

**Connector, AMP\* ECU-1****1. SCOPE**

## 1.1. Content

This specification covers performance, tests and quality requirements for the AMP\* ECU1 104 position connector. This connector consists of a plug and a header and is available only to Ford Motor Company or Ford approved buyers where it is known as the Enhanced EEC connector.

## 1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

## 1.3. Qualification Test Results

Successful qualification testing on the subject product line was completed in Jun99. The Qualification Test Report number for this testing is 501-484. This documentation is on file at and available from Engineering Practices and Standards (EPS).

**2. APPLICABLE DOCUMENTS**

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies.

## I 2.1. Tyco Electronics Documents

- 109-1: General Requirements for Test Specifications
- 109 Series: Test Specifications as indicated in Figure 1
- 114-6054: Application Specification
- 501-484: Qualification Test Report

## 2.2. Ford Motor Company Documents

- ES-F0EB-14474-AA, Revision D: Terminal-Wire Snap-On Female
- ES-E7EB-14474-AA, Revision R: Terminal Wire Snap-On Female
- ES-F33B-14A464-AA, Revision E: SLV Assembly-Wire Connector
- ES-F8D8-14A464-AA, REL, USCAR/PF-1: Electrical Connector Specification

**3. REQUIREMENTS**

## 3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing.

## 3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable product drawing.

3.3. Ratings

- Current: See Figure 3 for applicable current carrying capability
- Temperature: -40 to 125°C based on material
- Torque: 48 ± 8 inch pounds

3.4. Performance and Test Description

Product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 1. Unless otherwise specified, all tests shall be performed at ambient environmental conditions per AMP Specification 109-1.

3.5. Test Requirements and Procedures Summary

Test Description	Requirement	Procedure
Examination of product.	Meets requirements of product drawing and Application Spec 114-6054.	Visual, dimensional and functional per applicable quality inspection plan.
ELECTRICAL		
Termination resistance.	20 milliohms maximum final.	ES-F8DB-14A464-AA. Subject mated contacts assembled in housing to 20 mv maximum open circuit voltage at 100 ma maximum. See Figure 4.
Temperature rise vs current.	30°C maximum temperature rise at specified current.	AMP Spec 109-45-1. Measure temperature rise vs. current. See Figure 3 for energized circuits.
Current cycling.	See Note.	AMP Spec. 109-51, Condition A, Test Method 4. Subject mated contacts to 1000 cycles at 100% rated current for 45 minutes ON and 15 minutes OFF. See Figure 3 for energized circuits.
MECHANICAL		
Vibration, random.	No loss in electrical continuity (7 ohms minimum) greater than 1 microsecond on any terminal pair (for test group 1 only). See Note.	ES-F8DB-14A464-AA. Subject mated connector to 8 hours of vibration in each of 3 mutually perpendicular axes using AMP Spec 109-21-7, Condition C. Mount connectors as shown in Figure 5. Wire bundling shall be a wire tie at wire shield exit and every 4 inches along wires.
Durability.	See Note.	AMP Spec 109-27. 10 manual mate/unmate cycles using 8 inch pounds of torque.

Figure 1 (cont)

Test Description	Requirement	Procedure
<b>ENVIRONMENTAL</b>		
Temperature life.	See Note.	AMP Spec 109-43. 125°C for 1000 hours. Record dry circuit resistance on days 1, 2, 4, 8, 16, 32 and 42.
Mixed flowing gas.	See Note.	AMP Spec 109-85-3. Mated connectors.
<b>INDIVIDUAL, NON-SEQUENTIAL TESTS</b>		
Low energy electrical load durability validation test. (To demonstrate electrical resistance stability of contact system using thermal cycling durability.)	$\Delta R$ 100 milliohms maximum.	<ol style="list-style-type: none"> <li>1. Terminals shall be installed in connector housings, with all 104 terminal cavities used unless otherwise specified.</li> <li>2. M.V.D. leads shall be attached as shown in Figure 4.</li> <li>3. Samples shall be secured and placed within a temperature chamber which will pass samples automatically from a 125°C [257°F] chamber to a -40°C [-40°F] chamber for 1000 temperature cycles.</li> <li>4. Each temperature cycle shall be 2 hours at hot and 1 hour at cold temperature, 3 hour total cycle time. This includes transition time.</li> <li>5. Each overall resistance shall be measured in both hot and cold chambers to approximate schedule below (subject to Product Engineer's discretion): Initial, 1, 50, 100, 150, 200, 250, 300, 400, 500, 600, 700, 800, 900, 1000. Forward and reverse voltage readings shall be recorded.</li> <li>6. No voltage shall be applied except at time of readings. An open circuit voltage of 20 millivolts and a current of 100 milliamperes shall be used for all readings. A voltage and current above these levels shall not be applied to circuit at any time.</li> <li>7. Base value is first cycle reading.</li> </ol>
Terminal insertion force.	4 pounds [17.8 Newtons] maximum.	ES-F33B-14A464-AA. Grip wire 15 millimeters from end of terminal.

Figure 1 (cont)

Test Description	Requirement	Procedure
Terminal retention force.	Average (3 x Standard Deviation) = 10 pounds minimum without secondary lock. Average (3 x Standard Deviation) = 18 pounds minimum with secondary lock.	ES-F33B-14A464-AA. Use actual terminals unless otherwise specified.
Force to seat secondary lock.	Shall withstand 5 pounds minimum push-in force. Force to fully seat shall be 12.5 pounds maximum.	Push to seat with secondary lock in preset position (i.e. locking latches extended, staging latches engaged). Disengage staging latches and record force to fully seat secondary lock.
Force to remove secondary lock.	Force to pull back from seated to preset position shall be less than 12.5 pounds. Force to remove from preset position shall be 3 pounds minimum.	With lock fully seated, attach grips as shown in Figure 6 and record force necessary to move lock to preset position. With lock in preset position, record force necessary to remove it from plug housing.
I Push nut, push out and turning force.	Push out force shall be 350 pounds minimum. Turning, bolt clip location shall not change more than $\pm 0.5$ millimeter from its original position.	ES-F33B-14A464-AA, unless otherwise specified.
Solderability.	5% maximum dewetting.	AMP Spec 109-11-5.
Pin contact, push through and push or pull back.	Force required to push pin through housing, Average minus (3 x Standard Deviation) = 15 pounds minimum. Force required to move pin back in housing, Average minus (3 x Standard Deviation) = 7.5 pounds minimum.	Using collet shown in Figure 7, push header pin 0.025 inch further through housing. Using a pin vice, grip another pin and pull it back towards front of housing 0.025 inch (or push it with collet from opposite side of housing).
Threaded insert retention.	Push out force, Average minus (3 x Standard Deviation) = 800 pounds minimum. Push through force, Average minus (3 x Standard Deviation) = 1600 pounds minimum. Torsional resistance, Average minus (3 x Standard Deviation) = 175 inch pounds minimum.	ES-F33B-14A464-AA. Variation in procedure are as follows: A socket head cap screw is used instead of a production bolt to provide needed torsional strength. Screw is locked into insert with Loctite 277 and cured for 24 hours before torque testing.
Maximum connector mating torque.	5.5 Newton-meters [48.8 inch pounds] maximum.	ES-F33B-14A464-AA. Minimum assembly torque.
Over torque.	There shall be an increase in bolt diameter of no more than 8% from an applied torque of 6.77 Newton-meters [60 inch pounds].	ES-F33B-14A464-AA.

Figure 1 (cont)

Test Description	Requirement	Procedure
Submergible air leak.	Connector shall withstand 48 kiloPascal [7 psi] before heat age and 28 kiloPascal [4 psi] after heat age.	ES-F33B-14A464-AA, except with heat age temperature to 135°C. Use 12 systems with all open wire cover, 12 systems with ½ of wire cover open and ½ with all circuits of wire cover closed.
Retainer plate retention.	Force to remove, Average minus (3 x Standard Deviation) shall be greater than 2.5 pounds.	Place retainer plate pull tool (gage PN 92-660452-000) under retainer plate as shown in Figure 8, and record force necessary to remove plate from header housing.

**NOTE** *Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Figure 2.*

Figure 1 (end)

3.6. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group (a)		
	1(b)	2(c)	N(d)
	Test Sequence (e)		
Examination of product	1,14	1,10	
Termination resistance	2,5,7,9,11,13	2,4,6,9	
Temperature rise vs current	3,12		
Current cycling	8		
Vibration, random	10	8	
Durability	4	3	
Temperature life		7	
Mixed flowing gas	6	5	
Low energy electrical load durability			1
Terminal insertion force			2
Terminal retention force			3
Force to seat secondary lock			4
Force to remove secondary lock			5
Push nut, push out and turning force			6
Solderability			7
Pin contact, push through and push or pull back			8
Threaded insert retention			9
Maximum connector mating torque			10
Over torque			11
Submergible air leak			12
Retainer plate retention			13

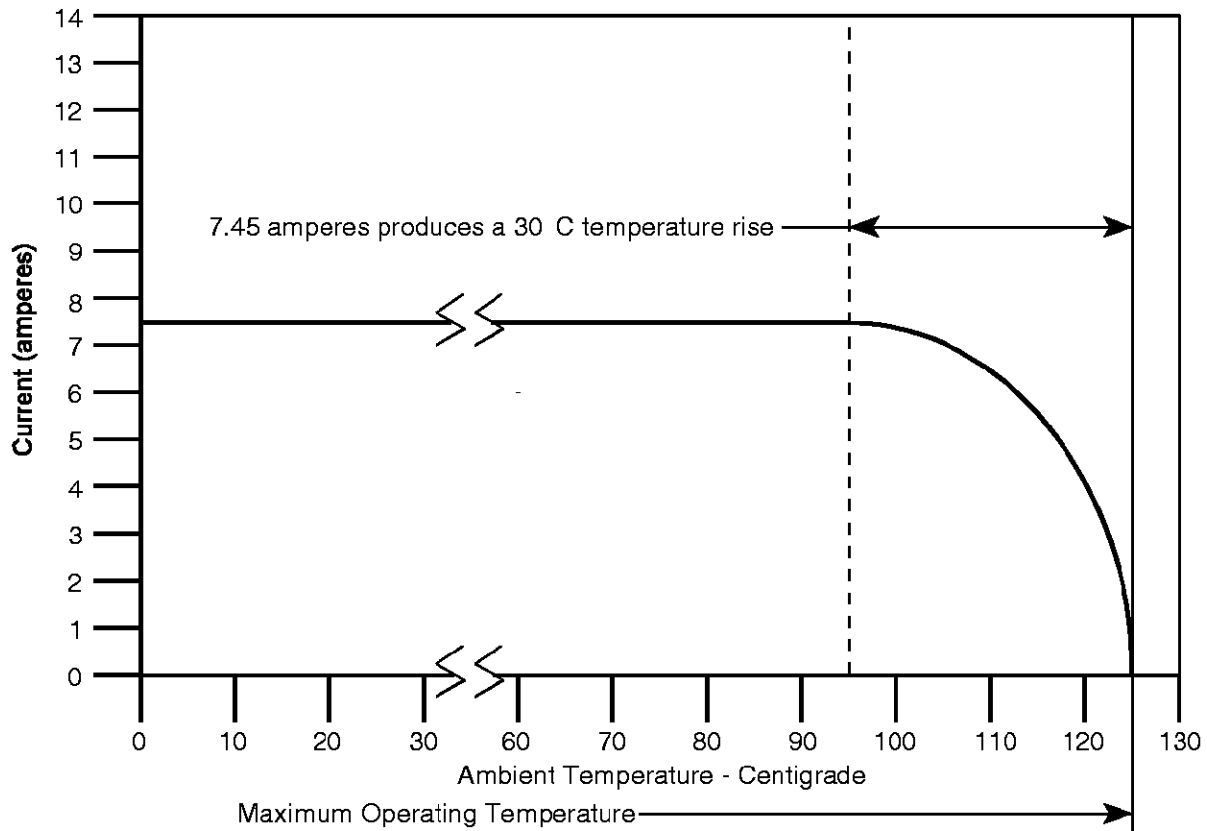
**NOTE**

- (a) See paragraph 4.1.A.
- (b) Test Group 1 is for power applications.
- (c) Test Group 2 is for signal applications.
- (d) Test Group N is for groups of individual, non-sequential tests which are applicable to both power and signal applications.
- (e) Numbers indicate sequence in which tests are performed.

The above testing was established during the product’s development phase and reflects agreement between AMP and Ford Motor Company. It does not comply with AMP’s typical product evaluation format as defined in AMP Specification 102-6, Preparation of Product Specification.

Figure 2

Current Carrying Capability  
100% Loaded, 15% energized, 18 AWG Stranded Wire



**NOTE** This graph represents current rating of 16 contacts located in circuits 79 through 86 and 97 through 104 (i.e. 2 groups of 8 adjacent contacts in upper outside corners of 4 row circuit pattern). It is required that applications exceeding this above current rating shall be reviewed by ECU-1 Product Engineering.

Figure 3

#### 4. QUALITY ASSURANCE PROVISIONS

##### 4.1. Qualification Testing

##### A. Sample Selection

Samples shall be prepared in accordance with applicable Instruction Sheets and shall be selected at random from current production. Test group 1 shall consist of 4 mated connectors with right angle wire shields, and all 104 circuits loaded with terminals crimped on 24 inches of 18 AWG stranded wire. Each connector shall be installed on a P.C. board which is designed so that only positions 79 through 86 and 97 through 104 can be energized at rated current. These 16 power circuits, plus another 14 chosen at random (positions 3, 11, 14, 25, 32, 35, 47, 63, 65, 67, 69, 91, 92 and 94) are to be wired to permit voltage drop readings to be taken (see Figure 4) and overall resistance values established. Only the power circuits require thermocouples.

All 104 wires must be bundled together (reference vibration test procedure for details) and even those not being monitored are to be secured to the P.C. board. 3 of the 4 samples shall use terminals with crimp heights at nominal (0.054 inch), the fourth shall contain 50% minimum crimp height (0.052 inch) and 50% maximum (0.056 inch). These are to be equally distributed either side of connector centerline (i.e. 0.053 inch for 52 circuits bordered by positions 14, 26, 92, and 104).

Test group 2 shall consist of 4 mated connectors with right angle wire shields, and all 104 circuits loaded with terminals crimped on 24 inches of 18 AWG stranded wire. Each connector shall be installed on a P.C. board and have 30 random circuits (positions 1, 4, 8, 13, 17, 21, 24, 26, 28, 33, 36, 40, 42, 45, 46, 52, 54, 57, 59, 61, 64, 68, 72, 77, 87, 89, 90, 93, 95, 96) wired to permit voltage drop readings to be taken (see Figure 4) and overall resistance values established. No thermocouples are required. Remaining circuits are wired for overall voltage drop readings only.

All 104 wires must be bundled together, as specified in vibration test procedure. Mix of terminal crimp heights in each of 4 connectors shall be same as in Test Group 1.



Test	Sample Quantity & Type
Low energy electrical load durability	5 mated connectors
Terminal insertion force	104 contacts (See Note) on 20 AWG wire, 2 plug assemblies
Terminal retention force	1 plug assembly
Force to seat secondary lock	30 plug assemblies (See Note)
Force to remove secondary lock	30 plug assemblies (See Note)
Push nut, push out and turning force	30 plug assemblies (See Note)
Solderability	30 pin contacts (assorted lengths)
Pin contact, push through and push or pull back	2 header assemblies
Threaded insert retention	60 header assemblies (See Note) (20 for each procedure)
Maximum connector mating torque	30 mated connectors (See Note)
Over torque	30 mated connectors (See Note)
Submergible air leak	36 mated connectors (See Note)
Retainer plate retention	15 header assemblies (See Note)

**NOTE** *Made up of similar quantities from any 3 dies/molds.*

B. Test Sequence

Qualification inspection shall be verified by testing samples as specified in Figure 2.

4.2. Requalification Testing

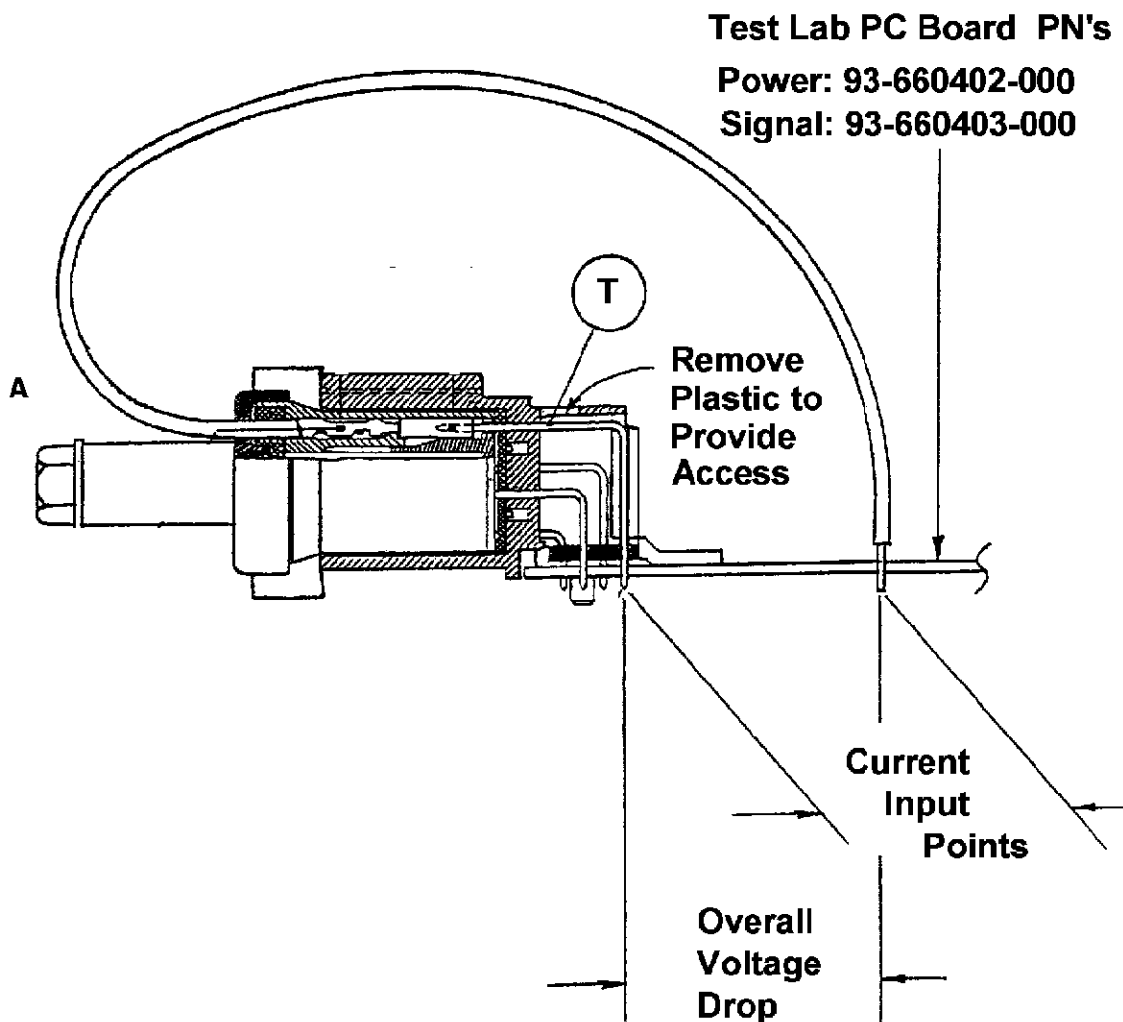
If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of Figure 1. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for evaluation/qualification. Testing to confirm corrective action is required before resubmittal.

4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.



- NOTE**
- A Wire shield shall be used for vibration testing. Wire lengths shall vary for each variation in wire shield style.
  - B Thermocouple placement for temperature rise vs current testing is shown as location "T".

Figure 4  
 Resistance Measurement Points

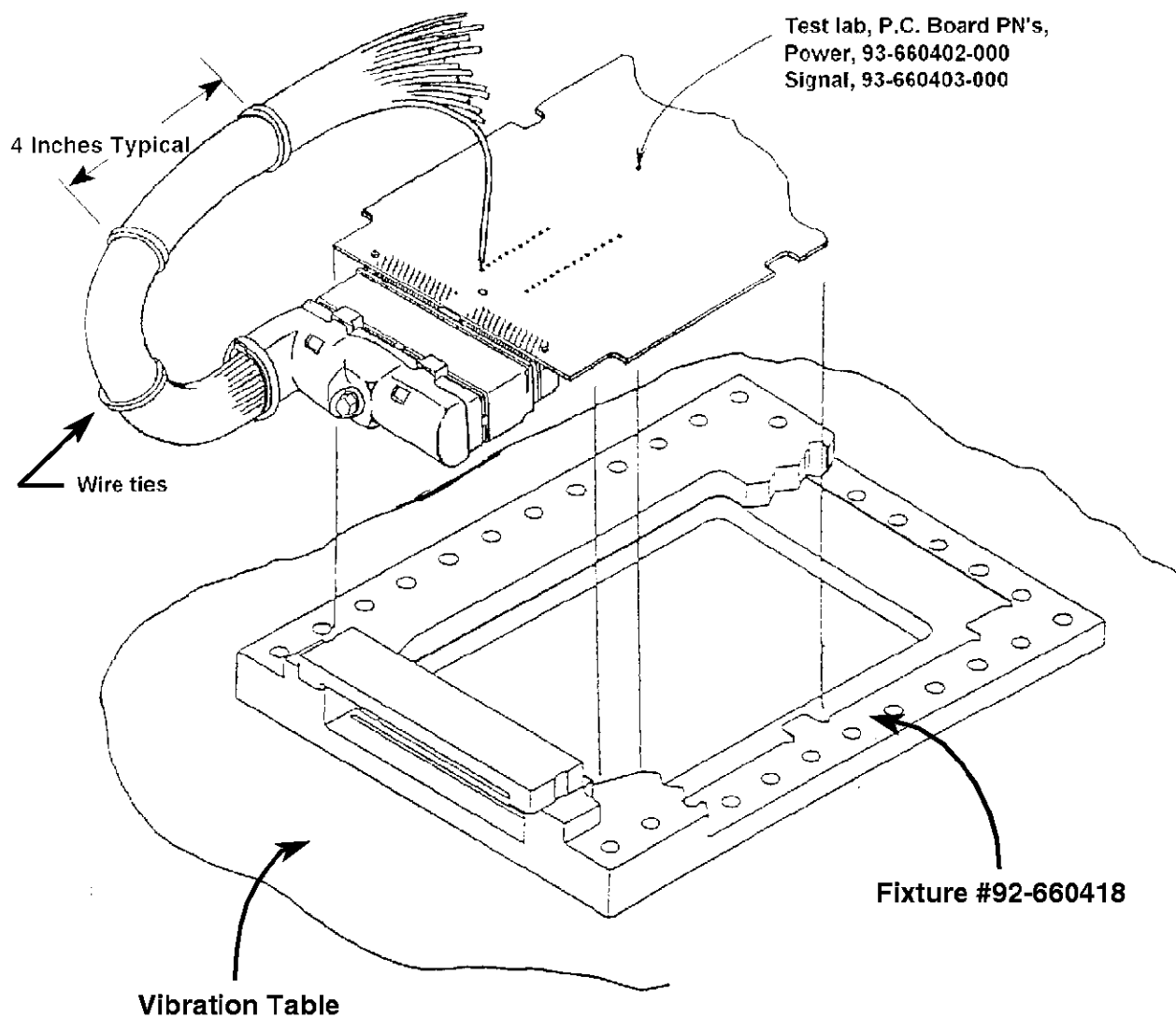


Figure 5

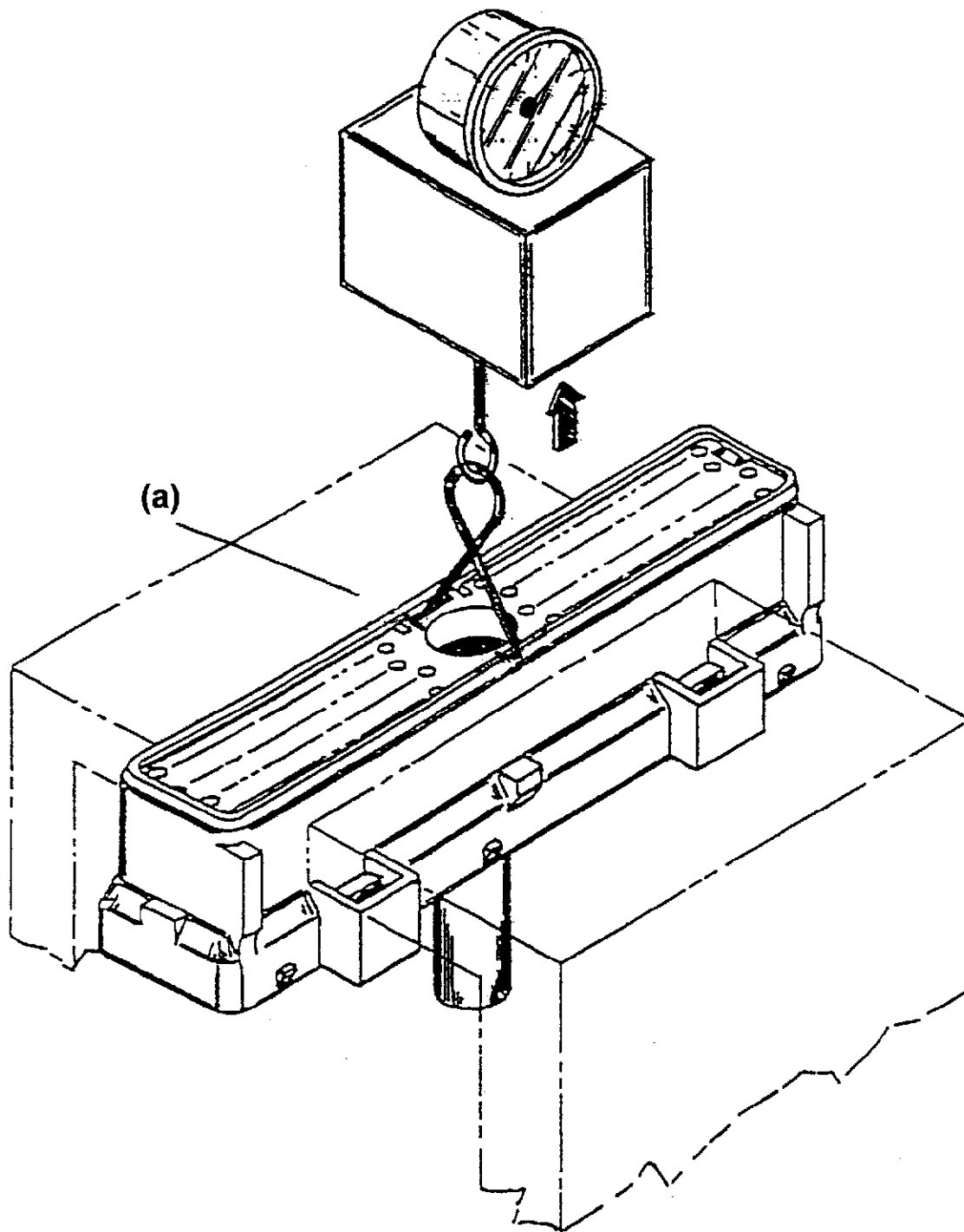


Figure 6

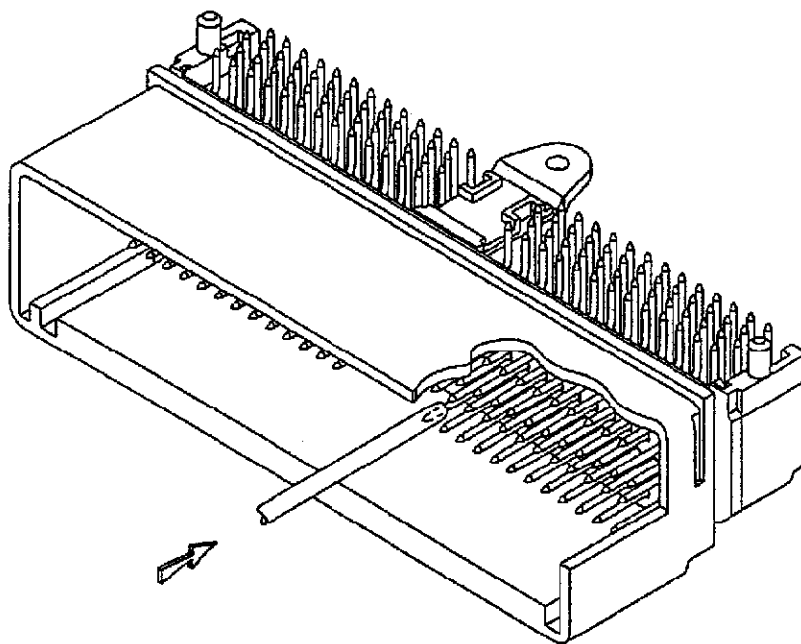
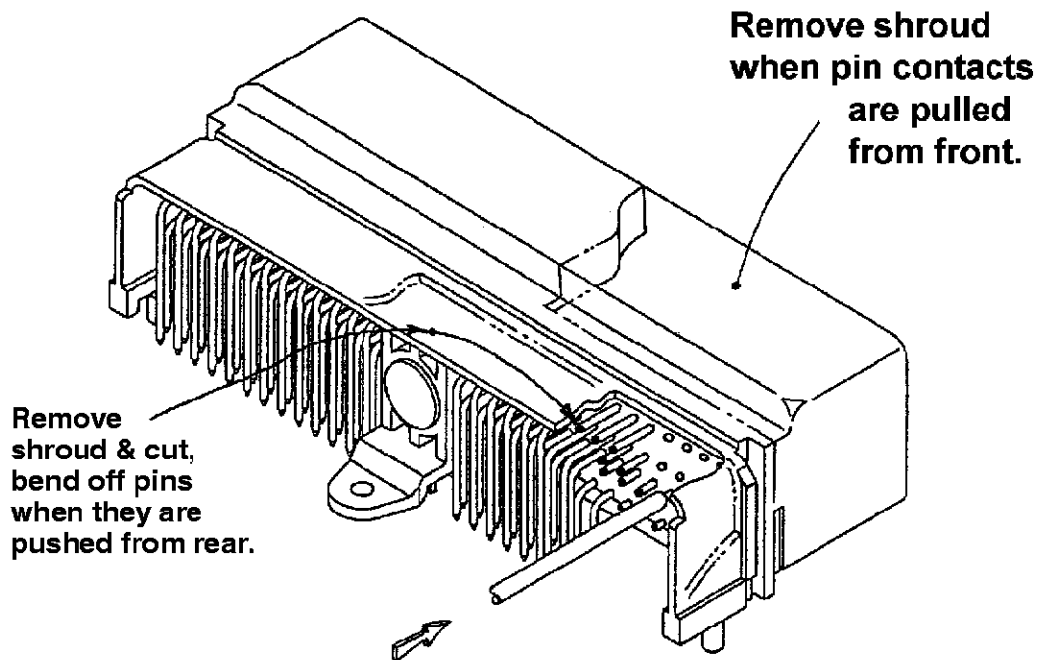


Figure 7

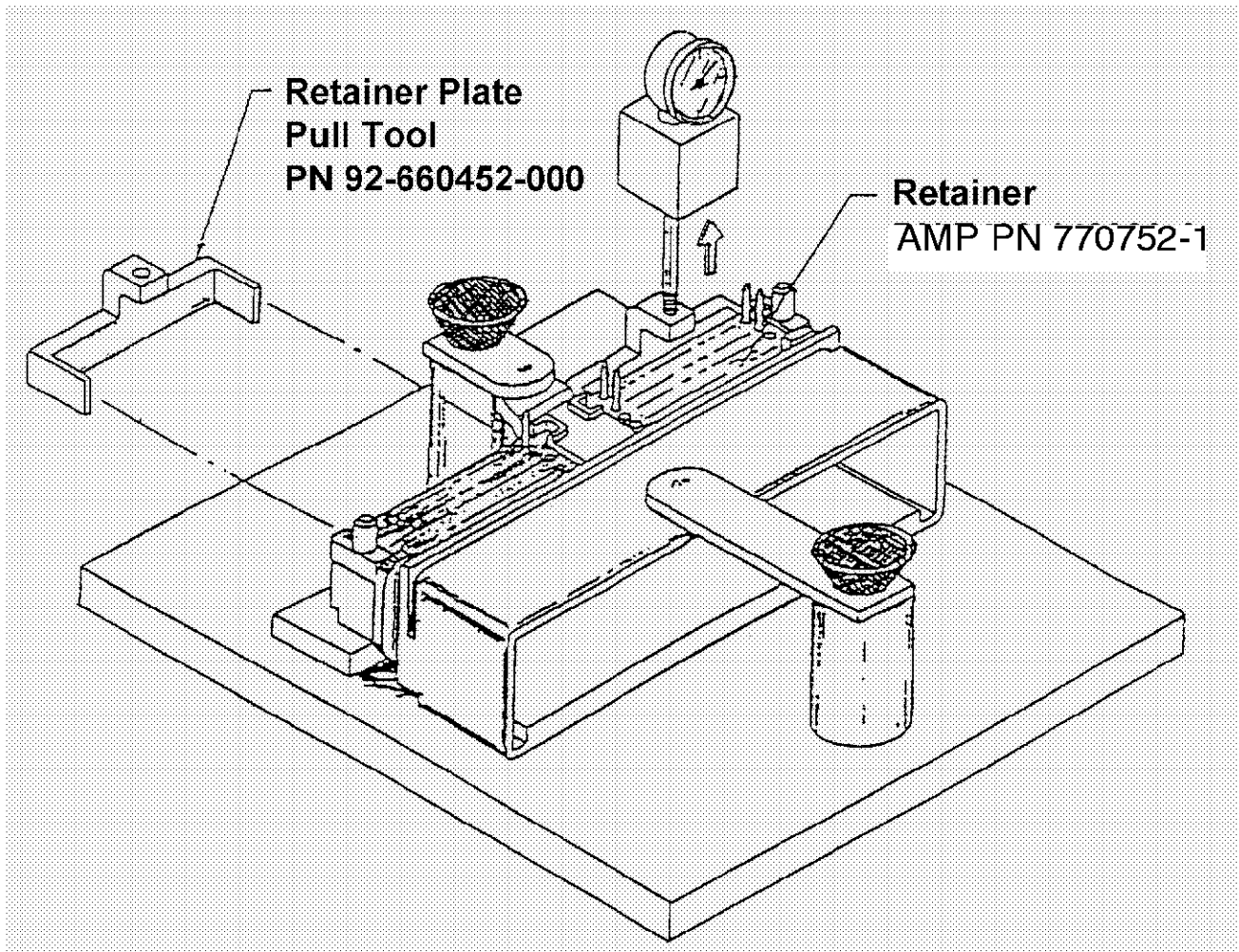


Figure 8