MB DYNAMICS

MODAL 50A
VIBRATION EXCITER

Rev. June '90

MB Dynamics
25865 Richmond Road
Cleveland, Ohio 44146

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MODAL 50A EXCITER

Section 1: PREPARATION

1.1 UNPACKING

NOTE: If the crate has suffered extensive shipping damage notify the shipper and contact MB DYNAMICS.

Place the crate containing the MODAL 50 on a flat, stable surface or table in the proper position as indicated by "THIS SIDE UP" (see Fig. 1-1).

PLEASE NOTE: The crate provided was specifically designed to protect the exciter and inertia blocks, and if care is taken in uncrating, it can be used again if you need to ship the exciter to a test site.

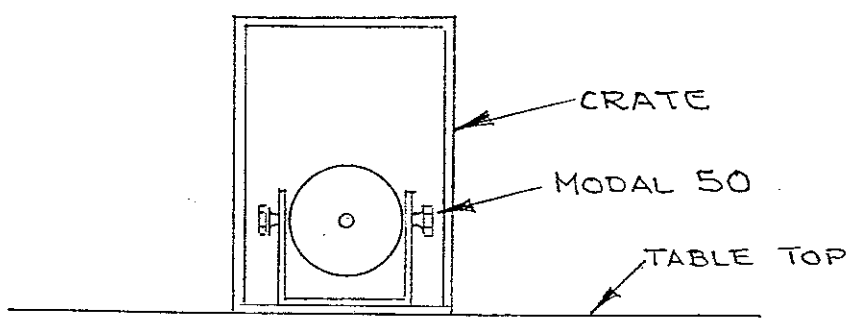
Remove the top cover from the crate. Remove any additional packing material then remove the brace from between the exciter and inertia blocks.

Remove the inertia blocks from the crate by removing bolts from the outside.

Remove the bolts from the crate into the base of the exciter. Position the crate so the bottom of the exciter base can be pulled from the crate onto the flat stable surface or table (see Figure 1-2).

After removal of the exciter from the crate, loosen the trunnion locking knobs on each side of the base and turn the exciter until the projecting armature end is in the vertical position, and then retighten the locking knobs.

FIGURE 1.2



SECTION 2: DESCRIPTION

2.1 GENERAL

MODAL studies and testing of mechanical structures require an exciter that is highly portable, rugged, and easy to set up and operate. The light compact design of the permanent magnet MODAL 50 exciter was designed with these features in mind, allowing for one-man setup and operation. Some of the major features of the MODAL 50 are:

1. Lightweight body and base provides handling ease when transporting or suspension mounting.

2. Quick-locking trunnion base along with its adjustable screw legs provide complete freedom of alignment when floor mounting.

   Four turnbuckles allow the same degree of freedom when adjusting alignment attitude in suspended applications.

3. Collet-type gripper at attachment end of armature allows any length stinger to be used. Excess stinger length can project through collet, armature, and the hollow bore which extends through body of exciter. The stinger therefore needs to have threads on only one end.

   NOTE: An important advantage of this method of attachment is that it allows the armature to be clamped on the stinger while the armature is maintained at its center-of-displacement instead of using up a portion of the available stroke to position the armature relative to the stinger end.

4. Lightweight armature minimizes force drop off at resonance of test articles that are lightly damped or those having low modal mass.

5. Low axial stiffness of the armature suspension system offers minimum influence on the dynamics of the test structure.

6. Natural mechanical resonance of the armature is well above modal test frequencies so as not to contribute erroneous information to the test data.

7. Easily attached inertial masses are supplied to offer increased force reaction in installations where the exciter must be suspended, thereby allowing such tests to go down to lower frequencies (as low as 2 Hz).

8. Long one-inch stroke allows higher force levels to be obtained from structures having relatively low stiffness.

9. The armature has selectable A.C. load impedances of 3 or 12 ohms, allowing it to be matched to a variety of power amplifiers.

   The maximum rating of 50 pounds (peak) and 1.0 inch total displacement are obtained when a 250 volt-ampere amplifier and forced air cooling of the exciter is used. Cooling limitations reduce the rating to 25 pounds (peak) if forced air is not available (see Section 2.4).

2.2 SPECIFICATIONS

Force Output:	
Cooling (Convection)	25 pounds (peak)
(Forced air)	50 pounds (peak)
Stroke	1.0 inch peak-to-peak 1.1 inches between stops
Armature Axial Stiffness:	<15 pounds/inch
Armature Weight:	<0.4 pounds
Frequency Range of Shaker:	DC to 2000 Hz, usable to 5000 Hz
Driver Coil Current:	8.5 Amperes Maximum (low impedance connection) 4.2 Amperes Maximum (high impedance connection)
Driver Coil DC Resistance:	1.3 Ohms (low impedance connect) 5.2 Ohms (high impedance connect)
Stinger Attachments:	Chuck with collets to handle wire sizes from .020"(24AWG) to .127" (8AWG). Collet Sizes: 0 -.031" .031"-.062" .062"-.093" .093"-.127"

Shaker Attachments:	Floor mount with adjustable trunnion base and adjustable legs. Suspension mount with multiple turnbuckles.
Dimensions:	11-1/2" high (to top of collet chuck without feet. 7-1/2" X 9-1/4" footprint
Weight:	55 lbs w/trunnion base
Accessory Kit:	Two easy-mount 30 lb weights for increasing inertial mass. An accessory case containing: installation hardware, cables and accessory items (see Section 2.6).
Available Options:	Portable cooling package w/10 ft flexible hose & 6 ft power cord. Extra length drive cable.

2.3 POWER REQUIREMENTS

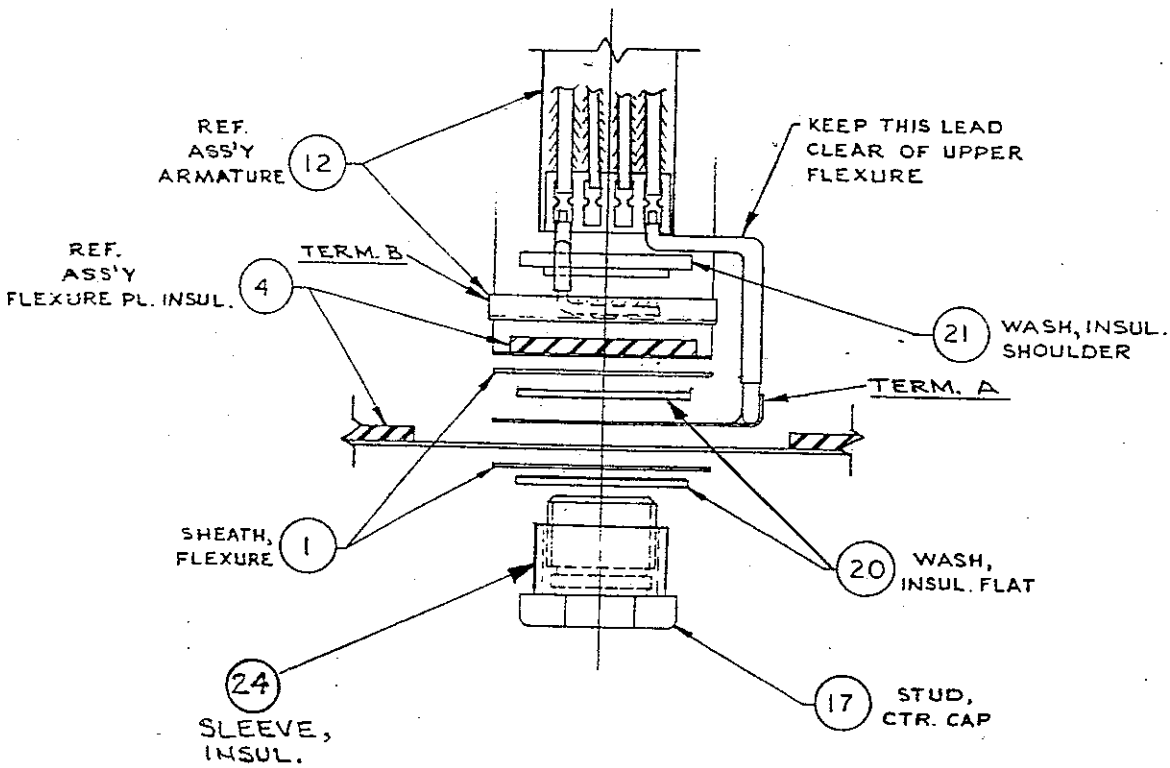
While MB recommends the Model SS250 VCF Power Amplifier for driving the MODAL 50, any audio amplifier capable of supplying 250VA (continuous rating) into a 3 or 12 ohm load may be used. In many modal tests, low frequency performance is required. As a result, the amplifier should have acceptable output at these frequencies. The MB Model SS250 VCF operates down to DC THE MODAL 50 is normally supplied with driver coil jumpers connected for 3 ohms as standard to match the Model SS250 VCF amplifier. For operating at the higher 12 ohms impedance refer to Figure 2.0.

2.4 COOLING REQUIREMENTS

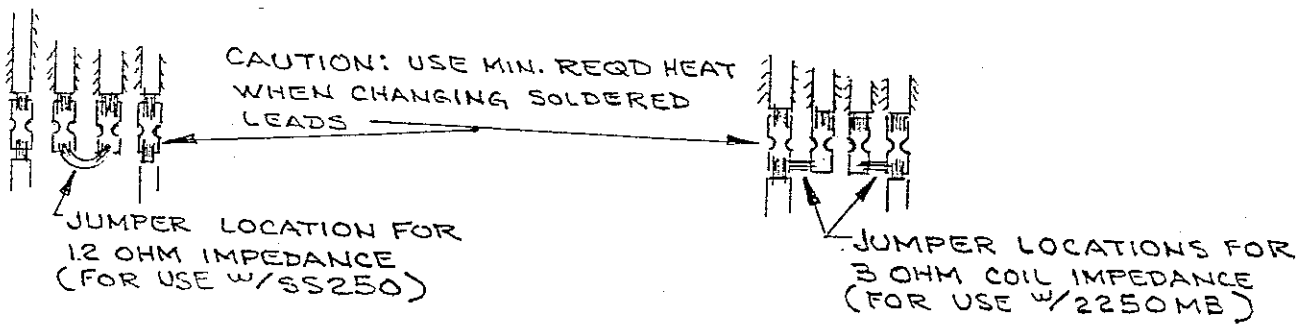
The MODAL 50 may be operated up to 25 peak pounds using natural convection cooling. When operating above this level, forced air cooling is required. Forced air cooling is accomplished by means of oil and water shop air. A source capable of supplying 13 SCFM of air at a pressure of 4 inches H_2O is required. A 1/2" NPT adapter is provided for connecting a shop air hose to the bottom of the exciter. To obtain correct flow, one of the screws holding the bottom of the exciter. To obtain correct flow, one of the screws holding the bottom plate on the exciter may be removed and a pressure gage held there manually while the air flow is adjusted to obtain the required 4 inches H_2O. If convenient, the pressure required to provide this flow can be measured at some other point in the supply system and that reading duplicated for later cooling air setting.

Also available from MB is a portable cooling package which operates from 115VAC for installations where shop air isn't available. A ten foot flexible air hose is supplied with the cooling package. It is not necessary to make the pressure measurement when using the portable cooling unit.

Figure 2.0
COIL IMPEDANCE JUMPERS



VIEW OF COIL LEAD TERMINALS ON BOTTOM ARMATURE SPACER

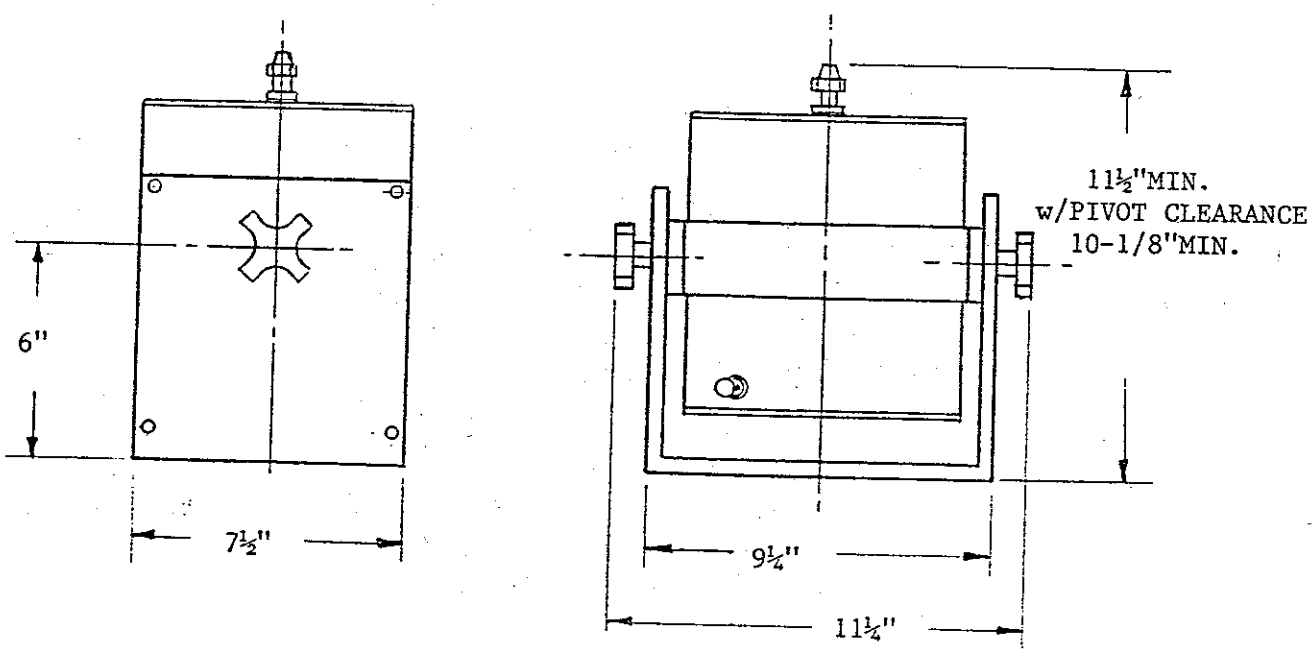


2.5 MECHANICAL OUTLINE

The overall physical dimensions of the MODAL 50 are shown in Figure 2.1.

Installing the exciter trunnion via the upper set of holes in the base provides room for the body to swivel in both directions. The lower set of mounting holes allows the body to be attached to the base, providing the minimum height, but without the ability to swivel.

Figure 2.1
MECHANICAL OUTLINE

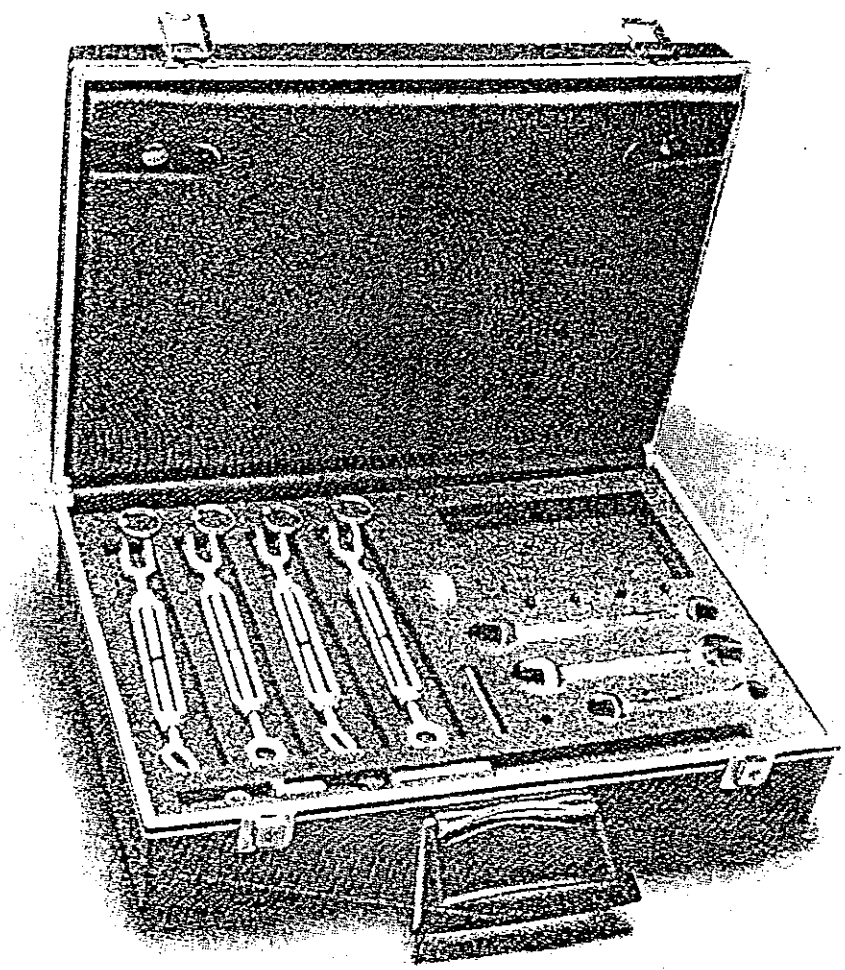


2.6 ACCESSORY KIT

A kit of tools and hardware is supplied with the MODAL 50 as a convenience during installation. The accessory kit consists of a case containing necessary tools and hardware. Two 30 pound inertial masses are furnished loose. The accessory case (Figure 2.2) contains extra compartments for storing user supplied load cells, accelerometers, cables, with room for stingers up to 14 inches long. The Bill of Material 9380032 at the rear of the manual lists the tools and hardware provided.

NOTE: See Drawing A9380438 for recommended wire stinger assembly.

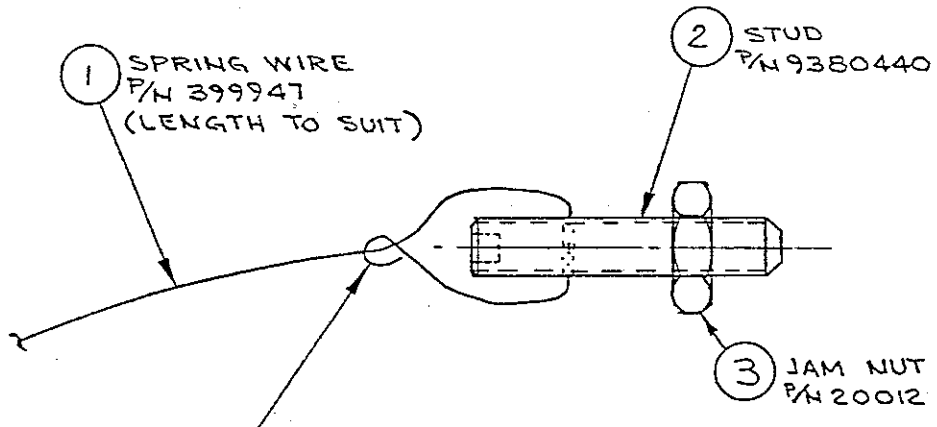
Figure 2.2
ACCESSORY CASE



DRAWING NO. A9380438

A9380438

REV	DESCRIPTION	DATE	DR	APPR
A	ADD (3) & ATTACHMENT NOTE	5/14/68	J.F.	J.S.



RECOMMENDED METHOD OF ATTACHMENT.
NOTE: MAKE LOOP AS SMALL AS POSSIBLE WITHOUT SHARP BENDS.

STD. DESIGN	B/M 9380438	SCHEMATIC	WIRING	PART NO.

TOLERANCE ON FINISHED DIMENSIONS UNLESS OTHERWISE SPECIFIED		
BASIC DIMENSIONS	FRACTIONAL DIMENSIONS	DECIMAL DIMENSIONS
UP TO 6"	±1/64	± .005
ABOVE 6" TO 24"	±1/32	± .010
ABOVE 24"	±1/16	± .015
ANGULAR DIMENSIONS ± 1/2°		

MB Dynamics

WIRE STINGER KIT

RECOMMENDED ASSY

SCALE 2x DATE 5-4-88

DR. TEK CK. APPR.

A9380438 REV. A

USED ON

BRUNING 40 21

2.7 OPTIONAL EQUIPMENT

Available as extra cost options are:

Model SS250 VCF Power Amplifier

* 250 watt output with short circuit protection. Matches high impedance (12 ohm) armature connection to produce full rated performance from the MODAL 50.

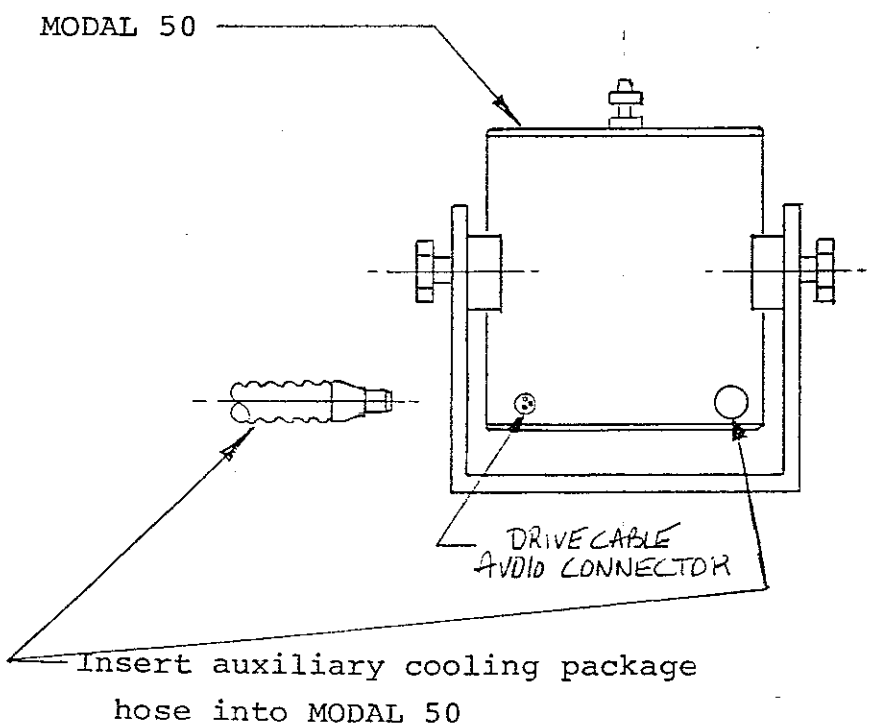
* Internal cooling fan for reliable and continuous operation.

* Clipping indicator lamp to show when the amplifier is being overdriven or when the IOC circuit is distorting the applied signal.

Cooling Package

* Portable forced air supply provides cooling requirements for doubling the force limit (25 peak pounds with natural convection cooling) to full rating. Internal muffler provides quiet operation. Operates from 120 Vac - 50/60 Hz power.

Figure 2.3



SECTION 3: INSTALLATION

3.1 GENERAL

Installing an exciter relative to the desired excitation point of the test structure poses the problem of how to support it and maintain the necessary alignment. In some cases the exciter may be supported from the floor or ground without too much trouble, but as is often the case it must be mounted alongside or above the test structure and therefore must be suspended. the following sections are intended to present ideas and some guidelines toward solving these problems.

3.2 EXCITER ALIGNMENT

Critical to the success of the installation is establishing the alignment of the exciter's thrust axis to the load axis of the transducer mounted on the test structure. Misalignment of these axes is responsible for (a) the transmission of unmeasured forces into the structure due to side loading of the transducer, (b) buckling of the stinger in compression, (c) excessive rubbing wear of the armature from side loading.

As an aid in establishing the attitude of the exciter while mounting it, a stiff, straight threaded stinger can be used as an alignment tool. The stinger is inserted through the opened collet chuck and into the body of the exciter. It is then slid forward until it meets the threaded attachment hole in the load cell. If the alignment is proper, the stinger will easily thread into the load cell without forcing it.

3.3 CHUCK ATTACHMENT

The collet type chuck is designed to grip round stingers (threaded or unthreaded) ranging in sizes from the thinnest wire to No.8 AWG (.127" diameter).

One good source for stingers in certain applications is the spokes from a bicycle wheel. The wire typically needs an appropriately sized stud brazed to it for attachment to the load cell. Four interchangeable collets cover the following clamping diameters:

0 -.031"
.031"-.062"
.062"-.093"
.093"-.127"

The collets are stored in the accessory case in individual compartments.

To attach the stinger to the chuck, first select the collet size that most nearly fits the diameter of the stinger. Slip the stinger into the collet with the tapered end of the collet towards the end of the stinger that threads into the transducer. Remove the threaded chuck sleeve from the chuck body and insert the stinger with collet attached into the chuck body. The length of the stinger is not critical since any excess may extend into the bore of the armature. In fact, in awkward situations, by leaving the collet off, the stinger may be inserted through the hole in the rear of exciter until it projects through the chuck body. The collet and chuck sleeve are installed and the stinger is then threaded securely into the transducer.

Before tightening the chuck, position the armature until the red index groove on the chuck body is in line with the top edge of the cover. This position permits full allowable stroke to be obtained if required. Use open-end wrenches on the hex flats of the chuck sleeve and the wrench flats on the chuck body. Use only enough torque to prevent the chuck from slipping. Excessive torque will damage the threads.

CAUTION: Do not wrench on chuck sleeve without using a wrench on the flats of the chuck body. Excessive torque on the armature will cause internal damage.

3.4 FLOOR MOUNTING

Vertical: When the mounting position of the exciter is to be more or less vertical and the exciting force is to be applied to the test structure from below, the exciter may be installed by setting its trunnion base on the floor or, on a platform or table if additional height is required.

Angular positioning through one plane may be done by loosening the trunnion locking knobs located on each side of the base and tipping the exciter. As is usually the case, alignment of the exciter to the point of attachment on the structure will require greater adjustability.

Using the three 2-1/4" bolts and jam nuts from the accessory case, a considerable range of adjustment is possible. The widely spaced three legged stance provides a reasonably stable base without rocking.

Inclined: As the angle of thrust approaches horizontal, the lateral force may cause the base to skid or rock. This will result in offsetting the armature from its center of stroke position, thereby reducing the total stroke available.

In this case, the leveling legs can be captured to prevent this from happening. the inertial mass No.2, supplied with the MODAL 50, may be used for this purpose by placing it on the floor with the counter bore side up. The exciter leveling legs may then be set into the counterbores which serve as retaining sockets.

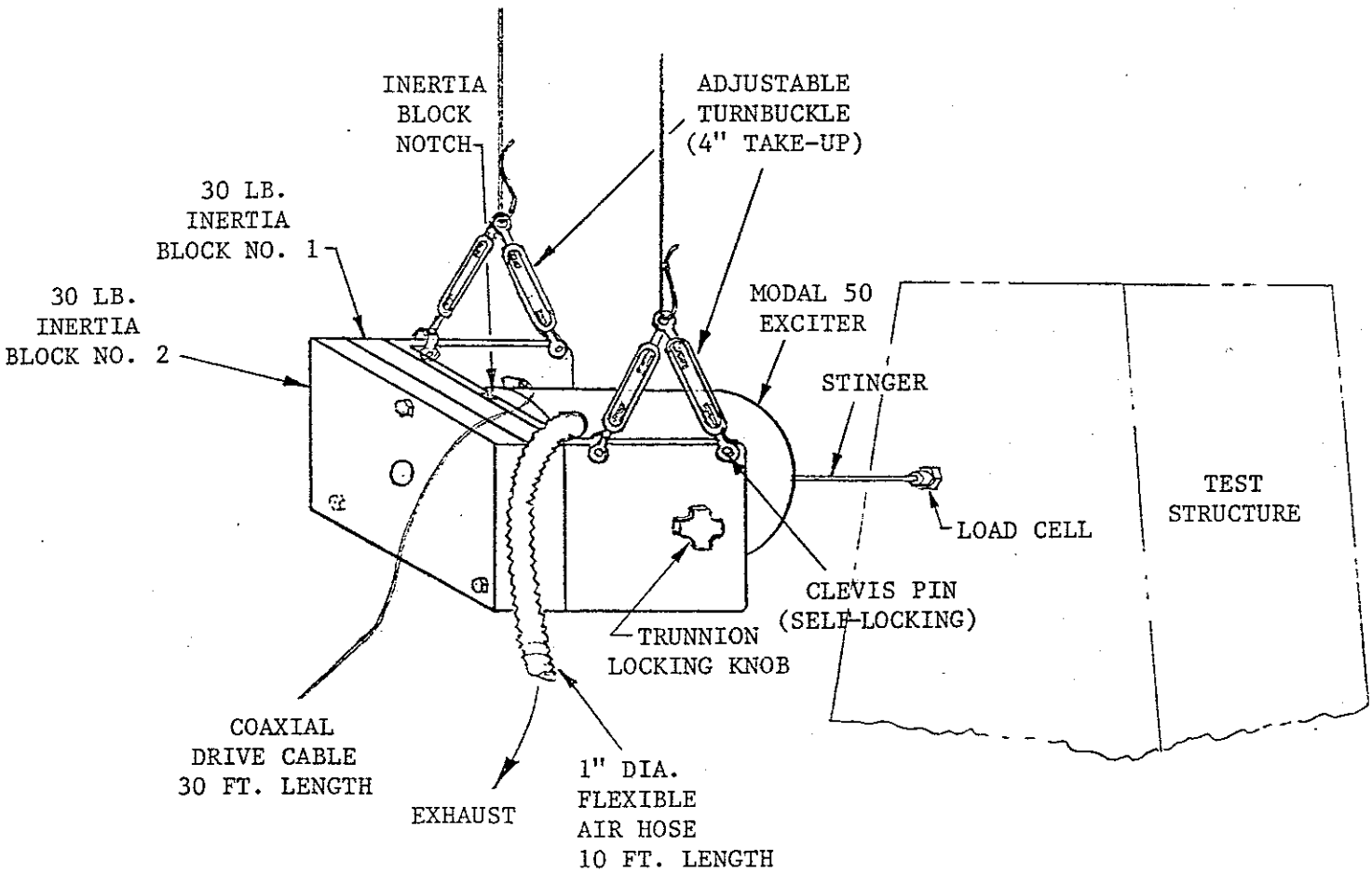
If floor conditions are such that the inertia block still slides, it then becomes necessary to anchor the block. On tile floors, a thin sheet of rubber may increase the coefficient of friction sufficiently to restrain it. While this same method may be used on a concrete surface, sometimes; and particularly when installing an array of exciters around a structure; a more permanent method of mounting is desired. If masonry screws or anchors are not acceptable, hot melt adhesives provide a reliable bond to concrete surfaces and can be cleaned up with petroleum based solvents when finished. A piece of one or two inch lumber, cut to serve as a glue block, may be bolted or screwed to the inertia block or exciter base and the wood block in turn bonded with hot glue to the concrete surface. One quarter-inch lag bolts or screws may be used, mounted through the trunnion base or inertia block and into the wood so that the exciter or inertia block can be removed before trying to knock the glue block loose after the test is finished.

3.5 SUSPENSION MOUNTING

When the point of exciter attachment to the structure requires suspending the exciter from overhead, it becomes difficult to provide proper alignment. The MODAL 50 is supplied with four turnbuckles.

When suspending the MODAL 50 exciter, the turnbuckles should be attached to the base so that the inertia block mounting notch on the edge of the base appears in the up position along with the air exhaust hole in the side of the exciter. The four-point suspension provides easy adjustment of vertical position as well as pitch and yaw of the exciter axis. See Figure 3.0 SUSPENSION MOUNTING.

Figure 3.0
SUSPENSION MOUNTING



3.6 ADD-ON INERTIA BLOCKS

The MODAL 50 Exciter is supplied with two (2) thirty pound steel weights which can be attached to the exciter after it is suspended to increase the inertial mass. The performance curves in Figure 4.1 show the degree of force coupling with the inertia blocks attached. The MODAL 50 Exciter was designed for installation, if necessary, by one man. As a result the inertia blocks are supplied in a manageable size for easy attachment to the exciter after it has been suspended. The following procedure outlines the steps required to mount the two blocks. Each step is keyed to corresponding numbers in Figure 3.4 INERTIA BLOCK INSTALLATION.

1. Suspend the MODAL 50 Exciter and align it as close to its final position as possible. Remove the leveling leg bolts which will be used later.

2. Thread the 3/8-16x1" Hex Head Bolt along with a flat washer about three or four turns into the top center hole of inertia block No.1.

3. Hang the inertia block on the exciter by dropping the projecting bolt with washer into the notch on the base.

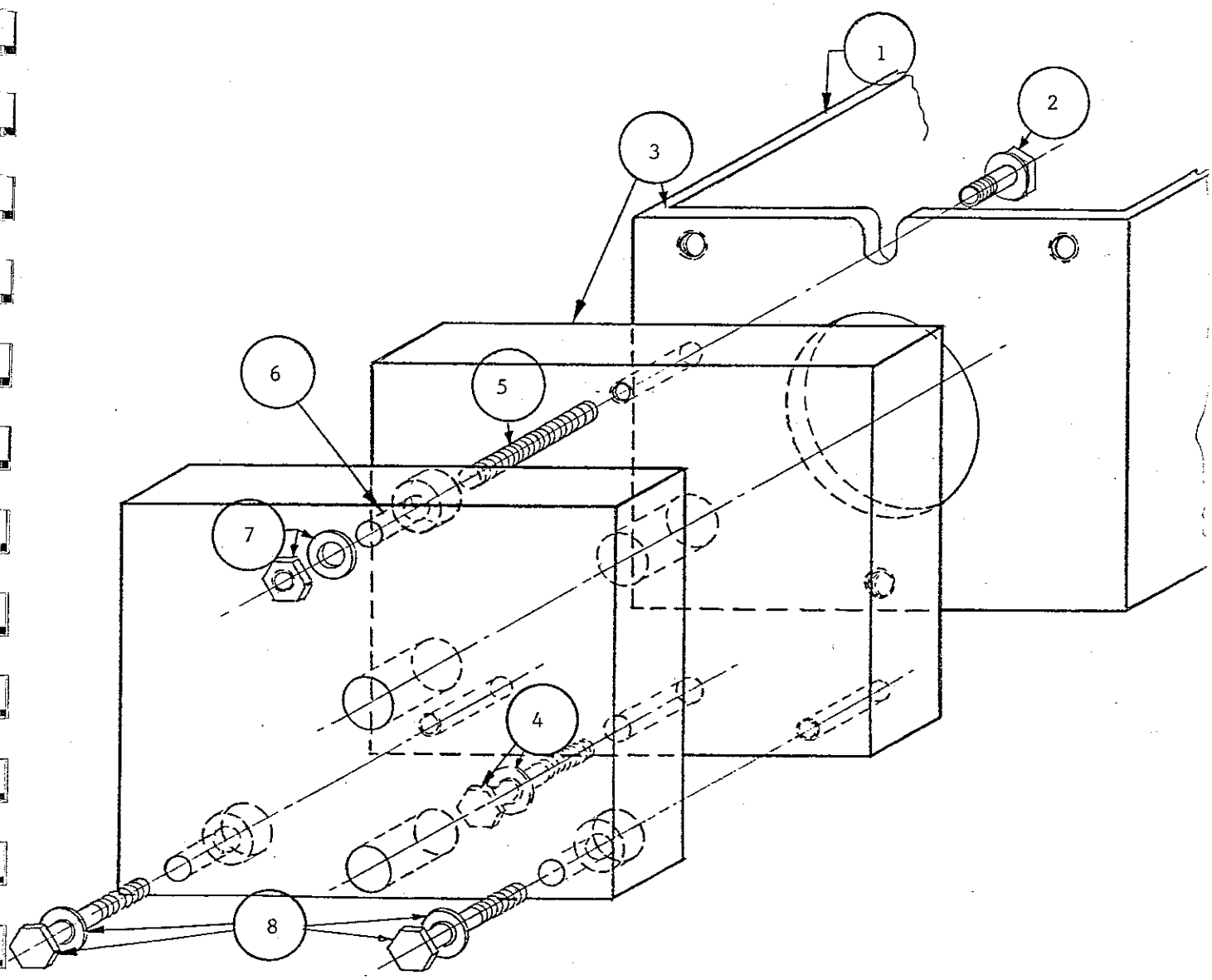
4. Insert one of the 3/8-16x2.25" leveling leg bolts, along with a flat washer, through the clearance hole in the bottom of the weight and thread into the base. Tighten both upper and lower bolts securely.

5. Thread the 3/8-16x2-1/2" stud, hand tight (approximately 5 to 6 turns), into the top center hole of block No.1.

7. Secure weight with 3/8-16 Hex nut and flat washer.

8. Install remaining two leveling leg bolts with flat washers through the two lower clearance holes in block No.2. Tighten securely the nut and both bolts.

Figure 3.4
INERTIA BLOCK INSTALLATION



3.7 PRE-LOADED WIRE STINGER

Advantages:

The ideal stinger would be infinitely stiff in the axial (thrust) direction and have no stiffness in bending (perpendicular-to-thrust) direction. Obviously this is not possible in the real world but it can be approached with a pre-loaded wire stinger. For instance if a thin wire, e.g., a piano wire, has a tensile load of 60 lbf. it can be oscillated at +/-50 lbf. Such a set up would have a very small stiffness in the direction perpendicular to the thrust direction.

The MODAL 50 Exciter was designed with a center bore extending through its body to allow the pre-loaded wire stinger to be easily implemented. Some of the advantages of using the pre-loaded wire stinger along with the features offered by the MODAL 50 are as follows:

1. The pre-loaded wire stinger remains in tension while delivering peak dynamic force, thereby eliminating the bending moment errors that can result during compression loading of stiff stingers.

2. Thin wire stinger provides greater isolation of side loads that result from axial misalignment of the system along with the rotatory inertial effects of the exciter.

3. Preload is independent of MODAL 50 and therefore does not require additional restraint of the exciter body.

4. Preload can be applied with MODAL 50 suspension mounted including the ADD-ON INERTIA BLOCKS.

5. Easy to install. Wire extends from transducer on test structure through the exciter body and pre-tensioning system (not a part of MODAL 50) directly to the anchor point.

Installation procedure:

The following is a brief outline of the steps required to properly install the pre-loaded stinger. See Figure 3.5.

1. Attach the load cell to the test structure at the desired "point of excitation" with its sensitivity axis in alignment with the MODAL 50 thrust axis.

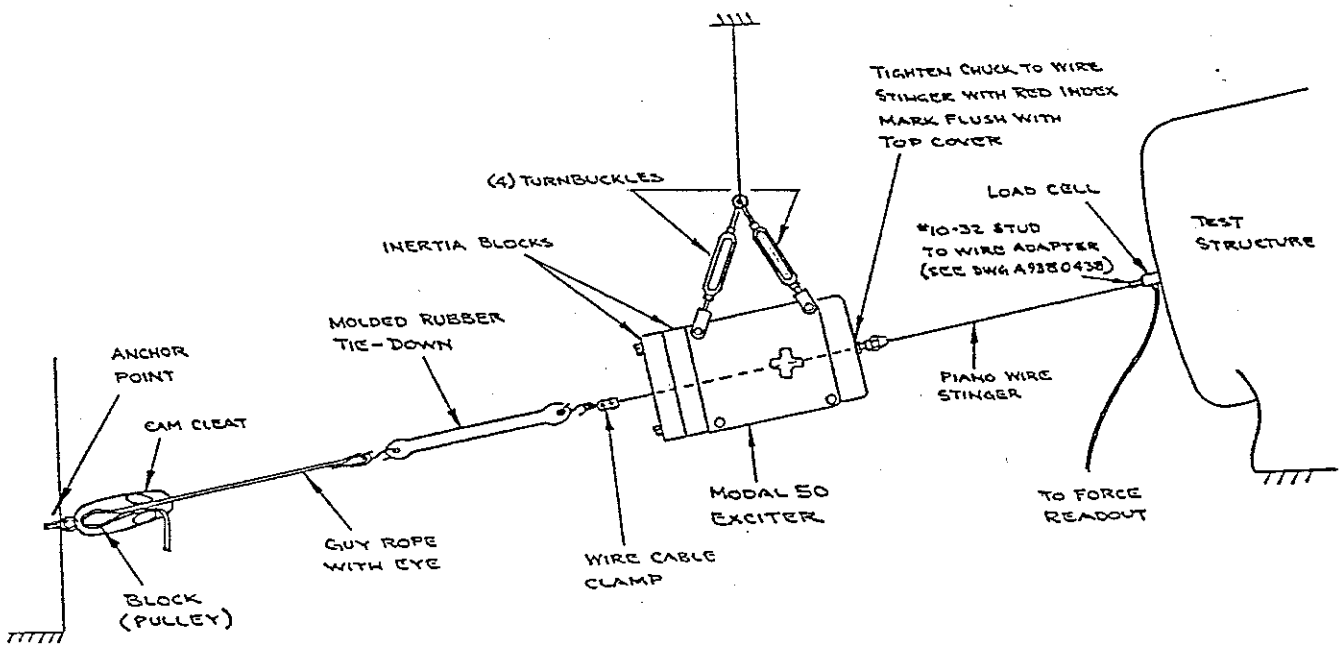
2. Mount the exciter to a base common with the test structure or suspend with cables. Maintain reasonable alignment between load cell axis and the exciter thrust axis.

3. Insert wire stinger through collet chuck and out through the rear of the exciter. Attach pre-tensioning system to end of stinger.

4. Locate anchor point so that wire stinger extends in a straight line through center of hole in base of the MODAL 50.

5. Tighten molded rubber tie-down strap until the static force exceeds the expected peak force. If the force readout is AC coupled, the pre-load force will be ignored and only the dynamic force will be displayed.

Figure 3.5
SUGGESTED PRE-LOADED WIRE STINGER INSTALLATION



SECTION 4: OPERATION

4.1 GENERAL

The MODAL 50 Exciter may be driven to full performance with an audio amplifier capable of supplying either 25V at 8.5 amps AC. (such as the earlier MB Model 2250 and the presently recommended SS250 VCF) or 50V at 4.2 amps AC as provided by the MB Model SS250 Power Amplifier. The coil impedance is selected by jumpers which are accessible under the bottom cover of the MODAL 50 (See Section 2.1).

The Model SS250 and the SS250 VCF may be operated from power lines ranging from 100 volts AC to 250 colts AC. It is normally supplied wired for 117 volts AC. If the available line voltage deviates from this voltage by more than 10%, internal jumpers should be changed to accommodate the available voltage. Refer to the instruction manual supplied with the SS250 or SS250 VCF for the proper connections.

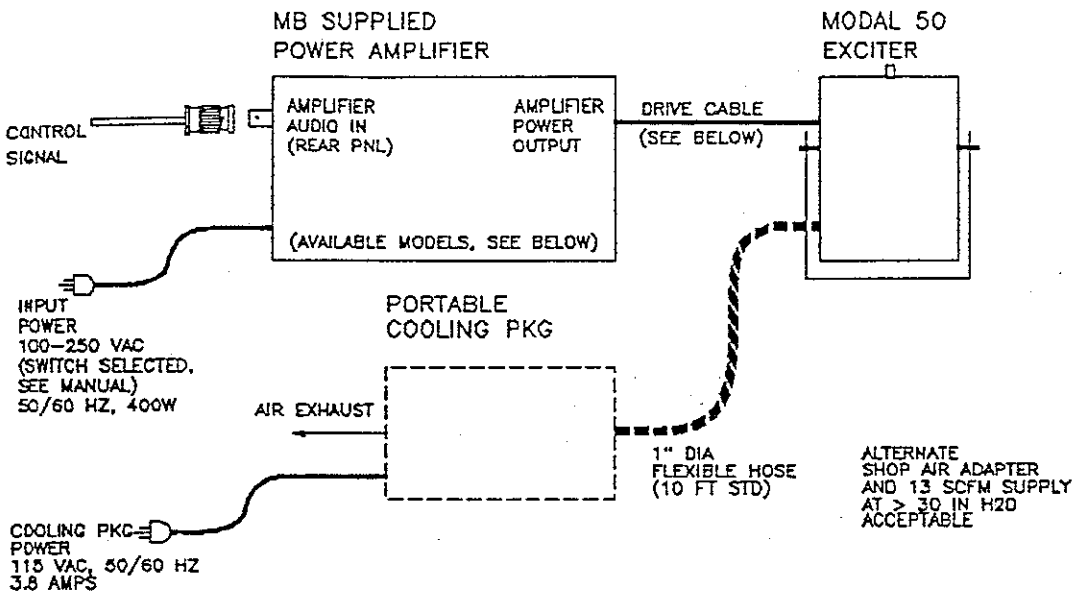
4.2 OPERATING CONTROLS

After the proper line voltage tap (see Section 4.1 above) has been made and the correct fuse size installed, connect the signal source and the MODAL 50 as shown in Figure 4.0 (electrical hook-up). The system is now ready to use. Refer to Section 4.3 for attainable continuous duty performance ratings.

The Exciter is now connected to the amplifier output and the system is ready to operate. turn the amplifier "ON". The AMPLITUDE control may be turned to its maximum position (fully clockwise) if the signal source being used also has a means for controlling signal level or amplitude. When driving the MODAL 50 do not exceed its 50 pound Peak force rating. If forced air cooling is not being used the drive level should not exceed 25 pounds Peak force for more than a few seconds.

NOTE: Refer to amplifier manual for operating instructions and proper electrical hook-up. Observe any precautions regarding potential ground loops between the amplifier and the signal source.

Figure 4.0
ELECTRICAL HOOK-UP



SYSTEM OPTIONS

	AMPLIFIER	DRIVE CABLE
STANDARD	MODEL SS250	9356583
CURRENT FB	MODEL SS250VCF	9356668

NOTES:

1.) SS250 DRIVE CABLE WIRED TO "RED" OUTPUT TERMINALS VIA CABLE BANNANA PLUG

2.) SS250VCF DRIVE CABLE WIRED TO OUTPUT TERMINAL BLOCK PINS LABELLED "OUTPUT" AND "SAMPLED COMMON"

4.3 PERFORMANCE CURVES

The MODAL 50 Exciter is designed specifically as a force generator for determining the dynamic charactistics of complicated structures. The exciter's performance capability is limited by the compliance of the exciter support system, the stinger, and the input point of the structure. The force envelope of Figure 4.1 implies an infinitely stiff test article and stinger stiffness when the exciter is freely suspended as shown in Section 3.5 Figure 3.0. Of course, this is the dynamic equivalent of having a free suspended test article weighing 115 pounds excited by a MODAL 50 which is fixed to ground. Also shown in Figure 4.1 is the force envelope for the fixed MODAL 50 body with a stiff test article.

Figure 4.1
FORCE ENVELOPES "SINE PERFORMANCE"

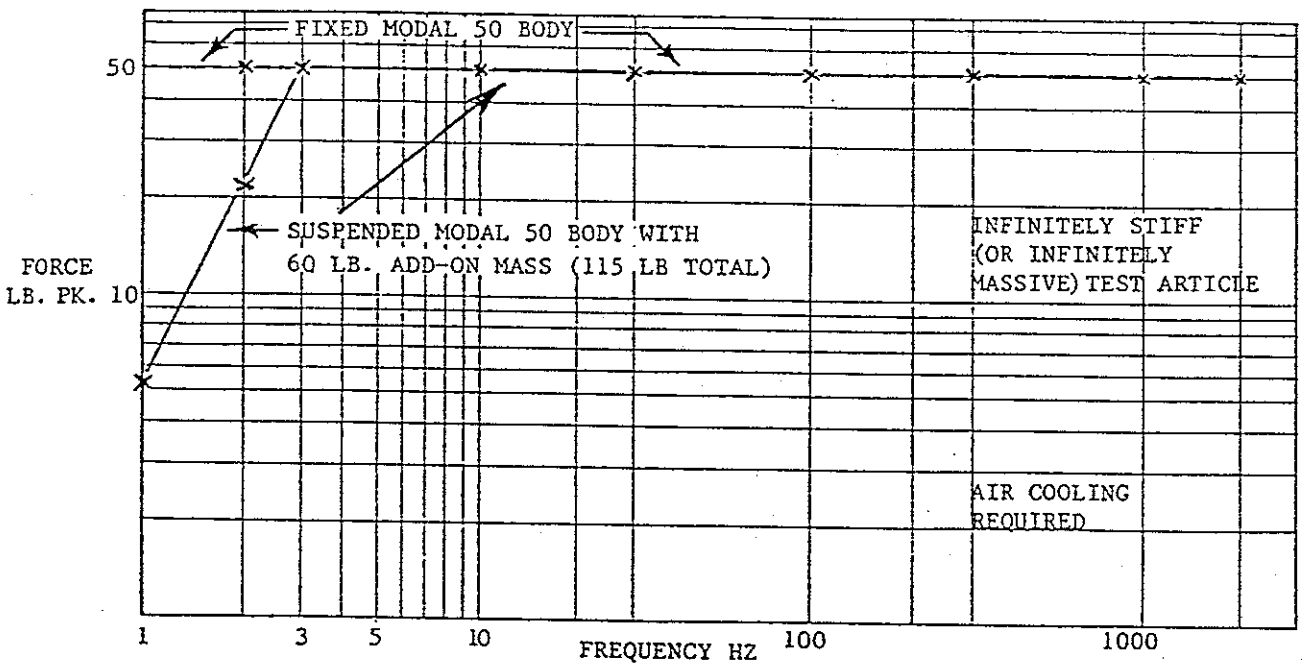
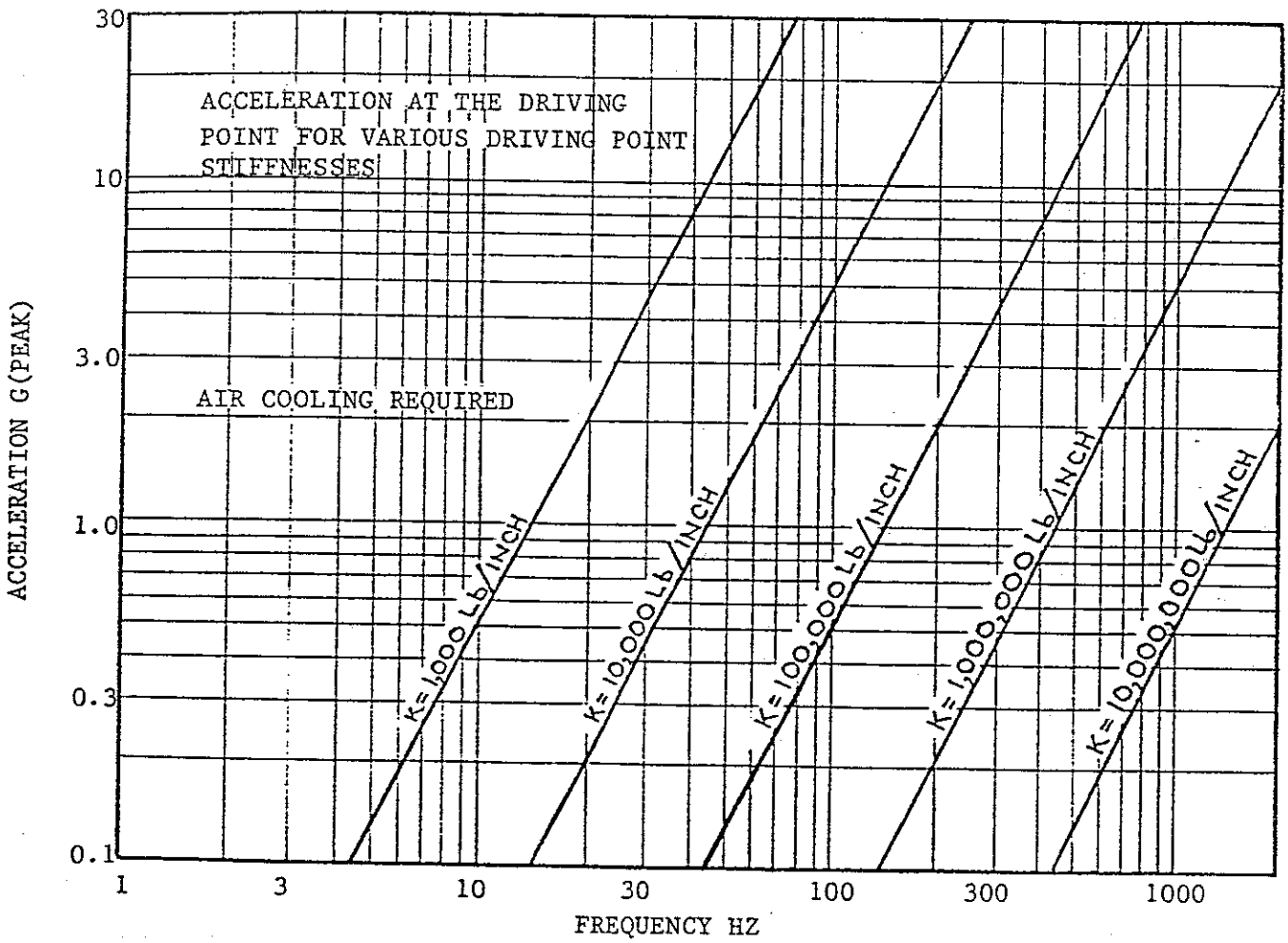


Figure 4.2 is a theoretically derived set of curves showing the acceleration levels versus frequency obtained from structures of various stiffness when excited by a force of 50 pounds (peak). these curves are particularly helpful in choosing accelerometers with adequate sensitivity to measure the dynamic response of the structure.

Figure 4.2
ACCELERATION RESPONSE "SINE PERFORMANCE"



SECTION 5: MAINTENANCE

The MODAL 50 is a relatively rugged device requiring little or no preventive maintenance except reasonable care when handling and operating. Repair of damage to the exciter body or magnet structure should not be attempted. Broken magnets or body misalignment requires special tooling available only at MB.

Damage to the armature due to overdriving, either electrically or mechanically, may be handled by replacing the whole moving element with a spare unit or by sending the damaged element to MB Dynamics to be rebuilt. In the uncommon event a flexure leaf in the suspension system should fail, it may be replaced with a spare unit.

5.1 FLEXURE REMOVAL

It is easier to work on the exciter if it is left on the trunnion base so that both ends are easily accessible.

Remove the two end covers. Each is attached to the body with four button head socket screws. If a damaged flexure is to be replaced, leave the flexure assembly at the opposite end firmly attached so that the radial position of the armature in the air gap remains undisturbed. If the broken flexure is at the top end, unscrew the chuck assembly from the armature shaft, or if at the bottom end, remove the center stud cap. Remove the four 3/8" hex standoffs, which hold the flexure assembly to the body, and lift out the complete unit, being careful of the wire leads extending from the armature at the bottom end. The flexure assemblies at each end are identical except for the flexure assembly plate. The plate at the bottom end is made of insulating material and the two should not be interchanged. Be careful not to lose the insulating washers and flexure sheathes when removing either assembly.

5.2 ARMATURE REMOVAL

The chuck assembly must be unthreaded from the armature shaft and the flexure assembly at the wired (bottom) end must be removed. See Section 5.1 above.

Install hardened #6-32 jacking screw in the flanges of the split sleeve that is installed between the bottom magnet cover and the pole segments. Jack the split sleeve halves out of the gap uniformly to prevent binding and remove from the exciter. The armature can now be removed from the body.

5.3 ARMATURE INSTALLATION

NOTE: IF A REPLACEMENT ARMATURE IS BEING INSTALLED, BE SURE THAT THE PROPER COIL IMPEDANCE JUMPERS ARE IN PLACE. (SEE SECTION 2.3).

The armature is installed by reversing the procedure outlined in Section 5.2 above. After the armature is inserted into the body, replace the split sleeves by tapping them into the gap between the magnet cover and the wedge segments. Make certain the insulated shoulder washers are inserted properly through the hole in the flexures and the flexure sheathes. It is necessary to center the armature in the magnet structure so that it doesn't rub while moving through its stroke. Rubbing will damage the driver coil as well as distort the armature motion. Before tightening the four hex spacers holding each flexure assembly to the body, rotate the armature assembly back and forth to determine its rotational clearance. Center the armature in the center of its rotation and finger tighten the eight spacers holding the flexure assemblies.

The armature must next be aligned on its driven axis so that it doesn't rub throughout the stroke. This adjustment is easily accomplished by attaching an accelerometer to the armature and monitoring its output on an oscilloscope. Drive the exciter with a sinusoidal signal at a low frequency (around 10 Hz). increase the stroke until the waveform indicates rubbing. Loosen one flexure assembly and while the armature is stroking carefully watching fingers, move the armature to diminish the rubbing. Increase the stroke while adjusting for minimum rub. In all probability it will be necessary to finger tighten the flexure assembly and perform the same operation by loosening the flexure assembly on the opposite end. continue adjustment until no rubbing is apparent throughout the full stroke. Do not drive the armature hard against its stops which will become apparent by a rapping sound. Continuing to do so will damage the armature. Once the armature is aligned, tighten securely the eight hex spacers, using a wrench. Complete the assembly by putting on the end covers.

5.4 RECOMMENDED SPARE PARTS

DESCRIPTION	QTY	MB PART NO.
Bolt, Hex Head 3/8-16 x 1" LG	1	10026
Bolt, Hex Head 3/8-16 x 2-1/4" LG	3	11599
Nut, Hex 3/8-16	3	20163
Washer, Flat 3/8"	5	25026
Turnbuckle	4	162265
Wrench, Open-End, 3/8" & 7/16" (3/8" for chuck body) (7/16" for turnbuckle jam nuts)	2	164029
Wrench, Open-End, 1/2" & 9/16" (1/2" for center stud cap, sleeve chuck, 3/8" bolts/nuts)	1	164024
Stud 3/8-16 x 2-1/2" LG	1	9342106
Cable, Drive - 30 Feet	1	9356668-30
Chuck Body	1	9380046
Shop Air Adapter	1	9380443
Collets & Chuck Sleeve Kit	1	9380457
FOR MODAL 50 REPAIR		
Armature Assembly	1	9380093
Flexure, Insulated Assembly	1	9380095

SECTION 6
BILL OF MATERIALS

MC Software, Inc.
BREP02

MB Dynamics, Inc.
BILL OF MATERIALS WITH BURDEN
AVERAGE COSTS
FOR ASSEMBLY 9380397 ASSY, MODAL 50A VIBRATION EXCITER

REV C 6-17-89

ITEM	LEVEL	SEQ.	DESCRIPTION	BEG DATE	END DATE	QUANTITY
9380037	*1	1		01/30/89		6.000
			SHEATH, FLEXURE (MB TO SUPPLY 399909)			
25042	*1	2				8.000
			WASHER,FLT,.20"I.D. X .50"O.D. X .04"THK,BRS,ZN PL			
9380094	*1	3				1.000
			ASSY, FLEXURE PLATE			
9380095	*1	4				1.000
			ASSY, INSULATED FLEXURE			
9380041	*1	5				1.000
			PLATE, BOTTOM (MK FR BURNOUT 9380494)			
9380042	*1	6				1.000
			POLE PIECE, MODAL 50			
9380423	*1	7				1.000
			MAG STRUC,MDAL 50A/CAL50 (PURCH) W/BASE MTG HOLES			
9380001	*1	8				4.000
			MAGNET, PM25 50 75 100, MODAL 50			
9380349	*1	9				1.000
			SLEEVE,COVER,2/SET, PM25,50,75,100,(MK FRM 400065)			
9380097	*1	10				1.000
			ASSY, BODY JACKET,MODAL 50			
9380044	*1	11				2.000
			COVER (MK FR 399936) CAL50 BOTM, MODAL50 TOP&BOTM			
9380093	*1	12		09/26/89		1.000
			ASSY & WIRING, ARMATURE FOR MODAL 50A			
9380425	*1	13				1.000
			MAG STRUC PLATE,(PURCHASE)PM25,50,75,100,MODAL 50			
9380427	*1	14				2.000
			SPACER, TRUNNION/BODY			
9380035	*1	15				1.000
			ASSY, BASE, MODAL 50			
116474	*1	16				1.000
			PLUG, SNAP HOLE, 5/16"HOLE, BLACK NYLON			
9380278	*1	17				1.000
			CTR STUD CAP, (PURCH) PM25,75,100, MODAL 50			
9380153	*1	18				1.000
			ASSY, CHUCK			
20163	*1	19				3.000
			NUT,HEX,JAM,3/8"-16,BRASS,NI PLATE			
27114	*1	20		01/30/89		2.000
			WASHER, FLAT NYLON; OD:11/16, ID:7/16; THICK:1/16			
27110	*1	21		01/30/89		3.000
			WASHER,7/16",NYLON,SHLDR,.443"I.D. X .625"O.D. X *			
25004	*1	22				2.000
			WASHER,FLT,11/32"ID,11/16"OD,.06"THK,STL,ZNC PLT			

MB Dynamics, Inc.
BILL OF MATERIALS WITH BURDEN
AVERAGE COSTS
FOR ASSEMBLY 9380397 ASSY, MODAL 50A VIBRATION EXCITER

ITEM	LEVEL	SEQ.	DESCRIPTION	BEG DATE	END DATE	QUANTITY
25123	*1	23				1.000
			WASHER,FLT,.438"ID X 3/4"OD X .04"THK,STL,ZINC PLT			
360833	*1	24		01/30/89		1.000
			UNHEADED SLEEVE, NYLON			
12192	*1	25				8.000
			SCREW, #10-32 X 1/2;ALLEN BUTTON SOC HD;NIC PLATE			
35206	*1	26				4.000
			STANDOFF,MALE/FEM,#10-32 X 1-1/4"LG,3/8"HEX,ALUM,*			
113267	*1	27				1.000
			CONNECTOR, AUDIO SWITCHCRAFT #B3M-HU			
162248	*1	28				2.000
			KNOB, ALUM HAND, 2", 5/16-18 X 1-3/4 STUD			
399295	*1	29				1.250
			ROD,THREADED,1/4"-20,BRASS,BRIGHT ZINC PLATE,(FT)			
120272	*1	30				2.000
			TERMINAL LUG, RING, 22-16 AWG, 4-6 STUD, TIN PLATE			
20014	*1	31				3.000
			NUT,1/4-20,HEX,BRASS,NICKLE PLATE			
26004	*1	32				3.000
			LOCKWASHER,HEL,1/4",.255"ID,.493"OD,.062",STL,ZNC			
27092	*1	33		01/30/89		8.000
			WASHER,#8,NYLON,SHLDR,.188"I.D. X .25"SHLDR D. X *			
11599	*1	34				3.000
			BOLT,3/8"-16 X 2-1/4"LG,FULL THD,HEX HD,STL,ZNC PL			
9380079	*1	35				8.000
			SNUBBER, (MK FR 399915) 1/2"x5/16"x1-1/8"LG			
116470	*1	36				1.000
			GROMMET, 5/16" ID X 1" OD, 1/16" PNL, 3/4"MTG HOLE			
9356668-30	*1	37		12/12/89		1.000
			ASSY, DRIVE CABLE, MODAL 50A TO SS250VCF, 30 FT.			
9380032	*1	38				1.000
			ASSY, MODAL 50 EXCITER ACCESSORY KIT			
9380151	*1	39				1.000
			INERTIAL MASS #1 (MADE FR BURNOUT 9380236)			
9380152	*1	40				1.000
			INERTIAL MASS #2 (MADE FR BURNOUT 9380236)			
35214	*1	41				4.000
			STOFF,THD,HX ALU 3/8,10-32x1-7/16,AMA38585-A-1032			
13021	*1	42				4.000
			SCREW,SET,10-32 X 3/4"LG,HDLESS SOC,CUP PT,STL,PLT			
9406109	*1	43				1.000
			VIBRATION "WARNING" PLATE			
9380133	*1	44				1.000
			NAMEPLATE, MODAL 50			
9380159	*1	45				1.000
			PLATE, MODAL 50 INSTRUCTION			
9380024	*1	46				1.000
			NAMEPLATE, MODEL #/SERIAL #			

MC Software, Inc.
BREP02

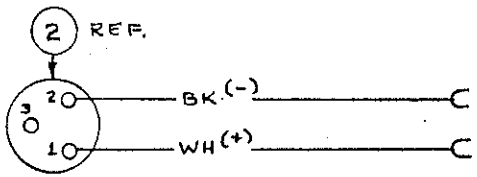
MB Dynamics, Inc.
BILL OF MATERIALS WITH BURDEN
AVERAGE COSTS
FOR ASSEMBLY 9380032 ASSY, MODAL 50 EXCITER ACCESSORY KIT

REV. G, 5-14-90

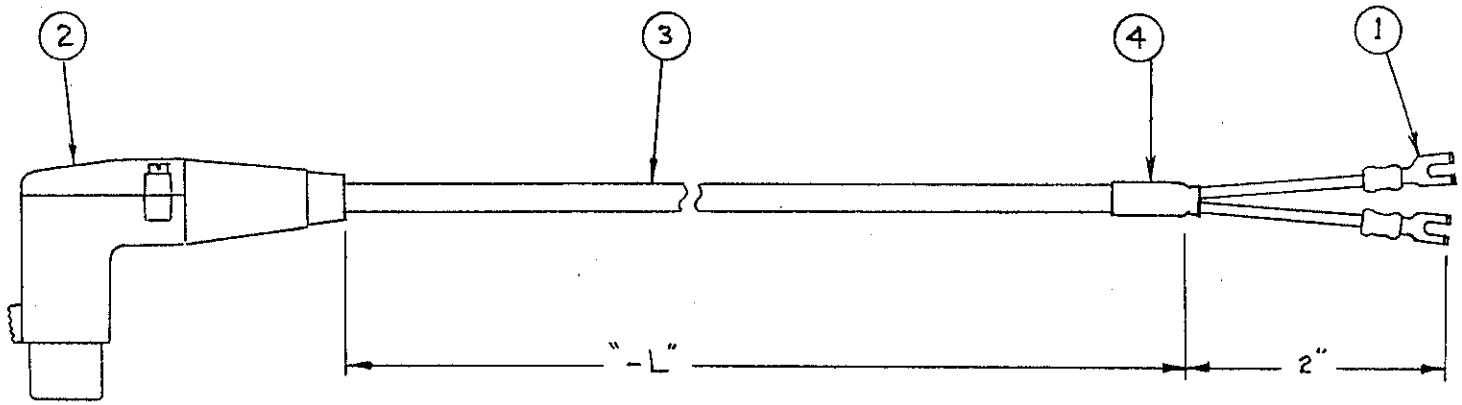
ITEM	LEVEL	SEQ.	DESCRIPTION	BEG DATE	END DATE	QUANTITY
109193	*1	1				1.000
			CASE, PLASTIC, 17"L X 12"W X 2TOP/3BOT 2B1712-194			
162265	*1	2		01/06/89		4.000
			TURNBUCKLE, JAW AND EYE, S.S.			
10236	*1	3				4.000
			SCREW, 1/4"-20 X 1-1/4"LG, HEX HD CAP, ST. STEEL			
9342106	*1	4				1.000
			STUD, 3/8-16 UNC X 2-1/2 LG, STEEL			
10026	*1	5				1.000
			BOLT, HX HD 3/8"-16 X 1" LG PLT			
25033	*1	6				5.000
			WSHR,FLT,13/32"I.D. X 13/16"O.D. X 5/64"THK,STL,ZN			
9380422	*1	8				1.000
			MANUAL, MODAL 50 INSTRUCTION			
164029	*1	9				2.000
			WRENCH, 3/8" & 7/16" OPEN END MCMSTR-CARR 5408A14			
164024	*1	10				1.000
			WRENCH, 1/2 & 9/16 OPEN END #5408A18			
9380436	*1	11				1.000
			ASSY, MODAL 50 STINGER DEMO KIT (10-32 TH'D)			
9380443	*1	12				1.000
			ADAPTER, SHOP AIR/MODAL 50 (MAKE FR 399952)			
162269	*1	13				2.000
			TIE-DOWN, MOLDED RBR, "S" HOOKS BOTH ENDS			
20016	*1	14				4.000
			NUT, HEX, 1/4"-20, ST. STEEL			
20178	*1	15				4.000
			NUT, HEX, 1/4-20 L.H. THREAD,STEEL,ZINC PLATE			
20015	*1	16				4.000
			NUT,1/4 -20,HEX,STEEL,BRIGHT ZINC PLATE			
9380032-OPT1	*1	18				0.000
			ASSY,STINGER DEMO KIT(1/4-28 TH'D) P/N 9380506			
9999020	*1	20				0.800
			DIRECT LABOR			

DWG. NO. B 9356668 | SH 1 | REV.

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



REAR VIEW



NOTE:
1) THE LENGTH "L" IS THE LENGTH SPECIFIED BY THE CUSTOMER ORDER. STANDARD LENGTH SUPPLIED WITH THE MODAL 50 IS 30 FEET.

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

	9380397
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± | DECIMALS .XX ± .XXX ± | ANGLES ±

MATERIAL ~

FINISH ~

DO NOT SCALE DRAWING

CONTRACT NO.

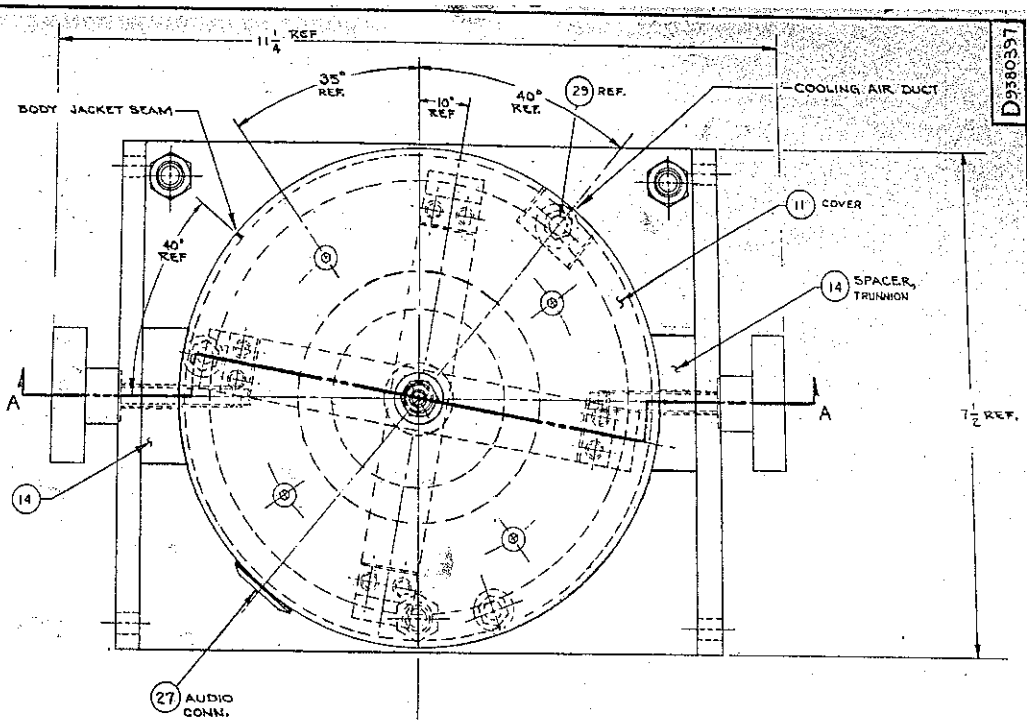
APPROVALS	DATE
DRAWN RS	12-27-89
CHECKED [illegible]	12/27/89
ISSUED	

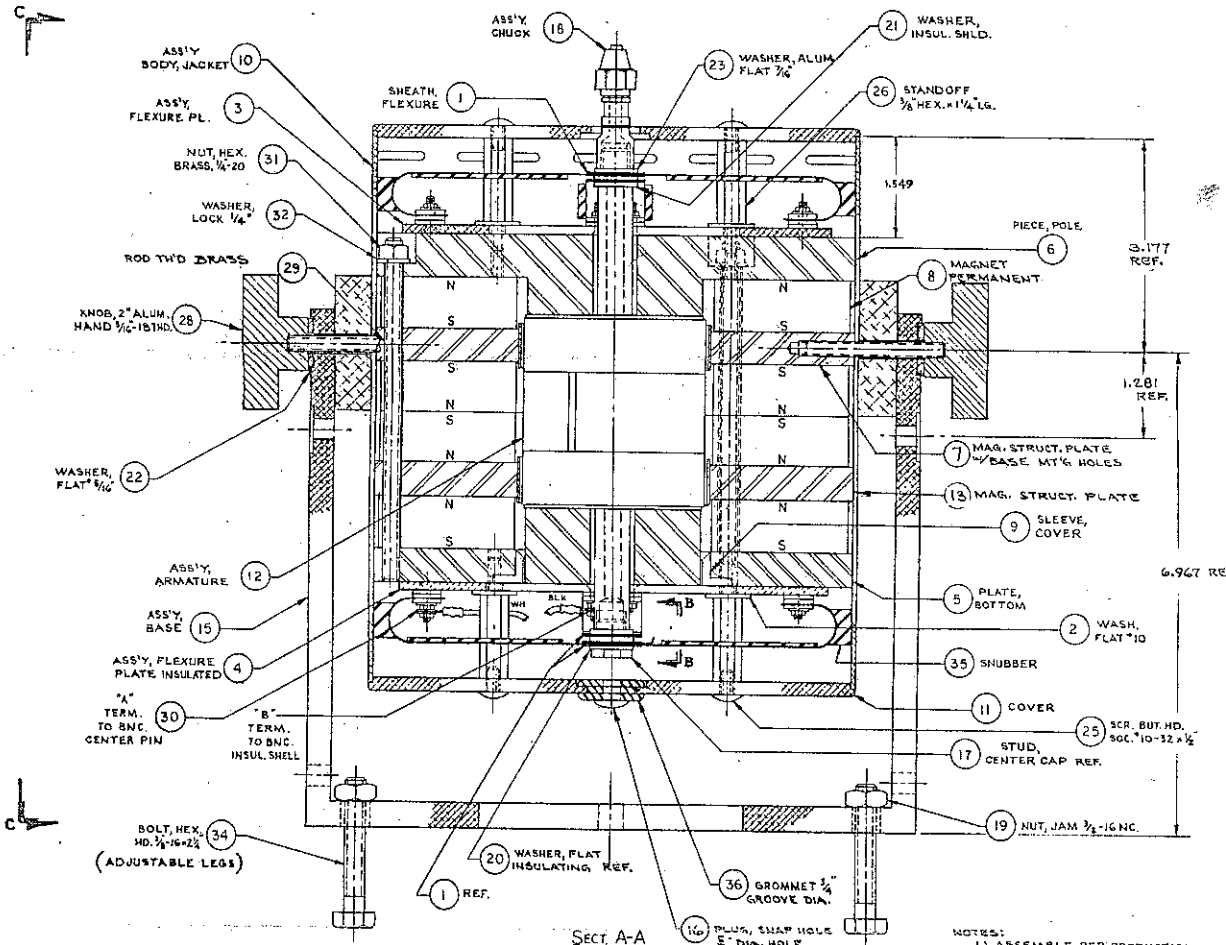
MB Dynamics
CLEVELAND, OHIO

ASSY, DRIVE CABLE
MODAL 50A TO SS250 VCF

SIZE	FSCM NO.	DWG. NO.	REV.
B		B9356668	

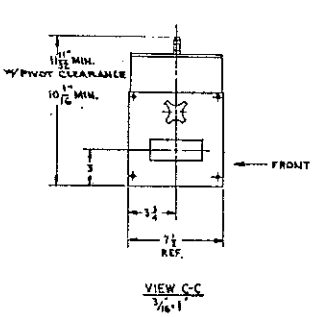
SCALE ~ | SHEET 1 OF 1



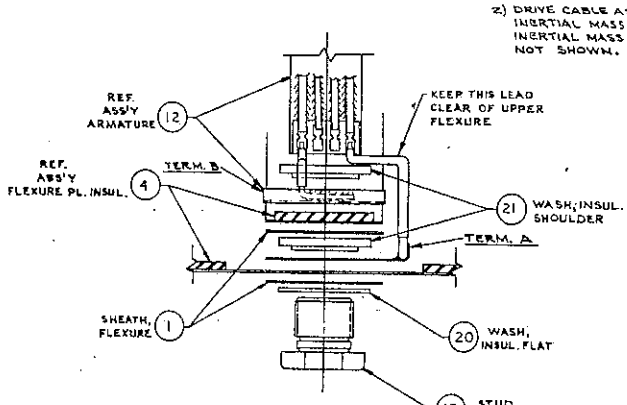


SECT. A-A

NOTES:
1.) ASSEMBLE PER PRODUCTION PROCEDURE # A9380033, 3 SHEETS.
2.) DRIVE CABLE ASS'Y, ITEM 37; INERTIAL MASS #1, ITEM 39; INERTIAL MASS #2, ITEM 40, NOT SHOWN.



VIEW C-C
3/16=1"



VIEW B-B
2"=1"

REV.	DESCRIPTION	DATE	BY	CHK	APPD

STD. DRAWING
SCHEMATIC
WIRING
PART NO.

MB Dynamics
Assy Model 50A Exciter
SCALE 1"=1"
DRAWING NO. D9380397
D9380397

D9380397