

(NASA-CR-193944) MARSHALL SPACE  
FLIGHT CENTER HEAD DEVELOPMENT  
PROGRAM Final Report (Datatape)  
28 p

N94-34073

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Report for  
**Marshall Space Flight Center  
Head Development Program**

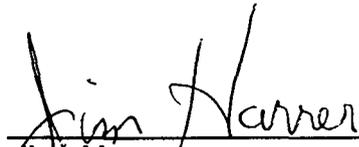
Contract No. NAS8-39407



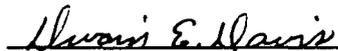
**DATATAPE**  
INCORPORATED

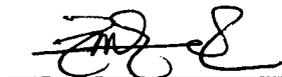
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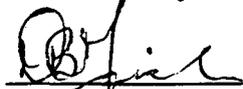
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# 1. INTRODUCTION

This report summarizes the results of the candidate head evaluation for the new long-life magnetic head per the SOW of Contract No. NAS8-39407, MSFC Head Development Program. The original program plans were to test a candidate head, fabricate a new head, then qualify the new head. These activities were scheduled to be carried out between March 1993 and March 1994. The program was halted after the evaluation of the candidate head by NAS8-39407 Amendment No. 4.

MSFC has provided and authorized the use the MARS-2000 SRB QUAL Recorder PN 10400-0677-801 - Serial Number 200004 (Datatape PN 591000 - Serial Number 1004), Reproduce Amplifier Module (RAM) Datatape PN 533040 - Serial Number 2006, associated cables, and magnetic tape on special SRB/DFI tapered reels to Datatape for this program.

All the testing that has been done for the candidate head evaluation was done at Datatape's facility in Pasadena, CA. The testing was performed in a Class 100,000 particle counts clean room at ambient temperature, except for the thermal testing which was conducted in a different area at Datatape.

The Performance Verification Test Procedure PVT-11004-4 (PVT) and Acceptance Test Procedure ATP-11004-09 (ATP) procedures were used when tests were conducted on the recorder .

# 2. CANDIDATE HEAD SELECTION

**OBJECTIVE:** From the Spin Physics heads available, select the most appropriate unit to be the candidate head.

**FINDINGS:** The following heads were available at Datatape for evaluation:

<u>PART NUMBER</u>	<u>SERIAL NUMBER</u>
800527-0001	42462
591036-0000	35928
591036-0000	35962

**CONCLUSION:** Based upon head performance testing and manufacturability Part Number 591036-0000, Serial Number 35962 was selected as the candidate head. This configuration of head is still producible by Spin Physics.

### **3. GENERATE CUSTOMER REPAIR INSTRUCTION REWORK ORDER (CRIRO)**

**OBJECTIVE:** Evaluate GFE units to determine their condition "as received" by Datatape. Log the "as received" configuration. Generate CRIRO to track the units and any work on the units.

**FINDINGS:** No shipment damage or problems were found. Verified the "as received" configuration.

**CONCLUSION:** No special actions were required. Generated CRIRO No. 93-04.

### **4. INITIAL TEST AND EVALUATION**

**OBJECTIVE:** Determine if the recorder required refurbishment prior to conducting head tests. Visual inspection and the Performance Verification Test Procedure PVT-11004-4 (PVT) were used to determine the condition of the recorder.

**FINDINGS:** The following tests from the PVT were performed: Isolation; Flutter; Erase; Frequency Response; SNR; Harmonic Distortion; and BER. The PVT was performed with the Western Magnetics head that was received in the recorder. Only the reproduce electronics were adjusted for the PVT. The record electronics were left "as received" so that the recorder's condition "as received" would not be disturbed. The test results from the 2nd and 3rd harmonic distortion were within spec, but revealed that the record/reproduce electronics should be adjusted. The 3rd harmonic distortion should be near 1% - not the typical 0.3% that was measured for most tracks.

**CONCLUSION:** The PVT test results showed that the recorder was functioning properly and that no recorder refurbishment was required. Initially, the Input/Output Switch Panel of the test fixture was intermittent. The data signal level would change when the switches on the panel were flipped. The intermittence was attributed to oxidation built up on the switch contacts resulting from the panel being in storage. The problem was resolved by using contact cleaner and exercising the switches to remove the oxidation. See Appendix A for the PVT Procedure and Appendix B for the PVT Data sheets.

## 5. ABBREVIATED ATP

**OBJECTIVE:** Determine if any transport function or signal data problems exist in the recorder. The Acceptance Test Procedure ATP-11004-09 (ATP) was used for this test.

**FINDINGS:** The following test from the ATP were performed - Transport functions, Isolation, Flutter, Erase, Reference Oscillator, Frequency Response, SNR, Crosstalk, Harmonic Distortion, Amplitude Stability, Linearity, Intermodulation Distortion, and PCM BER.

The ATP was performed with the Western Magnetics head that was received in the recorder. No realignment of the record/reproduce electronics was done for the abbreviated ATP from the way the recorder was for the PVT. The test findings from the harmonic distortion were the same as in the PVT.

During the Bit-Error-Rate test (BER), a significant dropout was found on Track No. 1 at 2000 feet from Beginning Of Tape (BOT). The BER test was repeated over the first 2500 feet to see if the dropout was repeatable. On the retest a significant dropout was again recorded on Track No. 1 at 2000 feet from BOT. Since the dropout was in the same area and about the same size the dropout was classified as a tape defect.

**CONCLUSION:** There were no problems found in the transport functions or the data signals, only that the record/reproduce electronics should be adjusted. See Appendix C for the ATP Procedure. See Appendix D for the appropriate Data Sheets.

## 6. CANDIDATE HEAD TESTING - SYSTEM

**OBJECTIVE:** Install the candidate head in the recorder, align the record/reproduce electronics, and test the performance of the candidate head in the recorder using Ampex 799 tape that was received with the recorder.

### 6.1 Installation of Candidate Head

**OBJECTIVE:** Install candidate head and align record/reproduce electronics.

**FINDINGS:** The Western Magnetics head, serial number 2154, was removed and replaced by the Spin Physics candidate head, serial number 35962. No

problems were encountered during the installation. During the alignment of the record/reproduce electronics the recorder's operation became intermittent. The recorder would stop moving tape while it was in the run mode. The alignment was stopped and an investigation was started to locate the cause. The cause of the problem was traced to a bad Capstan Motor drive transistor, Q1008. The customer was advised and authorization was obtained to replace transistor Q1008. With approval from USBI/MSFC, the replacement transistor was obtained from the USBI bonded stock at Datatape. Transistor Q1008 was replaced, then the transport functions and tape speed were tested.

The alignment for the candidate head was restarted. The record/reproduce electronics were setup as follows:

bias current - adjusted for 2 dB over-bias of the 250 KHz data signal when 50% of the nominal signal level is applied;

data current - adjusted for 1% third harmonic distortion of 25 KHz reproduced data signal;

output level - adjusted for 1 Vrms (0 db) output at 25 KHz with 1 Vrms input signal.

output response - adjusted for 1 Vrms output at 10 KHz, 25 KHz, and 100 KHz and adjusted 250 KHz for -1 to -2 dB down from the reference signal at 25 KHz;

phase - adjusted using 25 KHz square wave.

During the alignment process the tape had deteriorated to the point that the head stacks were continually getting dirty and resulted in the data signal levels changing erratically. Up until this point in time the tape that was received with the recorder was being used. Ampex 799 tape, Serial number A87-1021, was removed and replaced by another Ampex 799 tape, Serial Number A88-1038, supplied by USBI/MSFC.

After the record/reproduce electronics were aligned the reproduce output was checked out to 18 MHz, using a HP3585A Spectrum Analyzer, in search of the 5MHz oscillation that was observed in the original Spin Physics head. No oscillations were present, but the bias frequency was present during record.

A frequency sweep was made from 0 Hz to 300 KHz, using the HP3583A's internal generator, on Track No. 1, 2, 7, 8, 13, and 14 to check the flatness of the frequency response.

## 6.2 ATP Ambient Temperature Test (test aborted)

**OBJECTIVE:** Test Flutter, Erase, Frequency Response, SNR, Crosstalk, Harmonic Distortion, Linearity, Intermodulation, and PCM BER.

**FINDINGS:** The ATP was aborted due to data signal levels changing erratically. The following tests were completed before the ATP was aborted - Frequency Response, SNR, and Harmonic Distortion. During the crosstalk test it was noticed that the data signal levels were erratic and acted like the first Ampex 799 tape that was received with the recorder. The ATP was aborted to look into the erratic signal levels. See Appendix C for the ATP Procedure. See Appendix E for the appropriate Data Sheets.

The tape was removed from the recorder and processed through a tape cleaner. Then the recorder with the tape was placed in a temperature chamber at 35°C / 35% R.H. for 93 hours and 25°C / 35% R.H. for 22 hours to stabilize the tape, see Appendix F for the temperature chamber charts. After the tape cleaning and stabilizing, variations in the data signal were still observed. A new reel of AMPEX 797-57GJ11 tape was procured from Datatape's stockroom and installed on the recorder. The Datatape part number for this tape is 477797-2462 the AMPEX serial number for this tape is 769301500304 DC 92129. This reel of AMPEX 797 tape does not have windows at BOT or at EOT to stop the recorder. Additionally, the tape is not on a tapered flange reel.

In order to see if the data signal level would vary with this new tape a 250 KHz band-edge signal was recorded. The recorded test signal was sequenced through all the tracks twice. Then the signal was played back over an additional 19 reverse/forward cycles to check for signal level variation. No signal variation as seen with this tape. The record/reproduce electronics were then aligned for this reel of Ampex 797 tape.

## 6.3 ATP Ambient Temperature Test (new Ampex 797)

**OBJECTIVE:** Test Flutter, Erase, Frequency Response, SNR, Crosstalk, Harmonic Distortion, Linearity, Intermodulation, and PCM BER.

**FINDINGS:** The procedure used to adjust the reproduce electronics provided for a flat response at 10 KHz, 25 KHz, and 100 KHz. By adjusting for a flat response at these frequencies the resulting low frequency response for the

candidate head was measured. The reproduce electronics could have been adjusted to pickup the low frequency by giving up flatness at 10 KHZ. The low frequency response (300Hz) for Tracks 3 and 4 were at the spec limit, -3 dB. See Appendix C for the ATP Procedure. See Appendix G for the appropriate Data sheets.

#### 6.4 ATP Thermal Cycle (new Ampex 797)

**OBJECTIVE:** Two cycles (+31°F to +100°F) test Flutter, Frequency Response, SNR.

**FINDINGS:** A point on the end opposite of the connectors near the screws that hold the transistor heat sink bar was used for the monitoring the thermal mass. See Appendix C for the ATP Procedure. See Appendix G for the appropriate Data sheets.

**CONCLUSION:** The candidate head performance was relatively consistent throughout the Thermal cycle. The 300 Hz level on Track 4 was slightly out of spec at +31°F during cycle 1. It was 3.5 db down from the 25 KHz level. There were several tracks that were at the -3.0 dB limit. The thermal cycle did not cause a shift in the candidate head.

### 7. 375 FT LOAD TEST

**OBJECTIVE:** Test the performance of the candidate head when loaded with 375 feet of cable. The cable was designed to only load Tracks 1, 3, 5, 9, 11 and 13.

**FINDINGS:** The 375 foot test cable was connected between Recorder J106 (Odd Data Output) and Reproduce Amplifier Module (RAM) J151 (Data Input). An overall reduction was noted for signals passing through the cable. It measured approximately 1.5 dB at 25 KHz. The greatest reduction was at upper bandedge, but in no case was the normalized frequency response down more than 2 dB. No attempt was made to realign the reproduce electronics to match the long cable, but the capability should be well within the range of the reproduce amplifier equalization circuits. There was no evidence of any oscillation when the reproduce output was checked out to 18 MHz.

**READINGS TAKEN WITH NORMAL CABLE LENGHT**

TRACK	300 Hz	25 KHz	100 KHz	250 KHz
1	-2.5	0	0	-1.5
3	-3.0	0	.5	-1.0
5	-2.5	0	0	-1.0
9	-2.5	.5	.5	-1.0
11	-2.5	0	.5	-1.0
13	-2.0	0	.5	-2.0

**READINGS TAKEN WITH 375 FT CABLE**

TRACK	300 Hz	25 KHz	100 KHz	250 KHz
1	-4.5	-1.5	-2.0	-5.0
3	-4.5	-1.5	-2.0	-4.5
5	-4.0	-1.5	-2.0	-4.5
9	-4.0	-1.5	-2.0	-4.5
11	-4.5	-1.5	-2.0	-4.0
13	-4.0	-1.5	-2.0	-5.5

**DIFFERENCE BETWEEN NORMAL CABLE & 375 FT CABLE**

TRACK	300 Hz	25 KHz	100 KHz	250 KHz
1	-2.0	-1.5	-2.0	-3.5
3	-1.5	-1.5	-2.5	-3.5
5	-1.5	-1.5	-2.0	-3.5
9	-1.5	-2.0	-2.5	-3.5
11	-2.0	-1.5	-2.5	-3.0
13	-2.0	-1.5	-2.5	-3.5

### NORMALIZED READINGS FOR 375 FT CABLE

TRACK	300 Hz	25 KHz	100 KHz	250 KHz
1	-.5	0	-0.5	-2.0
3	0	0	-1.0	-2.0
5	0	0	-0.5	-2.0
9	.5	0	-0.5	-1.5
11	-.5	0	-1.0	-1.5
13	-.5	0	-1.0	-2.0

**CONCLUSION:** The candidate head functioned properly with the 375 foot cable load.

## 8. HEAD SPECIFICATION

**OBJECTIVE:** Revise the head specification Datatape drawing number 591037 based upon findings of the candidate head evaluation.

**FINDINGS:** See Appendix H for the summary matrix. Since the discussion in Dec '93 some additional changes were added to the changes in the head drawing:

added para 2.4 MII-E-5400K to applicable documents - it is used in para 3.7.5.2

clarified para 3.2.7 Bias Current - adjustment is done at 50% nominal input signal

revised para 3.4.3.2 - will use  $V_{pp}$  instead of  $V_{rms}$  and use  $mApp$  instead of  $mArms$  - readings are taken peak-to-peak.

correction para 3.4.3.8 matrix indicated M16878/4 wire, wire used will be 30 AWG M22759/11 type.

revised para 3.4.3.10 should read ...pattern on tape consisting... - typo

clarified para 3.5.2 crosscoupling - taken without tape motion

revised para 3.7.5.2 revision on spec - make same as the recorder

See Appendix I for updated Head Specification 591037 Rev C.

**CONCLUSION:** The existing design of the candidate head Part Number 591036, Serial number 35962, is a usable design that should satisfy the data performance and head life requirements of the SRB/DFI program.

## APPENDIX H

### Head Spec Change Summary Matrix

**SUMMARY MATRIX ON MARSHALL LONG-LIFE-HEAD QUALIFICATION. F1944. REV. A**

Paragraph	Subject	800527 Rev. J	591037 Rev. A	591037 Rev. B	591037-C Recomm'd	worst 1st article	worst sys. data	Comments
3.2.2	Tension (oz.)	12-16	10-14	10-14	10-14	11	11	
3.2.3	Tape Type	766	766	799	799-A1B	797	799/ 797	A1B tape has been flown on OEX, MADs. Also installed on MSL.
3.2.5	Data Freq.	100Hz - 250KH z	100Hz - 250KHz	300Hz - 250KHz	200Hz - 250KHz	100Hz / 250KHz	300Hz / 250KHz	Western had problems at 300Hz. Spin response ok to 100.
3.2.6	Repro Head Termination fig.3	3	3	3	3	3	591155	591155 has a gain of 24, fig.3 has 100
3.2.7	Bias Current (-db)	3	3	2	2	2	2	I-band/W-band Tape compensation.
3.3.11.3	Non-metallic material	lead	lead	lead	head	N/A	N/A	Typo.
3.4.3.1	Bias Voltage (V-RMS.)	17	17	17	9.7	9.55	9.2	Wide band tape with lower Voltage
3.4.3.1	Bias Current (mA-RMS)	25	25	25	20	18.4	15.2	Wide band tape with lower current
3.4.3.3	Data Current/Ref. (mA/KHz)	2.5/1	2.5/25	2.5/25	2.5/25	2.12/25		Wide band Tape response
3.4.3.4	Inductance (μ-henry)	50±20	50±20	50±20	40±15	32	N/A	Actual test results are much lower
3.4.3.5	Q at 1 KHz	KC	KC	KC	KHz	N/A	N/A	Consistency
3.4.3.8	Cable- 2-Conductor Twisted (Mil-STD-*****)/***AWG.	N/A	N/A	N/A	16878/4, 30AWG	N/A	N/A	Clarification
3.4.3.8.2	Track Numbering....Figures 6.2	Figures no-unit	Figures no-unit	Figures no-unit	Figure RMS	N/A	N/A	Typo
3.4.4.1.	Output in microamps	16878	16878	16878	c-27500, 22759/11	N/A	RMS	Test data taken as RMS value
3.4.4.3	Cable- Mil-W-16878, vinyl	16878	16878	16878		N/A	N/A	Spin uses Teflon wires, Individual wires are w-22759/11
3.5.1	Crosstalk, 30/200hz-1k, Preamp p/n 804691	30/200/ 804691	30/200/ 804691	22/300/ 804691	28/300 / fig 3	30/300/ fig 3	32/300/ 591155	Western Heads had problem below 300Hz. 804691 in error, correct ref. is fig. 3
3.5.2..	Crosscoupling 35/100hz-250k/ Preamp p/n 804691	35/100/ 804691	35/100/ 804691	35/100/ 804691	35/200/ fig 3	38/200/ fig 3	N/A	Neither Western or Spin would pass 100Hz 804691 in error, correct ref. is fig. 3.
3.6	Head life (hrs)	500	500	200	1000	N/A	N/A	Hard tipped heads per Spin Physics
4.1.1	Testing IRIG 118-79	71	79	79	82	N/A	N/A	Consistent with applicable IRIG document.
4.2.1	Testing IRIG 118-79	71	79	79	82	N/A	N/A	Consistent with applicable IRIG document
4.3.3	Slot noise measurement termination ( fig-3 )	not shown	not shown	not shown	fig-3	N/A	N/A	Added fig-3 for clarification
4.4.5	Crosstalk measurement	30/200	30/200	22/300	28/300	30/300	32/300	Improved response on Spin Head

**APPENDIX I**

**Revised Head Specification**

**591037 Revision C**

591037

APPLICATION		REVISIONS					
NEXT ASSY	USED ON	LTR	ECN	DESCRIPTION	DATE	BY	APP.
	SRB MARS 2000	A	—	RELEASED TO PRODUCTION	4/20/87	ABC	ET EW
	B11004	B	43751	INC PER ECN	9/15/89	JR	EW
		C	47505	REDRAWN WITH CHANGES	2/3/94	RW	EW

ONLY THE ITEMS DESCRIBED ON THIS DRAWING, WHEN PROCURED FROM THE SUPPLIER LISTED HEREON IS APPROVED BY DATATAPE INCORPORATED FOR USE IN THE APPLICATIONS WHERE SPECIFIED. A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR TESTING AND APPROVAL BY DATATAPE INCORPORATED.

IDENTIFICATION OF THE APPROVED SOURCE (S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OF CONTIUNED AVAILABILTY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBES ON THE DRAWING.

**PROCUREMENT SPECIFICATION**

HEAD, MAGNETIC TAPE, RECORD/REPRODUCE SUBASSEMBLY,  
14 CHANNELS INTERLACED ANALOG  
INTERMEDIATE BAND

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APPROVED SUPPLIER	
WESTERN MAGNETICS, INC. GLENDALE, CA CAGE: 26549	SIMILAR TO: 800527 REV J. SEE PARA 3.1.5
SPIN PHYSICS INC. SAN DIEGO, CA CAGE: 31728	REV C IS LONG LIFE CONFIGURATION OF REV B

SOURCE CONTROL DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.	DO NOT SCALE DRAWING		<b>DATATAPE</b> INCORPORATED Pasadena, California	
	TOLERANCES	SIGNATURE		
ANGULAR —	DRAWN A. B. COOK	4/87	<b>HEAD, MAGNETIC TAPE</b>	
DECIMAL 2 PL —	CHK E. TRENKLER	4/87		
DECIMAL 3 PL —	DESIGN			
MATERIAL	APPROVAL A. B. COOK	4/87		
	E. WEBSTER	4/87		
NOTED	Q.A. A. REA	4/87	SIZE A    CODE IDENT. NO. 14028    DWG. NO. 591037    LTR C	
SCALE —		ISSUE:	SHEET 1 OF 12	

↓

## GENERAL

### 1.0 SCOPE

- 1.1 This specification covers a 14 track record/reproduce head stack assembly for use in an airborne instrumentation tape recorder.
- 1.2 The head stack assembly shall consist of two (2) interlaced seven (7) track record head stacks and two (2) interlaced seven (7) track reproduce head stacks arranged in a single mounting assembly.

### 2.0 APPLICABLE DOCUMENTS

- 2.1 IRIG 106-80 except as noted herein.
- 2.2 MIL-STD-202F except as noted herein.
- 2.3 IRIG-118-82 except as noted herein.
- 2.4 MIL-E-5400T Curve II except as noted herein.

### 3.0 REQUIREMENTS

#### 3.1 GENERAL

- 3.1.1 The head stack assembly shall be in accordance with this specification and the applicable documents listed in 2.0.
- 3.1.2 In the event of conflicts between the requirements of this specification and any applicable documents, this specification shall take precedence.
- 3.1.3 Definition of Terms - Unless otherwise specified herein, terms as defined in IRIG 106-80 shall apply.
- 3.1.4 Configuration  
Shall be configured with two (2) record head stacks and two (2) reproduce head stacks and shall meet all sections of this specification.

SIZE	PRINT CODE IDENT NO.	DWG NO.	
A	14028	591037	
SCALE	—	REV.	SHEET
		C	2

- 3.1.5 This drawing is the same as 800527 Rev. J Basic except:
- Para. 3.2.2 Tape tension was 14 oz.
  - Para. 3.2.3 Tape Type was AMPEX 766.
  - Para. 3.2.7 Bias Current was adjusted for 3 db.
  - Para. 3.4.3.3 Data Current was adjusted at 1.0 KHz.
  - Para. 3.5.1 Was 30 db over frequency 200 Hz to 1 KHz.
  - Para. 3.6 Head life was 500 hours minimum.
- All dates on referenced IRIG Documents updated.
- Para. 3.2.5 Was 100 Hz.
  - Para. 4.4.5 22 db was 30 db, 300 Hz was 200 Hz.

3.2 Standard Conditions

- 3.2.1 Tape Speed: 60 ips
- 3.2.2 Tape Tension: 12 oz  $\pm$  2 oz
- 3.2.3 Tape Type: Ampex 799 or 799-A1B
- 3.2.4 Bias Frequency: 4.85 KHz
- 3.2.5 Data Frequency: 200 Hz to 250 KHz (When using Ampex 799)
- 3.2.6 Reproduce Head Termination: Datatape current mode preamplifier, Part No. 804691, per Figure 3.

3.2.7 Normal Record Level - Is herein defined as the bias and data signal current requirements of a head when trimmed as follows:

Bias Current: - Adjust for maximum reproduce data signal of 250 KHz at 50% of normal input signal and then over-bias for a 2 db reduction of the 250 KHz data signal.

Data Current: - Adjust for 1% third harmonic distortion of a 25 KHz reproduce data signal.

3.2.8 Normal Reproduce Level - Is herein defined as the output voltage level appearing at the output of the Datatape current mode preamplifier, circuit shown in Figure 3, when reproducing a tape recorded using normal record levels.

SIZE	PRINT CODE IDENT NO.	DWG NO.
A	14028	591037
SCALE	REV.	C
		SHEET 3

3.3 **Mechanical Requirements**

3.3.1 Outline, detail dimensions, and mounting shall be in accordance with Datatype Drawing 591037, Figures 1 and 2.

3.3.2 Number of Tracks: 14

3.3.3 Track Spacing: .070 in. interlaced

3.3.4 **Effective Track Width**

Record: .050 ± .002 inch

Reproduce: .050 ± .002 inch

3.3.5 **Head Stack Tilt:** - The plane tangent to the front surface of the head stack at the centerline of the lead gaps shall be perpendicular to the head mounting plate within ± 3 minutes of arc.

3.3.6 **Gap Scatter:** - Head gap centerlines shall be located within two parallel lines that are separated by 0.0001 inch or less.

3.3.7 **Mean Gap Azimuth Alignment:** - The mean gap azimuth shall be perpendicular to the head mounting plate within ± 1 minute of arc.

3.3.8 **Angular Gap Alignment:** - The head stacks shall be assembled on the base plate such that the centerline of the gaps of each head stack is the perpendicular bisector of the tape wrap angle within ± 15 minutes of arc.

3.3.9 **Head Location:** - Any head within a head stack shall be located within ± 0.002 inch of the nominal position required to match track location per figure 6-1 and Table 6-2 of IRIG 106-80.

3.3.10 **Head Stack Placement:** - The two stacks of a head pair (record or reproduce) shall be mounted in such a manner that the centerlines through the head gaps of each stack are parallel and spaced 1.500 ± 0.001 inches apart (tape travel distance).

3.3.11 **Head Surface**

3.3.11.1 The head surface contacting the tape shall be all metal faced.

3.3.11.2 All surfaces contacting the tape shall have a finish to 8 microinches or better.

3.3.11.3 Non-metallic materials (plastic or epoxy used in constructing the head) shall be kept to a minimum and shall not contribute to the build-up of deposits on the head or otherwise degrade performance for the life of the head as defined in paragraph 3.6 of this specification.

3.3.11.4 Passage of 100,000 feet of tape over the head shall cause no adhering of oxide or other deposits to the head surface.

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3.3.12 Azimuth Adjustment

3.3.12.1 No azimuth adjustment required.

3.4 Electrical Requirements

3.4.1 Grounding: - All housings, shields, and cores shall have less than 1 ohm resistance to mounting surface.

3.4.2 Insulation: - Each winding shall withstand 50 v rms 60 Hz for 10 seconds applied between it and the housing.

3.4.3 Record Head

3.4.3.1 Bias Voltage and Current Limits:- All record tracks in the head assembly shall be within the following limits when set for the normal bias current as specified in paragraph 3.2.7.

Bias Voltage:- The track that requires the highest bias voltage shall not exceed 27 Vpp; however, if it is less than 14 Vpp, it must satisfy the equation in paragraph 3.4.3.2.

Bias Current: - No track shall exceed 56 ma peak-to-peak.

3.4.3.2 Bias Voltage and Current Variation Between Tracks: - The bias voltage and current requirements on all tracks shall satisfy the following equation:

$$\frac{\sqrt{V_h^2 - V_x^2}}{I_x} \leq 1500 \text{ ohms}$$

Where  $V_h$  is 14 Vpp of the voltage for the track which requires the highest voltage whichever is greater,  $V_x$  and  $I_x$  are the voltage and current required by each of the other tracks in the head assembly.

3.4.3.3 Data Current:- Requirements shall not exceed 2.5 ma rms when adjusted for 1% third harmonic distortion of a 25 KHz reproduce data signal.

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- 3.4.3.4 **Inductance:-**  $40 \pm 15$  microhenrys at 1 KHz with .1 volt rms across winding.
- 3.4.3.5 **"Q":-** 0.3 or greater at 1 KHz with a .1 volt rms across winding.
- 3.4.3.6 **Self Resonance:-** 6 MHz or higher with .1 ma rms in winding.
- 3.4.3.7 **Saturation:-** Head core and/or tip saturation shall not occur prior to tape saturation.
- 3.4.3.8 **Cable:-** Twisted red and black 30 AWG pair 18 inches long. Conductors per MIL-W-22759/11 except 30 AWG: M22759/11-30-2 (Red) and M22759/11-30-0 (Blk).
- 3.4.3.8.1 Each cable shall be identified with track number approximately 3 inches from head.
- 3.4.3.8.2 Track numbering shall be in accordance with figure 6-2 of IRIG 106-80.
- 3.4.3.9 **Gap Length:** - As required.
- 3.4.3.10 **Winding Polarity:-** A positive going pulse applied to the red lead with respect to the black lead shall cause a magnetic pattern on the tape consisting of a polarity sequence of south-north-north-south.
- 3.4.4 **Reproduce Head**
- 3.4.4.1 **Output:** - 7 to 14 microamps rms at 1.0 KHz, the 200 Hz output shall be  $2 \text{ db} \pm 2.0 \text{ db}$  below the 1.0 KHz output, and the 250 KHz output shall be  $25 \text{ db} \pm 5.0 \text{ db}$  below the 1.0 KHz output.
- 3.4.4.2 **Slot Signal to Noise Ratio:** - The ratio of rms signal to rms noise shall not be less than 65 db as measured per paragraph 4.3 of this specification.
- 3.4.4.3 **Cable:** - Twisted red and black 30 AWG pair, with silver-coated copper shield, with teflon jacket, and 18 inches long. Cable per MIL-C-27500 except 30 AWG conductors and red and black colors. Cable M27500-30-RC-2-S-09
- 3.4.4.3.1 Each cable shall be identified with track number approximately 3 inches from the head.
- 3.4.4.3.2 Track numbering shall be in accordance with figure 6-2 of IRIG 106-80.
- 3.4.4.4 **Winding Polarity** - A magnetic flux sequence of south-north-north-south polarity passed across the head shall produce a positive pulse at the red wire with respect to the black.

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**3.5**      Crosstalk and Crosscoupling

**3.5.1**      Crosstalk is herein defined as the rms reproduce voltage of the track under test appearing at the output of the Datatape current mode preamplifier, Part No. 804691 upon playback of a tape recorded with all tracks recording at normal record level except that track under test. This voltage shall not be greater than 45 db below the normal record level of that track under test over the frequency spectrum of 1 KHz to 250 KHz nor shall this voltage be greater than 28 db below the normal record level of that track under test over the frequency spectrum of 300 Hz to 1 KHz.

**3.5.2**      Crosscoupling is herein defined as the rms reproduce voltage appearing at the output of the Datatape current mode preamplifier, Part No. 804691 with normal record current applied to all record heads without tape motion. This voltage shall not be greater than 35 db below the normal playback level of that track under test over the frequency spectrum of 200 Hz to 250 KHz.

**3.6**      Head Life - Heads shall perform as required in this specification for a cumulative operating life of 1000 hours minimum.

**3.7**      Environmental Requirements

**3.7.1**      Storage Temperature:      -65° C to +85° C

**3.7.2**      Operating Temperature:      -20° C to +71° C

**3.7.3**      Altitude:      Sea level to 50,000 feet

**3.7.4**      Humidity:      Relative humidity up to 95%

**3.7.5**      Vibration:

**3.7.5.1**      The natural frequency of the head stack assembly shall be higher than 700 Hz.

**3.7.5.2**      The head stack assembly shall operate within the requirements of this specification when subjected to a vibration environment per Curve II of MIL-E-5400T in any axis.

**3.7.6**      Shock: - The head stack assembly shall survive a 15 g, 11 ms shock in any axis.

**3.7.7**      Thermal Rate of Change: - The head stack assembly shall operate within the requirements of this specification and not be damaged when subjected to a thermal rate of change of 3° C per minute throughout the entire operating temperature range.

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4.0 TEST METHODS

4.1 General

4.1.1 Testing shall be in accordance with procedure outlined in IRIG 118-82 and MIL-STD-202F except as noted herein.

4.1.2 In event of conflicts between the test methods outlined in the specification and those of any applicable documents, this specification shall take precedence.

4.2 Winding Polarity

4.2.1 Testing shall be in accordance with IRIG 118-82 used with amplifiers without signal inversion.

4.3 Slot Signal-to-Noise Ratio Test Procedure

4.3.1 Record a 250 KHz data signal using Standard Conditions per 3.2 above and normal record levels.

4.3.2 Rewind tape and reproduce the recorded signal.

4.3.3 Measure the output current level using the Datatape current mode preamplifier, circuit shown in Figure 3, followed by a wave analyzer having a 3 to 5 KHz slot bandwidth centered at 250 KHz.

4.3.4 Stop transport and measure noise output using the same set-up as in 4.3.3 above.

4.3.5 The ratio of the rms signal measured in 4.3.3 above to the rms noise measured in 4.3.4 above is the slot signal-to-noise ratio. This shall be greater than 65 db.

4.4 Crosstalk Test Procedure

4.4.1 Record a 250 KHz data signal on the track under test using Standard Conditions per 3.2 above and normal record levels.

4.4.2 Rewind tape and measure the reproduce data signal level of the track under test.

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- 4.4.3 Degauss the tape and record a 250 KHz data signal on all tracks except the track under test.
- 4.4.4 Rewind tape and measure the reproduce level of the track under test using a wave analyzer.
- 4.4.5 The rms level measured in 4.4.4 above is the crosstalk measurement and this shall be greater than 45 db below the normal reproduce level measured in 4.4.2 above over the frequency spectrum of 1 KHz to 250 KHz and greater than 28 db over the frequency spectrum of 300 Hz to 1 KHz.

5.0 PREPARATION FOR DELIVERY

- 5.1 GENERAL: - Deliverable units shall be preserved, packaged, packed and marked in accordance with standards of best commercial practice.

6.0 QUALITY CONTROL DATA LOGGING

- 6.1 GENERAL: - Applicable test data taken at the vendor's facility shall be submitted upon delivery of each head stack assembly on the vendor's format in accordance with standards of best commercial practice.

7.0 IDENTIFICATION

- 7.1 Each head assembly shall be identified with Part No., Revision letter and Serial No. at location indicated in Figure 1 in accordance with MIL-STD-130. Use Datatape 546715 Identification Plate. Engrave characters .04 C to C, Godeon Condensed.

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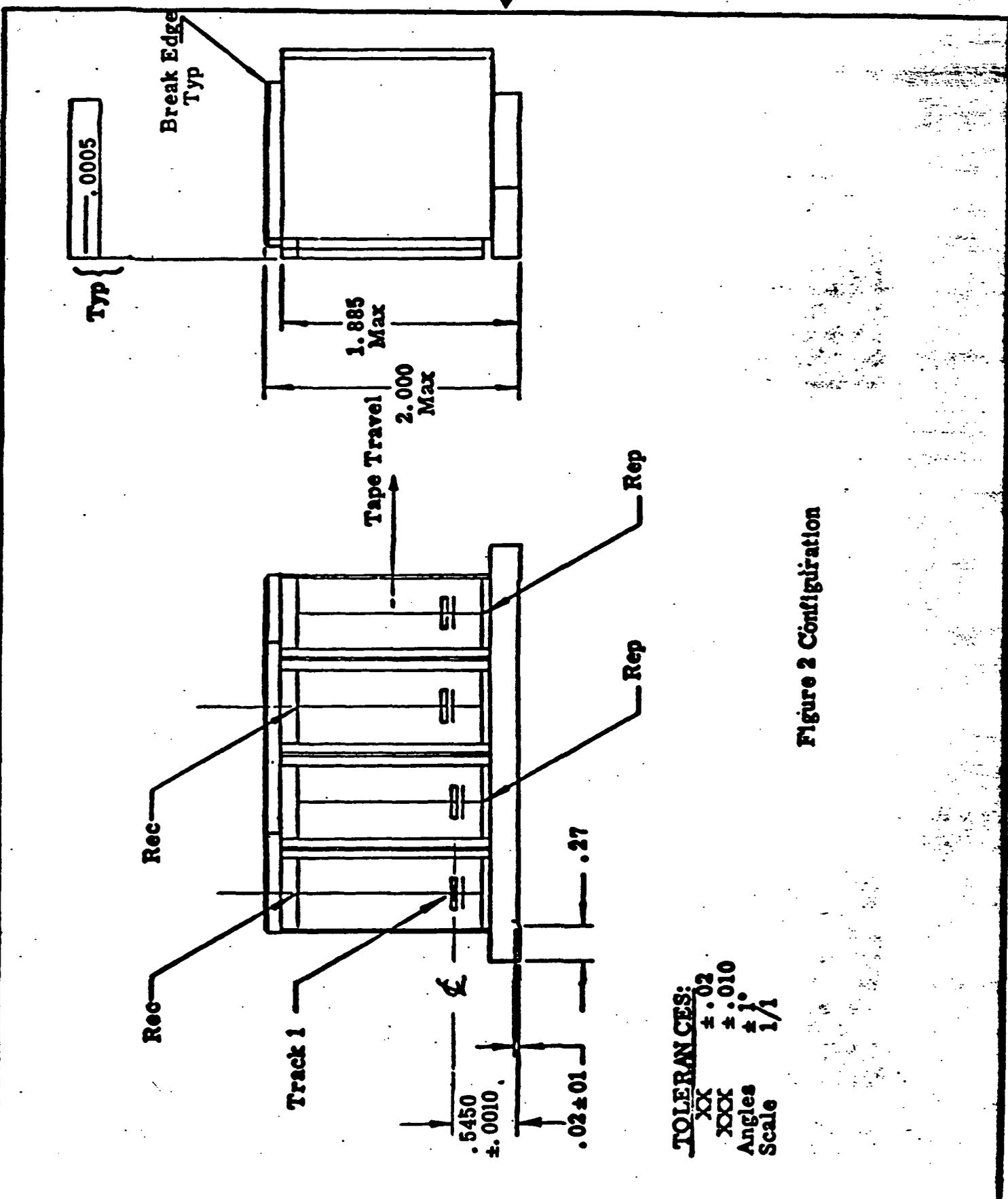


Figure 2 Configuration

ORIGINAL

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SCALE <i>NONE</i>	REV. <b>C</b>	SHEET <b>II</b>

