

MARK IV Memo #272

Tape Drive Manual  
for  
Operation in Field and Processor Sites

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## **1. INTRODUCTION**

The Tape Drive Manual for Operation in Field and Processor Sites has been compiled at Haystack Observatory of Massachusetts Institute of Technology, by people who work on these tape drives to ensure better and more reliable operation of the VLBI tape drives. Their insight and experience has been incorporated into this manual. The manual is organized in to six working chapters related to maintenance of the VLBI tape drives. Where appropriate the topics are introduced as "simple" "to-do" lists in order to obtain a useful hands-on document. Several memoranda have been referenced throughout this manual and are included in Chapter 7.

Chapter 2 describes tests and adjustments which are necessary to insure a) that the tape drive is working properly, and b) that the installation of new parts and modifications to the tape drive have been done properly. Inspection of the tape path and tests of forward-to-reverse shift, vacuum shift, door shim, and setting of record level are discussed here. This chapter ends with a brief description of the theory behind the tests and some corrective actions that can be taken.

Chapter 3 covers the adjustments for the proper operation of the tape position sensors. Spontaneous loss of vacuum can occur if the reelservo is not properly configured and adjusted. The reel servo configuration for reliable high-speed operation is also covered in this chapter.

Vacuum motor setup, control, and upgrade issues are discussed in Chapter 4. Procedures are described for setting the correct voltage for the reliable operation of the vacuum motor. Vacuum pressure switch adjustments for using the tape drive at lower tension (vacuum) values are also described in this chapter.

Using 15  $\mu\text{m}$  thin tape on a Metrum tape drive requires mechanical upgrades to the tape drive. The parts required for this upgrade as well as the steps of the upgrade are given in Chapter 5.

In order to ensure a low relative humidity near the head stacks, use of the Haystack Dry Air Kit (HDAK) is recommended. Chapter 6 discusses the issues related to HDAK implementation and gives the parts lists.

Finally, the VLBA Acquisition and Mark IV memos referenced in this manual are included in Chapter 7.

## **2. TESTS AND ADJUSTMENTS**

This section covers adjustments and tests needed to insure that a) the tape drive is working properly, or b) the installation of new parts and modifications to the tape drive have been done properly and meet specifications.

These tests have been designed to verify the performance of the tape recorder and to help diagnose problems. Some of the tests should be performed frequently and on a regular basis, while

others can be performed only occasionally. This memo supersedes VLBA memo #151 and includes additional tests that were described in subsequent memos.

If you record thin tape on a regular basis, use thin tape for these tests. In particular, using thick tape for the vacuum shift test will damage a headstack contoured for thin tape usage.

## **2.1 Tape path inspection (VLBA Acquisition Memo #301)**

Load a tape and set the vacuum to 10 inches. Run the tape in the forward direction and perform the following checks.

1. Check that the tape edge is not touching the precision plate or entrance to the vacuum column door; i.e. the edges should touch only the reel flanges, I/O flanges, edge guiding points (inside vacuum columns), and front door at turn-around.
2. Check that the tape runs over the input-output rollers without any problems, such as folding or damaging the tape.
3. Repeat steps 1. and 2. in the reverse direction.
4. Use a light to inspect the tape path to check for large forward-reverse offset. Hold the light to view the separation between the tape edge and the precision plate in the areas of the capstan, headblock, and idler roller. Reverse the direction of tape motion while observing this separation and note if there is a large forward-reverse offset. (A finer check will be done later.)
5. Play back and peak on any recording in the forward direction and carefully slide a feeler gauge between the precision plate and the tape near the idler where the tape leaves the upper vacuum column. Find the gauge that just shifts the tracking. The distance between the tape edge and the precision plate near the vacuum column should be between.

.001 and .004 inch (0.02-0.1 mm) without the thin-tape upgrade

.010 and .014 inch (0.25-0.35 mm) with the thin-tape upgrade

Repeat with the tape moving in the reverse direction and measuring where the tape leaves the lower vacuum column. This measurement should meet the above specification and should be within 0.002 inch (0.05 mm) of the previous measurement.

## **2.2 Tests**

1. **Forward-reverse shift test** Measure the tape position by issuing a pass command after peaking on a recorded track while moving the tape in the forward direction. Repeat in the reverse direction. The difference between these two readings must be less than 50 micrometers. Occasionally (approximately monthly, or after calibrating the head positioner), repeat this test at the beginning, middle, and end of the tape.
2. **Speed shift test.** Use 'peak' and 'pass' to measure the shift in tape position between normal (80 or

135) and double (160 or 270) speed. This shift should be less than 20 micrometers. Check in both directions. Perform this test once per observing day.

3. **Vacuum shift test.** Perform this test only occasionally, unless you can easily control the vacuum under computer control. **DO NOT USE THICK TAPE FOR THIS TEST ON A THICK-THIN TAPE RECORDER.** Measure the shift in position when changing the vacuum from 5 to 15 inches. This shift should be less than 15 micrometers. Repeat in the other direction. Reset vacuum to 10 inches when done.
4. **Door shim test** (VLBA Acquisition Memo #330). Set vacuum to 10 inches. Peak on a recorded track and watch the eye pattern on the oscilloscope while opening the vacuum column door slightly. The eye pattern should not change at all when the vacuum column door is opened by 6 mils (0.15mm). (Since it is difficult to measure the door opening at the left hand side, this is equivalent to measuring an opening of 3 mils (0.08 mm) halfway across the door from the opening to the hinge.) Also, at less than 15 mils (0.38 mm) of opening the eye pattern should be affected.

You can use two layers of paper (~80 um per layer) for a shim. Thread the tape and close the door on the shim. Peak up on a recorded track and remove the shim. The eye pattern should not change when removing a 0.15 mm (0.006-inch) shim (two layers of paper) placed near the top left, or bottom left, corner of the vacuum column. The eye pattern should change, or disappear, when removing a 0.4 mm (0.015-inch) shim.

5. **Tape shift with write stack position.** Peak up on a recorded track and move the write stack to +/- 700  $\mu\text{m}$ . The tracking should change by less than 10  $\mu\text{m}$ .
6. **Read stack calibration test.** Record 1000 feet with heads 14, 15, and 16 with 'tapeformc' 'pass=13,13'. (For a VLBA or Mark IV recorder, use 'tracks=17, 18, 19' and 'form=m'.) Reproduce with head 15 (VLBA 18), move the read stack with 'stack=,698.5,,f ' and 'stack=,-698.5,,f ' to find the tracks near +/- 700  $\mu\text{m}$ . Use 'peak' and 'stack' to verify that these tracks are at +/-698.5 +/- 10  $\mu\text{m}$ .
7. **Write stack calibration test** (for Mark IIA/IV only). Record 1000 feet with head 15 (VLBA/MK4 head 18) enabled at 'stack =0, , f '. Back up the tape 1000 feet and repeat with 'stack=-700,, f ' and with 'stack = 700,,f '. Use 'stack=,+/-700,,f ', 'peak', and 'stack' to verify that these tracks are at +/-700 +/- 10  $\mu\text{m}$ .
8. **Record margin check.** Record a forward Mode C pass followed by the next reverse pass. Measure the error rates on all 14 tracks in both directions after the reverse pass. If the forward recording is worse than the reverse recording, reduce the head voltage in 1 volt steps until the error rates for forward and reverse passes are approximately equal.

## **2.3. THE THEORY BEHIND THE TESTS**

### **1. Visual inspection.**

The tape path is designed to keep the tape from touching the precision plate or the door of the vacuum column. A properly aligned tape path will keep the tape edge away from the precision plate by a specified amount in the region between the idler roller and the capstan. Measuring this spacing provides a check on the mechanical alignment of the tape path. The most common misalignments are due to:

- a. A tilted idler roller.
- b. A tilted head stack.
- c. A tapered or tilted capstan.
- d. A strained or bent precision plate.

### **2. Forward-reverse shift.**

Asymmetries in mechanical alignment are the primary cause of a forward-reverse shift, although anisotropies in the tape's elastic constants can also produce a significant forward-reverse shift. Components before the capstan affect the forward shift, while components after the capstan affect the reverse shift.

### **3. Speed shift.**

At high speed, the tape is subject to additional forces due to air entrapment. Any shift in tracking with speed is a measure of tension variations across the tape that result in asymmetries in the air entrapment. These tension variations can be caused by alignment errors or capstan taper.

### **4. Vacuum shift.**

A shift in tracking with vacuum is another indication of tension variation across the tape. Also, changing the vacuum moves the position of the loop in the vacuum column (since the reel servo is a first-order servo) and produces a small shift that can be greatly magnified by dirt or grooves in critical areas.

### **5. Door shim test.**

Failure of the door shim test can be caused by a vacuum leak, which can be caused by a poorly adjusted vacuum door hinge, or by deep grooves in the aluminum plate attached to the vacuum door.

To adjust the vacuum door hinge: With vacuum on, loosen the 4 screws holding the hinge, push on the door, and re-tighten the screws.

The depth of the grooves in the tape edge contact areas on the tape edge bearing plate mounted on the vacuum door can be measured with a sliver of paper about the size of the fortune from a Chinese fortune cookie, or with two thicknesses of thick tape about the same size. These grooves can be allowed to wear to a depth of .002 inches. The bearing plate should then be turned 180 degrees, followed by 2 additional wear cycles on the other side. After 4 wear cycles the bearing plate must be replaced. A replacement plate can be made from .062-inch-thick #6061-T6 aluminum with a flatness better than .002 inches per inch (or 0.02 mm per cm). (See Haystack DWG No. 6310-109.)

## LOG RESULTS

Recorder Serial # \_\_\_\_\_ Station \_\_\_\_\_

Date of Tests \_\_\_\_\_ Performed by \_\_\_\_\_

0. Visual Inspection:	O.K.	Y	N
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Tape angle: \_\_\_\_\_ Distance from tape edge to plate \_\_\_\_\_mils

1. Forward-reverse shift: \_\_\_\_\_microns

2. 270-135 speed shift: (or 80-160) Forward \_\_\_\_\_microns

Reverse \_\_\_\_\_microns

3. 15" - 5" vacuum shift: Forward \_\_\_\_\_microns

Reverse \_\_\_\_\_microns

4. Door shim test Maximum \_\_\_\_\_mils

5. LVDT cal. Test                      Read LVDT error          \_\_\_\_\_microns

Write LVDT error \_\_\_\_\_microns

6. Record margin check: Worst Track Per \_\_\_\_\_

Worst Track # \_\_\_\_\_

Speed \_\_\_\_\_inches/sec

Direction \_\_\_\_\_

Vacuum \_\_\_\_\_ inches

Write voltage \_\_\_\_\_volts

7. Tape shift: By read stack motion \_\_\_\_\_microns

By write stack motion \_\_\_\_\_microns

Calibration constants: Please attach a copy of the HEAD.CTL file

### 3. REEL SERVO ADJUSTMENTS AND CONFIGURATION

#### 3.1 Tape Sensor Adjustment

The reel servo keeps the tape loops positioned in the vacuum columns by using light from LEDs to sense the position of the loops. If this servo system is not adjusted properly, spontaneous losses of vacuum will occur. The tape position sensor adjustment procedure described below is based on pages 5-12 of the Metrum Tape Transport Maintenance Manual and VLBA Acquisition Memo #371.

#### SUPPLY and TAKEUP SENSORS

1. Adjustment to obtain a voltage difference of  $1.6 (\pm 0.05)$  Vdc between highest and lowest readings.
  - a. Using your hand, rotate reel clockwise until you hear a "honking" sound. Record voltage reading at "honking" sound.
  - b. Rotate reel counter-clockwise, record voltage at "honking" sound.
  - c. Add values, dropping the negative sign. The correct total is  $1.6 (\pm 0.05)$  Vdc.
  - d. Adjust R7 (x pot) until desired setting is obtained, repeating steps a,b and c.
2. Adjustment to obtain a voltage reading of  $+0.8 (\pm 0.05)$  Vdc when tape is completely into the column and a voltage reading of  $-0.8 (\pm 0.05)$  Vdc when the tape is completely out of the column.
  - a. Rotate reel clockwise to "honking" point. Record voltage reading.
  - b. Rotate reel counter-clockwise to "honking" point. Record voltage reading.
  - c. Adjust R3 (s pot) to obtain a reading of  $+0.8 (\pm 0.05)$  Vdc in one direction and  $-0.8 (\pm 0.05)$  Vdc in the other direction, repeating steps a and b.
3. Repeat procedure for takeup sensor.
4. Run tape drive for a while and recheck settings.

The supply and takeup tape sensors in the vacuum columns each have two adjustments: gain and symmetry. The procedures in the following paragraphs explain how to make these adjustments. Figure 5-4 locates the adjustments and test points on the transport.

#### 1. Preliminary Procedures



- a. Mount tape and load
  - b. Adjust the vacuum to 10" on gauge
  - c. Connect digital voltmeter between (bottom wht blu lead) and (ground) Black lead for the takeup sensor, or between (top wht blu lead) and black lead (ground for the supply sensor. (See Figure 5-4).
2. Adjustment (be sure to warm up tapedrive before doing adjustment) \* See practical description below.
- a. Observe voltmeter while manually rotating the appropriate reel to move tape completely into, then out of the column.
  - b. Repeat step a and adjust R7 to obtain a voltage difference of 1.6 ( $\pm 0.05$ ) Vdc between the highest and lowest readings.
  - c. Repeat step a and adjust R3 to obtain a voltage reading of + 0.8 ( $\pm 0.05$ ) when tape is completely into the column, and a voltage reading of -0.8 ( $\pm 0.05$ ) Vdc when tape is out of column.

#### NOTE

Repeat steps b and c until desired setting is obtained.

- d. Repeat procedure for takeup sensor.
- e. Remove the DVM.

### **3.2 Reel Servo Configuration**

This section covers the reel servo/driver configuration that will provide the most reliable high-speed operation. Honeywell and Metrum have made design changes to the reel servo boards and reel servo drivers. Undesirable combinations of old and new parts and VLBI use of the 1/4" tape mode have created problems. The reel-servo and driver configuration upgrade is REQUIRED, regardless of thin-tape upgrade status.

- a. Disable 1/4" tape mode current limit halving (VLBA #371 p.5-par.4)
- b. Do 'best combo' modifications to old servo (VLBA #371 p.5-par.2) and new drivers (VLBA #371 p.3-par.3)
- c. Guarantee 105 volts minimum AC line voltage

- d. Replace 10 amp reel servo fuses with 15 amp time delay fuses.  
(The original 10 amp fuses will eventually blow due to transient loads intentionally permitted by a. and b. These transients do not cause damage to anything but the original fuses. The fuse change has been extensively tested in the lab and processor drives. There is no other memo regarding the fuse change. Fuse part #MDA-15.)
- e. Check Operational Vacuum Margin: Make sure the tape loads and shuttles without difficulty up to 30" water vacuum.

Purpose:

This memo is intended glean from VLBA Acquisition Memo #371 / MK IV MEMO #167, written by Hans Hinteregger, those portions that will insure reliable tape drive operation at 320 ips. This memo is not, in any way, intended to replace Hans's memo. Rather, it is to provide a step-by-step-procedure for determining the necessity of the suggested changes and to perform them if it is deemed necessary.

The number of tape drives that I am addressing is quite small when compared to the total number in use in the VLBI world today. They are older drives that were in operation when Honeywell (now Metrum) made several changes in the reel servo circuits that adversely affected our usage of the drives. The problem occurred when the new components were inadvertently mixed with the old units in the same tape drive.

In addition to the Honeywell changes in the reel servo system, an earlier modification that was installed by Haystack to limit the servo gain during acceleration was deemed detrimental to reliable high speed operation. This modification is also to be removed.

Old and New Servos and Drivers:

Honeywell's changes involve both the Dual Reel Servo circuit card: 16778850 old, 16813450 new; and the Driver/Heatsink subassemblies (one for each reel): 16776995 old, 16813453 new. A WORSE CASE COMBINATION HAS BEEN DETERMINED TO BE AN OLD SERVO CARD WITH A NEW DRIVER ASSEMBLY.

Both the old Servo circuit card and the new Driver assembly can be modified to bring them into a configuration that will improve their high speed reliability.

The new drivers can be easily converted to have the same low voltage drop advantage as the old version by strapping a 0.3 ohm, 3 watt resistor in parallel with each 4 ohm resistor. Both Heatsink Assemblies must be completely removed from the drive to complete this procedure. Ten (10) 0.3 ohm resistors are needed.

The Metrum modification to the new reel servo circuit card provided an increase in the overspeed margin for each motor that is sufficient enough to recommend that it be installed in the old versions. The easiest way, which can be done in place, is to clip open the output of the unnecessary inverter (pin 6 of U7) and interchange the power leads from the takeup motor (the 5<sup>th</sup> and 6<sup>th</sup> wire counting from the red edge of the ribbon cable and going normally to TB1-19 and TB1-20 respectively).

#### Abandonment of Gain and Current Limit Switching:

To disable low gain/current limit mode in Mk3A/Mk4 acquisition drives that are so equipped, the following hardware control must be changed: on the Honeywell Control Logic Card, the jumper from U3504 to U5012 must be unsoldered at the U35 end and connected to ground at U3607.

#### Additional Checks:

The following additions were included in the tape drive conversion to Mk3 in the earliest days of the program, but they are worth while verifying because they do contribute to reliable tape movement at all speeds.

Reel Servo circuit board; Insure that the ground return from the reel motors is jumpered to chassis ground. Jumpers are between TB-1 10-11 and TB1 12-13.

Vacuum column Light Sensor Assy.; There are two of these assemblies, one on each outer leg of the vacuum column E"casting. Access is from the inside of the tape deck plate door. The printed circuit board of this assembly should be insulated from chassis ground (mounting angle bracket) with nylon screws and washers. These screws and washers are normally white in color and can be seen from the back side of the front door.

Reel Servo fuses; The + 33v and 33v Reel Servo fuses marked 10A (two lower left fuses on front of main power supply should be 15A slow blow. This is to prevent indiscriminate blowing of the fuses during high current spikes, while still providing protection to the power supply from direct shorts in the Servo Driver Assemblies.

#### **4. VACUUM SETUP, CONTROL, AND UPGRADE**

The wide range switchable vacuum setup can be implemented in any drive. Vacuum-switched operation is mandatory only for drives that must handle both thick and thin tapes and use the present standard single-CAP head contour. This complex operation is a stop-gap measure and is required only on MKIIIA/MKIV processor drives until a new thickness-insensitive contour design head, such as the triple-CAP or flat head, eliminates the requirement.

Acquisition recorders are expected to use ONLY THICK or ONLY THIN tapes and to operate always at 10"water vacuum.

To operate a tape drive at 5"water vacuum for thin tape and 15"water vacuum for thick tape, adjustments are needed to the vacuum motor and vacuum pressure switch.

The following wide range vacuum setup is necessary for mixed thick and thin processing capability with present single-CAP head contour:

- a) Vacuum switch trip point adjust to 3"water vacuum.
- b) 3 volt minimum control voltage specification.

Details are given in the following pages.

##### **4.1 Vacuum pressure switch adjustment**

The standard cut-out setting on the vacuum pressure switch is 6"water vacuum. This needs to be lowered to  $3" \pm 0.5"$ water vacuum to be able to run tape drive reliably at 5"water vacuum for thin tapes. There is a set screw on the back of the switch that will allow this adjustment. The switch is located on the panel inside the tape drive next to the vacuum gauge.

1. Power down tape drive
2. Loosen screws holding panel and carefully pivot down
3. Locate the switch on the back. You will notice 2 set screws (some switch models have 3 set screws) locked with epoxy. The set screw that is "off-center" and next to the connector labeled NO is the screw that will need adjusting. DO NOT adjust the set screw in the center.
4. Scrape off epoxy
5. lower the cut-out threshold by turning the set screw in a clockwise direction
6. Power up tape drive.
7. To check the level when the pressure switch will cut-out, there are a couple of methods you can use.

- a. Load a junk tape on the drive. Lower the vacuum setting and watch the vacuum gauge to see where the vacuum cuts out. Adjust the set screw accordingly to reach the 2.5"/3.5"water vacuum setting. (You will have to reload the tape each time as you try to get the proper setting. REMEMBER to turn the vacuum setting back up to load tape.)

Or

- b. Remove the E-Casting" from the tape drive and cover part of the vacuum chamber on the precision plate to trick the drive into thinking a tape is loaded. Proceed to load"and adjust the set screw to the 2.5"/3.5"water vacuum setting.
8. As a suggestion, let the tape drive warmup for a while and check the setting a couple of times.
  9. Power down the tape drive and put the panel back into position.

#### **4.2 Vacuum Motor Control Voltage**

The vacuum motor requires a minimum control of voltage of 3 volts, by manufacturers specifications, in order to start reliably and run stably. With the control voltage set to 3 volts, the vacuum may be higher than the minimum required vacuum 4"water.

An adjustment to the vacuum motor gain trim pot is needed to bring the setting to specification. On the Ametek/Lamb brushless motor there is a gain adjustment trim pot located on the side of the motor near the power connector.

1. Locate the trim pot on the vacuum motor.
2. With the control voltage set at 3 volts, slowly turn the trim pot until 4"water is read on the vacuum gauge. A clockwise direction will decrease the vacuum and counter-clockwise will increase the vacuum.
3. Make sure the tape loads and shuttles without difficulty down to 4"water vacuum and up to 30"water vacuum for at lease 20% margin.

## **5. MECHANICAL UPGRADE**

### **5.1 Thin tape mechanical upgrade steps**

1. Remove the head assembly - put it in a safe place.
2. Disconnect the cables and vacuum hoses going into the precision plate assembly and the capstan motor.
3. Remove the capstan motor - 3 large bolts.
4. Remove the precision plate - 3 large bolts.
5. Install the new plate - Metrum #16827015-001
6. Reel Motor Alignment:

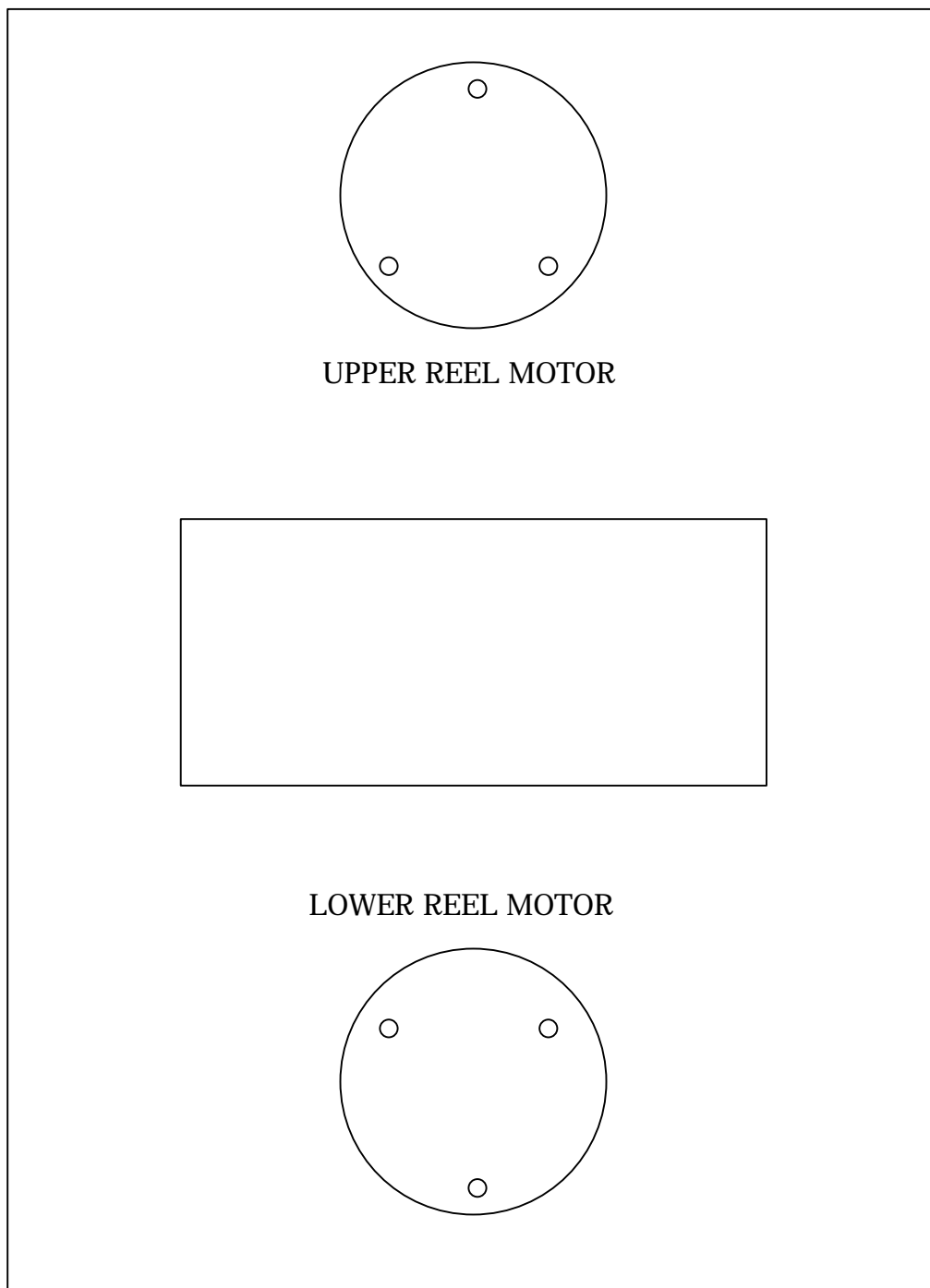
Measure the reel table locations, as shown on the Fig. 1 worksheet, with a 2' straight edge, single-flange metal reel, shim stock and/or depth micrometer. Compare the height of the reel flange near the hub with that of the precision plate. Select shim stock to the nearest 5 mil thickness increment to make these heights equal. Slip one piece, preferably with a hole for the screw, between each of the three pads on the deck-plate and the reel motor mounting flange. Make sure the flange and precision plate are in the same plane with no significant tilt of reel table. See memo #290 - Section IV Reel Alignment for more detailed information.

7. Install capstan motor (see Special Notes and Cautions #4 in the previous section)
8. Install new Idler roller - Metrum #16821285-004
9. Install new I/O roller assembly - Drawing #A4712M001
10. Install new "E"-casting - Drawing #D6310-113A
11. Install new half-moon loading blocks - Drawing #A6310-112
12. Transfer vacuum hose connectors and front door hinges from old precision plate to new plate.
13. Install new vacuum door - Drawing #C6310-114A
14. Install tape wrap angle adjuster (dummy headstack post) - Drawing #A54330M022 (VLBA Acquisition memo #220)

15. Install head assembly as per Drawing #A54330M023

16. Connect cables and vacuum hoses.

FIGURE 1



## 5.2 Summary of parts, drawings, assembly drawings, and part numbers - VLBA Acquisition Memo #349

This section contains information on the parts, assembly, installation and specifications used in upgrading tape drives for thin tape operation.

Thin Tape Upgrade associated modifications and checks:

- a. High-speed headblock for reliable contact at 320 ips. (Drawing # D54330M007RevB)
- b. Capstan surface specifications, resurfacing, tests (#4 below)
- c. Critical screw lengths, torques, (Drawing #A54330M023)

### Drawings

### Drawing Number

I/O Sleeve .....	C6310-101 Rev D
"E" Casting.....	D6310-105 Rev C
(also known as vacuum spacer)	
Vacuum Door .....	C6310-108 Rev C
Vacuum Front Door Plate.....	C6310-109 Rev B
Mods. to Loading Blocks.....	A6310-112
Edge Bearing Plate .....	A6310-83A
Tape Wrap Angle Adjuster.....	A54330M022
(also known as dummy headstack post)	
Head Assy Mounting Screws Specs.....	A54330M023
Head Block Modification.....	D54330M007 Rev B
(for high speed recording and playback - Mark IV Memo #185)	

### Assembly Drawings:

"E"-Casting Assy & Install .....	D6310-113A
Vacuum Door Assy & Install.....	C6310-114A
I/O Roller Assy .....	A4712M001



## Part Numbers:

Precision Plate - Metrum.....	16827015-001
Backing Plate - Metrum .....	16827014-002
(modified according to Dwg. 6310-82 Rev A)	
I/O Roller - Metrum .....	16812759-005
Idler Roller - Metrum.....	16821285-004
Loading Blocks - Metrum.....	16776407-003
Alumina Plates - Coors.....	A6310-83A

## Special Notes and Cautions:

1. Be sure alumina plates are clean, especially in the area which is epoxied. BE SURE THE EPOXY BOND IS GOOD since, if the bond breaks, the plate might be pulled out by the vacuum far enough to damage tapes. VLBA Acquisition Memo #349
2. The slope in the depth of the vacuum column should be  $4 \pm 0.8$  mils per inch. Check, with a depth-micrometer, that depths at points C, the tape edge-bearing points (1.25" from points A', A", B', B", along the inside edges of the bearing plates), are close to 5 mils greater than at those points (A,B), and, in any case, between 1.0065" and 1.0085". The depth along the outside edge of the 3" square bearing plate is nominally 12 mils greater than along the inside edge, that is,  $1.0145" \pm 0.0029"$  (worst case sum of errors). Drawing #D6310-113 - VLBA Acquisition Memo #349
3. A new style head block is required for high speed recording and playback to prevent tape flying. The new headblock has three beveled surfaces (10, 22.5 and 67.5 degrees) nearest the tape to increase the distance of closest tape approach. If your head blocks have only a double bevel (original MKIIIA design), they must be replaced with the new style according to Drawing #D54330M007 revision B. (In principle, the old part can be modified to the new specification, but in practice, installation of a new head block is recommended.)
4. The old solid-urethane-surfaced capstan motor is subject to severe wear, unlike the newer urethane-impregnated porous ceramic version. A worn capstan, because it develops a severe taper at both tape edges, can cause the tape to ride into the precision plate, before or after the new thin tape upgrade parts are installed, damaging the tape. The capstan motor can be resurfaced at PTC<sup>1</sup> and the tape position shift must meet the following specifications to qualify to be operational:
  - a. Forward-Reverse shift < 50  $\mu$ m to 320 ips.
  - b. Tape shift with speed in forward or in reverse direction < 20  $\mu$ m at speeds up to 320 ips.

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<sup>1</sup> PTC Engineering Inc, 42355 Sandak Rd., Temecula, CA 92592 (p)909-676-3335 (f) 909-676-3443

- c. A 10 mil shim, held in contact with the precision plate where the temporarily removed idler is mounted, must not touch (interfere with) the inside tape edge. A 14 mil shim should interfere. Otherwise, the taper-induced tape-angle change is too great in either direction.

## **6. HAYSTACK DRY AIR KIT**

(MARK IV MEMO #258)

The Haystack Dry Air Kit (HDAK) is recommended for use in all MK3A, VLBA, MK4 acquisition and processor tape drives in order to ensure that the relative humidity (RH) in the tape path is under 30%. The purpose of this low relative humidity is to minimize head wear rate.

Currently the stepped VLBI heads have an initial depth of gap of 25 $\mu$ m-35 $\mu$ m. In order to obtain more than 5000 hours of use from the head the wear rate must be less than about 5 nm/hour. In VLBA Acquisition Memo #369 this wear rate appears to be safely achievable for relative humidity at the head of less than 35%. Above this value the wear rate increases dramatically. Since relative humidity sensors typically have an uncertainty of about 5%, we would like to keep the relative humidity in the tape path as close to, or below, 30% as possible.

There is a relationship between air temperature and relative humidity according to which, if room air at 68°F (20°C) and 60% RH is raised to 104°F (40°C), the relative humidity of that air is reduced to about 20%. The HDAK lowers tape-path relative humidity by raising the temperature of the air blown into the tape path.

The HDAK consists of a motor to provide the heat and air supply, and tubing to get the air to the heads. The blower motor is identical to the vacuum motor. It is surrounded by porous foam sheet stock and encased in a two-piece sheet-metal housing. This packaging greatly reduces audible noise and allows the blower to be used up to full power without creating an annoyance. Rack mounting-ears, an air hose identical to the vacuum hose, a feed-through plate, and a sheet-metal air guide with a hole for thermometer probe are included. A mini DC supply and potentiometer for motor speed control are attached to one of the mounting ears.

The thermometer included in the kit measures the temperature of the blown-in air, and the relative humidity is calculated from the ambient conditions.

The speed of the blower motor should be adjusted until the blown-in air temperature is stable at 104°F +/- 1°F. The potentiometer is provided for this purpose.

Although the kit is normally mounted inside the VLBA or MK3A/MK4 tape drive, it is electrically independent of the drive. The HDAK can be used when the recorder is powered off if it is plugged into a separate AC source.

Room humidity must be kept below 60% RH for the HDAK to maintain the low relative humidity in the tape path. The room humidity should be monitored and reported in the pre-experiment checkout. If this condition cannot be maintained, Haystack can offer suggestions to alleviate the problem.

Complete documentation for the HDAK is available from Haystack (see parts list and drawing numbers below). The cost for all parts is less than \$1000.

Though not part of the kit, an inexpensive temperature and relative humidity meter for the room (not the tape-path) can be supplied on request. This humidity meter is accurate to 5% RH in mid-range, degrades to 7% accuracy at 20% RH, and does not read below 20% RH.

Better humidity meters (quoted accuracy 2% down to 0% RH) are also available for about \$300. In operational use it is unnecessary to include one of these for direct measurement of tape-path humidity. However, a slightly modified feed-through plate allows the use of such a meter for accurate experimental work.

#### Haystack Dry-Air Kit Parts List

Qty	DESCRIPTION	PART NO.	REF. DWG.
1	Housing Receptacle	6400M001A	6400M001A
1	Housing Cover	6400M002	6400M002
1	Mounting Ears Short/Long	6400M003A	6400M003A
1	Ametek Motor	6400M004	6400M004
1	Hose Mounting Plate	6400M005	6400M005
1	Air Flow Deflector	6400M006	6400M006
1	Metrum Hose Assembly	16817935-001	6400A001
1	PVC Pipe 1" dia/1.5"long	NA	6400A001
1	Motor Hose Collar	A54313M002	6400A002
1	Metrum Hose Adaptor	16738263-001	6400A002
1	Filter Screen	NA	6400A002
2	Porous Foam Filters	NA	6400A001/002
1	Foam Pieces/McMaster-Carr	8723K14	6400M007/A002
1	Terminal Strip	NA	6400S001
1	Terminal Strip Cover	NA	6400S001
1	Acopian Power Module	10E12	6400S001
1	Acopian Accessory Socket	ES-1	6400S001
2	H.H.Smith 1/4" Standoff	2330	6400S001
4	H.H. Smith 1/2" Standoff	2332	6400S001
1	C&K On/Off Switch	7201	6400S001
1	Clarostat 10K Pot.	RV6NAYSD103A	6400S001
1	3M Plug Connector 34-Pin	4634-6300	6400S001
1	3M Socket Connector 34-Pin	3414-6034	6400S001
1	AMP Socket Connector 6-Pin	6410250-6	6400S001
4	Amp Female Pins	640706-1	6400S001

## **7. REFERENCED MEMOS**

### VLBA Acquisition Memo Series:

- #220 Dummy headstack post for improved tracking- symmetry. (MkIV#020)
- #290 Configuration of tape path for thin tape and high speed (see also #333 and #349)
- #301 Mechanical upgrade steps. (MkIV#070)
- #330 Capstan and Idler alignment tests.
- #333 Thin tape upgrade- changes/additions to memo #290.
- #349 Thin tape upgrade - summary of parts, drawings, assembly and test. (updated version of memo #333)
- #371 Reel Servo/Driver Configuration and Margin Analysis, Recommendations for More Reliable Operation at 320 ips maximum

### Mark IV Series

- #185 Revised Head Block Design
- #258 Haystack Dry Air Kit

CHANGE LETTER	D/WN BY	CHK'D BY	APP'D BY	DATE	DRAW. & DESCRIPTION
C	RJC	HFH	AEER	6/92	TIGHTENED TOLERANCES
D	RJC	HFH	AEER	6/92	2 (POLISH) FINISH NDW 8 (POLISH)

Technical drawing of a mechanical part, likely a tape guide or support, showing multiple views (front, side, and end views) and dimensions.

Key dimensions and features include:

- Overall width: 20 x
- Top edge thickness: .015, .017
- Internal width: .009, .011
- Internal width: .0003
- Internal width: .0005
- Internal width: .0005
- Internal width: .768
- Internal width: .32
- Internal width: .012, .014
- Internal width: 1.06
- Internal width: 1.012, 1.014
- Internal width: 1.06
- Internal width: .80 D.D.
- Internal width: .70 DIA. x 45° ± 5° CHAMFER
- Internal width: .009 RAD. (SMOOTH BLEND WITH TANGENTS)
- Internal width: 8 (POLISH)
- Internal width: .015, .017

Scale: 2X

USER NOTES:

- PREVENTS EDGE DAMAGE TO THIN TAPE WITH REASONABLE PACK MISALIGNMENT TOLERANCE.
- TAPE BEARING SURFACE TO MINIMIZE FRICTION.
- LENGTH OF SURFACE ALLOWS .050 TAPE EDGE MISALIGNMENT AT 5" DISTANCE WITHOUT BINDING (IF TAPE IS FREE TO SLIDE).
- FLANGE DETAIL TO MINIMIZE TAPE ENTRY/EXIT CONTACT LENGTH.

NO RACK MARKS OR RAISED SCRATCHES  
PERMITTED ON -B-.

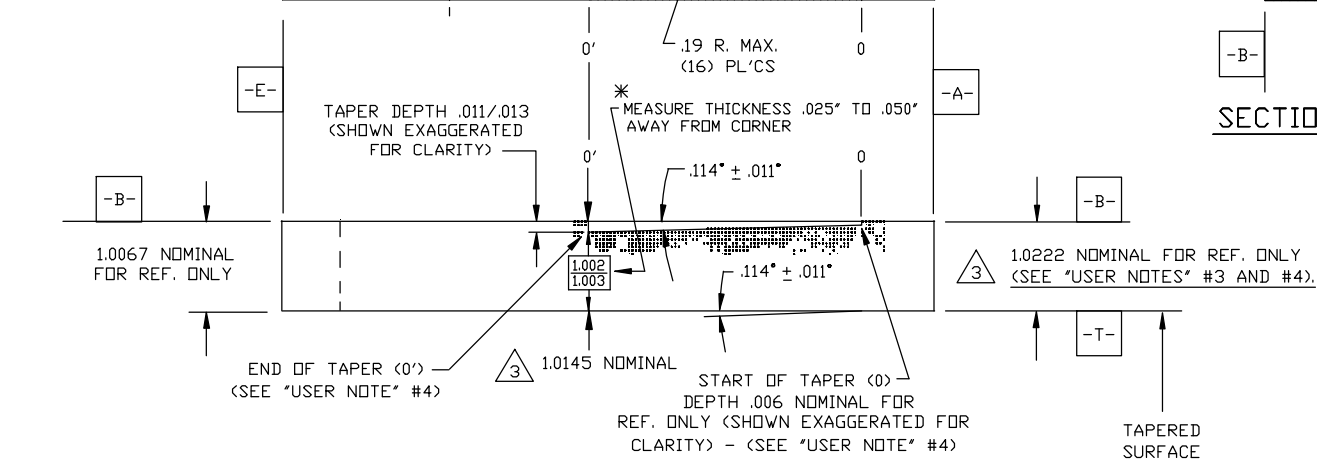
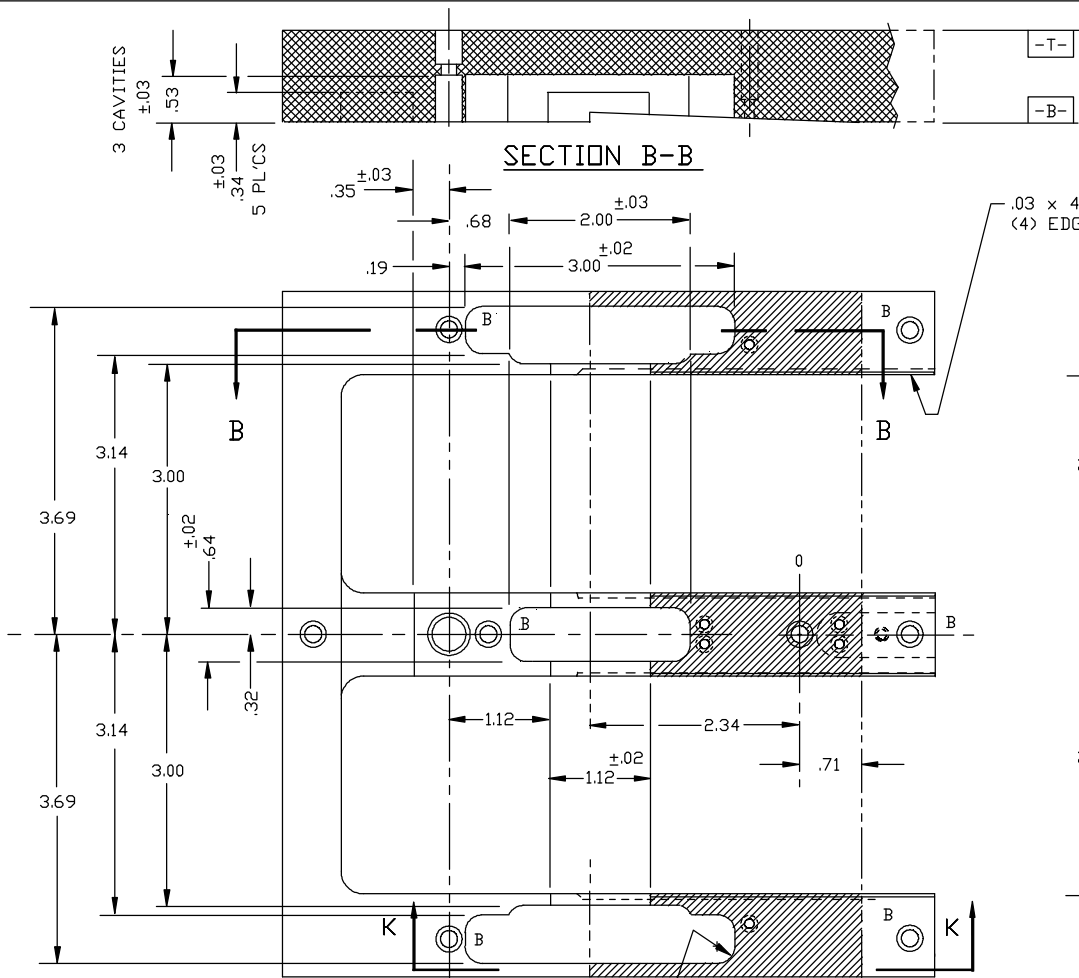
FINISH AND/OR HEAT TREATMENT  
NONE

1. DIMENSIONS ARE IN INCHES  
2. TOLERANCE ON DIMENSIONS  
FRACTIONAL  $\frac{1}{64}$   
DECIMAL .XX  $\pm .01$   
DECIMAL .XXX  $\pm .005$   
ANGULAR  $\pm .01^\circ$   
3. SURFACE ROUGHNESS  
PER MIL-STD-10 63 ✓  
4. REMOVE BURRS AND BREAK  
SHARP EDGES  $\frac{1}{64}$  MAX.  
5. SCREW THREADS PER MIL-STD-9  
6. ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

NEXT ASSEMBLY
WEIGHT
SCALE 2X
CLASSIFICATION

NORTHEAST RADIO OBSERVATORY CORPORATION			
HAYSTACK OBSERVATORY			
WESTFORD, MASSACHUSETTS			
SLEEVE, TURNAROUND ROLLER (1 INCH THIN TAPE)			
6310101	C	6310-101	D
	DWG. SIZE	DWG. NO.	REV.

CHANGE LETTER	D/VN BY	CHK'D BY	APP'D BY	DATE	DCN. & DESCRIPTION
A	RJC	HFH	AER	6/92	THICKNESS INCREASE .006 (SEE D-6310-105)
C	RJC	HFH	AER	9/92	*RETOLERANCE CRITICAL THICKNESS DIMENSION



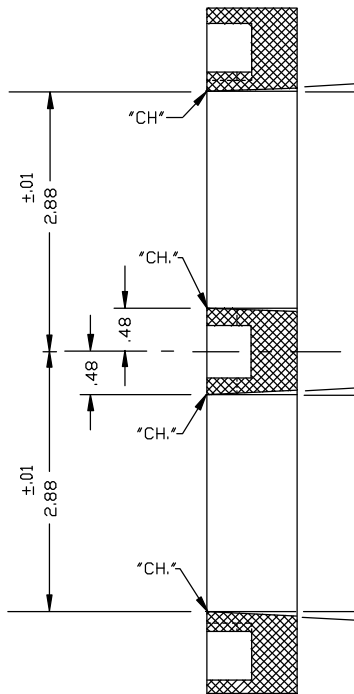
TYPICAL SECTION K-K  
REPRESENTS SIMILAR TAPER AREAS ON ALL (3)  
LEGS OF VACUUM COLUMN SPACER

NOTE: HOLE REPRESENTATIONS OMITTED FOR CLARITY.

### NOTES

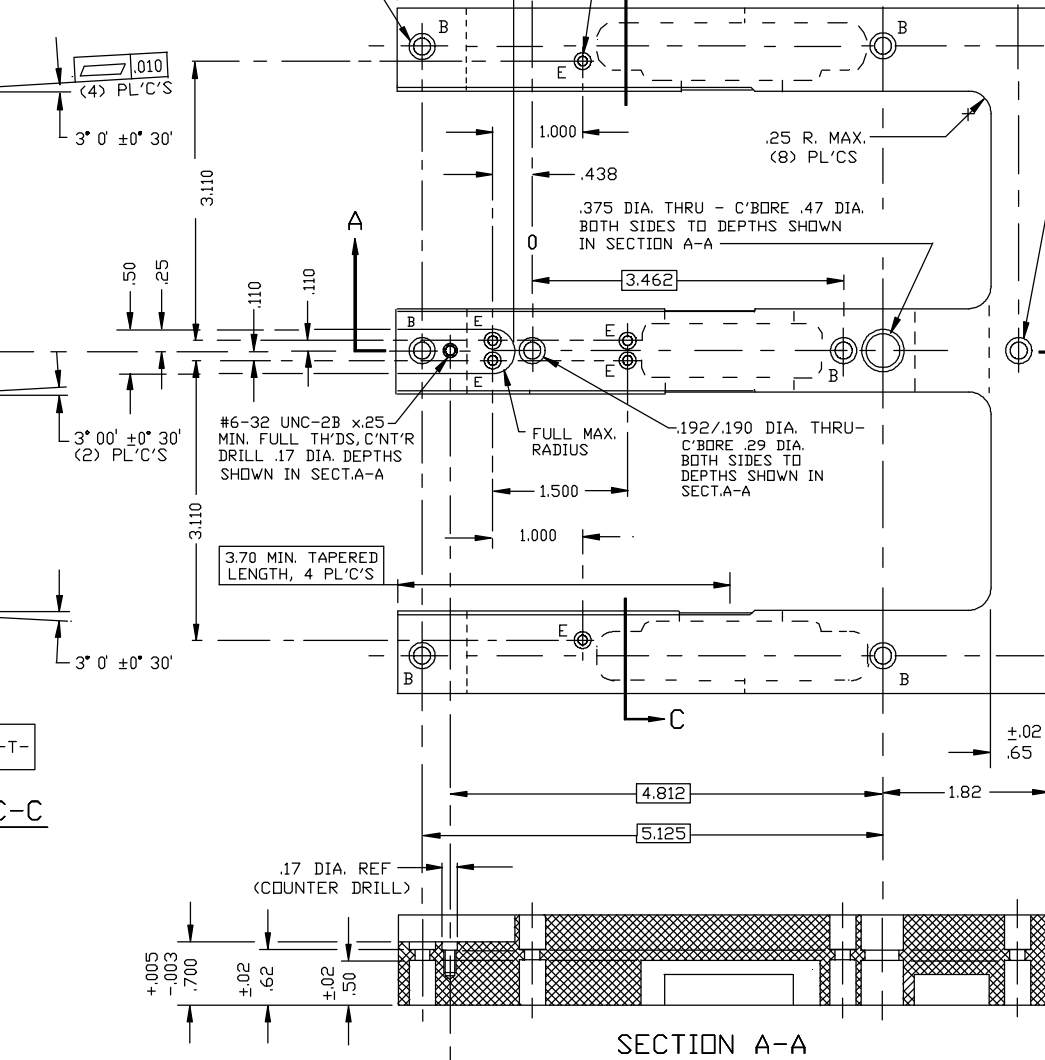
- SHADED AREA REPRESENTS TAPER ZONE; MACHINE BEFORE TAPER ON -T- ON SAME .114\"/>
- SURFACES -A- AND -E-  $\perp$  TO SURFACE -B-.
- DENOTES MEASUREMENTS TO BE MADE WITH PART SECURED IN RESTRAINED STATE (SURFACE -C- DOWN).  
- USE (6) 'B' HOLES AS TIE-DOWN POINTS.
- BREAK ALL SHARP EDGES .030 x 45\"/>
- INSIDE CORNER RADII TO BE .02 MAX.

.03 x 45\"/>



SECTION C-C

.173 DIA. THRU-C\"/>



SECTION A-A

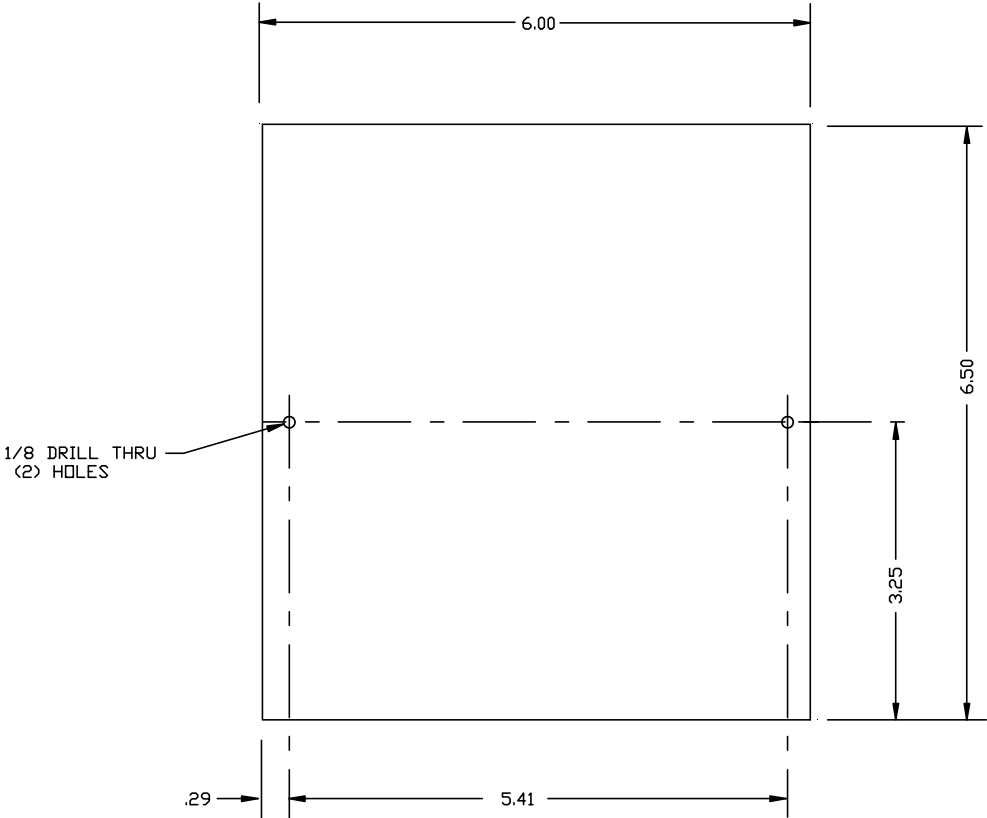
- USER NOTES: \*THIS PART SERVES VLBA AND MARK IV (HIGH SPEED, THIN TAPE) VERSIONS OF METRUM 96 TAPE TRANSPORT.
- 'E' HOLES SERVE TO MOUNT INNER TAPE EDGE BEARINGS (HARD POINTS) ON ALUMINA PLATES.
  - TAPERED SURFACES ADDED TO PREVENT DAMAGE TO THIN TAPE AT HIGH SPEED.

MATERIAL: ALUMINUM TOOLING PLATE, AMAX MIC-6	SHOP NOTES: UNLESS OTHERWISE SPECIFIED 1. DIMENSIONS ARE IN INCHES 2. TOLERANCE ON DIMENSIONS FRACTIONAL $\pm 1/64$ DECIMAL .XX $\pm .01$ DECIMAL .XXX $\pm .005$ ANGULAR $\pm 0^{\circ}30'$ 3. SURFACE ROUGHNESS PER MIL-STD-10 4. REMOVE BURRS AND BREAK SHARP EDGES 1/64 MAX. 5. SCREW THREADS PER MIL-STD-9 6. ALL DIMENSIONS TO APPLY BEFORE PLATING OR CONVERSION COATING.	USED ON: NEXT ASSEMBLY: WEIGHT: SCALE: FULL CLASSIFICATION:	DRAWN FOR: H.HINTEREGGER DRAWN BY: R.JCADDY CHECKED BY: PROJECT: ENGINEER: MATERIAL & PROCESS: STRUCTURES: THERMAL: MECHANICAL ANALYSIS:	DATE: 4/92 4/92	NORTHEAST RADIO OBSERVATORY CORPORATION HAYSTACK OBSERVATORY WESTFORD, MASSACHUSETTS
FINISH AND/OR HEAT TREATMENT: NONE					VACUUM SPACER (\"E\" CASTING)
					6310105 CAD FILE
					D 6310 - 105 C





CHANGE LETTER	D/WN BY	CHK'D BY	APP'D BY	DATE	D.C.N. & DESCRIPTION
A	RJC	HFH	HFH	8/92	.29 WAS .28, 5.41 WAS 5.44
					NO FINISH WAS GLASS BEAD
					IMPACT BLAST. NOTE #1 REFERS
					TO CHANGE "A" ON DOOR DWG.
B	RJC	HFH	HFH	1/93	"NOTES" AREA : C-6310-108A
					IS NOW C-6310-108



C - 6310-109 B

# NOTES

- FOR "VACUUM DOOR" DRAWING SEE C-6310-108
- PLATE FLATNESS TO BE .002/INCH

<b>MATERIAL</b>
.062 ALUMINUM, #6061-T6
<b>FINISH AND/OR HEAT TREATMENT</b>
NONE

- SHOP NOTES: UNLESS OTHERWISE SPECIFIED
- DIMENSIONS ARE IN INCHES
  - TOLERANCE ON DIMENSIONS  
FRACTIONAL 1/64  
DECIMAL .XX ± .01  
DECIMAL .XXX ± .005  
ANGULAR ± .01
  - SURFACE ROUGHNESS  
PER MIL-STD-10
  - REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
  - SCREW THREADS PER MIL-STD-9
  - ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

63

<b>USED ON</b>
NEXT ASSEMBLY
WEIGHT
SCALE FULL
CLASSIFICATION

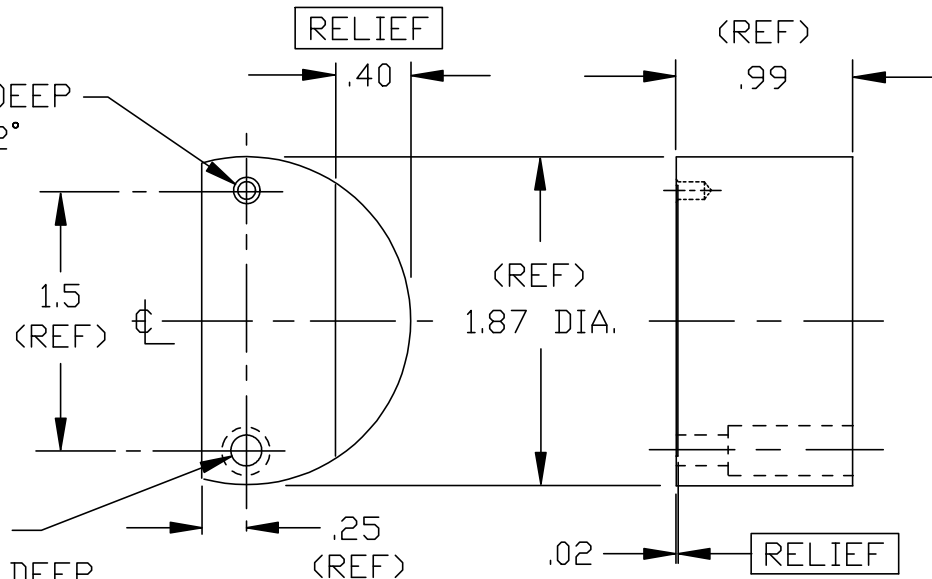
<b>DRAWN FOR</b>	<b>DATE</b>
H.HINTEREGGER	8/92
<b>DRAWN BY</b>	<b>DATE</b>
R.CADY	8/92
<b>CHECKED BY</b>	
<b>PROJECT</b>	
<b>ENGINEER</b>	
<b>MATL. &amp; PROCESS</b>	
<b>STRUCTURES</b>	
<b>THERMAL</b>	
<b>MECH. ANALYSIS</b>	

NORTHEAST RADIO OBSERVATORY CORPORATION HAYSTACK OBSERVATORY WESTFORD, MASSACHUSETTS			
TAPE EDGE BEARING PLATE FOR VACUUM DOOR			
6310109	C	6310-109	B
CAD FILE	DWG. SIZE	DWG. NO.	REV.

CHANGE LETTER	D'WN BY	CHK'D BY	APP'D BY	DATE	D.C.N. & DESCRIPTION

3/32 DRILL X .23 DEEP  
C'SINK .15 DIA. X 82°

5/32 DRILL THRU - C'BORE  
FAR SIDE 17/64 DIA. X .69 DEEP



MAT'L - METRUM #16776407 - 003  
ALUM. #6061-T6

FINISH - NONE

SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS  
FRACTIONAL ? 1/64  
DECIMAL .XX ? .01  
DECIMAL .XXX ? .005  
ANGULAR ? 01'
- SURFACE ROUGHNESS  
PER MIL-STD-10
- REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

32

USED ON

NEXT ASSEMBLY

WEIGHT

SCALE FULL

CLASSIFICATION

DRAWN FOR H.HINTEREGGER

DRAWN BY R.J.CADY

CHECKED BY

DATE 9/92

DATE 9/92

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

APPROVALS

PROJECT

ENGINEER

MATL. & PROCESS

STRUCTURES

THERMAL

MECH. ANALYSIS

LOADING BLOCK (WITH RELIEF  
MODIFICATION FOR EDGE  
BEARING PLATE)

6310112

A

6310 - 112

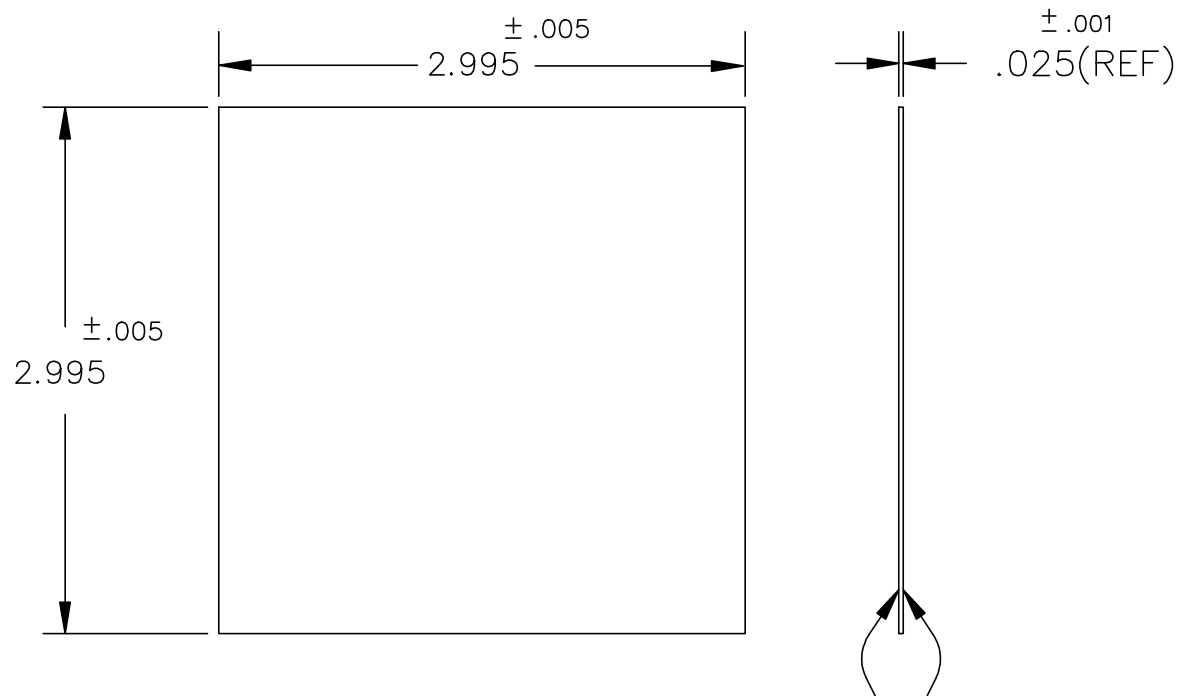
DWG. SIZE

DWG. NO.

REV.

CHANGE LETTER	DW'N BY	CHK'D BY	APP'D	DATE	D.C.N. & DESCRIPTION
A	RJC	HFH	HFH	2/93	PREVIOUS 3.000 $\pm$ .003 DIMENSION IS NOW
					2.995 $\pm$ .005 (TO INSURE PROPER FIT)

COORS CERAMIC COMPANY  
ELECTRONICS DIVISION  
17750 WEST 32nd AVENUE  
GOLDEN, COLORADO 80401  
FAX. NO. (303) 277-4779  
TELEPHONE: (303) 278-4000



MAT'L:  $\pm$  .001  
ALUMINA .025 THICKNESS  
SUPERSTRATE 99.6% ULTRAGRADE

FINISH:  
SURFACE FINISH 2 $\mu$ IN. CLA, BOTH FACES  
PART TO BE EDGE GROUND

SURFACES FLAT & PARALLEL  
TO .0005 IN./IN.

SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS  
FRACTIONAL ? 1/64  
DECIMAL .XX ? .01  
DECIMAL .XXX ? .005  
ANGULAR ? 0°
- SURFACE ROUGHNESS  
PER MIL-STD-10
- REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

USED ON

DRAWN FOR H.HINTEREGGER  
DATE 12/89  
DRAWN BY C.KOSTKA  
12/89  
CHECKED BY

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

NEXT ASSEMBLY

WEIGHT

SCALE FULL

CLASSIFICATION

APPROVALS  
PROJECT  
ENGINEER  
MATL. & PROCESS  
STRUCTURES  
THERMAL  
MECH. ANALYSIS

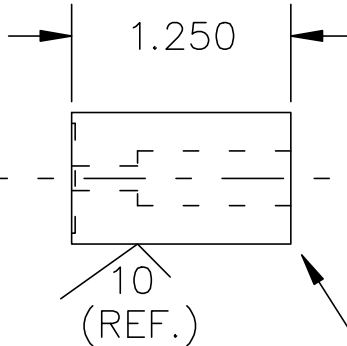
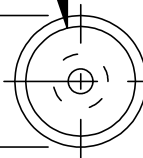
ALUMINA EDGE BEARING  
PLATE, MODIFICATION TO  
HONEYWELL PRECISION PLATE

631083A	A	6310-83	A
FILE NAME	DWG. SIZE	DWG. NO.	REV.

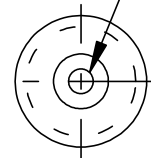
CHANGE LETTER	D'WN BY	CHK'D BY	APP'D BY	DATE	D.C.N. & DESCRIPTION

5/8 DIA. C-BORE  
X .02 DEEP  
- DEBURR

.7500 DIA.  
(REF.)



9/64 DRILL THRU  
- C'BORE 5/16 DIA.  
X .875 DEEP



BREAK EDGE  
.005/.010 EACH END

#### MATERIAL:

$+.0000$   
.7500 $-.0004$  DIA. S.S. 303 GND  
STOCK, BERG #S1-58; CAT.B6

#### FINISH:

NONE

SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS  
FRACTIONAL ? 1/64  
DECIMAL .XX ? .01  
DECIMAL .XXX ? .005  
ANGULAR ? 0°
- SURFACE ROUGHNESS  
PER MIL-STD-10
- REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

USED ON

DRAWN FOR K.WILSON  
DRAWN BY C.KOSTKA  
CHECKED BY

DATE  
9/90  
9/90

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

NEXT ASSEMBLY

WEIGHT

SCALE FULL

CLASSIFICATION

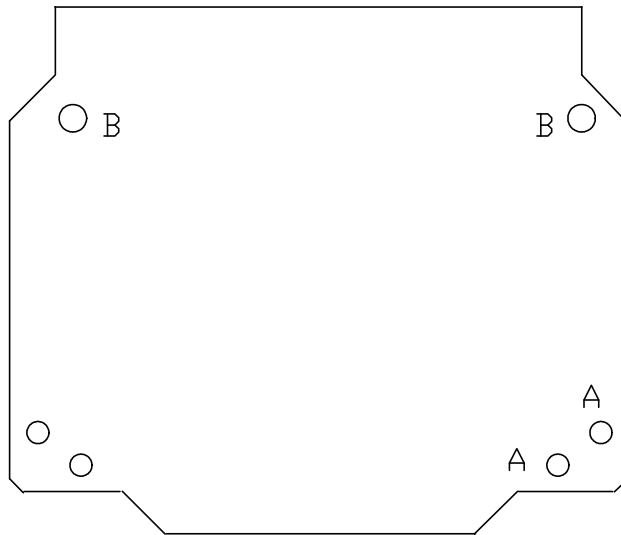
PROJECT  
ENGINEER  
MATL. & PROCESS  
STRUCTURES  
THERMAL  
MECH. ANALYSIS

VLBA RECORDER  
HEAD ASSEMBLY UNIT  
TAPE WRAP ANGLE ADJUSTER

A330M022	A	A54330M022	A
FILE NAME	DWG. SIZE	DWG. NO.	REV.

CHANGE LETTER	D'WN BY	CHK'D BY	APP'D BY	DATE	D.C.N. & DESCRIPTION

## SPECIFICATIONS



HEAD BLOCK  
FRONT VIEW

A LOCATIONS - #4-40 x 9/16" L'NG, S.S.  
SOCKET HEAD CAP SCREWS.

\*TORQUE - 4.5 TO 5 IN/LBS. (NOTE: 9/16"  
LENGTH IS NOT A STOCK ITEM.  
-USE A 5/8" LENGTH SCREW  
AND GRIND TO 9/16" LENGTH.

B LOCATIONS - #6-32 x 5/8" L'NG, S.S.  
SOCKET HEAD CAP SCREWS.

\*TORQUE - 7.5 TO 8 IN/LBS.

SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS  
FRACTIONAL ? 1/64  
DECIMAL .XX ? .01  
DECIMAL .XXX ? .005  
ANGULAR ? 0°
- SURFACE ROUGHNESS  
PER MIL-STD-10 ✓
- REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

USED ON

DRAWN FOR D.W.FIELDS DATE 3/10/93

DRAWN BY R.J.CADY 3/10/93

CHECKED BY

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

NEXT ASSEMBLY

WEIGHT

SCALE FULL

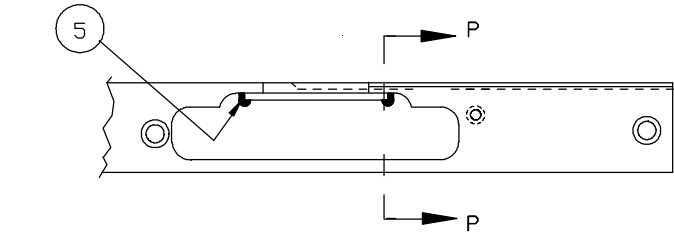
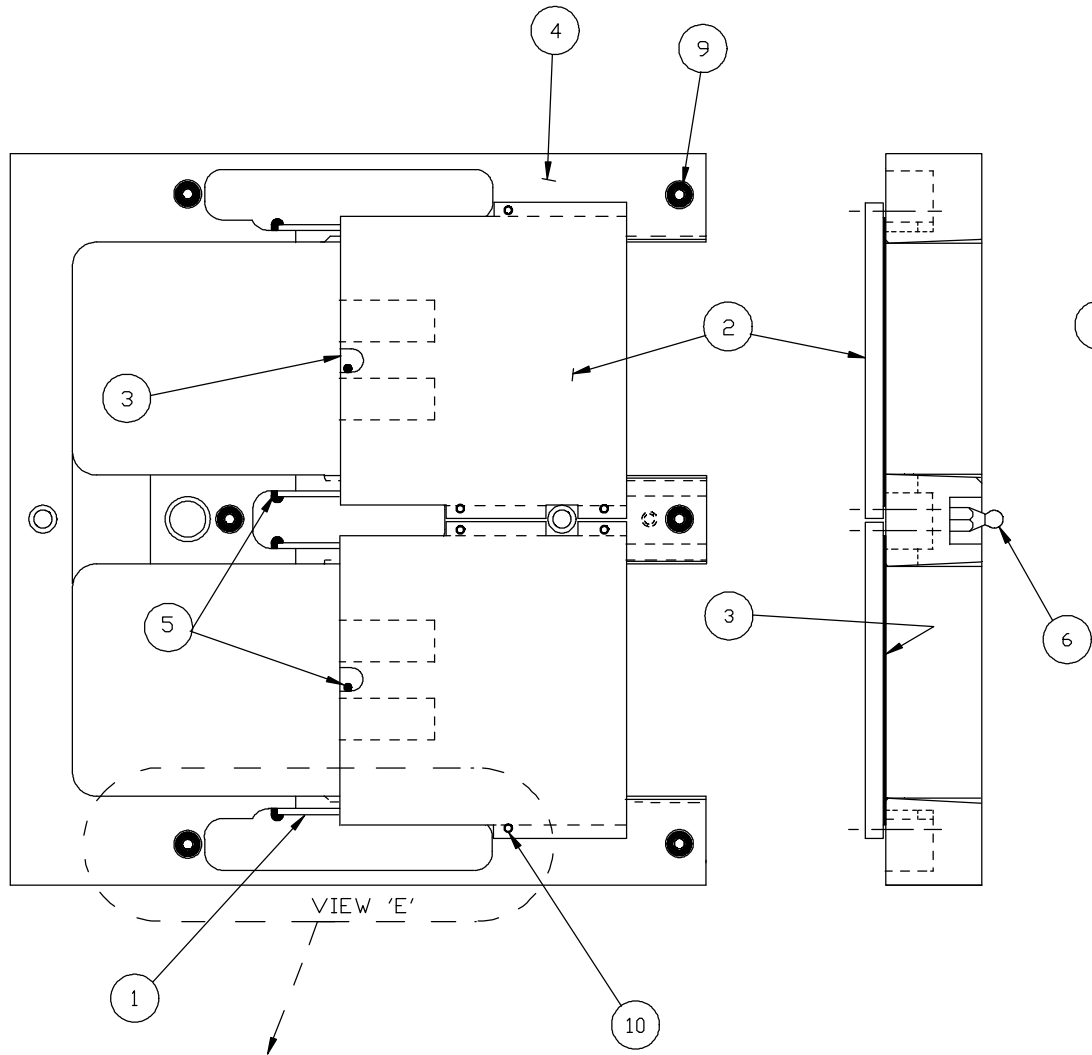
CLASSIFICATION

APPROVALS	PROJECT	
	ENGINEER	
	MATL. & PROCESS	
	STRUCTURES	
	THERMAL	
	MECH. ANALYSIS	

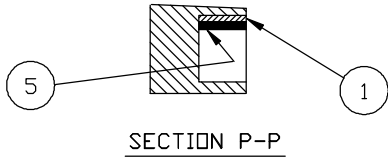
VLBA RECORDER  
HEAD ASSEMBLY  
MOUNTING SCREWS SPECIFICATIONS

A330M023	A	54330M023	
CAD FILE	DWG. SIZE	DWG. NO.	REV.

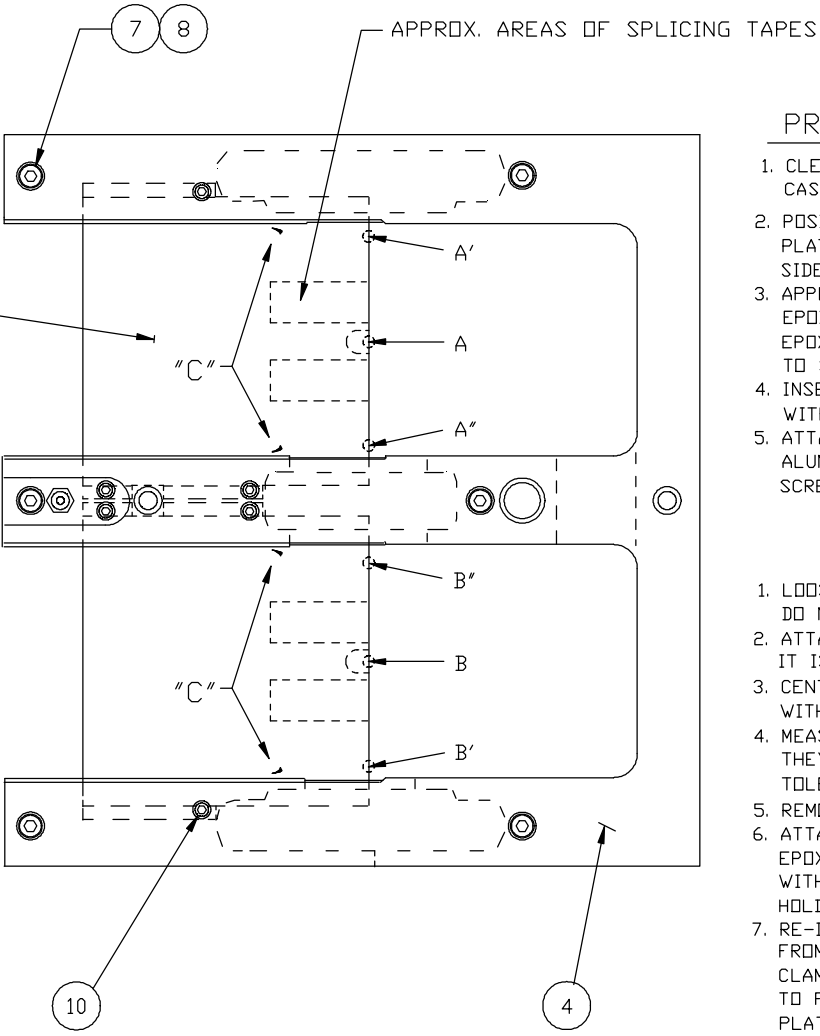




VIEW 'E' OF WINDOW AREA WITH ALUMINA BEARING PLATE AND CLAMP BEARING PLATE NOT SHOWN.



SECTION P-P



PARTS LIST				
FIND #	QTY	PART #	DESCRIPTION	SOURCE
1	4	HAY DWG A-6310-115	WINDOW, VAC. COLUMN	MONKS
2	2	HAY DWG A-6310-82	PLATE BEARING CLAMP	MONKS
3	2	HAY DWG A-6310-83A	ALUMINA BEARING PLATE	COORS
4	1	D-6310-105C	VACUUM SPACER ("E" CASTING)	MONKS
5	AS REQ.	TRA-BOND 2116	LOW VAPOR EPOXY	TRA-CON
6	1	16762807-018	STUD, CATCH, #6-32	METRUM
7	6	#6-32 x 7/8" L'NG	S'K'T H'D CAP SC'W, S.S.	LAWSON
8	6	#6	SPL'T L'KW'SH'R, S.S.	LAWSON
9	6	006	1/8 I.D. x 1/4 O.D. VITON O-RING	LAWSON
10	6	#2-56 x 3/8" L'NG	S'K'T H'D CAP SC'W, S.S.	LAWSON

## NOTES

## PREPARATION OF "E" CASTING FOR INSTALLATION

- CLEAN PARTS TO BE BONDED WITH ALCOHOL. ATTACH BEARING CLAMP PLATES TO "E" CASTING WITHOUT ALUMINA PLATES. TIGHTEN SECURELY.
- POSITION VACUUM COLUMN WINDOWS IN PLACE, ALIGNING THEM AGAINST BEARING PLATES. SECURE WINDOWS IN PLACE WITH A DROP OF SUPER GLUE OR DOUBLE SIDED TAPE. REMOVE BEARING CLAMP PLATES.
- APPLY A BEAD OF RECOMMENDED EPOXY ALONG THE ENDS OF EACH WINDOW. EPOXY NOT ALLOWED IN PORTION OF WINDOW VISIBLE THRU SPACER OPENING. EPOXY NOT TO PROTRUDE OUTSIDE OF WINDOW CUTOUT. ALLOW EPOXY TO SET FOR 24 HOURS.
- INSERT #6-32 x 7/8" LONG SCREWS WITH LOCKWASHERS AND SECURE IN PLACE WITH O-RINGS. ATTACH FRICTION CATCH STUD.
- ATTACH BEARING CLAMP PLATES WITH #2-56 x 3/8" LONG SCREWS. PLACE ALUMINA PLATES BETWEEN BEARING CLAMP PLATES AND "E" CASTING AND TIGHTEN SCREWS JUST ENOUGH TO KEEP ALUMINA PLATES FROM FALLING OUT.

## HARD POINT ASSEMBLY

- LOOSEN BEARING CLAMP PLATE SCREWS BEING CAREFULL THAT ALUMINA PLATES DO NOT FALL OUT.
- ATTACH "E" CASTING TO A PRECISION PLATE (METRUM 16827015-001) CHECKING TO SEE THAT IT IS SITTING FIRMLY AGAINST THE PRECISION PLATE. TIGHTEN "E" CASTING SCREWS.
- CENTER ALUMINA PLATES IN CAVITIES (APPROX. EQUAL CLEARANCE ON EACH SIDE) AND TEST WITH 2 MIL TO 5 MIL SHIM STOCK. TIGHTEN BEARING CLAMP SCREWS TO 8 IN. OZ.
- MEASURE DEPTH OF "E" CASTING WITH DEPTH MICROMETER AT POINTS A, A', A" AND B, B', B". THEY SHOULD ALL AGREE TO WITHIN 1 MIL BETWEEN 1.0015" AND 1.0035". IF NOT WITHIN TOLERANCE TRY TO DETERMINE REASON - SEEK ADVICE IF NECESSARY.
- REMOVE "E" CASTING, LEAVING BEARING CLAMP PLATE SCREWS TIGHT.
- ATTACH 2 PIECES OF SPLICING TAPE TO ALUMINA PLATE, (1) ABOVE AND (1) BELOW EPOXY SLOT IN BEARING CLAMP PLATE. WRAP TAPE AROUND EDGE OF ALUMINA PLATE; WITH TAPE UNDER TENSION, ATTACH TO BACK OF BEARING CLAMP PLATE. THIS WILL HOLD ALUMINA PLATE SECURELY AGAINST BEARING CLAMP PLATE.
- RE-INSTALL "E" CASTING AND MEASURE DEPTHS AT POINTS A AND B. A CHANGE OF 1 MIL, FROM SQUEEZING OUT A WITHIN-SPEC LACK OF FLATNESS IN THE ALUMINA AND BEARING CLAMP PLATES IS POSSIBLE. IF A GREATER CHANGE IS OBSERVED START OVER AND TRY TO FIND CAUSE.(ROTATE OR FLIP ALUMINA PLATE, EXCHANGE AND FLIP BEARING CLAMP PLATES FOR EXAMPLE).
- IF DIMENSIONS ARE ACCEPTABLE AGAIN REMOVE "E" CASTING, LEAVING BEARING CLAMP PLATE SCREWS TIGHT. ALSO, LEAVE TAPE IN PLACE.
- PLACE A DROP OF RECOMMENDED EPOXY IN SLOT OF BOTH BEARING CLAMP PLATES SO THAT ALUMINA PLATE BONDS TO BEARING CLAMP PLATE. EPOXY SHOULD NOT WICK IN BETWEEN ALUMINA PLATE AND BEARING CLAMP PLATE. LET EPOXY SET FOR 24 HOURS.
- FINALLY, REMOVE TAPE AND REINSTALL "E" CASTING. TAKE MEASUREMENTS AS IN STEP 4. IF ALL MEASUREMENTS ARE WITHIN SPEC., ASSEMBLY IS COMPLETE AND SHOULD BE INTERCHANGEABLE BETWEEN MACHINES WITHOUT HARDPOINT ADJUSTMENT.

## NOTES

- THE DEPTH AT A AND B SHOULD BE CHECKED PERIODICALLY AS PREVENTIVE MAINTENANCE.
- WHEN AN ALUMINA PLATE DEVELOPS SIGNIFICANT WEAR AT THE EDGE BEARING ARCS "C" IT CAN BE REUSED BY BREAKING THE EPOXY TIE-DOWN POINT BY TWISTING THE ALUMINA PLATE OFF THE CLAMP PLATE, CLEANING THE EPOXY RESIDUE OFF, ROTATING THE HARD PLATE 90, 180, OR 270 OR FLIPPING IT OVER FOR 4 ADDITIONAL WEAR POSITIONS, AND REPEATING THE HARDPOINT ASSEMBLY INSTRUCTIONS. SIGNIFICANT WEAR AND SCRATCHES >.0005" DEEP, CAN ONLY BE DIRECTLY EVALUATED BY INSPECTION OF THE HARD-PLUS-CLAMP PLATE SUBASSEMBLIES UNDER A HIGH-POWER MICROSCOPE. OTHER SYMPTOMS SUCH AS AN INCREASE IN THE AMPLITUDE OF THE INTERCHANGE TRACKING SIGNATURE MAY INDICATE HARD POINT WEAR. ONLY THE CENTRAL EDGE BEARING ARCS ADJACENT TO THE MIDDLE LEG OF THE "E" CASTING AFFECT TRACKING.

MATERIAL:

FINISH AND/OR HEAT TREATMENT:

SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS FRACTIONAL ± 1/64 DECIMAL .XX ± .01 DECIMAL .XXX ± .005 ANGULAR ± 0°30'
- SURFACE ROUGHNESS PER MIL-STD-10
- REMOVE BURRS AND BREAK SHARP EDGES 1/64" MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY BEFORE PLATING OR CONVERSION COATING.

USED ON:

DRAWN FOR: H.HINTEREGGER

DRAWN BY: R.J.CADY

CHECKED BY:

PROJECT:

ENGINEER:

MAT'L & PROCESS:

STRUCTURES:

THERMAL:

MECH. ANALYSIS:

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

ASSEMBLY - VACUUM SPACER  
("E" CASTING)

6310113A

CAD FILE

D

6310 - 113

A

CHANGE LETTER	D'WN BY	CHK'D BY	APP'D BY	DATE	DCN. & DESCRIPTION
A	RJC	HFH	HFH	1/93	PT # HAY C6310-108A IS NOW
					HAY C6310-108C & HAY C6310-109A
					IS NOW HAY C6310-109B.

## FRONT DOOR ASSEMBLY

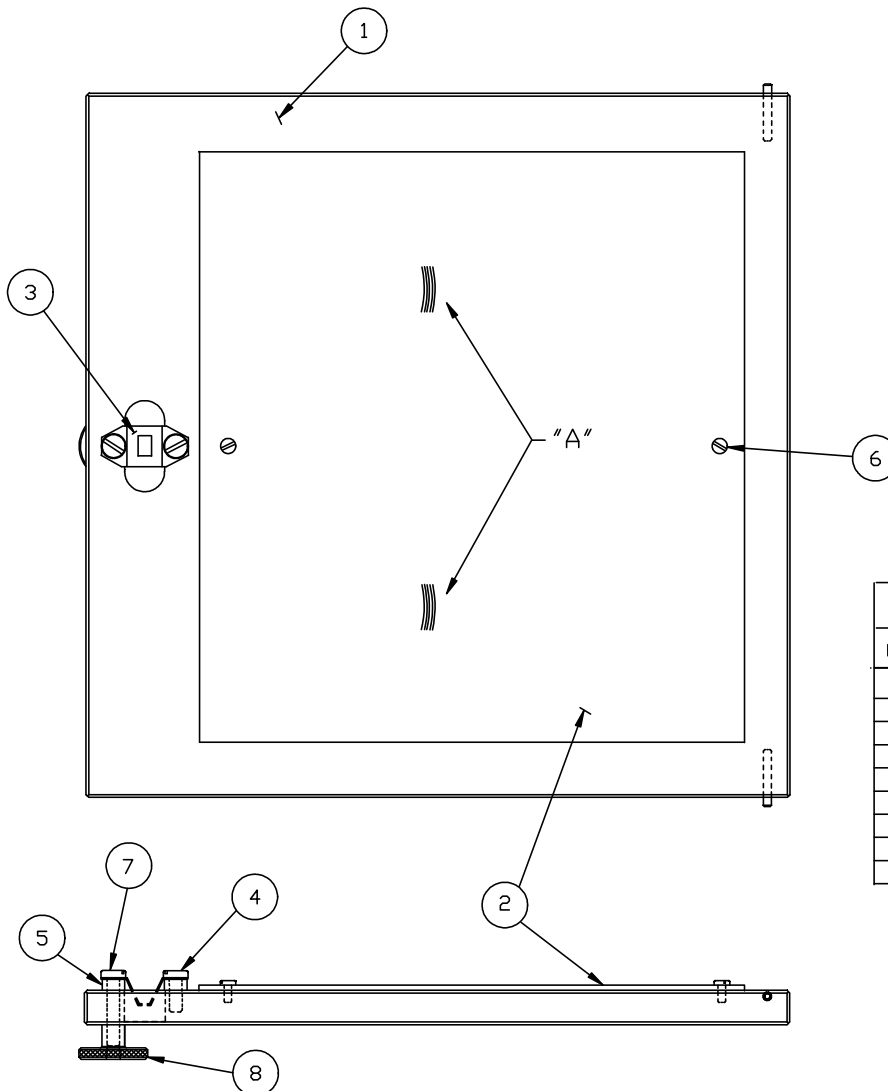
- CHECK TAPE EDGE BEARING PLATE FOR BURRS. IF NECESSARY, CLEAN PLATE WITH SCOTCHBRITE AND RAZOR BLADE TO REMOVE BURRS.
- ATTACH FRICTION CATCH WITH 1/8" THICK STANDOFFS BETWEEN DOOR AND CATCH. ASSEMBLE CATCH AND STANDOFFS TO DOOR WITH #6-32 PAN HEAD SCREWS.
- ATTACH TAPE EDGE BEARING PLATE TO DOOR WITH #2-56 PAN HEAD SCREWS.

## NOTE

TAPE EDGE CONTACT AREAS "A", CAN BE ALLOWED TO WEAR TO A DEPTH OF .002" (MEASURE WITH STRAIGHTEDGE AND SHIM SLIVER PROBE). THE BEARING PLATE SHOULD THEN BE TURNED 180°, FOLLOWED BY 2 ADDITIONAL WEAR CYCLES ON THE OTHER SIDE. AFTER 4 WEAR CYCLES THE BEARING PLATE MUST BE REPLACED.

## PARTS LIST

FIND #	Q'NT'Y	PART #	DESCRIPTION	M'F'T'R
1	1	HAY C6310-108C	VACUUM DOOR	MONKS
2	1	HAY C6310-109B	TAPE EDGE BEARING PLATE	MONKS
3	1	16762805-007	RECEPTACLE, FRICTION CATCH	METRUM
4	1	#6-32 x 3/8" L'NG	PAN HEAD SCREW, S.S.	LAWSON
5	2	8500	.125 R'ND CLEAR STANDOFF	H.H.SMITH
6	2	#2-56 x 3/16" L'NG	PAN HEAD SCREW, S.S.	LAWSON
7	1	#6-32 x 3/4" L'NG	PAN HEAD SCREW, S.S.	LAWSON
8	1	PD1-7	KNURLED THUMB NUT	BERG



## NOTES

### MATERIAL

### FINISH AND/OR HEAT TREATMENT

### SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS  
FRACTIONAL 1/164  
DECIMAL .XXX 1.01  
DECIMAL .XXX 1.005  
ANGULAR 1.0°
- SURFACE ROUGHNESS  
PER MIL-STD-10
- REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

### USED ON

### NEXT ASSEMBLY

### WEIGHT

### SCALE

### CLASSIFICATION

### DRAWN FOR

### DRAWN BY

### CHECKED BY

### PROJECT

### ENGINEER

### MAT'L. & PROCESS

### STRUCTURES

### THERMAL

### MECH. ANALYSIS

### DATE

### DATE

### DATE

### DATE

### DATE

### DATE

### DATE

### DATE

### DATE

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

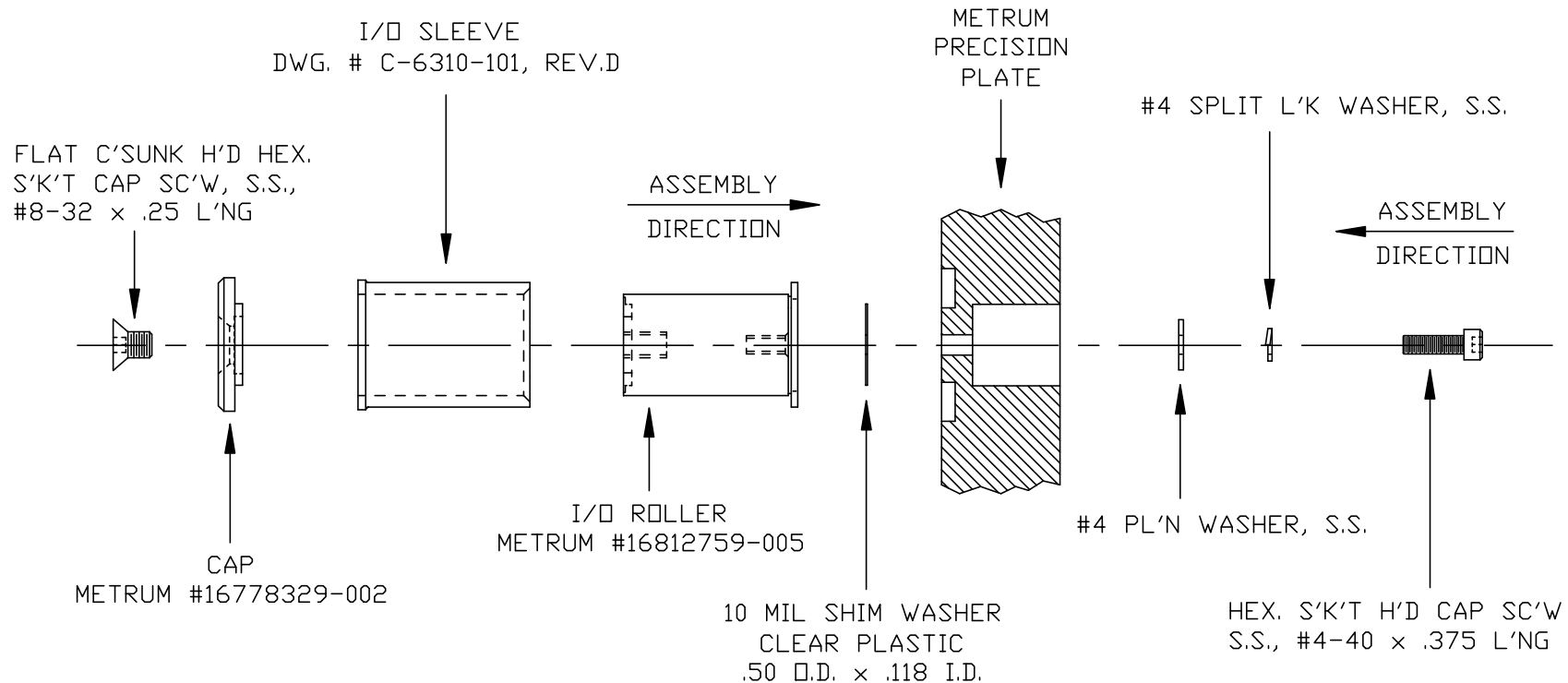
## ASSEMBLY - VACUUM DOOR

6310114A	C	6310 -114	A
CAD FILE	DWG. SIZE	DWG. NO.	REV.

C - 6310 - 114 A



CHANGE LETTER	D'WN BY	CHK'D BY	APP'D BY	DATE	D.C.N. & DESCRIPTION			
A	RF			4/25/97	DWG NO. WAS 4712M001			
B	RF			10/2/98	DWG NO. WAS 4712A001			



SHOP NOTES: UNLESS OTHERWISE SPECIFIED

- DIMENSIONS ARE IN INCHES
- TOLERANCE ON DIMENSIONS  
FRACTIONAL ? 1/64  
DECIMAL .XX ? .01  
DECIMAL .XXX ? .005  
ANGULAR ? 0°
- SURFACE ROUGHNESS  
PER MIL-STD-10
- REMOVE BURRS AND BREAK  
SHARP EDGES 1/64 MAX.
- SCREW THREADS PER MIL-STD-9
- ALL DIMENSIONS TO APPLY  
BEFORE PLATING OR CON-  
VERSION COATING.

USED ON

NEXT ASSEMBLY

WEIGHT

SCALE FULL

CLASSIFICATION

DRAWN FOR

D.FIELDS

DATE

2/96

DRAWN BY

R.J.CADY

2/96

CHECKED BY

PROJECT

ENGINEER

MATL. & PROCESS

STRUCTURES

THERMAL

MECH. ANALYSIS

NORTHEAST RADIO OBSERVATORY CORPORATION  
HAYSTACK OBSERVATORY  
WESTFORD, MASSACHUSETTS

MK IV RECORDER  
I/O ROLLER ASSEMBLY  
(METRUM PRECISION PLATE)

4712M001.DWG

A

4712M001

B

CAD FILE

DWG. SIZE

DWG. NO.

REV.