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Responsible Office: GSFC / Code 661 / GLAST ACD

Title: TDA-PMT-Resistor Network End-to-End Thermal-Vacuum Test Procedure

1. Purpose

This Document defines the Engineering Tests to be performed on two Tile Detector Assemblies (TDAs) and Photo Multiplier Tube (PMT)/Resistor Network Assemblies in a thermal vacuum chamber for the Gamma-ray Large Area Space Telescope (GLAST) AntiCoincidence Detector (ACD).

2. Scope

This document describes the procedures to verify the design of the TDA, Clear Fiber, and PMT assembly) under thermal-vacuum conditions, including high temperature operational & survival, low temperature operational & survival, and thermal cycling.

3. Acronyms

ACD – AntiCoincidence Detector
GLAST – Gamma-ray Large Area Space Telescope
TDA – Tile Detector Assembly
T-Vac – Thermal Vacuum
TTA – Triggering Tile Assembly
PMT Photo multiplier Tube
RN- Resistor Network

4. Applicable Documents

This test requires that the following documents completed.

Tile Detector Assembly (TDA) TEST B PROCEDURE
Tile Detector Assembly (TDA) TEST A PROCEDURE
Tile Detector Assembly (TDA) Thermal Vacuum Test Report
PMT/Resistor Network Test Procedure

5. Safety Precautions and Warning Notes

5.1. The PMT/RN assemblies operate at approximately 1000V DC. Do **Not** operate any PMT/Rn at a pressure less than 1 atm. or greater than 1*10 –5 torr, nor during transition from 1 atm. to vacuum (<1*10 –5 torr).

5.2 All personnel who come in direct contact with the hardware under test shall wear charge conducting wrist straps. Each strap shall be connected to facility ground.

6. References

TDA Test B Procedure
PMT/Resistor Network Test Procedure

7. Resources

7.1. Tools

Tools	Make, Model, Vendor
TBS	TBS

7.2. Materials

Materials	Make, Model, Vendor
Cleaning materials	TBS

7.3. Equipment

Equipment	Make, Model, Vendor, S/N
High Voltage Power Supply	Tennelec TC 952
Digital Multi-Meter	Fluke
High Voltage Probe	Fluke 80K-40 HV Probe
Thermal Vacuum Chamber	Building 4
TDA Signal Pre Processor Rack	LeCroy
VME Box	Data Design Corp., SCICrate
PC, monitor, keyboard, printer	TBS
High Resistance Tester	Hewlett Packard HP 4329A
TDAs with Clear Fiber	Fermi Labs S/N 01,02, 03
Low Voltage Power Supply	Topwood 6302A
Oscilloscope	Tectronic TDS754C

7.4. Fixtures

Fixtures	Drawing #
Support for TDA under test	Figure 2
Support for TTA Tiles	Figure 2

Test Cables	TestbCab.doc

8. Personnel

The test will require one test conductor between 7:00 am to 5:00 pm, and two test conductors between 5:00pm and 7:00 am.

All test conductors will have training in the use of the ACD TDA test equipment and the operation of the Building 4 thermal-vacuum chamber.

The Thermal Engineering Branch will provide personnel to perform specific operations related to the thermal vacuum chamber and on-site equipment in building 4.

9. Location

This Thermal Vacuum Test will be conducted the Thermal Engineering Branch's 36-inch vacuum chamber located in Building 4. Room 191 at GSFC.

10. Test Procedure

10.1. Set Up Test Equipment

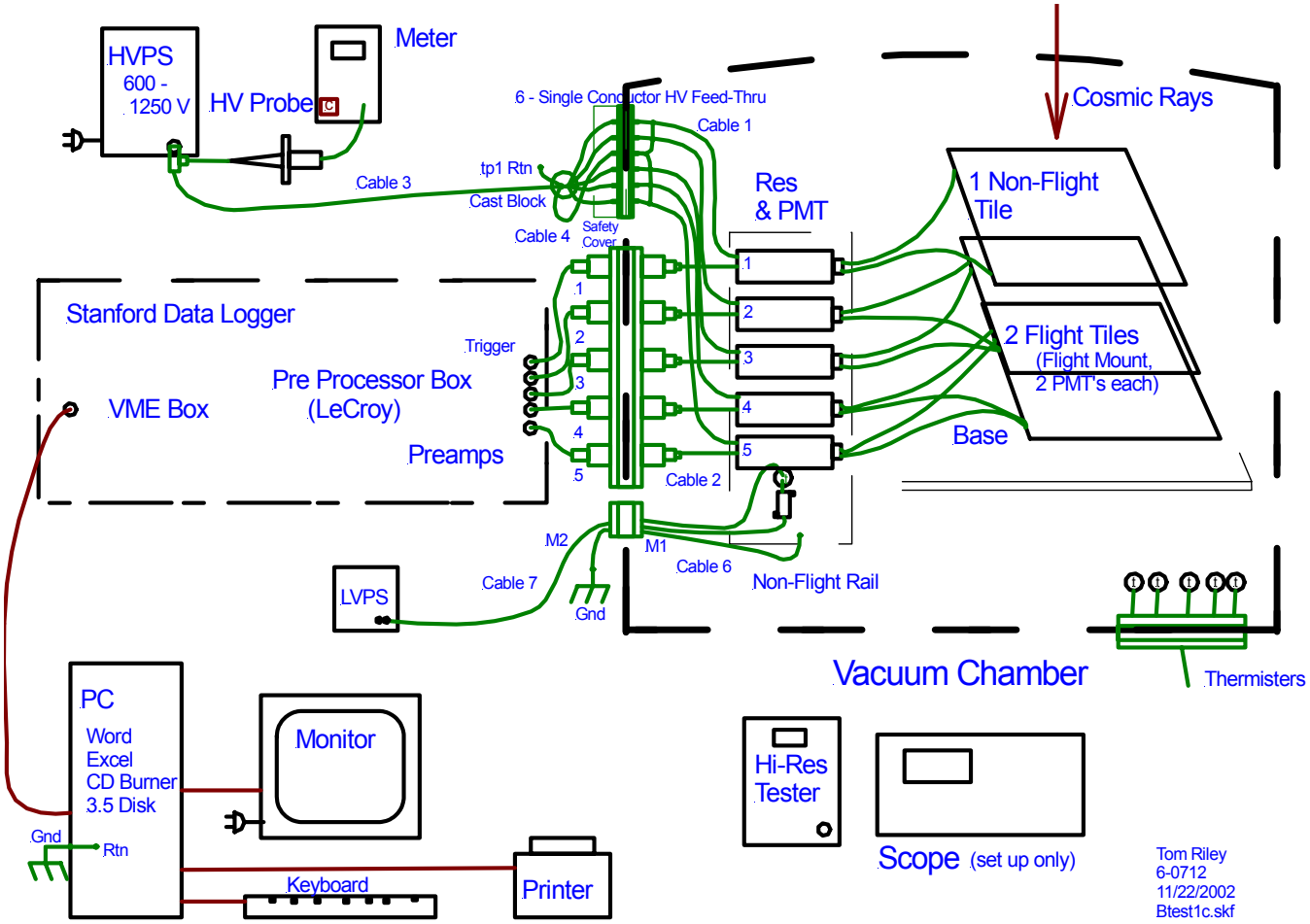


Figure 1 -- Engineering "B" Test Configuration

10.1.1. Clean Test Area

Use shop vacuum cleaner on floor and household cleaner on bench tops, and Windex on computer screens.

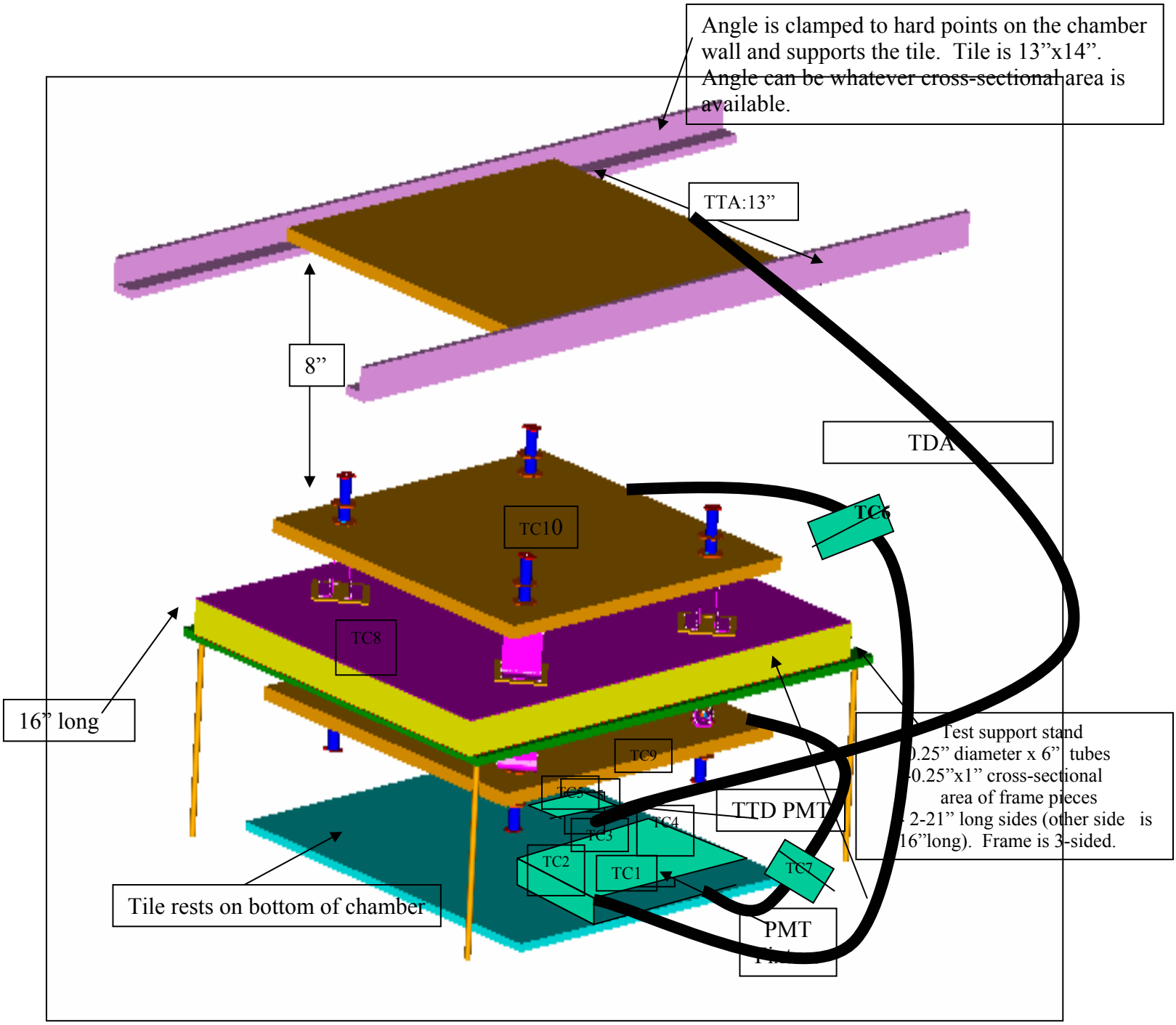

Angle is clamped to hard points on the chamber wall and supports the tile. Tile is 13”x14”. Angle can be whatever cross-sectional area is available.
TTA:13”
8”
TDA
TC10
TC6
TC8
16” long
TC9
TC5
TC4
TC3
TC2
TC1
TC7
TTD PMT
Test support stand
0.25” diameter x 6” tubes
0.25”x1” cross-sectional
area of frame pieces
2-21” long sides (other side is
16”long). Frame is 3-sided.
Tile rests on bottom of chamber
PMT

Figure 2

10.1.2. Set Up Internal Unit Under Test

Using the TDA Test B Procedure. Set-up test equipment in and around T-Vac chamber as shown in Figure 1.

10.1.2.1. Position Unit Under Test

Place the units under test on the TDA test fixture in the vacuum chamber. Attach PMT/Resistor network assemblies and fixture on the thermal vacuum chamber baseplate.

10.1.2.2. Make Internal Connectors

Attach safety ground wires to rail and stand. Make internal electrical connectors, internal high voltage, and signal cables, as shown in Figure 1 and Appendix A.

Enter the serial number of the PMT assembly, the number of the internal High Voltage, and the high voltage feed-thru as a clock position (as seen from outside) in the following table. The High Voltage common must the on the center feed-thru.

PMT Serial Number	Internal HV Cable Number	Feed-thru Clock Position

Enter the serial number of the PMT Resistor assembly, the internal cable number and the external cable number, and the Preamp Input number in the following table. The internal cables may be marked with bands of kapton tape.

PMT Serial Number	Internal Cable	External Cable	Preamp Input

10.1.2.3. Site thermocouples

Attach thermocouples to test hardware at locations designated below, and as shown if Figure 2.

Thermocouple #	Location
1	PMT Assembly

2	PMT 1
3	PMT 2
4	PMT 3
5	TDT PMT
6	TDA 01 Connector
7	TDA 02 Connector
8	Panel (Top)
9	TDA Tile Bottom
10	TDA Tile Top

10.1.3. Set Up External Test Equipment

Using the TDA Test B Procedure Section 3., set up external test equipment outside the vacuum chamber as shown in Figure 1.

10.1.3.1. Aliveness Test with Scope

Turn On Power supplies and set to initial voltage using the calibrated digital multimeter. Using the TDA Test Procedure Section 3.2 thru Section 3.17 use the oscilloscope to demonstrate that each PMT assembly produces data events.

10.1.3.2 Disconnect The High Voltage

Turn off high voltage power supplies and de-mate the high voltage connections at the high voltage supplies.

10.1.3.3 High Resistance Test

Using the PMT/Resistor Network Test Procedure, measure the resistance between the high voltage + input and high voltage return (shield for high voltage connectors), for each PMT/ Resistor Network. Log resistances below.

Warning: Failure to connect the High Voltage connections properly could damage flight equipment.

PMT S/N	(+)Probe	(-) Probe	Expected	Resistance
_____	Center Conductor	Shield	886 +/-88Mohms	_____ Mohms
_____	Center Conductor	Shield	886 +/-88Mohms	_____ Mohms
_____	Center Conductor	Shield	886 +/-88Mohms	_____ Mohms
_____	Center Conductor	Shield	886 +/-88ohms	_____ Mohms

10.1.3.4 Reconnect HV Cable

Reconnect the External High Voltage and check that the common return is on the center feed-thru.

Warning: An improper connection of the External High Voltage Cable could damage Test Hardware.

10.1.3.4. Close Vacuum Chamber

This step is to be performed by Code 545 personnel.

10.1.3.5. Functional Test B

Run TDA Test B Procedure (Section 4.) with the chamber closed to demonstrate that all cables are connected properly and all PMT are operating.

10.2. Vacuum Testing

Turn off high voltage power supplies and de-mate the external high voltage connections at the high voltage supplies.

Warning: Failure to disconnect the High Voltage prior to pump down could damage test hardware.

High Voltage Power Supplies turned off and disconnected .

Performed by _____ (initials) Time_____

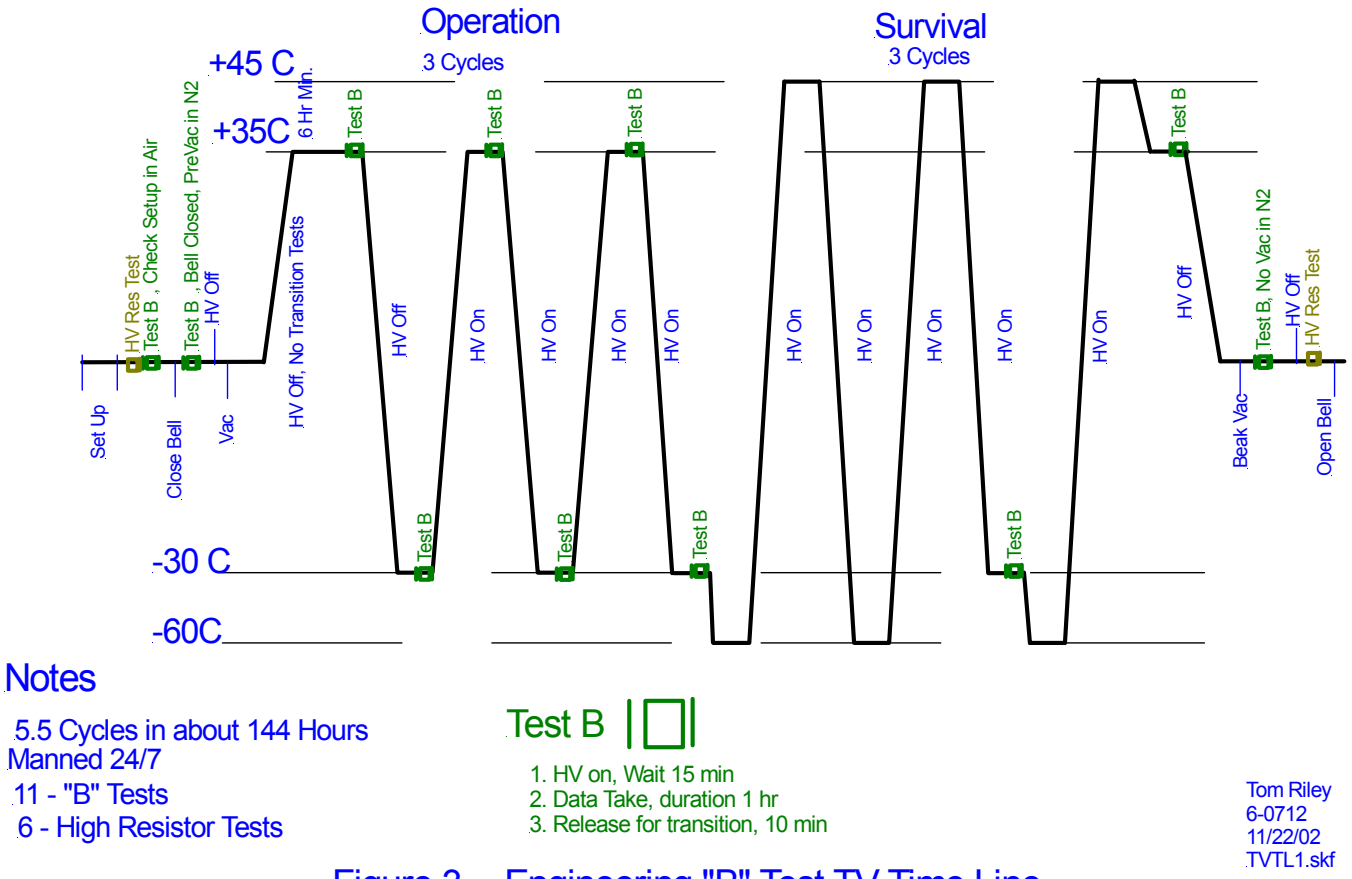


Figure 3 -- Engineering "B" Test TV Time Line

10.3.1 Pump down Vacuum Chamber

This step will be performed by Code 545 personnel.
Initiate vacuum chamber pump down. The target pressure for this test is 1x10-6 torr.

10.3.2 Reconnect HV Cable

After the chamber pressure has been less than 1 x 10-6 for 4 hours,
Reconnect the External High Voltage and check that the common return is on the center feed-thru.

Warning: Miss-connection of the External High Voltage Cable could damage test hardware.

10.4 Thermal Cycling

10.4.1 Following the profile in Figure 3, set the chamber shroud temperature +50 C.

Note: During hot soaks the chamber pressure may go above 1x 10-6 torr due to outgassing. Therefore it is prerequisite to wait until the chamber pressure is less than 5 x10-5 torr prior to initiating hot soaks.

10.4.2. After all TCs have reached +35 C +/- 2 C, and the chamber pressure is less than 5 x 10-5, begin Hot Soak #1. Set chamber temperature to +35 C. Record the Hot Soak #1 start time and chamber pressure.

_____Start Time Hot Soak #1 _____Chamber Pressure (torr)

10.4.3. After 4 hours of Hot Soak # 1, using TDA Test B Procedure Section 3., run Test B.

_____Start Time for Test B
_____End Time for Test B

10.4.4. Hot to Cold Transition (Following the profile in Figure 3)

10.4.5. Set the chamber shroud temperature to -45 C.

10.4.6. After all TCs have reached -30 C +/- 2 C, Set chamber shroud temperature to –30 C. Begin Cold Soak #1.

_____Start Time Cold Soak #1

10.4.7. After 2 hours at –30 C +/-2 C, using TDA Test B Procedure Section 3., run Test B.

_____Start Time for Test B
_____End Time for Test B

10.4.8. Cold to Hot Transition (Following the profile in figure 2)

10.4.9. Set the chamber shroud temperature to +50 C.

10.4.10. After all TCs have reached +35 C +/- 2 C. Set chamber temperature to +35 C. When the chamber pressure is less than 5 x 10-5, begin Hot Soak #2. Record the Hot Soak #2 start time and chamber pressure.

_____Start Time Hot Soak #2 _____Chamber Pressure(torr)

10.4.11. After 2 hours at Hot Soak #2, using TDA Test B Procedure Section 3.0, run Test B.

_____Start Time for Test B
_____End Time for Test B

10.4.12. Hot to Cold Transition (Following the profile in Figure 3)

10.4.13. Set the chamber shroud temperature to -45 C.

10.4.14. After all TCs have reached -30 C +/- 2 C, Set chamber temperature to -45 C, begin Cold Soak #2.

_____Start Time Cold Soak #2

10.4.15. After 2 hours at –30 C +/-2 C, using TDA Test B Procedure Section 3.0, run Test B.

_____Start Time for Test B
_____End Time for Test B

10.4.16. Cold to Hot Transition (Following the profile in Figure 3)

10.4.17. Set the chamber shroud temperature to +50 C.

10.4.18. After all TCs have reached +35 C +/- 2 C, Set chamber temperature to +35 C. Begin Hot Soak #3.

Record the Hot Soak #3 start time and chamber pressure.

_____Start Time Hot Soak #3 _____Chamber Pressure(torr)

10.4.19. After 2 hours at Hot Soak #3 C, using TDA Test B Procedure Section 3.0, run Test B.

_____Start Time for Test B
_____End Time for Test B

10.4.20. Hot to Cold Transition (Following the profile in figure 2)

10.4.21. Set the chamber shroud temperature to -45 C.

10.4.22. After all TCs have reached -30 C +/- 2 C, Set chamber temperature to -35 C. Begin Cold Soak #3.

_____Start Time Cold Soak #3

10.4.23. After 2 hours at –30 C +/-2 C, using TDA Test B Procedure Section 3.0, run Test B.

_____Start Time for Test B
_____End Time for Test B

10.4.24. Cold Operation to Cold Survival Transition (Following the profile in Figure 3)
10.4.25. Verify that the PMT survival heater on the PMT test assembly is turned on.
10.4.26. Set the chamber shroud temperature to -80 C.

10.4.27. After all TCs, (other than those associated with the PMTs, which will be maintained above -40C by survival heaters), have reached -60 C +/- 2 C, set chamber temperature to -60 C . Begin Cold Survival Soak #1. Record the start time for survival soak #1. After 4 hours at –60 C +/-2 C, record the end time for Survival Cold Soak #1.

_____Start Time Cold Survival Soak #1 _____End Time for Survival Soak#1

10.4.28. Cold to Hot Transition (Following the profile in figure 2)

10.4.29. Set the chamber shroud temperature to +50 C.

10.4.30. After all TCs have reached +45 C +/- 2 C, set chamber temperature to +45 C, begin Hot Survival Soak #1.

_____Start Time Hot Survival Soak #1

10.4.31. After 4 hours at +45 C +/-2 C. Record the end time for Hot Survival Soak #1.

_____End Time for Hot Survival Soak #1

10.4.32. Hot Survival to Cold Survival Transition (Following the profile in figure 2)

10.4.33. Set the chamber shroud temperature to -80 C.

10.4.34. After all TCs, (other than those associated with the PMTs, which will be maintained above -40C by survival heaters), have reached -60 C +/- 2 C, set chamber temperature to -60 C begin Cold Survival Soak #2. Record the start time for Survival Soak #2. After 4 hours at –60 C +/-2 C, record the end time for Survival Cold Soak #2.

_____Start Time Cold Survival Soak #2 _____End Time for Survival Soak#2

10.4.35. Cold to Hot Transition (Following the profile in figure 2)

10.4.36. Set the chamber shroud temperature to +50 C.

10.4.37. After all TCs have reached +45 C +/- 2 C, Set chamber temperature to +45 C, begin Hot Survival Soak #2.

_____Start Time Hot Survival Soak #2

10.4.38. After 4 hours at +45 C +/-2 C. Record the end time for Hot Survival Soak #2.

_____End Time for Hot Survival Soak #2

10.4.39. Hot Survival to Cold Operational Transition (Following the profile in figure 2)

10.4.40. Set the chamber shroud temperature to -45 C.

10.4.41. After all TCs have reached -30 C +/- 2 C, set chamber temperature to +35 C, begin Cold Soak #4. Record the start time for Cold Soak #4. After 2 hours at –30 C +/-2 C, Using TDA Test B Procedure Section 4.0, run Test B.

_____Start Time Cold Soak #4
_____Start time for Test B.

10.4.42. Cold Operation to Cold Survival Transition (Following the profile in Figure 2)

10.4.43. Set the chamber shroud temperature to -80 C.

10.4.44. After all TCs, (other than those associated with the PMTs, which will be maintained above -40C by survival heaters), have reached -60 C +/- 2 C, Set chamber temperature to -60 C, begin Cold Survival Soak #3. Record the start time for survival soak #1. After 4 hours at –60 C +/-2 C, record the end time for Survival Cold Soak #3.

_____Start Time Cold Survival Soak #3 _____End Time for Cold Survival Soak #3

10.4.45. Cold to Hot Transition (Following the profile in figure 2)

10.4.46. Set the chamber shroud temperature to +50 C.

10.4.47. After all TCs have reached +45 C +/- 2 C, set chamber temperature to +45 C, begin Hot Survival Soak #3.

_____Start Time Hot Survival Soak #3

10.4.48. After 4 hours at +45 C +/-2 C. Record the end time for Hot Survival Soak #3.

_____End Time for Hot Survival Soak #3

10.4.49. Hot Survival to Hot Operational Transition (Following the profile in Figure 3)

10.4.50. Set the chamber shroud temperature to +50 C.

10.4.51. After all TCs have reached +35 C +/- 2 C, set chamber temperature to +35 C begin Hot Soak #4. Record the start time for Hot Soak #4. After 2 hours at +35 C +/-2 C, Using TDA Test B Procedure Section 4.0, run Test B.

_____Start Time Hot Soak #4

_____Start time for Test B.

10.4.52. Set the chamber shroud temperature to +20 C.

10.4.53. After all TCs, have reached 25 C +/- 2 C, begin Ambient Soak. Record the start time for Ambient Soak.

10.**5** End Thermal Cycling/Break Vacuum

10.5.1 Turn off High Voltage to PMTs and disconnect leads from the power supply**.**

_____(initials) _____time High Voltage turned off.

10.5.2 After 2 hours at 20 C +/-2 C, backfill the chamber with GN2 for 20 min.
This step is to be performed by Code 545 personnel.

10.6 Final Functional Test

10.6.1 Turn on the High Voltage to the PMTs and using After 20 minutes of GN2 purge, using TDA Test B Procedure Section 4.0, run Test B.

_____Start time for Test B

10.6.2 Turn of High Voltage to PMTs and disconnect leads from the power supply.

_____(initials) _____time High Voltage turned off.

_____Start Time Cold Survival Soak #3 _____End Time for Cold Survival Soak#3

10.7 Perform High Resistance Test on PMT/Resistor Networks.

Using the PMT/Resistor Network Test Procedure, check the resistance between the high voltage + input and high voltage return (shield for high voltage connectors), for each PMT/ Resistor Network. Log resistances below.

Warning: Failure to connect the High Voltage connections properly could damage test hardware.

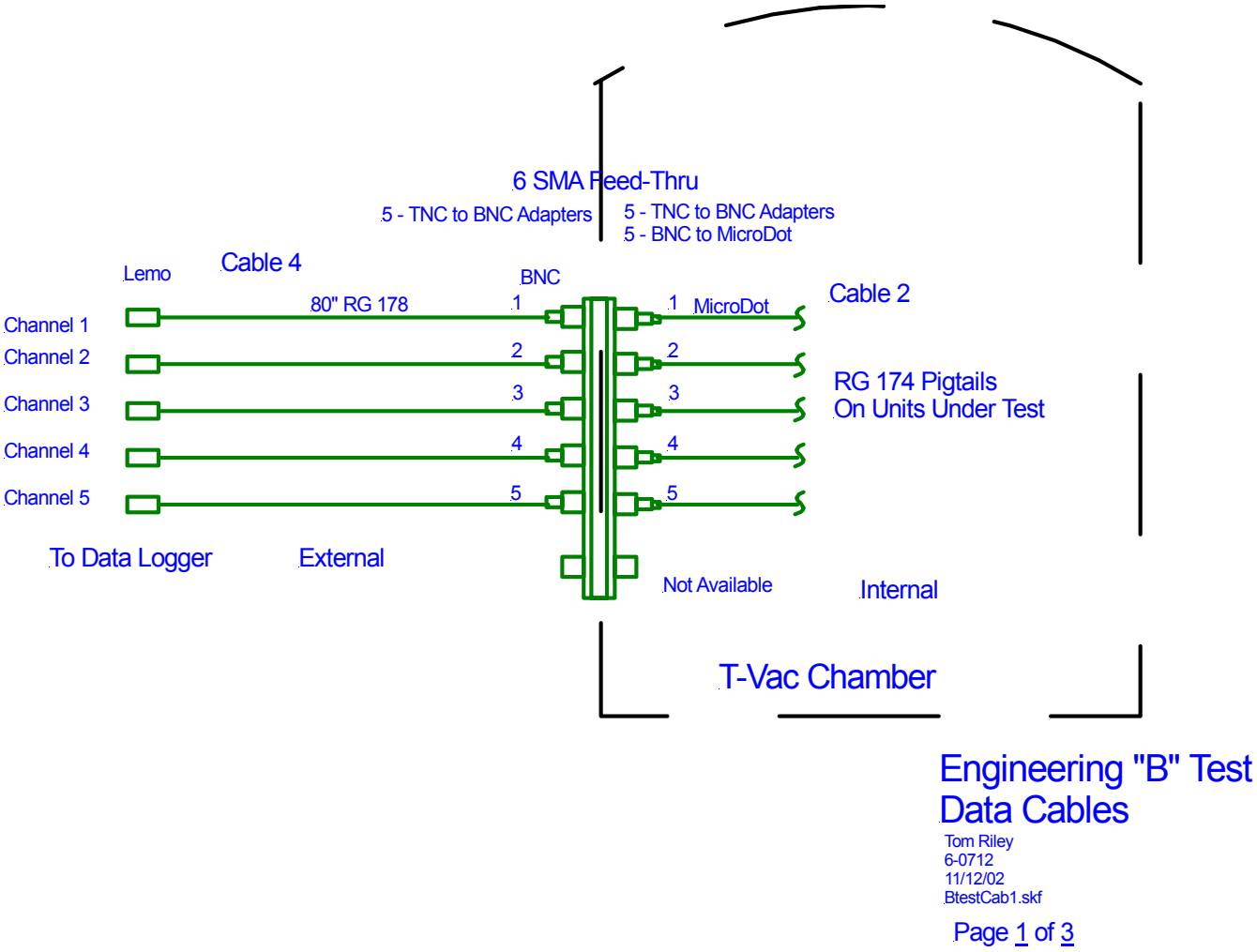
PMT	(+)Probe	(-) Probe	Expected	Resistance
_____	Center Conductor	Shield	886 +/-88mohms	_____ Mohms
_____	Center Conductor	Shield	886 +/-88mohms	_____ Mohms
_____	Center Conductor	Shield	886 +/-88mohms	_____ Mohms
_____	Center Conductor	Shield	886 +/-88mohms	_____ Mohms

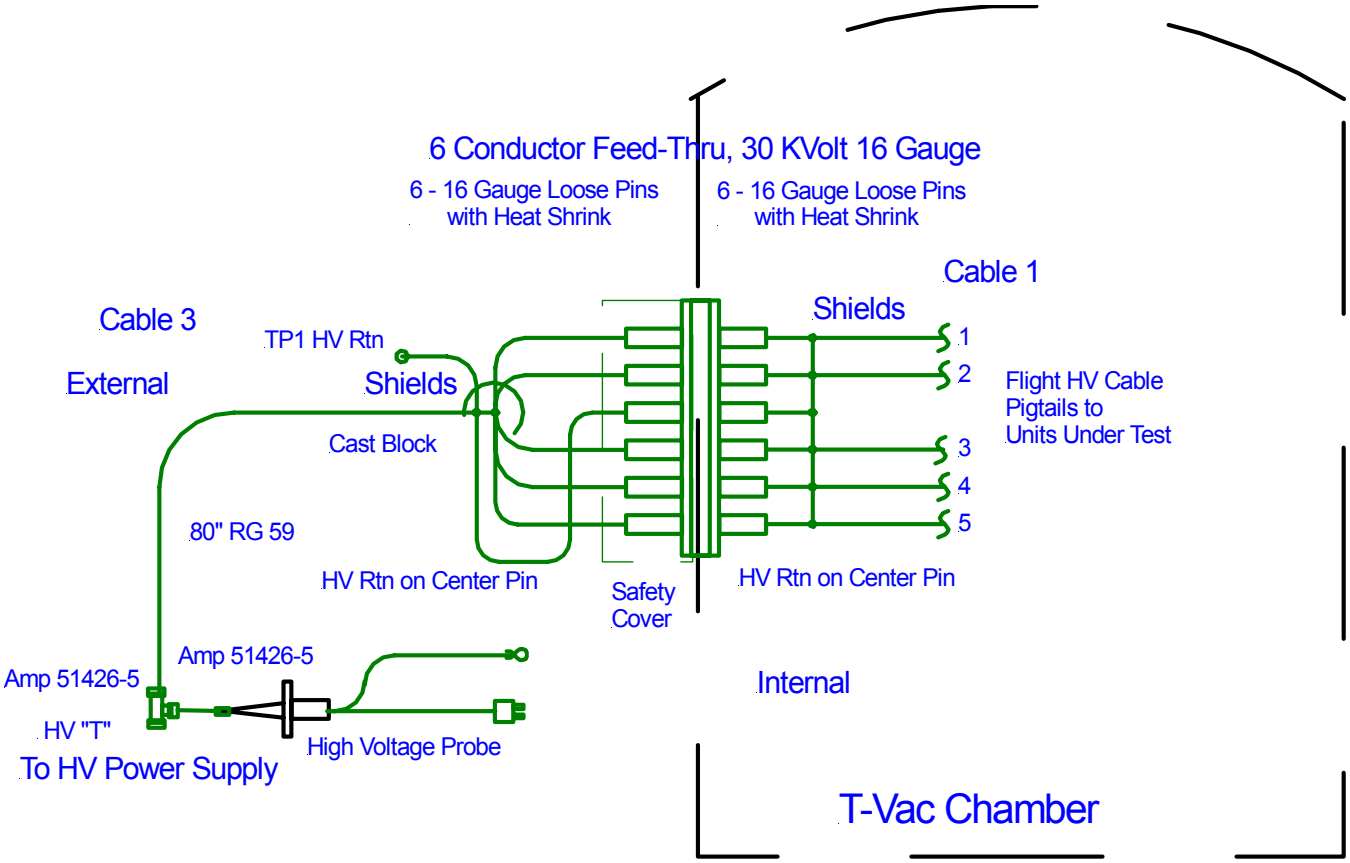
10.8 Turn off High Voltage Supplies, Turn off and disconnect all test equipment.

10.8.1. Open the Vacuum Chamber. Code 545 personnel shall perform this step.

10.8.2. Back Up Data to disks

Appendix A, Cable Drawings





Notes:

1. External HV Cable High-Pot to 1400 Volts for 20 minutes
2. Secure internal cable with head srink and flight tie wraps.
3. Secure external cable with tye wraps.

Engineering "B" Test High Voltage Cables

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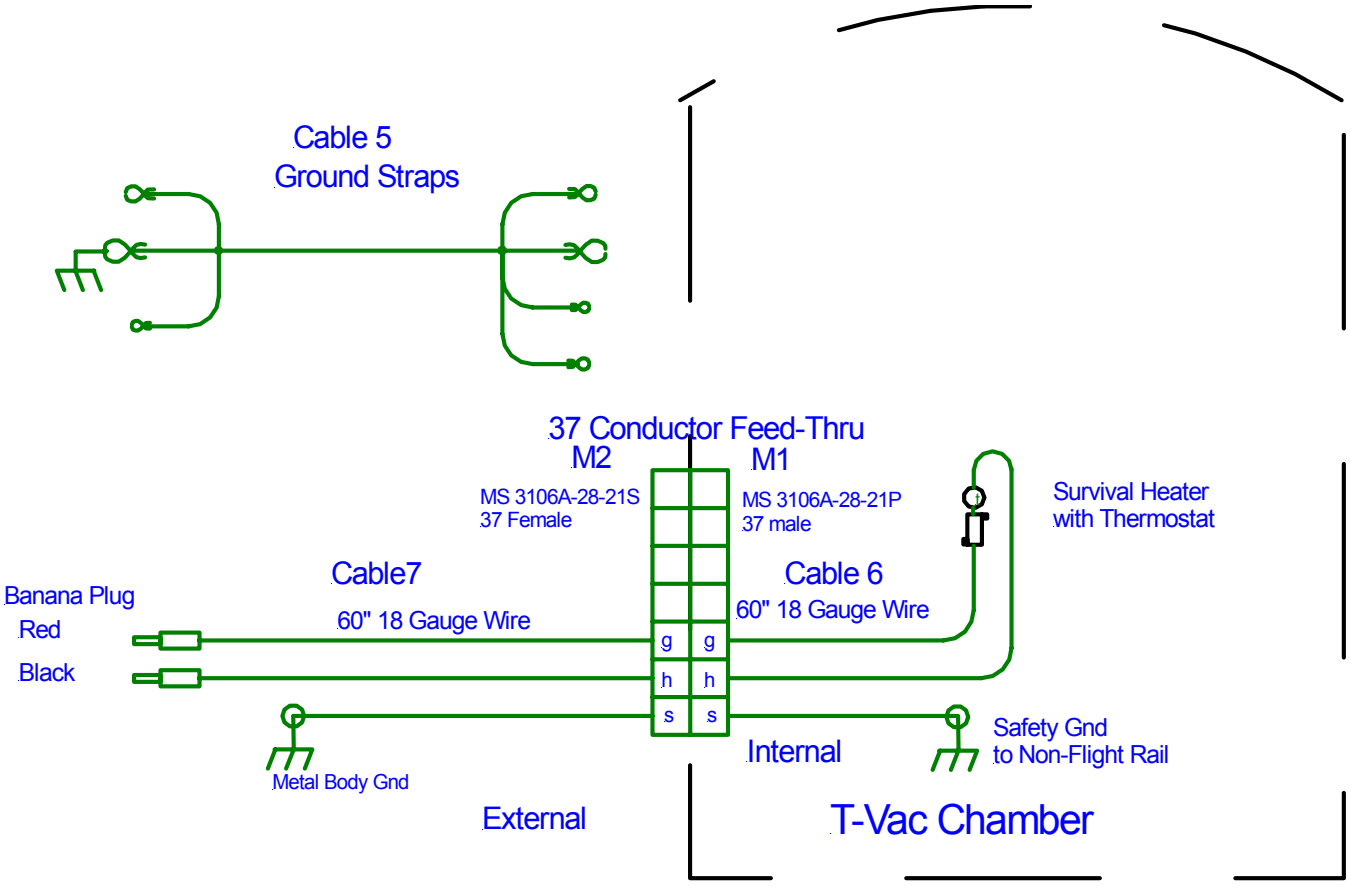

Engineering "B" Test
Miscellaneous Cables

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CHANGE HISTORY LOG

Revision / Author	Effective Date	Description of Changes
Tom Riley	10/08/02	Base Version
Bill Reaves	10/29/02	Draft
Bill Reaves	11/15/02	Final Draft
Tom Riley	11/22/02	Revise illustrations, add cable drawings