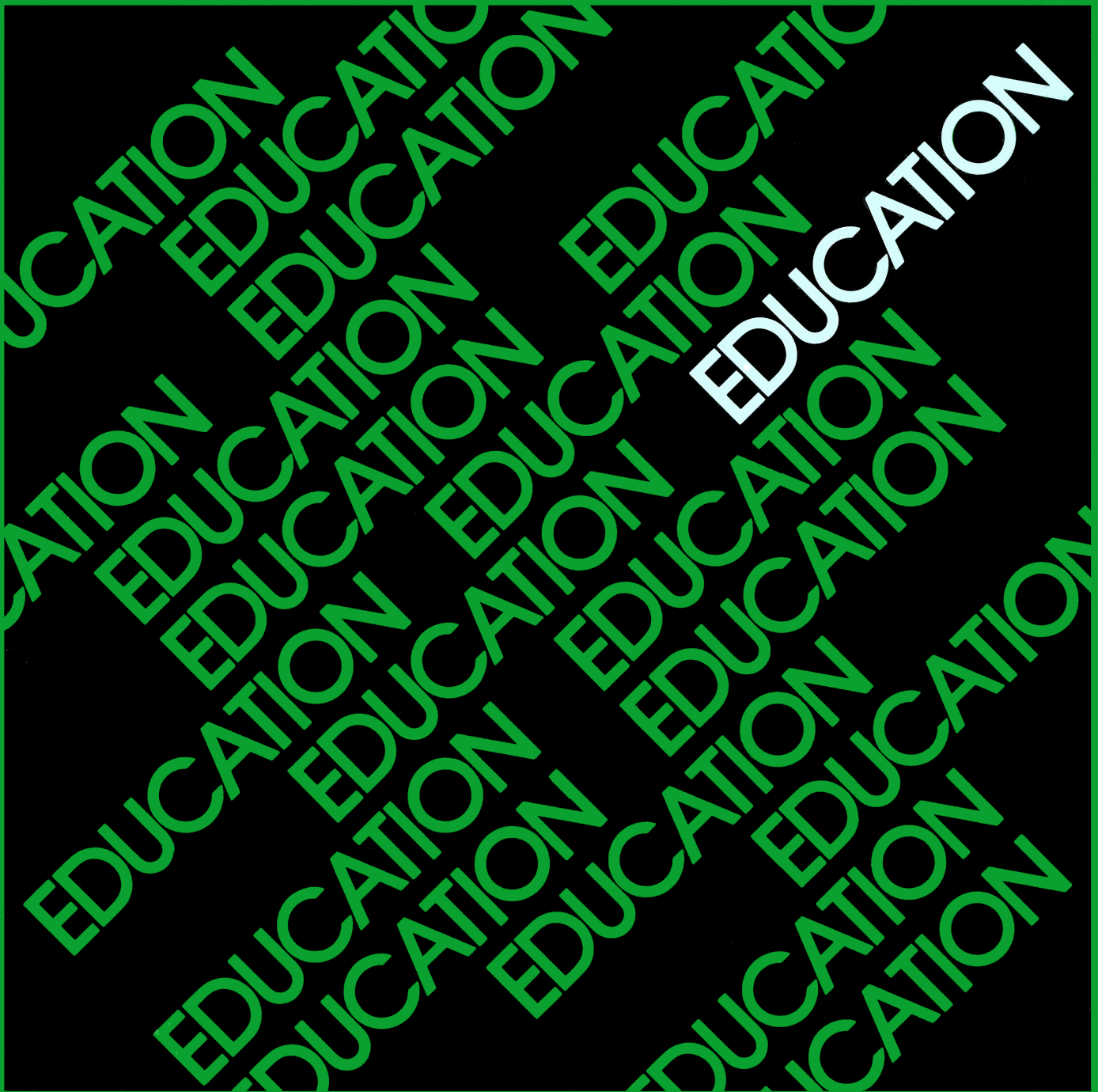


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RK05 HEAD INSTALLATION  
AND ALIGNMENT PROCEDURES





**RK05 HEAD INSTALLATION  
AND ALIGNMENT PROCEDURES**



MAYNARD, MASSACHUSETTS

**ENGINEERING SPECIFICATION**

DATE 4/17/73

**TITLE** MODEL RK05 HEAD INSTALLATION AND ALIGNMENT PROCEDURES USING DIGITAL EQUIPMENT CORP. ALIGNMENT CARTRIDGE

**REVISIONS**

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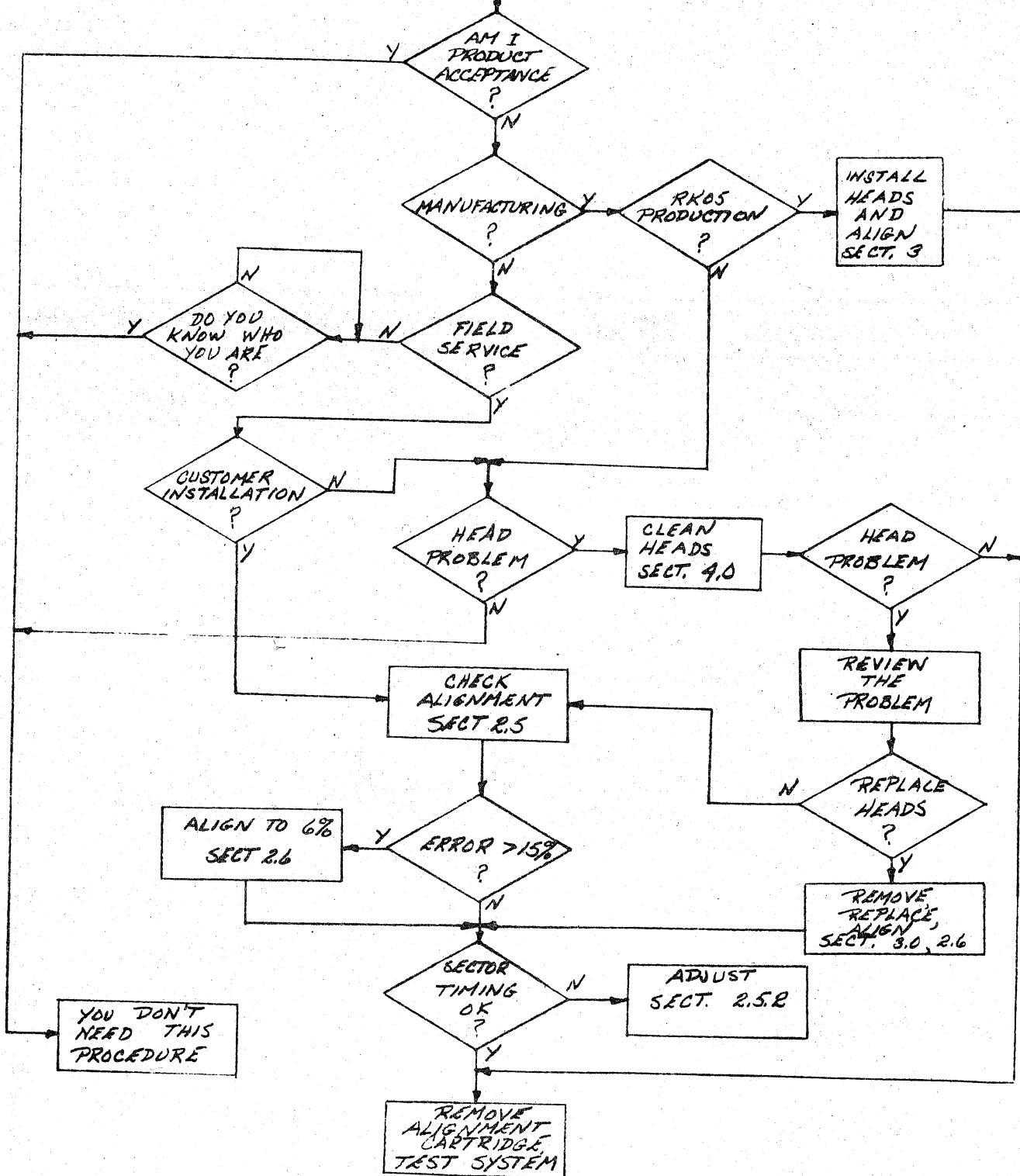
- 5.1 Function
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RK05 HEAD INSTALLATION AND ALIGNMENT PROCEDURES1.0 SCOPE

This specification defines the procedures for RK05 head installation and alignment. Its usage is confined to the following:

- a) Initial installation and alignment of heads in production.
- b) QC Acceptance at the end of the RK05 production test line.
- c) Field Service alignment check at customer site installation.
- d) Whenever a malfunction occurs which indicates the possibility of head misalignment.
- e) When a head is replaced.

Head alignment or check is not required at any other point.

2.0 HEAD ALIGNMENT2.1 Test Equipment and Tools

The following items are required:

- a) Tektronix Type 453 oscilloscope or equivalent.
- b) 1:1 probe for external trigger.
- c) 10:1 probe for signal display.
- d) Assorted backboard wire jumpers.
- e) Torque wrench C-1A-9605893-0-0.
- f) No. 0 Phillips head screwdriver.
- g) Slotted head screwdriver, 1/8" blade.

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- h) RK05 Head Holder #C-AD-9305667-0-0.
- i) Digital Equipment RK05K-AC Alignment Cartridge. (See Section 5.0).
- j) Head Cleaning Kit Part #2200007.

2.2 System Environment

## a) Off-Line

If operated completely off-line, the RK05 must be provided with an M930 terminator module.

## b) On-line

The RK05 may be operated in an off-line mode without removal from the controller bus. The following must be observed.

- 1) Computer is in HALT status. Power remains on in the system.
- 2) In a multi-drive system all drives are powered.
- 3) All drives except the unit under test are in the LOAD state.

2.3 Preliminary (observe Section 2.2)

- a) Make certain that the drive to be examined is in sound operating condition and that the heads have not been contaminated by exposure to a defective cartridge.
- b) Insert the alignment cartridge and cycle the RK05 to operating status.
- c) Allow the drive to operate for at least 30 minutes to allow all components to thermally stabilize.
- d) Use the WR PROT switch to place the drive in write protect condition.

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2.4 Instrumentation

- a) Connect scope external trigger to A02S2 (SECTOR). Use a 1:1 probe.
- b) Connect Channel 1 probe to TP3 or TP4 on G180 module. Use 10:1 probe. Connect probe ground to TP1.
- c) Set controls as follows:

Vertical

Mode - Channel 1  
Gain - 20 mv/div (0.2V with 10:1 probe)  
Coupling - dc

Sweep

A sweep

Time - 500 us/div  
Trigger - normal

Trigger

Source - external  
Coupling - ac  
Slope - (-)

2.5 Alignment Measurement

## 2.5.1 Track Location

In the following procedure the use of logic block jumper wires is indicated as the recommended method for moving the positioner to the calibration track. This method is strongly recommended because of the ease of returning to the reference track when the positioner has been physically moved.

Where a simple alignment check is required and appropriate on-line diagnostics for operator control of the positioner are available such usage is acceptable.

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The RK05 Off-Line Tester may be used also. The operator is cautioned to initiate a RESTORE operation before ordering a seek to the calibration track if other than backboard jumper addressing is used.

- a) With the drive in operational status, check the positioner scale indicator. This must show Cylinder 0.
- b) Connect backboard jumpers from the following points to any ground bus pin:

A08E1 CYL ADD 6 (64)

A08J1 CYL ADD 5 (32)

A08C1 CYL ADD 3 (8)

A08K1 CYL ADD 1 (1)

A04V1 SEL/RDY L

- c) Connect a jumper from B08H1 (STROBE) to B08N2 (SECTOR PULSE).
- d) The positioner will move to CYL 105. Confirm this by observing the track scale indicator.
- e) Observe the oscilloscope display which should appear approximately as indicated in Figures 1-7. Adjust the trigger level control so that the bright horizontal line appears at beginning of sectors displayed at left of screen. This indicates that these are odd sectors, while sectors displayed on right side of screen are even numbered sectors. The odd numbered sector amplitudes correspond to  $X_1$ , and even numbered,  $X_2$  in equation for % error.

If none of the illustrated waveforms appear, indicating a major misalignment, as may be the case for initial head installation or replacement proceed to Section 2.6.2.

These sketches illustrate the calibration waveform for varying degrees of misalignment. Figures 1-3 show the head on the low (toward CYL 104) side of the correct location. Fig. 4 is exact alignment. Figures 5-7 show the head on the high (toward CYL 106) side of the correct location.

GO to CYL 105

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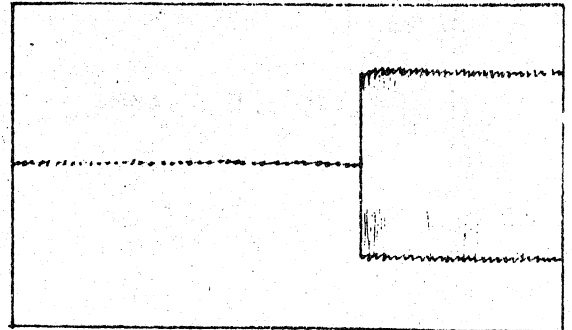
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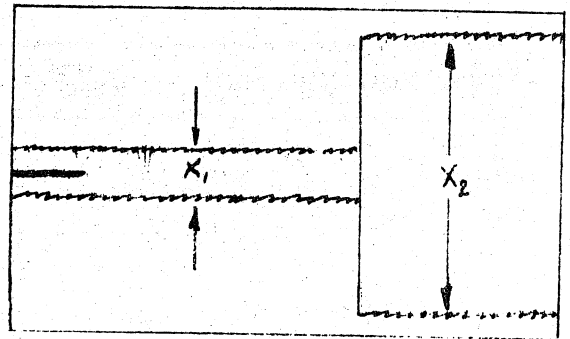
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**Fig. 1**  
 Large misalignment. Head at too great a track radius. Further misalignment reduces amplitude of signal on right side of screen.



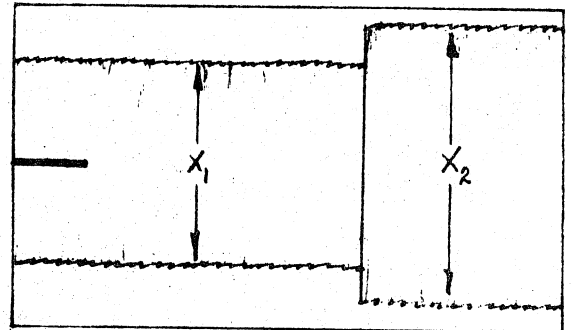
**Fig. 2**  
 Head considerably misaligned. Smaller left amplitude indicates head outside of CYL 105.

$$\text{error} = -72\%$$

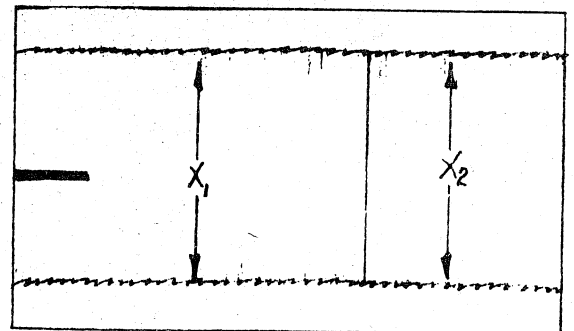


**Fig. 3**  
 Head slightly misaligned. Smaller left amplitude indicates head outside of CYL 105.

$$\text{error} = -15\%$$



**Fig. 4**  
 Head correctly aligned. Amplitudes are equal.



HEAD ALIGNMENT WAVEFORMS

See also Fig. 8

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Fig. 5

Heads slightly misaligned. Larger left amplitude indicates head inside of CYL 105 (toward 106)

error = +15%

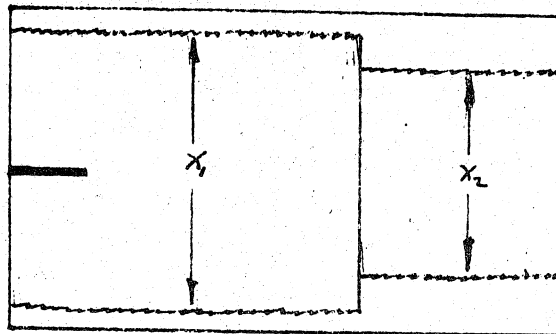


Fig. 6

Head considerably misaligned. Larger left amplitude indicates head inside of CYL 105.

error = +72%

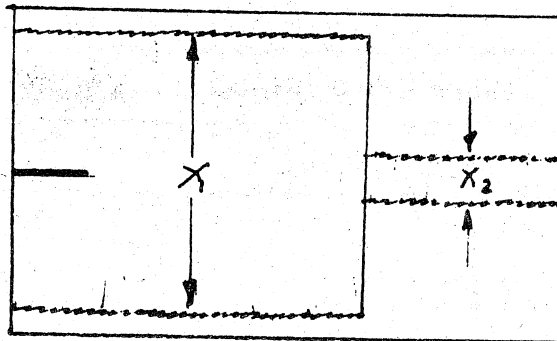
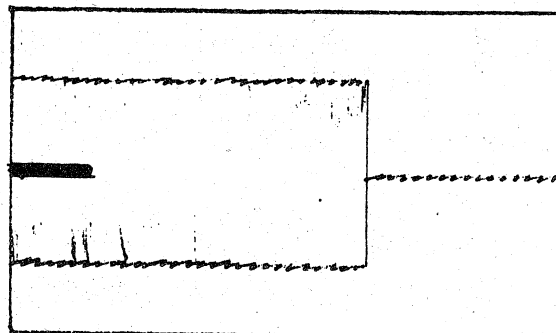


Fig. 7

Large misalignment. Head inside of CYL 105. Further misalignment reduces amplitude of signal on left side of screen.



HEAD ALIGNMENT WAVEFORMS

See also Fig. 8

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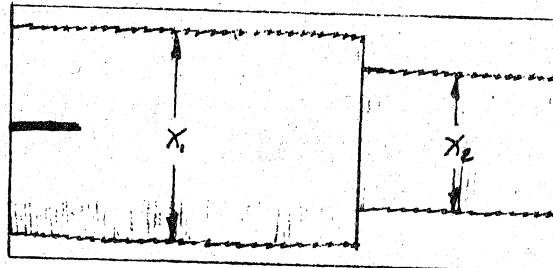
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- f) Referring to Fig. 8, the alignment error is denoted as a percentage figure with sign, derived from the relative amplitudes of the two signal modes, X1 and X2 according to the following expression:

$$\% \text{ error} = \frac{X_1 - X_2}{X_1 + X_2} \times 100$$

$$\text{Approx. error (in u in.)} = \% \text{ error} \times 35$$

Figure 8  
HEAD ALIGNMENT PATTERN



The sign denotes the direction of the alignment error. A negative (-) sign, (X1 smaller) indicates a head too far from center (track < 105).

- g) Ground B08M2 to select the upper head and repeat the preceding steps of Section 2.5.1.

EXCEPT AT PRODUCTION CHECKOUT OR WHERE A HEAD HAS BEEN REPLACED DO NOT REALIGN IF THE ERROR DOES NOT EXCEED 15%.

#### 2.5.2 Index/Head Timing

NOTE: Heads must be aligned to track before checking sector/index timing.

- Set up oscilloscope as described in Section 2.4, except connect external trigger to A02R2 (Index) and set sweep time to 10 us/div.
- Address the positioner to Cylinder 105 by use of the jumper wires as in 2.5.1 b and c.
- Select lower head (B08M2 open).
- Observe oscilloscope display. A single pulse followed by data beginning 10 us following the pulse should appear.

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If only the data is visible, the single pulse is off-screen to the left. See Step (g).

- e) Observe the pulse timing which should be 70 us  $\pm$  10 us from sweep start.
- f) Ground B08M2 to select the upper head. The pulse should also appear 70 us  $\pm$  10 us from sweep start.
- g) If correction is required, adjust R6 on the 7700 module (card position 2) so that the average time of the two pulses is 70 u sec. and the 70  $\pm$  10 u secs. requirement is maintained.

## 2.6 Alignment Procedure

There are two conditions which may be encountered in head alignment. The first of these involves the situation where the head is sufficiently aligned to display the alignment pattern when positioned to Cylinder 105. In this case, final alignment may take place directly.

In the second case, typically encountered during head installation, the head may be sufficiently removed from the correct location to require manual manipulation of the positioner to determine the required adjustment to place the head sufficiently close for final adjustment.

Both conditions are covered in the following:

### 2.6.1 Where Alignment Pattern is Visible

- a) Observe the procedure of Section 2.5.1.
- b) If the alignment pattern, Figures 1-7, is visible, proceed to (c). If the pattern is not observed, use Section 2.6.2.
- c) Noting the direction of alignment error, loosen the head clamping screw. (See Figure 10). If the head is to be moved backward, also unscrew the adjustment screw slightly and force the head back, noting the change of pattern. The adjustment screw is used as a vernier to move the head forward.

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- d) Set the head as close to perfect alignment as possible and use torque wrench to tighten clamp screw to 55 oz.-in. Recheck alignment and repeat procedure if required.

**NOTE:** If the detented positioner is moved off cylinder 105 during adjustment, move the carriage by turning off positioner power (Sl down) fully forward. Turning on positioner power (Sl up) includes a return to zero action. The positioner will automatically return to Cylinder 105 following RTZ.

- e) Make a reasonable attempt to achieve the best possible alignment in a 5-minute period.

FINAL ADJUSTMENT ERROR (Section 2.5.1 f, Figure 8) MUST NOT EXCEED 6%.

- f) Head adjustment screws are used only for purposes of moving the head during alignment and must not be left at a setting which may exert a force tending to move a head forward. As a final alignment step, unscrew each adjustment screw by one-half turn.

Am I still on CYL 105

- g) Ground B08M2 to select the upper head and repeat the alignment procedure.
- h) Refer to Section 2.5.2 for index/sector timing.

**2.6.2 Alignment Pattern Not Visible**

- a) Observe the procedure of Section 2.5.1.
- b) Failing to find the calibration pattern, turn off positioner drive power (Sl, H604 down) and manually move the carriage until the pattern appears.

**CAUTION!!!**

Spare alignment tracks are recorded at Cylinders 85 and 125. Be sure to align to the correct track.

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- c) Observe the positioner track scale indication at the point where the alignment pattern appears.
- d) If the scale indicates less than 105, this denotes that the head is too far forward on the carriage. Loosen clamp and adjustment screws and move the head back toward the carriage until the calibration track is located with the indicator showing slightly greater than 105.
- e) Lightly tighten the clamping screw and reapply positioner power (S1, H604). Cause an RTZ and return to Cylinder 105 as in 2.6.1 d. See NOTE.
- Am I still on CYL 105 f) Observe Section 2.6.1 for aligning head when pattern is visible.
- g) If the head is found initially to be on the low side of Cylinder 105 (scale reads greater than 105 when alignment pattern is found), move the head forward until the indicator shows the pattern as in Step (d), and then proceed to Step (e).
- h) Select the upper head (B08M2 to ground) and repeat alignment procedure.
- i) Refer to Section 2.5.2 for index/sector timing.

### 3.0 HEAD INSTALLATION AND REMOVAL

During head installation and removal always observe the following rules:

Remove power from the drive.  
 Disconnect positioner power cable.  
 Clamping screws must be removed.  
 Do not reverse bend a head loading spring.  
 Do not touch the ceramic head pads.  
 Always clean new heads after installation.

In a first-time installation or where a screw is being replaced

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run head adjusting screws and head clamping screws all the way into the carriage holes to cut threads into the nylon locking inserts of the screws. Completely remove the clamping screws and back up the adjusting screws so they are only a few turns into the holes before proceeding with head installation.

### 3.1 Installation With Head Holder

The head holder, illustrated in Figure 9, holds a pair of heads with the pads separated and the tailpieces oriented so that both heads may be simultaneously inserted in the head carriage. Proceed as follows:

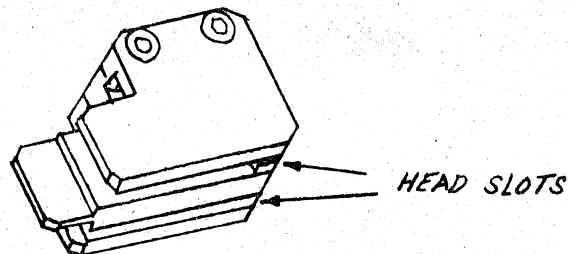


Figure 9 RK05 Head Holder

- a) With the head holder arranged as in Figure 9, place the center section of the lower head suspension arm (pad facing up and to the right) in the lower slot of the holder.
- b) Slide the head forward into the holder, forcing the tailpiece to a straightened position so that the front end of the tailpiece is within the slot of the holder and the head spring retaining screws rest against the thin portion of the holder center section.
- c) Install the upper head in the upper slot of the holder in similar fashion (pad facing down).
- d) Push both heads solidly against the rear wall of the holder.
- e) Disconnect the positioner power cable from J5 of the power supply assembly.

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- f) Screw a pair of head adjusting screws slightly into the rear holes of the carriage (Figure 10). Clamping screws must not be in place.

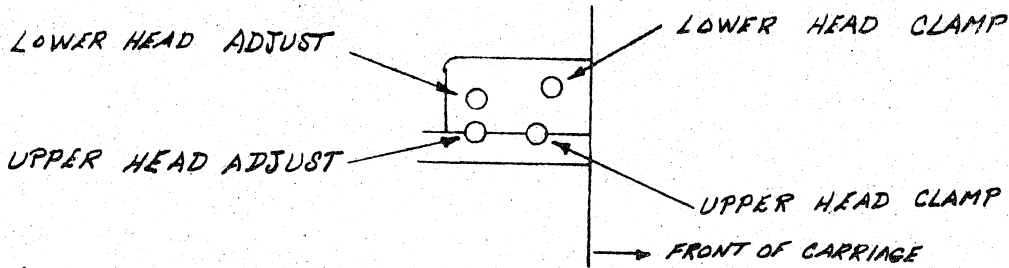


Figure 10: Head Screw Locations

- g) Secure the cartridge opening bail to the front of the positioner in a fully lifted position so as not to obstruct the area in front of the positioner. Use Retaining Fixture 9605892 if available.
- h) Holding the carriage forward with the left hand, grasp the head/holder assembly with the right hand, thumb on top of the holder and index finger and middle finger on the bottom of the holder and carefully insert the head tailpiece shafts into the mating carriage holes. It may be necessary to manipulate the tailpieces slightly to provide the alignment required for easy insertion. Do not force.
- i) With the heads pushed into the tailpiece approximately .060" from the fully seated position, remove the holder. Install clamping screws and tighten lightly.
- j) Secure the head lead spring shields by clamps at front of positioner. Upper head goes to inner clamp. Attach head connector to G180.
- k) Replace P5.
- l) Clean the heads (Section 4).
- m) Proceed to Section 2.6 for alignment.

upper head cable to lower G180 connector

### 3.2 Installation Without Head Holder

- a) Disconnect P5 (positioner power).
- b) Screw a pair of head adjusting screws lightly into the

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carriage. (See Figure 10)

- c) Extend the head carriage in the direction of the disk spindle.

**CAUTION: AVOID TOUCHING THE SURFACES OF THE CERAMIC HEAD PADS DURING INSTALLATION.**

Insert the lower head in position in the carriage.

- d) Move the carriage back to the home position so that the lower head is supported by the lifting block on the plastic disk guide in the front of the positioner.
- e) Install the upper head. It will be necessary to straighten the head out from its natural position in order to clear the lower head during insertion. This is best accomplished by starting with the end of the tailpiece just inside the carriage hole, simultaneously pushing down at the front of the tailpiece and lifting the front of the suspension while pushing backwards. This will force the tailpiece shaft to a horizontal position to allow easier insertion into the carriage hole. Great care must be taken in this operation to avoid over bending the head suspension arm. If the yield point of the head suspension spring is exceeded, this can result in a change in the loading force of the spring. Install the two front head clamping screws and tighten lightly with the tailpieces approximately .060" from the fully seated position.

Upper head cable to lower G180 connector.

- f) Secure head lead spring shields by clamps at front of positioner. Upper head goes to the inner clamp. Replace P5. Replace head connectors on G180.
- g) Clean the heads (Section 4.0).
- h) Proceed to Section 2.6 for alignment.

### 3.3 Removal With Head Holder

- a) Remove drive power. Disconnect P5 (positioner power).
- b) Detach the head cable spring shields from the clamps at the front of the positioner, and detach the head connectors from the G180 read/write module.

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- c) Remove the head clamping screws. See Figure 10.
- d) Place the carriage in fully retracted position.
- e) Reach through the front opening of the positioner and install the head holder.
- f) With the right hand holding the carriage in the retracted position, reach through the positioner front opening and grasp the holder/heads with the left hand, thumb on the closed side of the holder, index and middle fingers on the edges of the head suspension arms at the junction with the tailpieces.
- g) Squeeze to prevent the holder from slipping on the heads and carefully work both heads out of the carriage.

#### 3.4 Removal Without Head Holder

- a) Remove drive power. Disconnect P5 (positioner power).
- b) Detach the head cable spring shields from the clamps at the front of the positioner, and detach the head connectors from the G180 read/write module.
- c) Remove the head clamping screws. See Figure 12.
- d) Place the carriage in the fully retracted position.
- e) Insert the blade of a small screwdriver between the rear of the tailpiece of the upper head and the carriage and twist to work the head partially forward. Use the fingers to extract the head completely.
- f) Move the carriage fully forward. The lower head may be easily removed.

#### 4.0 HEAD CLEANING

Recording Head and Disk Cleaning Kit, Digital Part #2200007 is used.

The following procedure is suggested:

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- a) Remove cartridge from the drive.
- b) Extract a head cleaning pad from its sealed envelope. Insert in the bifurcated end of the cleaning wand and wrap tightly.
- c) Insert the wrapped wand between the retracted head pads and rub each pad gently. If more pressure is required to remove a stubborn accumulation of oxide, use the finger to restrain the head from being reverse bent. In extreme cases it may be necessary to remove a head for cleaning.
- d) Continue rubbing, turning pad if necessary, until head appears clean to inspection.

## 5.0 ALIGNMENT CARTRIDGE

### 5.1 Function

The RK05K-AC Alignment Cartridge provides three tracks (track 105 plus spare tracks 85 and 125) of constant frequency data with alternating sectors recorded at displacements of +2.5 milliinches and -2.5 milliinches from the ideal track locations respectively.

When a head is aligned to specifications, the readback signal shows equal amplitudes for all sectors (as shown when the oscilloscope displays only two sectors and triggered by the SECTOR SIGNAL). The degree of amplitude inequality in alternating sectors is indicative of the departure from exact alignment. See Figures 1-7.

Sector timing data is included on these three tracks to indicate the head gap location relative to sector pulse detection. This data is represented by a single pulse 70 u sec nominal following the INDEX pulse and 10 u sec prior to the onset of head alignment data.

An additional feature of the alignment cartridge is its ability to indicate the degree of runout of the spindle. By triggering the oscilloscope on INDEX and displaying a complete revolution of the disk on the display, the head may appear to be aligned at a few sector locations while misaligned at others. Such a condition is indicative of the degree of wobble of the spindle. Figure 11 shows a display with negligible runout while Figure 12 shows a

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spindle with considerable runout. The amount of wobble can be determined by the amplitude differences occurring in any adjacent pair of sector boundaries by the same equations as used for head alignment. The acceptance criteria for spindle runout is to be determined.

## 5.2 Alignment Cartridge Specifications

Alignment and Sector Timing Tracks:

Primary Track - 105  
Backup Tracks - 85, 125

Recorded Frequency: Nominal 720 KHz

No. of Sectors: 12

Alignment Accuracy, track 105:  $\pm 200$  u in.

Alignment Accuracy, tracks 85, 125:  $\pm 300$  u in.

Sector Timing: Single pulse 70  $\pm$  1 u. sec following INDEX pulse

Fig. 11  
Negligible runout

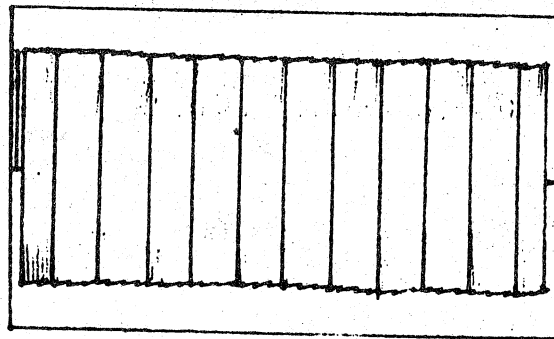


Fig. 12  
Considerable runout.  
NOTE: If this condition exists ensure that mating of spindle and disk are clean. Improper mating can cause such runout.



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