ARIZONA NUCLEAR POWER PROJECT

PALO VERDE III

LOOSE PART MONITORING SYSTEM

LOOSE PART DETECTION PROGRAM REPORT

Prepared By C M Schmitt Date 4/29/88

Technical Review and Concurrence J. Hebi Date 4-29-88

Engineering Evaluation IC&E Supervisor
Review and Concurrence Larry L Henson Date 5-2-88

Nuclear Engineering I&C Supervisor
Review and Concurrence J. W. Rowland Date 5-10-88

LIST OF ABBREVIATIONS

P/N	Part number
nvt	Integrated neutron flux (neutron/cm^2)
Rad	Radiation exposed unit
pc	Pico - Coulomb
pf	Pico - Farad
g	Gravitational acceleration unit
V/g	Volt per g
LED	Light emitting Diode
KH_z	Kilo Hertz

II. SYSTEM DESCRIPTION

A. LOOSE PART MONITORING SYSTEM (LPMS)

The LPMS consists of eight channels. Each channel is made up of the following:

a). A piezoelectric crystal sensor (accelerometer).
b). A preamplifier (charge converter).
c). A signal processing unit.

These sensors are positioned in the following location: (See attached drawings for details).

a). Two sensors are mounted on the reactor vessel upper head studs.
b). Two are clamped on the in-core instrumentation guide tube (penetrating the reactor vessel lower position).
c). Two are on steam generator (S/G) inlets. (One (1) per S/G).
d). Two sensors are on steam generator outlets (leg 1A for SG1 and leg 2A for SG2).

B. SENSOR SPECIFICATION AND MOUNTING DETAILS

The sensor (P/N 76M1) and cabling (P/N 3075M6) are manufactured by Rockwell International. They are high temperature, radiation resistant and hermetically sealed.

76M1 ACCELEROMETER WITH 3075 M6 CABLE FOR THE FOLLOWING ENVIRONMENT:

Temperature: (°F)	0 to 650
Radiation: neutron (nvt)	10^{18}
Radiation: Gamma (rad)	10^{10}
Vibrations (g)	100
Pressure (psig)	70
Sensitivity (ft. lb.)	0.05

The sensor mounting installation was performed using vendor procedure ER-001-530-001 (Reference procedure attached) as a guide.

C. PREAMPLIFIER (Charge Converter)

The remote Charge Converter (P/N 52M9), supplied by Rockwell International, is used to change the charge developed by the accelerometer into a voltage signal that is proportional to vibrations/impacts. The system sensitivity (accelerometer and preamplifier) is 100 mV/g. The preamplifiers are located outside of biological shield, inside the containment building (see attached drawing for location).

REMOTE CHARGE CONVERTER 52M9 FOR THE FOLLOWING ENVIRONMENT:

Sensitivity:	10mv/pc
Radiation: Neutron (nvt)	10^{12}
Radiation: Gamma (rad)	10^{7}
Frequency Response:	±3db .45 to 50kHz
Accuracy:	±1% of full scale with source capacities of 1000 pf or less
Temperature (°F)	40 to 150
Vibration (g)	10

D. FUNCTIONAL DESCRIPTION OF LPMS

The LPMS performs three primary functions: 1) detects the presence of loose parts in the Reactor Coolant System (RCS); 2) alert the operator of alarm setpoint exceeded; 3) provides a location to connect equipment for diagnostic information to locate the loose parts.

The piezoelectric sensors detect loose parts by measuring the acoustic signals which are generated when the loose parts impact the RCS components or structures. The sensors produce a charge signal that is proportional to the impact forces. This signal is sent to a charge converter which converts the charge signal to a proportional voltage signal. The voltage signal is then sent to a signal processing unit for amplification, signal conditioning and detection. The signal is bandpass filtered to the resonance frequency of the accelerometer ($23KH_z$) before it is sent to the detector and comparator section of the processing unit.

When an alarm condition is determined by the comparator circuit a logic level output change is initiated to the logic circuit card.

The manual mode of operation:

When an alarm logic level is received, two functions are initiated:

A. Local red LED is illuminated continuously at the loose parts panel for the channels in alarm condition for reactor coolant system.
B. Initiates annunciation in the control room to alert the operators of alarm condition at the loose parts panel.

The Automatic mode of operation:

When an alarm logic level is received, three functions are initiated:

A. Local red LED is illuminated and flashing at the loose parts panel to indicate first channel to alarm.
B. Provide logic to initiate auto start of a tape recorder.
C. Initiates annunciation in the control room to alert the operators of alarm condition for reactor coolant system at the loose parts panel.

REMOTE CHARGE CONVERTER 52M9 FOR THE FOLLOWING ENVIRONMENT:

Sensitivity:	10mv/pc
Radiation: Neutron (nvt)	10^{12}
Radiation: Gamma (rad)	10^{7}
Frequency Response:	±3db .45 to 50kHz
Accuracy:	±1% of full scale with source capacities of 1000 pf or less
Temperature (°F)	40 to 150
Vibration (g)	10

D. FUNCTIONAL DESCRIPTION OF LPMS

The LPMS performs three primary functions: 1) detects the presence of loose parts in the Reactor Coolant System (RCS); 2) alert the operator of alarm setpoint exceeded; 3) provides a location to connect equipment for diagnostic information to locate the loose parts.

The piezoelectric sensors detect loose parts by measuring the acoustic signals which are generated when the loose parts impact the RCS components or structures. The sensors produce a charge signal that is proportional to the impact forces. This signal is sent to a charge converter which converts the charge signal to a proportional voltage signal. The voltage signal is then sent to a signal processing unit for amplification, signal conditioning and detection. The signal is bandpass filtered to the resonance frequency of the accelerometer ($\approx$23KH$_z$) before it is sent to the detector and comparator section of the processing unit.

When an alarm condition is determined by the comparator circuit a logic level output change is initiated to the logic circuit card.

The manual mode of operation:

When an alarm logic level is received, two functions are initiated:

A. Local red LED is illuminated continuously for the channels in alarm condition.
B. Initiates annunciation in the control room to alert the operators of alarm condition at the loose parts panel.

The Automatic mode of operation:

When an alarm logic level is received, three functions are initiated:

A. Local red LED is illuminated and flashing to indicate first channel to alarm.
B. Provide logic to initiate auto start of a tape recorded.
C. Initiates annunciation in the control room to alert the operators of alarm condition at the loose parts panel.

In either mode of operation the local panel alarm indication will remain even though the initiating condition may no longer exist.

The tape recorder is a dual selectable speed cassette type with a frequency range of 0.0H_z to 5.0KH_z. The recorder has the capability of recording up to four channels simultaneously. The recording channels are preprogrammed by the analog signal selector switch. The recordings are made such that the signals are in phase relationship with each other.

II. OPERATING PROCEDURES

A. SYSTEM CALIBRATION PROCEDURES AND RESULTS

1. Calibrations: The system was calibrated by utilizing an actual input from an impact instrument with an equivalent force of 0.5 ft. lb. There are ten impacts at each sensor location at which time an output signal value from each repetition is recorded. An average value is determined from the obtained values. To ensure system sensitivity, the alarm setpoint utilizes 70% of the averaged value. In so doing the system sensitivity is enhanced, thus assuring a conservative approach. After implementation of the determined value verification is performed by impacting at each sensor five times of which at least four impacts are to initiate an alarm condition.

2. Functional check: The LPMS functional check is performed by the surveillance program at a frequency of 31 days in Mode 1 and Mode 2. The functional test includes verifying that the alarm indicators (LED), tape recorder auto-start at the LPM cabinet, the main control board annunciator, and plant computer events log typer operate correctly.

3. Channel check: The channel check and audio sound check for each loose parts channel (eight (8) channels) is performed by a surveillance procedure, at 24 hour intervals.

B. PLANT OPERATOR INSTRUCTION FOR USE OF LPMS

1. The procedure to be used following indication of a loose part, "Operating the Loose Part and Vibration Monitoring System", is an Administrative Control Procedure to direct the operator in the event of an LPMS alarm condition. The operator is to verify that the alarm is valid by trying to clear the alarm. If the alarm will not clear, he or she will notify the Shift Technical Advisor (STA) of the condition. The STA will follow the instruction in "Loose Parts and Vibration Monitoring System STA Analyses" procedure to analyze the alarm by comparing audio levels between channels and signal traces of alarm channels. The spectrum from the alarming channel is compared to quarterly spectrum data to verify the presence of loose parts. The STA will also notify the System Engineer and, Vibration Group for further advice.

2. Method to diagnose loose parts: Presently, there are three methods being utilized: 1) relative time at arrival, 2) relative amplitude at arrival, and 3) the audio level detection. The relative time and amplitude analysis is conducted by the Vibration Group. The most common method of verifying and locating loose parts, within a general region, is by audio level comparisons between channels using the systems audio speaker.

III. EXPERIENCE WITH LPMS

A. FALSE ALARMS

The system experienced a high false alarm rate during no-core and off design condition operation. The system is still experiencing many false alarms. The major source of the false alarms is the operation of various support system operations. An example of this is control rod motion which activates the upper reactor vessel alarms. The system has also alarmed due to major feedwater flow changes to the Steam Generator. When the Steam Bypass Control System has a sudden large flow rate this is also detected by the system's sensors. One contributing cause to the false alarm rate is the difficult alarm setting procedure. If the person doing the "impacting" is not very careful in holding the punch, a low reading will be obtained. This results in the setpoint being set too low, and thus being overly sensitive to the high background noise and high amplitude standing waves which are produced by the Reactor Coolant Pumps.

However, modification has been made to the system that is expected to reduce the high false alarm rate. This was done by circuit change to reduce the DC bias caused by the high background levels.

B. LOOSE PARTS

There have been no loose parts.

C. SYSTEM AVAILABILITY

The system has been available for loose parts determination. There has been two problem areas.

1. The high false alarm rate due to the high background levels.
2. The tape recorder has had several malfunctions.

IV. EVALUATION FOR CONFORMANCE TO R.G.1.133

A. LOOSE PART DETECTION PROGRAM

The Palo Verde Loose Parts Detection Program is in accordance with the guidelines established in Regulatory Guide 1.133 Rev. 1 May 1981 with the exception of the 92 day background noise level measurement during normal plant operation (section 3.a(2)e). This exception has previously been approved by NRC. Technical Specification 4.3.3.8 for Palo Verde takes exception to the 92 day background noise level measurements. However, the maintenance program does obtain background data on a time permitted basis.

N001OMM530001

Atomics International
North American Rockwell

SUPPORTING DOCUMENT

NUMBER	REV LTR/CHG NO.
ER-001-530-001	6 (SEE SUMMARY OF CHG)

PROGRAM TITLE
VIBRATION AND LOOSE PARTS MONITORING SYSTEMS

DOCUMENT TYPE
ENGINEERING REPORT

KEY NOUNS
V&LP, Installation

DOCUMENT TITLE
INSTALLATION PROCEDURE

ORIGINAL ISSUE DATE
7-24-74

GO NO.	S/A NO.	PAGE 1 OF TOTAL PAGES
4068	10000	19 / 22

REL. DATE 8-8-74 BK

PREPARED BY/DATE	DEPT	MAIL ADDR
P. J. Pekrul pjp	731	LB18

IR&D PROGRAM? YES [X] NO [ ] IF YES, ENTER TPA NO. 430

APPROVALS

	DATE
O. R. Hillig Ora R. Hillig	
A. W. Thiele A.W. Thiele	7-24-74

SECURITY CLASSIFICATION

(CHECK ONE BOX ONLY)	AEC	DOD
UNCL	[X]	[ ]
CONF.	[ ]	[ ]
SECRET	[ ]	[ ]

(CHECK ONE BOX ONLY)
RESTRICTED DATA [ ]
DEFENSE INFO. [ ]

AUTHORIZED CLASSIFIER ____ DATE ____

DISTRIBUTION

*	NAME	MAIL ADDR
*	O.R.Hillig	LA24
	E. H. Carter	LB18
*	P.E.McCourt	LA37
	P. G. Jencek	NB14
	P.J.Pekrul (25)**	LB18
	J.G.Radcliff	T009
*	C.R.Spencer	LA37
	A.W.Thiele	NB14
*	H. Weiseneck	LB19

**3/8" 3-hole punch

* TITLE PAGE ONLY

ABSTRACT

The Vibration and Loose Parts Monitoring System sensor assemblies installation procedures are presented.

RESERVED FOR PROPRIETARY/LEGAL NOTICES

FORM 734-C REV 4-71

Atomics International Division
Rockwell International

NO. ER-001-530-001
PAGE 1.1

REV	SUMMARY OF CHANGE	APPROVALS AND DATE
	CHANGE # 1 Page 5: Section 4.6 changed to include 10-32 threaded pilot	P J Pekrul 10-11-74 O.R. Hilby 10-16-74 REL. DATE: 10-23-74
	CHANGE # 2 Page 7.1: Added Section 4.9, Waterhammer Sensor Assembly	P J Pekrul 3-31-75 REL DATE 4-15-75
	CHANGE # 3 Add Installation Checklist. Corrections on pages 4, 7, 11, 12, 13, 14, 15. REL. DATE: 9-17-75	P J Pekrul 9-13-75 Q.W. 9-16-75
	Change #4 Added Figure 6 and J-Box hole spacing to Page 5. REL DATE 1-19-76	P J Pekrul 1-19-76 Q.W. 1-19-76
	CHANGE #5 Updated for latest methods. Correction on pages 3, 4, 6, 7. REL DATE: 8-1-77	P J Pekrul 7-29-77 7-31-77
	CHANGE #6 Figure 1, page 11 replaced REL. DATE: 8/19/77	P J Pekrul 8-10-77 8-18-77

FORM 734-C-1 REV. 2-74

INSTALLATION PROCEDURE
V&LP SENSOR AND PREAMP
INSTALLATION AND CHECKOUT

1.0 SCOPE

This procedure describes the installation and checkout of the sensors (accelerometers) for the Vibration and Loose Parts Monitor system.

2.0 APPLICABLE DOCUMENTS

1) Interface Specification
2) Operation Manual
3) Installation
4) Purchase Order, Proposal or Contract
5) Buyer Specification

3.0 DESCRIPTION

See Operating Manual and other applicable documents.

4.0 PROCEDURE (Sensor Installation and Cable Checkout)

4.1 Parts

Check availability of parts. All parts or approved substitutes are required before starting. Installation can be started with partial availability only with engineering approval.

4.2 Tools Required

1) Standard Electricians Hand Tools
2) Volt Ohmmeter (VOM)
3) 7/8" Spotface and chamfer

4) Alcohol or other acceptable solvent

5) Power drill and No. 21 drill bit

6) 10-32 start and bottom taps

7) Torque wrench and socket (3/8" drive, 5/8" long socket and 0-50 in-lb torque wrench)

8) 600 volt Megohm meter (Megger)

9) Fiberglass tape

10) Standard Electricians Vinyl Tape

4.3 Installation Conditions

1) Cabinet to preamp cable, and/or conduit has been installed per the Interface Specification.

2) Preamp junction box installed per applicable A&E installation drawing.

3) Rigid conduit from preamp junction box to within 3' of sensor location in place.

4) Cabinet in place (welded if required) and 120 volt, 60 Hz power connected with breaker in "off" position. Low noise instrument power required.

NOTE: Sensors can be installed without cabinet in place.

4.4 Connector Installation

1) Attach Indicator Assembly cable connectors per instruction sheet.

2) Attach preamp cable connectors per instruction sheet.

.5 Sensor Installation - Mounting Block

1) Assemble mounting as shown in Figure 3-3 and 3-4.

2) Attach flexible conduit to sensor J-Box. Then install pull box between flexible and rigid conduit.

3) Pull sensor to the preamp cable through conduit.

CAUTION: Maximum tensile load on 10-32 connector is to be less than 5 lbs. Use caution so as not to scratch or deform cable.

4) Attach coupling to sensor-preamp cable at sensor end.

5) Attach high temperature coax leader to coupling.

6) Tape with fiberglass tape.

NOTE: Omit step 4, 5 and 6 for low temperature sensors.

7) Attach a known resistance (approximately 1 K Ω) to sensor end of sensor cable assembly and using a VOM check continuity. Also check resistance from signal wire to ground and shield to ground. Remove 1 K resistor. Using a 600 volt Megger, insulation resistance of signal to shield should be greater than 10^4 MΩ/1000 ft. and shield to ground should be greater than 10^3 MΩ/1000 ft. Complete Table I. Discharge cables upon completion.

8) Repeat step 7 on preamp to cabinet cable by attaching resistance at one end and checking continuity.

9) Clean mounting surface with alcohol or other solvent.

10) Screw insulated stud in place and torque to 25 inch pounds.

NOTE: Extreme caution should be taken to assure that sensor and preamp cables are not broken or shorted to conduit.

11) Screw sensor in place and torque to 18 inch pounds.

12) Attach sensor connector and safety wire in place.

4.6 Sensor Installation - Stud Mounting

1) Locate exact sensor location. If necessary, remove insulation.

2) Center punch and drill #21 hole. Depth not to exceed 3/8 in. Tap for 10-32 screw. Complete hole by using bottom tap. 5/16 in. of threads are necessary. (see Figure 6)

3) Clean threaded hole and install 10-32 threaded pilot.

4) Spot face to smooth base metal. Spot face should be about 0.010 in. deep.

5) Chamfer pilot hole 1/32 in. with 1/4 in. drill.

6) Clean area with alcohol or other solvent.

7) Screw stud in place and torque to 25 in. pounds.

8) Place junction box in position around stud. Do not mount junction box with screws at this step.

9) Repeat steps 2 through 8 of section 4.5.

10) The junction box can now be positioned to allow for the best orientation of the flexible conduit and to minimize load on the wiring.

11) Center punch mounting holes for the J-box. (see Figure 4)

The J-Box hole spacing is:

3 in. J-box	1.20 ± 0.03 in.
4 in. J-box	1.325 ± 0.03 in.

12) Drill (#21 drill) and tap (bottom tap) for 10-32 screws. Depth is not to exceed 3/8 in.

13) Clean area and holes with solvent.

14) Install mounting screws to secure junction box.

15) Screw sensor in place and torque to 18 in. pounds.

16) Attach sensor connector and safety wire in place (see Figure 4 AND FIGURE 6). SAFETY WIRE SHOULD BE INSTALLED AT SAFETY WIRE HOLES ON SENSOR CONNECTOR IF NON-INSULATED STUD IS USED (SEE FIGURE 6A). BR5 BR6

17) Attach sensor J-box cover.

4.7 Sensor Installation - Magnetic Mounting

1) Assemble mounting per Figure 7 & 8. Attach flexible conduit.

2) Determine actual sensor mounting location.

3) Clean surface with alcohol or other acceptable solvent and check to assure that surface beneath magnet is flat to within ±0.002" and a minimum of surface material is between vessel steel and magnet.

4) Install pull box between flexible and rigid conduit.

5) Repeat steps 3 through 9 of Section 4.5.

6) Apply high temperature adhesive (.010") evenly over entire top of sensor. Allow to set for one hour. Remove any adhesive on the side of the sensor.

7) Attach high temperature leader to sensor with spring over leader.

8) Tape with fiberglass tape the 10-32 coupling on top of sensor one revolution only.

9) Slide assembly into retainer (Fig. 7) and verify smooth movement over entire stroke. Correct until smooth movement is present.

10) Apply .005" adhesive on base of sensor.

11) Holding entire assembly (conduit, magnet and sensor) in place, attach assembly to mounting location. Check to assure that sensor alignment has been maintained and that magnet is in contact with surface at all poles.

12) Apply a 20 pound force, perpendicular to the mounting surface, to the magnet. Magnet should remain in place. If not, check mounting surface, alingment, and magnet flux and then repeat #5. Recheck adhesive.

.8 Sensor Installation - Threaded Fasteners

1) Clear threads of threaded receptical. Use bottom tap if necessary. Clean area with acceptable solvent.

2) Insert threaded fastener through J Box and mount.* Threaded fastener's torque should be appropriate for size of thread.

3) Repeat steps 3 through 12 of Section 4.5.

* Upper vessel fasteners use mounting stud to hold J-Box in place.

4.9 Waterhammer Flush Mounting Sensor/Adaptor Assembly Installation.

(Refer to figure 3) The following procedure applies to assemblies 602R; 612(X)1 and 612(X)2. Proceed as follows:

1) Determine pressure chamber wall thickness at intended installation site; determine by how much overall thickness exceeds accumulated cavity dimension 0.465/0.435-inch. Excess is dimension X.

2) Drill through, using 21/64 (0.328)-inch dia drill.

3) Ream through 0.328-inch dia to 0.332-inch dia, using size Q standard reamer.

4) If required, counterbore 0.750-inch dia by X dimension, using flat-end counterbore or spot-facer with size Q pilot.

5) Counterbore to form seal recess and seal surface, 7/16 (0.4375)-inch dia x 0.05-inch depth, using flat-end spot-facer with size Q pilot.

CAUTION: Seal surface must have 32 finish.

6) Chamber 0.332 Bore, 90° x 0.39-inch dia.

7) Tap through, using 3/8-24 - 2B taps.

8) Remove all chips and cutting oil; clean cavity thoroughly.

9) Coat adaptor threads and seal surfaces with film of silicone grease; coat a new seal, Model 200E10 (0.062 thk) with silicone grease and place on assembly. Insert into cavity and tighten finger tight.

10) Tighten assembly to suggested maximum torque of six to eight foot-pounds, using 7/16-inch six-point socket with torque wrench.

NOTE: Do not remove protective cap until installing cable.

4.9.1 Testing for Leaks at Installation. Before operating the pressure source, test for leaks. Three methods are listed in order of preference:

1) Apply soapy solution at seal, only; pressurize chamber with air or nitrogen. Observe for bubbles. Clean thoroughly, afterward.

2) Connect a pressure gauge to chamber and apply pressure, Block input and outlet and observe gauge for long enough elapsed time to assure a seal.

3) Observe for extruded liquid.

4.9.2 Cable Installation. The cable should be routed to avoid kinking and sharp bends, particularly at the connectors. All connections must be clean and dry at assembly and the hookup should be kept as clean and dry as possible in use. The connection between cable and sensor can be made waterproof with heat-shrinkable tubing applied as shown in Figure 3. Installations which are subjected to severe vibration should have the cable connector secured to the sensor with a small amount of epoxy cement applied only to the external threads of the sensor connector at assembly.

CAUTION: Do not use Loctite or other thread sealant which can contaminate connector insulation!

4.9.3 Safety Wire. Safety wire connector in place.

4.9.4 J-Box. Attach J-Box and cover.

5.0 PROCEDURE (Preamp Checkout)

When the Indicator Assembly is available install and checkout the preamps according to the following.

5.1 Install Preamps

1) Install preamps in designated J-Boxes by mounting preamp bracket. Note serial numbers.

2) Attach sensor cable connectors.

3) Attach cabinet cable connector at preamp.

NOTE: Do not tape preamp connectors until each channel is completely checked out.

5.2 Preamp Electrical Checkout

NOTE: Steps 1 through 4 are performed at cabinet.

1) Attach a 1 KΩ resistor at Indicator Assembly to each preamp cable input connector. Do not connect preamp to indicator assembly.

2) Turn-on Indicator Assembly.

3) 3.9 volts should be measured across the 1 KΩ resistor on each channel. (See Table II)

4) Remove the 1 KΩ resistor. 20 volts should be measured at each preamp cable across signal and shield.

5) Attach each preamp with a BNC "T" inbetween the preamp and Indicator Assembly. About 4 volts should be measured on "T" across signal to shield terminal. Remove T's after completion .

6) Listen to each channel on audio monitor. The characteristic plant background noise should be heard.

7) Complete Table II.

8) Calibrate each V&LP channel per the appropriate procedure. (See Operation Manual)

9) Tape preamp and preamp connectors with two layers of vinyl electrical tape.

TABLE I

CABLE CHECKOUT

Channel Number	Cable Number	Signal to Ground	Shield to Ground	Signal to Shield	
				Open	R
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

TABLE II

PREAMP CHECKOUT

Channel Number	1 K Voltage	Open Ckt Voltage	Preamp Voltage	Signal Content
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Figure 1

GOLDEN CRIMP Change 6

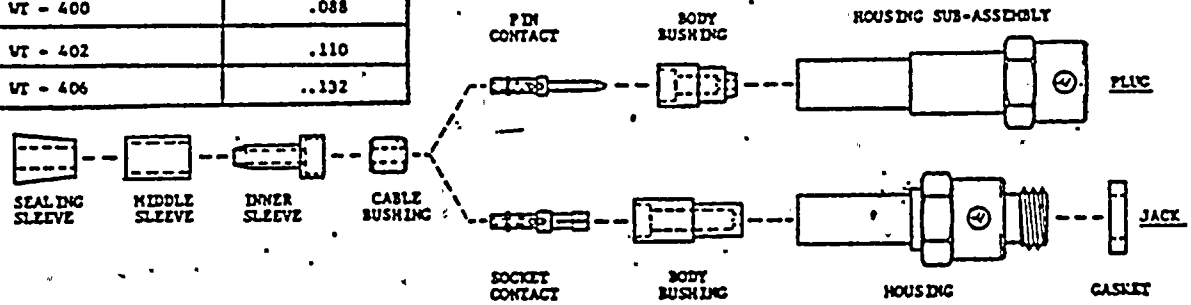
ASSEMBLY INSTRUCTIONS
PLUG & JACK
RF-ASMB-8

TABLE I (CONTACT CRIMP TOOLS)

MICRODOT PART NUMBER	MANUFACTURERS PART NUMBER
010-0065-0000	DAVO PRODUCTS # 810
010-0134 (SETTING #1) WITH 001-0104 LOCATOR	DANIELS #MH750 (SETTING #1) WITH LOCATOR # P79

TABLE II (HOUSING CRIMP TOOLS)

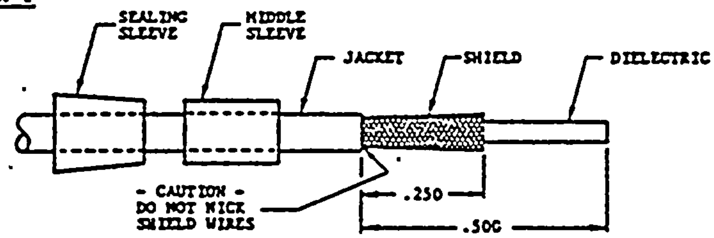
MICRODOT PART NUMBER	THOMAS & BETTS PART NO	MAXIMUM CABLE DIA.
010-0081	WT - 400	.088
010-0082-0600	WT - 402	.110
010-0083	WT - 406	.132



STEP 1

SLIP SEALING SLEEVE AND MIDDLE SLEEVE OVER CABLE AS SHOWN IN FIGURE I.

FIG. I



STEP 2

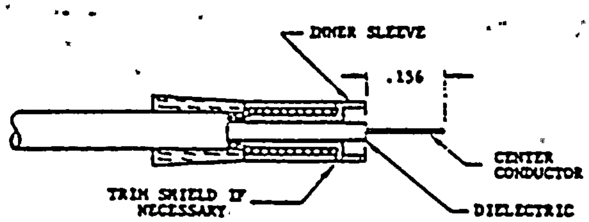
STRIP CABLE TO DIMENSIONS SHOWN IN FIGURE I. FAN SHIELD SLIGHTLY, BUT DO NOT UNBRAID. EXTREME CARE MUST BE TAKEN TO AVOID NICKING OR CUTTING SHIELD WIRES WHEN TRIMMING JACKET.

STEP 3

SLIDE INNER SLEEVE (SMALL END FIRST) OVER DIELECTRIC AND UNDER THE SHIELD UNTIL SHIELD WIRES ARE FLUSH WITH SHOULDER.

(TRIM EXCESS SHIELD IF NECESSARY.) SLIDE MIDDLE SLEEVE FLUSH WITH SHOULDER OF INNER SLEEVE. SLIDE SEALING SLEEVE UNTIL IT BUTTS AGAINST THE MIDDLE SLEEVE AS SHOWN IN FIGURE II.

FIG. II



STEP 4

TRIM DIELECTRIC FLUSH WITH FACE OF INNER SLEEVE; BUT DO NOT NICK CENTER CONDUCTOR. TRIM CENTER CONDUCTOR TO LENGTH SHOWN IN FIGURE II.

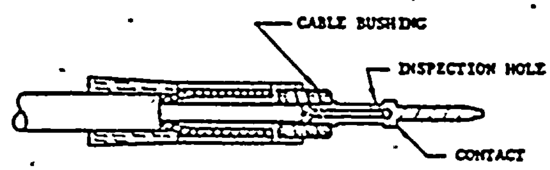
STEP 5

SLIDE CABLE BUSHING OVER CENTER CONDUCTOR AND INTO INNER SLEEVE AS SHOWN IN FIGURE III.

STEP 6

SLIDE CONTACT OVER CENTER CONDUCTOR AND PRESS INTO CABLE BUSHING AS SHOWN IN FIGURE III. CENTER CONDUCTOR MUST BE VISIBLE THRU INSPECTION HOLE. WITH ALL PARTS FITTED SECURELY, CRIMP CONTACT WITH ANY ONE OF MICRODOT CRIMP TOOLS SPECIFIED IN TABLE I.

FIG. III

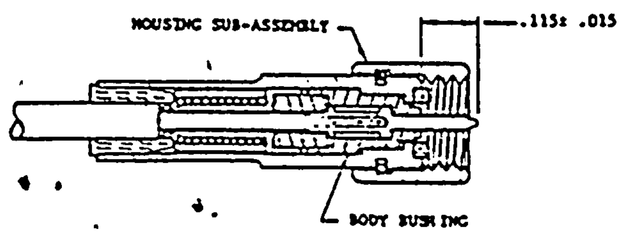


STEP 7

SLIDE BODY BUSHING OVER CONTACT AND PRESS ONTO CABLE BUSHING. INSERT ASSEMBLY INTO HOUSING (JACKS) OR HOUSING SUB-ASSEMBLY (PLUGS) AS SHOWN IN FIGURE IV. MAKE SURE IT IS PROPERLY FITTED AND IN AS FAR AS POSSIBLE. (ROTATE WHILE PUSHING TO SECURE A TIGHT FIT.) CRIMP REAR OF HOUSING WITH PROPER TOOL AS INDICATED IN TABLE II.

THIS COMPLETES PLUG ASSEMBLY. SEE STEP 8 FOR JACKS.

FIG. IV



STEP 8

LOCATE THE RUBBER GASKET IN THE RELIEF DIRECTLY BEHIND THE MATING THREADS.

NOTES:

1. TEST VOLTAGE - 1000 V. R.M.S.

2. INSULATION RESISTANCE - 5.0 X 10^9 OHMS MIN.

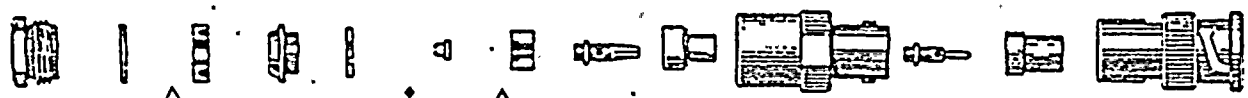
MICRODOT INC

GC-ASMB-8

Printed in U.S.A.

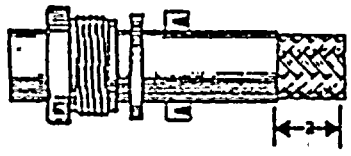
aptivated Contacts - continued

Figure 2



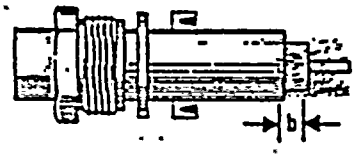
△cross section views ◆this part is only used when RG-62 & -71/U cables are employed.

cables RG-59/U, RG-59A/U, RG-59B/U, RG-62/U, RG-62A/U, RG-62C/U, RG-71/U, RG-71B/U, RG-140/U



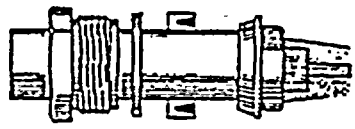
Cut end of cable sharp and square. Slide nut, washer and gasket, with "V" groove toward clamp over jacket, and cut off jacket to dimension a shown below.

dimension	plugs	all others
a	5/64"	3/16"

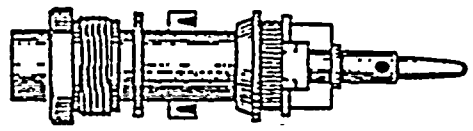


Comb out braid and fold out. Cut off cable dielectric to dimension b shown below. Cut to be sharp and square. Do not nick center conductor.

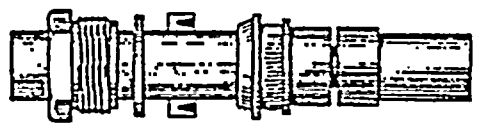
dimension	RG-59/U, RG-59A/U, RG-59B/U, RG-140/U	RG-62/U, RG-62A/U, RG-62C/U, RG-71/U, RG-71B/U
b	1/4"	1/2"



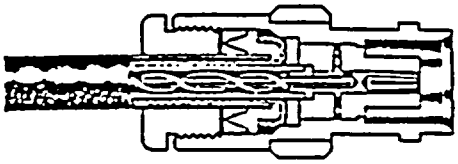
Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.



Fold back braid wires as shown, trim to proper length and evenly form over clamp as shown. Tin exposed center conductor using minimum amount of heat.■ Do not distort dielectric so as to prevent proper mating with bushing and rear insulator.
Slide on bushing, (for RG-62 & -71/U cable, add insulator bushing), rear insulator and contact. These parts must butt, as shown. Solder contact to center conductor.■ Remove flux and excess solder from contact O.D.



Slide front insulator over contact and butt against contact shoulder as shown. Do not reverse direction of insulator.



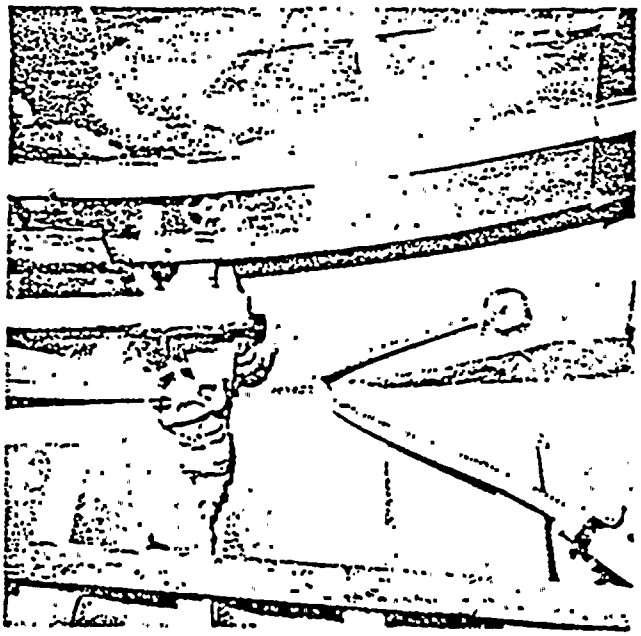
Insert prepared cable termination into conductor body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut, holding body stationary.

■ Use Divco #276 (or other high temp. alloy) solder for high temp. applications.

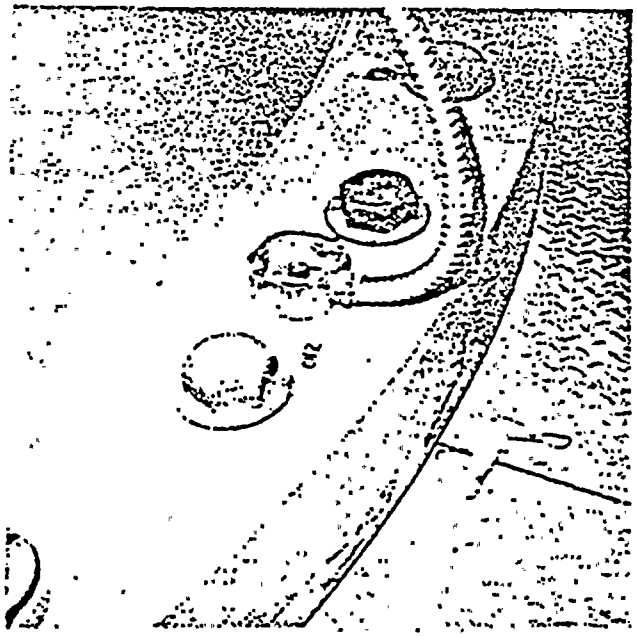
note: For RG-141/142-type copper jacketed cable, see assembly instructions for Improved Type connectors.

TYPICAL SENSOR INSTALLATION* FOR AI'S VIBRATION AND LOOSE PARTS MONITORING SYSTEM

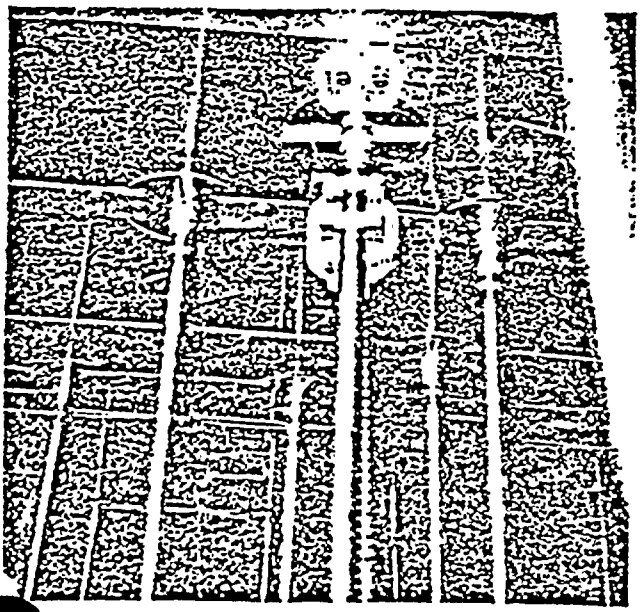
Figure 3

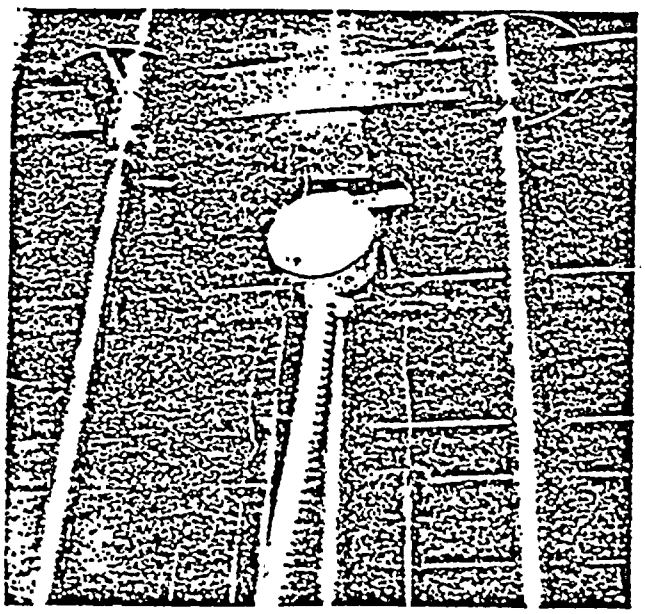


3.1 STEAM GENERATOR Sensor Mounted on Upper Tubesheet



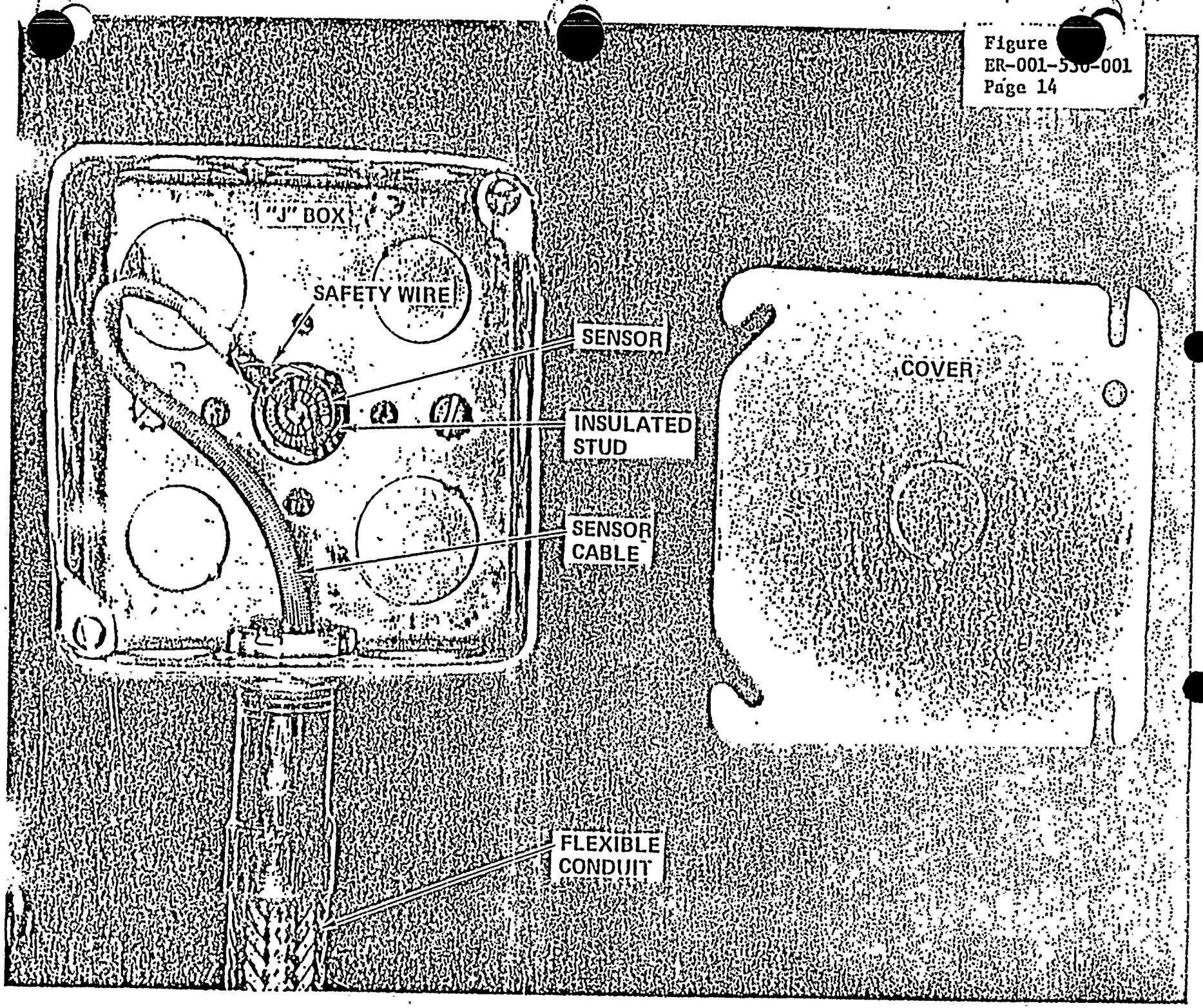
3.2 REACTOR UPPER VESSEL Sensor Mounted Between Bolts of Service Structure Flange





3.3,3.4 REACTOR LOWER VESSEL Sensor Mounting Clamped to Instrument Guide Tubes

* Photographs depict actual sensor installations on Arkansas Power & Light Co., Nuclear One


"J" BOX
SAFETY WIRE
SENSOR
INSULATED STUD
SENSOR CABLE
COVER
FLEXIBLE CONDUIT

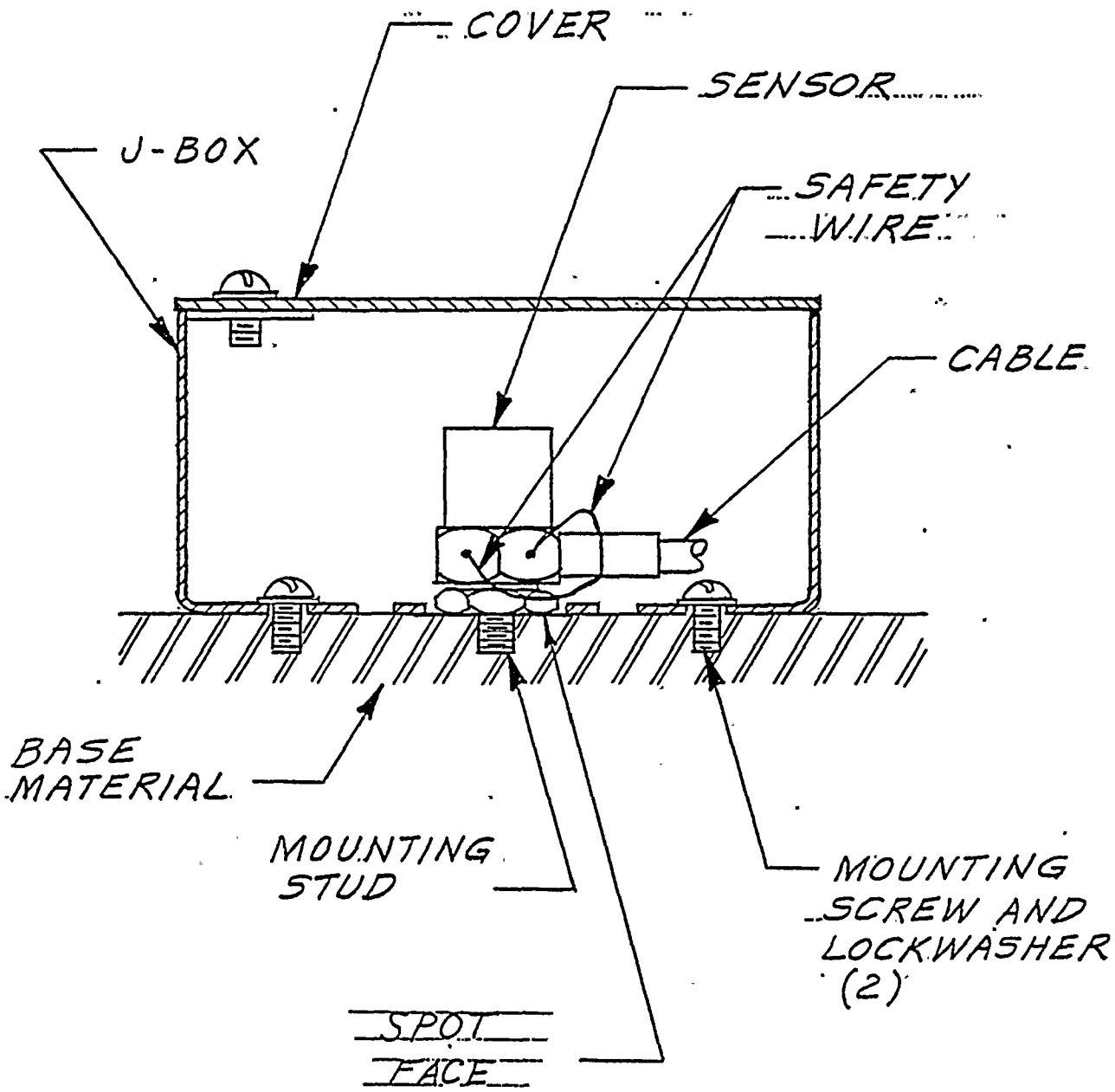


FIGURE 6
STUD MOUNTING CROSS SECTION

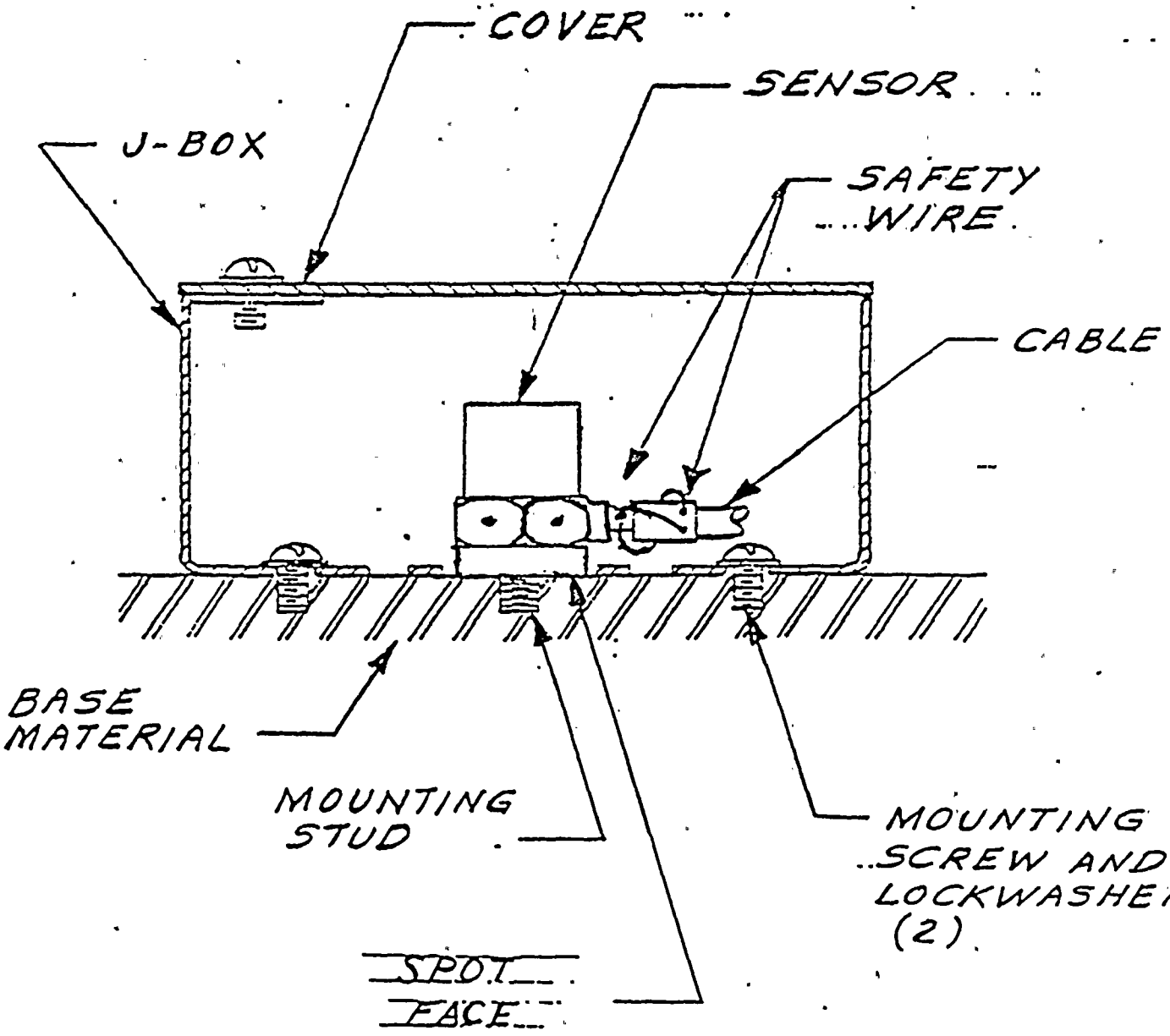
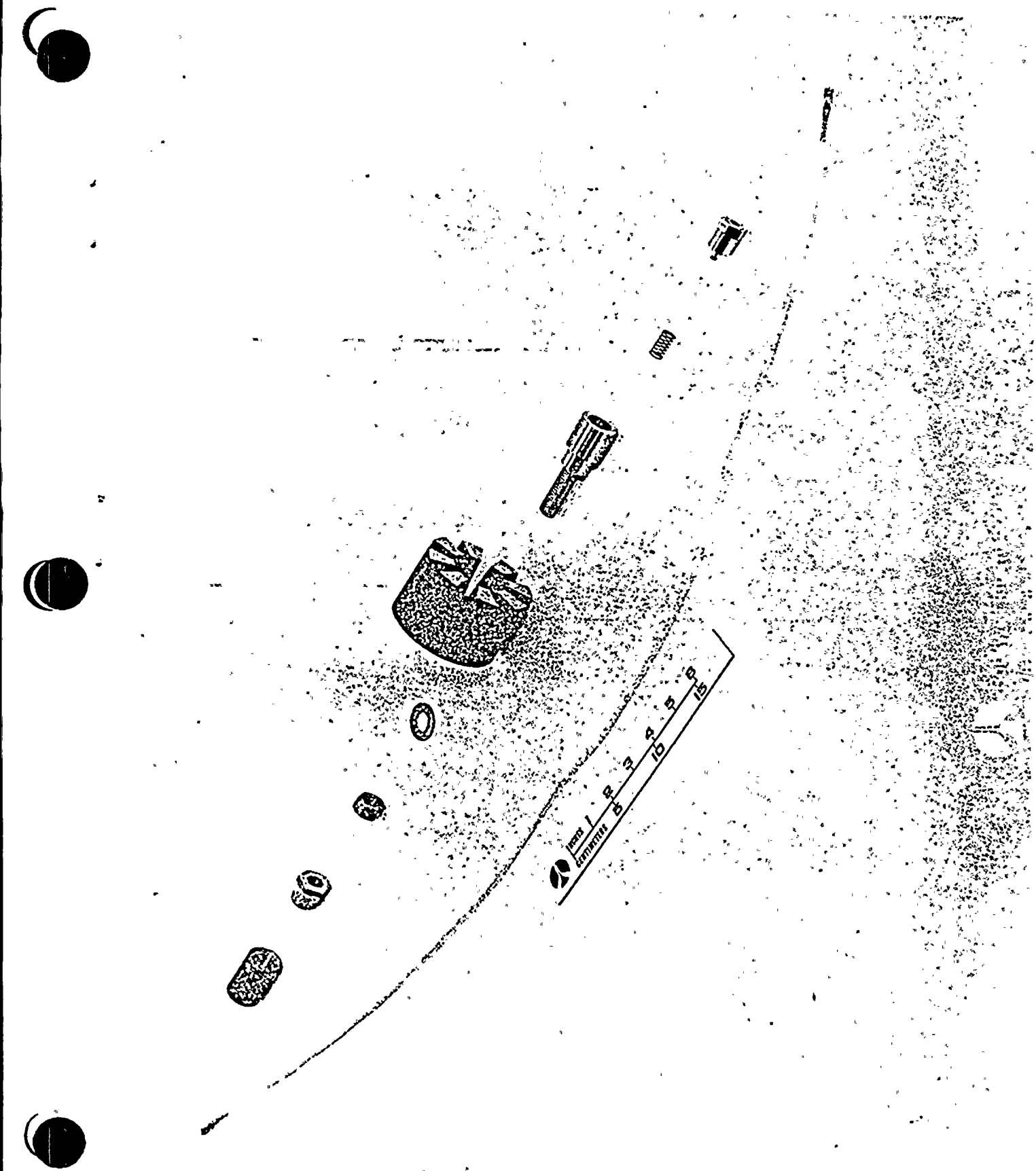


FIGURE 6A NON INSULATED STUD MOUNTING CROSS SECTION

FIGURE 7



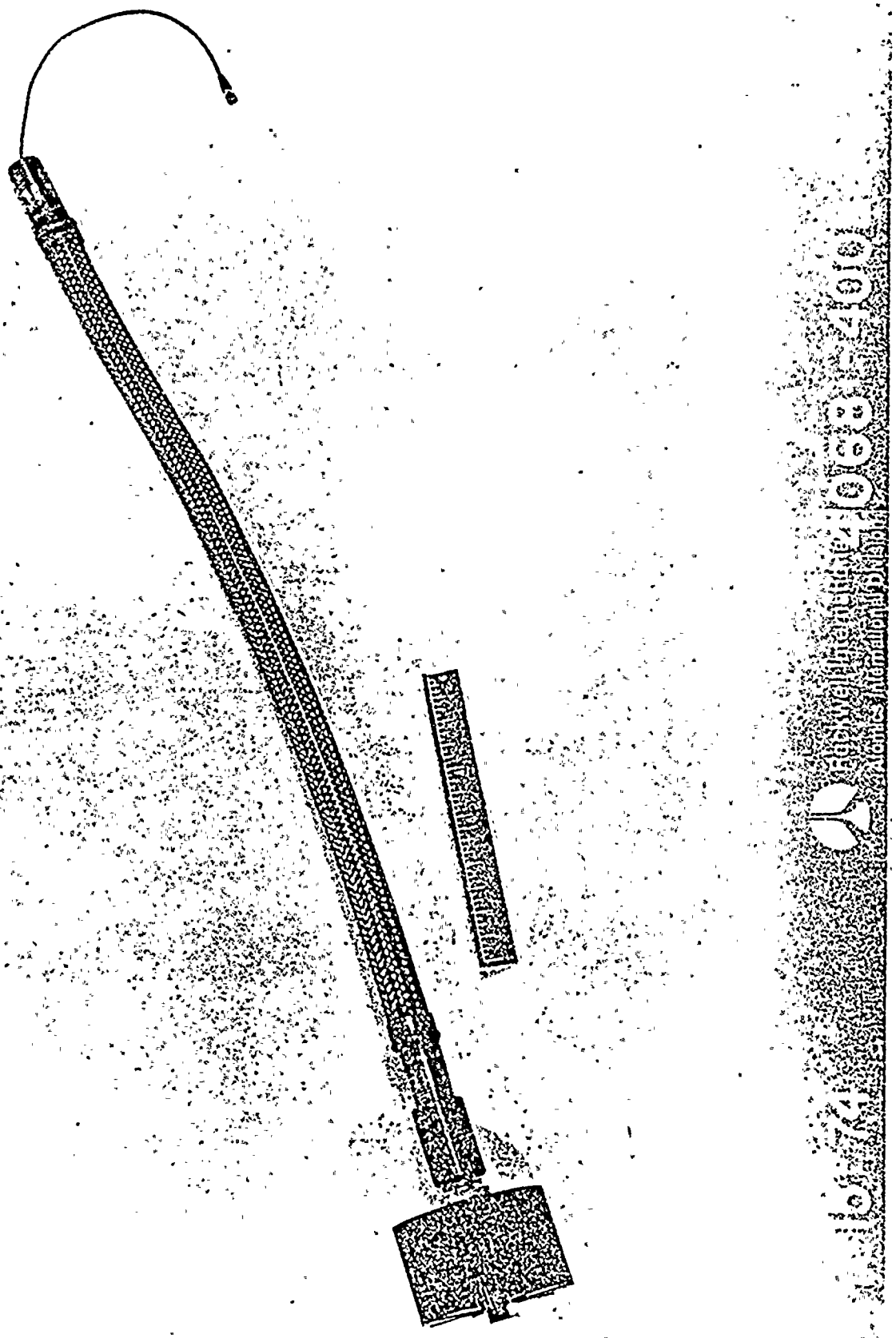


TABLE II

V&LPM INSTALLATION CHECKLIST

1. All sensor installations inspected.

2. All preamp installations inspected.

3. All cable installations inspected, including sensor and preamp cables inside containment, penetrations and ex-containment cables.

4. Table I complete.

5. Table II complete.

6. All major components in V&LPM system; i.e., indicator assembly, spectrum analyzer, X-Y plotter, tape recorder, calibrator, functionally checked for proper operation.

7. Section 5.0 of the test procedure DTP-001-530-0XX repeated.

8. System accepted by customer or agent.

_____ _____

Customer Signature Date

9. Telephone report to AI project.

feh:3/7