TM 55-4920-243-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DS, GS AND DEPOT MAINTENANCE MANUAL

VIBRATION MONITORING KIT (FSN 4920-879-0331)

This copy is a reprint which includes current pages from Changes 2 thru 8.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JULY 1968

CHANGE
No. 8

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 January 1992

Operator, Organizational, DS, GS, and Depot Maintenance Manual

VIBRATION MONITORING KIT
NSN 4920-00-879-0331
(P/N 171170-0104)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Page 1-12, Figure 1-13, item 6, 2nd column under T53 Series Engine, Change "1" to "0."

Page 1-13, Figure 1-14, last column, 2nd block, under No. 3 Transducer, change "171578 Power Turbine Oil Feed Line" to "N/A."

Page 1-13, Figure 1-14, 1st column under Engine, after T63-A-5, add "T63-A-700."

Page 1-13, Figure 1-14, last column, third block, under No. 3 Transducer, change "N/A" to "687 2473 Accessory Gear Box, Test Cell Use Only."

Page 3-1, Delete Change 4 to TM, which states, "Note 1. When forwarding unit to depot, send unit only. Do not send entire Vibration Monitoring Kit to Depot."

Add 2028s and Metric page.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
01207

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CHANGE
No. 7

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WASHINGTON, DC., 21 October 1987

Operator, Organizational, DS, GS, and Depot Maintenance Manual

VIBRATION MONITORING KIT
NSN 4920-00-879-0331
(P/N 171170-0104)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Page i. Between the manual title and table of contents, add the following:

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manusl. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Aviation Systems Command, ATTN: AMSAV-MPSD, 4300 Goodfellow Blvd., St. Louis, Missouri 63120-1798. A reply will be furnished directly to you.

Page i. LIST OF ILLUSTRATIONS, after Figure 1-12 ..., add "1-12A. T63-A-720 Engine Vibration Test Data Sheet".

Page 1-11. After Figure 1-12, add new illustration "Figure 1-12A. T63-A-720 Engine Vibration Test Data Sheet".

Page 2-2. Figure and Index Number 2-1, item 4, change Part Number "171589-0001" to read "171589-1".

Page 2-2. Figure and Index Number 2-1, item 6, change Part Number "171589-0002" to read "171589-2".

Page 2-6. Figure and Index Number 2-4, first Part Number, change "171589-0001" to read "171589-1".

Page 2-6. Figure and Index Number 2-4, second Part Number, change "171589-0002" to read "171589-2".

T63-A-720 ENGINE VIBRATION TEST DATA SHEET

Engine Serial No. _____ (TSN) _____

Last Overhaul Location _____ (TSLO) _____

Aircraft Serial No. _____ A/C Time _____

Test Location _____ Date _____

Tested By _____ Observer _____

Engine Passed Test-Accepted ☐ Engine Failed Test ☐

VIBRATION LIMITS 200 CPS FILTER

	Actual	Max Allowable *
Compressure Transient		2.0 in./sec
Compressure Steady State		.9 in./sec
Turbine Transient		3.0 in./sec
Turbine Steady State		1.5 in./sec

* Maximum allowable engine vibration (velocity).

Vibration meter OPERATION selector switch must be set to V (velocity) position.

Figure 1-12A. T63-A-720 Engine Vibration Test Data Sheet

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

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CHANGE
No. 6

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Operator, Organizational, DS, GS, and Depot Maintenance Manual

VIBRATION MONITORING KIT
NSN 4920-00-879-0331
(P/N 171170-0104)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Page 1-5. Paragraphs 1-11A and 1-11B are added after paragraph 11.

1-11A. MODIFICATION OF VIBRATION MONITOR 1-117, FOR USE WITH ACTIVE FILTERS.

a. This modification will provide power to operate the active filters in the same sockets used for passive filters. Each vibration will then operate with active and/or passive filters. If the monitor has already been modified, there will be a label so stating on the rear of the chassis. A label is furnished with each active filter for an unmodified monitor that is changed.

b. Equipment required to perform the modification.

(1) Soldering iron, solder flux and solder wick.

(2) 20 or 22 gauge single conductor, stranded, insulated wire.

(3) Wire cutters.

(4) Wire strippers.

(5) Voltmeter, AC for 1-117 Vibration Monitor.

1-11B. MODIFICATION PROCEDURE FOR 1-117 VIBRATION MONITOR.

a. Turn power switch off and disconnect instrument from power source.

b. Remove cover from instrument.

c. Locate "Power On" indicator lamp assembly (Marked I-1 on figure 1-6A.).

d. On the lamp assembly there are two terminal lugs with one wire in each lug. There is an additional hole in each lug, strip and insert one wire of the twisted pair into one terminal and the other wire into the other terminal.

e. Solder both of these connections.

f. Route the wires from the lamp assembly following the existing wire harness around the switch and out to the first filter socket J8 (refer to figure 1-6A, I-1).

g. Measure the wires for the proper length to solder into terminals 4 and 6 on the socket.

h. Cut and strip the wires and attach one wire to terminal 4 and one wire to terminal 6. Do not solder. (Polarity of wires is not important.)

i. Cut and strip each wire in the remaining pair and attach them to terminals 4 and 6 of J8. Solder both of the connections.

j. Route the wires from J8 to J9 (refer to figure 1-6A) and attach to terminals 4 and 6 as shown in step h above.

k. Repeat steps *h* and *i* for the wires to terminals 4 and 6 of J10.

l. Check all wires for good solder joints and shorts.

m. Tie into existing harness by using nylon tiewraps or lacing string.

n. Plug the instrument into a power source and turn the power switch ON. Use CAUTION as high voltages are present in the instrument.

o. Using the A.C. Voltmeter measure the voltage between pins 4 and 6 of J8, J9 and J10. It should read approximately 8 Vac. The A.C. Voltage between pin 4 and chassis and pin 6 and chassis should be approximately 4 Vac. No voltage should be present on any of the other pins.

p. Install the filters as required and check operation as outlined in this manual.

q. Turn power off, unplug unit from the power source and put case back on unit.

r. Install modification tag (furnished with filter) in line with, and to the right of the existing nameplate on the back of the instrument.

Page 1-5. Figure 1-6A is added.

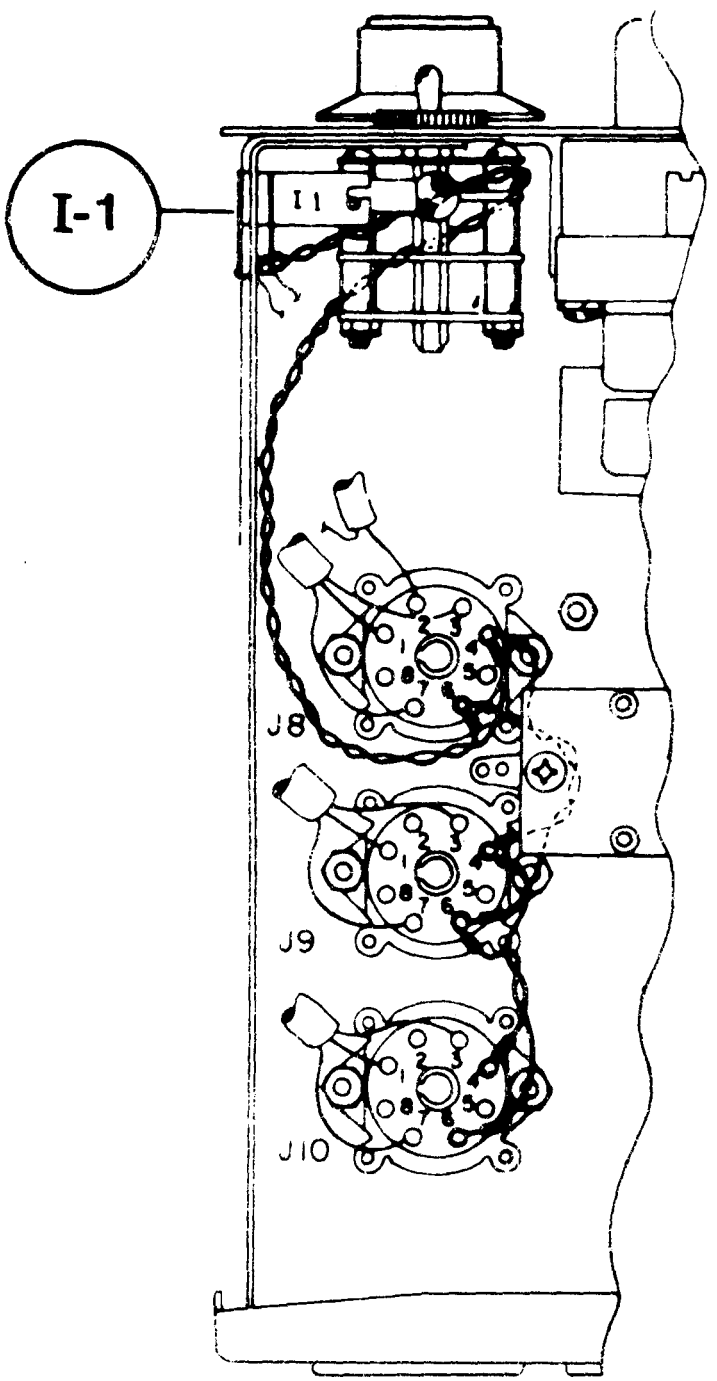

Figure 1-6A. Vibration Monitor Modification and Installation

Page 1-12. Figure 1-13. The following items are changed as follows:

	T55 Series Engine	T63 Series Engine
	5/7	5A
15. Bracket Accessory Gearbox CEC P/N 6872473		1
16. Filter, 213 cps CEC P/N 367112-0100, NSN 4920-00-078-2574	1	

Page 1-12, figure 1-13. Note is added as follows:

NOTE

P/N 6872473 is used only in test stand operation.

Page 1-13, figure 1-14. Note is added as follows:

NOTE

P/N 6872473 is used only in test stand operation.

Page 1-14, figure 1-15. Note is added as follows:

NOTE

P/N 6872473 is used only in test stand operation.

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CHANGE
No. 5

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Operator, Organizational, DS, GS and Depot Maintenance Manual

VIBRATION MONITORING KIT
NSN 4920-00-879-0331
(P/N 171170-0104)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Cover. Title is changed as shown above.

Page i. Title is changed as shown above.

Page 1-1, paragraph 1-2. In lines 3 and 4, "Federal Stock Number 4920-879-0331" is changed to read "National Stock Number 4920-00-879-0331."

Page 1-11. Figure 1-12 is superseded as follows:

Page 1-13. Paragraph 1-30a is superseded as follows:

a. Install the proper adapters at the proper locations on the engine, removing engine bolts as necessary. See figures 1-13 and 1-14 for the adapters and cables to use for a particular engine, and figures 1-15 through 1-18 for proper location of adapters on the engine.

T63-A-5A/-700 ENGINE VIBRATION TEST DATA SHEET

Engine Serial No. _____ (TSN) _____

Last Overhaul Location _____ (TSLO) _____

Aircraft Serial No. _____ A/C Time _____

Test Location _____ Date _____

Tested By _____ Observer _ _____

Engine Passed Test - Accepted ☐ Engine Failed Test ☐

SAMPLE

VIBRATION LIMITS WITH 200 CPS FILTER WITH ENGINE IN MOBILE TEST STAND

	ACTUAL	MAX ALLOWABLE*
Compressor Vertical Transient		1.2 in./Sec
Compressor Vertical Steady State		0.6 in./Sec
Gearbox Vertical Transient		1.0 in./Sec
Gearbox Vertical Steady State		0.5 in./Sec
Turbine Vertical Transient		1.8 in./Sec
Turbine Vertical Steady State		0.9 in./Sec

Figure 1-12. T63-A-5A, T63-A-700 Engine Vibration Test Data Sheet (Sheet 1 of 2)

VIBRATION LIMITS WITH 200 CPS FILTER WITH ENGINE IN AIRCRAFT

	ACTUAL	MAX ALLOWABLE*
Compressor Vertical, Transient		2.0 in./Sec
Compressor Vertical, Steady State		0.9 in./Sec
Turbine Vertical, Transient		3.0 in./Sec
Turbine Vertical, Steady State		1.5 in./Sec

*Maximum allowable engine vibration (velocity)

Vibration meter OPERATION selector switch must be set to V (velocity) position.

Figure 1-12. T63-A-5A, T63-A-700 Engine Vibration Test Data Sheet (Sheet 2 of 2)

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CHANGE
No. 4

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WASHINGTON, D.C., *6 September 1974*

Operator, Organizational, DS, GS and Depot Maintenance Manual

VIBRATION MONITORING KIT

(FSN 4920-879-0331)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Page 3-1. Add "See Note 1" under the REMARKS column for GROUPS NO. 01, 02, and 07.

Page 3-1. The following Note is added below the MAINTENANCE ALLOCATION CHART. "Note 1. When forwarding unit to depot, send unit only. Do not send entire vibration monitoring kit to depot".

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Vice Chief of Staff

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CHANGE
No. 3

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WASHINGTON, D. C., *12 April 1974*

Operator, Organizational, DS, GS and Depot Maintenance Manual

VIBRATION MONITORING KIT

(FSN 4920-879-0331)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Page 1-7. Paragraph 1-25 is superseded as follows:

1-25. Vibration.

a. The vibration test kit measures engine vibration at specified operating speeds of the N1 and N2 systems. Vibration transducers attached to adapters mounted on the engine, transmit electrical impulses through cables to the vibration meter. The vibration meter indicates the total amount of engine movement (peak-to-peak displacement) in mils. Meter indications are recorded on an Engine Vibration Test Data Sheet (see figures 1-9 through 1-12). The recorded figures are compared with the figures given on the data sheet for maximum permissible engine vibration. If these maximum figures are exceeded, the cause of the excessive vibration must be found and corrected before the engine can be accepted for unrestricted flight.

b. The performance of the CH-47 Aircraft Cross Shaft Vibration check requires the use of a 213 cps narrow band pass filter, P/N 367112-0100. Inspect vibration meter for 213 inked on the skirt of the Input Selector Control. If 213 is not present proceed as follows:

(1) Remove housing 31013 from vibration meter.

(2) Remove mounting strap 171585 spanning the two existing filters and plug 213 cps filter 367112-0100 into the available Input Network socket.

(3) Print 213 below the socket. Use India ink MS18038A-02.

(4) Replace the mounting strap and the meter housing.

(5) Print 213 on the skirt of the Input Selector Control to correspond with the unmarked switch position between the 70 and 200 markings. Use India ink MS18038A-02.

(6) Warmup, checkout, installation, adjustment, and operation are as described in paragraphs 1-29 thru 1-49.

(7) Read and record the vibration meter indications for the number one and number two engine at the power settings shown in figure 1-11A.

Page 1-10. Figure 1-11A is added.

TEST	NO. 1 ENG. TORQUE %	NO. 2 ENG. TORQUE %	NO. 1 ENG. READING	NO. 2 ENG. READING
20% Matched Torque	20 ± 2	20 ± 2		
Highest Matched Torque				
Lowest Matched Torque				
20% Matched Torque	20 ± 2	20 ± 2		

*The aft lift point limit at Hz which results from 8 G's vertical vibration at the engine transmission is 1.0 MIL D.A. as read directly from the vibration meter.

Figure 1-11A. CH-47 Cross Shaft Vibration Test Data Sheet.

Page 1-11. Figure 1-12, sheet 2 of 2 is superseded as follows:

VIBRATION LIMITS WITH 200 HTZ FILTER AND ENGINE IN AIRCRAFT REFERENCE TABLE 10-3, TM 55-2840-231-40

	Setting #3		Setting #3-4		Setting #4	
Transient	Limit	Actual	Limit	Actual	Limit	Actual
Compressor No. 1 pick up	2.0		2.0		XX	XX
Turbine No. 2 pick up	3.0		3.0		XX	XX
Steady State						
Compressor No. 1 pick up	0.9		XX	XX	0.9	
Turbine No. 2 pick up	1.5		XX	XX	1.5	

Figure 1-12. T63-A-5A, T63-A-700, Engine Vibration Test Data Sheet (sheet 2 of 2).

Page 1-12, figure 1-13. The following items are added.

	T55 Series Engine	T63 Series Engine
	5/7	5A
15. Bracket Accessory Gearbox CEC P/N 6872473	1	
16. Filter, 213 cps CEC P/N 367112-0100 FSN 4920-078-2574		1

Page 1-13, figure 1-14. The following is added.

Engine	No. 1 Transducer	No. 2 Transducer	No. 3 Transducer
T63-A-5 -A-700	362885 Compressor Front Support-to-Compressor Case Splitline, 11 O'clock position.	362854 Gas Produce Support-to-Power Turbine Support Splitline, 11 O'clock position.	6872473 Accessory Gearbox
CH-47 Cross Shaft	171576 Rear Lifting Point Hoist Adapter T55 Engine		

Page 1-22. Paragraph 1-49*h* is superseded as follows:

h. If filtering of the signal is desired, turn the INPUT NETWORK selector switch to 70 for 70 cps filtering, or to 200 for 200 cps filtering of input signal. For CH-47 Cross Shaft Vibration measurement turn Input Network Selector Switch to 213 cps filtering of input signal.

Page 1-23. Paragraph 1-50*d* is added after 1-50*c* as follows:

d. Vibration measured with the 213 cps filter represents CH-47 cross shaft vibration only. If the recorded meter indicates exceed the maximum permissible vibration figures, corrective action must be taken before the cross shafts are again tested for vibration, prior to acceptance for unrestricted flight.

Page 2-16. Add new index number as follows:

Fig. & Index No.	Part No.	Description	Unit Per Assy
-97.	367112-0100	Filter, 213 cps	1

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

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VERNE L. BOWERS
Major General, United States Army
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CHANGE
No. 2

HEADQUARTERS
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WASHINGTON, D. C., *19 October 1972*

Operator, Organizational, DS, GS and Depot Maintenance Manual

VIBRATION MONITORING KIT

(FSN 4920-879-0331)

TM 55-4920-243-15, 12 July 1968, is changed as follows:

Page i. So much of "List of Illustrations, Figure 1-12," is changed to read:

Figure 1-12 T63-A-5A, T63-A-700 Engine Vibration Test Data Sheet

Page ii. The following is added to "List of Illustrations":

Figure 2-18 Vibration Transducer Adapter - Gearbox Part No. 6872473, Location of Parts Page 2-18

Page 1-5. The following "Note" is added after paragraph 1-9:

NOTE

Gearbox adapter, part no. 6872473, is not a component part of the vibration test kit. It is used during vibration monitoring of the T63-A-5A and T63-A-700 engines.

Page 1-11. Figure 1-12 is superseded.

Page 1-12. In figure 1-13, change column heading "T63 Series Engine 5A" to read "T63 Series Engine 5A and A-700." Also, for item 3 under this column, change from "3" to "2," and for item 5, change from "2" to "3."

Add item 15 as follows:

15. Adapter Gearbox, P/N 6872473, FSN 4920-428-6448, quantity 1 under "T63 Series engine" column.

Page 1-13. In figure 1-14, add to "Engine" column "T63-A-700" and to "No. 3 Tranducer" column, delete "N/A," and add "6872473 Accessory Gearbox."

*These changes supersede Change 1, 24 February 1969.

T63-A-5A/-700 ENGINE VIBRATION TEST DATA SHEET

Engine Serial No._____(TSN)_____

Last Overhaul Location_____(TSLO)_____

Aircraft Serial No._____A/C Time_____

Test Location_____Date_____

Tested By_____Observer_____

Engine Passed Test-Accepted /___/ Engine Failed Test /___/

SAMPLE

VIBRATION LIMITS WITH 200 CPS FILTER WITH ENGINE IN MOBILE TEST STAND

	ACTUAL	Max Allowable*
Compressor Vertical Transient		1.2 in./Sec
Compressor Vertical Steady State		0.6 in./Sec
Gearbox Vertical Transient		1.0 in./Sec
Gearbox Vertical Steady State		0.5 in./Sec
Turbine Vertical Transient		1.8 in./Sec
Turbine Vertical Steady State		0.9 in./Sec

Figure 1-12. T63-A-5A, T63-A-700 Engine Vibration Test Data Sheet (Sheet 1 of 2)

VIBRATION LIMITS WITH 200 CPS FILTER AND ENGINE IN AIRCRAFT

	ACTUAL	Max Allowable*
Compressor Vertical, Transient		2.0 in./Sec
Compressor Vertical, Steady State		1.0 in./Sec
Gearbox Vertical, Transient		2.0 in./Sec
Gearbox Vertical, Steady State		1.0 in./Sec
Turbine Vertical, Transient		2.0 in./Sec
Turbine Vertical, Steady State		1.0 in./Sec

* Maximum allowable engine vibration (velocity)

Vibration meter OPERATION selector switch must be set to V (Velocity) Position.

Figure 1-12. T63-A-5A, T63-A-700 Engine Vibration Test Data Sheet (Sheet 2 of 2)

Page 1-13. In paragraph 1-30*a*, after the word "engine" in line 6, add the following:

"when monitoring T63-A-700 gearbox vibration while installed in the aircraft, the anti-ice actuator mounted on top of the gearbox/engine mount pad must be removed and the engine anti-ice valve wired closed. When the adapter is mounted on the T63-A-5A gearbox, the engine lifting eye must be removed from the gearbox engine mount pad."

Page 1-14. Figure 1-15 is superseded as follows:

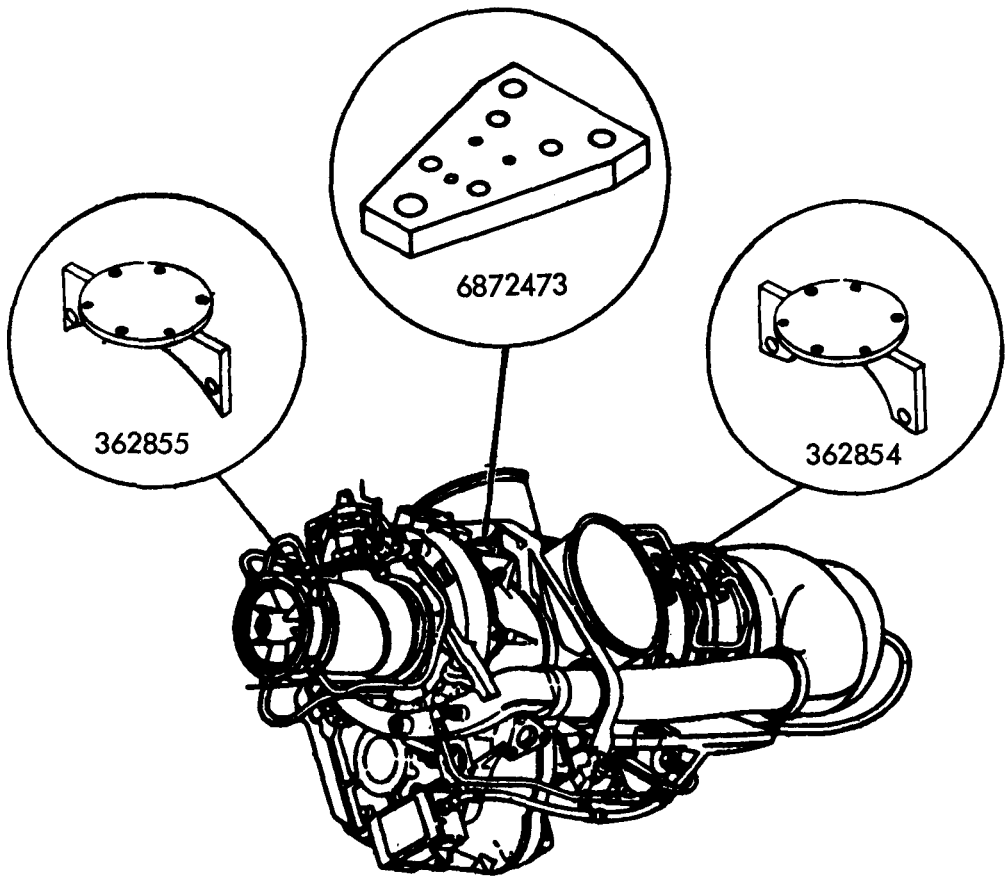

Figure 1-15. Location of Vibration Transducer Brackets, T-63-A-5A/A700 Engine

Page 1-15. Figure 1-16 is superseded.

Page 1-16. Figure 1-17 is superseded.

Page 2-18. Figure 2-18 is added.

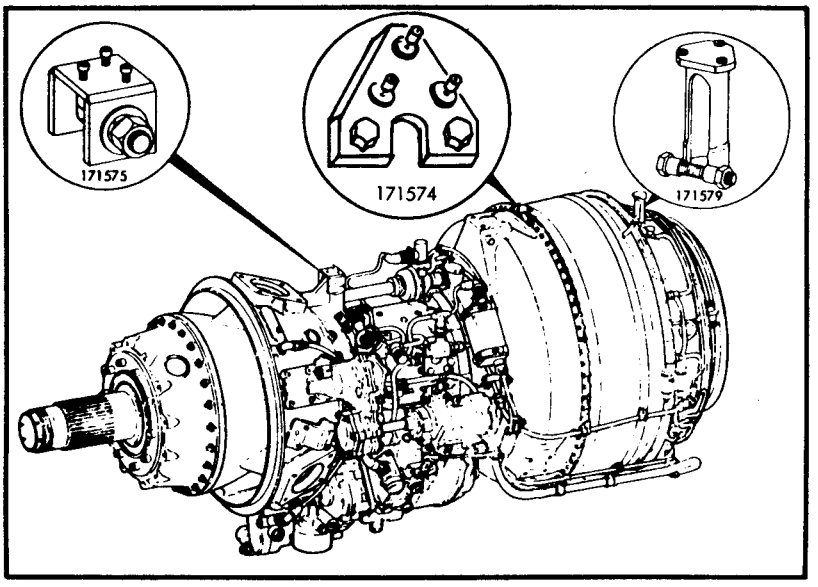

Figure 1-16. Location of Vibration Transducer Adapters, T53-L-3/7 Engines

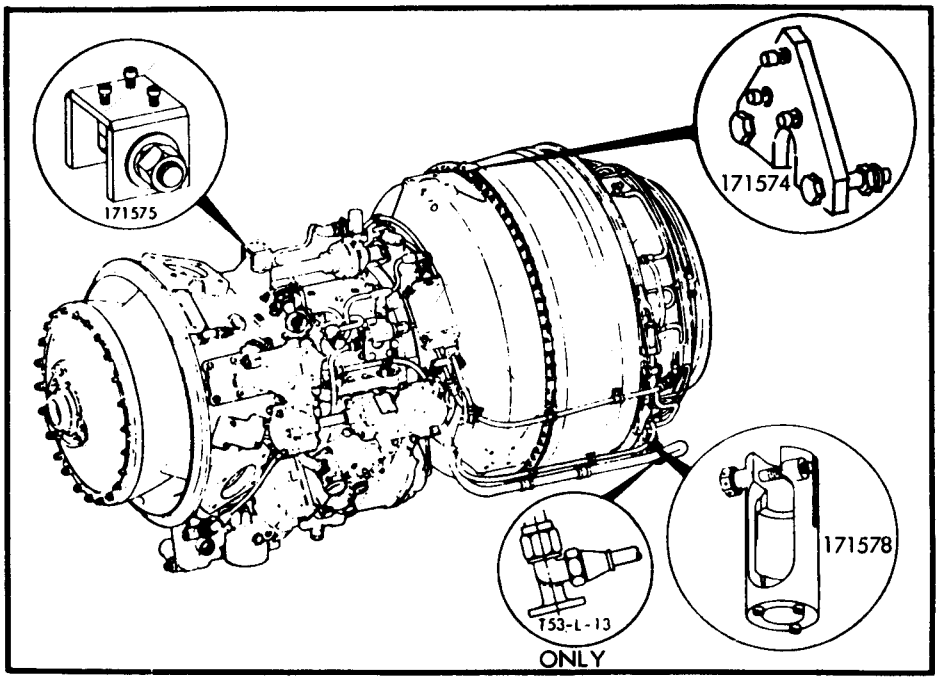

Figure 1-17. Location of Vibration Transducer Adapters T53-L-5/9/11 Engines

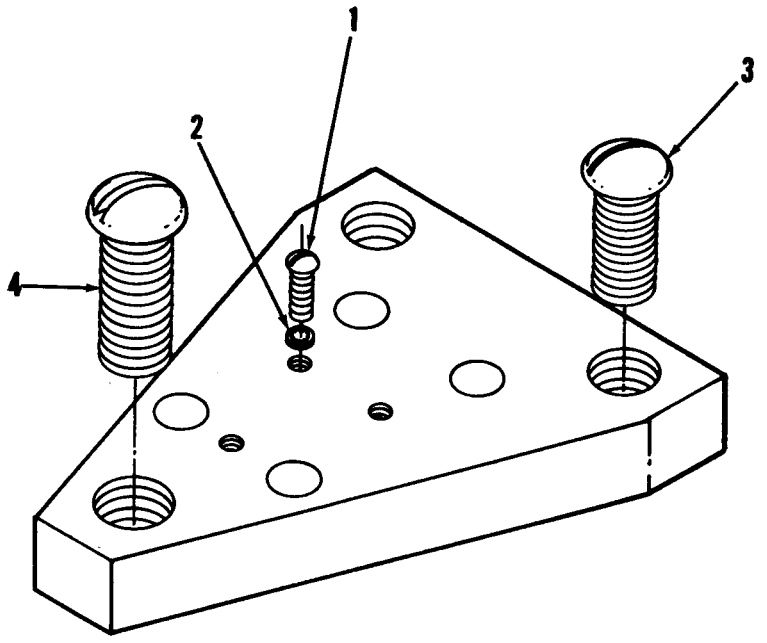

FIG & INDEX NO.	PART NO.	DESCRIPTION	Unit Per Assy	Ref. Design	Usable on Code
2-18-	6872473	ADAPTER, GEARBOX	Ref		
-1	MS51957-17	Screws	3		
-2	MS35333-70	Washers	3		
-3		.3125-24x7/8 Machine Screw	2		
-4		.375-24x7/8 Machine Screw	1		

Figure 2-18. Vibration Transducer Adapter - Gearbox Part No. 6872473 Location of Parts

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TECHNICAL MANUAL
NO. 55-4920-43-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 12 July 1968

VIBRATION MONITORING KIT
(FSN 4920-879-0331)

Section

LIST OF ILLUSTRATIONS

List of Illustrations (Cont.)

SECTION I

USE AND MAINTENANCE

1-1. INTRODUCTION.

1-2. SCOPE. This publication is issued as the basic technical manual for the Vibration Monitoring Kit No. 171170-0104 (figure 1-1) (Federal Stock No. 4920-879-0331), manufactured by Consolidated Electrodynamics Corporation, Monrovia, California (09384). This kit is applicable to all models of the T53, T55, and T63 engine series and supersedes kit No. 171170-0100 (Federal Stock No. 4920-973-2149) which is applicable only to T53 and T55 engines. Kit No. 171170-0104 provides three new vibration transducers Type 4-128-0101 which are required for the T63 engine and may be used for T53 and T55 engines. This manual also contains operation and maintenance instructions for the Type 4-118-0107 transducer contained in Kit No. 171170-0100. The Type 4-118-0107 Vibration Transducer may still be used on the T53 and T55 engines but not on the T63 engines. Two Type 4-128-0101 Transducers and appropriate adapters for the T63 engine are contained in CEC Kit No. 10-101-0209 (FSN 4920-851-9173) and should be used to supplement the No. 171170-0100 Vibration Monitoring Kit.

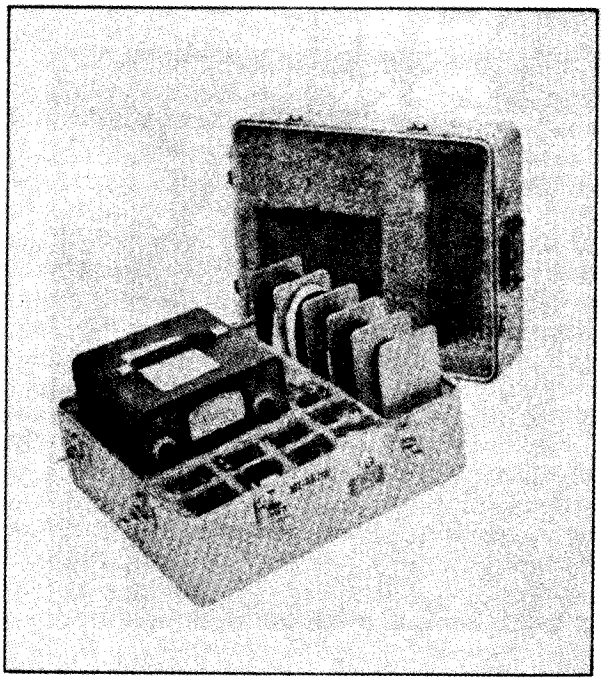


Figure 1-1. Vibration Monitoring Kit

1-3. PURPOSE AND USE. The vibration monitoring kit is used to check maximum permissible engine vibration on turbine engines. Figure 1-2 shows a typical system application. In this system, the vibration transducer is attached to the point on the engine where vibration is to be observed and a direct reading of the measured vibration is read from the vibration meter. A variable filter may be connected in the vibration meter circuit for tuning to a specific frequency. The variable filter eliminates all signal components on either side of the tuned frequency, permitting study of a single frequency component of vibration. Vibration components are evaluated on the vibration meter as either a displacement (peak-to-peak distance in roils) or an average velocity (inches

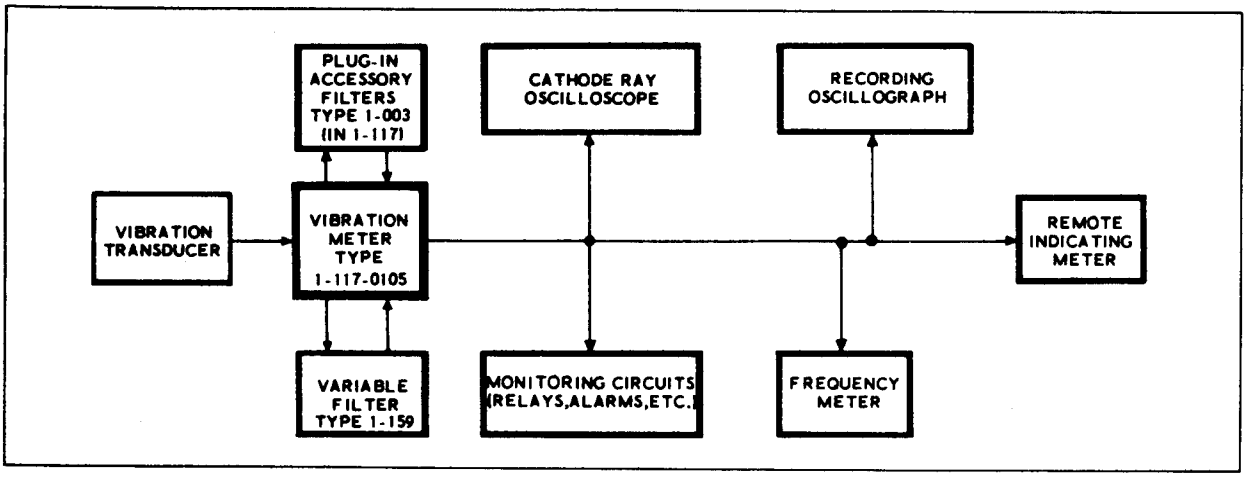
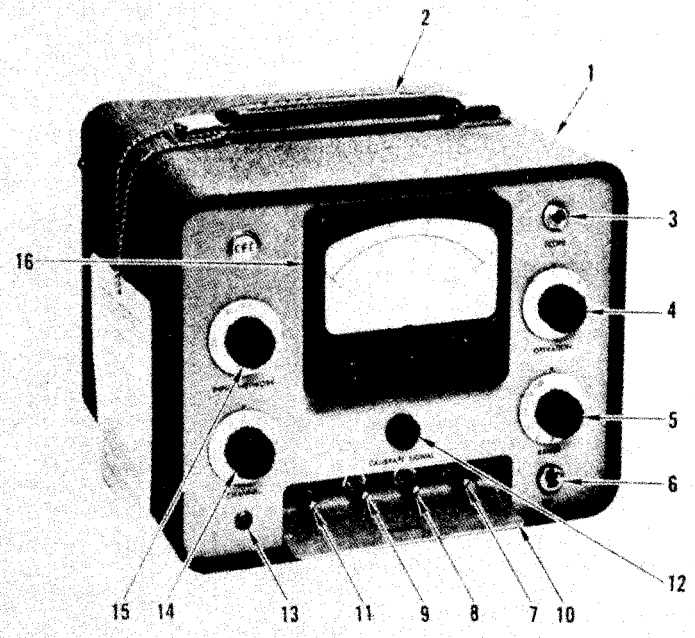


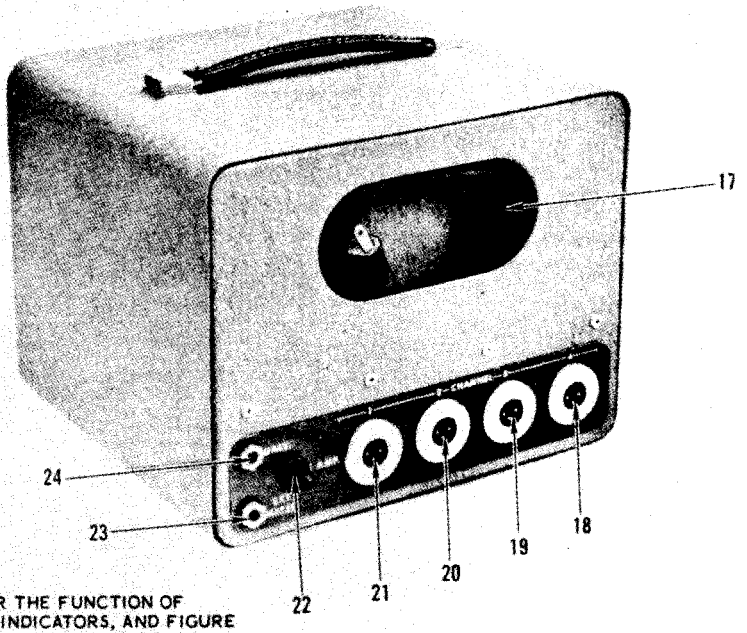
Figure 1-2. Typical Applications, Block Diagram



FRONT VIEW

1. Case
2. Carrying Handle
3. SCOPE Connector
4. OPERATION Selector Switch
5. RANGE Selector Switch
6. OFF Power Switch
7. SENSITIVITY 4 Control
8. SENSITIVITY 3 Control
9. SENSITIVITY 2 Control
10. Access Door
11. SENSITIVITY 1 Control
12. CALIBRATE SIGNAL Control
13. Power On Indicator Light
14. CHANNEL Selector Switch
15. INPUT NETWORK Selector Switch
16. Indicating Meter

17. AC Power Cord
18. CHANNEL 4 INPUT Connector
19. CHANNEL 3 Input Connector
20. CHANNEL 2 Input Connector
21. CHANNEL 1 Input Connector
22. Input Power Fuse
23. EXT. METER Connector
24. GALV. CONNECTOR



NOTE: SEE FIGURE 1-20 FOR THE FUNCTION OF THE CONTROLS AND INDICATORS, AND FIGURE 1-21 FOR FUNCTION OF THE CONNECTORS.

REAR VIEW

Figure 1-3. Vibration Meter Type 1-117-0105, Front and Rear Views

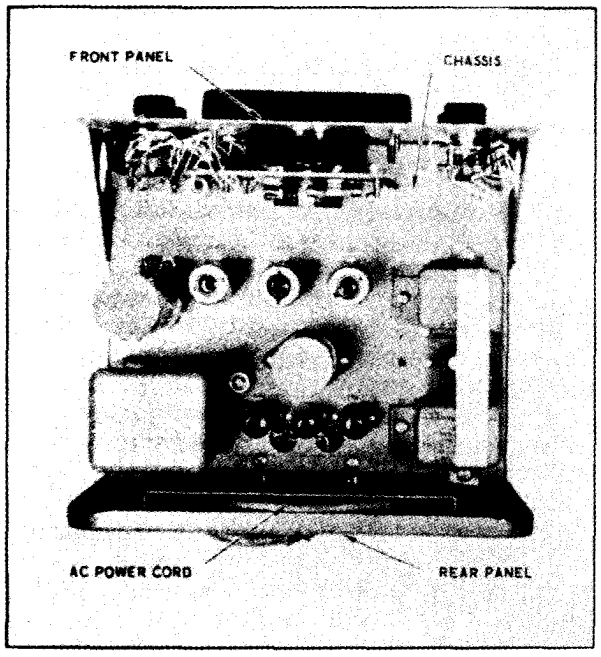


Figure 1-4. Vibration Meter Type 1-117-0105, Top View, Cover Removed

per second). Additional equipment may be included in the system for further examination or for recording, as shown in figure 1-2.

1-4. PHYSICAL DESCRIPTION.

1-5. The vibration test kit consists of one vibration meter, three vibration transducers, five cable assemblies mounted on five cable reels, eight different types of adapters and brackets for mounting the transducers on the aircraft engine, and an ac grounding plug adapter. All components are contained in a hermetically sealed, aluminum carrying case for maximum protection from outside environment. Each component fits into an individual cutout of a molded animal hair cushion support where they are further protected against vibration and shock. The carrying case has two handles on each end, and is secured closed by six latches. A relief valve is included to equalize the pressure inside the case. The carrying case conforms to Specifications MIL-C-4150E, MIL-T-945A, and MIL-STD-108D Class I.

1-6. VIBRATION METER TYPE 1-117-0105. (See figures 1-3 and 1-4.) The vibration meter is a portable precision instrument consisting of a chassis assembly and case assembly. The chassis assembly consists of a chassis suspended between a front panel and a rear panel. The instrument provides four input channels. Each channel will accommodate any self-generating transducer with characteristics compatible with the vibration meter. A sensitivity control is provided for each channel for adjusting the channel gain for the type of transducer being used. A self-generated calibration signal provides a means for calibrating each channel individually. The output of the selected channel is normally read directly on the meter. The front panel contains an indicating meter and the primary operating controls. Four sensitivity controls are located behind an access door near the bottom of the front panel. An electrical connector is provided on the front panel for connecting an oscilloscope to the vibration meter output circuit. The rear panel contains four channel input connectors, an input power fuse, and connectors for connecting an external remote meter and a galvanometers to the vibration meter output circuit. A six-foot long ac power cord is permanently attached to the vibration meter. This cord is stored in a recessed section of the rear panel as shown in figures 1-3 and 1-4.

1-7. VELOCITY VIBRATION TRANSDUCER ASSEMBLY, Type 4-128-0101. (See figure 1-5.) The velocity vibration transducer is a linear, self-generating unit that produces a voltage output proportional to vibrational velocity. Measurements of vibratory motion is accomplished by using the seismic mass principle. The transducer measures vibrations of from 15 to 1500 cps, and is designed for use with the Type 1-117-0105 Vibration Meter. The transducer converts mechanical vibrations into ac voltage signals which are proportional to the velocity of vibration.

1-8. CABLE ASSEMBLIES AND CABLE REELS. The vibration monitoring kit includes three 300-inch cables (Part No. 49657-300) and two 900-inch cables (Part No. 49657-900) wound on five cable reels (Part Nos.

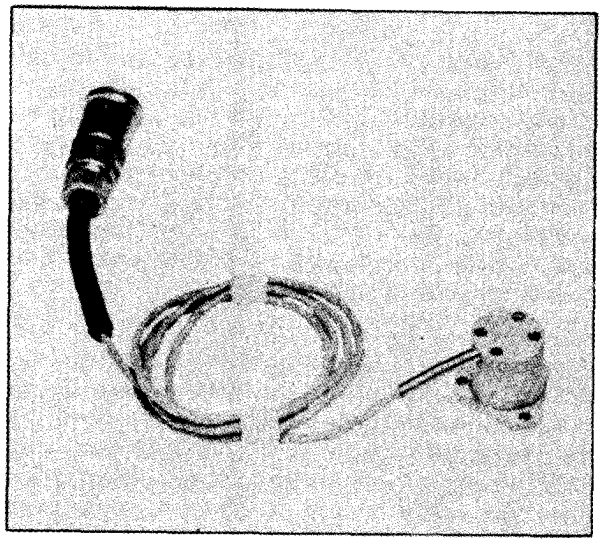


Figure 1-5. Velocity Vibration Transducer

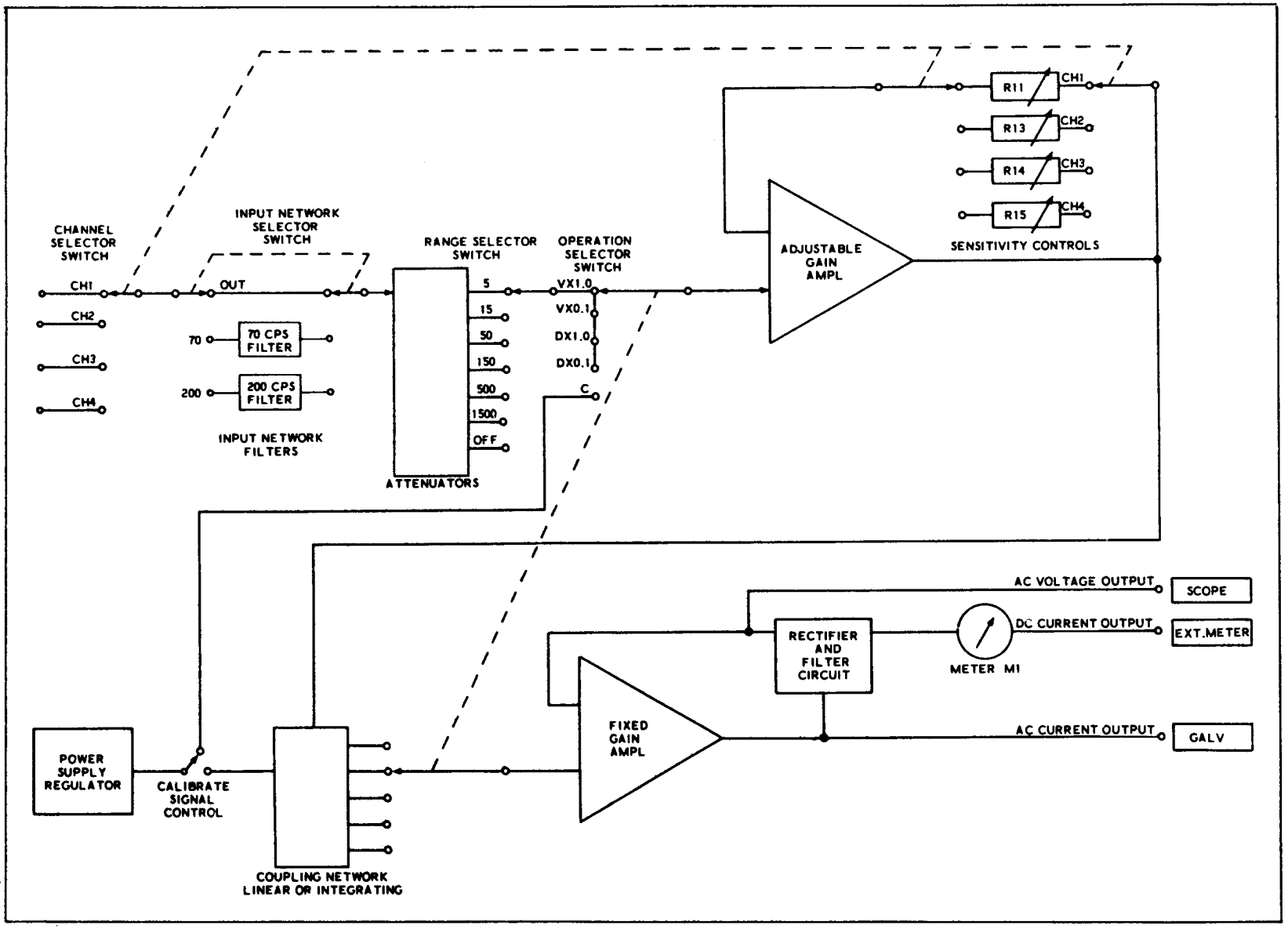


Figure 1-6. Vibration Meter Type 1-117-0105, Simplified Block Diagram

171589-0001 and 171589-0002). The reels are identical except for their width, and the cables are identical except for their length. The cable assemblies are used to connect the transducers to the vibration meter.

1-9. ADAPTERS. The vibration test kit contains eight adapters for mounting the transducers to the engine, and a grounding adapter for connecting to the ac plug. Adapters included are: Grounding Adapter Part No. 171581, Vibration Transducer Adapters Part Nos. 171580, 171574, and 171576, Inlet Housing Adapter Part No. 171575, Power Turbine Adapters Part Nos. 171578 and 171579, and Vibration Brackets Part Nos. 362854 and 362855.

1-10. FUNCTIONAL DESCRIPTION, VIBRATION METER. (See figure 1-6.)

1-11. A simplified block diagram of the vibration meter is shown in figure 1-6. A complete schematic diagram is shown in figure 1-25. The signal from the desired transducer is selected by the CHANNEL selector switch and applied to the input network. When the INPUT NETWORK selector switch is set to the OUT position, the input signal is applied without filtering directly to the attenuator stage. When the INPUT NETWORK selector switch is set to the 70 position, the signal from the transducers filtered by the 70 cps filter; when the switch is set to the 200 position, the signal is filtered by the 200 cps filter. The attenuated signal is increased by the adjustable gain amplifier, tempered by the coupling network, and again amplified by the fixed gain amplifler. The amplified signal is full-waved rectified and filtered by the rectifier and filter circuit and applied to the indicating meter M1 and the EXT. METER connector.

1-12. The ac voltage applied to the SCOPE output connector and the ac current applied to the GALV. output connector are both instantaneously proportional to the transducer signal voltage. The output at the EXT. METER connector is a dc current proportional to the short term average value of the transducer signal voltage. All outputs are integrated when the OPERATION selector switch is set to the D (displacement) position.

NOTE

Greater accuracy is obtained when the OPERATION selector switch is set to Vx1.0 and Dx1.0 positions, than when the switch is set to the Vx0.1 and Dx0.1 positions.

1-13. The adjustable gain amplifier is a two-stage amplifier utilizing the two sections of tube V1. The gain of the amplifier is adjusted by SENSITIVITY controls, variable resistors R11, R13, R14 and R15. Each variable resistor consists of two sections mounted on the same shaft. The A section of each variable resistor adjusts the gain of the first stage of the amplifier, and the B section adjusts the gain of the second stage of the amplifier.

1-14. For velocity measurements, the output of the adjustable gain amplifier is connected through a linear attenuator to the fixed gain amplifier tube V2A. The linear attenuator consists of resistors R19, R21, R23 and R41. For displacement measurements, the output of the adjustable gain amplifier is connected through an integrator to the fixed gain amplifier tube V2A. The integrator consists of resistor R22, and capacitors C6 and C7.

1-15. The fixed gain amplifier is a two-stage, fixed gain amplifier utilizing the two sections of tube V2. The output of the fixed gain amplifier is applied through cathode follower tube V3B to the rectifier and filter circuit. During calibration, the fixed-gain amplifier and meter circuitry serve to adjust a “calibrate signal” voltage to the proper value, which is then applied to the input of the instrument. When this is done, the gain may be adjusted to permit direct reading of velocity or displacement from the meter. Each channel has its individual SENSITIVITY (gain) control, Both the high voltage dc (B+) and the dc filament supplies are fully regulated.

NOTE

The vibration meter is simultaneously "in calibration" for four vibration transducers of different sensitivities. Instrument calibration may be accomplished by utilizing the internal circuitry, by using an external oscillator and voltmeter, or by using vibration transducers and a vibration table. (Refer to paragraph 1-40.)

1-16. TECHNICAL CHARACTERISTICS. (See figures 1-7 and 1-8.)

1-17. The technical characteristics for the Vibration Meter Type 1-117-0105 are listed in figure 1-7, and the technical characteristics for the Vibration Transducer Types 4-118-0107 and 4-128-0101 are listed in figure 1-8.

1-18. ASSOCIATED EQUIPMENT.

1-19. The equipment described in paragraphs 1-20 through 1-23 is not required for normal operation of the vibration test kit but may be used with the vibration meter to perform certain additional functions.

Item	Characteristic
POWER REQUIREMENTS	105 to 125V ac, 50/60/400 cps, single phase, 30 watts OR 210 to 250V ac, 50/60/400 cps, single phase, 30 watts.
INPUT IMPEDANCE	10,000 ohms.
LINEARITY DEVIATION	Less than ±3% of full scale.
OPERATING TEMPERATURE	-10°C (+14°F) to +40°C (+104°F).
STORAGE TEMPERATURE	-40°C (-40° F) to +50°C (+122°F).
TEMPERATURE STABILITY	Meter indication changes less than 0.2% of full scale per degree C within operating temperature range.
NOISE LEVEL	Less than 2% of full scale under any operating condition (as read at SCOPE connector).
SENSITIVITY AND FREQUENCY RESPONSE:	
VELOCITY NORMAL SENSITIVITY RANGE (V x 1)	Frequency response is within ±3% from 5 to 5,000 cps (amplifier circuits exclusive of input network). Sensitivity is adjustable to read full scale for any unattenuated input from 278 to 834 millivolts.
VELOCITY HIGH SENSITIVITY RANGE (V x 0.1)	Frequency response is within ±3% from 5 to 5000 cps (amplifier circuits exclusive of input network). Sensitivity is adjustable to read full scale for any unattenuated input from 27.8 to 83.4 millivolts.
DISPLACEMENT NORMAL SENSITIVITY RANGE (D x 1)	Frequency response is within ±4% from 5 to 1000 cps (amplifier circuits exclusive of input network). The meter is capable of giving full scale indication with the attenuator set for maximum sensitivity, for any self-gener - ating transducer with sensitivities of from 50 to 150 mv/inch/ second, being given a 0.005 inch peak-to-peak displacement, and 5 to 15 mv/degree s/second for torsiogr aphs, being given at 0.05° peak-to-peak displacement.
DISPLACEMENT HIGH SENSITIVITY RANGE (D x 0.1)	Frequency response is within ±4% from 50 to 1000 cps (amplifier circuits exclusive of input network). The meter is capable of giving full scale indication with the attenuator set for 0.1 of maximum sensitivity, for any self-generating transducer with sensitivities of from 50 to 150 mv/inch/second, being given a 0.0005 inch peak-to-peak displacement and 5 to 15 mv/degree/second for torsiographs being given a 0.005° peak-to-peak displacement.

Figure 1-7. Technical Characteristics, Vibration Meter Type 1-117-0105

Item	Characteristics	
	Type 4-118-0107	Type 4-128-0101
Range of Operation:	50-500 cps.	15-1500 cps.
Sensitivity:	105 ±5 mv/in./sec at 250 cps.	60 ±2 mv/in./sec at 100 cps.
Peak Acceleration:	100 g's.	50 g's.
Coil Resistance:	750 ohms nominal.	490 ohms nominal.
Frequency Response:	Flat within ±10% of sensitivity at 250 cps.	±12% of sensitivity in vertical position, and ±6% in horizontal position at a constant velocity drive level.
Operating Temperature Range:	-65°F to 300°F.	-65°F to 700°F.
Weight:	2 oz maximum less cable.	3 oz maximum less cable.
Mounting:	3 mounting holes in base to accommodate No. 4 screws and washers.	3 mounting holes in base to accommodate No. 4 screws and washers.

Figure 1-8. Technical Characteristics, Vibration Transducer Types 4-118-0107 and 4-128-0101

1-20. RECORDING EQUIPMENT. The vibration meter output may be permanently recorded for detailed waveform study by connecting a galvanometers of a recording oscillograph to the GALV. connector on the rear panel of the vibration meter. The vibration meter readings are not affected by the use of this connector. Full scale on the meter corresponds to approximately 555 microampers rms in the galvanometer circuit. Galvanometers with resistance of 100 ohms or less should be used.

1-21. OSCILLOSCOPES. A cathode-ray oscilloscope with an input impedance of 0.5 megohm or greater may be connected to the SCOPE connector on the front panel of the vibration meter. This permits simultaneous viewing of the amplitude and velocity indications on the vibration meter and waveforms on the oscilloscope.

1-22. EXTERNAL METER. An external meter may be used for remote indication of velocity of displacement. This meter should have a full scale value of 500 microampere dc and a resistance of 200 ohms or less.

1-23. CONTROL AND WARNING DEVICES. A wide variety of special circuits may be devised for automatic control of equipment, or for warning operators of unsafe vibrations of any predetermined magnitude. Any of the three vibration meter output circuits may be used for this purpose, provided the impedances introduced are within the specified ranges. Devices connected to the ac outlets should have pure resistive inputs. All three output connections may be used simultaneously.

1-24. APPLICATIONS.

1-25. The vibration test kit measures engine vibration at specified operating speeds of the N1 and N2 systems. Vibration transducers attached to adapters mounted on the engine, transmit electrical impulses through cables to the vibration meter. The vibration meter indicates the total amount of engine movement (peak-to-peak displacement) in mils. Meter indications are recorded on an Engine Vibration Test Data Sheet (see figures 1-9 through 1-12). The recorded figures are compared with the figures given on the data sheet for maximum permissible engine vibration. If these maximum figures are exceeded, the cause of the excessive vibration must be found and corrected before the engine can be accepted for unrestricted flight.

1-26. Vibration engine tests are performed by third echelon maintenance activities. Measurements are taken after removal and installation of the first stage turbine rotor assembly, the engine combustion section, the engine exhaust section, or when excessive engine vibration is suspected.

1-27. PREPARATION FOR USE.

1-28. Paragraphs 1-29 through 1-30 are installation procedures and preliminary checkout procedures for the vibration test kit.

1-29. PRELIMINARY SYSTEM CHECKOUT. Prior to installation of mounting adapters and transducers on the engine, check the system out to be sure that all parts are functional, as follows:

T53-L-3/7 ENGINE VIBRATION TEST DATA SHEET

Engine Serial No _____ (TSN) _____

Last Overhaul Location _____ (TSLO) _____

Aircraft Serial No _____ A C Time _____

Test Location _____ Date _____

Tested By _____ Observer _____

Engine Passed Test – Accepted ☐ Engine Failed Test ☐

Propeller Shaft rpm (± 20 rpm)	n_1 Speed in Percent (± 0.5%)	No. 1 Pickup S/N_____ (200 cps Filter)	No. 2 Pickup S/N_____ (200 cps Filter)	No. 3 Pickup S/N_____ (200 cps Filter)	REMARKS
1350	80	(3.5)	(3.5)	(4.4)	
1500	85	(2.5)	(2.5)	(4.0)	
1600	90	(2.5)	(2.5)	(3.8)	
1660	95	(2.5)	(2.5)	(3.7)	
1670	MAX	(2.5)	(2.5)	(3.7)	

Note: The figures given in parentheses are the maximum permissible engine vibration.

Figure 1-9. T53-L-3/7 Engine Vibration Test Data Sheet

T53-L-9, -9A, -11, -11B, -13 ENGINE VIBRATION TEST DATA SHEET

Engine Serial No. _____ (TSN) _____

Last Overhaul Location _____ (TSLO) _____

Aircraft Serial No. _____ A/C Time _____

Test Location _____ Date _____

Tested By _____ Observer _____

Engine Passed Test – Accepted ☐ Engine Failed Test ☐

n_{II} Speed in rpm (± 50 rpm)	n_I Speed in Percent (± 0.5%)	No. 1 Pickup S/N _____ (70 cps Filter)	No. 1 Pickup S/N _____ (200 cps Filter)	No. 2 Pickup S/N _____ (200 cps Filter)	No. 3 Pickup S/N _____ (200 cps Filter)	REMARKS
6200	90	(2.5)	(2.5)	(2.5)	(3.7)	
6400	75	(3.5)	(3.5)	(3.5)	(3.7)	
6400	85	(2.5)	(2.5)	(2.5)	(3.7)	
6400	90	(2.5)	(2.5)	(2.5)	(3.7)	
6400	95	(2.5)	(2.5)	(2.5)	(3.7)	
6400	MAX.	(2.5)	(2.5)	(2.5)	(3.7)	
6600	90	(2.5)	(2.5)	(2.5)	(3.7)	

Note: The figures given in parentheses are the maximum permissible engine vibration.

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Figure 1-10. T53-L-9/9A/ 11/ 11B/ 13 Engine Vibration Test Data Sheet

T55-L-5/7/7B/7C ENGINE VIBRATION TEST DATA SHEET

Engine Serial No. _____ (TSN) _____

Last Overhaul Location _____ (TSLO) _____

Aircraft Serial No. _____ A/C Time _____

Test Location _____ Date _____

Tested by _____ Observer _____

Engine Passed Test – Accepted ☐ Engine Failed Test ☐

N_I %	N_I RPM	N_{II} %	N_{II} RPM	No. 1 Pickup S/N ____				No. 2 Pickup S/N ____			
				70 CPS Filter		200 CPS Filter		70 CPS Filter		200 CPS Filter	
				Actual	Maximum Allowable*	Actual	Maximum Allowable*	Actual	Maximum Allowable*	Actual	Maximum Allowable*
70	13,000	97.0	14,870		3.5		2.5		3.5		2.5
75	14,000	99.0 104.4 †	15,180 16,000 †		3.5		2.5		3.5		2.5
81	15,160	99.0* 104.4 †	15,180 16,000 †		3.5		2.5		3.5		2.5
81	15,160	90.0	13,800		3.5		2.5		3.5		2.5
85	15,900	90.0	13,800		3.5		2.5		3.5		2.5
90	16,890	90.0	13,800		3.0		2.0		3.0		2.0
Max	–	90.0	13,800		3.0		2.0		3.0		2.0

SAMPLE

100 % N_I = 18,720 RPM
100 % N_{II} = 15,330 RPM
* = Maximum allowable engine vibration (double amplitude)
Maximum N_I & N_{II} = Maximum RPM per engine/aircraft specification
† T55-L-7C ONLY

DISPOSITION

Exceeds the 70 CPS Maximum Allowable	Exceeds the 200 CPS Maximum Allowable	Action
No	No	None
Yes	Yes	Investigate Engine
No	Yes	Investigate Engine
Yes	No	Investigate Installation

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Figure 1-11. T55-L-5/7/7B/7C Engine Vibration Test Data Sheet

T63-A-5A ENGINE VIBRATION TEST DATA SHEET

Engine Serial No. _____ (TSN) _____

Last Overhaul Location _____ (TSLO) _____

Aircraft Serial No. _____ A/C Time _____

Test Location _____ Date _____

Tested By _____ Observer _____

Engine Passed Test-Accepted ☐ Engine Failed Test ☐

SAMPLE

VIBRATION LIMITS (150) 200 CPS FILTER

	Actual	Max Allowable*
Compressor Transient		2.0 in./sec
Compressor Steady State		1.5 in./sec
Turbine Transient		4.0 in./sec
Turbine Steady State		2.5 in./sec

*Maximum allowable engine vibration (velocity).

Vibration meter OPERATION selector switch must be set to V (velocity) position.

Figure 1-12. T63-A-5A Engine Vibration Test Data Sheet

Test Equipment	T53 Series Engine		T55 Series Engine	T63 Series Engine
	3/7	9/11/13	5/7	5A
1. Products Test Kit CEC P/N 171170-0104 FSN 4920-879-0331	1	1	1	1
2. Vibration Meter CEC P/N 1-117-0105 FSN 6625-590-6502	1	1	1	1
3. Cable Assembly (25 ft. long) CEC P/N 49657-0300, FSN 4920-083-0409	3	3		2
4. Cable Assembly (75 ft. long) CEC P/N 49657-0900, FSN 4920-981-5089			2	
5. Vibration Transducer CEC P/N 4-128-0101 FSN	3	3	2	2
6. Vibration Transducer Adapter CEC P/N 171578, FSN 4920-996-7421		1		
7. Vibration Transducer Adapter CEC P/N 171579, FSN 4920-856-6088	1			
8. Vibration Transducer Adapter CEC P/N 171574, FSN 4920-972-6118	1	1		
9. Vibration Transducer Adapter CEC P/N 171575, FSN 4920-858-0016	1	1		
10. Vibration Transducer Adapter CEC P/N 171576, FSN 4920-509-8072			1	
11. Vibration Transducer Adapter CEC P/N 171580, FSN 4920-976-9318			1	
12. Bracket, Turbine, CEC P/N 362854 FSN				1
13. Bracket, Compressor CEC P/N 362855 FSN				1
14. Grounding Adapter CEC P/N 171581 FSN 4920-552-4372	1	1	1	1

Figure 1-13. Vibration Test Equipment Used with T53, T55, and T63 Series Engines

a. Prior to opening the case, vent the case to atmosphere by turning the pressure relief valve one-half turn counterclockwise using a coin or a screwdriver. When closing the case, reverse the procedure.

b. Remove the vibration meter from the carrying case and set power switch to OFF.

c. Connect ac power cord to a 115V ac power source.

NOTE

If a power source to be used is 230V ac, refer to paragraph 1-31 for procedure for restrapping the vibration meter transformer, before connecting power to unit.

NOTE

If power source receptacle does not have ground plug, install Grounding Adapter Part No. 171581 into power source receptacle and attach black grounding lead of adapter to a ground point. Install vibration meter plug in receptacle of grounding adapter.

d. Turn meter power switch on and allow one-half hour for temperature to stabilize within the meter before using.

Engine	No. 1 Transducer	No. 2 Transducer	No. 3 Transducer
T53-L-3/7	171575 Front Lifting Eye (Inlet Housing)	171574 Diffuser Flange, 12 O'clock Position	171579 Power Turbine Oil Feed Line
T53-L-9/11/13	171575 Front Lifting Eye (Inlet Housing)	171574 Diffuser Flange, 12 O'clock Position	171578 Power Turbine Oil Feed Line
T55-L-5/7	171580 Anti-ing Pickup Pad (Inlet Housing)	171576 Rear Lifting Point Hoist Adapter	N/A
T63-A-5	362885 Compressor Front Support-to-Compressor Case Splitline, 11 O'clock position.	362854 Gas Produce Support-to-Power Turbine Support Splitline, 11 O'clock position.	N/A

Figure 1-14. Location of Vibration Transducer Adapters on T53, T55, and T63 Series Engines

e. While the meter is warming up, lay out the cables and transducers.

f. Connect the transducer and cable for each channel to the proper CHANNEL receptacle at the rear of the meter.

CAUTION

Handle vibration transducers with care, accidental dropping or jarring may permanently damage or decrease the accuracy of the unit.

g. Set the meter IN PUT NETWORK selector to OUT.

h. Set the CHANNEL selector to 1.

i. Set the RANGE selector to 5.

j. Shake the transducer connected to CHANNEL 1 by hand while observing the vibration meter. The indicator should jog, or show a slight movement.

NOTE

If the indicator does not move, check the condition of the transducer, connectors, cable, and vibration meter receptacle. Interchange components until the defective unit is found. Replace or repair the defective component.

k. Set the CHANNEL selector to the applicable number and, using the same procedures outlined in step j, check operation of each of the remaining transducers.

1-30. INSTALLATION OF EQUIPMENT. Follow the procedure outlined below for installation of the adapters and transducers onto the engine, and for interconnecting the cables.

a. Install the proper adapters at the proper locations on the engine, removing engine bolts as necessary. See figures 1-13 and 1-14 for the adapters and cables to use for a particular engine, and figures 1-15 through 1-18 for proper location of adapters on the engine.

b. Secure each transducer to its adapter with three 4-40 screws and suitable lockwashers. Be sure to tighten screws securely.

c. Connect the proper cable assembly to each transducer.

NOTE

Identify adapters and cable connections with numbers or colors to make certain the transducers will be connected to the proper vibration meter CHANNEL receptacles.

CAUTION

To prevent damage to the equipment, secure the cable assemblies to the engine and airframe with tape or cord. Leave enough slack in the cables to prevent undue strain, on the transducers and connections. Avoid kinks and sharp bends in cable assemblies. Avoid conditions which would cause cables to deteriorate from heat or abrasion.

d. Secure vibration meter with bungee cord, or other suitable means, to a cushioned, protected location in the airframe.

NOTE

When testing engines installed in fixed wing aircraft, the vibration meter may be placed on a secure stand on the ground, if desired.

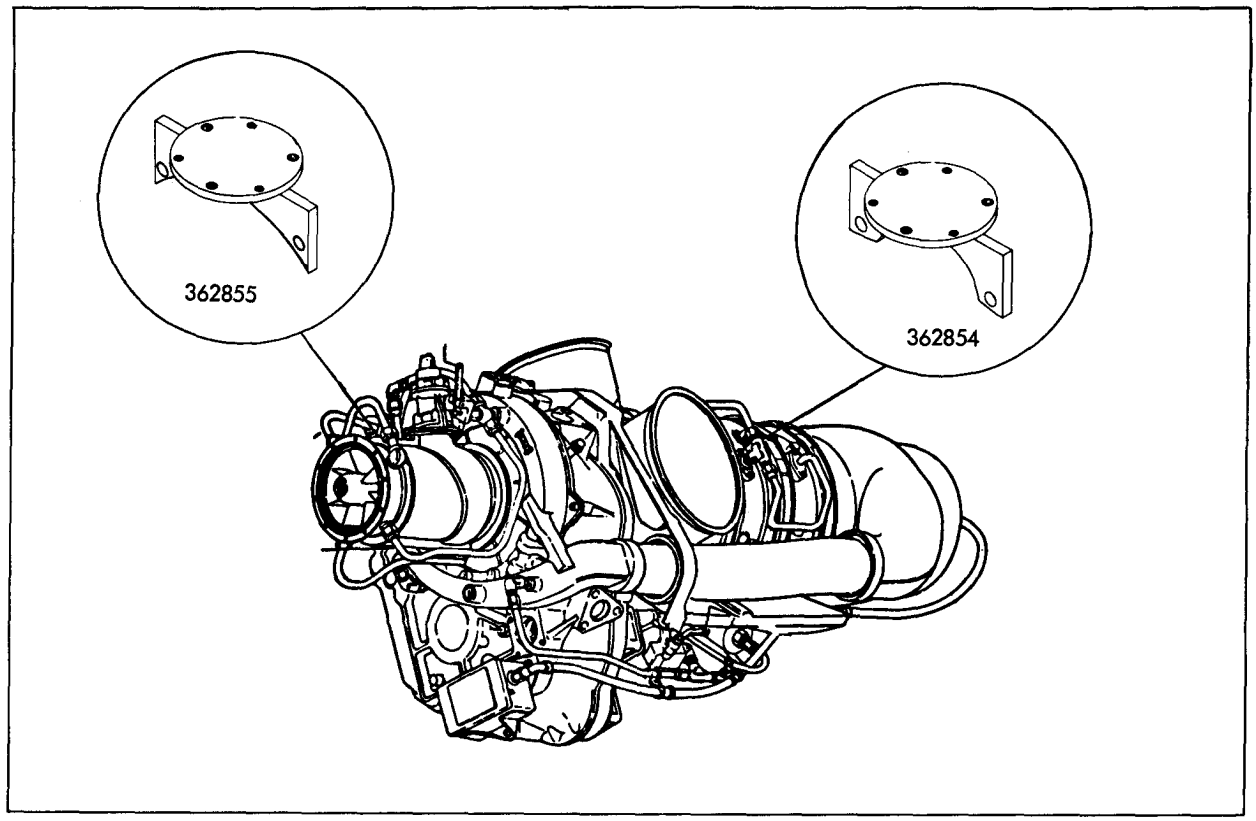


Figure 1-15. Location of Vibration Transducer Brackets, T-63 Engine

e. Disconnect the vibration meter from the source of power used for preliminary meter warmup, and immediately connect it to the airframe power.

NOTE

To prevent undue cooling off of the vibration meter, it must not be without power for more than two minutes.

f. Connect the cable assemblies to the proper CHANNEL receptacles at the rear of the vibration meter.

1-31. POWER SUPPLY CONNECTIONS. The vibration meter is shipped wired for operation into a 115V ac power source. If it is desired to operate the vibration meter from a 230V ac power source, change the transformer strapping as shown in figure 1-19 (detail B), and replace the 1 amp fuse with a 1/2 amp fuse. (See figure 2-11 for transformer location.)

1-32. CONTROLS, INDICATORS, AND CONNECTORS.

1-33. OPERATING CONTROLS AND INDICATORS. Operating controls and indicators for the vibration meter are listed in figure 1-20. The locations of operation controls and indicators are shown in figure 1-3.

1-34. ELECTRICAL CONNECTORS. The electrical connectors for the vibration meter are listed in figure 1-21. The locations of the electrical connectors are shown in figure 1-3.

1-35. CALIBRATION OF VIBRATION METER.

1-36. The vibration meter is designed for direct reading when used with a Type 4-128-0101 Vibration Transducer or when used with any self-generating vibration transducers with resistances of 1100 ohms (or less) and velocity sensitivities which lie between 50 and 150 millivolts per inch per second, or 5 and 15 millivolts per degree per second. Each channel may be calibrated to give direct readings with vibration transducers whose electrical characteristics lie within these ranges. There is no interaction between channels, thus fewer than four channels may be used. In the following paragraphs, vibration transducer calibration will be discussed first inasmuch as this operation is essential to the proper operation of the vibration meter.

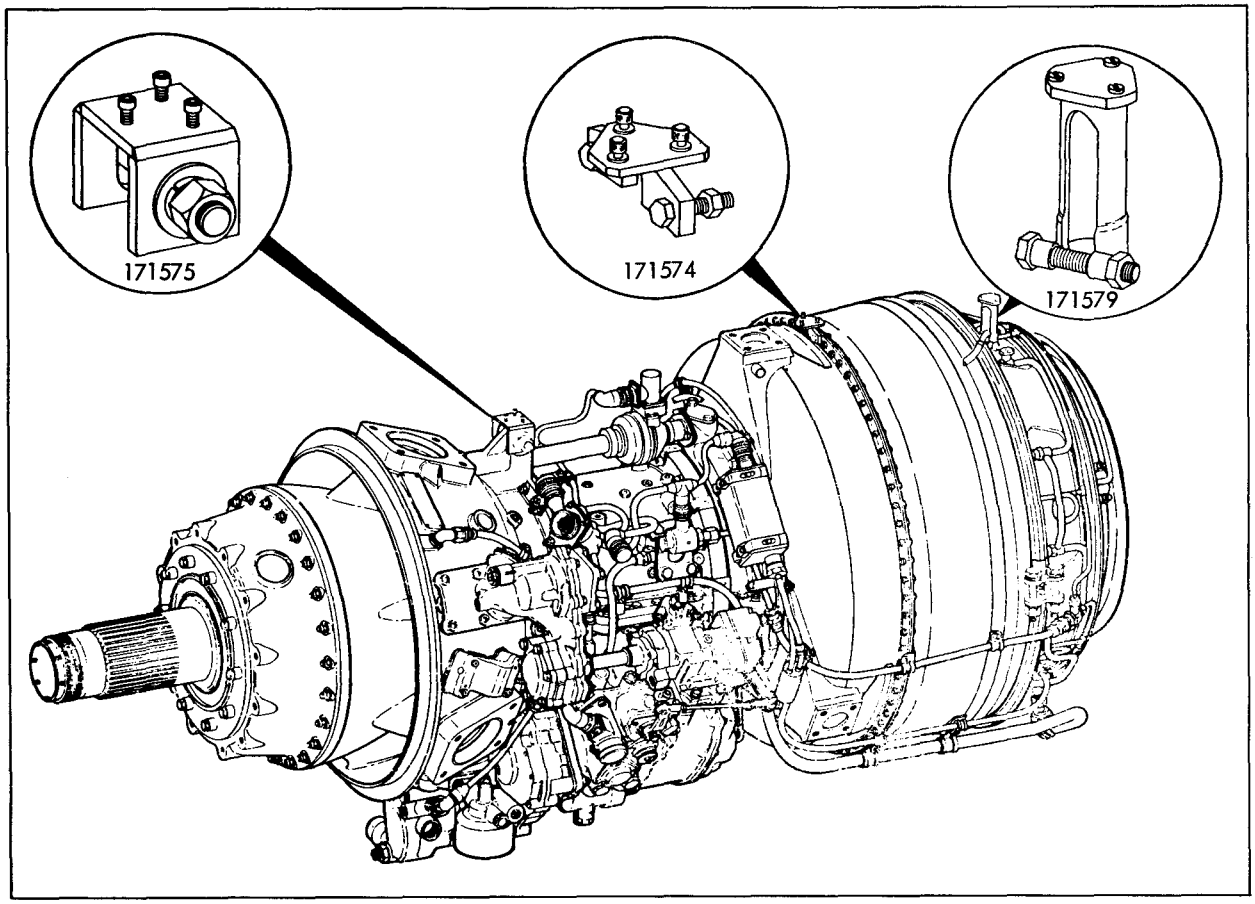


Figure 1-16. Location of Vibration Transducer Adapters, T53-L-3/7 Engines

1-37. CALIBRATION OF VIBRATION TRANSDUCER.

1-38. VIBRATION TRANSDUCER SENSITIVITY RATING. The basic sensitivity rating of velocity responsive vibration transducers is given by the following formula:

$$S = \frac{E}{V}$$ where:

S = the sensitivity rating, expressed as "millivolts per inch per second"

E = millivolts, i.e., (volts divided by 1000)

V = velocity in inches per second

The sensitivity rating, S, is given in consistent units, i.e., if the input velocity is given in average inches/second, it may be multiplied by S to obtain average millivolts output; if the input is given in RMS inches/second, it may be multiplied by S to obtain RMS millivolts output, etc.

1-39. CALCULATION OF CORRECTED SENSITIVITY. The sensitivity rating, S, can only be assumed correct when given in terms of operation into a load impedance equal to the input impedance of the vibration meter used. The input impedance of Vibration Meter Type 1-117-0105 is 10K ohms, and all Consolidated Electrodynamics Corp. vibration transducers are rated in terms of operation into a 10K + 500 ohm load. If vibration transducers rated for load impedances other than 10K ohms are used, it is necessary to calculate the "corrected sensitivity."

a. Sample calculation when vibration transducer open-circuit voltage is known (see figure 1-22):

Sample No. 1: With S_1 known to be 62 millivolts per inch per second and R_1 known to be 925 ohms, and using equation $S_2 = S_1 \frac{R_2}{R_1 + R_2}$ = corrected sensitivity, the following sample calculation is given:

$$S_2 = 62 \frac{10,000}{925 + 10,000}$$

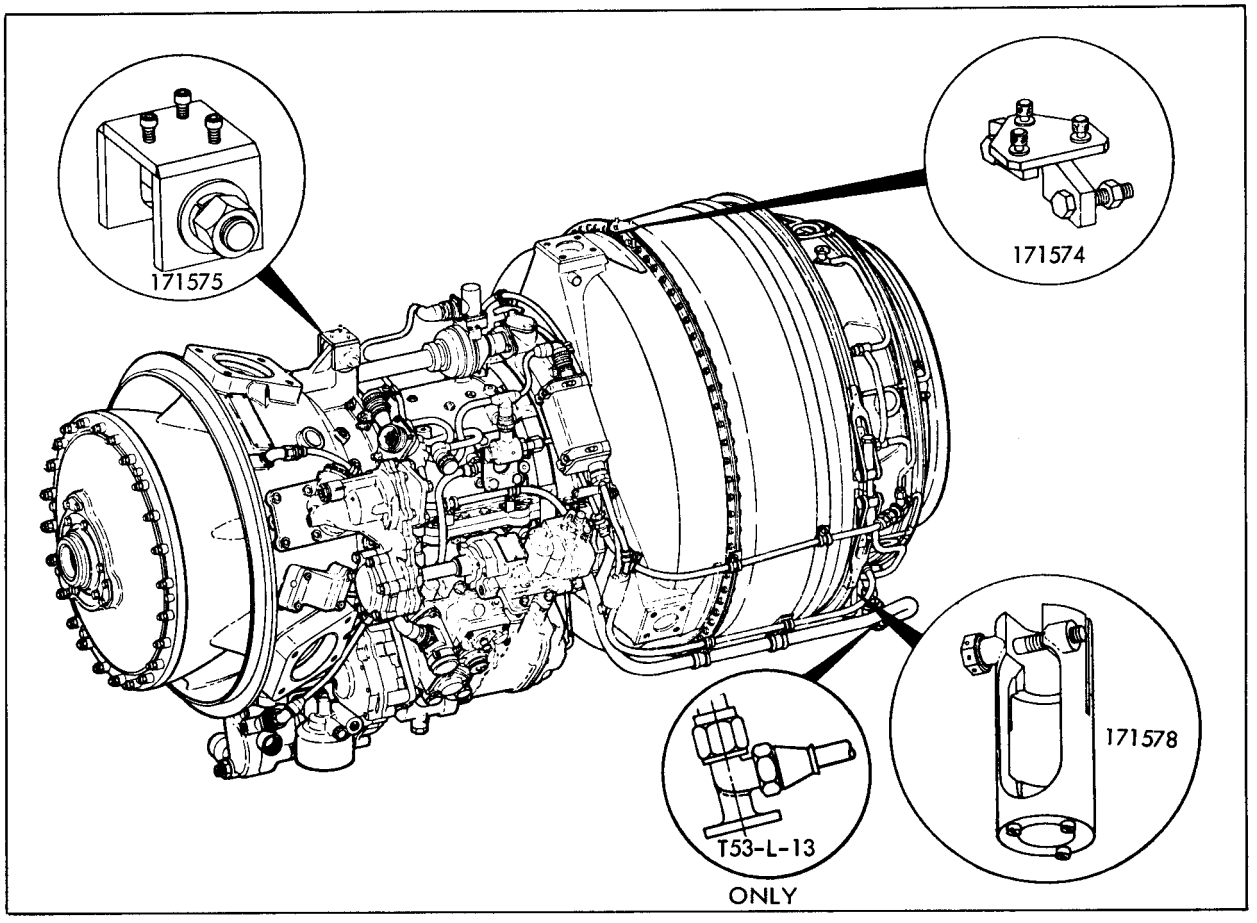


Figure 1-17. Location of Vibration Transducer Adapters T53-L-5/9/11 Engines

S_2 = 56.76 millivolts per inch per second

Sample No. 2: (For Torsiograph Type 9-102):

S_1 = 9.0 mv/degree/sec

R_1 = 700 ohms

$$S_2 = 9.0 \frac{10,000}{(700 + 10,000)}$$

S_2 = 8.4 mv/degree/sec

b. Calculation of vibration transducer open-circuit sensitivity: If the manufacturer's specifications do not given the open-circuit voltage, but do state the voltage across some resistive load other than 10K ohms, the corrected sensitivity may be calculated as follows:

1. Designate S_3 as the sensitivity into a load other than 10,000 ohms, i.e., R_3.

2. Designate R_3 as the resistive load known.

3. Calculate S_1 the open circuit sensitivity.

4. From S_1 calculate S_2, the corrected sensitivity.

5. With S_3 known to be 60 millivolts per inch per second, R_3 to be 50K ohms, and R_1 to be 750 ohms, the following sample calculation is given:

$$S_1 = S_3 \frac{R_1 + R_3}{R_3} \text{ or } 60 \frac{(750 + 50,000)}{(50,000)}$$

S_1 = 60.9 + millivolts,

$$S_2 = S_1 \frac{R_2}{R_1 + R_2} \text{ or } 60.9 \frac{(10,000)}{(750 + 10,000)}$$

S_2 = 50.65 millivolts per inch per second.

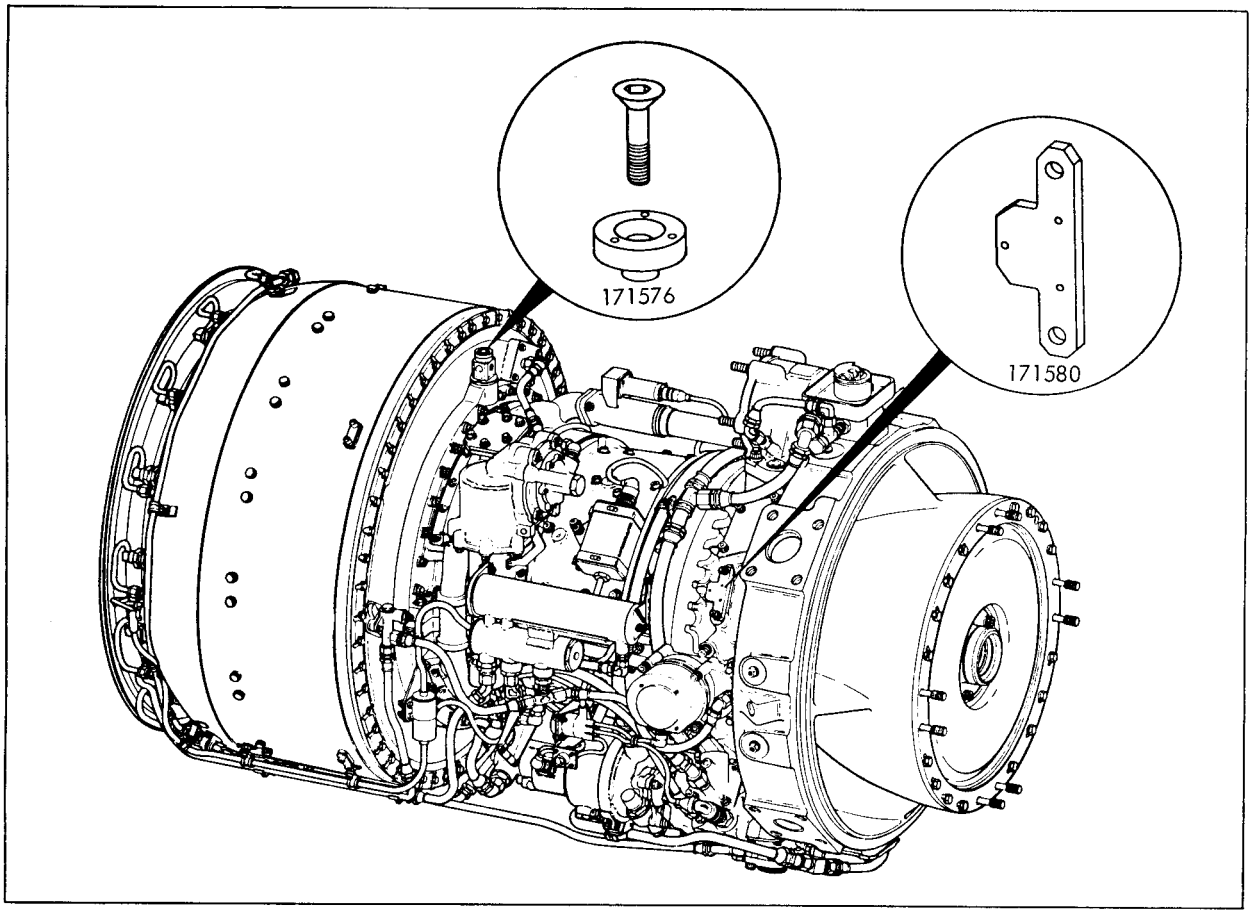


Figure 1-18. Location of Vibration Transducer Adapters, T55-L-5/7 Engines

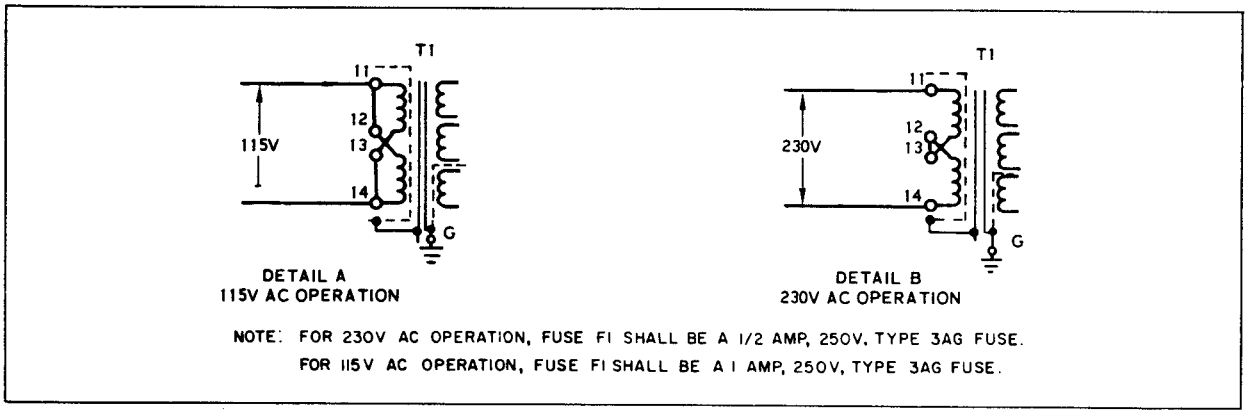


Figure 1-19. Power Transformer T1 Connections, Vibration Meter

Fig. 1-3 Index	Name of Control or Indicator	Ref. Desig.	Function
4	OPERATION Selector Switch	Rotary Switch S4	Used to select the calibration, the velocity, or the displacement measuring function of the vibration meter. Provides two ranges of sensitivity for each measurement function. The meter indication must be multiplied by the setting of both the RANGE and OPERATION selector switches.
5	RANGE Switch	Rotary Switch S2	This switch is a seven-position attenuator. The setting of this switch indicates the full-scale meter reading. The meter indication must be multiplied by the setting of both the RANGE and OPERATION selector switches.
6	OFF Power Switch	Toggle Switch S5	Two-position toggle switch used to turn the input ac power on or off.
7	SENSITIVITY 4 Control	Dual Variable Resistors R15A, R15B	Used to adjust the sensitivity (gain) of the adjustable gain amplifier for channel 4 operation. Both variable resistors are mounted on the same shaft and are connected to the amplifier when the CHANNEL selector switch is set to position 4.
8	SENSITIVITY 3 Control	Dual Variable Resistors R14A, R14B	Used to adjust the sensitivity (gain) of the adjustable gain amplifier for channel 3 operation. Both variable resistors are mounted on the same shaft and are connected to the amplifier when the CHANNEL selector switch is set to position 3.
9	SENSITIVITY 2 Control	Dual Variable Resistors R13A, R13B	Used to adjust the sensitivity (gain) of the adjustable gain amplifier for channel 2 operation. Both variable resistors are mounted on the same shaft and are connected to the amplifier when the CHANNEL selector switch is set to position 2.
11	SENSITIVITY 1 Control	Dual Variable Resistors R11A, R1lB	Used to adjust the sensitivity (gain) of the adjustable gain amplifier for channel 1 operation. Both variable resistors are mounted on the same shaft and are connected to the amplifler when the CHANNEL selector switch is set to position 1.
12	CALIBRATE SIGNAL Control	Variable Resistor with 2-Position Switch R35, S6	Used to calibrate the instrument. When the CALIBRATE SIGNAL switch is depressed (and the OPERATION switch is set to position C), a portion of the ac filament supply voltage is supplied to the fixed gain amplifier. When not depressed, voltage is supplied to the adjustable gain amplifier. The level of this voltage is adjusted by variable resistor R35.

Figure 1-20. Functions of Operating Controls and Indicators (Sheet 1 of 2)

Fig. 1-3 Index	Name of Control or Indicator	Ref Desig.	Function
13	Power On Indicator Light	I-1	Indicates power is being supplied to the unit.
14	CHANNEL Selector Switch	S1	Used to switch the desired vibration transducer into the input network. This switch also connects the appropriate SENSITIVITY control to the adjustable gain amplifier for the selected channel.
15	INPUT NETWORK Selector Switch	S3	Used to switch the appropriate filter into the circuit. The OUT position is used to connect the unfiltered vibration transducer signal directly to the attenuator and adjustable gain amplifier. The 70 position connects the 70 cps filter into the system, and the 200 position connects the 200 cps filter into the system.
16	Indicating Meter	M1	This meter indicates the average velocity in inches per second, or tens of degrees per second. It also indicates peak-to-peak displacement of vibratory motion in thousandths of an inch (roils), or hundredths of a degree. Values are read from the upper or lower scale, depending on the setting of the RANGE selector switch. Either average velocity or peak-to-peak displacement is indicated, depending on the setting of the OPERATION selector switch. The complete applicable scale factor is the product of both the RANGE and OPERATION selector switch settings.

Figure 1-20. Functions of Operating Controls and Indicators (Sheet 2 of 2)

Fig. 1-3 Index	Name of Connector	Ref. Desig.	Function
3	SCOPE Connector	J7	A telephone type jack used for connecting an oscilloscope to the output of the vibration meter for making a visual inspection of the signals. This connector may also be used for connecting warning circuits which are of sufficiently high input impedance. NOTE The oscilloscope used with the vibration meter must have an input impedance of 0.5 megohm or more to avoid loading the meter circuit.
18	CHANNEL 4 Connector	J4	Used to connect the channel 4 vibration transducer to the vibration meter.

Figure 1-21. Function of Electrical Connectors (Sheet 1 of 2)

Fig. 1-3 Index	Name of Connector	Ref. Desig.	Function
19	CHANNEL 3 Connector	J3	Used to connect the channel 3 vibration transducer to the vibration meter.
20	CHANNEL 2 Connector	J2	Used to connect the channel 2 vibration transducer to the vibration meter.
21	CHANNEL 1 Connector	J1	Used to connect the channel 1 vibration transducer to the vibration meter.
23	EXT. METER Connector	J6	A telephone type jack (normally closed), used to connect an external dc meter in series with the vibration meter, The dc meter used should have a value of 0 to 500 microamperes with a resistance of not over 200 ohms. This connector may also be used to connect external warning or control circuits of not over 200 ohms resistance. (The connector sleeve is negative, and should not be grounded.)
24	GALV. Connector	J5	A telephone type jack (normally closed), used to connect an external galvanometers to the vibration meter. The galvanometers used should be of suitable sensitivity and frequency range, and have an internal resistance of 100 ohms or less. Full scale on the indicating meter M1 corresponds to approximately 555 microampere rms nominal in the galvanometers circuit. The vibration meter controls will affect the galvanometer and indicating meter M1 simultaneously. Meter M1 indications will not be altered by the use of a suitable galvanometers.

Figure 1-21. Function of Electrical Connectors (Sheet 2 of 2)

1-40. CALIBRATION OF THE VIBRATION TRANSDUCER/METER SYSTEM.

1-41. CALIBRATION WITH INTERNAL TEST VOLTAGE. Normally, the vibration meter will be calibrated using the internal test voltage as follows:

NOTE

If calibration by this means does not lead to results which correlate with those obtained when calibration is performed using alternative methods, check the accuracy of the internal calibration systems by the procedure described in paragraph 1-59.

a. Divide the corrected sensitivity or the sensitivity of the transducer as indicated on the CEC calibration certificate by 10.

b. Leave the INPUT NETWORK selector switch in any position.

c. Set the CHANNEL selector switch to the channel to be calibrated.

d. The vibration transducer maybe either connected or disconnected.

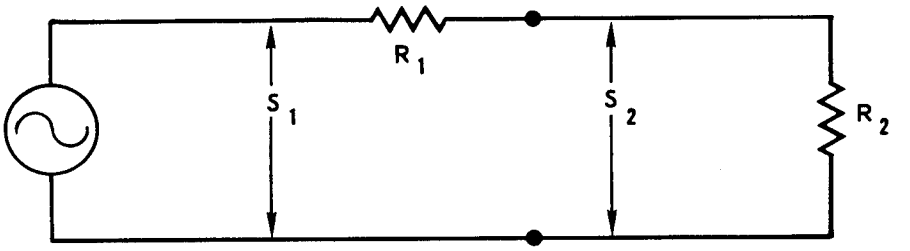
e. Turn the OPERATION selector switch to position C.

f. Depress the CALIBRATE SIGNAL control and rotate the control until the meter indication as read on the lower scale corresponds to the corrected sensitivity in millivolts per inch per second, divided by 10 as calculated in step a.

g. Release the CALIBRATE SIGNAL control.

h. Adjust the meter to read full scale using the SENSITIVITY control applicable to the channel in which the vibration transducer is to be used.

i. Calibrate each channel using a vibration transducer according to the procedures described in steps



$S_2 = S_1 \frac{R_2}{R_1 + R_2}$ Equation 1; Corrected Sensitivity

S_1 = Open circuit sensitivity of transducer

S_2 = Transducer sensitivity when loaded with R_2

R_1 = Transducer internal impedance

R_2 = Load impedance (10,000 ohm input impedance of the vibration meter)

R_1 and either S_1 or S_2 will usually be specified by the manufacturer. However, if a transducer sensitivity other than S_1 or S_2 is specified, use the method given in the following section to determine S_1.

Figure 1-22. Equivalent Circuit of Vibration Transducer Feeding Vibration Meter Type 1-117-0105

a through h above. In each case, the appropriate channel SENSITIVITY control should be used.

1-42. CALIBRATION WITH STANDARD AC VOLTAGE SUPPLY. To calibrate the vibration meter using a standard ac voltage supply, proceed as follows:

a. Determine the corrected sensitivity rating of the vibration transducer (s) to be used. From this figure, determine the vibration transducer output in millivolts when operation is at 5 inches/second average velocity (or 50 degrees/second for torsiographs).

b. The calculation in step a above is based on an average velocity figure; therefore, the calculated vibration transducer output will be in average millivolts. Since most available voltage sources and/or voltmeters are calibrated in RMS levels, correct the calculated output level as follows:

RMS millivolts = (1.11) (average millivolts)

c. Adjust a standard sine-wave voltage to the value calculated in b above and apply this voltage to the vibration transducer input of the meter.

d. Set the OPERATION selector switch to V x 1.

e. Set the RANGE switch to 5.

f. Set the INPUT NETWORK switch to OUT.

g. Adjust the proper channel SENSITIVITY control until the meter is at full scale indication. The frequency used must be between 5 and 5000 CPS.

1-43. CALIBRATION USING A VIBRATION TABLE. Calibration of the vibration meter using a vibration table is the most conclusive method of calibration, and may be performed either with a standard vibration table equipped with standardized monitoring means or with special calibrators equipped with an accurate internal velocity-sensing coil. In either case, the channel SENSITIVITY control should be set to provide a reading equal to the known average velocity or peak-to-peak displacement of the vibration transducer.

a. DISPLACEMENT CALIBRATION: Displacement can be accurately determined by optical or other means. In calibrating the vibration meter by this technique, the OPERATION selector switch should be set to "Dx0.1" or "Dx1." Note that the frequencies of calibration must fall within the following ranges:

on "Dx0.1": from 50 to 1000 CPS
on "Dx1": from 5 to 1000 CPS

b. VELOCITY CALIBRATION: In this technique, the OPERATION selector switch should be set to "Vx0.1"

or "Vx1," and the frequencies of calibration should be between 5 and 5000 CPS (or as limited by vibration transducer frequency response). Many calibrators are calibrated in terms of RMS velocity, whereas the vibration meter is calibrated in terms of average velocity. Assuming that sine-wave functions are being used, the following simple conversion factors can be used:

Average inches/second = (0.90) (RMS inches/second)
RMS inches/second = (1.11) (average inches/second)

c. These examples may serve to clarify the use of the conversion factors:

(1) Assume that a calibrator is used at a level of 0.5 RMS inches/second. To determine what the vibration meter should read under this condition, use the first formula given above:

Average V = (0.90) (RMS V) = (0.90) (0.5)
= 0.45 inches/second average

(2) Alternatively, assume that it is desired to produce a vibration input corresponding to a full-scale reading on the 0.5 inches/second average velocity range of the vibration meter. Here the problem is to determine the RMS velocity of the shaker corresponding to this condition. This may be done using the second formula given above:

RMS V = (1.11) (average V) = (1.11) (0.5)
= 0.555 inches/second RMS

1-44. OPERATING INSTRUCTIONS.

1-45. GENERAL. When using Vibration Meter Type 1-117 with a compatible vibration transducer for measuring purposes, install the equipment as described in paragraph 1-30.

1-46. The vibration meter may be set up to indicate the value of the peak-to-peak amplitude of the vibration. This reading will serve as a check against known acceptable limits for the equipment being tested. For production work, monitoring checks at key points are usually sufficient to establish product acceptability.

1-47. If further details pertaining to the nature of the vibration are needed, the average velocity may also be read directly from the meter. When the vibration consists of a single frequency, the frequency of vibration may be calculated from the reading of displacement and velocity by the use of the following equation. With f representing the frequency of vibration (cycles per second), $V_{average}$ as the average velocity of vibration (inches per second), and D as the peak-to-peak displacement (inches), the equation reads:

$$f = \frac{V_{average}}{2D}$$

1-48. PRELIMINARY CONTROL SETTINGS AND CHECK OF CIRCUITS. Before performing any measurements with the vibration meter, the following steps should be taken:

a. Turn the RANGE switch to the OFF position.

b. Leave the INPUT NETWORK and CHANNEL selector switches in any position.

c. The vibration transducer may be connected or disconnected.

d. Connect the meter ac power cord to 115 volts ac. Turn the OFF power switch to the on position.

e. Perform the zero test by indexing the OPERATION selector switch through the Vx1.0, Vx0.1, Dx1.0, and Dx0.1 positions. A reading of not more than two percent of full scale should be obtained, indicating a noise level of less than two percent.

f. Perform the calibrate signal test. Turn the OPERATION selector switch to position C. Depress the CALIBRATE SIGNAL control to operate. This control should adjust the meter indicator from one-third to full scale. Set the meter indicator at 5 on the lower scale and release the CALIBRATE SIGNAL control, preparatory to step g.

NOTE

The CALIBRATE SIGNAL control taps a portion of the filament supply voltage. The voltage regulator for the power supply distorts the sine wave; however, the resultant wave is suitable for setting the gain of the first half of the amplifier.

g. Perform the sensitivity control test. Index the CHANNEL selector switch to each of its four positions. At each position, it should be possible to obtain a full scale reading on the output meter by adjusting the applicable channel SENSITIVITY control.

1-49. MEASUREMENT PROCEDURE.

a. Make preliminary circuit checks and adjustments set forth in paragraph 1-48.

b. Turn power switch to the on position.

c. Allow instrument approximately one-half hour to warm up.

d. If the transducer or transducers being used are not connected, they should be connected to meter circuits as required.

e. Calibrate or match each transducer with the channel in which it will be used. Use calibration methods detailed in paragraph 1-35.

f. Set the CHANNEL selector switch for connection with the transducer whose output is desired.

g. If the transducer signal is to be metered without the use of filters, or other modifying methods, turn the INPUT NETWORK selector switch to OUT.

h. If filtering of the signal is desired, turn the INPUT NETWORK selector switch to 70 for 70 cps filtering, or to 200 for 200 cps filtering of input signal.

i. To measure peak-to-peak displacement, set the OPERATION selector switch to one of the D positions. Use the Dx1 position rather than the Dx0.1 position, whenever possible.

j. To measure average velocity, set the OPERATION selector switch to one of the V positions. Use the Vx1 position rather than the Vx0.1 position, whenever possible.

k. Adjust the RANGE switch so that meter readings will be above mid-scale. If set to 5, 50, or 500, read the upper-scale figures. If set to 15, 150, or 1500, read the lower group of figures.

l. Attach any desired readout equipment whose characteristics are compatible with the vibration meter.

m. Use a prepared form for the tabulation of all variables and readings. (See figures 1-9 through 1-12.)

n. Refer to figure 1-23 for full-scale meter indications vs. dial settings.

NOTE

Data seen in figure 1-23 are pertinent to linear vibration transducers with a resistance of 1100 ohms or less and velocity sensitivities which lie between 50 and 150 millivolts per inch per second.

Operation Setting	Range Setting	Average Velocity (Inches per second)	Displacement Inches Peak-to-Peak
X0.1	5	.5	.0005
X1.0	5	5.0	.005
X0.1	15	1.5	.0015
X1.0	15	15.0	.015
X0.1	50	5.0	.005
X1.0	50	50.0	.050
X0.1	150	15.0	.015
X1.0	150	150.0	.150
X0.1	500	50.0	.050
X1.0	500	500.0	.500
X0.1	1500	150.0	.150
X1.0	1500	1500.0	1.500

Figure 1-23. Full-Scale Meter Indications vs. Operation and Range Selector Settings

1-50. EVALUATION OF VIBRATION TEST DATA.

a. Compare the meter indications recorded on the data sheet (figures 1-9 through 1-12) with the figures given in parentheses for the maximum permissible engine vibration. If all recorded figures are below the permissible vibration, the engine as installed, has passed the vibration test.

b. Vibration measured with the 70 cps filter will include installation, or airframe vibration. If the recorded meter indication, using the 70 cps filter, exceeds the maximum permissible engine vibration figures but, using the 200 cps filter, is within permissible figures, the excessive vibration is caused by the airframe. Corrective action must be taken before the aircraft is again tested for vibration, prior to acceptance for unrestricted flight.

c. Vibration measured with the 200 cps filter represents engine vibration only. If the recorded meter indication exceeds the maximum permissible engine vibration figures, corrective action must be taken before the engine is again tested for vibration, prior to acceptance for unrestricted flight.

1-51. MAINTENANCE INSTRUCTIONS, VIBRATION METER TYPE 1-117-0105.

1-52. CLEANING AND LUBRICATING. The vibration meter requires no lubrication or periodic cleaning beyond keeping the unit free from dust and foreign matter.

Part or Type Number	Nomenclature	Application
Weston Model 433, 0-150V ac (or equivalent)	Line voltage meter	Monitors line voltage
Hewlett-Packard Model 400H (or equivalent)	Vacuum tube voltmeter	Measures AC
General Radio Model V-5 (Variac). 5 amperes (or equivalent)	Voltage changer	Varies line voltage
Kron-hite Model 466 (or equivalent type which has a range from 5 cps to 5000 cps)	Audio oscillator	Supplies test signal
Triplett Model 630A (or equivalent meter of 20,000 ohms/volt)	Multimeter	Measures voltages and resistances
RCA Model WV-77A (or equivalent)	Voltohmist	For high impedance measurements
Tektronix Model 545 (or equivalent)	Oscilloscope	Visual observation of waveforms

Figure 1-24. Test Equipment Required for Test and Maintenance of the Vibration Meter Type 1-117-0105

1-53. TEST EQUIPMENT REQUIRED. Required test equipment for testing and maintenance of the vibration meter is listed in figure 1-24.

1-54. TROUBLESHOOTING. A study of the troubleshooting information contained within the subsequent paragraphs will necessitate frequent reference to the schematic, figure 1-25. Under normal operating conditions, the vibration meter should require very little attention beyond replacement of fuses, vacuum tubes and such defective parts as can be located by visual inspection.

1-55. If visual inspection, tube replacement and simple component replacement does not eliminate the instrument trouble, or the difficulty is faulty operation rather than failure to operate, the fault probably lies in the vibration transducer, interconnecting cables, or in the wiring circuitry associated with these components. Component values are often critical and considerable caution should be exercised in soldering any connections, wiring, or parts that need repair or work. Variable resistor R47 (see figures 1-25 and 2-14) is in the circuit for the purpose of adjusting the filament voltages of tubes V1 and V2. This control is set at the factory and should need no attention. If, however, insufficient gain is indicated, the filament voltage should be checked and, if necessary, an adjustment made. This check should indicate approximately 6.3 volts dc for normal operation of the meter. All filament voltages should be measured with a Triplett Model 630A, or equivalent, 20,000 ohm/volt multimeter. See figures 1-26 and 1-27 for typical instrument voltages. Figure 1-28 lists the troubles, probable causes and remedies which apply in case of instrument failure or malfunction.

1-56. REPAIR AND REPLACEMENT. (GENERAL.) If visual inspection or troubleshooting indicate the replacement or repair of resistors, capacitors, variable resistors, transformers or similar components, such components should first be separated with care from instrument chassis. After removal of defective component, replace it with new or repaired part, making the appropriate solder connections.

1-57. REPLACEMENT OF FUSE. The line fuse located on the rear panel of the instrument can be removed by unscrewing the holder knob. To check fuse, remove fuse cartridge from holder. If cartridge is burned out, replace with spare. A spare fuse of the correct value is located on the terminal board directly behind the front panel. To reach the spare fuse, first separate the instrument chassis assembly from the case by removing four screws located on the bottom and side of the case.

1-58. REPLACEMENT OF PILOT LAMP. To replace the 0.25 ampere, 6-8 volt pilot lamp located at bottom left on the front panel, separate the instrument chassis assembly from the case as outlined in paragraph 1-57. After the chassis assembly has been withdrawn from the case, remove the burned-out bulb from the pilot lamp holder and replace with the spare.

1-59. DETERMINING THE ACCURACY OF INTERNAL CALIBRATION OF VIBRATION METER.

a. With the OPERATION selector switch in the C position, depress the CALIBRATE SIGNAL control

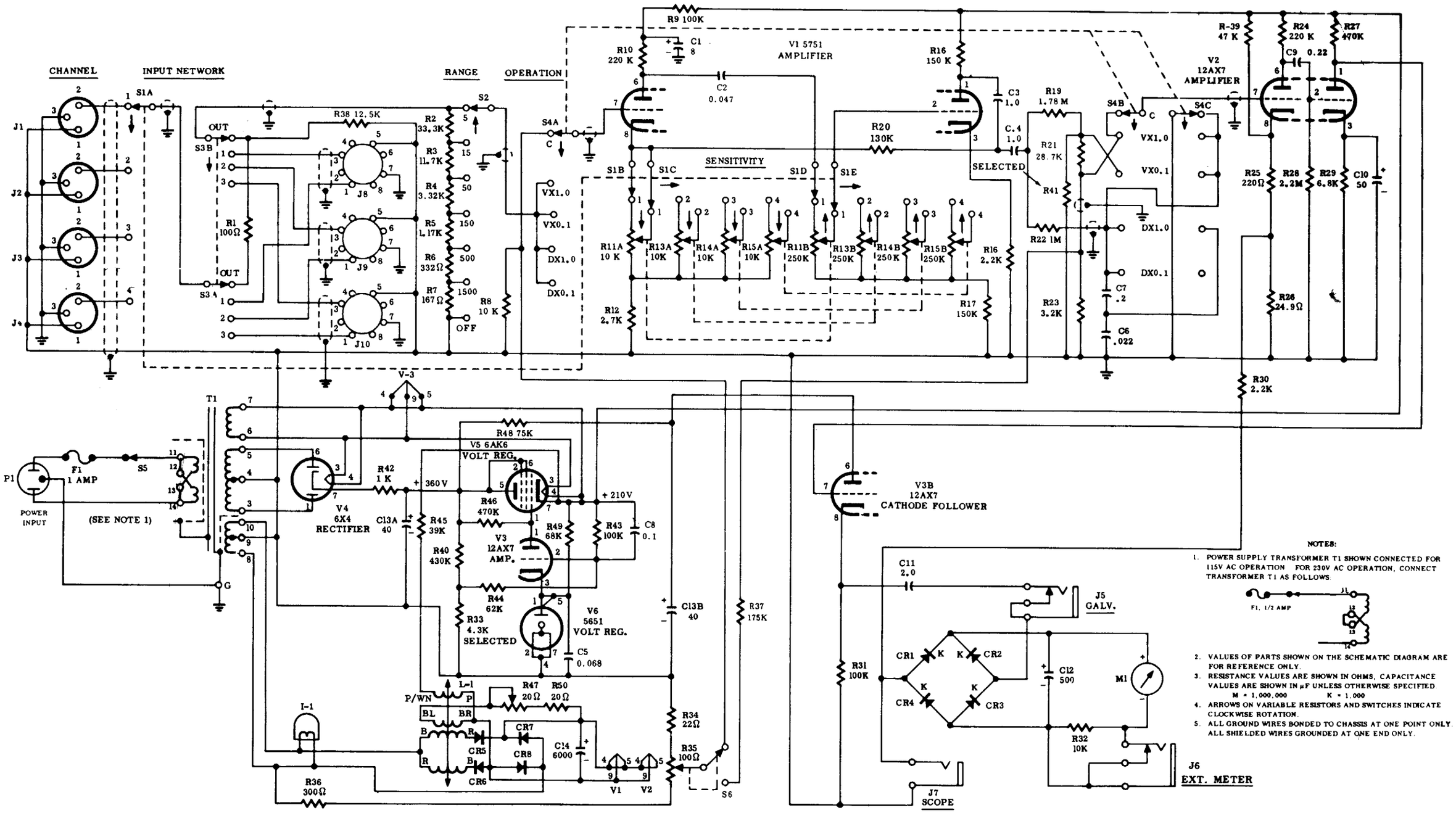


Figure 1-25. Vibration Meter Type 1-117-0105, Schematic Diagram

Ref. No. (See Fig. 1-25)	Part No. or Type	Description	Voltage
T1	34599	Transformer Primaries: Filament Windings Regulated Filaments High Voltage Secondary	115V ac 8V ac 6.3V dc 330V ac per section
V3	70091-0060 (12AX7)	Vacuum tube, Pin 1 Pin 2 Pin 3	200V dc 84V dc 85V dc
V5	70091-0026 (6AK6)	Vacuum tube, Pin 1 Pins 2, 5, 6 Pin 7	200V dc 370V dc 210V dc
V6	70091-0128 (5651)	Vacuum tube, Pin 1	85V dc

Figure 1-26. Typical Power Supply Voltages

Ref. No. (See Fig. 1-25)	Part No. or Type	Description	Voltage
V1	70091-0099 (5751)	Vacuum tube, Pin 1 Pin 3 Pin 6 (at minimum gain) Pin 8 (at minimum gain)	120V dc 1.2V dc 140V dc 2V dc
V2	70091-0060 (12AX7)	Vacuum tube, Pin 1 Pin 3 Pin 6 Pin 8	107V dc 1.3V dc 118V dc 1.1V dc
V3	70091-0060 (12AX7)	Vacuum tube, Pin 6 Pin 8	290V dc 115V dc

Figure 1-27. Typical Amplifier Voltages

Trouble	Probable Cause	Remedy
Meter does not operate (dead)	No primary (line) power is being supplied).	Check primary power source.
	Ac power (line) cord P 1 is defective.	Check cord and plug; replace if needed.
	Fuse is blown.	Replace fuse F1.
	Power transformer T1 is defective.	Check transformer; replace if defective.
Power source checks, but tube filaments do not light	One or more tubes burned out.	Check tubes; replace if needed.
	Switch S5 is defective.	Check switch; replace if needed.

Figure 1-28. Troubleshooting Chart Vibration Meter Type 1-117-0105 (Sheet 1 of 3)

Trouble	Probable Cause	Remedy
Power source checks, but tube filaments do not light (cont.)	Ac power (line) cord or plug P1 are defective.	Check cord and plug; replace if needed.
	Power transformer T1 is defective.	Check transformer; replace if needed.
Meter does not respond to normal input signal	Set the OPERATION selector switch to C position. Turn the RANGE selector switch to 5. If meter indication is obtained and amplifier is operating, the difficulty is to be found in the input circuitry.	Check input circuitry. Replace defective components or perform such minor repairs as are necessary and feasible.
	If meter does not indicate with the OPERATION selector switch at C and the RANGE selector switch at 5, depress the CALIBRATE SIGNAL control. If the meter now indicates, the difficulty is to be found in V1 or its associated circuitry.	Check V1 and replace if defective. Check associated circuitry. Replace defective components, or perform such repairs as are necessary and feasible.
	If meter does not indicate with the OPERATION selector switch at C, the RANGE selector switch at 5, and the CALIBRATE signal control depressed, the trouble may be in the power supply and V1 or V2 or their associated circuitry.	Check power voltages to determine if V4, V5, and V6 are operating properly. Refer to figures 1-26 and 1-27 for typical voltages. Perform such replacement or repairs as are necessary after circuitry check.
	If meter is erratic and appears to be sluggish, EXT. METER connector may have been damaged during removal of chassis assembly from case, opening the normally closed contact.	Check EXT. METER connector and bend contacts back into proper position, If unable to repair, replace connector.
	If power supply is operating properly, again, depress the CALIBRATE SIGNAL control with the OPERATION selector switch in C position. Measure the voltage at pin 7 of V2. The CALIBRATE SIGNAL control should be capable of adjusting this voltage to at least 15 millivolts which should give approximately full scale reading on the meter. If the voltage at pin 7 of V2 is correct and no meter reading is obtained, the difficulty will be found in V2 or V3 or their associated circuitry.	Check V2 and V3. Check circuitry. Replace any tubes found to be defective. Replace component found to be defective, or perform such repairs as are necessary and feasible.
Transient response is poor	Rectifiers for the dc filament supply have poor contact.	Tighten holder to which rectifiers are mounted. Check joints for good contact to copper of board.

Figure 1-28. Troubleshooting Chart Vibration Meter Type 1-117-0105 (Sheet 2 of 3)

Trouble	Probable Cause	Remedy
Transient response is poor (cont.)	Winding on toroid may be open. Check to see if there is a voltage drop across R45 which would indicate such an opening.	If winding is open, replace toroid, or repair if feasible.
	A change of 0.1 volt or more in filament volt age while a transient is being injected will cause output to increase excessively.	Monitor filament voltage with Triplett Meter on 12 volts while injecting a transient. Adjust filament potentiometer R47 so that filament voltage is 6.3V dc on low side.
Amplifier peaks up on low frequency end of frequency response	V2 defective. Check potential on grid of tube (pin 7) using voltohmist. Voltage should read 0.	If reading is not 0, replace tube V2.
Gain is high	This may be due to a ground at scope connector J7. This would short out the negative feedback. The ground may or may not be intermittent.	Remove short or replace scope connector.
High hum in last stages	Defective microswitch. (CALIBRATE SIGNAL control.) Hum turns out to be calibrating signal.	Check switch; replace if defective.
Amplifier is noisy	Capacitor C1 on plate of first stage. It may be noisy.	Check capacitor; replace if defective.
	Resistor R2 is noisy. Short one end of R22 to ground; short other end. If noise does not decrease, fault lies in R22.	Replace R22.
Filaments will not regulate Voltage is low. Rectifiers get hot.	Filter capacitor C14 may have one side shorted to the case. Measure from one side of filament to ground. Should not be dead short.	Replace capacitor if necessary, or remove short.
Filaments will not regulate or regulation is poor	Diodes CR5, CR6, CR7, and CR8 have incorrect or faulty resistance. Remove all diodes and measure forward and reverse. Resistance should be 2-3 ohms forward, and over 500 ohms in reverse.	Replace defective diodes.

Figure 1-28. Troubleshooting Chart Vibration Meter Type 1-117-0105 (Sheet 3 of 3)

and adjust the CALIBRATE SIGNAL control until a full-scale reading is obtained. This corresponds to a theoretical transducer sensitivity of (15 x 10) = 150 mv/in./sec = S. As an example, for 5 in./sec average velocity:

$$M\,V_{RMS} = (1.11)\ (S)\ (V_{average})$$
$$= (1.11)\ (150)\ (5) = 833 \text{ mv}$$

b. Adjust the SENSITIVITY control for the channel under test to obtain a full-scale reading (CALIBRATE SIGNAL control released; channel selector set to the channel under test; INPUT NETWORK selector switch set to OUT).

c. Inject a sine wave signal into the CHANNEL connector corresponding to the channel under test from

a suitable audio generator, and monitor the rms input voltage with an accurate ac VTVM. Using a test frequency of 500 cps, adjust the input level to obtain a full-scale reading with the OPERATION selector switch set on Vx1.0. The rms input should be 833 mv ± 3% when the full-scale reading is obtained.

d. Set the OPERATION selector switch to Vx0.1 and again adjust the input for full scale. The rms input should be 83.3 mv ± 3% when the full-scale reading is obtained.

e. Set the OPERATION selector switch to Dx1.0 and adjust the input voltage for a full-scale reading. The rms input should be 833 mv ± 4% when the full-scale reading is obtained.

NOTE

If the test frequency is not exactly 500 cps and the waveform is not purely sinusoidal, readings will be incorrect when testing the displacement ranges.

f. Set the OPERATION selector switch to Dx0.1 and adjust the input for a full-scale reading. The rms input should be 83.3 mv ± 4% when the full-scale reading is obtained.

g. Repeating steps a through c should be adequate to check the remaining channels.

1-60. LOCALIZING TROUBLES IF INTERNAL CALIBRATION IS INACCURATE.

a. Connect an rms-reading ac VTVM between the end of variable resistor R37 nearest switch S6 (the CALIBRATE SIGNAL control microswitch) and ground. With the CALIBRATE SIGNAL control depressed, OPERATION selector switch on C, and the CALIBRATE SIGNAL control adjusted for full scale meter reading, the measured rms voltage should be 833 mv. If this reading is correct, shift the VTVM to read the rms voltage between pin 7 of V1 and ground. This reading should also be 833 mv rms when the CALIBRATE SIGNAL control is released. If it is not, the trouble exists in the V1 circuits.

b. If the reading obtained between the end of variable resistor R37 and ground differs from 833 mv rms (step a above), readjust the CALIBRATE SIGNAL control until this reading is obtained. Then shift the VTVM to read between the junction of variable resistor R37 and R23 and ground. This reading should now be 15 ±0.3 mv rms. If it is not, trouble exists in the R37/R38 divider network. Check to be sure the values of R37 and R23 are within ±1% of the marked values.

c. Inject a signal of approximately 15 mv rms between pin 7 of V2 and ground. Adjust this signal level until the vibration meter reads full-scale exactly. (CALIBRATE SIGNAL control released; OPERATION selector switch on Vx1.0 position; range switch OFF.) Use a 500 cps test signal. The input signal level should be 15 ± 0.3 mv rms at the time a full-scale reading is obtained. If not, trouble exists in the output/meter circuitry.

1-61. DEFINITION OF TERMS AND FUNDAMENTAL RELATIONSHIPS, SIMPLE HARMONIC MOTION.

a. S = MV/IN./SEC = MV/V = Sensitivity
MV = Millivolts (one millivolt = 0.001 volt)
V = Velocity, inches/second
F = Frequency, cycles/second
D = Displacement, double amplitude, i.e., peak-to-peak displacement

(1) $MV_{Peak} = (\sqrt{2})(MV_{RMS})$

(2) $V_{Peak} = (\pi/2)(V_{Avg}) = (\sqrt{2})(V_{RMS})$

(3) $V_{Avg} = (2)(F)(D)$

(4) $S = (MV_{Peak})/(V_{Peak}) = (MV_{RMS})/(V_{RMS}) = (MV_{Avg})/(V_{Avg})$

b. RMS Millivolts vs. Average Velocity:

$$S = \frac{MV_{Peak}}{V_{Peak}} = \frac{\sqrt{2}\, MV_{RMS}}{(\pi/2)\, V_{Avg}}, \text{ therefore:}$$

$$MV_{RMS} = \frac{\pi\, S\, V_{Avg}}{2\sqrt{2}},$$

or: $MV_{RMS} = (1.11)(S)(V_{Avg})$

c. RMS Millivolts vs. RMS Velocity:

$$S = \frac{MV_{Peak}}{V_{Peak}} = \frac{\sqrt{2}\, MV_{RMS}}{\sqrt{2}\, V_{RMS}}, \text{ therefore:}$$

$MV_{RMS} = (S)(V_{RMS})$

d. Millivolts RMS vs. Peak-to-Peak Displacement:

$$MV_{RMS} = \frac{\pi\, S\, V_{Avg}}{2\sqrt{2}}, \text{ from b above. Also,}$$

$V_{Avg} = 2\,F\,D$, from 3 above. Therefore,

$$MV_{RMS} = \frac{\pi\, S\,(2\,F\,D)}{2\sqrt{2}} = \frac{\pi\, S\, F\, D}{\sqrt{2}} \text{ or approx.:}$$

$MV_{RMS} = (2.22)(S\,F\,D)$

Equipment	Manufacturer	Use
Oscilloscope, Type 531 (or equal)	Tektronix, Portland, Oregon	To monitor transducer output waveforms.
Vibration Test Equipment, Model C11 (Vibration Table) (or equal)	MB Manufacturing Co., New Haven, Conn.	To provide controlled vibration for calibration of the transducer.
Vacuum Tube Voltmeter, Model 400H (or equal)	Hewlett-Packard Co., Palo Alto, Calif.	To measure driving voltage applied to the vibration table and transducer output voltages.
Wheatstone Bridge, Model 5305 (or equal)	Leeds and Northrup, Chicago, Ill.	To measure resistance of transducer coils.
Insulation Tester, Model 779 (or equal)	Weston Electrical Instrument Corp., Newark, N. J.	To measure electrical leakage.

Figure 1-29. Test Equipment Required for Testing and Maintenance of the Vibration Transducer

1-62. MAINTENANCE INSTRUCTIONS, VIBRATION TRANSDUCER TYPE 4-118-0107 AND TYPE 4-128-0101.

1-63. TEST EQUIPMENT REQUIRED. Required test equipment for testing and maintenance of the vibration transducer is listed in figure 1-29.

1-64. PERIODIC INSPECTION. Inspect the vibration transducer carefully after each use for evidence of damage to the case. Check the electrical connector for bent terminals and evidence of corrosion. Check that the four screws attaching the cover to the bobbin assembly (or coil and pole piece assembly) are tightened securely.

1-65. TROUBLESHOOTING. If the vibration transducer fails to operate properly, most troubles can be rapidly isolated by referring to the troubleshooting chart in figure 1-30 or figure 1-31.

1-66. LEAKAGE RESISTANCE TEST.

a. Connect an insulation tester across pins 1 and 3 (figure 1-32) of connector. Reading on the insulation tester must be above 0.1 megohm at 45V dc for the Type 4-128-0101, and above 100 megohms at 45V dc for the Type 4-118-0107.

b. Connect an insulation tester across pins 2 and 3 (figure 1-32) of connector. Reading on insulation tester must be above 0.1 megohm at 45V dc for the Type 4-128-0101, and above 100 megohms at 45V dc for the Type 4-118-0107.

1-67. COIL RESISTANCE TEST. Connect a Whetstone Bridge across pins 1 and 2 (figure 1-32) of connector. Reading on the bridge test set should be as specified in the calibration record (between 770 ohms and 850 ohms for the Type 4-118-0107, and between 441 ohms and 539 ohms for the Type 4-128-0101).

1-68. NATURAL FREQUENCY. Test the natural frequency of the transducer as follows:

a. Install the vibration transducer on a vibration table as shown in figure 1-33.

b. Connect the output of the transducer to the vertical input of an oscilloscope.

c. Connect the output of the vibration table signal generator to the horizontal input of the oscilloscope.

d. With the transducer at 77°F, set the vibration table to vibrate at approximately 20 cps with a velocity of 2 in./sec. Vary the frequency of vibration until a 90° phase shift is observed on the oscilloscope (as indicated by a reversal in direction of tilt of the lissajous pattern on the oscilloscope screen). This phase shift will occur within ±2 cps of the nominal natural frequency. The natural frequency should be approximately 15 cps for the Type 4-128-0101 and 30 cps for the Type 4-118-0107.

1-69. FREQUENCY RESPONSE TEST. With the transducer installed on a vibration table in a vertical position as shown in figure 1-34, read and record the output of the transducer at each of the vibration table settings listed in figure 1-35. Monitor the output waveforms of both the transducer and the vibration table during each test. The test results must be as follows:

$$\text{Sensitivity} = \frac{\text{Transducer Output}}{\text{Vibration Table Drive}} \quad \frac{\text{Mv}}{\text{In./Sec}}$$

Action or Condition	Normal Indications	Corrective Action
Measure the resistance of the transducer coil as described in paragraph 1-67.	Coil resistance should be as specified on the calibration record.	a. Check the connections between the coil terminals and the cable wires. Repair as required.
		b. Check the coil windings carefully for defective insulation or broken wires. Replace the bobbin assembly if necessary.
Measure the leakage resistance from the connector terminals to the case as described in paragraph 1-66.	Leakage resistance should exceed 0.1 megohm at 45 volts.	a. Check the internal parts of the transducer carefully for shorting due to contaminants which may have entered the case. Carefully clean all internal parts and reassemble the unit.
		b. Check the coils carefully for defective insulation. Replace the bobbin assembly if necessary.
Check the natural frequency of the transducer as described in paragraph 1-68.	Natural frequency must be ±2 cps of the nominal natural frequency.	Replace the two compression springs and repeat the test.
No output or erratic output from the transducer.	Output should be as specified in figure 1-8.	a. Check for loose connections between the coil windings and the connector terminals.
		b. Check for shorted or open coil windings. Replace the bobbin assembly if necessary.
		c. Check the magnet assembly for rough bearing surfaces, or binding. Replace the magnet assembly and sleeve if necessary.
		d. Check cable assembly for broken or shorted wires. Replace if necessary.
Check the frequency response as described in paragraph 1-69.	Response from 15 to 1500 cps must be within ±12% of the mean sensitivity. Transducer waveforms must be the same as the vibration table waveforms.	a. Calibrate the vibration transducer as described in paragraph 1-91.
		b. Check for broken hermetic seal between the bobbin assembly and the case assembly. Clean the mating surfaces and reseal.
		c. Check the magnet assembly for rough bearing surfaces, or binding. Replace the magnet assembly if necessary.
		d. Check the natural frequency of the transducer as described in paragraph 1-68. Perform the natural frequency corrective action described in this figure.

Figure 1-30. Trouble Shooting Chart, Vibration Transducer Type 4-128-0101

The response from 15 to 1500 cps for the Type 4-128-0101 in the vertical position must be within ± 12% of the mean sensitivity; and the response from 50 to 500 cps for the Type 4-118-0107 must be within ±10% of the mean sensitivity. The mean sensitivity is one-half the sum of the lowest and highest sensitivity in the frequency range.

1-70. OVERHAUL, VIBRATION TRANSDUCER TYPE 4-118-0107.

1-71. SPECIAL TOOLS. Special tools and test equipment required for overhaul are listed in figure 1-36.

1-72. DISASSEMBLY. (See figure 1-37.) Disassemble the velocity vibration transducer assembly in the

Trouble	Probable Cause	Remedy
Output voltage too low.	Magnet defective.	Replace magnet.
No output voltage indicated on oscilloscope.	Cable assembly defective.	Replace or repair cable assembly.
	Bad connection between cable assembly and terminal on coil and pole piece assembly.	Repair connection.
	Defective coil and pole piece assembly.	Replace coil and pole piece assembly.
Waveform pattern not typically sinusoidal.	Defective coil and pole piece assembly.	Replace coil and pole piece assembly.
	Velocity vibration transducer assembly magnetic force not stable.	Calibrate unit per paragraph 1-91.

Figure 1-31. Troubleshooting Chart, Vibration Transducer Type 4-118-0107

same order as the index numbers assigned to the exploded view, noting the following:

CAUTION

Do not attempt to disassemble the transducer unless it has been definitely determined to be malfunctioning.

a. Demagnetize magnet (10) (before disassembly) in the following manner:

(1) Secure velocity vibration transducer assembly to a vibration table that is set for 250 cycles per second and at a velocity of 1/2 inch per second (and note the output voltage on voltmeter).

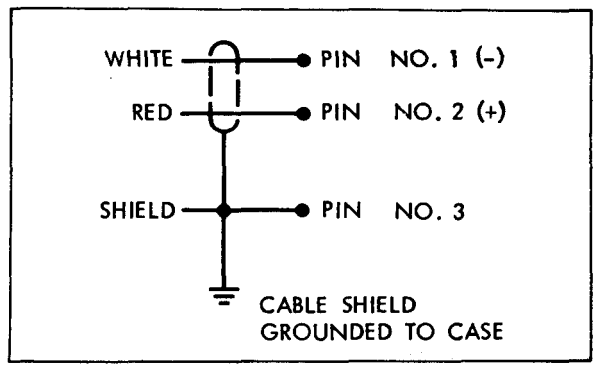


Figure 1-32. Schematic Wiring Diagram Vibration Transducer

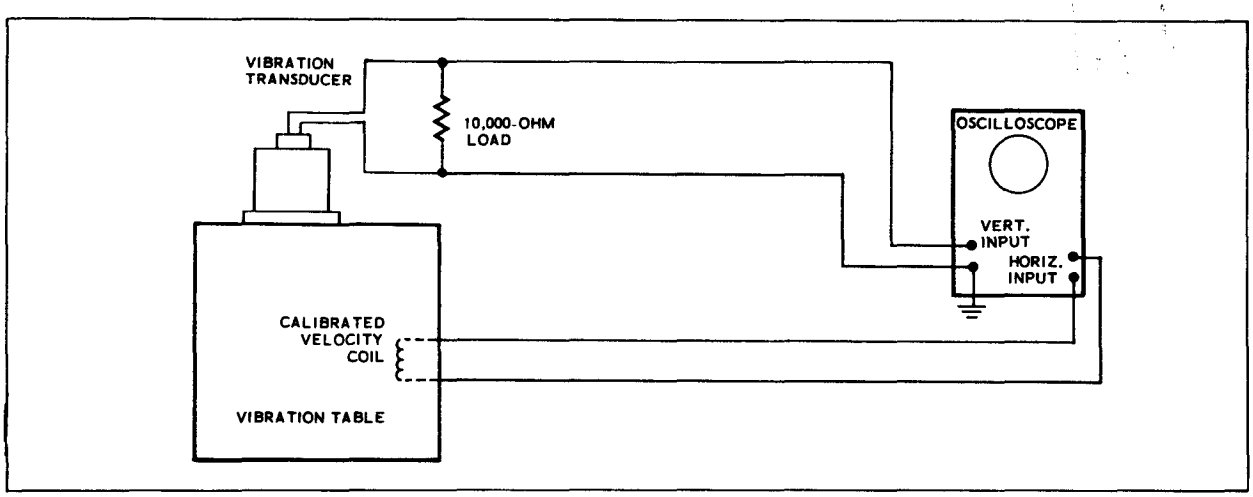


Figure 1-33. Bench Test Set -Up for Natural Frequency Test

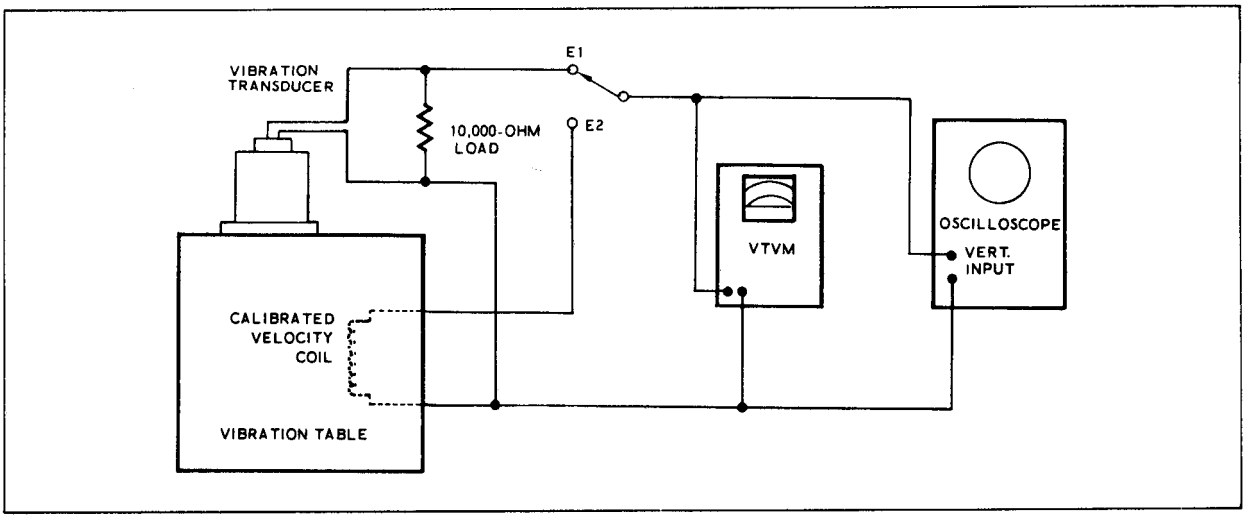


Figure 1-34. Bench Test Set-Up for Frequency Response Test and Calibration

Vibration Table Setting With Ambient Temperature at 75 ±50F	
Frequency (cps)	Velocity (In./Sec/Rms)
*15	2.0
*30	2.0
50	2.0
100	2.0
250	1.0
500	0.5
*1,000	0.25
*1,500	0.25
*Not required for Type 4-118-0107.	

Figure 1-35. Transducer Sensitivity Test Data

(2) Connect a 130V, 60 cycle, variable transformer to Knockdown Coil Part No. 28024-AE-8.

NOTE

The velocity vibration transducer assembly operates with a 10,000 ohms resistance load.

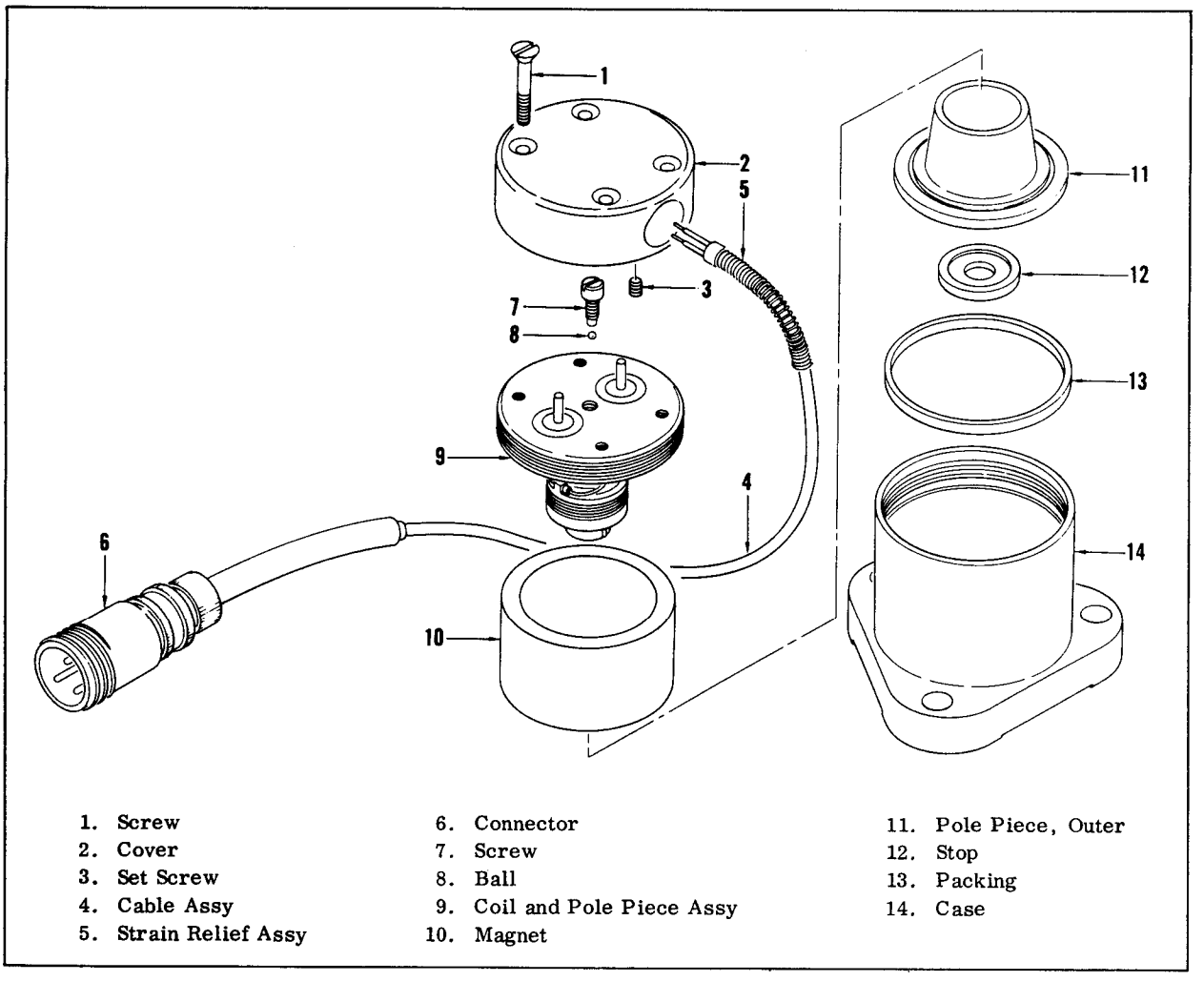
(3) Set the variable transformer for 30V ac output, and within 5 seconds manually pass the knockdown coil over the velocity vibration transducer assembly until it is totally enclosed. Remove the knockdown coil and again note the output voltage.

NOTE

Do not turn off the variable transformer whenever the knockdown coil is in the vicinity of the velocity vibration transducer assembly.

Part No.	Description
1400B (W. M. Welch, Chicago, Ill.) (or equal)	Vacuum Pump-Dual-Seal
95460 (Corning Glass, Corning, N. Y.) (or equal)	Bell Jar 6-1/2 x 11 in.
V-10 (General Radio Co. Cambridge, Mass.) (or equal)	Variable Transformer, 130V, 60 cycle
28024-B-2 (Consolidated Electrodynamics)	Vibration Control
28024-AE-3 (Consolidate Electrodynamics)	Taper Plug
28024-AE-4 (Consolidate Electrodynamics)	Straight Plug
28024-AE-5 (Consolidate Electrodynamics)	Button Setting Plug
28024-AE-6 (Consolidate Electrodynamics)	Holding Fixture
28024-AE-7 (Consolidate Electrodynamics)	Spanner Wrench
28024-AE-8 (Consolidate Electrodynamics)	Knockdown Coil, AC

Figure 1-36. Special Tools and Test Equipment Required for Overhaul of the Vibration Transducer Type 4-118-0107



1. Screw
2. Cover
3. Set Screw
4. Cable Assy
5. Strain Relief Assy
6. Connector
7. Screw
8. Ball
9. Coil and Pole Piece Assy
10. Magnet
11. Pole Piece, Outer
12. Stop
13. Packing
14. Case

Figure 1-37. Velocity Vibration Transducer Assembly Type 4-118-0107, Exploded View

(4) Repeat step (3) using a slightly higher voltage setting each time on the variable transformer until a minimum output voltage from the velocity vibration transducer assembly is obtained.

b. Remove cable assembly (4) from terminals on coil and pole piece assembly (9).

c. Place assembly in oven for 5 minutes at 500°F before disassembling (9) through (14).

CAUTION

Use extreme care when removing coil and pole piece assembly (9) and cable assembly (4) from case (14) so as not to damage terminal contacts.

d. Turn assembly upside down to remove coil and pole piece assembly (9) from case (14), using spanner wrench, Part No. 28024-AE7.

NOTE

Store coil and pole piece assembly (9) with largest diameter pole piece assembly as base to reduce tension in spring.

e. When it is necessary to remove strain relief assembly (5) from cable assembly (4), mark wiring for reconnection and remove solder so that strain relief assembly (5) will be a slip fit from cable assembly (4).

NOTE

Do not use sharp tools to remove solder from the outer wire jacket.

f. When it is necessary to remove connector (6) from cable assembly (4), mark wiring for reconnection and remove solder so that wires will be a slip fit from connector (6).

1-73. CLEANING.

WARNING

Use cleaning fluids in a well ventilated area. Avoid breathing fluid vapors or vapor contact with skin. Do not direct compressed air against skin.

1-74. Clean all parts except electrical components in dry-cleaning solvent, Federal Specification P-D-680. Electrical components, clean first: with ammonia, Federal Specification U-A-500; second, alcohol, Military Specification MIL-A-6091B; and third, methyl ethyl ketone, Federal Specification O-C-265. Use a stiff camel's hair brush to remove stubborn accumulations of dirt and foreign matter. Clean coil and pole piece assembly (9) with lens paper and methyl ethyl ketone. While cleaning, pay particular attention to all internal passages, ports, and packing grooves. Dry with moisture-free compressed air or, in some cases, a clean, lint-free cloth.

1-75. INSPECTION. Inspect parts for serviceability as follows:

a. Inspect all metal parts for cracks, nicks, burrs, and corrosion. Pay particular attention to machined surfaces.

b. Inspect all threaded areas for crossthreading and stripping.

c. Check gold plating of terminals on coil and pole piece assembly (9) for worn or defective plating.

d. Check the spring alignment of coil and bobbin and center pole piece by pushing center pole piece down and releasing pressure. There must be no indications of binding and coil and bobbin should spring freely.

1-76. COMPONENT TESTING. Individual component testing is not required. All system testing is covered in paragraphs 1-66 through 1-69.

1-77. REPAIR OR REPLACEMENT. (See figure 1-37.) Replace all parts which are cracked, show signs of excessive wear, scoring, or corrosion, or are damaged beyond minor repair.

a. Remove mild corrosion, minor nicks, or scores from steel parts, with crocus cloth, Federal Specification P-C-458. Use aluminum oxide abrasive cloth, Federal Specification P-C-451 for polishing aluminum parts.

b. Remove minor defects from threaded parts by tapping or chasing. Replace part or replace entire assembly if tapping or chasing does not repair part.

c. Replace stop (12) and packing (13) at each overhaul regardless of condition.

1-78. LUBRICATION. Lubrication is not required.

1-79. REASSEMBLY. (See figure 1-37.)

NOTE

Be sure magnet is completely demagnetized before installing.

1-80. Reassemble in reverse order of disassembly observing the following:

a. Use two Taper Plugs, Part No. 28024-AE-3 to install packing (13, figure 1-37) in case (14).

b. Use Button Setting Plug, Part No. 28024-AE-5 to install magnet (10, figure 1-37) in case (14).

c. Check springs, coil, and bobbin of coil and pole piece assembly (9) for dimension of 0.257 ±0.005. (See figure 1-38.)

d. Apply a thin coat of Dow Corning 200 Fluid, 100,000 cs to all the threads of coil and pole piece assembly (9) and the threads of the case (14).

e. Place the reassembled parts (9 through 14) in oven for two hours at 500°F and then let air cool to room temperature.

f. Remove the coil and pole piece assembly (9) from the housing (14), and remove all oil from the coil and pole piece assembly.

g. Apply a thin coat of Dow Corning 510-50 cs fluid to the sapphire guides of the coil and pole piece assembly.

h. Replace the pole piece assembly in the case and hand tighten.

i. Place the transducer in a 500°F oven for 5 minutes. Remove unit from oven and tighten pole piece assembly securely into the case using a Spanner Wrench, Part No. 28024-AE-7, and Holding Fixture, Part No. 28024-AE-6.

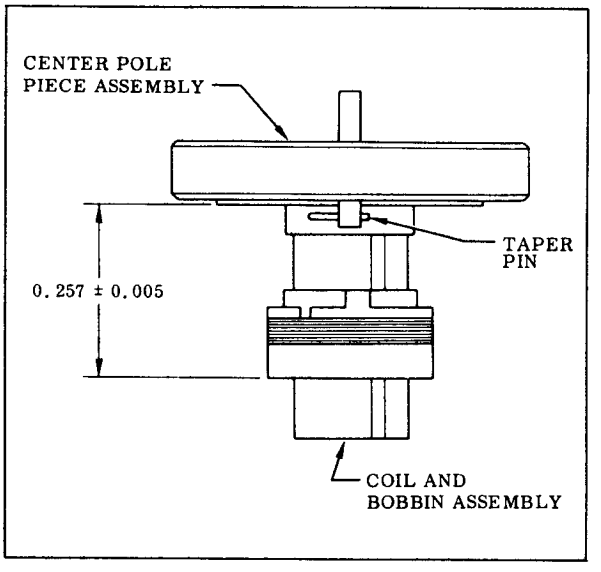


Figure 1-38. Coil and Pole Piece Assembly, Tolerance

j. Using a vacuum pump and bell jar, evacuate air from assembled parts (9 through 14) and fill with three psig argon gas. Install ball (8) and tighten screw (7).

k. Install cable assembly (4) to terminals of center pole piece assembly in the following manner:

(1) Install set screw (3) in cover (2), and tighten securely. Be sure set screw sets in the recess of the strain relief assembly (5).

(2) Wrap leads of cable assembly (4) around terminals of center pole piece assembly at least one turn.

CAUTION

Care should be taken during soldering of leads to terminals. Excessive heat will damage internal parts. Rating of soldering iron must not exceed 50 watts. Do not use a soldering gun.

(3) Install leads of cable assembly (4) to terminals of center pole piece assembly as per figure 1-32. Using 98% lead and 2% silver solder with solid core and Nokorode flux, solder the leads of cable assembly (4) to terminals of coil and pole piece assembly (9).

(4) Clean as per paragraph 1-73.

l. Apply a thin coat of Plaskon to the four screw holes on top of the pole piece assembly (9). Install screws (1) in cover (2) and tighten securely to the coil and pole piece assembly (9).

Part No.	Description
360284-4 (Consolidated Electrodynamics)	Torque Plate
170267 (Consolidated Electrodynamics)	Non-Magnetic Tweezers
360284-3 (Consolidated Electrodynamics)	Spanner Wrench

Figure 1-39. Special Tools Required for Overhaul of Vibration Transducer Type 4-128-0101

1-81. OVERHAUL INSTRUCTIONS, VIBRATION TRANSDUCER TYPE 4-128-0101.

CAUTION

The vibration transducer is a precision instrument and should NOT be overhauled unless it has definitely been found to be defective. Periodic overhaul is not recommended. Test the transducer as described in paragraphs 1-66 through 1-69, and do not disassemble or overhaul if the transducer functions properly. If overhaul is required, perform the work in a clean, air conditioned instrument shop, or equivalent. Use extreme care not to damage the parts during removal and overhaul. Keep the parts clean and avoid contact with any substance or materials that could contaminate the parts.

1-82. SPECIAL TOOLS. (See figure 1-39.) To disassemble and reassemble the vibration transducer, the special tools listed in figure 1-39 are required.

1-83. DISASSEMBLY. (See figure 1-40.)

CAUTION

Do not attempt to unscrew the bobbin assembly from case while cover is still attached. Attempted removal in this manner will cause the screws to shear off.

NOTE

It is recommended that the vibration transducer be demagnetized prior to disassembly to prevent attraction of foreign particles.

To disassemble the vibration transducer, proceed as follows :

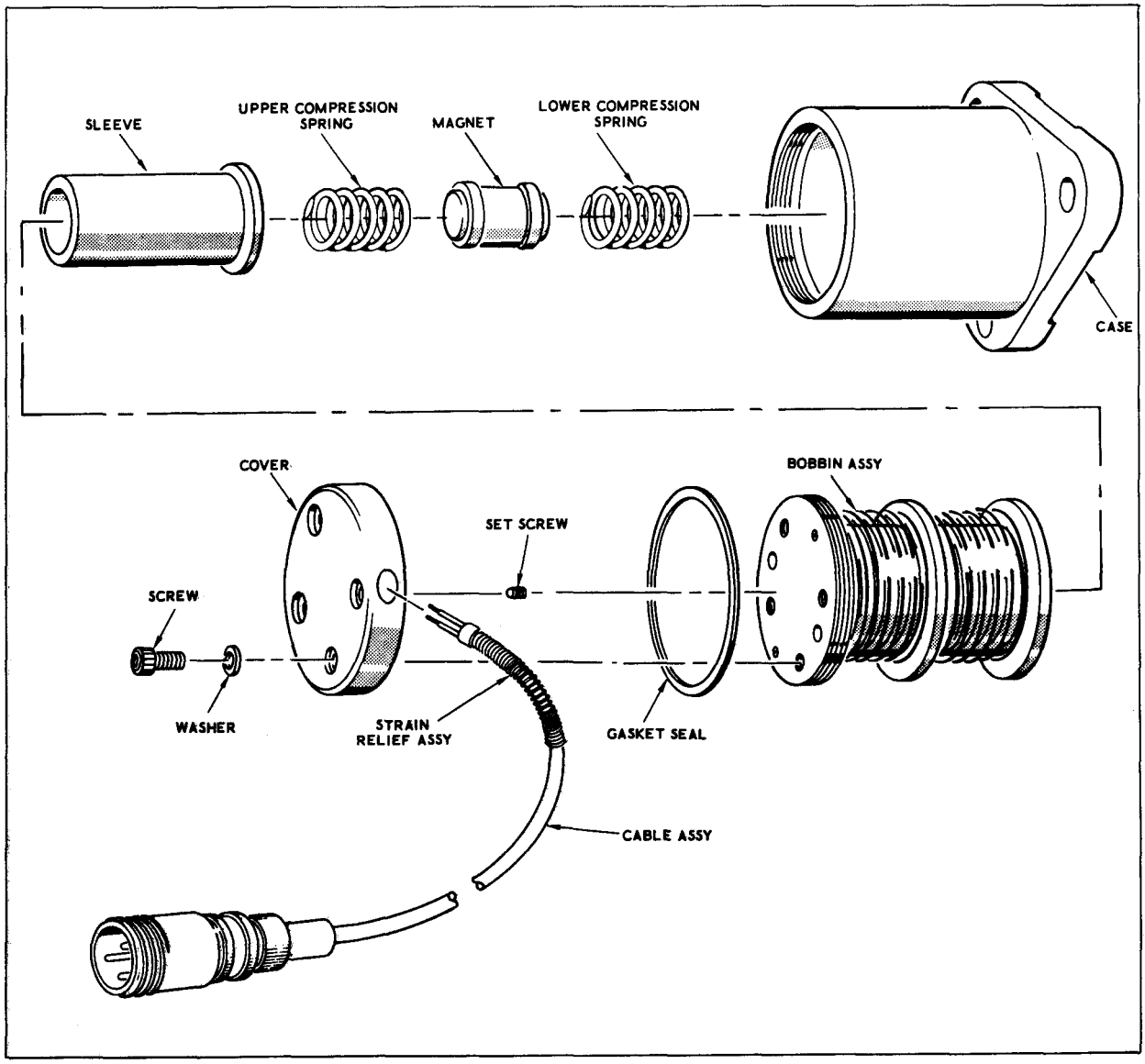


Figure 1-40. Vibration Transducer Type 4-128-0101, Exploded View

a. Place the vibration transducer on the Torque Plate Part No. 360284-4, or equivalent holding device.

b. Remove the four screws and washers from the cover using a 5/64 Allen wrench.

c. Carefully lift the cover away from the bobbin and case assembly, taking care not to break the wires connecting the cable assembly to the terminals of the bobbin assembly.

d. Unsolder the cable assembly from the bobbin assembly, and remove gasket seal from the bobbin and case assembly.

e. Insert pins of the Spanner Wrench, Part No. 360284-3, into the two non-threaded holes in the bobbin assembly. Carefully turn spanner wrench counterclockwise, unscrewing bobbin assembly from the case.

f. When bobbin assembly is hose from case, remove the transducer from the torque plate and carefully remove bobbin assembly from the case. Be careful not to allow the springs, magnet, or sleeve to fall free.

g. Using Non-Magnetic Tweezers, Part No. 170267, carefully remove the lower spring, the magnet, and

the upper spring. Place all components on a clean, lint free cloth.

h. Using non-magnetic tweezers, carefully remove the sleeve from the bobbin assembly and place on a clean. lint-free cloth.

i. Cable assembly can be removed from cover by loosening set screw on underside of cover.

1-84. CLEANING. Clean all parts of the vibration transducer except cable assembly, as follows:

CAUTION

Do not ultrasonically clean the bobbin assembly, or the coil insulation will be damaged.

a. Flush sleeve and the bore of the bobbin assembly with Freon, and bake for one hour at 600°F. Remove from oven and immediately place in a dry area.

b. Using dry nitrogen, blow any lint from the sleeve and bore of the bobbin assembly.

NOTE

It is recommended that the magnet assembly be demagnetized before cleaning to prevent attraction of foreign particles.

c. Spray the magnet assembly with Freon TMC for approximately 30 seconds.

d. Ultrasonically clean the magnet assembly in Freon TMC for 5 minutes.

e. Remove magnet assembly from ultrasonic cleaner and spray with Freon TMC for approximately 30 seconds.

f. Ultrasonically clean the magnet assembly in methyl alcohol for 5 minutes.

g. Vacuum bake the magnet assembly for a minimum of 15 minutes at 140°F at one millimeter of pressure.

h. Bake the magnet in a 500°F oven for 8 hours minimum.

i. Ultrasonically clean the case, springs, and gasket in Freon for 5 minutes.

1-85. INSPECTION. Inspect the parts of the vibration transducer as follows:

a. Inspect the bobbin assembly for loose or damaged terminals, loose or broken weld connections, or damaged threads. Inspect the coil carefully for damaged insulation or broken windings.

b. Using a microscope (10 power), inspect the surface of the magnet, and the bore of the magnet sleeve for cracks, nicks, scratches, or foreign particles.

c. Inspect the bearing surface of the magnet sleeve for evidence of rubbing, binding, or excessive friction. Replace magnet assembly or magnet sleeve with new parts even if very slight defects are noted.

d. Inspect the cable assembly connector for loose pins, and the case for damaged threads.

1-86. COMPONENT TESTING. Individual component testing is not required. All system testing is covered in paragraphs 1-66 through 1-69.

1-87. REPLACEMENT OF PARTS. All parts which do not meet the inspection requirements of paragraph 1-85 should be replaced with new parts. Any time replacement of parts is indicated, all new parts should be cleaned and processed as described in paragraph 1-84.

1-88. LUBRICATION. Lubrication is not required.

1-89. REASSEMBLY. Reassemble the transducer as follows :

CAUTION

Reassembly should be performed in a dry atmosphere using non-magnetic tweezers. Do not touch internal parts with hands. If parts have been in contact with the skin, clean the parts as described in paragraph 1-84 before reassembly.

a. Place sleeve in bobbin assembly bore.

b. Place upper compression spring in the sleeve, then place the magnet assembly in the sleeve. Insert the lower compression spring in the sleeve.

c. Place bobbin assembly in case, being very careful not to allow the springs, magnet assembly, or sleeve to fall out of place. Place case assembly on torque plate and carefully screw the bobbin into the case, using the spanner wrench. Torque to approximately 15 inch-pounds.

d. If replacement of the cable assembly is required, perform the following:

(1) Insert ends of cable assembly into opening at side of cover.

(2) Solder ends of cable assembly to terminals on bobbin assembly. Connect red lead to the (+) terminal and white lead to the unmarked terminal. Use 98% lead and 2% silver solder with Nokorode flux.

(3) Clean the terminals on the bobbin assembly thoroughly with a camel's hair brush and hot water.

(4) Dry terminals at 160°F for 20 minutes.

(5) Secure strain relief assembly to cover with set screw.

e. Place the gasket seal on bobbin and case assembly.

f. Place cover over the bobbin and case assembly, aligning screw holes.

g. Coat threads of screws with Kwickheat antifreeze compound to prevent breaking screws. Place a screw and washer in each screw hole in the cover and tighten, using 8 to 9 inch-pounds torque. Partially tighten one screw, then the opposite screw; then partially tighten the adjacent screw and its opposite screw. Continue this process until final torquing of screws is completed.

h. Calibrate the magnet assembly as described in paragraph 1-91.

i. If the magnet or sleeve has been replaced, mechanically age the transducer as described in paragraph 1-90.

j. Test the transducer as described in paragraphs 1-66 through 1-69.

k. Clean the exterior of the transducer with methyl alcohol.

1-90. DYNAMIC AGING. Whenever the magnet assembly or the magnet sleeve has been replaced, the vibration transducer must be dynamically aged. Dynamic aging consists of vibrating the magnet assembly using a 20-22 cps, 10V ac power source while slowly rotating the vibration transducer to allow the magnet assembly and magnet sleeve to burnish evenly on all sides. To dynamically age the vibration transducer, proceed as follows:

a. Energize the magnet assembly as described in paragraph 1-92. Do not reduce the level of magnetic charge at this time.

b. Mount the vibration transducer in a horizontal position on a surface that can be rotated continuously at 4 rpm.

c. Connect output of the audio oscillator to a 40-watt power amplifier and connect the output of the power amplifier to the vibration transducer. Set the oscillator for 22 cps and adjust the output of the power amplifier to 10V ac. Make fine adjustments to the voltage until the magnet can be heard hitting its stops (audible clicking sound), then decrease the voltage slightly until the magnet is moving its full travel at 20 to 22 cps without hitting the stops.

d. With the adjusted voltage applied, rotate the vibration transducer at 4 rpm for approximately 12 hours to permit the magnet assembly and magnet sleeve to burnish properly on all sides.

e. When the dynamic aging procedure has been completed, reduce the level of the magnetic charge to obtain a sensitivity of 60 ±2 mv/in./sec at 75°F as described in paragraph 1-93.

1-91. VIBRATION TRANSDUCER CALIBRATION (MAINTENANCE).

NOTE

The procedure described in this paragraph applies only to vibration transducers which have been overhauled or accidentally de-energized.

1-92. GENERAL. Calibration of the vibration transducer consists of impressing a strong magnetic field on the unit with the direction of the field parallel to the sensitive axis. The impressed magnetic field must be strong enough to completely saturate the magnet assembly. The magnetic charge is then reduced to the level required to obtain a sensitivity of 60 ±2 mv/in./sec at 75°F for the Type 4-128-0101, or 105 ±5 mv/in./sec at 75°F for the Type 4-118-0107. Test equipment required for calibration is listed in figure 1-41.

1-93. ENERGIZING THE MAGNET ASSEMBLY. To energize the magnet assembly, proceed as follows:

a. Place the assembled vibration transducer in Magnet Charger Model 2470 on an insulated base. Center the transducer within the charging coil and connect the charging coil to the magnet charger.

b. Set the CHARGING VOLTAGE LEVEL switch to position 1. Press the ENERGIZE button on the magnet charger and wait until the voltmeter indicates approximately 50 volts. Press CHARGE button.

Equipment	Manufacturer	Use
Charging Coil, Model HB-19154 (or equal)	Radio Frequency Laboratories, Inc., Boonton, N.J.	Energizes magnet assembly.
Magnetreater, Model 889B (or equal)	Radio Frequency Laboratories, Inc., Boonton, N.J.	Adjusts sensitivity.
Magnet Standardizing Coil, Part No. HC-7010-16 (or equal)	Radio Frequency Laboratories, Inc., Boonton, N.J.	Knock-down coil for adjusting sensitivity,
Magnet Charger, Model 2470 (or equal)	Radio Frequency Laboratories, Inc., Boonton, N.J.	Energizes magnet assembly.

Figure 1-41. Test Equipment Required for Vibration Transducer Calibration

c. Set the CHARGING VOLTAGE LEVEL switch to position 2. Press the ENERGIZE button and wait until the voltmeter indicates approximately 100 volts. Press CHARGE button.

d. Repeat the procedure described in step c, allowing approximately 50 volts increase for each cycle until the voltage build-up has reached 300 volts. At this point, the magnet assembly in the transducer will be completely saturated.

e. Remove the vibration transducer from the magnet charger.

NOTE

Energizing the magnet assembly using 50-volt steps as described above, reduces the force of impact with which the magnet hits its stops during the field transient. The charging time for low voltage is usually between 1 and 4 seconds.

f. The sensitivity range of the Type 4-128-0101 Vibration Transducer, when the magnet assembly is completely saturated, is between 65 and 72 mv/in./sec (vertical), when the transducer is vibrated at 100 cps at a velocity of 2 in./sec/rms. For the Type 4-118-0107, the sensitivity range of the vibration transducer is between 180 and 240 mv/in./sec when magnet assembly is completely saturated and vibrated at 100 cps at a velocity of 2 in./sec/rms.

NOTE

If the fully saturated sensitivity is below the required sensitivity stated in f, the magnet assembly may not be properly charged, or it may be defective. Repeat the charging procedures described in steps a through f at least twice. If the fully saturated sensitivity is still below the required sensitivity stated in f, replace the magnet assembly and sleeve for the Type 4-128-0101, or the magnet for the Type 4-118-0107.

1-94. CALIBRATION PROCEDURE. Calibration of the magnet assembly consists of reducing the level of the magnetic charge to obtain a sensitivity of 60 ±2 mv/in./sec for the Type 4-128-0101 or 105 ±5 mv/in./sec for the Type 4-118-0107. Perform the calibration as follows:

a. Mount the vibration transducer in a vertical position on a vibration table. Connect the vibration transducer and the test equipment as shown in figure 1-34.

b. Operate the vibration table at 100 cps with a velocity of 2 in./sec/rms. Calculate and record the transducer output in mv/in./sec.

c. Connect the Magnet Standardizing Coil, Part No. HC-7010-16 to the Magnetreater Model 889B, and place over the vibration transducer.

d. Set the pulse rate at position 1 or 2.

NOTE

The pulse rate may be increased when use of the magnetreater becomes familiar.

e. Adjust the coarse control by starting from zero and increasing until the output of the transducer indicates a slight drop on the readout meter. Adjust the fine control until output of the transducer reaches the desired sensitivity level on the readout meter.

NOTE

If the sensitivity is dropped below the desired sensitivity, re-energize the magnet assembly and repeat the calibration procedure.

SECTION ii

PARTS BREAKDOWN

2-1. GENERAL.

2-2. This portion of the technical manual lists and describes the parts for the Vibration Monitoring Kit, Part No. 171170-0100 and 171170-0104, manufactured by Consolidated Electrodynamics Corporation, Monrovia, California (H-4 Mfg. Code No. 09384).

2-2. VENDORS' CODE NUMBERS.

2-3. Vendors' code numbers, in accordance with the Federal Supply Code for Manufacturers Cataloging Handbook H4-1, are shown in parentheses in the Description column of the Group Assembly Parts List. Manufacturers who have not been assigned a code are identified by name and address parenthetically in the Group Assembly Parts List.

2-4. USABLE ON CODE.

2-5. When two or more assemblies are listed in the same Group Assembly Parts List, the code letter (A, B, etc.) is assigned to each main assembly. All components that are peculiar to a particular assembly are identified by the same code letter as the main assembly. If parts are common to all assemblies, the Usable On Code column is left blank.

CODE	NAME AND ADDRESS
00656	Aerovox Corp. New Bedford, Mass.
02660	American Phenolic Corp. Chicago, Ill.
03614	Bussmann Fuse Division of McGraw-Edison Co. Los Angeles, Calif.
04941	Walsco Electronics Corp. Rockford, Ill.
06228	Texas Instruments, Inc. Dallas, Texas
07716	International Resistance Co. Burlington, Iowa
09384	Consolidated Electrodynamics Corp. Monrovia, Calif.
12697	Clarostat Mfg. Co., Inc. Brooklyn, N. Y.
14655	Cornell Dubilier Electric Corp. South Plainfield, N. J.
15605	Cutler-Hammer, Inc. Milwaukee, Wis.
24455	General Electric Co. Lamp Division of Consumer Products Group Nela Park, Cleveland, Ohio
37942	P. R. Mallory and Co., Inc. Indianapolis, Ind.
49956	Raytheon Mfg. Co. Waltham, Mass.
56289	Sprague Electric Co. North Adams, Mass.
56878	Standard Press Steel Co. Jenkintown, Pa.
71468	Cannon Electric Co. Los Angeles, Calif.
71785	Cinch Mfg. Corp. Chicago, Ill.
72619	Dialight Corp. Brooklyn, N. Y.
72962	Elastic Stop Nut Corp. of America Union, N. J.
74545	Hubbell Harvey, Inc. Bridgeport, Conn.
75173	Howard B. Jones Div. of Cinch Mfg. Corp. Chicago, Ill.
75915	Littelfuse, Inc. Des Plaines, Ill.
77969	Rubbercraft Corp. of California, Ltd. Torrance, Calif.
83259	Parker Seal Co. Culver City, Calif.
90139	Sylvania Electric Products, Inc. Boston, Mass.
91929	Micro Switch Division of Minneapolis-Honeywell Regulator Co. Freeport, Ill.
96214	Texas Instruments, Inc. Apparatus Division Dallas, Texas
95691	Arrow Hart and Hegeman Electric Co. Los Angeles, Calif.

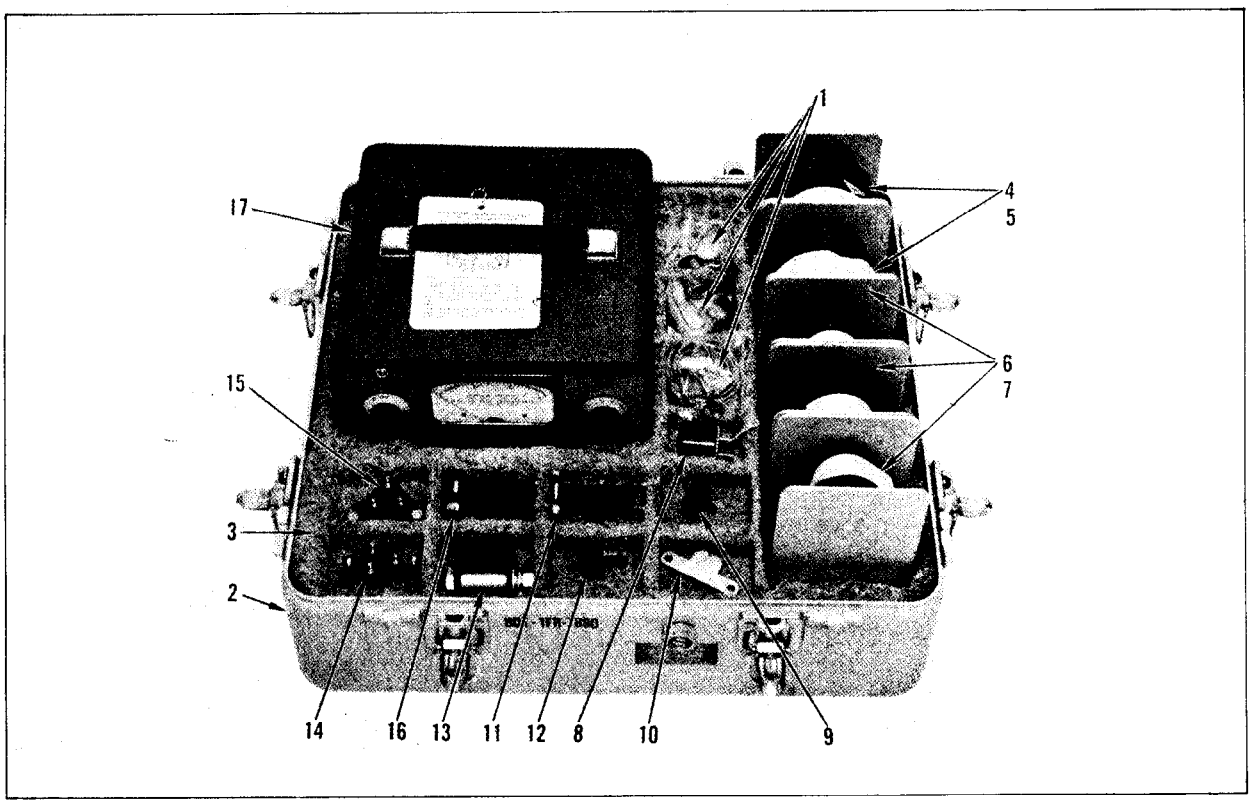


Figure 2-1. Vibration Monitoring Kit, Location of Components

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
-1-	171170-0100	MONITORING KIT, Vibration (Code A)	Ref		A
	171170-0104	MONITORING KIT, Vibration (Code B) . . .	Ref		B
-1	4-118-0107	TRANSDUCER, Velocity vibration (See fig. 2-2 for details)	3		A
	4-128-0101	TRANSDUCER, Velocity vibration (See fig. 2-3 for details)	3		B
-2	171563	CASE, Carry ing	1		
-3	171586	CUSHION, Support	1		
-4	171589-0001	REEL, Cable (See fig. 2-4 for details) .	2		
-5	49657-0900	CABLE, 900 in. (See fig. 2-5 for details)	2		
-6	171589-0002	REEL, Cable (See fig. 2-4 for details) .	3		
-7	49657-0300	CABLE, 300 in. (See fig. 2-5 for details)	3		
-8	171581	ADAPTER, Grounding	1		
-9	171577	ADAPTER, Vibration transducer . .	1		A
	362855	BRACKET, Compressor, vibration transducer (See fig. 2-6 for details)	1		B
-10	171580	ADAPTER, Vibration Transducer (See fig. 2-14 for details)	1		
-11	171579	ADAPTER, Power turbine, vibration trans - ducer (See fig. 2-7 for details)	1		

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-1-12	171576	. ADAPTER, Vibration transducer (See fig. 2-8 for details)	1		
-13	171575	. ADAPTER, Inlet housing (See fig. 2-9 for details)	1		
-14	171573	. ADAPTER ASSY, Vibration transducer, combustion flange (See fig. 2-10 for details)	1		A
	362854	. BRACKET, Turbine, vibration transducer (See fig. 2-11 for details)	1		B
-15	171574	. ADAPTER, Vibration transducer, combustion flange (See fig. 2-12 for details)	1		
-16	171578	. ADAPTER, Power turbine, vibration transducer (See fig. 2-13 for details)	1		
-17	1-117-0105	. VIBRATION METER ASSY (See fig. 2-15 for details)	1		

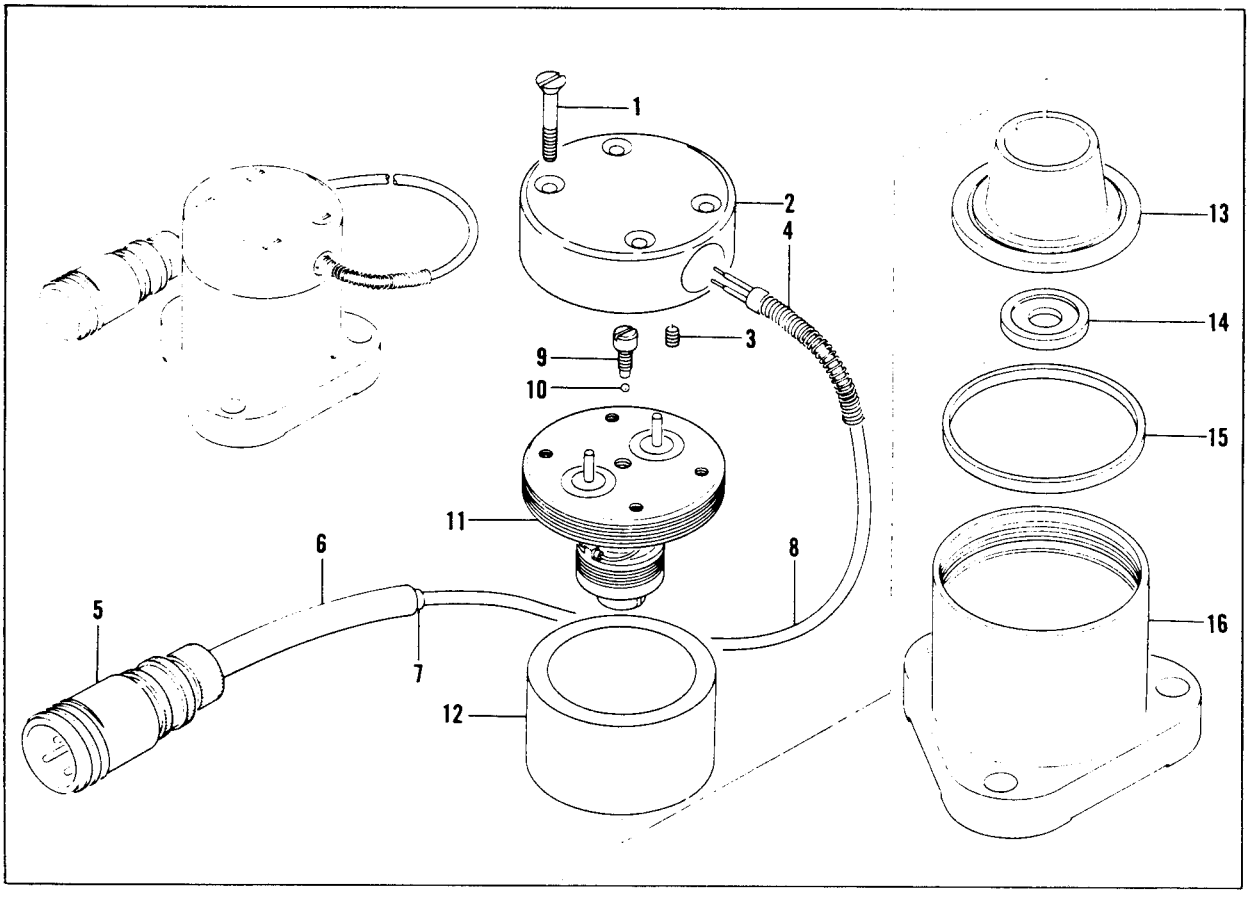


Figure 2-2. Velocity Vibration Transducer, Type 4-118-0107, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-	4-118-0107	TRANSDUCER, Velocity vibration (See fig. 2-1 for NHA)	Ref		
-1	28012	SCREW, Cover	4		
-2	28019	COVER, Transducer	1		
-3	85529-7200	SET SCREW, Cover	1		
	28108-0036	CABLE ASSY	1		
-4	28103	. . STRAIN RELIEF ASSY	1		
-5	XK3-12	. . CONNECTOR (71468)	1		
-6	AN3420-4	. . BUSHING, Cable adapter	1		
-7	AN3420-3	. . BUSHING, Cable adapter	1		
-8	31833	. . CABLE, Two wire	1		
-9	35022-0001	SCREW, Special	1		
-10	29318-0002	BALL	1		
-11	28020	COIL AND POLE PIECE ASSY	1		
-12	28017	MAGNET	1		
-13	28018	POLE PIECE, Outer	1		
-14	27997	STOP, Bobbin	1		
-15	35008	PACKING, Preformed	1		
-16	168720-0004	CASE, Engraved	1		

g. & dex lo.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
3-	4-128-0101	VELOCITY VIBRATION TRANSDUCER	Ref		
-1	360283-0003	CASE	1		
-2	361597	SPRING, Compression	2		
-3	360069	MAGNET ASSY	1		
-4	360081	SLEEVE	1		
-5	360282	BOBBIN ASSY	1		
-6	363129	GASKET, Seal	1		
-7	363170	COVER	1		
-8	360090	WASHER, Flat (Gold)	4		
-9	166648-1304	SCREW, Machine, 3-48 x 3/16 in. lg	4		
-10	85529-7200	SET SCREW, Cover	1		
	169760-0036	CABLE ASSY	1		
-11	28103	. . STRAIN RELIEF ASSY	1		
-12	31833	. . CABLE	1		
-13	AN3420-3	. . BUSHING, Cable adapter	1		
-14	AN3420-4	. . BUSHING, Cable adapter	1		
-15	XK-3-12	. . CONNECTOR (71468)	1		

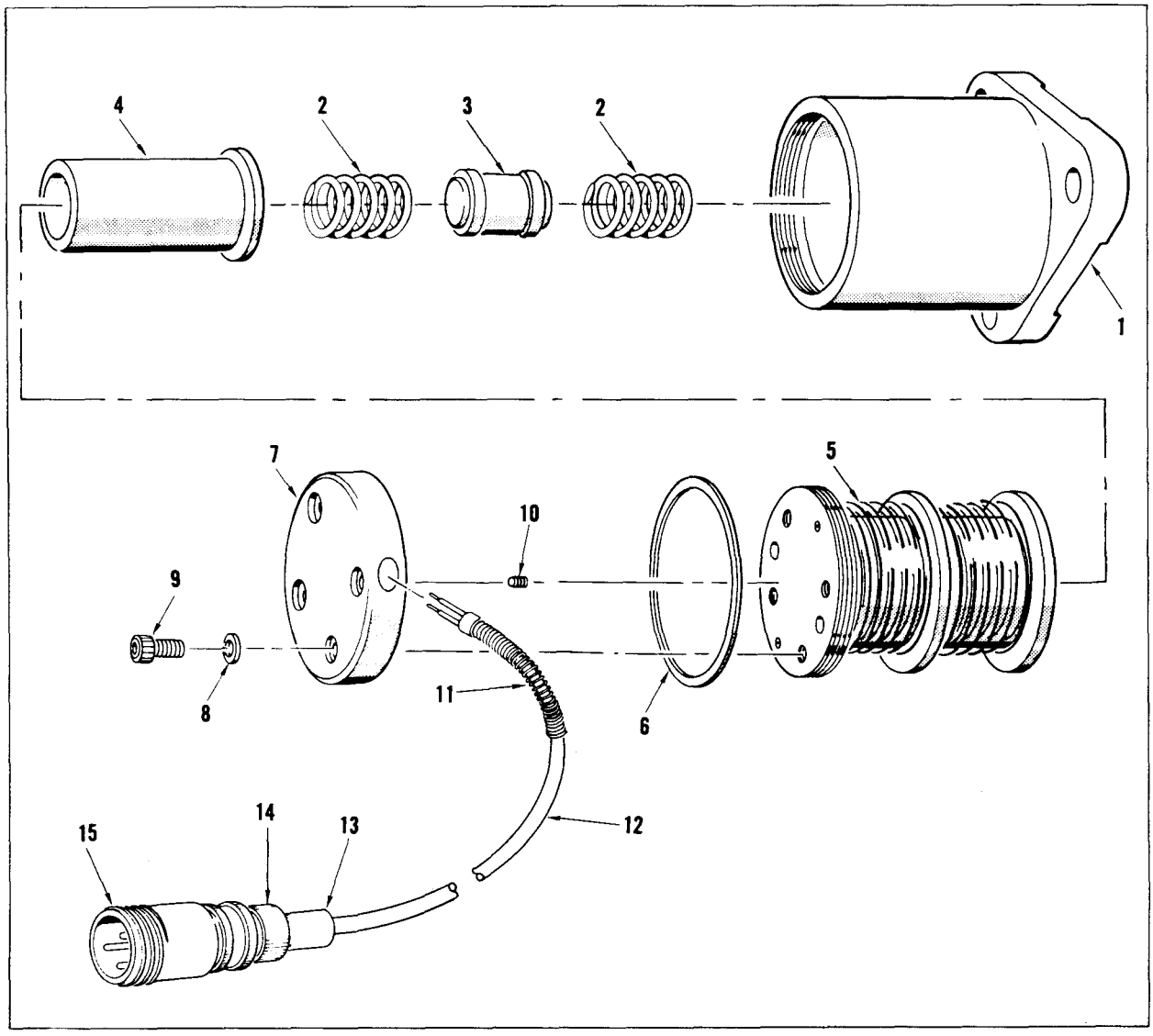


Figure 2-3. Velocity Vibration Transducer, Type 4-128-0101, Location of Parts

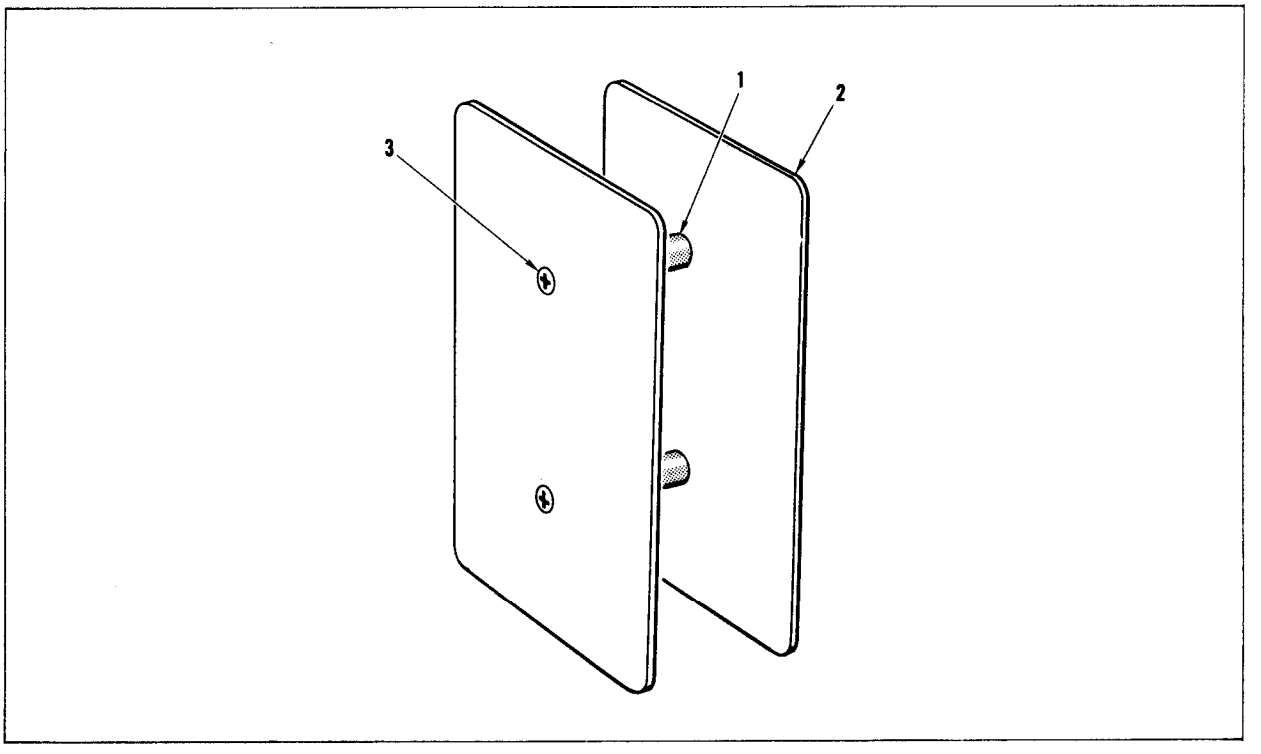


Figure 2-4. Cable Reel, Part No. 171589, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-4-	171589-0001	REEL, Cable (See fig. 2-1 for NHA)	Ref		
	171589-0002	REEL, Cable (See fig. 2-1 for NHA) . . .	Ref		
-1	171587-0001	SPACER, Threaded (Used on P/N 171589-0001)	2		
	171587-0002	SPACER, Threaded (Used on P/N 171589-0002)	2		
-2	171588	PLATE, Side	2		
		(ATTACHING PARTS)			
-3	AS-166154-1706	. SC REW, 8-32 NC x 7/16 lg	2		
		---* ---			

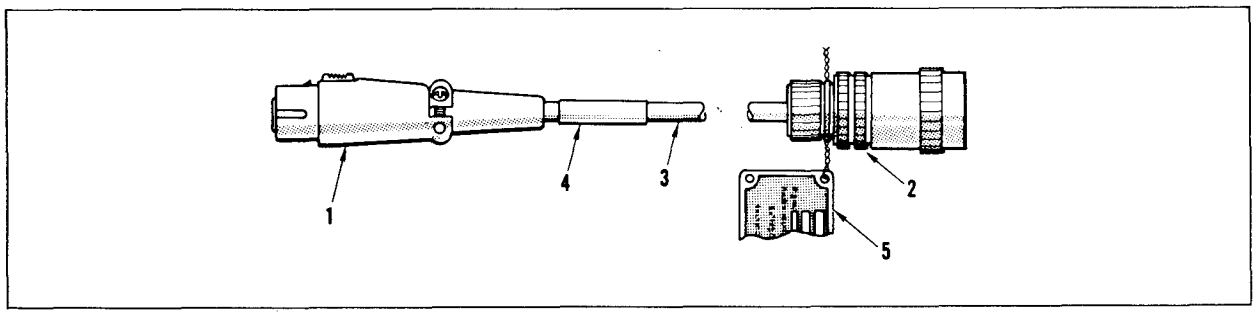


Figure 2-5. Cable Assembly, Part No. 49657, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-5-	49657-xxxx	CABLE ASSY (Dash No. indicates length in inches) (See fig. 2-1 for NHA)	Ref		
-1	XLR-3-11C	CONNECTOR (71468)	1		
-2	XK-3-11	CONNECTOR (71468)	1		
-3	157475-xxxx	CABLE (Dash No. indicates length in inches)	1		
-4	169767	TAG, Cable (Marked with cable length and cable No.)	1		
-5	173206	NAMEPLATE (Per MIL-STD-130)	1		

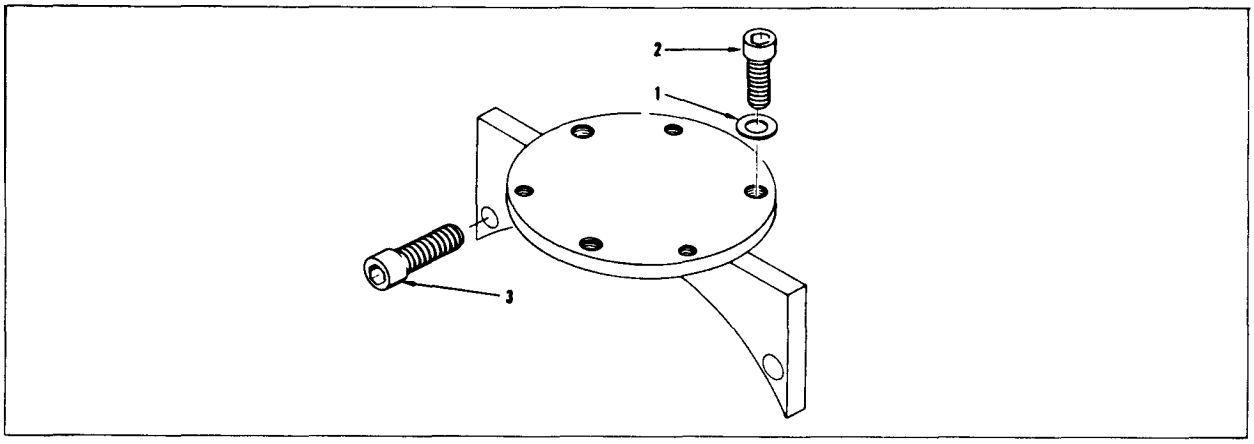


Figure 2-6. Vibration Transducer Compressor Bracket, Part NO., 362855. Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-6-	362855	BRACKET, Compressor, vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	70077-0513	WASHER, No. 4	3		
-2	166648-1405	SCREW, Cap, soc hd, 4-40	3		
-3	363433-0001	SCREW, Cap, soc hd	2		

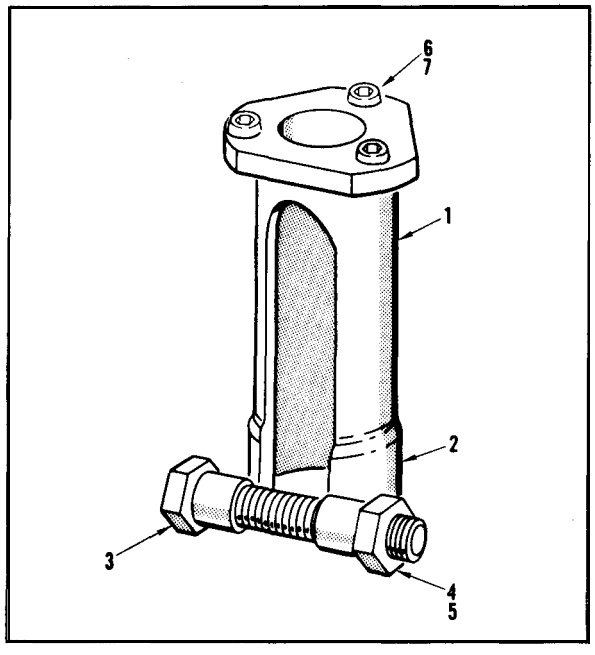


Figure 2-7. Vibration Transducer Power Turbine Adapter, Part No. 171579, Location of Parts

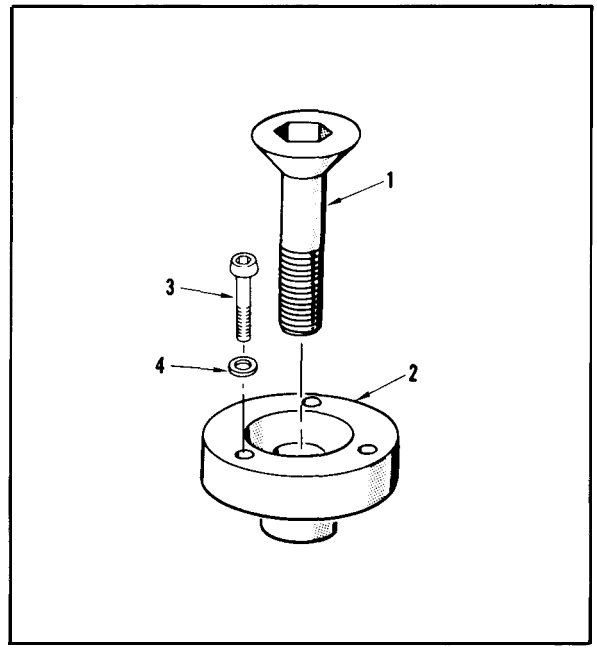


Figure 2-8. Vibration Transducer Adapter, Part No. 171576, Location of Parts

Fig. & Index No.	Part No	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
1-7-	171579	ADAPTER, Power turbine, vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	171579-0001	MOUNT	1		
-2	171579-0002	TUBE	1		
-3	AN101022	BOLT, Hex hd	1		
-4	AN960-10L	WASHER, Flat	2		
-5	MS21045-3	NUT, Self-locking	1		
-6	MS16997-10	SCREW, Cap, soc hd	3		
-7	AN935-4	WASHER, Lock, spring	3		

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-8-	171576	ADAPTER, Vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	171576-0001	ADAPTER	1		
-2	171576-0002	SCREW	1		
-3	MS16997-10	SCREW, Cap, soc hd	3		
-4	AN935-4	WASHER, Lock spring	3		

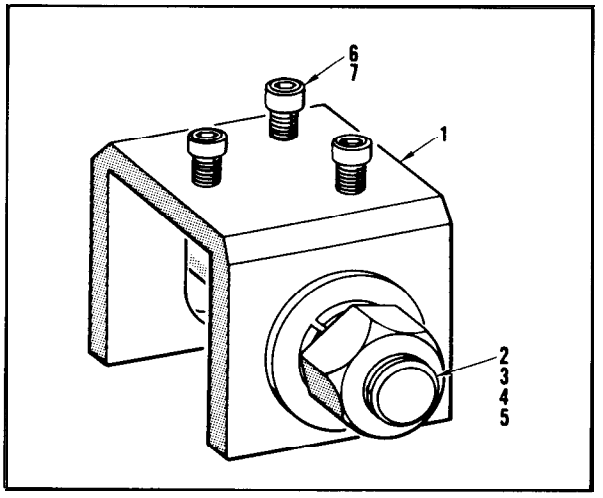


Figure 2-9. Vibration Transducer Inlet Housing Adapter, Part No. 171575, Location of Parts

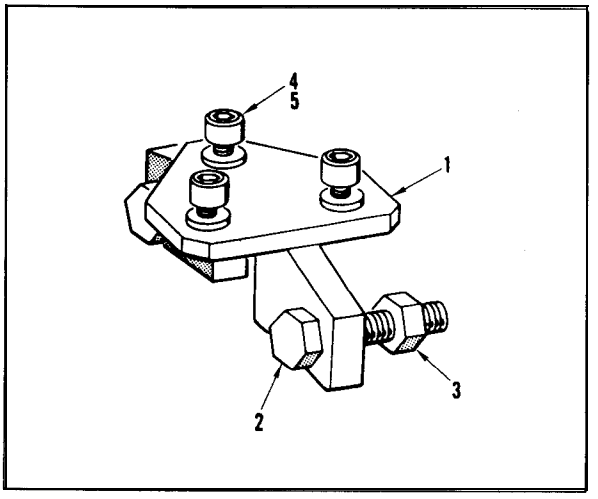


Figure 2-10. Vibration Transducer Combustion Flange Adapter Assembly, Part No. 171573, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-9-	171575	ADAPTER, Inlet housing, vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	171575-0001	BRACKET, Weldment	1		
-2	AN8-23A	BOLT, Machine, aircraft, 1/2-20 UNF-3Ax2, 15/32 lg	1		
-3	AN960-816	WASHER, Flat	1		
-4	AN935-816	WASHER, Lock, spring	1		
-5	AN315-8R	NUT, Plain, airframe, 1/2-20	1		
-6	MS16997-10	SCREW, Cap, soc hd, 4-40 NC-3 Ax3/8 lg . .	3		
-7	AN935-4	WASHER, Lock, spring	3		

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-10-	171573	ADAPTER ASSY, Vibration transducer, combustion flange (See fig. 2-1 for NHA)	Ref		
-1	171582	BRACKET	1		
-2	AN101014	BOLT, Hex hd	2		
-3	MS21045-3	NUT, Self -locking	2		
-4	MS16997-10	SCREW, Cap, soc hd	3		
-5	AN935-4	WASHER, Lock, spring	3		

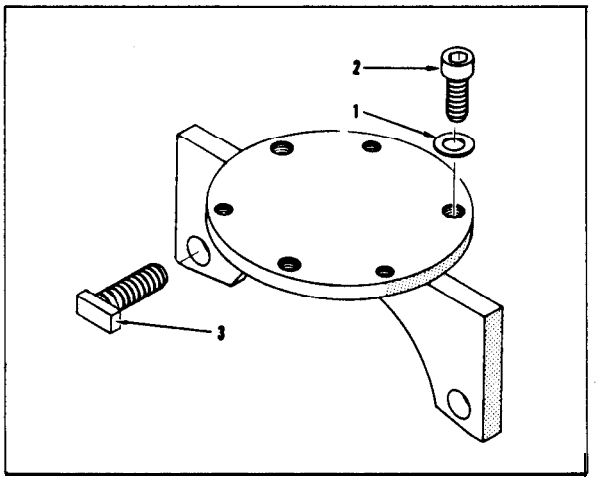


Figure 2-11. Vibration Transducer Turbine Bracket, Part No. 362854, Location of Parts

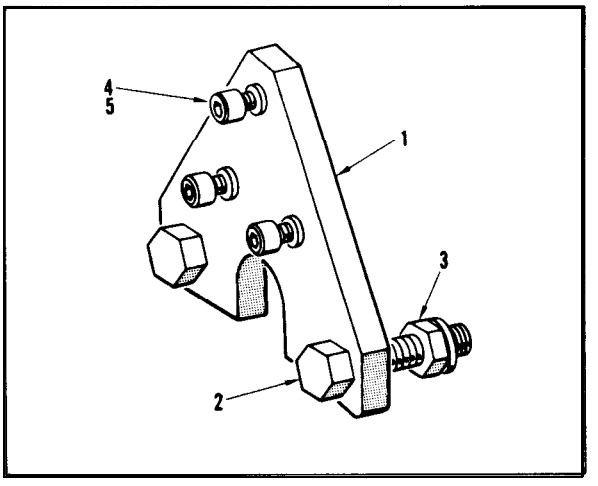


Figure 2-12. Vibration Transducer Combustion Flange Adapter Assembly, Part No. 171574, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-11-	362854	BRACKET, Turbine, vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	70077-0513	WASHER, No. 4	3		
-2	166648-1405	SC REW, Cap, soc hd, 4-40	3		
-3	363173-0007	BOLT, Tee hd	2		

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-12-	171574	ADAPTER ASSY, Vibration transducer, combustion flange (See fig. 2-1 for NHA)	Ref		
-1	171601	BRACKET	1		
-2	AN101014	BOLT, Hex hd	2		
-3	MS21045-3	NUT, Self-locking	2		
-4	MS16997-0010	SCREW, Cap, soc hd	3		
-5	AN935-4	WASHER, Lock, spring	3		

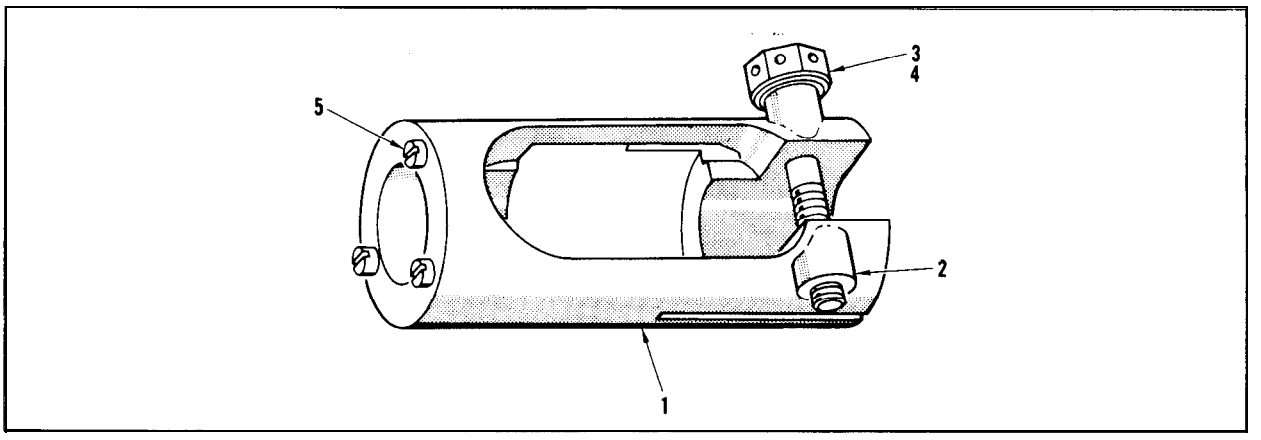


Figure 2-13. Vibration Transducer Power Turbine Adapter Part No. 171578, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-13-	171578	ADAPTER, Power turbine, vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	171578-0001	MOUNT	1		
-2	171578-0002	TUBE	1		
-3	AN103820	BOLT, Drilled hex hd	1		
-4	AN960-416L	WASHER, Flat	1		
-5	AN500AD4-6	SCREW, Machine, fil hd	3		

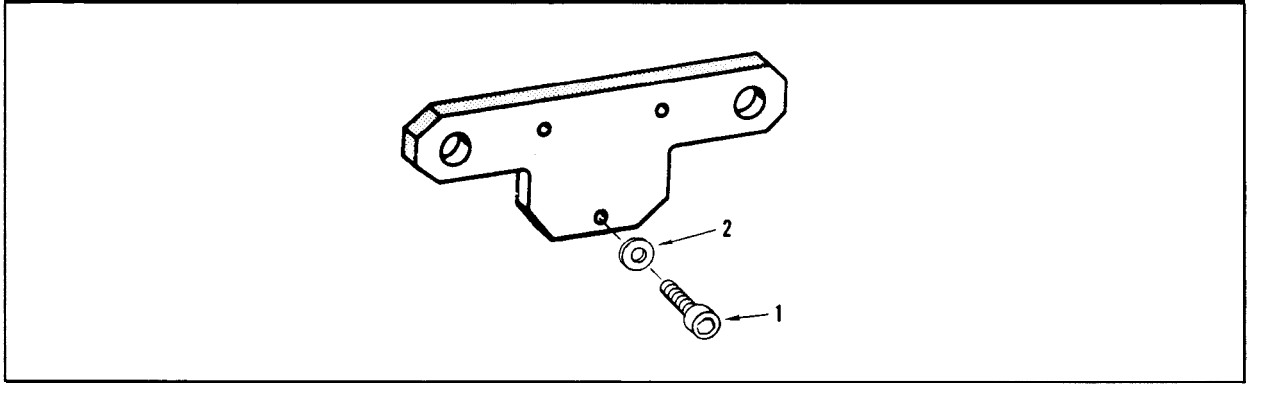
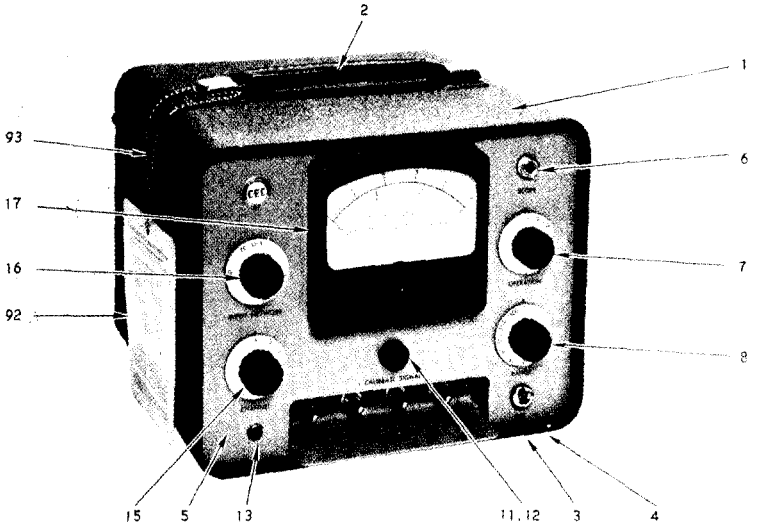
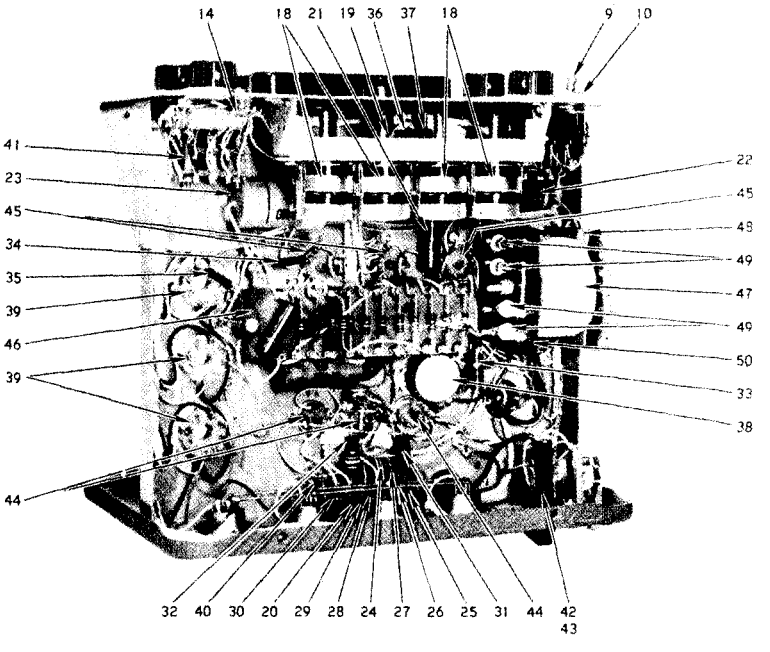


Figure 2-14. Vibration Transducer Adapter, Part No. 171580, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Ref. Desig.	Usable On Code
2-14-	171580	ADAPTER, Vibration transducer (See fig. 2-1 for NHA)	Ref		
-1	MS16997-10	. SCREW, Cap, soc hd	3		
-2	AN935-4	. WASHER, Lock, spring	3		



FRONT VIEW



BOTTOM VIEW

Figure 2-15. Vibration Meter Type 1-117-0105, Location of Parts (Sheet 1 of 2)

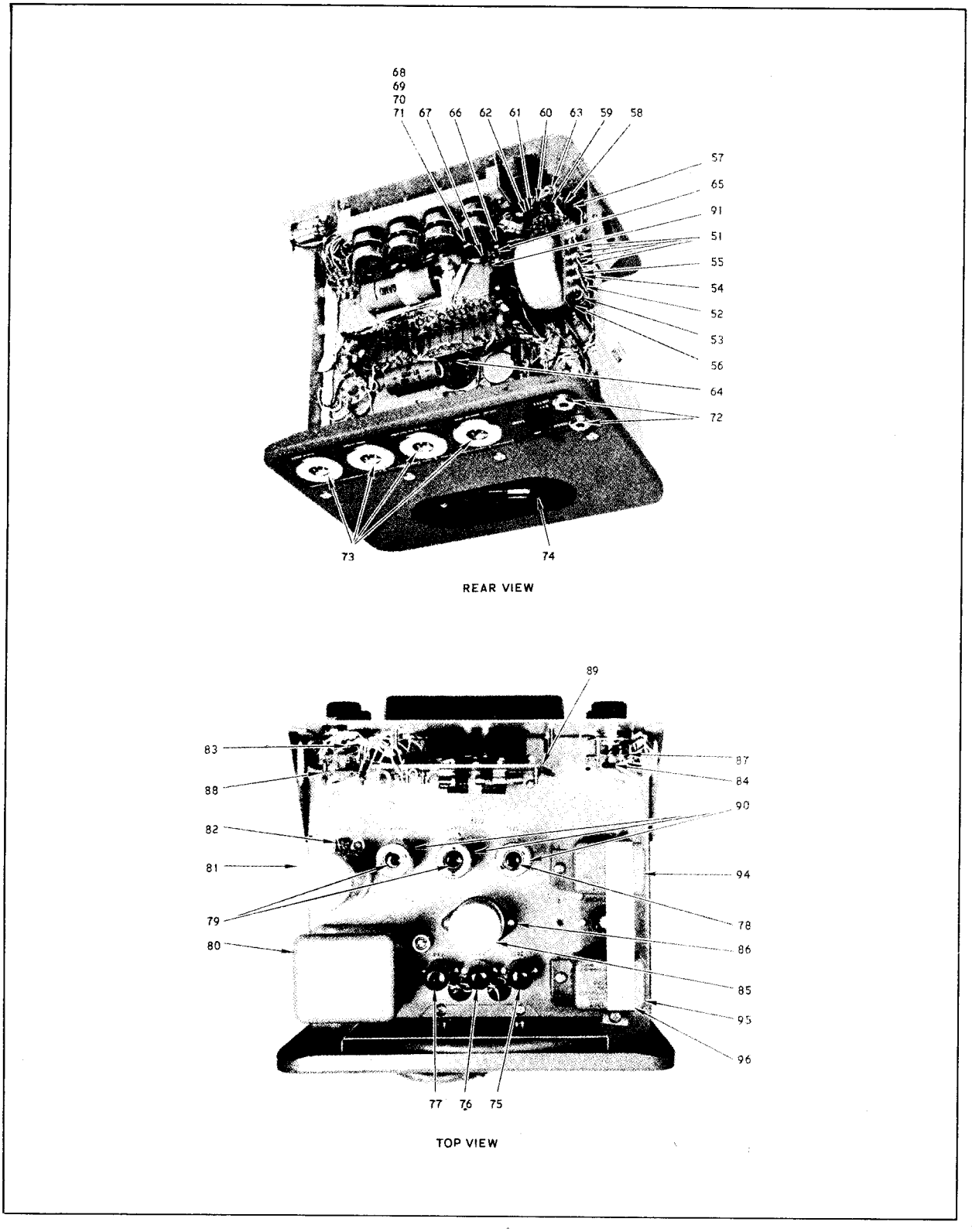


Figure 2-15. Vibration Meter Type 1-117-0105, Location of Parts (Sheet 2 of 2)

ig. & ndex No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Usable On Code
-15-	Type 1-117-0105	VIBRATION METER (See fig. 2-1 for NHA)	REF	
-1	31013	CASE	1	
-2	159987	HANDLE ASSY	1	
-3	30973	PLUG, Ventilating (04941)	4	
-4	9102-B	FOOT, Rubber (77960)	4	
-5	171613	CHASSIS ASSY	1	
-6	A-1	. . CONNECTOR, Electrical (37942) (J7)	1	
-7	34548	. . KNOB AND DIAL ASSY	1	
-8	34549	. . KNOB AND DIAL ASSY	1	
-9	8280-K-14	. . SWITCH, Toggle, SPST (15605) (S5) (ATTACHING PARTS)	1	
-10	15742	. . NUT, Knurled (95691) ---*---	1	
-11	29237	. . KNOB, Control	1	
	29244	. . . SPRING, Knob	1	
	RD-4	. . . PIN, Roll (56878)	1	
-12	AN6227-14	. . PACKING, Preformed (83259)	1	
-13	L-149	. . LIGHT, Indicator (72619)	1	
-14	51	. . LAMP, Incandescent, 6-8V (24455) (I1)	1	
-15	34547	. . KNOB AND DIAL ASSY	1	
-16	171610	. . KNOB AND DIAL ASSY	1	
-17	34605	. . METER, 0-500 microamperes (M1)	1	
-18	30624	. . RESISTOR, Variable, dual, 10K and 250K (R11, 13, 14, 15)	4	
-19	43-100	. . RESISTOR, Variable, ww, 100 ohms (12697) (R35)	1	
-20	109P10494	. . CAPACITOR, 0.1 μf, 400V dc (56289) (C8)	1	
-21	Type BBR50-6	. . CAPACITOR, 50 μf, 6V (14655) (C10)	1	
-22	Type PB2-92ZN	. . CAPACITOR, 2 μf, 200V (00656) (C11)	1	
-23	34504	. . CAPACITOR, 1.0 μf, 400V (14655) (C3)	1	
-24	109P68394	. . CAPACITOR, 0.068 μf, 400V (14655) (C5)	1	
-25	RC20GF392J	. . RESISTOR, Fixed comp (3900 ohms nominal value selected in test)	1	
-26	RC20GF434J	. . RESISTOR, Fixed comp (R40)	1	
-27	RC20GF474J	. . RESISTOR, Fixed comp (R46)	1	
-28	RC20GF623J	. . RESISTOR, Fixed comp (R44)	1	
-29	RC20GF683J	. . RESISTOR, Fixed comp (R49)	1	
-30	RC20GF104J	. . RESISTOR, Fixed comp (R43)	1	
-31	RC42GF102J	. . RESISTOR, Fixed comp (R42)	1	
-32	RC42GF393J	. . RESISTOR, Fixed comp (R45)	1	
-33	RC42GF200J	. . RESISTOR, Fixed comp (R50)	1	
-34	Type DCC(130K)	. . RESISTOR, Fixed, dep carbon, 130K ±1%, 1/2 w (07716) (R20)	1	
-35	Type DCC(12.5K)	. . RESISTOR, Fixed, dep carbon, 12.5K ±1%, 1/2 w (07716) (R38)	1	
-36	11SM1-T	. . SWITCH, Pressure sensitive (91929) (S6)	1	
-37	JS-5	. . ACTUATOR, Switch (91929)	1	
-38	43M-9	. . RESISTOR, Var, 20 ohms ±5%, 5/8 in. shaft (12697)(R47)	1	
-39	88-8T	. . SOCKET, Octal (02660)	3	
-40	2008	. . STRIP, Terminal, 8 terminals (75173)	1	
-41	30606	. . SWITCH, Rotary (S1)	1	
-42	342001	. . FUSEHOLDER (75915) (XF1)	1	

;. & dex o.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Usable On Code
5-4	AGC1/2	FUSE, 1/2 amp, 115V, 3AG (03614) (F1) (For 115V operation only)	1	
	AGC1	FUSE, 1 amp, 250V, 3AG (03614) (F1) (For 230V operation only)	1	
-44	22085	SOCKET, Tube, 7 pin (71785) (XV4-6)	3	
-45	44B13373	SOCKET, Tube, 9 pin (71785) (XV1-3)	3	
-46	30977	TERMINAL BOARD ASSY NO. 1 (For details see fig. 2-16	1	
	33365	TOROID ASSY	1	
-47	33356	TOROID (L 1)	1	
-48	33360	BRACKET, Mounting	1	
	155144	TERMINAL BOARD ASSY NO. 4	1	
-49	1N536	DIODE, Semiconductor (06228) (CR5-8) . .	4	
-50	155143	TERMINAL BOARD	1	
	30978	TERMINAL BOARD ASSY NO. 2	1	
-51	1N66A	DIODE, Semiconductor (49956) (CR1-4)	4	
-52	RC20GF221J	RESISTOR, Fixed comp (R25)	1	
-53	RC42GF473J	RESISTOR, Fixed comp (R39)	1	
-54	Type CD1/2MR (25)	RESISTOR, Fixed, dep carbon, 25 ohms ±1%, 1/2 w (96214) (R26)	1	
-55	Type DCC(2.2K)	RESISTOR, Fixed, dep carbon, 2.2K ohms, 1/2 w (07716) (R30)	1	
-56	30981	TERMINAL BOARD	1	
-57	Type CD1/2MR (33.2K)	RESISTOR, Fixed, dep carbon, 33.2K ohms ±1%, 1/2 w (96214) (R2)	1	
-58	Type DCC(11.7K	RESISTOR, Fixed, dep carbon, 11.7K ohms ±1%, 1/2 w (07716) (R3)	1	
-59	Type CD1/2MR (3.32K)	RESISTOR, Fixed, dep carbon, 3.32K ohms ±1%, 1/2 w (96214) (R4)	1	
-60	Type DCC(1.17K	RESISTOR, Fixed, dep carbon, 1.17K ohms ±1%, 1/2 w (07716) (R5)	1	
-61	Type CD1/2MR (332)	RESISTOR, Fixed, dep carbon, 332 ohms ±1%, 1/2 w (96214) (R6)	1	
-62	Type DCC(167)	RESISTOR, Fixed, dep carbon, 167 ohms ±1%, 1/2 w (07716) (R7)	1	
-63	29037	SWITCH, Rotary (S2)	1	
-64	RC20GF753J	RESISTOR, Fixed comp (R48)	1	
-65	Type DCC(150K)	RESISTOR, Fixed, dep carbon, 150K ohms ±1%, 1/2 w (07716) (R17)	1	
-66	Type DCC(2.7K)	RESISTOR, Fixed, dep carbon, 2.7K ohms ±1%, 1/2 w (07716) (R12)	1	
-67	Type DCC(3.2K)	RESISTOR, Fixed, dep carbon, 3.2K ohms ± 1%, 1/2 w (07716) (R23)	1	
-68	RC20GF103J	RESISTOR, Fixed comp (R8)	1	
-69	Type DCC(175K)	RESISTOR, Fixed, dep carbon, 175K ohms ±1%, 1/2 w (07716) (R37)	1	
-70	RC20GF301J	RESISTOR, Fixed comp (R36)	1	
-71	RC20GF220J	RESISTOR, Fixed comp (R34)	1	
-72	A-2	CONNECTOR, Electrical (37942) (J5, J6) . .	2	
-73	XLR-3-14N	CONNECTOR, Electrical (71468) (J1-J4) . . .	4	
-74	39310-0008	CORD, AC power, includes connector (P1)	1	

g. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Usabl On Code
15-75	5651	. . TUBE, Electron (90139) (V6)	1	
-76	6AK6	. . TUBE, Electron (90139) (V5)	1	
-77	6X4	. . TUBE, Electron (90139) (V4)	1	
-78	5751	. . TUBE, Electron (90139) (V1)	1	
-79	12AX7	. . TUBE, Electron (90139) (V2, V3)	2	
-80	34599	. . TRANSFORMER, Power step-down (T1)	1	
-81	HC-1060A	. . CAPACITOR, 6000 μf, 10V dc (37942) (C14)	1	
		(ATTACHING PARTS)		
-82	VR4	. . CLAMP, Capacitor (37942)	1	
		---*---		
-83	Type CD1/2MR (28.7)	. . RESISTOR, Fixed, dep carbon, 28.7 ohms ±1%, 1/2 w (96214) (R12)	1	
-84	RC20GF101J	. . RESISTOR, Fixed comp (R1)	1	
-85	TVL2764	. . CAPACITOR, 40-40 μf, 450V (56289) (C13)	1	
-86	BT-6	. . WAFER, Capacitor (37942)	1	
-87	29038	. . SWITCH, Rotary (S3)	1	
-88	29039	. . SWITCH, Rotary (S4)	1	
-89	30979	. . TERMINAL BOARD ASSY NO. 3 (For details see fig. 2-17)	1	
-90	12627	. . SHIELD, Tube (71785)	3	
-91	2005	. . STRIP, Terminal, 5 terminals (75173)	1	
-92	171614	TAG, Instruction	1	
-93	Comm	. CHAIN, Bead	1	
-94	30878	FILTER, 70 cps	1	
-95	38578	FILTER, 200 cps	1	
-96	171585	STRAP, Filter	1	

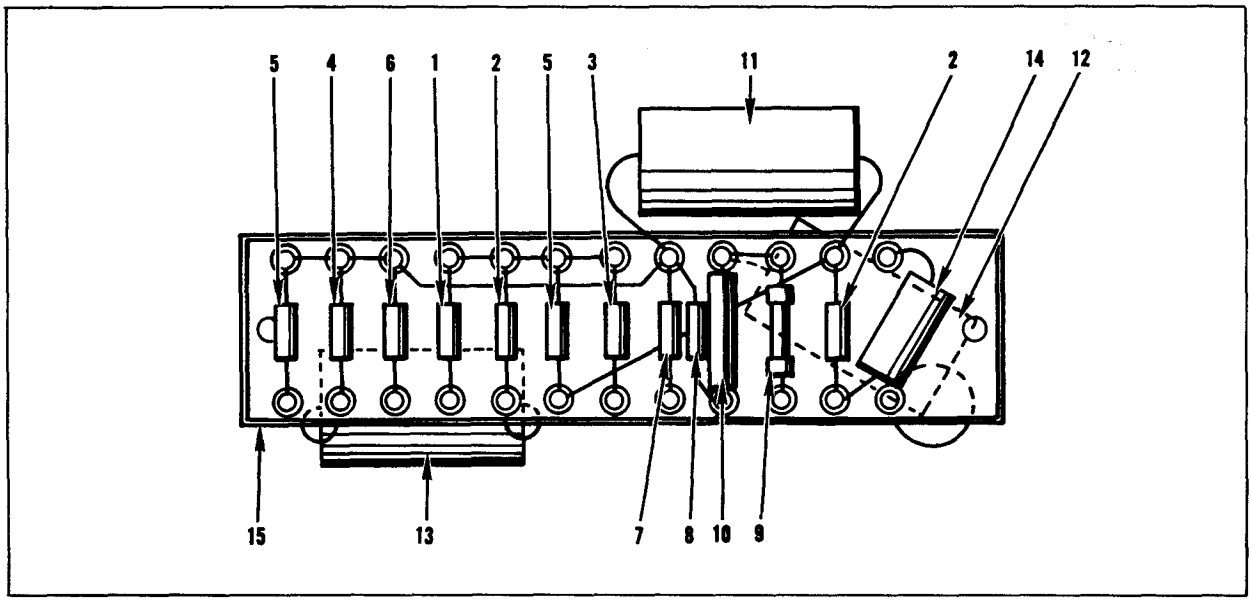


Figure 2-16. Terminal Board Assembly No. 1, Part No. 30977, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Usable On Code
-16-	30977	TERMINAL BOARD ASSY NO. 1 (See fig. 2-15 for NHA)	REF	
-1	RC20GF474J	. RESISTOR, Fixed comp (R27)	1	
-2	RC20GF224J	. RESISTOR, Fixed comp (R10, R24)	2	
-3	RC20GF154J	. RESISTOR, Fixed comp (R16)	1	
-4	RC20GF225J	. RESISTOR, Fixed comp (R28)	1	
-5	RC20GF104J	. RESISTOR, Fixed comp (R9, R31)	2	
-6	RC20GF682J	. RESISTOR, Fixed comp (R29)	1	
-7	RC20GF222J	. RESISTOR, Fixed comp (R18)	1	
-8	RC20GF334J	. RESISTOR, Fixed comp, 330K ohms nominal value, selected in test (R41)	1	
-9	Type DCC(1 meg)	. RESISTOR, Fixed, dep carbon, 1 megohm ±1%, 1/2 w (07716) (R22)	1	
-10	Type CD1R (1.78 meg)	RESISTOR, Fixed, dep carbon, 1.78 megohm ±1%, 1 w (96214) (R19)	1	
-11	Type BR845A	. CAPACITOR, 8 μf, 450V dc (14655) (C1)	1	
-12	2TM-M1	CAPACITOR, 1 μf ±20%, 200V dc (56289) (C4)	1	
-13	109P22494	CAPACITOR, 0.22 μf ±20%, 400V dc (56289) (C9)	1	
-14	109P47394	CAPACITOR, 0.047 μf ±1 0%, 400V dc (56289) (C2)	1	
-15	30980	TERMINAL BOARD	1	

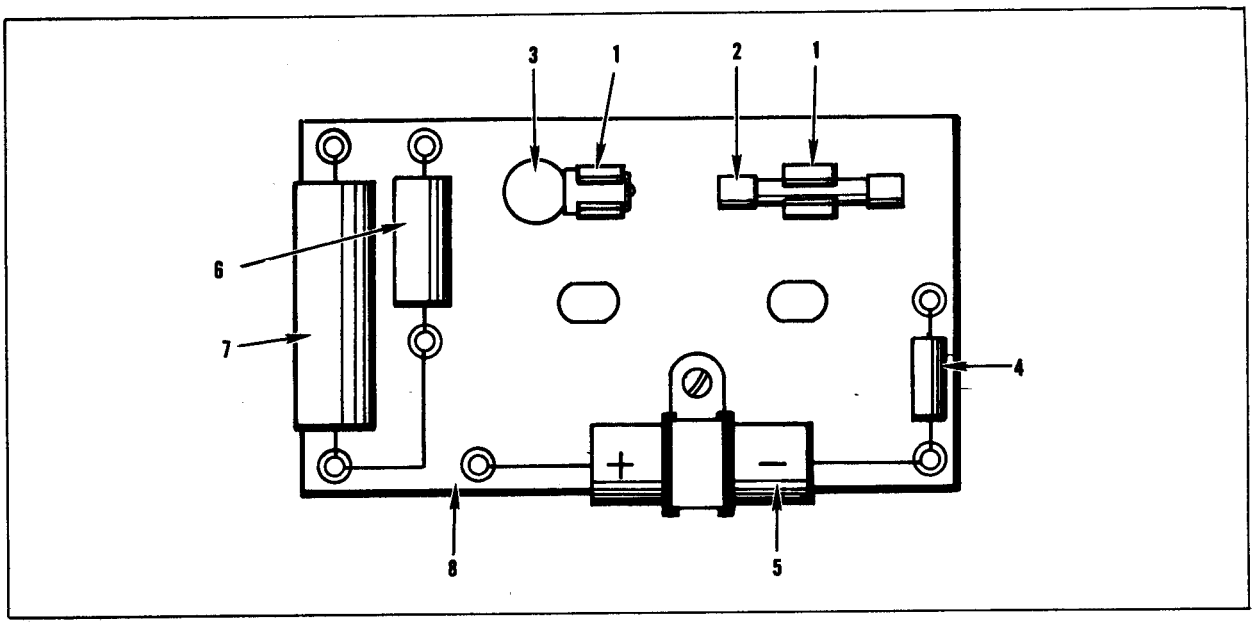


Figure 2-17. Terminal Board Assembly No. 3, Part No. 30979, Location of Parts

Fig. & Index No.	Part No.	Description 1 2 3 4 5 6 7	Units Per Assy	Usable On Code
-17-	30979	TERMINAL BOARD ASSY NO. 3, Wired (See fig. 2-15 for NHA)	REF	
-1	101002	CLIP, Fuse and lamp (75915)	2	
-2	AGC1/2	FUSE, 1/2 amp, 115V, 3AG (Spare) (03614) (For 115V operation)	1	
	AGC1	FUSE, 1 amp, 250V, 3AG (Spare) (03614) (For 230V operation	1	
-3	51	LAMP, 6-8 V (Spare) (24455)	1	
-4	RC20GF103J	RESISTOR, Fixed comp (R32)	1	
-5	DRHM605	CAPACITOR, 500 mfd, 6V (14655) (C12)	1	
-6	171997	CAPACITOR, 0. 022 mfd, 200V dc (Matched with Part No. 171966) (C6)	1	
-7	171996	CAPACITOR, 0.2 mfd, 200V dc (Matched with Part No. 171997) (C7)	1	
-8	30982	TERMINAL BOARD	1	

SECTION III

MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART
FOR
Vibration Monitoring Kit, Type 171170-0100 and 171170-0104
(AR 310-3)

(1) GROUP NO	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTION											(4) TOOLS AND EQUIPMENT	(5) REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
01	VIBRATION TRANSDUCER ASSEMBLY, TYPE 4-118-0107	O	D				D	O	O	D	D		2-D, 6-F, 7-F	
	Cover	O							O					
	Cable Assembly	O	O						O	O				
	Coil and Pole Piece	D							D	D			1-G	
	Magnet	D			D				D	D			3-G	
	Packing	D							D				4-G	
	Case								D	D				
	Internal Hardware	D							D	D				
02	VIBRATION TRANSDUCER ASSEMBLY, TYPE 4-128-0101	O	D				D	O	O	D	D		8-D, 9-D, 10-D, 11-D	
	Cover	O							O					
	Cable Assembly	O	O						O	O				
	Bobbin Assembly	D							D	D			5-G	
	Sleeve	D							D					
	Gasket Seal	D							D					
	Springs	D							D					
	Magnet Assembly .	D							D	D				
03	CASE, CARRYING	O							O	F				
04	REELS, CABLE	O							O	F				
05	CABLES	O	O					O	O	O				
06	MOUNTING BRACKETS, TRANSDUCER	O						O	O	F				
07	VIBRATION METER ASSEMBLY, TYPE 1-117-0105	O	F		O		O*			H	D			*using internal signal
	Case	O							O	H				
	Handle Assembly	O							F	F				
	Foot, Rubber	O							O					
	Chassis Assembly Wiring, Internal	F	F						F					
	Knob and Dial Assemblies	O	F						F	F				

MAINTENANCE ALLOCATION CHART
FOR
Vibration Monitoring Kit, Type 171170-0100 and 171170-0104 (continued)

(AR 310-3)

(1)	(2)	(3) MAINTENANCE FUNCTION											(4)	(5)
GROUP NO	FUNCTIONAL GROUP	INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	TOOLS AND EQUIPMENT	REMARKS
	Switches	O	F						F	F				
	Indicator Lights	O	O						O					
	Fuses	O	O						O					
	Meter						D		F	D				
	Resistors, Variable	F	F		F				F					
	Resistors, Fixed	F	F						F					
	Capacitors	F	F						F					
	Tube Sockets	F	F						F	F				
	Terminal Strips	F							F	F				
	Terminal Boards	F							F	F				
	Diode	F	F						F					
	Connectors, Electrical	O	O						O	F				
	AC Cord	O	O						O	O				
	Tubes, Electron	O	O						O					
	Transformer, Power	F	F						F	F				
	Filters	O	O						O	F				
	Mechanical Hardware	F							F	F				
	Signal, Calibration		H		H								12-F, 13-F	

Vibration Monitoring Kit, Type 171170-0100 and 171170-0104
Special Tools and Test Equipment Requirements Table

Tools or Test Equipment Reference Code	Nomenclature	Maintenance Category	Tool Number	Remarks
1	Spanner Wrench	D	28024-AE-7	Used for removal of coil and pole piece from case.
2	Knock-Down Coil	D	28024-AE-8	Used for calibration.
3	Button Setting Plug	D	28024-AE-5	Used to install magnet.
4	Taper Plug	D	28024-AE-3	Used to install packing.
5	Spanner Wrench	D	360284-3	Used to remove bobbin assembly from case.
6	Oscilloscope	D		
7	Vibration Table	D		
8	Charging Coil	D		
9	Standardizing Coil	D		
10	Magnetreater	D		
11	Magnet Charger	D		
12	VTVM	D		
13	Audio Generator	D		

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TM 55-4920-243-15	12 JULY 1968	OPER, ORGAN, DS, GS & DEPOT MAINTENANCE MANUAL VIBRATION MONITORING KIT

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO	TABLE NO
6	2-1 a		
81		4-3	
125	line 20		

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

In line 6 of paragraph 2-1a the manual states the engine has 6 Cylenders. The engine on my set only has 4 Cylenders. Clenge the Manual to show 4 Cylenders.

Callout 16 on figure 4-3 is pointing at a bolt. In key to figure 4-3, item 16 is called a shim - Please Correct one or the Other.

I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered, so the NSN is wrong. Please give me a good NSN

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P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS

REVERSE OF DA FORM 2028-2 Reverse of DRSTS-M Overprint 2, 1 Nov 80

TEAR ALONG PERFORATED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

Commander
US Army Aviation Systems Command
ATTN: AMSAV-MC
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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