Rectangular	0.12" x3.0" x 0.5" (3.05mm x 76.2mm x 12.7mm)
14163300	Rod	0.25" x 3.75" (6.35mm x 95.25mm)
14163400	Rod	0.12" x 3.75" (3.05mm x 95.25mm)
14163500	Rod	0.09" x 3.75" (2.29mm x 95.25mm)
14163600	Rectangular	0.06" x 2.75 x 0.12" (1.52mm x 69.85 x 3.05mm)
14258300	Flat Dumbell (D1708)	0.12" x 1.5" (3.05mm x 38.1mm)
14163800	Flat Dumbell (D1822)	0.12" x 2.5" (3.05mm x 63.5mm)

These molds require the use of the 4cc cup and cannot be used with the 2cc cup.
The drawings for each of the above molds can be found in figures 11-17.

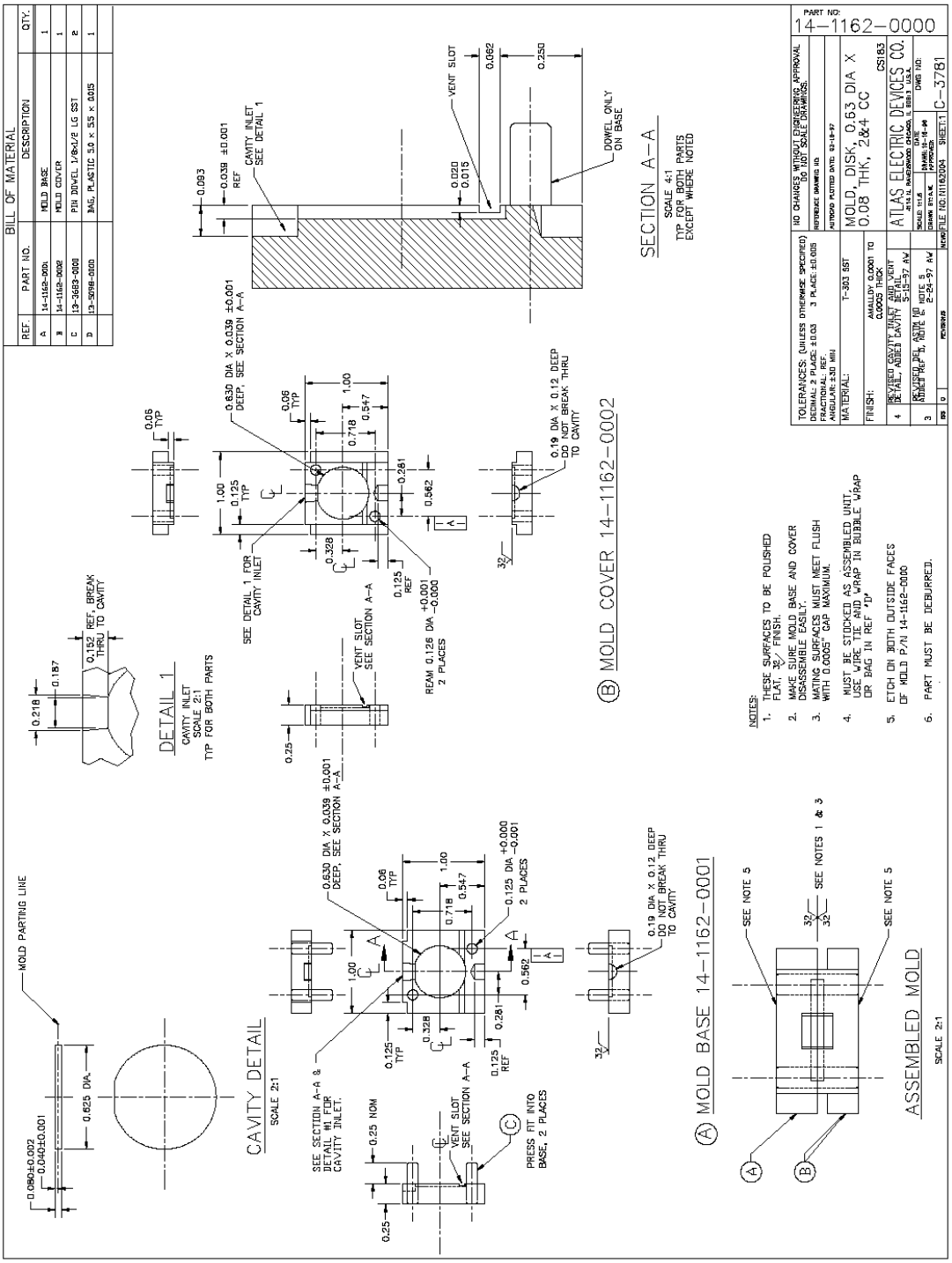

Figure 4
14116200 Disc Mold

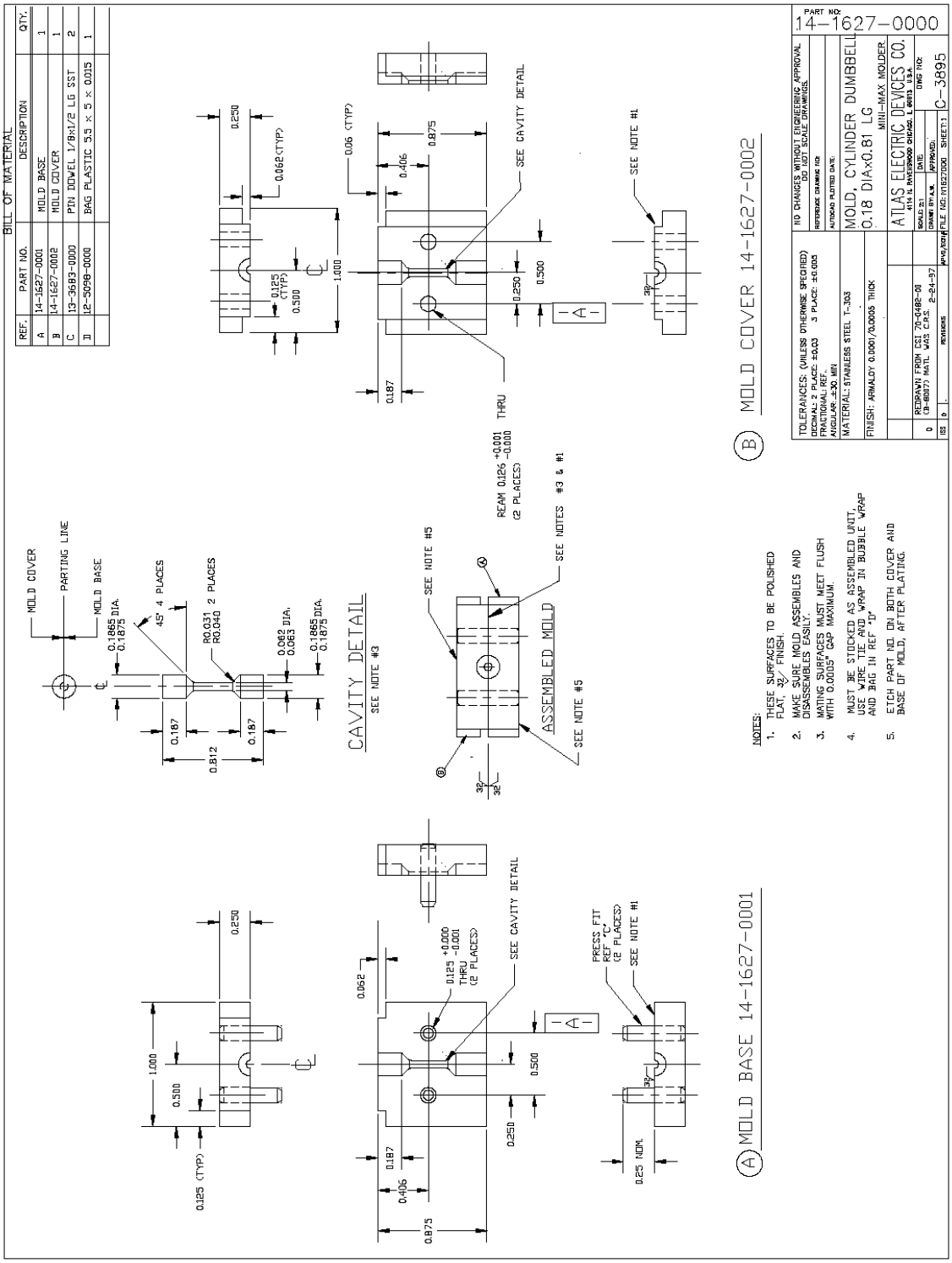

Figure 5
14162700 Cylindrical Dumbell

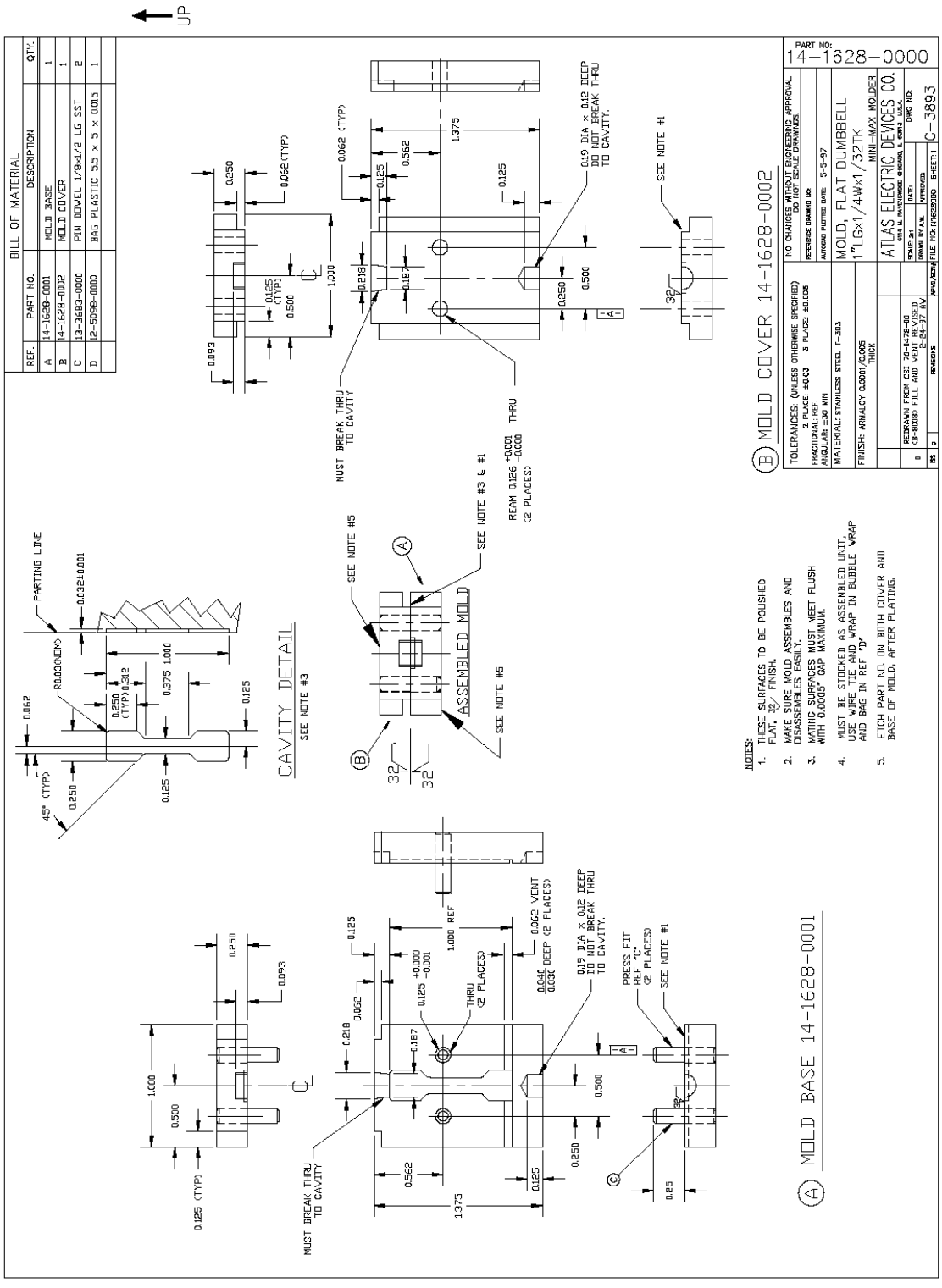

Figure 6
14162800 Flat Dumbell

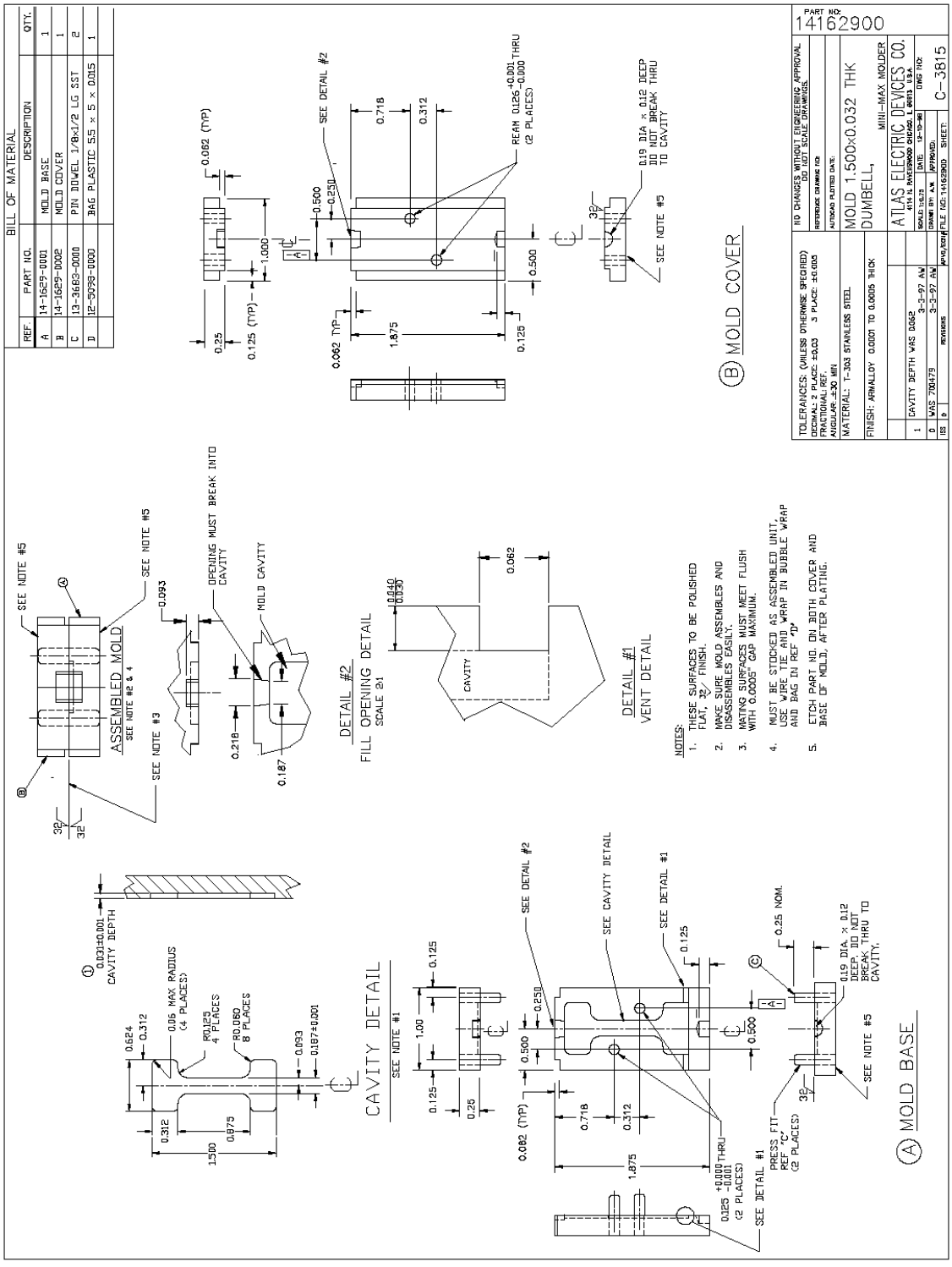

Figure 7
14162900 Flat Dumbell (D1708)

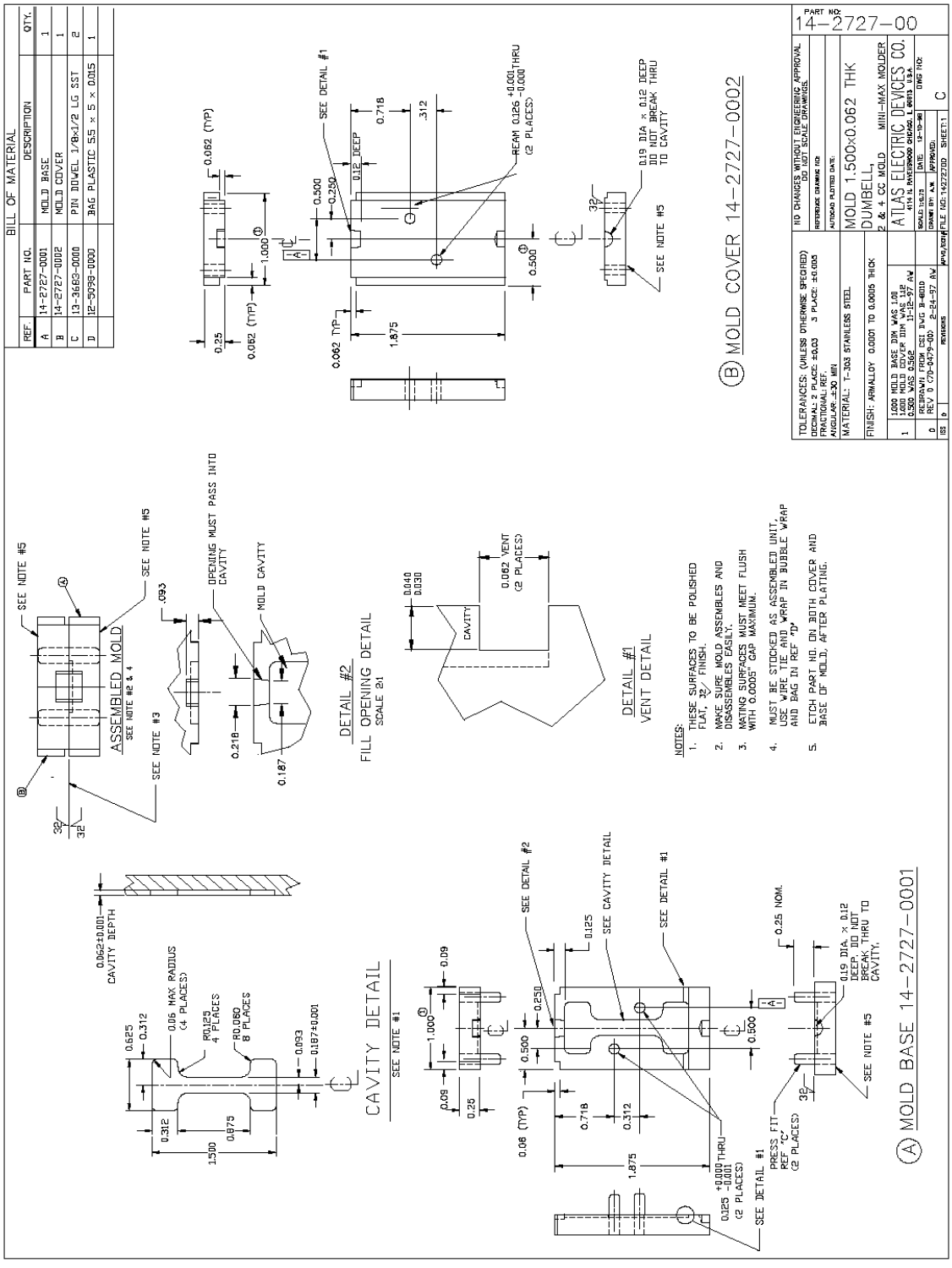

Figure 8
14272700 Flat Dumbell (D1708)

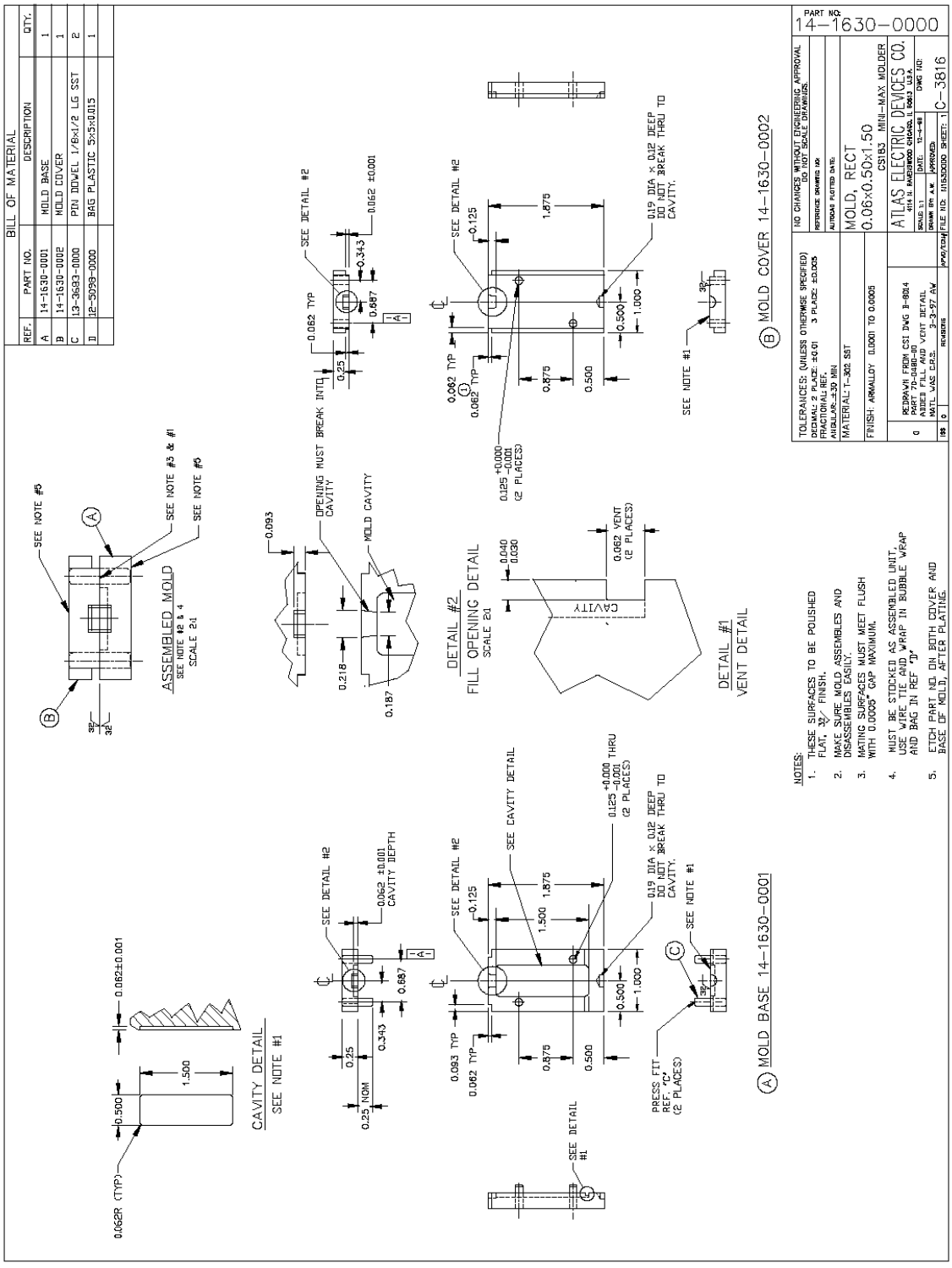

Figure 9
14163000 Rectangular Mold

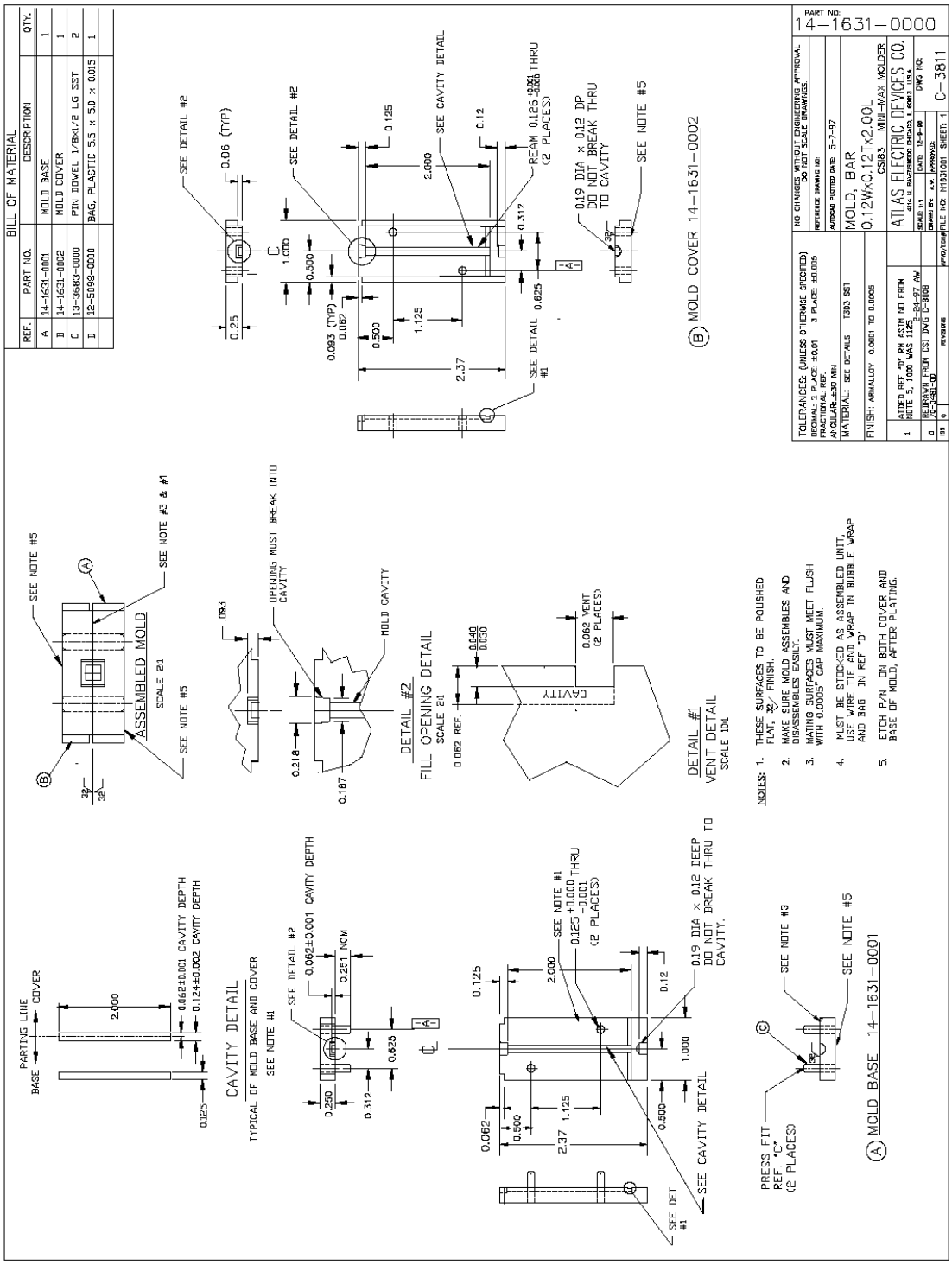

Figure 10
14163100 Rectangular Mold

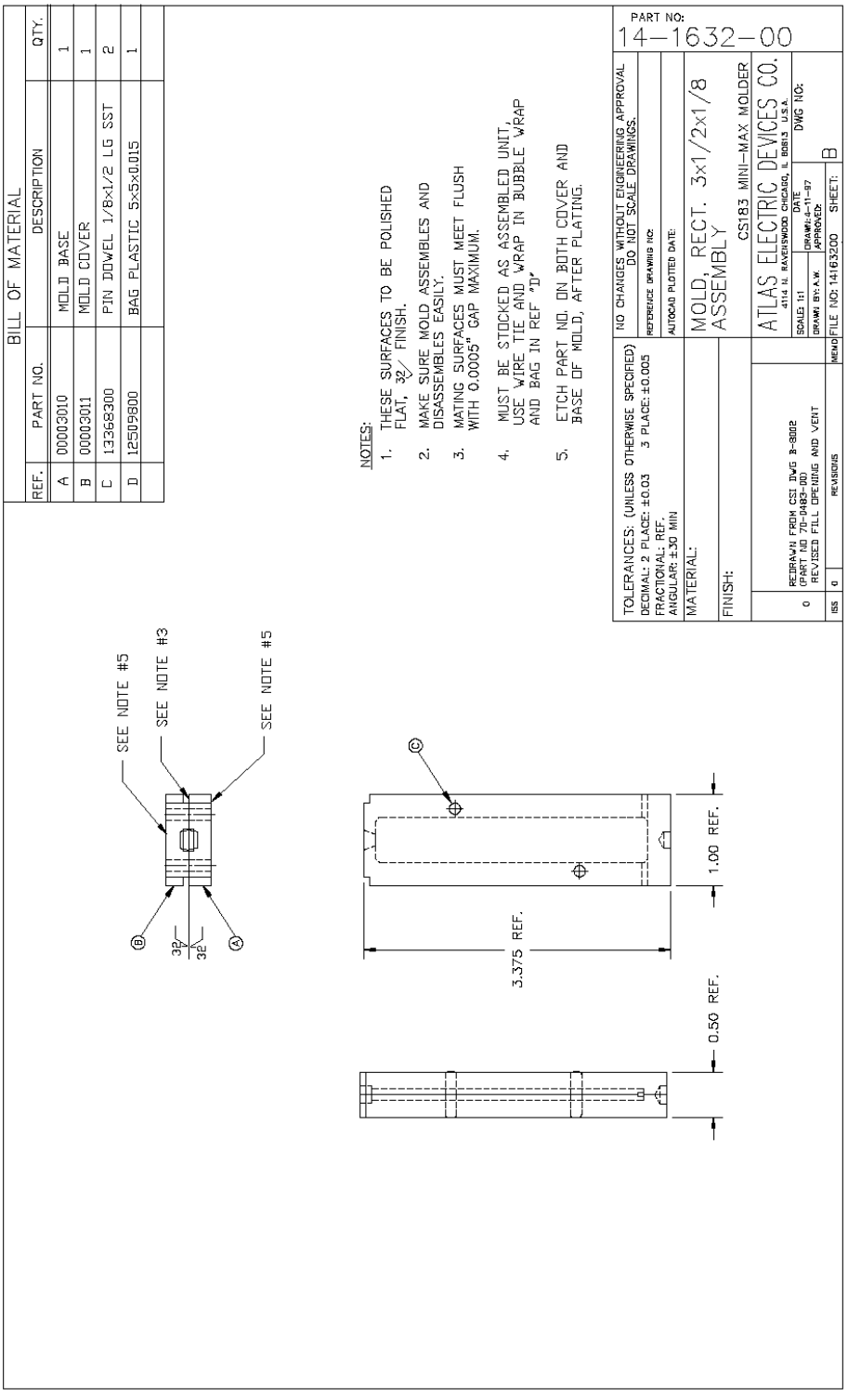

Figure 11
14163200 Rectangular Mold

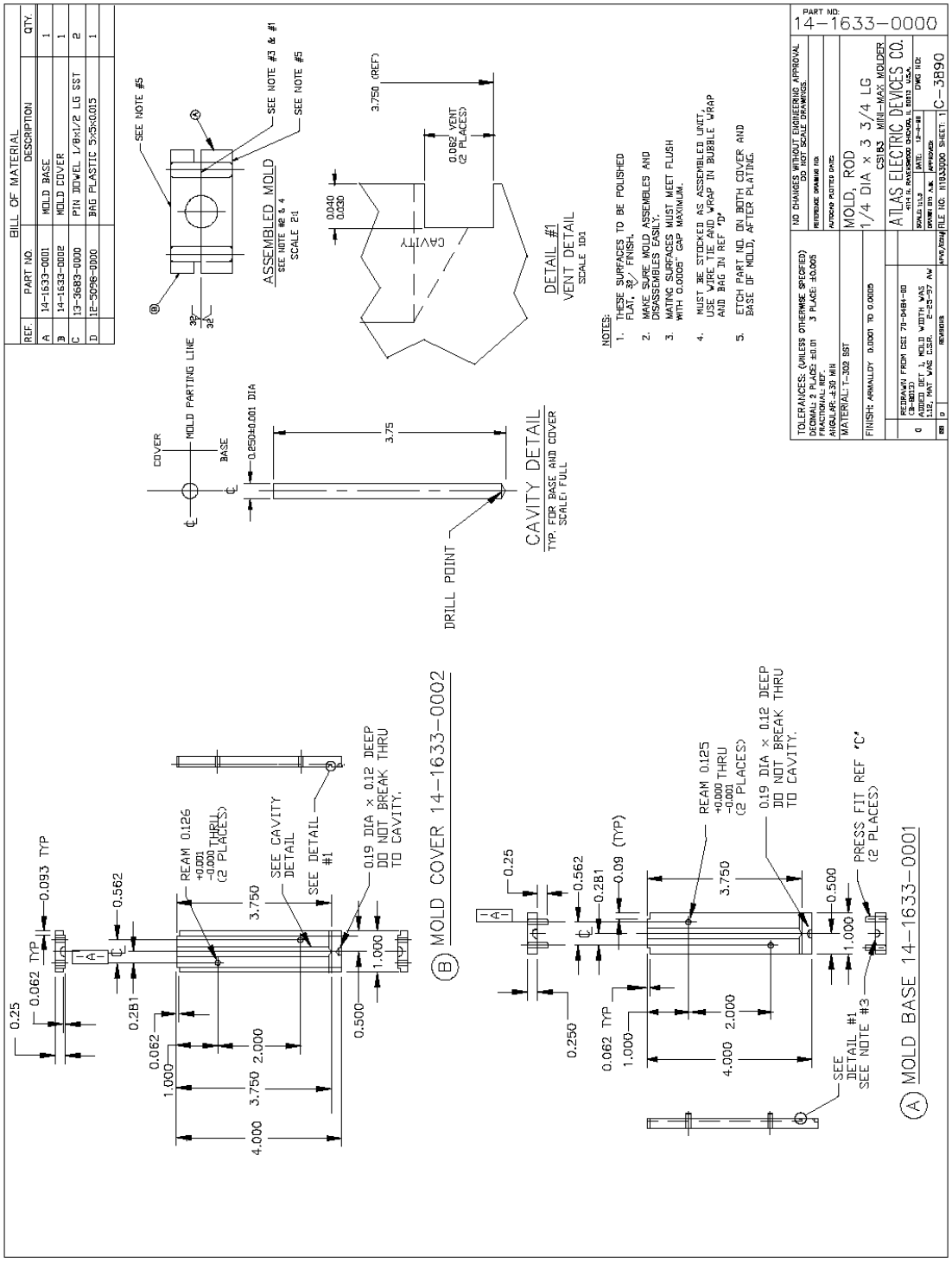

Figure 12
14163300 Rod Mold

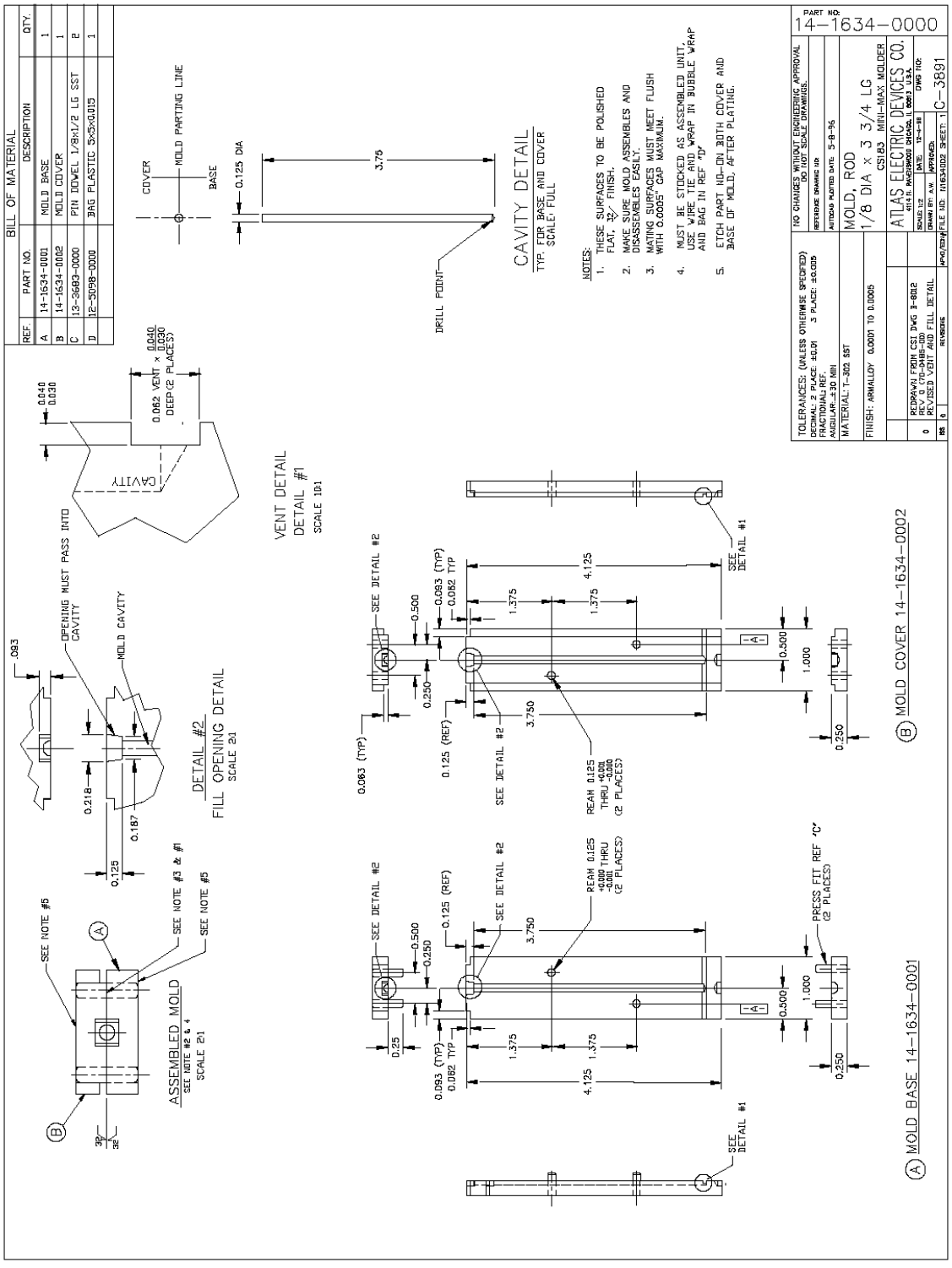

Figure 13
14163400 Rod Mold

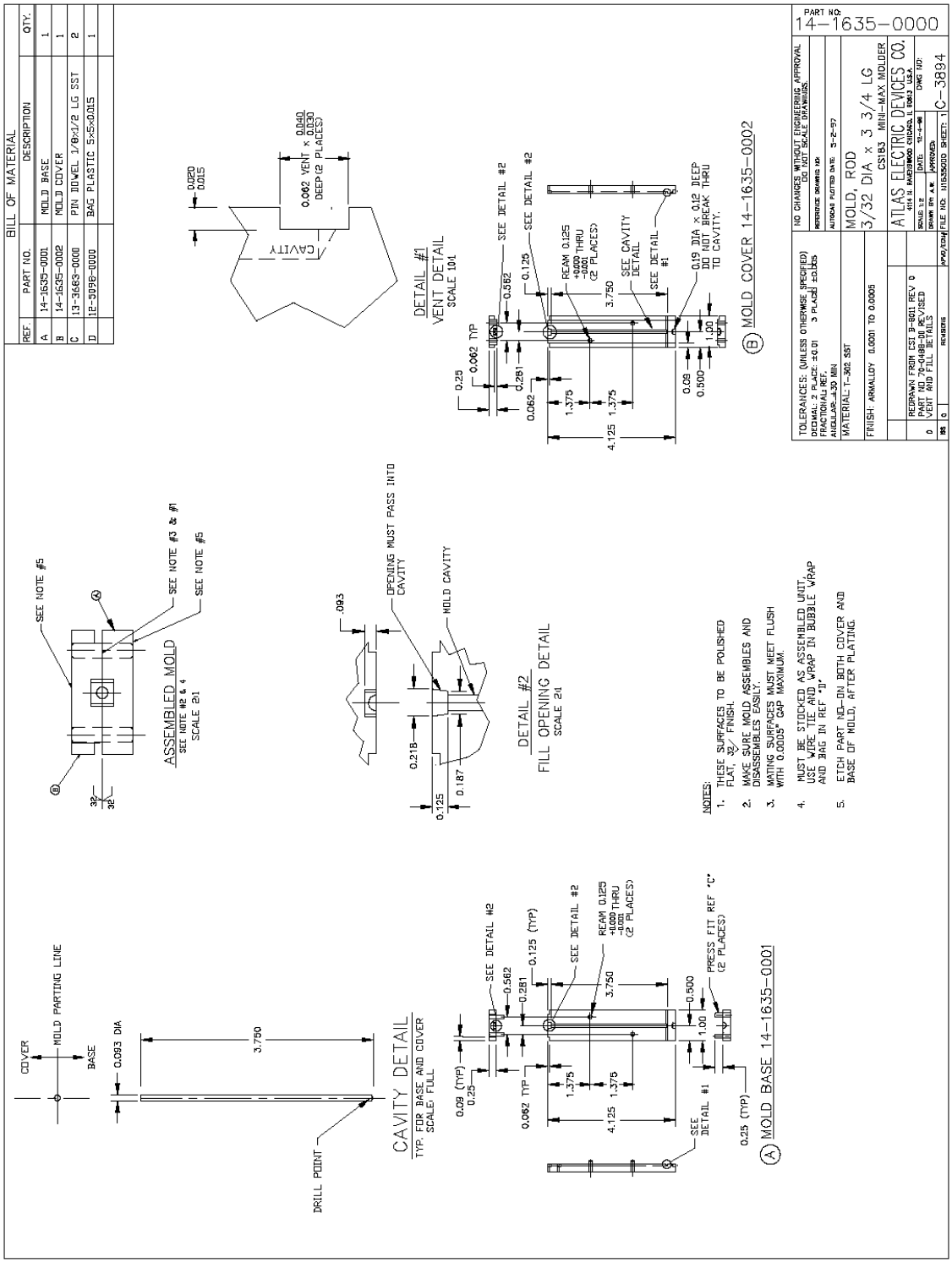

Figure 14
14163500 Rod Mold

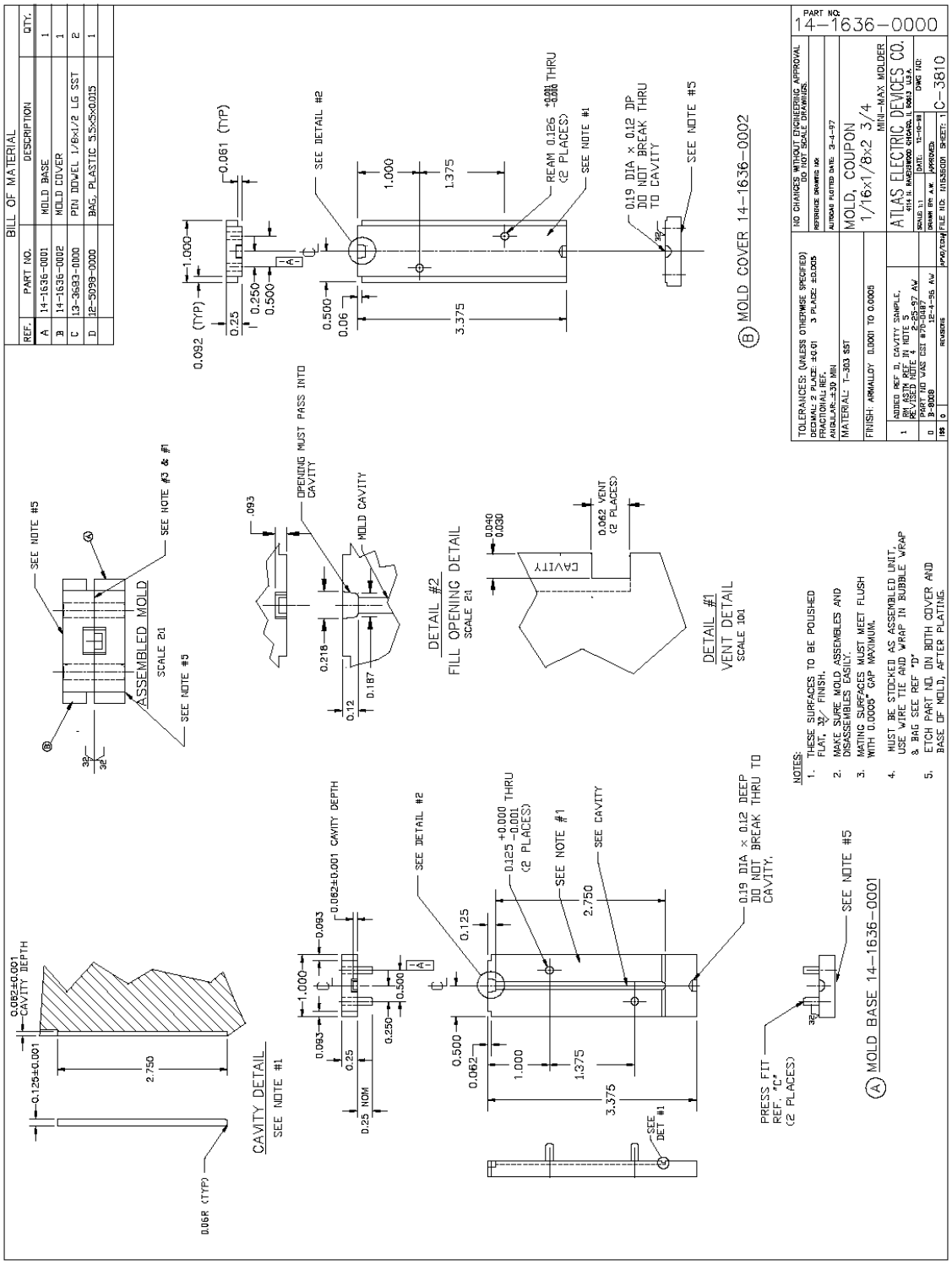

Figure 15
14163600 Rectangular Mold

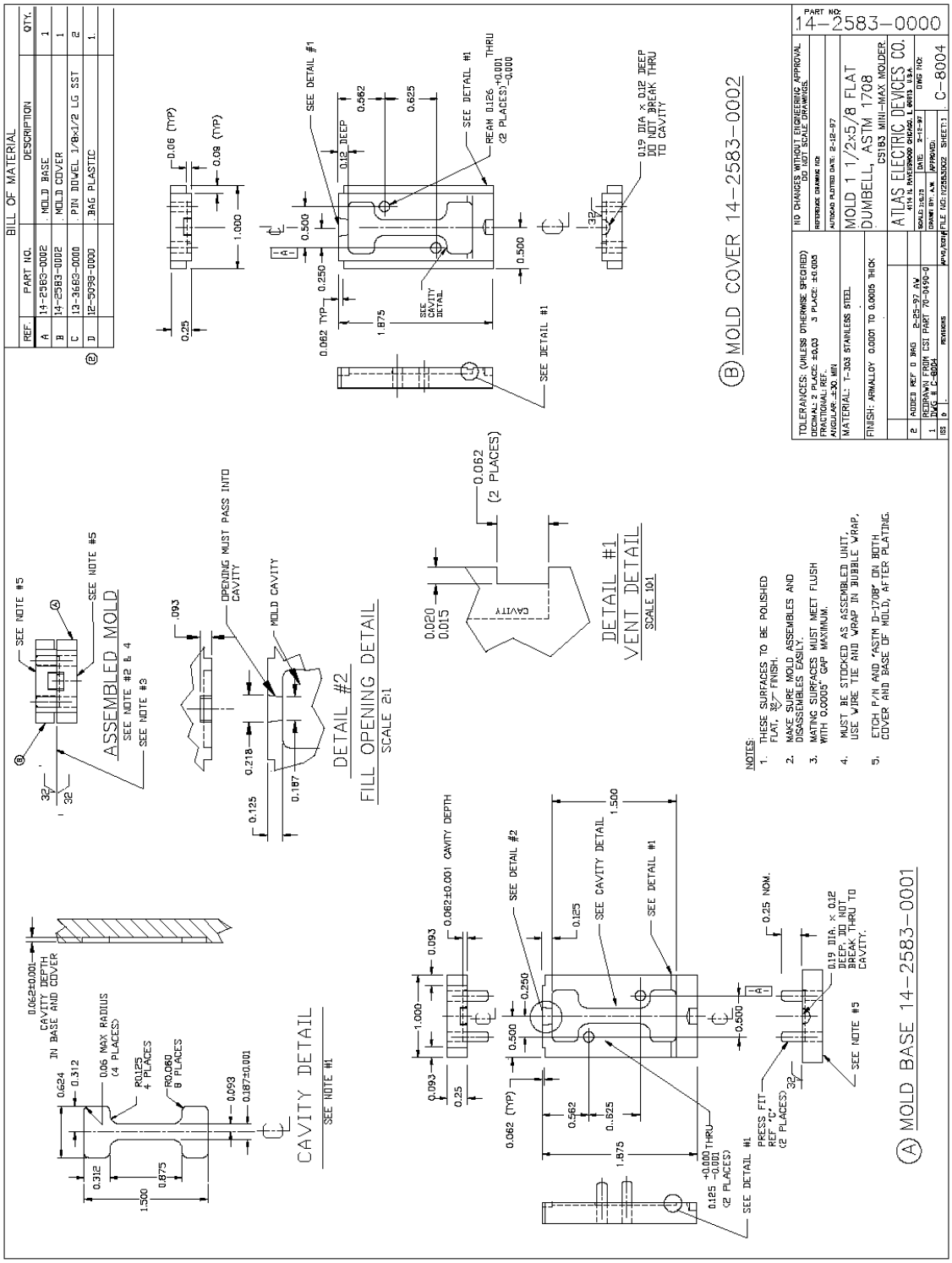

Figure 16
14258300 Flat Dumbell (D1708)

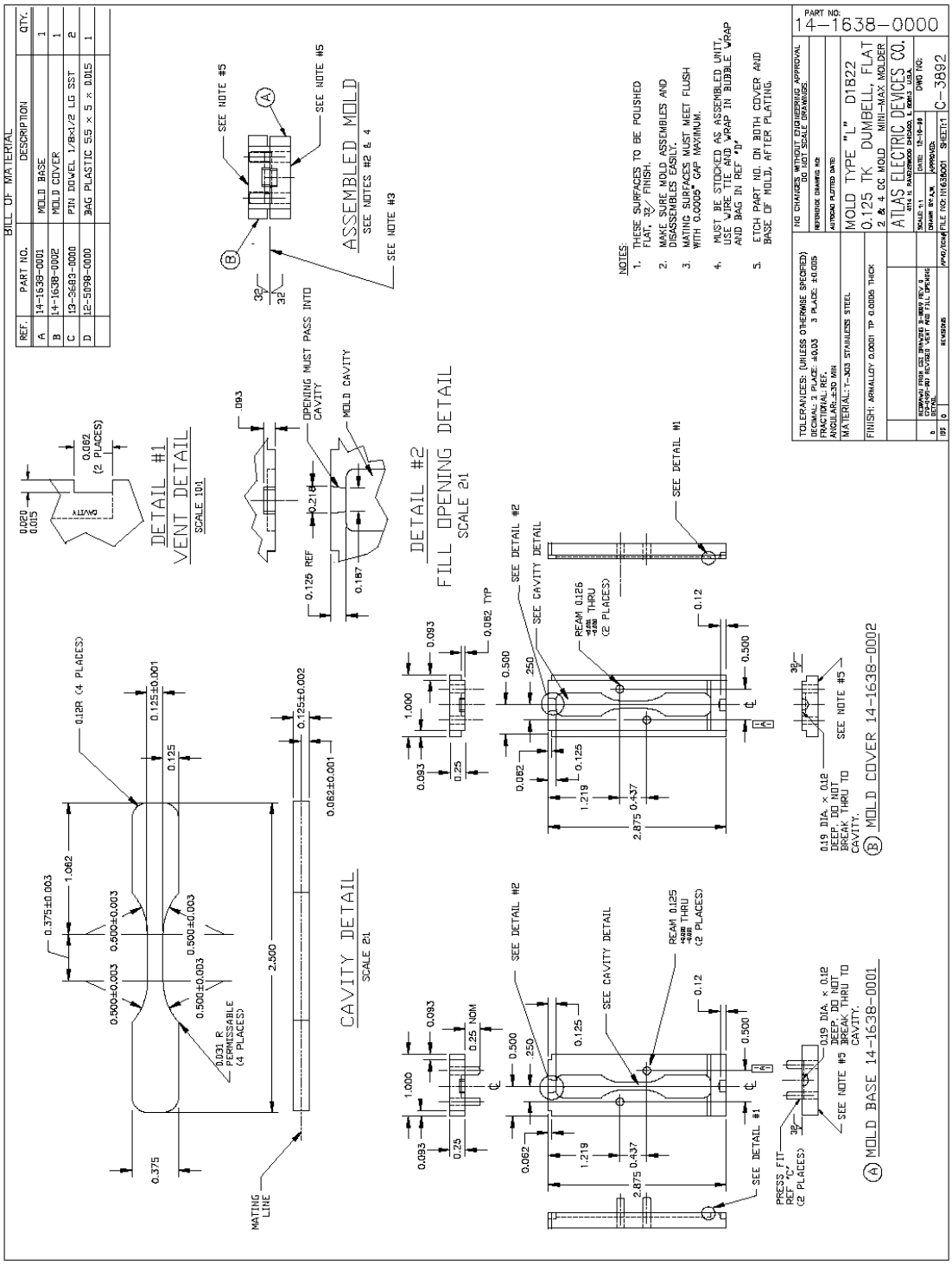

Figure 17
14163800 Flat Dumbell (D1822)