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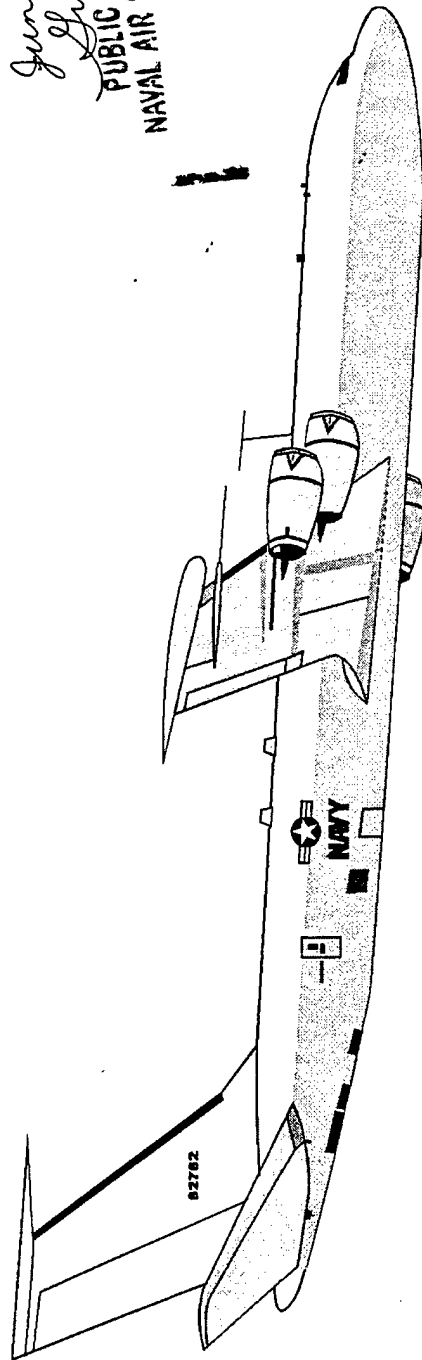
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E-6 E³ HM/HS TOOLS



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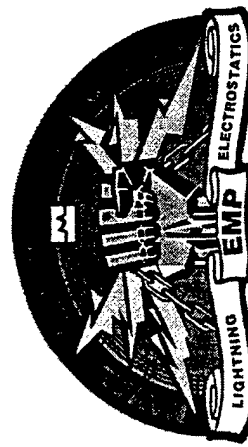
Jun 4 1996

Grace A. Clelland

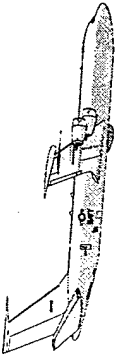
PUBLIC AFFAIRS OFFICE
NAVAL AIR SYSTEMS COMMAND



JOEL HAINES
MIKE CLELLAND



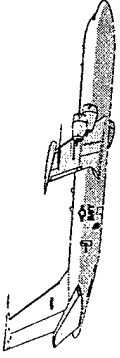
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND 20670-5304



E-6 AIRCRAFT



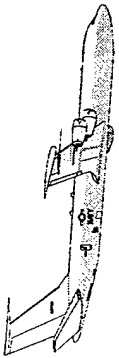
- The Design Is Based On The Commercial Boeing 707 And The Military E-3A Airframes
- Modifications And Special Equipment Installed To Support The Take Charge And Move Out (TACAMO) Strategic Communications Mission



E-6 AIRCRAFT

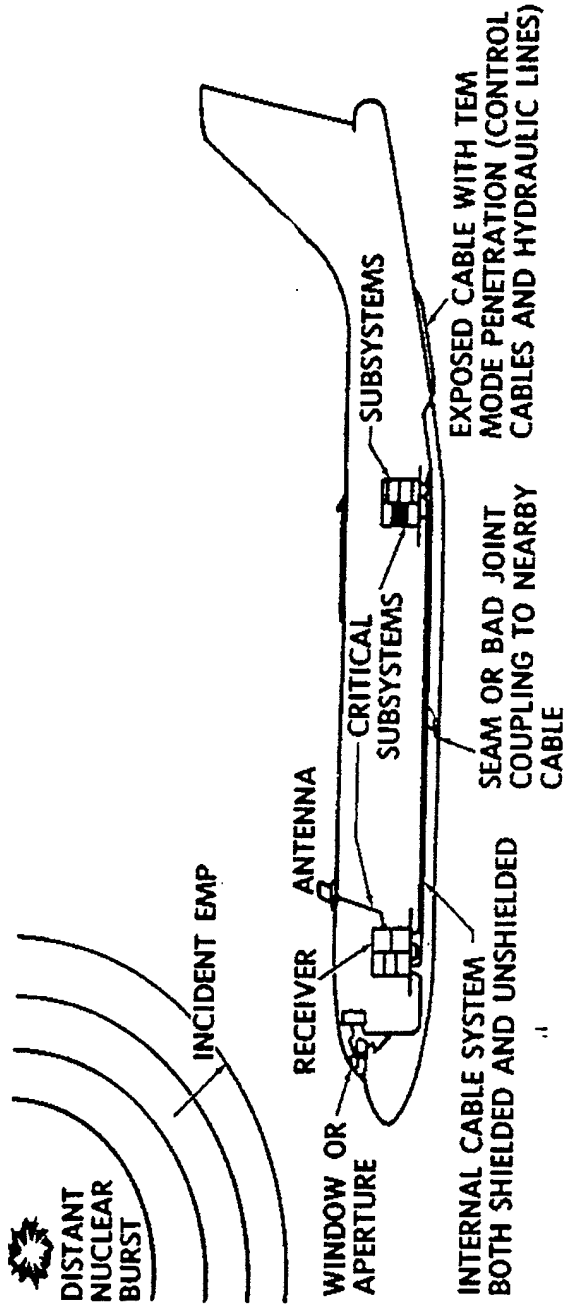


- The TACAMO Mission Is To Provide A Survivable Communications Link Between The Joint Chiefs Of Staff And The Ballistic Missile Submarine Forces

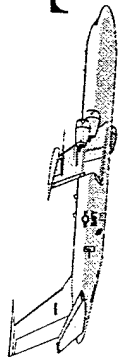


EMP COUPLING

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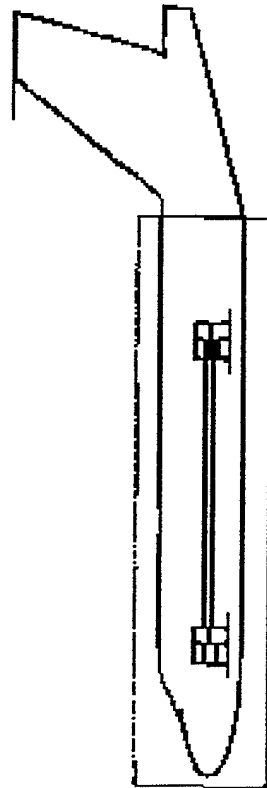
- INCIDENT EMP CAUSES CURRENT AND CHARGES ON EXTERNAL SURFACE
- SURFACE CURRENTS AND CHARGES EXCITE ANTENNAS AND INADVERTENT PENETRATIONS
- PENETRATIONS COUPLE ENERGY TO INTERNAL CABLING
- CABLE SYSTEMS ROUTE ENERGY TO CRITICAL SUBSYSTEMS



TYPICAL AIRCRAFT HARDENING TECHNIQUES



Reduce Stress

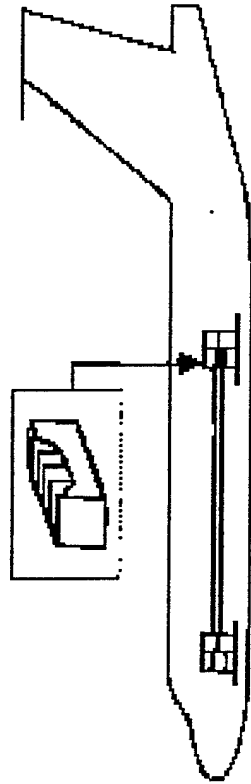


Layer 1

Hull Hardening

- Antenna hardening
- External wire hardening
- Mechanical penetration hardening

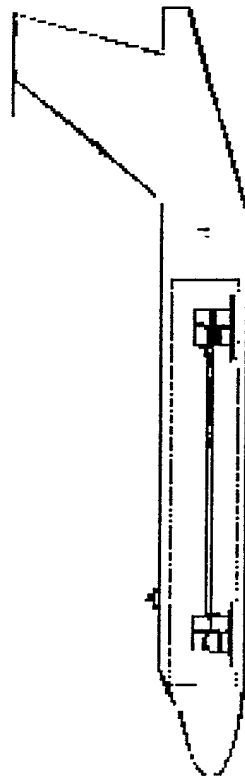
Increase Strength



Layer 3

Box Hardening

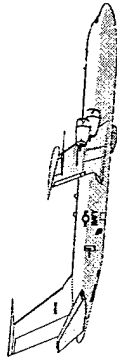
- Harden interface circuitry with diodes, inlets
- Parts control



Layer 2

Internal Shielding

- Wire shielding
- Cabinet shielding

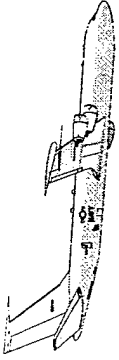


TBNH-6F



- BACKGROUND

- The Test Bench Nuclear Hardness (TBNH-6F) was procured to test the Terminal Protection Modules Installed on the E-6A. The TBNH-6F is a adaptation of the TBNH-160F which is used by the French Air Force with the mission equivalent to that of the E-6A.

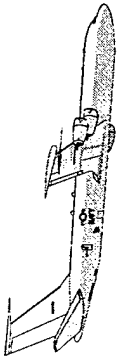


TBNH-6F



• FUNCTIONAL CHARACTERISTICS

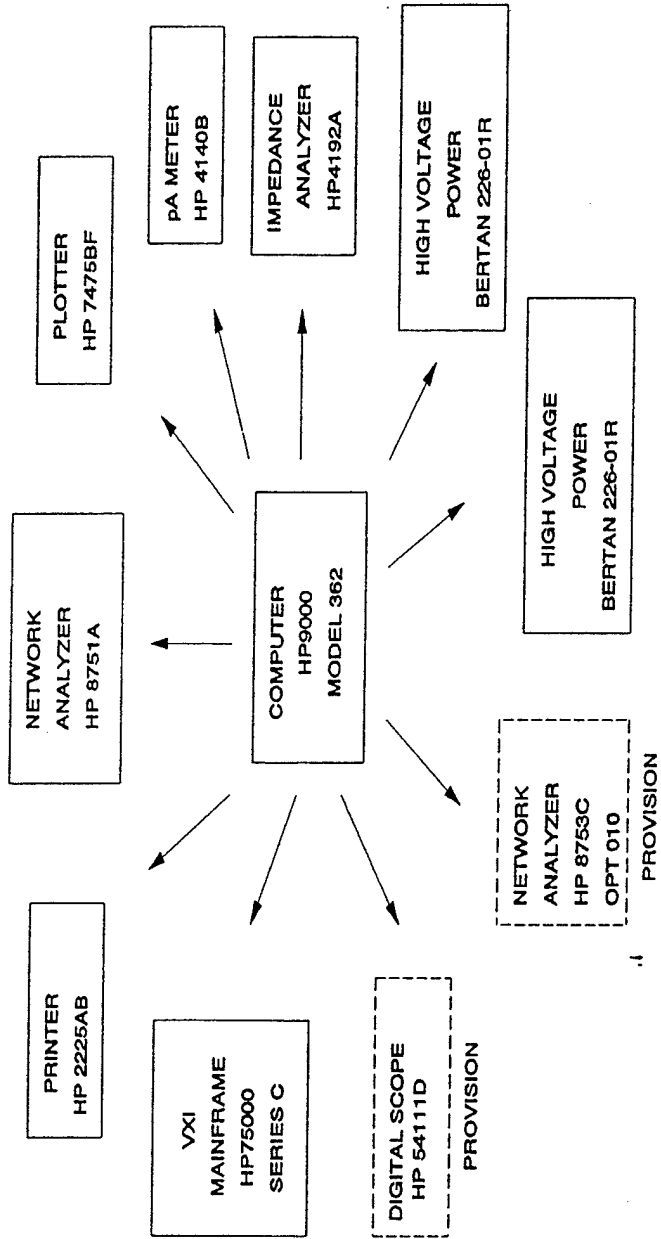
- Test Bench Allows Two Testing levels:
 - Organizational Level (TPM installed on the aircraft)
 - Depot Level (TPMs removed from the aircraft)
- TPM characteristics tested:
 - attenuation, capacitance, inductance, resistance, firing voltage and leakage currents.

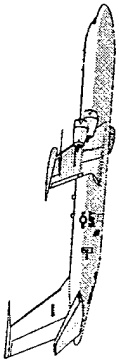


TBNH-6F

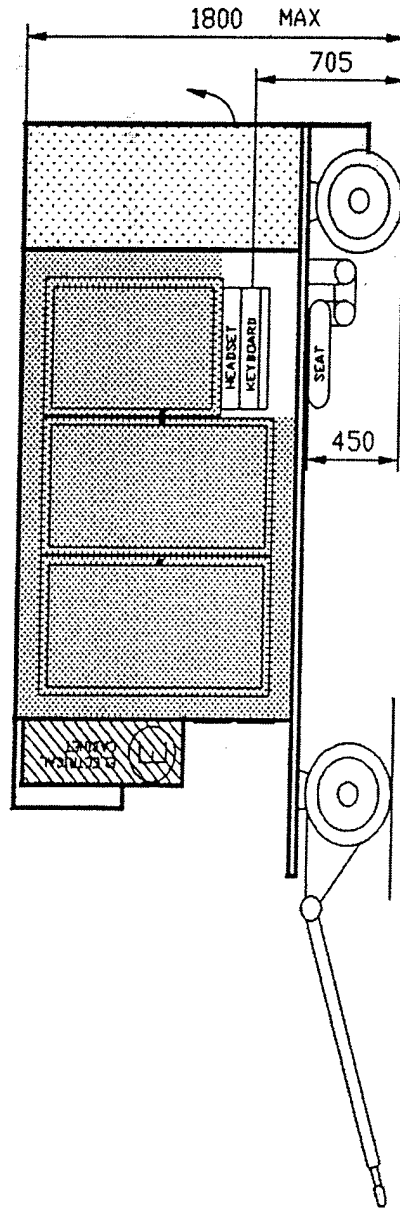


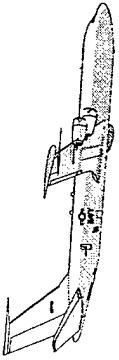
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TBNH-6F

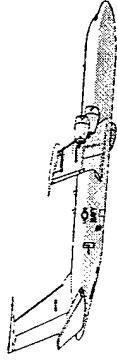




TBNH-6F

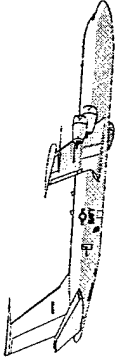


- TBNH-6F CONSIST OF:
 - Transportable Cart
 - Air-Conditioning System
 - Test Assembly



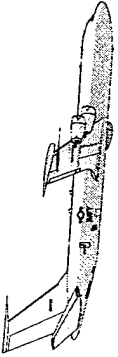
TRANSPORTABLE CART

- Divided Into 5 Sections:
 - Section A - This Section Includes The Air-Conditioning System And Power Supply
 - Section B - Includes A Height Adjustable, Retractable Seat, Computer Keyboard And The Headset Audio-Panel (For Audio Communications With The Remote Unit)
 - Section C - This Section Is A Rigid, Waterproof, Air-Conditioned Enclosure. The Cabinet Contains Three Parts Where Test Fixtures Are Mounted



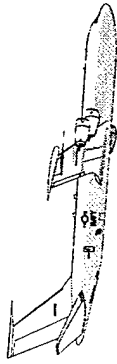
TRANSPORTABLE CART

- Divided into 5 Sections (Cont'd)
 - Section D - Includes The Lighting System, 2 Electrical Connectors, And Storage Space For Cables
 - Section E - Contains A Waterproof Main Power Control Cabinet, The Interface Panel, The Main Power Interface, And 2 Drums For Main Cables



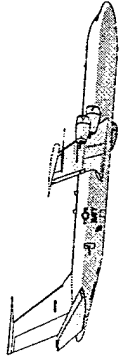
TRANSPORTABLE CART

- 1st Part of Cabinet
 - Picoammeter HP4140B
 - Picoammeter Interface
 - Switching Unit HP75000-C VX 1
 - Interface Module Interface



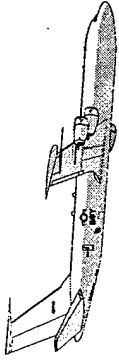
TRANSPORTABLE CART

- 2nd Part of Cabinet
 - Bertan Power Supply
 - HP 8751A Network Analyzer
 - Network Analyzer Interface
 - HP4192A Impedance Analyzer
 - Impedance Analyzer



TRANSPORTABLE CART

- 3rd Part of Cabinet
 - Bertan Power Supply
 - HP D1194 Display
 - HP A2240A Computer
 - Non-interruptible Power System

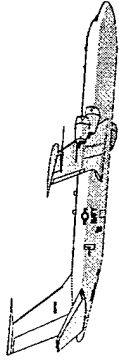


TBNH-6F

- **Testing System**

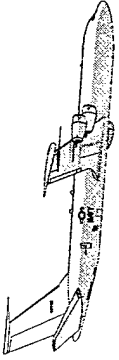
- Controlled by a HP 9000 model 362 through HPIB bus. HP basic software is used.

- HP 8751A-Network Analyzer- allows TPM attenuation measurement (1dB accuracy) from 2kHz to 150 MHZ.
- HP 4140B- pA meter allows measurement of total leakage current (components, connectors, etc.), measurement of firing voltage of non-linear components up to 100 v.



TBNH-6F

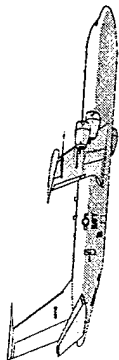
- Testing System (Cont'd)
 - HP 4192A - Impedance Analyzer- allows measurement of parallel capacitors and serial inductors with 1% accuracy.
 - Bertan H.V. PWR Supply - used for measurement of firing voltage of non-linear components for voltages higher than 100v.



TYPICAL TEST



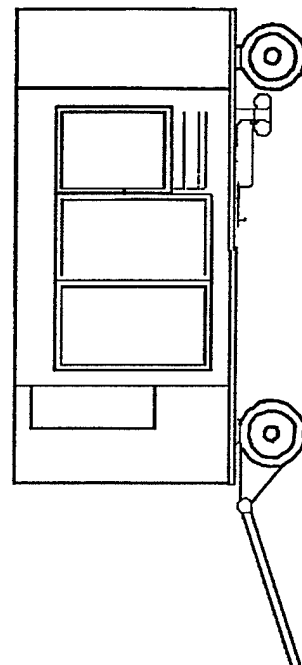
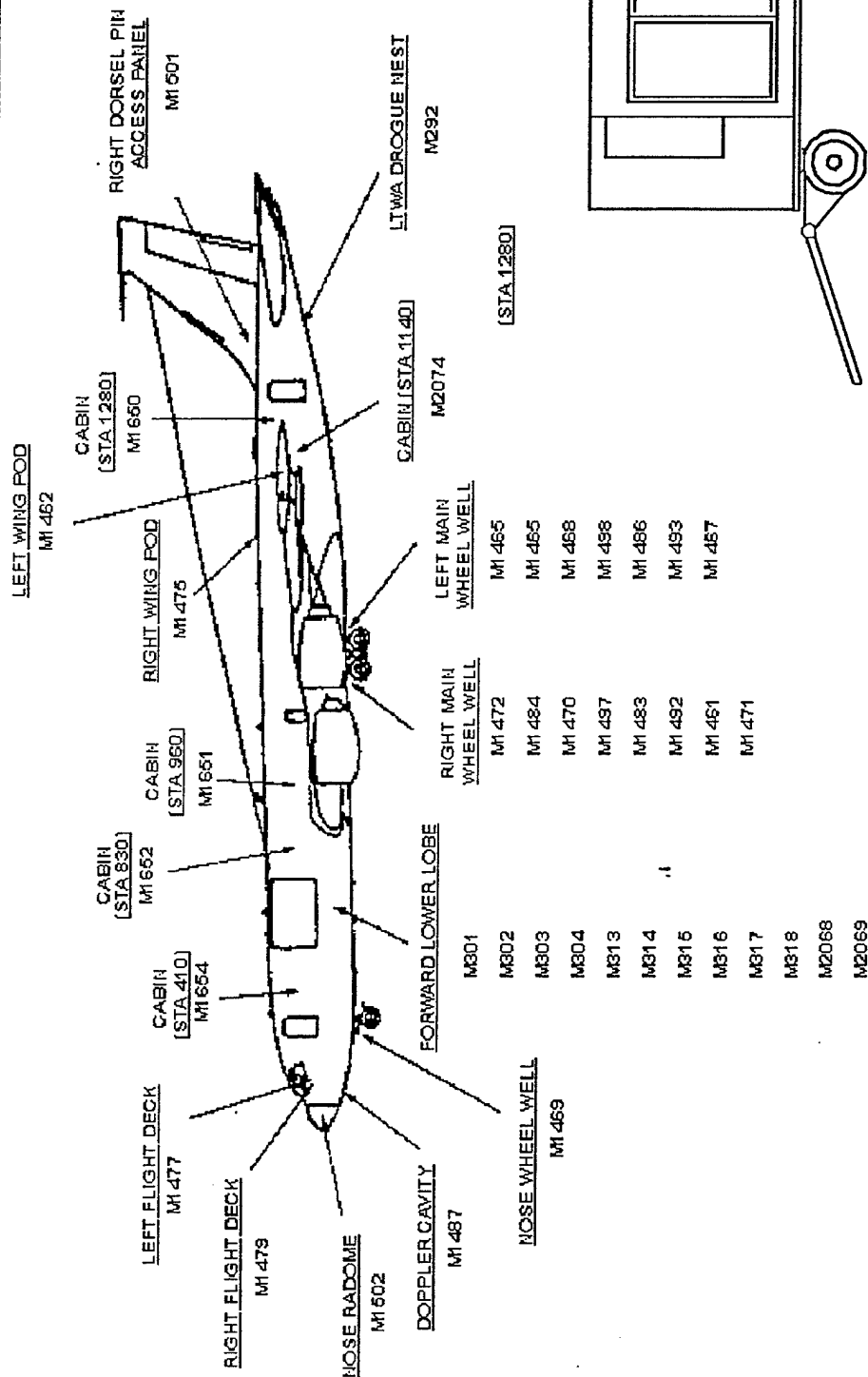
- Over 110 TPMs On Each Aircraft
- 15 - 30 TPMs Tested As Part Of EPM
 - Only One Section Of The Aircraft Goes Through EPM At A Time
 - The TBNH-6F Plots A Hard Copy And Saves All The Measured Data To A Disk

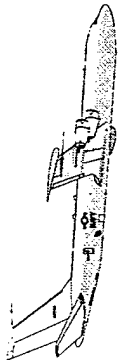


TPM LOCATIONS



RIGHT WING POD
LEFT WING POD

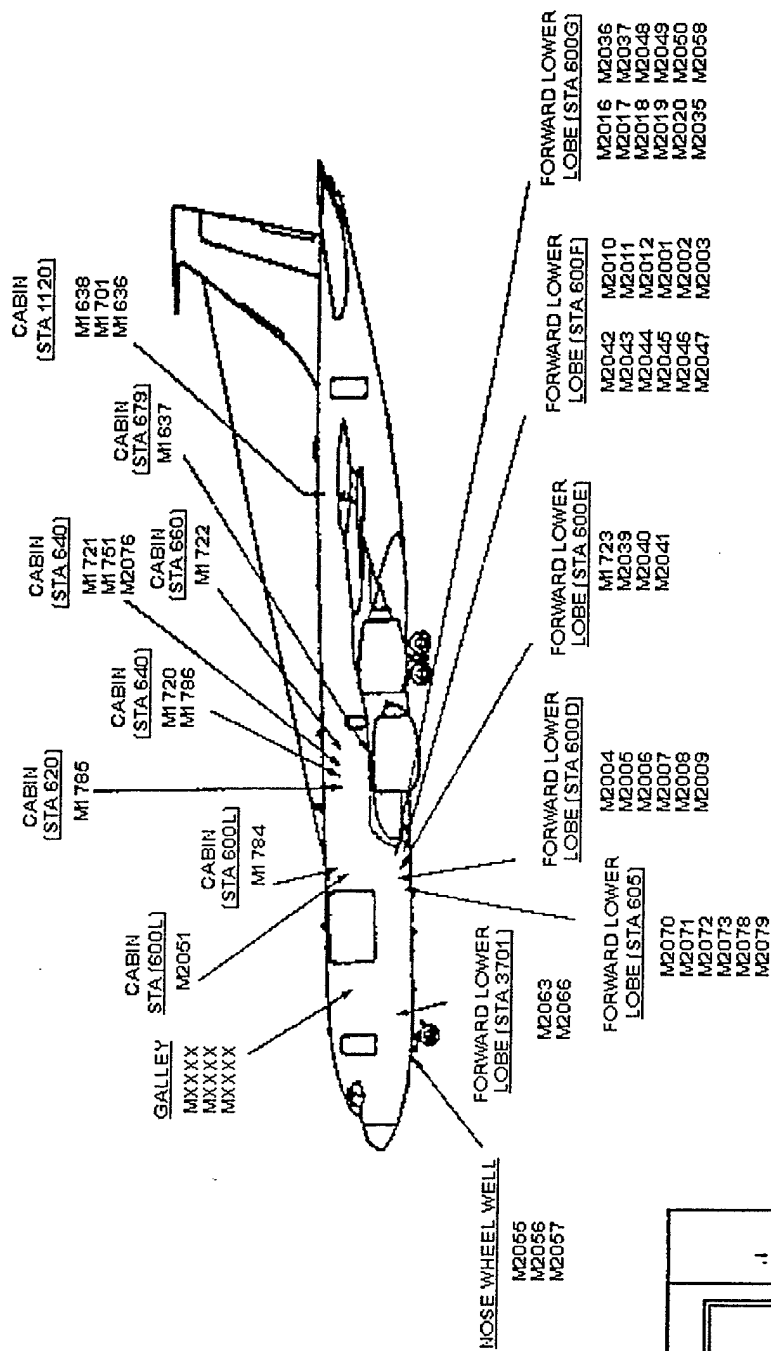




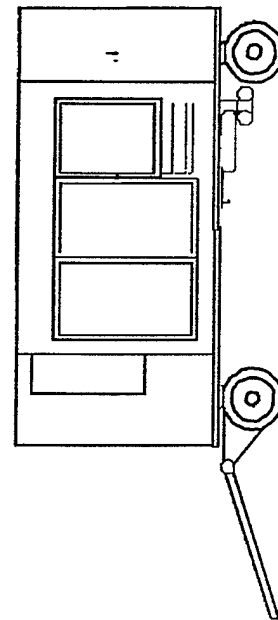
TPM LOCATIONS



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Internal TPMS

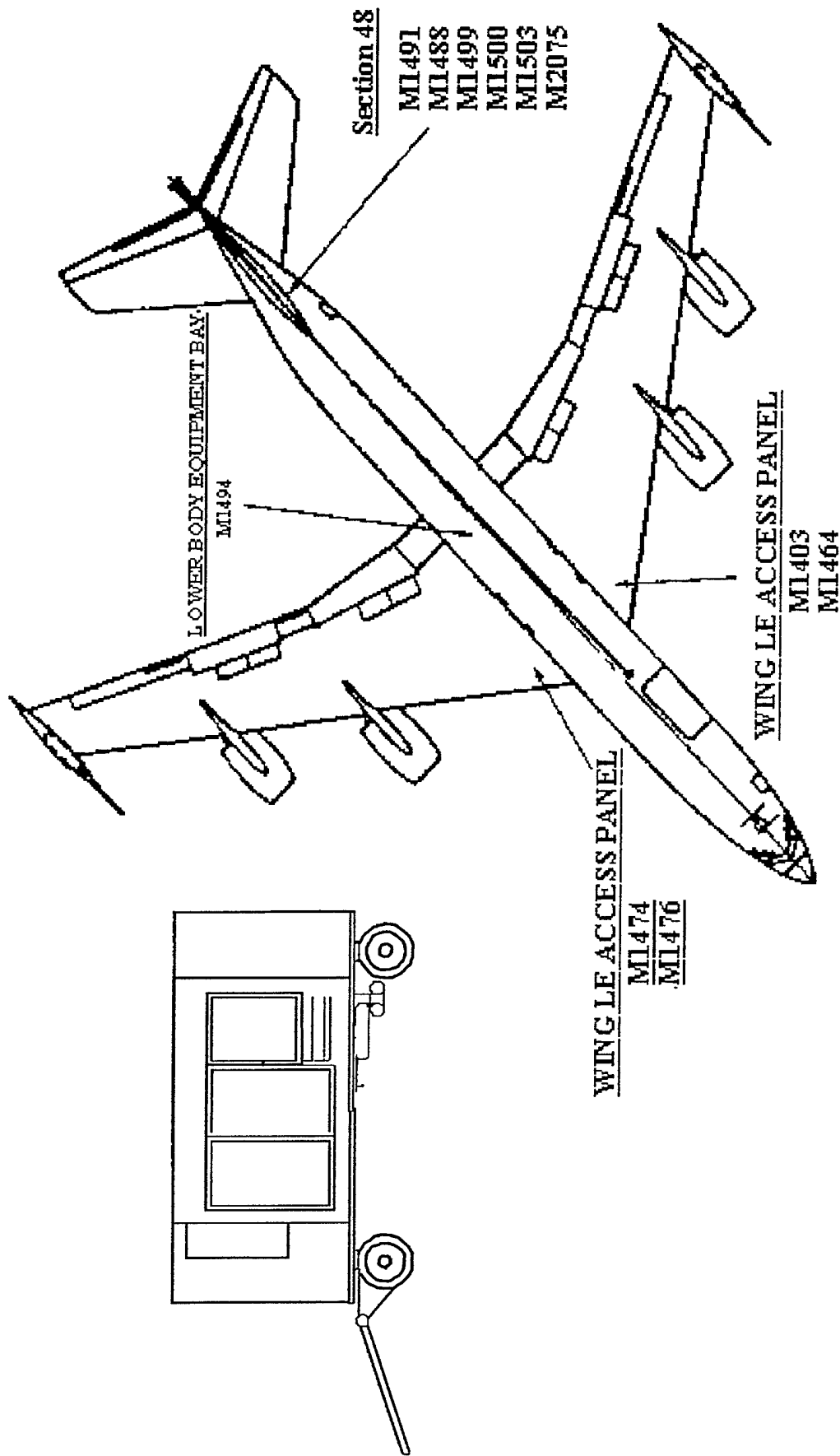


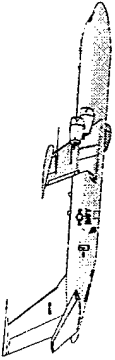


EXTERNAL TPMS



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4 CAPACITOR TPM

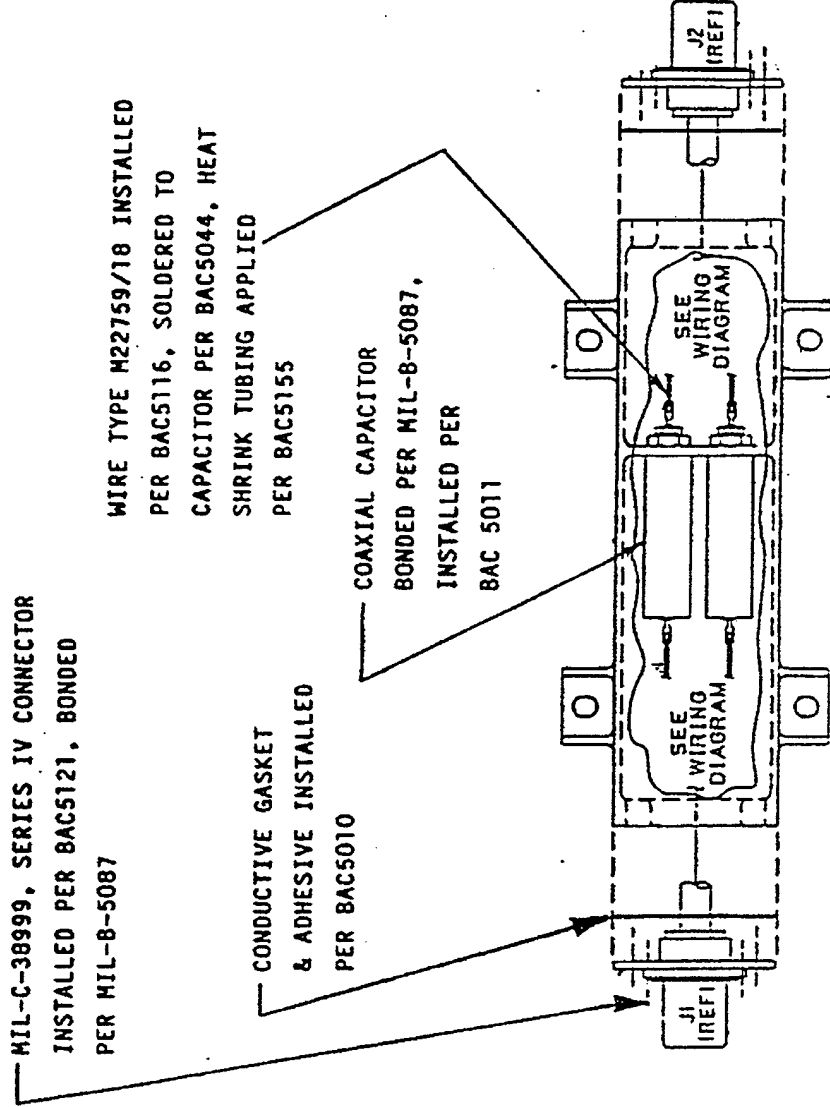
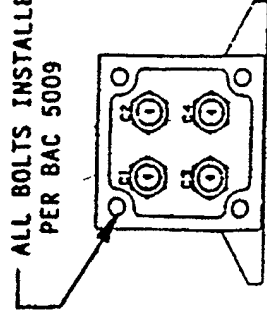
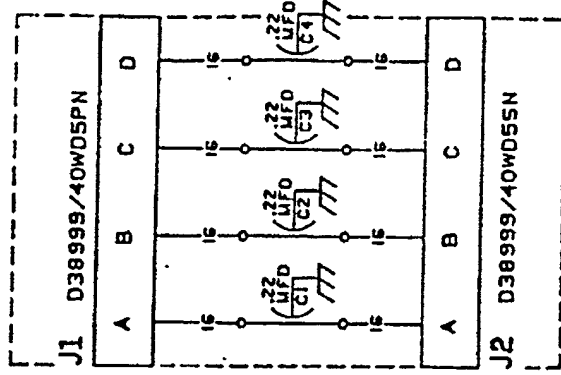
MIL-C-38999, SERIES IV CONNECTOR
INSTALLED PER BAC5121, BONDED
PER MIL-B-5087

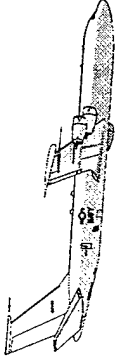
WIRE TYPE M22759/18 INSTALLED
PER BAC5116, SOLDERED TO
CAPACITOR PER BAC5044, HEAT
SHRINK TUBING APPLIED
PER BAC5155

CONDUCTIVE GASKET
& ADHESIVE INSTALLED
PER BAC5010

COAXIAL CAPACITOR
BONDED PER MIL-B-5087,
INSTALLED PER
BAC 5011

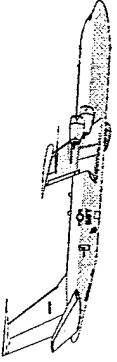
WIRING DIAGRAM
ALL BOLTS INSTALLED
PER BAC 5009





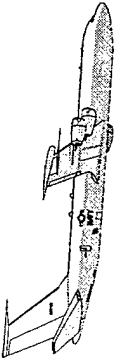
E-6 HM/HS RESULTS

- External TPM's Continue To Be A Problem
 - Water Intrusion Causes Corrosion Requiring Remove and Replace
 - Engineering Change In Process

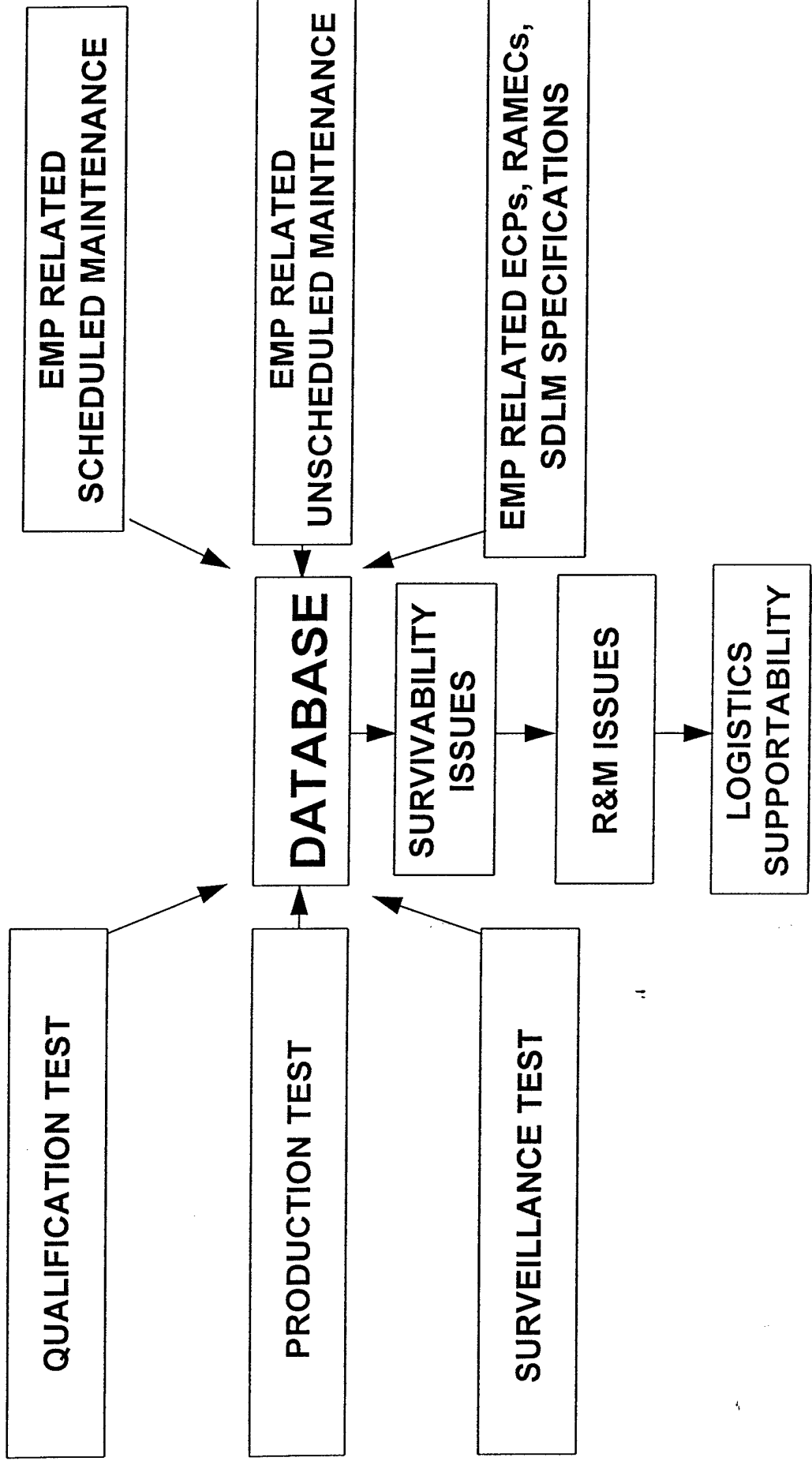


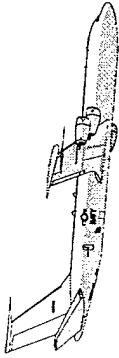
E-6 HM/HS RESULTS (Cont'd)

- 10% Of External TPM's Tested Fail
“Initially”
 - Excessive Amount Of Water Displacement Compound Inside Connectors
 - Most TPM's Check Good After Being Cleaned, Dried & Retested
- Failure Modes Are Generally Passive - Few Aircraft Downing Discrepancies



E-6 E³ HM/HS DATABASE





CONCLUSIONS

- The TBNH-6F Provides A Quick And Effective Method For Testing TPM's For The E-6 Aircraft
- The Test Set Is A Valuable Tool In The HM/HS Process