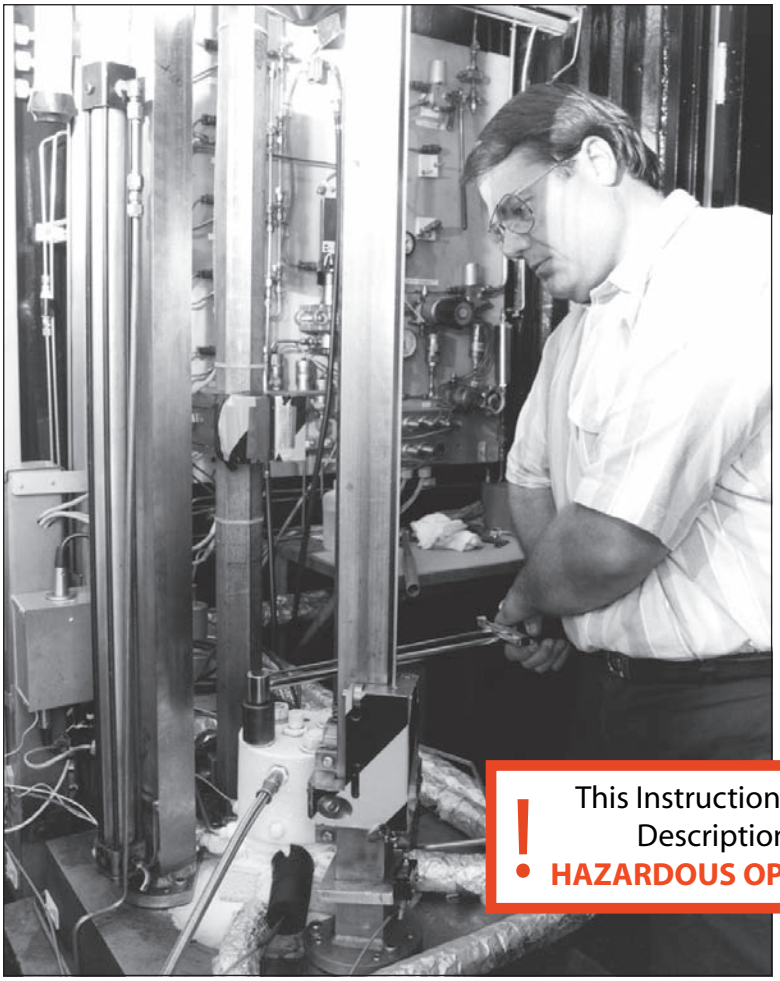
High Pressure Impact Testing

(NASA-STD-6001,Test 13B)



! This Instruction Contains Descriptions of HAZARDOUS OPERATIONS !

Materials and Processes Laboratory
Materials Test Branch, Building 4623

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

Release Authority	Name	Title	Organization	Date
Office of Primary Responsibility	[s] Gail H. Gordon	Materials Test Branch Chief	EM10	11/15/05
	[s] Dennis Davis	Industrial Safety	QD50	11/16/05

Revision	Date	Originator	Description	Affected Pages
Baseline	2/4/05	Eddie Davis	Document converted from ED36-OWI-033. Previous history retained in system as part of canceled or superseded ISO Document files.	All
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This document baselines the EM10 Organizational Work Instruction (OWI) for performing high pressure liquid oxygen and gaseous oxygen impact tests in Builiding 4623. Any deviation to this OWI shall be approved by the test engineer via an approved test plan. Any changes to the test equipment shall be noted on the tester maintenance log and approved by the test engineer. It is the responsibility of the test engineer to obtain NASA Contracting Officer's Technical Representative (COTR) approval where necessary for changes to the test equipment.

Any change to this OWI shall be submitted to and approved by the Materials Test Branch Chief, EM10. Revisions may be also be submitted to the concurring organizations listed below for review and concurrence by memo. The original OWI and all changes shall be maintained by EM10. Any change to materials used requires a change to mechanical drawings, in addition to Chemistry Team Leader approval. All documentation shall be approved by the appropriate persons mentioned above and incorporated into the OWI before operation of the reconfigured test equipment can resume.

Concurring organizations:
Building 4623 Test Contractor
EM10 COTR
Environmental Health, AD60M

Contents

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1.0 Scope

1.1 Scope

The scope of this Organizational Work Instruction (OWI) is NASA-STD-6001, Test 13B, High Pressure Impact Testing, as performed in Building 4623 at Marshall Space Flight Center

1.2 Purpose

The purpose of Test 13B is to determine the impact sensitivity of materials when exposed to 50- to 10,000-psi liquid oxygen (LOX) or gaseous oxygen (GOX). This document covers the determination of the reactivity of a material to mechanical impact when exposed to a high-pressure LOX or GOX environment, operating instructions, and calibration of instrumentation.

1.3 Applicability

This instruction applies to the Chemistry Team, Materials Test Branch, of the Materials and Processes Laboratory.

2.0 Applicable Documents

ASTM G 86-84. *Standard Test Method for Determining Ignition Sensitivity of Materials to Mechanical Impact in Pressurized Oxygen Environments.*

EM10-OWI-CHM-042. *Test Sample Preparation for Testing in Building 4623.*

EM10-OWI-CHM-050. *Building 4623 Guidelines for Test Operations.*

EM10-OWI-CHM-051. *Receipt, Handling, Prioritizing, and Data Requirements of Samples Submitted for Testing in Building 4623 of the Materials and Processes Laboratory*.

EM10-OWI-CHM-058, *Chemical Hygiene Plan for Building 4623*.

MPD 1840.3. *MSFC Respiratory Protection Program*.

MPR 1040.3. *MSFC Emergency Plan*.

MPR 1840.2. *MSFC Hazard Communications Program*.

MPR 8715.1. *MSFC Safety, Health, and Environmental (SHE) Program*.

MPR 8823.2. *Pressure Systems Guidelines and Certification Requirement*.

MSFC-SPEC-164B. *Specification for Cleanliness of Components for Use in Oxygen, Fuel, and Pneumatic Systems*.

MWI 3410.1. *Personnel Certification Program*.

MWI 8621.1. *Close Call and Mishap Reporting and Investigation Program*.

NHB 8060.1B. *Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion*. September.

NASA-STD-6001. *Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion*.

Note: Always refer to the most current version of the above documents.

3.0 Definitions

3.1 Definitions

Batch test. Test material for 100% LOX or GOX (use environment required) compatibility at maximum use pressure. Material shall pass NASA-STD-6001, Test 13B, or have an MUA written and approved by EM01 for use of the material.

Blank. A one-piece or two-piece specimen cup containing only a stainless-steel insert .

Disk. An anodized aluminum-alloy disk used as a carrier for dyes, dye penetrants, and emulsifiers. Because of the potential for ignition of the aluminum disk by reaction of certain materials, 316 stainless-steel or design-use metal disks shall be used in place of the aluminum disk when specified on the test plan by the test engineer.

Full access. Anyone may enter the test cell at any time.

Limited access. Only the test operator shall enter the test cell with the appropriate personal protective equipment. The back gates shall be locked. The red TensaBarrier® sign shall be placed in front of the door to the cells. The facility warning beacons that indicate that personnel are preparing to test shall be activated.

Mechanical impact. Energy delivered to a sample by a plummet that has been dropped from a pre-established height onto a striker pin in contact with the sample.

NASA. Marshall Space Flight Center EM10 responsible personnel.

No access. No one shall enter the test cell at any time. The back gates shall be locked. The test operator shall ensure that no one is in the testing area, shall place the *Danger -High Pressure - Do Not Enter* sign over the door to the cells, and shall turn on the facility warning beacon to indicate that a test is in progress or that part or all of the test system is pressurized.

Insert. A stainless-steel disk used solely for a blank test.

Insert (grease) cup. A stainless-steel cup used for semisolid samples.

One-piece specimen cup. An Inconel 718 alloy cup used for solid and liquid samples.

Oxygen deficient. Oxygen level in air is less than 19.5%.

Oxygen enriched. Oxygen level in air is greater than 23.5%.

Reaction. A chemical change or transformation in the sample resulting from mechanical impact that can be determined by a detected flash and that may be supplemented by obvious charring of the sample, sample cup, or striker pin.

Substrate. A stainless-steel disk used as a base for dry film lubricants or paint specimens. Design-use metal disks shall be used in place of the stainless disk when specified on the test plan by the test engineer.

Tag out. The placement of a tag-out device on an energy isolating device according to procedure to indicate that the energy isolating device and equipment being controlled shall not be operated until the tag-out device is removed by the person who placed it there.

Test 13B. Mechanical impact testing for materials in variable pressure LOX or GOX in accordance with NASA-STD-6001.

Test area. The portion of Building 4623 and fenced area south of the north wall of Room 118.

Test cell. The room in which the HIPIT tester itself is located: Room 118A of Building 4623

Test engineer. The person responsible for correctly following the approved test plan for a specific test from sample receipt to test data evaluation.

Test operator. The person responsible for conducting the test under the guidance of the test engineer.

3.2 Acronyms

GOX	Gaseous oxygen
GN_2	Gaseous nitrogen
HIPIT	High-Pressure Impact Tester
LOX	Liquid oxygen
LN_2	Liquid nitrogen
MSDS	Materials Safety Data Sheet
MSFC	Marshall Space Flight Center
MUA	Materials Usage Agreement
O_2	Oxygen
OWI	Organizational Work Instruction
PTFE	Polytetrafluoroethylene
RMS	Root Mean Square

4.0 Instructions

All operations of this equipment shall be conducted using the applicable documents referenced above (section 2). All critical measuring devices, *e.g.*, pressure gauges and pressure transducers, shall be in current calibration (section 9.4). All data and test results shall be recorded on form EM10-F-CHM-027, the Test 13B (section 7.2, Figure 7-2). A summary of pertinent test information and test results shall be compiled in an NASA memorandum, signed by the test organization management, and mailed to the test requester.

The purpose of Test 13B is to determine if materials in liquid oxygen or gaseous oxygen at pressures from 50- to 10,000-psi react when mechanically impacted. For a GOX environment, temperatures up to 600 ˚F are currently possible.

4.1 Sample Preparation

The *sample preparation technician* **shall prepare** Test 13B samples according to EM10-OWI-CHM-042, *Test Sample Preparation for Testing in Building 4623*. When non-standard samples are required, the *sample preparation technician* **shall follow** the directions written in the test plan for that test request. *If this information is not provided with the test plan*, the *sample preparation technician* **shall seek clarification** from the test engineer.

Before testing begins, the *test operator* **shall review** the information supplied on the test data sheet (prepared by the sample preparation technician) to make certain the information is complete and appears sound. *If a problem is identified*, the *test operator* **shall notify** the test engineer and **await further instruction**. The *test operator* shall also:

- **Verify** that the test request number and material designation are identical on all paperwork.
- **Confirm** that the prepared sample agrees with the test request.
- **Verify** that the sample preparation technician has noted if the sample has been cleaned or if the sample does not require cleaning.
- **Note** any flaws or imperfections in the sample, and **record** these on the test data sheet.
- **Review** the test plan and the original test request before proceeding. *If the test plan and the test request do not agree,* the test operator **shall request** clarification from the test engineer.

4.2 Pre-Test Photography

The *sample preparation technician* **shall take** a pre-test photograph of at least one of the samples, and **place** three copies of the photograph in the test folder. *If the pre-test photograph has not been taken*, the *test operator* shall **take** this photograph and **place** three copies of the photograph in the test folder before proceeding with the test. The entire sample **shall be visible** in the photo. Steps for photographing samples are outlined in the *Photography Operating Guide*.

4.3 Equipment Checkout

At the beginning of each test day, the test operator **shall perform** the following steps:

4.3.1. **Ensure** that the oxygen level in the test cell is acceptable before entering. Oxygen levels in each test cell are constantly monitored. *If the oxygen levels drop below 19.5% or rises above 23.5%,* an alarm will sound and a red light will flash. Exact oxygen levels are displayed at the facility monitoring station located in Room 113.

4.3.2. **Ensure** the safety dowel (located on the impact tester stand) is fully inserted in a hole on the magnet base support post closest to the plummet to prevent the plummet assembly from falling accidentally during system checkout.

4.3.3. **Ensure** that the test cell floor and the room behind the test cell are visibly clean before testing begins each day. *If conditions warrant*, **scrub** the floor of the cell with a detergent solution, and **rinse** with water. **Verify** that the test cell is neat and free of excess materials, spare parts, *etc.*

4.3.4. **Check** the plummet assembly before each test request, making sure that the plummet spiders are attached securely to the plummet body and that the wheels are securely mounted on the spiders. **Hand-tighten** and/or **replace** the wheels, axle bolts, *etc., if they are damaged.* Also, **ensure** that the spiders are in proper alignment with the test stand columns and that the wheels rotate freely. **Ensure** that the nut on top of the magnet housing is hand-tight. **Ensure** that the bolts holding the column in place are hand-tight (torqued to approximately 25 ft-lb) before chilling the tester.

4.3.5. **Examine** the concrete pedestal at the beginning of each test day for any crumbling. **Examine** the struts for bends or large scratches. Examine the plummet catcher assembly and cable for loose bolts, rollers, and frays in the cable. **Report** any problems to the test engineer.

4.3.6. **Ensure** that the ceiling exhaust fan, and facility warning beacon are working:

WARNING: Always use the safety dowel when working in the plummet fall/ impact path.

- **Turn on** the exhaust fan, and **listen** for operation.
- **Turn on** the facility warning beacon.

Report any problems to the test engineer.

4.3.7. **Use** clean, chemically resistant gloves during all cleaning operations. **Wipe** struts, base, plummet, catcher, photocell brackets, shelves, dome valve housings near the pressurized chamber, and lines near the pressurized chamber with a three-ply tissue dampened with a solution of non-ionic soap and distilled or deionized water (1 part soap to 128 parts water.) *If the soap solution does not appear to clean sufficiently after the equipment dries*, **clean** with a trichlorotrifluoroethane-dampened three-ply tissue. (Substitution of trichloroethylene or Brulin® 815 MX for trichloro-trifluoroethane is allowed, provided the cleaning is performed in a well-ventilated area.) **Cover** shelves with clean aluminum foil. *If the foil is damaged and worn,* **replace** it with new clean foil.

Note: Discard any rags and debris soaked with trichlorotrifluoroethane (or organic material) in the *Organic Rags and Debris* hazardous control drum located in Room 128 (in the fenced area south of Building 4623). **Do not discard these rags in any other receptacle.**

4.3.8. **Ensure** all test equipment, electrical components, wiring, *etc.,* are in good condition and properly connected and grounded. **Inspect** coax cables and wiring before each test for fraying, wetness, and damage. **Identify** any faulty wiring to the test engineer.

4.3.9. **Turn on** the video monitor and camera, and **verify** that they are working properly.

4.4 System Setup and Sample Loading

The test operator shall **perform** the following steps:

4.4.1. **Set up** the Nitrogen Control Panel, located in Room 118A.

4.4.1.1. At the Nitrogen Control Panel, **ensure** that the GN_2 supply valve is fully open, *i.e.,* turned counterclockwise as far as possible. *If the GN_2 supply valve is not open,* **perform** the following steps:

4.4.1.1.1. **Ensure** all regulators on the Nitrogen Control Panel are in the closed positions, *i.e.*, turned fully counterclockwise.

4.4.1.1.2. **Slowly open** the GN_2 supply valve by turning it counterclockwise until the GN_2 supply reaches its maximum pressure, as indicated by the supply gauge (GN2 SUPPLY PRESS).

4.4.1.1.3. **Slowly open t**he pin balance supply regulator by turning it clockwise to a maximum pressure of 1,000 psig, as indicated by the balance supply gauge (BALANCE PRESS.).

4.4.1.1.4. **Slowly open** the actuation supply regulator by turning it clockwise to a maximum pressure of 100 psig, as indicated by the activation supply gauge (ACTUATION PRESS.) on the Nitrogen Control Panel.

4.4.1.1.5. **Slowly open** the GN_2 purge supply regulator by turning it clockwise to a maximum pressure between 110 and 120 psig, as indicated by the GN_2 purge supply gauge (GN2 PURGE SUPPLY).

4.4.1.2. **Ensure** that an adequate supply of GN_2 is available (approximately 1000 to 1,500 psig) by reading the GN_2 supply gauge (GN2 SUPPLY PRESS.) located on the panel.

Note: In extreme cases and for low-pressure tests (≤1,999 psi) only, the system can be run with as low as 400 psi GN_2.

4.4.1.3. Visually **inspect** the gauges to ensure that all read as follows:

- Pin balance supply (BALANCE PRESS.): set to a maximum of 1,000 psig
- Actuation supply (ACTUATION PRESS.): set to a maximum of 100 psig
- GN_2 purge supply (GN2 PURGE SUPPLY): set to a maximum of 120 psig.

4.4.2. **Inspect** the contents of the test folder to ensure that the following information is provided:

- Test request
- Signed test plan
- Test data sheets
- Sample preparation sheet
- Test material's MSDS or the Exclusion Statement for the material being tested
- High-Pressure Impact Tester Pre-Test Checklist
- Pre-test photographs. (**See** section 4.2.)

WARNING: Read the test material's MSDS to ensure familiarity with all safety precautions associated with the material. Verify that the test engineer is aware of all highly hazardous, reactive, or toxic components of the test mate-

rial. The *test engineer* shall direct the test operator in proper safety procedures concerning these test materials.

4.4.3. The test plan shall define the energy and pressure as well as the test temperature. General guidelines for thresholding follow:

Note: Test plan instructions shall supersede the general procedures outlined in sections 4.4.3.1 and 4.4.3.2.

4.4.3.1. Pressure Screen Tests: **Perform** tests at an impact energy of 72 ft-lbf unless otherwise specified. **Vary** the pressure in increments or decrements indicated on the test plan. **Initiate** testing at the pressure level indicated on the test plan. Upon two reactions, **stop testing** at the pressure at which the two reactions occurred, and **decrease** the pressure in the decrements specified in the test plan. **Continue** to decrease the pressure until no reactions are observed in 20 drops or 1 reaction is observed in 60 drops. When this condition is met, testing is complete. If no reactions are observed after 20 drops or 1 reaction is observed out of 60 drops, **increase** the pressure in the increments specified in the test plan.

4.4.3.2. Energy Screen Tests: **Keep** pressure constant, and **start** testing at an impact energy of 72 ft-lbf unless otherwise specified. **Test** in decrements of impact energies (drop heights) as listed in section 7.2, Table 7-1. *If no reactions occur in 20 drops or if 1 reaction occurs in 60 drops,* testing is complete. Upon 2 reactions, drop to the next energy level as noted in section 7.2, Table 7-1. **Continue** to drop the energy level until no reactions are observed in 20 drops or 1 reaction is observed in 60 drops. When this condition is met, testing is complete.

4.4.4. **Ensure** that all required personal protective equipment is available and in proper working order. **Don** appropriate personal protective equipment: eye goggles, face shield, clean lab coat, clean safety shoes, and clean thermal gloves when handling cryogenic fluids.

4.4.5. **Check** LOX dewars to ensure that adequate amounts are available for testing. Check pressure on facility oxygen supply and the LN_2 ball dewar. When necessary, **change out** empty dewars, and **cap** both the tap and vent. **Ensure** that the flex line and diffuser tube do not touch the floor. **Send** any parts whose cleanliness is questionable to the Cleaning Facility.

4.4.6. **Turn on** facility warning beacon to indicate that hazardous testing is in progress. **Ensure** that the lights in the back and the front of the test cell are working. This places the area in a *limited-access* condition.

4.4.7. **Switch on** the test cell exhaust fan. This switch is on the south wall of the control room in Room 118.

4.4.8. From Controlled Inventory (Room 104), **obtain** the large and small PTFE spring-energized seals, balance piston, retainer nut bushings, balance chamber and base closure sections of the head assembly, PTFE washer/spacer, PTFE tape, 3/4-in. K seal, and elevated temperature GOX or GOX/LOX base as required by the test plan. (See Figure 4.4-1). Other spare piece parts (not including specimen cups, insert cups, disks, and substrates) shall be kept in the back of the test cell. **Refer** to the configuration control book for part numbers.

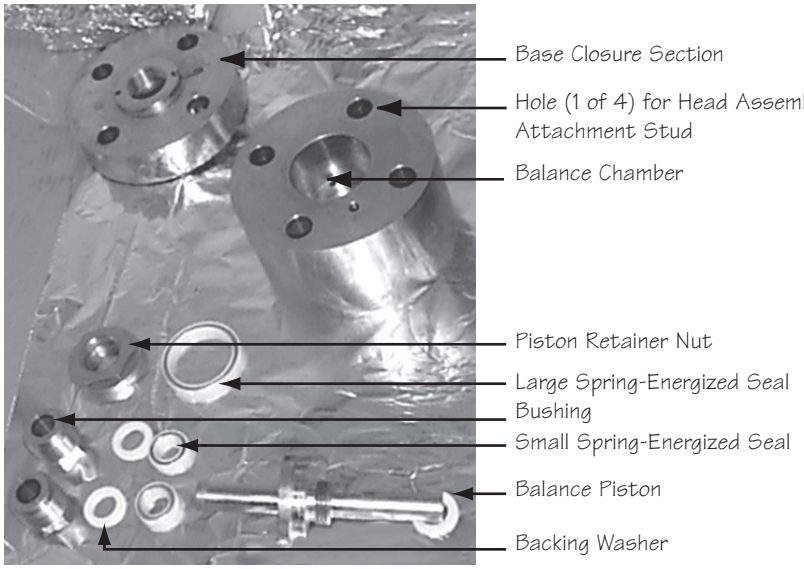


Figure 4.4-1.
Head Assembly Parts

4.4.9. **Ensure** that all of these parts that will or have the potential to be wetted with oxygen have been cleaned as described for LOX/GOX systems in sections 4.3.7 and 9.3, Required Tester Maintenance.

4.4.10. *If LOX tests were performed the day before*, the cell has undergone a forced thaw/drying process from the previous shift. **Don** hearing protection, and **remove** all residual condensation from the base area using dry filtered nitrogen.

4.4.11. **The two-part head assembly shall be built cleanly. Clean** the work area, and **line** it with clean aluminum foil. **Wear** clean latex gloves during assembly. **Refer** to the configuration control manual as needed during assembly and to the figures accompanying this section.

Note: In all subsequent assemblies, **tighten** threaded parts by turning them clockwise. **Loosen** them by turning them counterclockwise.

To put the head assembly together:

4.4.11.1. **Place** the spring side of a clean, large, spring-energized seal face up on the balance piston (Figure 4.4-2). **Do not crimp** the PTFE portion of the seal. The open spring portion of the seal always faces highest pressure.

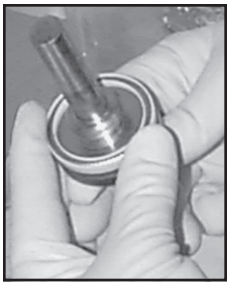


Figure 4.4-2.
Spring-energized seal on balance piston

Note: *If the head is to be used for a GOX test at 150 °F or greater*, **use** the *carbon-filled* spring-energized seals. *For GOX and LOX tests below 150 °F,* **use** the *white PTFE* spring-energized seals.

Figure 4.4-3.
Retainer nut atop seal.

4.4.11.2. **Place** a clean seal retainer nut on hand-tight but snug (Figure 4.4-3). (The spring side of the seal shall face the side of the nut resembling a washer.)

4.4.,11.3. **Place** a clean, small, spring-energized seal into the seating cavity on the top of the balance chamber section of the head assembly, spring side down (Figure 4.4-4).

4.4.11.4. **Thread** a clean bushing clockwise into the seating cavity until the bushing makes contact with the seal (Figure 4.4-5). **Gently tighten** the bushing until its shoulder is even with the top of the balance chamber section. This aids in seating the seal.

4.4.11.5. **Back out** the bushing counterclockwise from the balance chamber section. **Place** a PTFE backing washer into the cavity directly on top of the spring seal (Figure 4.4-6). **Apply** a small amount of perfluoroether grease (Krytox® 240AC or Braycote® 601EF) to the threads of the bushing, and **thread** the bushing clockwise into the seating cavity until hand-tight (Figure 4.4-7).

Assembling Top of Balance Chamber Section of Head Assembly

Figure 4.4-4.
Placing small seal.

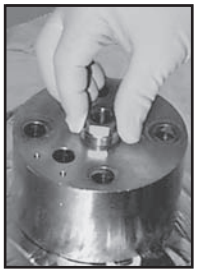


Figure 4.4-5.
Placing bushing in cavity.

Figure 4.4-6.
Placing washer on seal.

Figure 4.4-7.
Bushing threaded

4.4.11.6. **Check** the balance piston for straightness, changes in diameter, and sealing surface damage (mushrooming). **Apply** a small amount of perfluoroether grease (Krytox® 240AC or Braycote® 601EF) to the untapped end of the balance piston (approximately 1 in. up the shaft) and to the inside of the seating cavity (Figure 4.4-8). **Place** the balance chamber section on its side. **Gently insert** the untapped end of the balance piston into the spring-energized seal until the end protrudes through the top of the bushing or until the large spring seal on the striking piston makes contact with the opening in the bottom of the balance chamber section (Figure 4.4-9).

4.4.11.7. *Being careful not to crimp the PTFE* (if used) on the large spring seal, **gently tap** the 1/4-28 tapped end of the balance piston with a large rubber mallet until the large spring-energized seal has drifted completely inside the balance chamber section (Figure 4.4-10).

Installing Piston in Balance Chamber Section of Head Assembly

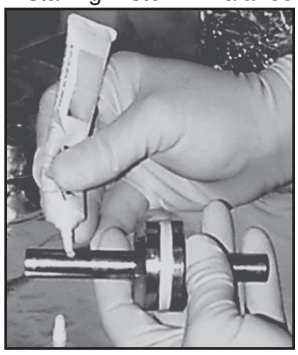


Figure 4.4-8.
Applying grease to balance piston.

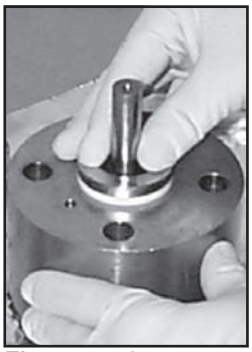


Figure 4.4-9.
Piston in balance chamber.

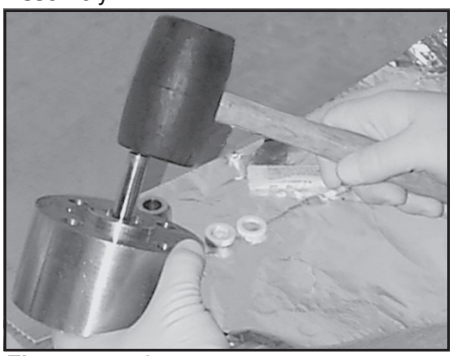


Figure 4.4-10.
Tapping piston.

4.4.11.8. **Place** pieces for the base-closure portion of the head assembly onto a clean section of aluminum foil. **Repeat** steps 4.4.11.3 through 4.4.11.5 to insert the small spring-energized seal into the base closure section of the head assembly (Figures 4.4-11 through 4.4-14).

Assembling Base Closure Section of Head Assembly

Figure 4.4-11.
Placing small seal.

Figure 4.4-12.
Placing bushing in cavity.

Figure 4.4-13.
Placing washer on seal.

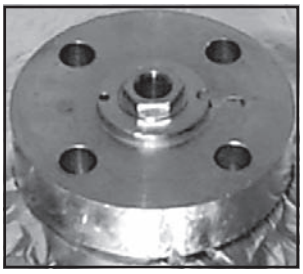


Figure 4.4-14.
Base closure assembled.

4.4.11.9. **Apply** a thin film of perfluoroether grease (Krytox® 240AC or Braycote® 601EF) to the 1/4-28 tapped end of the balance piston, approximately 1 in. up the shaft (Figure 4.4-15). **Insert** the 1/4-28 tapped end of the balance piston into the bushing of the base closure section (Figure 4.4-16). **Apply** enough force to the base closure section to cause the tapped end of the balance piston to protrude through the bottom of the base closure section (Figure 4.4-17).

4.4.11.10. **Tighten** the bushing on the top of the head assembly approximately 1/8 turn (Figure 4.4-18). The head assembly is ready for use and shall be installed after sample loading. **Set** the assembly aside on clean aluminum foil.

Completing Head Assembly

Figure 4.4-15. Applying grease.

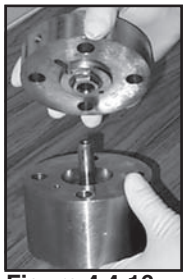


Figure 4.4-16. Piston inserted into base closure sections.

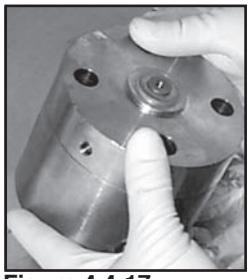


Figure 4.4-17. Inserting piston into base closure section/

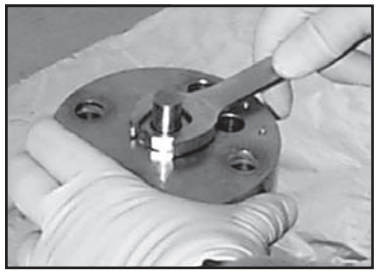


Figure 4.4-18. Tightening bushing to complete head assembly.

4.4.12. **Determine** the appropriate base for LOX/GOX or elevated temperature GOX testing as required in the test plan.

- **Use** base part number EH42-11A (Tilted Flash) for LOX test and ambient GOX test using short impact cups.
- **Use** base part number EH42-11B (Tilted Flash) for High Temperature GOX test using short impact cups.

Attach the clean base to the anvil/baseplate of the test stand with four NAS-1008-62A (or equivalent) bolts and four RD153-5005-008 (or equivalent) washers. (The maximum torque limit is 50 ft-lb.) **Refer** to the configuration control book as needed for assembly.

4.4.13. **Inspect** the head assembly attachment studs. **Replace** any worn studs with new or rethreaded studs. **Thread** the studs in the base, and **hand-tighten** them. To prevent seizing of the stud threads with the chamber head threads, **do not burr** the stud. **Tighten the studs before cooling the chamber.**

4.4.14. **Ensure** that the flash detector sight ports and adapters are clean. **Wrap** the 1/4-in. National Pipe Thread (NPT) threads of the adapters with clean, batch-tested PTFE tape, and **install** adapters into the base ports. **Refer** to the configuration control book for location of the base ports. **Inspect** the photodiodes and infrared filters for moisture and damage, and **replace** with new parts as necessary. **Place** the filters on the photodiodes, and **put** the photodiodes in the adapters in the base ports.

4.4.15. **Connect** the pressure transducer (PT) adapter to the impact base. **Refer** to the configuration control book for location of the PT port. The PT adapter consists of a section of 0.25-in. 316-SS tubing with a minimum wall thickness of 0.083 in. and a minimum length of 12 in. Tubing shall be coned and threaded on each end to accommodate a high-pressure nut and ferrel. A 0.25-in. high-pressure to 0.25-in. male NPT adapter shall be attached to one end to allow for PT connection. When elevated temperature GOX tests are scheduled, **install** an adapter in the new base, and **insert** the pressure transducer in the adapter.

4.4.16. When running GOX tests above ambient temperature, using base part number EH42-11B, **install** heaters as follows:

- **Wrap** 10-mil brass shim stock (cut to fit joint-to-joint) around the heating elements.
- **Attach** heater leads to the power cord using insulated butt-splices.
- **Insert** heaters into the base, taking care not to tear the shim stock. **Place** two at a 180-deg angle from each other for testing below 200 °F; **place** four at 90-deg angles from each other for testing above 200 °F. **Refer** to the configuration control book for location of the heaters
- **Plug** heaters into power receptacles provided. These receptacles are labeled 1 through 4 and are connected to a relay box (located on the east wall behind the impact tower), which indicates on the control panel in the control room that the heaters are operating correctly.

When running LOX test, using base part number EH42-11A, **connect** the LN2 cooling lines to the base.

Note: These are used to chill the base below the condensation temperature of GOX.

4.4.17. **Connec**t vent and feed lines to the base. **Refer** to the configuration control manual for locations.

4.4.18. Verify that the head assembly attachment studs are hand tight before chilling or heating the base chamber for the test.

4.4.19. **Perform** the following steps to load a blank:

4.4.19.1. **Don** clean latex gloves.

4.4.19.2. **Install** a clean striker pin on the head. **Finger-tighten** the striker pin until the back is flush with the balance piston. *If this is not possible,* the balance piston threads and/or striker pin threads may be damaged, or the balance piston may have contamination in the threaded hole that could escape during testing and contaminate the sample. *If threads are damaged on the piston,* **disassemble** the pinhead, and **send** the balance piston to a machinist for retapping. *If cleaning is required,* **refer** to section 9.3, Required Tester Maintenance.

4.4.19.3. Using clean tongs, **place** a blank in the test base.

4.4.19.4. **Place** a clean copper pressure head to the base gasket (P/N 50887 or equivalent) on the sealing surface of the test base. **Ensure** that the tapered end of the gasket is pointed upward.

4.4.19.5. **Align** the head assembly over the attachment studs in the base, and gently **lower** the head assembly onto the base, with the GN_2 balance port of the chamber facing the north test cell wall.

4.4.19.6. **Place** flat washers over the studs, and **hand-thread** the 5/8-in. nuts in a clockwise direction until two or three threads have engaged. Using a 1/2-in. drive pneumatic impact driver or a 1/2-in. drive ratchet, **tighten** the nuts. **Tighten** opposite nut pairs first to avoid damage to the studs; torque sequence shall be in a cross pattern. **Use** the 1/2-in. drive ratchet to complete torqueing. **Use** the minimum torque required to seal the chamber sufficiently to prevent leaks up to 80 ft lb. **Use** a calibrated torque wrench to verify finished torque.

4.4.20. **Adjust** the magnet housing assembly to the height required to achieve the desired energy level (section 7.2, Table 7-1) by performing one of the following procedures:

Note: Do not move the bottom velocity timer assembly. These timers are set to a predetermined height above the impact zone. Moving these timers will result in an incorrect energy reading.

4.4.20.1. Drop Height Adjustment Procedure for High to Low Adjustment

4.4.20.1.1. **Select** the correct drop height adjustment rod corresponding to the impact energy required for the test.

4.4.20.1.2. **Ensure** that the drop height adjustment rod is the correct length in accordance with section 7, Table 7-1.

4.4.20.1.3. **Ensure** that the plummet safety pin is in place under the plummet in one of the holes drilled in the magnet support post closest to the bottom (forward end) of the plummet.

4.4.20.1.4. *If it has not been released,* **use** the magnet by-pass switch on the operator console to release the plummet from the magnet.

4.4.20.1.5. With the drop height adjustment rod in easy reach, **stand** on the south side of the drop weight impact assembly facing the test console viewing window. **Ensure** that the plummet is resting on the plummet safety latch.

4.4.20.1.6. With the left hand, **support** the plummet at the lower (or forward) spider arm pointing west or the left of your position.

4.4.20.1.7. *If starting from a height above 33 inches:*

4.4.20.1.7.1. **Slide** the plummet safety pin out, and **place** it in a hole approximately half the distance to the head assembly or in the hole just above the velocity timers.

4.4.20.1.7.2. **Release** the plummet safety latch with the thumb of the right hand, and slowly **lower** the plummet until the plummet base plate clears the safety latch. At this point, **use** both hands to gently lower the plummet down to the plummet safety pin, where the plummet can be more easily held.

4.4.20.1.7.3. **Hold** the plummet at the top (or aft) left spider arm using the left hand.

4.4.20.1.7.4. **Pull** the plummet safety pin out enough to clear the plummet, and gently **lower** it to rest on the striking end of the balance piston.

4.4.20.1.8. *If starting from a height lower than 33 inches:*

4.4.20.1.8.1. **Slide** the plummet safety pin out enough to clear the plummet.

4.4.20.1.8.2. **Release** the plummet safety latch with the thumb of the right hand, and slowly **lower** the plummet until the plummet base plate clears the safety latch.

4.4.20.1.8.3. Gently **lower** the plummet until it rests on the striking end on the balance piston.

WARNING: **NEVER** place hands between the plummet head and the striking end of the balance piston or between the plummet and the gate timer. **THESE ARE PINCH POINTS AND MAY CAUSE SERIOUS INJURY.** The plummet weight is approximately 20 lb.

4.4.20.1.8.4. Using the weight of the plummet, gently **tap** the balance piston to ensure the striker pin is against the blank sample insert.

4.4.20.1.8.5. Using the heel of the left hand, **support** the magnet housing. Using a 3/4-in. wrench, **loosen** the magnet support clamp bolt by turning it counterclockwise one complete turn.

4.4.20.1.8.6. Using the right hand, **place** the drop height adjustment rod in the center of the plummet magnet base, and **hold** it as straight as possible.

4.4.20.1.8.7. **Lower** the magnet housing until the center of the magnet rests on the upper end of the drop height adjustment rod.

4.4.20.1.8.8. **Tighten** the magnet support clamp bolt clockwise.

Note: After tightening the magnet support clamp bolt, the drop height adjustment rod may be hard to remove, since there should be only just enough clearance between the drop height adjustment rod and the magnet to allow for adjustment rod removal.

4.4.20.1.8.9. After achieving clearance, **retighten** the magnet support clamp bolt by turning it clockwise. Final torque should be approximately 25 ft-lb. **Return** the plummet to the magnet. *If the power is on,* **ensure** that the magnet has a secure hold on the plummet and that the safety latch is in place. Immediately insert the plummet safety pin in the hole closest to the bottom of the plummet in the magnet base support post.

4.4.20.2. Drop Height Adjustment Procedure for Low to High Adjustment

4.4.20.2.1. **Select** the correct drop height adjustment rod that corresponds with the impact energy required for the test.

4.4.20.2.2. **Ensure** that the drop height adjustment rod is the correct length in accordance with section 7, Table 7-1.

4.4.20.2.3. **Ensure** that the plummet safety pin is in place under the plummet in one of the holes drilled in the magnet support post closest to the bottom of the plummet.

4.4.20.2.4. Using the magnet by-pass switch on the operator console, **release** the plummet from the magnet.

4.4.20.2.5. With the drop height adjustment rod in easy reach; **stand** on the south side of the drop weight impact assembly facing the test console viewing window.

4.4.20.2.6. **Ensure** the plummet is resting on the plummet safety latch. With the left hand, **support** the plummet at the lower (or forward) spider arm pointing west or the left of your position.

4.4.20.2.7. **Slide** the plummet safety pin out enough to clear the plummet.

4.4.20.2.8. **Release** the plummet safety latch with the thumb of the right hand, and slowly lower the plummet until the plummet base plate clears the safety latch.

4.4.20.2.9. Gently **lower** the plummet until it rests on the striking end of the balance piston.

WARNING: NEVER place hands between the plummet head and the striking end of the balance piston or between the plummet and the gate timer. **THESE ARE PINCH POINTS AND MAY CAUSE SERIOUS INJURY.** The plummet weight is approximately 20 lb.

4.4.20.2.10. Using the weight of the plummet, **gently tap** the balance piston to ensure the striker pin is down against the blank sample insert.

4.4.20.2.11. Using the heel of the left hand, **support** the magnet housing, and **loosen** the magnet support clamp bolt with a 3/4-in. wrench, turning it counterclockwise one complete turn.

4.4.20.2.12. **Raise** the magnet base approximately 3 in. higher than the target drop height, and **tighten** the magnet support clamp bolt clockwise.

4.4.20.2.13. **Place** the drop height adjustment rod in the center of the plummet magnet base, and **hold** it as straight as possible.

4.4.20.2.14. **Loosen** the magnet support clamp bolt with a 3/4-in. wrench, turning it counterclockwise one complete turn.

4.4.20.2.15. **Lower** the magnet housing until the center of the magnet rests on the upper end of the drop height adjustment rod.

4.4.20.2.16. **Ensure** that there is only enough clearance between the magnet and the drop height adjustment rod for easy rod removal.

4.4.20.2.17. **Tighten** the magnet support clamp bolt clockwise to approximately 25 ft-lb.

4.4.20.2.18. **Return** the plummet to the magnet.

4.4.20.2.19. *If the power is on,* **ensure** that the magnet has a secure hold on the plummet and that the safety latch is in place.

4.4.20.2.20. Immediately **insert** the plummet safety pin in the hole closest to the bottom of the plummet in the magnet base support post.

Note: Once the plummet height has been set and the plummet has been returned back to the magnet, the counter timers are triggered and must be reset. To reset the counter timers, unplug the timer circuit. The timer circuit is plugged into the outlet located on the inside of room 118A on the north wall to the right of the viewing window

4.4.21. *For LOX tests*, **connect** the 0.5-in. LN_2 lines to the base to chill the base below the condensation temperature of GOX.

4.4.22. **Turn on** the facility LN_2 flow valve (MV-MLN-P001) located on the west wall of Room 118A. **Turn** the valve handle counterclockwise until it stops.

Note: Time to achieve liquid flow is approximately 45 minutes when outside temperature is below 85 °F. Liquid flow may take approximately 1 hour when outside temperature is above 85 °F.

4.4.23. **Wear** clean latex gloves, and **inspect** the high-pressure impact pins for cleanliness. Inspect the pin's sample impacting surface to ensure it meets the 16 RMS finish requirement. **Use** the visual comparator to verify any questionable surface finish anomalies.

4.4.24. **Place** selected pins in a clean stainless container with a lid. *If the test is a LOX test*, **pre-chill** the striker pins and samples using either of the following methods:

Note: **Ensure** that storage at this stage of the procedure does not exceed 4 hours and that sample cleanliness is maintained.

4.4.24.1. NASA Standard Method.

4.4.24.1.1. **Fill** an additional clean dewar with LOX for ladling into the sample freezing box and specimen cup.

4.4.24.1.2. **Place** pins in a small clean dewar, and **fill** the dewar with enough LN_2 to cover pins with approximately 2 in. of liquid.

Note: As an alternative, **place** five pins in the freezing box with five test samples, and **fill** the freezing box with LOX. Once these pins are used, **add** five more to the box.

4.4.24.1.3. **Ensure** that the sample freezing box is level. **Place** at least 20 prepared samples and a minimum of 5 blanks in the sample freezing box over the holes in the retainer plate. **Begin filling** the freezing box with LOX. The time required to fill the freezing box and the cups to 1/8 in. from the top of the box is between 35 and 40 minutes.

Note: As an alternative, **place** five samples in the freezing box with five striker pins, and **fill** the freezing box with LOX. Once these samples are tested, **add** five more to the box.

Note: LOX is the only fluid that shall contact the samples and sample cup.

4.4.24.1.4. **Reject** any samples showing voids or holes. **Check** that sample material has not separated from the bottom of the cup. Using tongs, **submerge** samples that separate. **Do not reject cracked samples**. **Do reject broken samples.** Ask the test engineer for guidance, if needed.

4.4.24.2. Alternate Chilling Method.

4.4.24.2.1. **Fill** an additional clean dewar with LOX for ladling into the sample tray and specimen cups.

4.4.24.2.2. **Place** pins in a small clean dewar, and **fill** the dewar with enough LN_2 to cover pins with approximately 2 in. of liquid.

4.4.24.2.3. **Ensure** that the sample freezing box is level. **Fill** the sample freezing box with LN_2. **Place** the sample tray containing at least 20 prepared samples and a minimum of 5 blanks in the sample freezing box. **Wait** approximately 30 minutes, and **fill** the sample tray slowly with LOX until the sample cups are filled and the tray is filled to within 1/8 in. of its top. This takes between 5 and 10 minutes.

4.4.24.2.4. **Reject** any samples showing voids or holes. **Check** that the sample material has not separated from the bottom of the cup. Using tongs, **submerge** samples that separate. Do **not reject** surface-cracked samples. **Do reject broken samples. Ask** the test engineer for guidance, if needed.

4.5 Detailed Test Procedure

The test operator s**hall perform** the following procedures:

4.5.1. **Ensure** a clean blank is loaded in the base. If not and the correct drop height has been set, **install** a clean blank as stated in section 4.4.19.

4.5.2.**Purge** the test base with GN_2:

4.5.2.1. In the south room behind the tester:

- **Open** (counterclockwise) the main GN_2 supply valve, located on the HIPIT Gas Supply Panel (Room 118A east wall).
- **Open** the main GN_2 regulator (clockwise) to approximately 1,500 psig or until maximum facility supply is obtained on the main GN2 supply gauge.
- **Open** the Pin Balance supply regulator (clockwise) to a reading 1/10 of the maximum test pressure (but no greater than 1,000 psi) on the Pin Balance gauge.
- **Open** the GN_2 Purge regulator (clockwise) until a reading of 120 psig is obtained on the GN_2 Purge gauge.

- **Open** the Activation Supply regulator (clockwise) until a reading of 120 psig is obtained on the Activation supply gauge.

4.5.2.2. **Ensure** the O_2 isolation hand valve is closed (clockwise).

4.5.2.3. **Open** (counterclockwise) the GN_2 Purge supply isolation hand valve.

4.5.2.4. At the console, **power up** the control system by turning the **EMERGENCY POWER SHUT OFF** button approximately 1/8 turn counterclockwise or until the button pops outward.

Note: At several points in this procedure, the reader will find text printed in a **different font**. This font indicates button titles or actions to take on the Viewdac® screen

Note: With all software-controlled valves, **use** the mouse to move the cursor over the desired soft-key switch/button, and **click** the left mouse button to toggle the valve setting to **Open** and **Close**.

4.5.2.5. After control system boot, click on the red soft-key marked **EXIT VIEW-DAC**. The system will exit to the DOS prompt C:\.

4.5.2.6. At the DOS prompt C:\, **type** *VRUN*, and **press** the carriage return to access the manual valve control panel.

4.5.2.7. With the cursor, open the manual valve control program on the menu bar at the top of the screen by clicking on **FILE, OPEN,** and **SEQUENCE.** At this point, a drop-down box will open. Locate and click on the file **DIOST.SEQ,** and **click OK.** This will open the **MANUAL VALVE** control panel. After the panel has loaded, **use** the mouse to return to the menu bar at the top of the screen, **click** on the text "**PANEL**" and **START TASK** to activate the valve control panel.

WARNING: For personnel safety, all control power is normally off. **Insert** the plummet safety dowel before activating this program. Power to the electromagnet is normally off, and, *if the safety latch does not hold,* the plummet can fall.

4.5.2.8. **Return** to the file menu bar and **click FILE, OPEN,** and **SEQUENCE.** At this point, another drop-down box will open. Locate and click on the file **VTEST14T.SEQ**. **Click** on the file and then click **OK.** This opens the pressure transducer read-out panel. After the panel has loaded, **use** the mouse to return to the menu bar at the top of the screen, and **click** on the text "**PANEL**"and **START TASK**. This will activate the PT read-out panel.

4.5.2.9. **Open** valves in the following sequence by clicking on the soft-key button to toggle the switch **ON** or **OFF**:

- **GOX Supply ON**
- **Base Inlet ON**
- **Base Vent OFF.**

Toggling these valves starts a 15-minute GN_2 purge through the system, which rids the system of any moisture. Hold the purge for approximately 15 minutes.

4.5.3. **Set up** the GOX supply to perform a test:

4.5.3.1. In the back of the test cell, **close** the GN_2 regulator supply valve (located above the GN_2 regulator) by turning the handle clockwise.

4.5.3.2. In the control room, **open** the GOX vent valve. **Toggle** the switch **OFF**.

4.5.3.3. **Allow** excess pressure to bleed to ambient.

4.5.3.4. **Close** the GOX supply valve. **Toggle** the switch **OFF**.

4.5.3.5. **Rotate** the GN_2 purge regulator valve knob fully counterclockwise to turn it off.

4.5.3.6. **Slowly open** the GOX regulator until full pressure is applied to the GOX supply control panel. This shall be evident by the increase in pressure on the GOX supply gauge.

4.5.3.7. **Open** the GOX supply regulator knob clockwise until the desired test pressure (+10%) is obtained.

Note: Do not exceed the maximum working pressure of the chamber pressure transducer. (The maximum working pressure is written on the pressure transducer.)

4.5.4. **Check** both flash detection systems.

Note: The HIPIT tester is equipped with one silicon diode and one photo-resistor for the flash detection system. These shall be used (as a standard procedure) for LOX, ambient temperature GOX, and high-temperature GOX testing. These shall also remain separate on the test data sheet, record the location of the detectors, i.e., north for the photo-resistor or south for the silicone diode.

4.5.4.1. If used, **check** the *resistor flash detector*:

- **Turn on** the power to the Astro-Med® Dash IV recorder (section 9, Figure 9-7.
- **Verify** that the flash detector is mounted to the pressure base.
- **Verify** that the chart recorder is on and has ample paper to perform the test.
  Note: To verify that the chart recorder printer and paper feed mechanism is functioning properly; depress the **RUN/HALT** button for 5 to 8 seconds. **Depress** the button again to stop the paper feed. The paper must feed smoothly, and the grid lines must be visible. *If any of these are not functioning correctly,* **halt testing** immediately and co**ntact** the test engineer.
- **Verify** that two vertical lines are in the chart recorder window and to the right of the window. *If the two vertical lines are not at the right-hand side of the window*, **examine** the chart recorder for problems. **Contact** the test engineer before adjusting recorder parameters, *i.e.*, zero, sensitivity, *etc.*
- *If already installed*, **gently remove** the flash detector from the pressure base by holding the insulator around the detector.
  Note: Never remove the detector by pulling the wiring.
- **Place** the flash detector on top of the base so that the detector can receive light from the room.
- **Examine** the chart recorder window. **Verify** that the vertical line that was closest to the right in the window is either moving to the left of the window or is at the extreme left of the window. *If the vertical line has not moved,* **examine** the detector and/or the recorder for problems. **Contact** the test engineer before adjusting recorder parameters, *i.e.*, zero, sensitivity.
- **Place** the detector into the test base.

4.5.4.2 **Check** the *silicon diode flash detection system*:

- At the **DRUN** test screen, **click** the left mouse button on **FILE**, **OPEN**, and **SEQUENCE**. At this point, a drop-down window will open. **Locate** and **click** on the file **FLASH01.SEQ** and then on **OK** to open the silicon flash detection test screen.
- **Return** to the menu bar and, with the left mouse button, **click PANEL** and **START TASK**.
- **Click** on the soft key labeled **AGAIN** to reset the flash test sequence.
- **Verify** that the silicon flash detector is inserted into its port in the pressure base.
- **Click** on the soft key labeled **START**. The light detection is indicated by a blue line on the graph chart. *If the blue line does not appear at the zero position on the chart*, **examine** the detector for problems, such as cracks, moisture, or dirt. **Replace** the detector if necessary.
- **Gently remov**e the silicon flash detector from the base by holding the body of the detector.

Note: Never remove the detector by the cable.

- **Reset** the flash chart. First, **click** on the soft key labeled **AGAIN**, and then **click** the soft key labeled **START**. The blue line should appear in the center or at the extreme top of the chart, depending on the amount of light present. *If the line is not at the center of the chart or above*, **examine** the recorder or detector for problems.

4.5.4.3 **Inspect** the photodiode and infrared filter for moisture and damage. **Replace** with new parts as necessary. **Inspect** the photo-resistor for moisture and damage, and **replace** with new parts, if necessary. The photo-resistor shall be placed in a special PTFE holder. The holder has a cup design and is placed over the north flash detector sight port.

Note: This procedure can be performed at any time during the test cycle but only during a *No Pressure* condition.

4.543.4. The photo-resistor flash detector shall be installed using one of the following two methods:

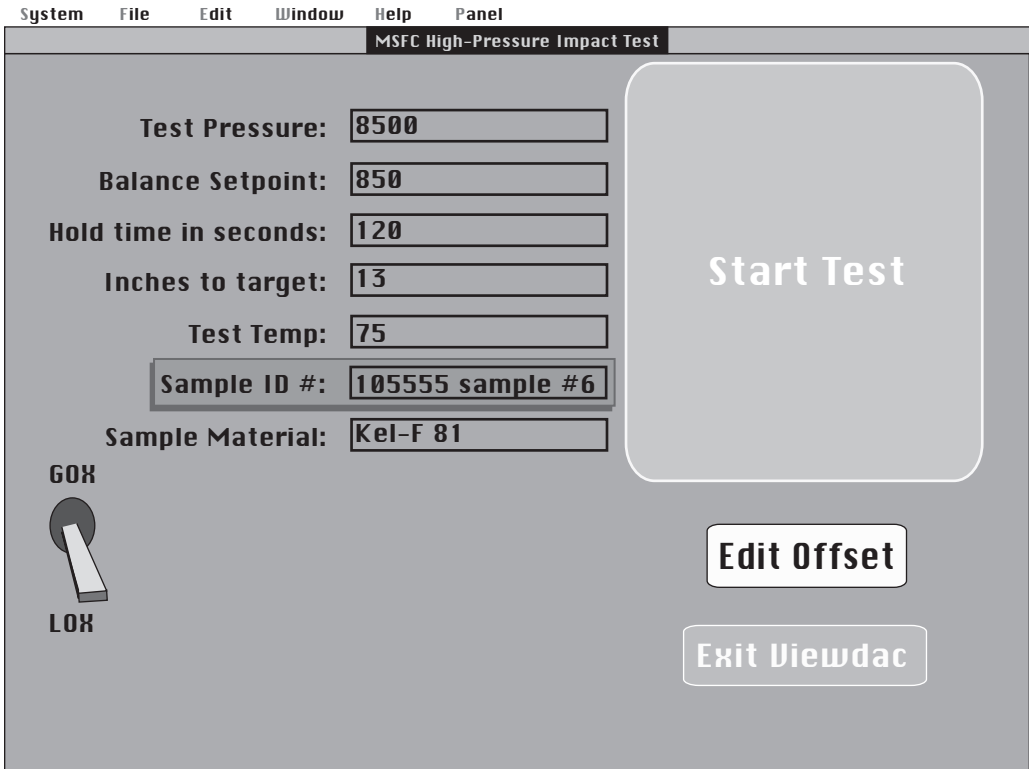
4.5.4.4.1. For a high-temperature GOX test: To install the photo-resistor, **cut** a 3-in. long x 2-in. wide piece of aluminum tape. Gently **place** the PTFE holder/photo-resistor assembly over the end of the north sight port assembly. Holding the photo-resistor in place, **wrap** the aluminum tape around the two assemblies so as to divide the tape evenly between the PTFE holder and the sight port assembly.

4.5.4.4.2. For LOX test and low temperature GOX test: **Cut** a piece of 3/4-in. ID urethane foam pipe insulation with a 1/2-in. wall thickness approximately 3 in. long. With the photo-resistor installed in the PTFE holder, gently **push** the holder and flash detector assembly approximately half way (1-1/2 in.) inside the foam pipe insulation. With the detector assembly installed, gently **push** the foam pipe insulation onto the flash detector port using a back-and-forth rotating motion until the flash detector assembly comes in complete contact with the flash detector port.

4.5.4.5. **Assemble** the photo diode: **Attach** the IR filter over the lens of the photodiode by cutting a small piece of PTFE adhesive tape (NSN 5970-00-069-2730) or equivalent, approximately 0.5-in. long. Gently **wrap** the tape around the photodiode/IR lens assembly until the ends of the tape overlap, and gently **slide** the photodiode/IR filter assembly into the south flash detector sight port.

4.5.4. **Exit** the **URUN** program by clicking on each open panel, moving the mouse cursor to the menu bar at the top of the screen and clicking **PANEL** and **STOP TASK.** After each panel has been stopped, **return** to the menu bar and click **SYSTEM and BYE**. A confirmation screen will appear. Click the **EXIT TO DOS** button. At the DOS prompt (C:\), **type** *VIEWRUN*, and **press** the carriage return. At this point, the Viewdac® setup screen (Figure 4.5-1) will load.

Figure 4.5-1 Test 13B Setup Screen.



Note: This drawing is representative. Actual screen appearance may vary slightly.

4.5.5. For LOX tests, the test operator shall:

4.5.5.1. Once liquid is flowing through the main facility LN_2 line, **open** (counterclockwise) the LN_2 supply valve (MV-MLN-P002) to the test cell to start LN_2 flow to the base. This LN_2 supply valve is located on the west wall in the south room (118A) behind the tester.

4.5.5.2. **Close** (clockwise) the GN_2 purge isolation hand valve.

4.5.5.3. **Open** (counterclockwise) the O_2 supply isolation hand valve.

4.5.5.4. Open (counterclockwise) the main tester O_2 supply valve.

4.5.5.5. **Open** (clockwise) the main tester O_2 supply regulator until the maximum test pressure is obtained on the O_2 supply gauge.

Note: For tests above 1,500 psig, **open** the main O_2 supply regulator until maximum facility supply pressure is obtained.

4.5.6. In the test cell, visually **inspect** the installed pressure transducers. **Check** PT3's (Chamber Pressure) range against the test requirements.

4.5.6.1. *If the PT range matches test requirements,* check its calibration due date, and record the calibration number.

- *If the PT is within its calibration due date*, **record** the transducer's model number, range, serial number, calibration due date, and calibration ID number on the Calibration Data sheet for the test folder. **Proceed** to step 4.5.7.
- *If the PT is beyond its calibration due date,* **replace** it. **Ensure** that the replacement PT has a current calibration sticker and is in the correct pressure range for the test. **Record** the replacement transducer's model number, range, serial number, calibration due date, and calibration ID number on the Calibration Data sheet for the test folder. **Proceed** to step 4.5.7.

4.5.6.2. *If a PT range does not match test requirements,* **remove** that PT, and **select** a replacement PT that meets the test requirements. **Ensure** that the replacement PT has a current calibration sticker and is in the correct pressure range for the test. **Record** the replacement PT's model number, range, serial number, calibration due date, and calibration ID number on the Calibration Data sheet for the test folder. **Proceed** to step 4.5.7.

Note: *If the incorrect pressure transducer is in place and the pressure applied is higher than the pressure transducer's range,* the pressure can damage the pressure transducer. It is always a good practice to use the lowest range pressure transducer to provide the resolution the software needs to keep test pressures within the ±3% error required by NASA-STD-6001.

Note: Always **ensure** the wiring configuration on the Pressure Transducer corresponds to the tester wiring configuration. *If the wiring is incompatible,* damage to the Pressure Transducer will occur.

Note: The current pressure transducer ranges are:

- 0 to 150 psi
- 0 to 300 psi
- 0 to 500 psi
- 0 to 1,500 psi
- 0 to 2,000 psi
- 0 to 3,000 psi
- 0 to 5,000 psi
- 0 to 10,000 psi.

4.5.7. At the Viewdac® test control screen (Figure 4.5-1), **enter** the correct slopes and offsets of each PT, using the **EDIT OFFSET** button as indicated in section 9.4, Calibration.

4.5.8. **Click** the cursor on the LOX/GOX switch to the correct test environment. *For LOX tests,* the minimum temperatures required to achieve LOX from GOX are affected by pressure, as shown in Table 4.5-1. **Wait to begin testing** until

Table 4.5-1. Temperature versus Pressure for Tests of LOX.

If testing at this pressure (psi)	Maintain below this temperature (˚F)
Ambient	-297
20	-292
30	-284
40	-278
50	-270
60	-268
80	-261
100	-253
120	-250
140	-245
160	-240
180	-238
200	-233
250	-225
300	-218
350	-212
400	-208
450	-203
500	-198
600	-190
700	-182
800 to 5,000	-228
6,000 to 10,000	-258

the minimum required temperature is attained. *For GOX tests*, **input** the Test Temp (temperature) into the Viewdac® system.

4.5.9. **Complete** the High-Pressure Impact Tester Pre-Test Checklist (section 7.2, Figure 7-1).

4.5.10. **Input** the desired control parameters in the appropriate windows on the Setup Panel (Figure 4.5-1):

4.5.10.1. **Input** the requested test pressure into the field labeled **Test Pressure**

4.5.10.2. **Input** the **Balance Setpoint**, which shall be 1/10 of the chamber pressure (test pressure).

4.5.10.3. *For LOX tests*, **input** the **Hold time in seconds** for the appropriate test pressure, as listed on the LOX condensation chart (Table 4.5-2).

Table 4.5-2.
LOX Condensation Chart.

Test Pressure	Minimum Hold Time
100 psi and less	15 minutes
100 psi to 300 psi	5 minutes
300 psi to 10 ksi	2 minutes

4.5.10.4. *For GOX test*s, **input** 2 minutes (120 seconds) standard.

Note: A manual bypass switch has been installed on the HIPIT tester. This switch is located on the panel to the right of the computer screen. Toggling this switch **ON** will bypass software control and will allow the heaters to remain on while test samples are changed.

4.5.10.5. **Enter** the correct **Inches to target**. **Refer** to section 7.2, Table 7-1, for the correct drop height.

4.5.10.6 **Enter** the **Sample Material**.

4.5.10.7. **Enter** the **Sample ID #** (test request number from the test plan and the sample number, using -1, -2, -3, etc.).

Note: The first two tests shall be blanks to verify plummet timing and to demonstrate the cleanliness of the chamber. (**Enter** "Blank-1", "Blank-2, *etc.,* in Sample ID # field). **Test** one blank after every five samples to verify the cleanliness of the chamber.

Note: Whenever a sample reaction occurs, **run** two blanks after the reaction. *If one blank reacts,* **cease** testing, and **blow** debris from the sample well with filtered GN_2. **Resume** testing with two blanks. *If a reaction occurs on either of these blanks,* **cease** testing, and **allow** the equipment to return to ambient temperature. **Reclean** the lines, base, and head, or **substitute** clean parts, and **resume** testing with two blanks. *(If the reaction scenario differs from that described above,* **see** the test engineer for direction. Possible reaction scenarios are presented in the flowchart in section 7, Figure 7-1)

Note: *If samples are depleted before thresholding is complete,* **note** this on the test data sheet, and **discontinue** testing.

4.5.10.8. For LOX tests, the minimum temperatures required to achieve LOX from GOX are affected by pressure, as shown in Table 4.5-1.

4.5.11. At the test stand, **ensure** that the plummet is securely against the magnet. **Remove** the plummet safety dowel.

4.5.12. **Go to** the control room, and **close** the door between the test cell and control room securely. **Place** the red TensaBarrier® across the front of the test cell door.

Note: When testing in high temperature GOX, the Viewdac® system will not allow the test operator to click-start the test until the test temperature has been reached.

Note: Three interlocks on the system must be in place before a test can occur. *If any of these interlocks is not in a safe position,* the test can not be performed.

(1) Catcher down: Indicates the catcher is clear of the plummet's path
(2) Plummet up: Indicates that the plummet is secure and mated with the magnet
(3) Door safety: Indicates that the door into the test cell is fully closed and secure.

Note: The most important of these interlocks is the door interlock. During a test, *if the door is accidentally opened,* the software will stop the test and place the tester in a safe condition, *i.e.,* all supply valves will close and the chamber will vent.

4.5.13. **Perform** the following steps to finish the test:

4.5.13.1. **Click Start Test** on the control screen (Figure 4.5-1). The Viewdac® software will automatically perform a 10-sec GN_2 purge, followed by a 10-sec GOX purge. After the GOX purge, the Viewdac® software will automatically raise the **Chamber** pressure to 60% of the specified test pressure for

the specified hold time. After the hold time is complete, the **Pin Balance** pressure will increase to the set point specified (Figure 4.5-2).

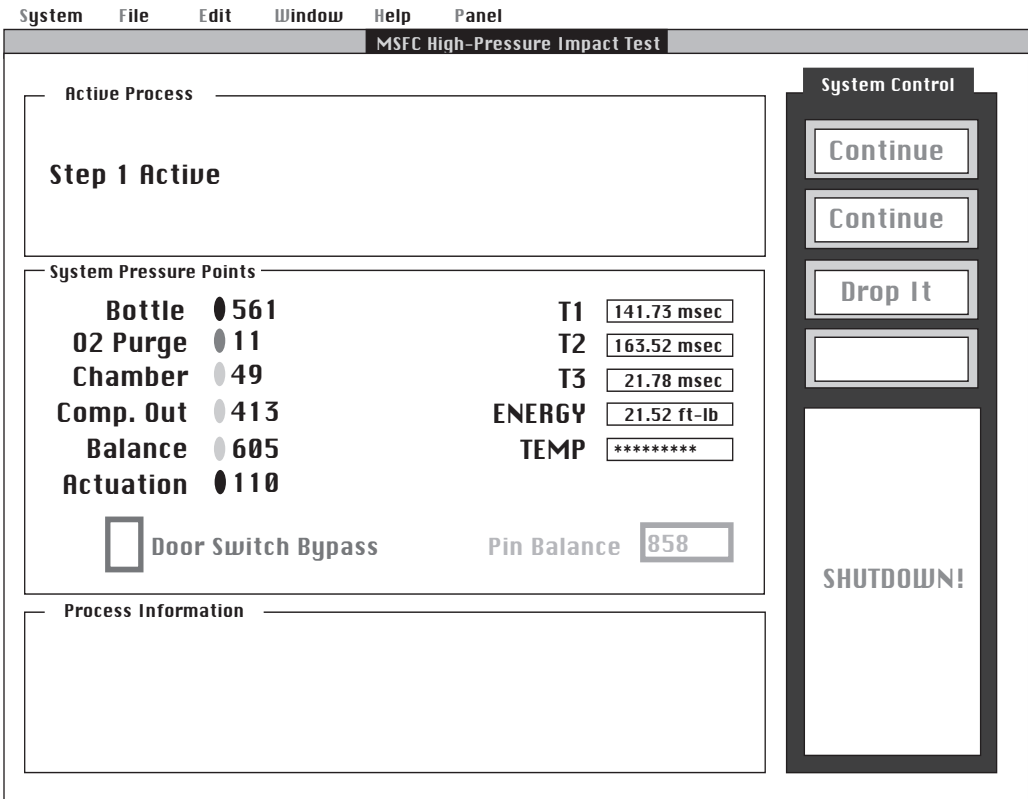


Figure 4.5-2. Test 13B System Control and Data Screen.

Note: This drawing is representative. Actual screen appearance may vary slightly.

4.5.13.2. When the pin **Balance** pressure reaches the set point entered, **click** the top **Continue** button (Figure 4.5-2). (**Continue** button will be highlighted.) This allows the Viewdac® software to raise the chamber pressure to 100% of the test pressure.

4.5.13.3. Once the test pressure has reached the test set point, the Viewdac® program will continue to maintain the test pressure and balance pressures, and the second **Continue** button will be active or highlighted.

4.5.13.4. *If the resistor detector is used,* **press** the **FEED** button on the strip chart recorder for approximately 5 seconds to ensure a blank space on the paper before the actual flash graph. **Use** the area to label the graph with the test information, *i.e.,* Request #, condition of test (LOX or GOX), energy level (ft-lb), Date, Test Pressure.

4.5.13.5. **Start** the chart recorder by depressing the **RUN/HALT** button.

4.5.13.6. When the test pressure is within ±3% of the test request pressure and the balance pressure is approximately 1/10 of the test pressure, **click** the

second **Continue** button and the **Drop It** button in quick succession. (**Refer** to Figure 4.5-2.) This action releases the plummet.

Note: Once the second **Continue** button is pressed, the chamber pressure control sequence pause to start collecting data from the velocity timers. *If there are leaks that make it difficult to maintain pressure,* the test pressure may drop below the 3% tolerance of the test pressure set point. *If this occurs* before the **Drop It** button can be activated, **re**start the test.

4.5.13.7. **Record** the actual temperature (**TEMP**) and pressure (**CHAMBER**) at time of drop, and **record** the delta time (**T3**) on the test data sheet (section 7.2, Figure 7-3).

Note: Record temperature and pressure immediately. These numbers will be lost when the chamber is vented and purged.

4.5.13.8. *If the resistor detector was used,* **push HALT** on the chart recorder, and **check** for an indication of a reaction from the flash detector. (A spike on the chart recorder paper indicates a reaction.)

4.5.13.9. **Index** the paper on the chart recorder forward between each drop by depressing and holding the **FEED** button for approximately 2 seconds.

Note: At the end of a test request set, **feed** the paper forward just a few lines to separate test requests. **Tear off** the paper when test request is complete and place it in the test folder.

4.5.13.10. **Determine** if the silicon flash detector picked up a reaction by looking at the display (Figure 4.5-3).

Note: Immediately after the plummet drops, the system vents, purges with GN_2, and displays silicon flash detector data. Some noise from the impact may be indicated in the signal and is not to be confused with a reaction. For this detector, a reaction is defined as an obvious increase in light intensity over several microseconds, indicating a continuous light emission.

4.5.13.11. *If a reaction occurred,* **print** the graph by clicking on the **PRINT** button located on the graph window. *If a reaction did not occur,* cancel the graph by clicking on the **PROCEED** button also located on the graph window.

Note: After clicking on the **PRINT** or **PROCEED** button on the reaction graph, the Viewdac® program will return to the test screen for the next drop.

4.5.13.12. Record the Energy (ft-lb) on the test data sheet, (section 7.2, Figure 7-3), and record the reactions from both detectors according to the legend on the test data sheet.

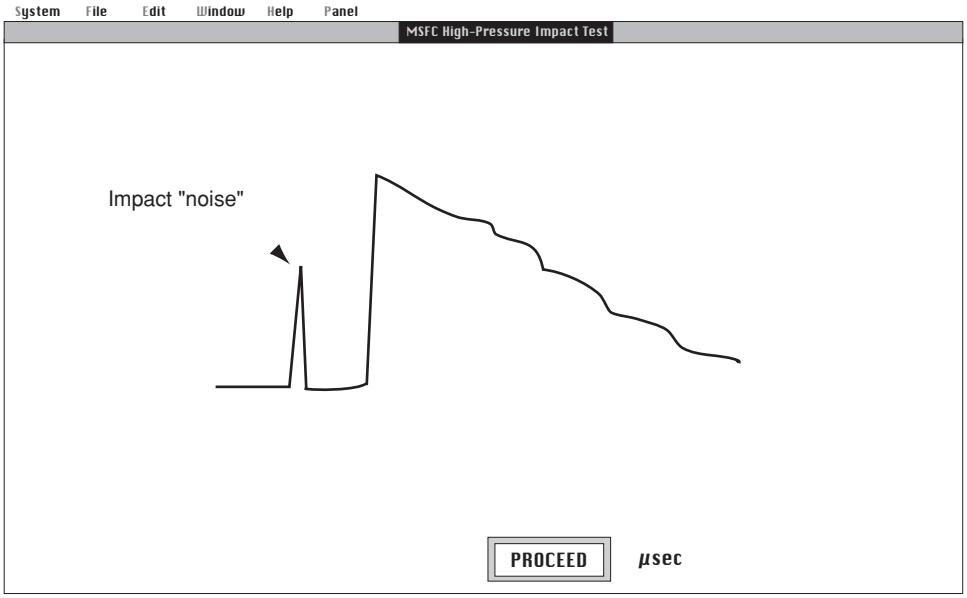


Figure 4.5-3. Silicon Flash Detector Screen (appears above the Setup Screen after the test)

Note: This drawing is representative. Actual screen may vary slightly.

Note: **Determine** the alignment of the vertical guide struts and the friction of the plummet assembly by timing the plummet fall with a blank in place. The free-fall time shall be within 3% of the theoretical value given for the associated height (section 7.2, Table 7-1).

4.5.13.13. To run the next sample, *if the material has not changed,* **enter** the new Sample ID #.

4.5.13.14. **Ensure** CHAMBER pressure is **0** psig, **remove** the TensaBarrier® across the door, **enter** the cell, and **secure** the plummet with the safety dowel.

4.5.13.15. *If testing in LOX,* **blow** frost from the head and base with filtered GN_2. **wear** gloves while handling cold test equipment. *If testing in high-temperature GOX,* **wear** thermal gloves while handling hot test equipment.

4.5.13.16. **Remove** the head assembly retaining nuts by turning them counter-clockwise one complete turn with a 5/8 x 1/2-in. ratchet and socket. Final removal can be accomplished with the 1/2-in. drive pneumatic impact wrench.

4.5.13.17. *If testing LOX samples:* After removing the nuts and washers, **place** them on a dry cloth or towel. This will help absorb the moisture produced during thawing. *If testing high-temperature GOX samples:* After removing the nuts and washers, **place** them on a dry non-flammable surface.

4.5.13.18. **Remove** the head assembly, and **place** it on clean foil. **Remove** the sample using clean tongs or forceps, being sure to place the sample so that the sample numbering system can be maintained for post-test analysis and packaging.

4.5.13.19. **Remove** the striker pin from the head assembly, turning it counter-clockwise to loosen it. **Inspect** the striker pin for damage or possible charring from a reaction. *If no damage to the pin has occurred,* **place** the pin into the pin rack (unless severely damaged, *e.g.,* burned, pitted, distorted by a reaction, thread damage). **Ensure** that striker pins remain in their respective racks to maintain striker surface and height grouping for future machining and cleaning.

4.5.13.20. **Don** clean gloves, **install** a clean striker pin finger-snug, and **ensure** the back of the pin is flush with the base of the balance pin. **Ensure** the balance piston is in the full upward position before installing the head. **Check** the copper head to base seal for damage; **replace** *if necessary.*

4.5.13.21. **Allow** the sample cup to defrost before inspection. Then, **inspect** the sample or blank for charring or obvious heat discoloration.

4.5.13.22. Visually **inspect** the next test coupon for any anomalies, *e.g.*, separation, cracking, floating.

4.5.13.23. **Insert** a new blank or sample and cup in the base well with clean forceps/tongs.

4.5.13.24. **Verify** the tightness of the studs before installing the head. **Install** the head over the studs by tightening the four nuts snugly in a staggered (cross) sequence, and **ensure** the head is parallel to the base. **Torque** the nuts in the same manner to 60 to 80 ft-lb. A calibrated torque wrench may be used for verification.

4.5.13.25. **Verify** that the delta drop time (**T3**) for the previous test was within 3% of the theoretical time (section 7.2, Table 7-1). *If the drop time was not within tolerance,* **contact** the test engineer.

4.5.14. **Repeat** steps 4.5.13.14 through 4.5.13.25 until the test request is complete for pressure or energy screening. First, **run two blanks** to demonstrate the cleanliness of the chamber. Then, **test** the samples, testing one blank after every five samples to verify the cleanliness of the chamber. *If a reaction occurs*, **run two blanks** after each reaction. *If a blank reacts*, **cease** testing, and **blow** debris from the sample well with filtered GN_2. **Resume** testing with two blanks. *If a reaction occurs again on a blank*, **cease** testing, and **allow** the equipment to return to ambient temperature. **Reclean** the lines, base, and head, or **substitute** clean parts, and **resume** testing with two blanks. *If samples are depleted before thresholding is complete*, **note** this on the test data sheet, and **discontinue** testing.

4.5.15. **Clean** inserts and excess materials from post-test cups. **Bag** cups and **take** these to the sample preparation laboratory. Sample preparation personnel shall

perform a pre-cleaning before submitting the cups to the Precision Cleaning facility for cleaning to MSFC-SPEC-164, Type 1, Class A.

4.6 Shutdown Procedure

The test operator **shall perform** the following procedures:

4.6.1. **Ensure** that the test is completed and that the system is thoroughly vented, *i.e.,* **CHAMBER** pressure gauge on the Viewdac® Test Screen reads ~**0** psig.

4.6.2. **Remove** the red TensaBarrier® across the door, and **enter** the test cell.

4.6.3. **Secure** the plummet safety dowel.

4.6.4. **Close** the oxygen supply valve in Room 118A by turning the valve handle fully clockwise.

4.6.5. **Fully reduce** (counterclockwise) the oxygen supply regulator.

4.6.6. *If running a LOX test:* **close** (clockwise) the test cell LN_2 supply valve (MV-MLN-P002). **Close** (clockwise) the facility LN_2 supply valve (MV-MLN-P001).

Note: *If another tester is using the facility LN_2* **do not close** this valve until the end of the shift or until everyone has finished testing.

4.6.7. **Remove** the last sample from the base (steps 4.5.13.16 through 4.5.13.19), and **reinstall** the head assembly (step 4.5.13.24).

4.6.8. *If running a high-temperature GOX test:* **ensure** the heater bypass switch located on the console is off, and **unplug** the heater elements from their electrical source.

4.6.9. **Close** (clockwise) the test cell nitrogen supply valve.

4.6.10. **Fully reduce** (counterclockwise) the test cell nitrogen supply regulator.

Note: Always **ensure** that all supply regulators are closed (turned fully counterclockwise) before applying the any pressure to avoid damage to the regulator.

4.6.11. **Enter** the control room, and **ensure** that test cell door is completely shut.

4.6.12. **Click** the **Start Test** soft key on the test control screen (Figure 4.5-1).

4.6.13. **Observe** the **Bottle** pressure on the control screen; this pressure will diminish rapidly after the software goes into its 10-second oxygen purge.

Note: By clicking the **Start Test** button, the purge cycles will vent the oxygen supply lines. Step 4.6.12 may have to be repeated before ~0 psig is attained.

4.6.14. When the pressure has reached **~0** psig, **click** the **SHUTDOWN!** soft key (Figure 4.5-2).

4.6.15. **Exit** the Viewdac® control program by clicking the **Exit Viewdac** soft-key (Figure 4.5-1).

4.6.16. **Turn off** power to the chart recorder (section 9, Figure 9-7).

4.6.17. **Shut down** power to the control console by pushing the **EMERGENCY POWER SHUT OFF** button located on the front of the console.

4.6.18. **Clean** the area and any tools, and **place** the tools in the proper storage areas.

4.6.19. *If running LOX or cooled GOX*, **close** the LN_2 supply valve to the HIPIT tester and the main LN_2 supply valve in Room 118A.

WARNING: The main LN_2 supply valve must be closed at the end of each shift.

4.6.20. *If LOX samples were tested,* a small box fan may be used to defrost the base and head assembly. **Position** the fan so that it will blow directly on the test assembly. A dehumidifier may also be used to aid in the drying process.

4.6.21. *If running GOX and using the heaters,* **disconnect** power to the heater controller.

4.6.22. **Perform** the steps in section 4.7 as soon as possible, based on whether samples have thawed.

4.6.23. If testing liquids or semi-solids or if visible residue is present in the sample well, **disassemble** and **clean** the head and chamber base assemblies as described in section 9.3, Required Tester Maintenance.

Note: This step may be performed the next day if testing is completed at the end of a shift.

4.6.24. At the end of the day, **close** and **secure** the rollup door to the outside of the facility with a chain. **Turn out l**ights in the test cell

4.7 Data Recording and Reduction; Post-Test Photography

The test operator shall perform the following steps:

4.7.1. **Fill out** the test report data sheet (section 7.2, Figure 7-3) completely. **Place** the test data sheet and the completed Pre-Test Checklist (section 7.2, Figure 7-2) in the work folder, and **return** the folder to the test engineer for evaluation.

4.7.2. **Photograph** reactions, charred or melted test equipment, or any anomalies, and **document** these in writing on the test report data sheet. **Do not photograph** post-test samples that did not react. **Take** the required photographs as close to the sample as possible. More than one sample or reaction per photo is acceptable, as long as the details of reactions are visible. Procedures for taking photographs are outlined in the *Photography Operating Guide*. **Place** three copies of each post-test photograph in the test folder before returning the folder to the engineer. Photographs shall be retained indefinitely.

4.7.3. **Package** the samples and inserts from reacted samples in clear photography slide sleeves. **Label** the protector with the test request number, pressure, oxygen environment (LOX/GOX), test date, tester, and energy level. **Identify** the samples by test order number and reaction indication. **Return** the samples with the test folder to the test engineer for evaluation. The *test engineer* **shall return** samples to the sample preparation laboratory for archival purposes.

5.0 Notes

Custodians for EM10-OWI-CHM-033	
Master List and Document Control	EM10 Management Support Assistant
Alternate Document Control	EM10 Group ISO Representative
Records	Materials Test Branch ISO Representative
Calibration	Materials Test Branch Calibration Contact
Memoranda	Materials Test Branch ISO Representative

6.0 Safety Precautions and Warning Notes

6.1 Hazards

Safety shall have precedence over all activities. Because of the nature of testing materials in pressurized LOX or GOX environments, the testing system involves several hazards to the operator and facility. These include:

- Handling and pouring of cryogenic fluids
- Pressurized systems and cylinders (oxygen and/or nitrogen)
- Potential of explosion and hazardous fume by-products from burning materials in a pure oxygen or oxygen-enriched environment
- Handling and moving of heavy parts of the test apparatus on a regular basis
- Potential of impact plummet disengaging during assembly or disassembly of the impact chamber, creating risks of dismemberment, dislocation, or fracture
- Possible shock hazard from electrical components
- Flammability and health risks from volatile cleaning solvents
- Potential touch temperature risks from elevated temperature GOX tests and cryogenic LOX tests, when handling test equipment
- Potential for exposure to oxygen-deficient environments.

Warning
Death, severe personal injury, or loss of major equipment may result if maintenance or operating procedures, techniques, restrictions, etc., are not followed exactly.

6.2 Safety Precautions

6.2.1. Test setup, testing, and shutdown shall be planned so that at least one test operator is in the test area and one other person is in Building 4623 during normal business hours. After normal business hours and on weekends, a test engineer shall be in Building 4623 during all test activities. **No more than five personnel** shall be in the cell at any given time. Operation of the tests shall comply with EM10-OWI-CHM-050, *Building 4623 Guidelines for Test Operations*.

6.2.2. The test controls **shall not be operated** when personnel are working with the tester. A sign **shall be placed** on the control panel warning that personnel are working with the tester.

6.2.3. All pressure leak checks shall be performed at or below 25 psia or with video observation, and shall be performed with an inert gas.

6.2.4. The test operator shall **keep** this OWI visible on the console during operation of the test equipment.

6.2.5. The Emergency Shutdown Procedure (section 6.4) shall be posted near the test console.

6.2.6. The test operator shall **refer to the MSDS** for information on personal protective equipment required for materials being handled (sample materials, solvents used, gaseous nitrogen, liquid nitrogen, and liquid oxygen) and shall **wear** safety gear appropriate for the test specimens and conditions:

- Safety shoes when there is a danger of foot injuries from falling or rolling objects, objects piercing the sole of the shoe, or when feet may be exposed to an electrical hazard
- Chemically resistant gloves and goggles while handling trichlorotrifluroethane or other cleaning solvents
- Clean thermal gloves and goggles when pouring, handling, or transferring cryogenic fluids. (Hydrocarbon residue can contaminate test equipment and affect oxygen compatibility test results or damage the tester.)
- Hearing protection while operating the electronic or pneumatic impact wrench and GN_2 high-pressure blow gun.
- Fire-retardant aprons or laboratory jackets, safety shoes, safety goggles and a face shield, and clean thermal gloves when pouring, handling, or transferring cryogenic liquids. (Hydrocarbon residue can contaminate test equipment and affect oxygen compatibility test results or damage the tester.)
- A respirator when working in closed or poorly ventilated spaces.The appropriate respirator shall be worn as indicated on the sample or grease MSDS. Cartridge respirators are only good for the constituents listed on the filtration cartridge and for dust particle filtration. **Personnel shall be qualified to use a respirator, and the respirator shall be supplied by MSFC.**
- Safety glasses at all times while in the test cell.

6.2.7.**Smoking shall not be permitted** in Building 4623. The test area is generally an oxygen-enriched environment. **Open flame or other high-temperature sources shall not be permitted** in the testing area while enriched-oxygen conditions exist. Personnel shall **not smoke or expose clothing** to an open flame or high-temperature source for 30 minutes after exposure to solvents and oxygen-enriched gasses.

6.2.8.Nothing shall be stored in the test cell area other than parts or components of the test apparatus that are designated as spare parts and the tools necessary for equipment maintenance. All other materials shall be removed from the test area. Any spare equipment that will be exposed to an oxygen-enriched environment shall be placed in the secured inventory area.

6.2.9.All testing shall be performed **remotely**. **No one shall be allowed** in the test cell during chamber pressurization until the plummet has dropped and the chamber has been vented. Only the test operator(s) **shall be** allowed in the test cell during pre-test and post-test activities. Sample preparation technicians shall be allowed in the test cell to prepare liquid samples for testing, as required. Other people shall be allowed in the test cell before and after testing as determined by the test engineer.

6.2.10. The plummet shall be secured by chain, clamp, or safety bar when personnel are in the test cell.

6.2.11. The building warning system, including warning lights, shall be activated for the duration of the test, in accordance with EM10-OWI-CHM-050. Personnel shall **evacuate the test cell immediately if the oxygen warning systems sound and lights flash**: the door between the control room and the test cell shall be closed, and the test cell ventilation shall be turned on. Personnel shall **leave** the control room until the oxygen in the area has balanced or Facilities has checked the system.

6.2.12. Personnel shall **not try to extinguish** an uncontrollable LOX fire but shall **evacuate** the area immediately, and **call 911** to notify the fire department.

6.2.13. Glass dewar flasks shall not be used for the transfer of cryogenic fluids.

6.2.14. **Serious tissue damage can occur** on exposure to cryogenic LOX or LN_2, cold vapors, or cold equipment. *If injury occurs,* personnel shall **dial 911** immediately and **request** medical assistance. Bystanders can **(but are not required to)** do the following:

- *If it is safe to do so*, **remove** the person from the source of cold.
- *In the event of limb-size cryogenic exposure*, **attempt to rapidly warm** the affected area with moist heat from a shower, eyewash, or warm water bath. The temperature of the moist heat must not exceed 102 °F (39 °C).
- *In the case of massive full-body cryogenic exposure*, **remove the person** from the exposure atmosphere, and **keep the person's airway open**. **Loosely wrap the person** in a blanket until medical personnel arrive.
- **Do not remove** frozen gloves, shoes, or clothing.
- **Do not massage** affected part(s).
- **Do not expose** affected part(s) to temperatures above 112 °F (45 °C).
- **Do not apply** ice, snow, or ointments to affected part(s).

6.2.15. The test operator shall **ensure** all electrical components, wiring, etc., are in good condition and properly connected and grounded, shall **use caution** when operating any electrical equipment, and shall **not operate** electrical devices when the floors in the test cell are wet.

6.2.16. The test operator shall **use only** halocarbon oil for the head assembly reservoir of the Newport Scientific intensifiers. *If the pump oil is low*, the appropriate support personnel shall be called for service.

6.2.17. Before exposure to LOX or GOX, the test operator shall **clean** all equipment that will contact LOX or GOX as described in section 9.3 Required Tester Maintenance.

6.2.18. When handling cylinders and dewars or when making connections for compressed gases and/or liquids, the test operator shall **refer** to *Working Safely with Compressed Gases and Cryogens* and *NSTC 313-Cryogenics Safety,* contacting the test engineer for these resources. The test operator shall **comply** with the suggestions inside these presentations.

6.3 Special Precautions Associated with Compressed Gases and Liquids

6.3.1. All operations involving compressed gases and liquids shall be conducted with at least two people in visual contact in the facility.

6.3.2. All operating personnel shall be instructed on the nature of hazards associated with compressed gases and liquids.

6.3.3. Before removal of any component of the system for servicing, the operator shall secure and inspect the system to ensure that no unsafe condition exists.

6.3.4. Personnel shall perform continuous monitoring, *e.g.,* check operating pressures, look for leaks, listen for unusual noises, during all operations. Personnel shall ensure that oxygen leak levels are adequate throughout operations.

6.4 Emergency Shutdown Procedure

The *test operator* **shall shut down** the test equipment in case of an emergency. *If the operator cannot do so*, *any person* may read the posted emergency shutdown procedures and shut down the equipment. The *test operator* **shall also notify** the test engineer of the emergency shutdown.

In an emergency, the test operator shall perform the following procedures to **shut down** the high-pressure impact testers as follows:

6.4.1. **Push** the **red EMERGENCY POWER SHUT OFF** button on the control console. The pressure from the base and the lines on the base side of the dome valves will vent immediately. The supply dome valve will close, and the vent dome valve will open. This action will also kill the magnet power, releasing the plummet. The plummet has two backup mechanisms for magnet power failure: a manual plummet safety dowel that should **always** be in place when not testing to prevent injury to personnel and a safety latch that is normally latched until a test is initiated.

WARNING: The safety latch is not a personnel safety device.

Note: The door is wired to kill all power to the tester when opened, except that of the magnet to the plummet. Opening the door achieves the same function as pushing the **red EMERGENCY POWER SHUT OFF** button, but it does not cause release of the plummet.

6.4.2. *If time permits*, **shut off** the LN_2 valve at the ball dewar at the east end of Building 4623 by turning the handle clockwise.

6.5 Accident Reporting

6.5.1. From a safe location, the *test operator* **shall immediately call 911** and **notify** the EM10 Branch Chief.

6.5.2. From a safe location, the *EM10 Branch Chief* **shall immediately report** the accident to the NASA Safety Monitor and the appropriate supervisor(s).

6.6 Emergency Response Plan

Emergency procedures and plans for Building 4623 are incorporated into the OWIs and are stated in MPR 1040.3, *MSFC Emergency Program*. Plans will be modified if operations change in a significant manner.

6.7 Mishap Reporting

Personnel shall report all mishaps occurring in Building 4623 to the test engineer, who shall report the mishap to the area coordinator/Safety Monitor. An initial verbal report shall be made within 8 hours, followed by a written report within 3 days. The EM10 Branch Chief shall prepare a managerial report within 7 days. Both reports shall be reviewed by the test operator's supervisor and by the NASA Safety Monitor. The detail and extent of the mishap report shall depend on the nature and extent of the damage. *If personnel injury or equipment damage does occur,* the mishap report shall be completed in accordance with MWI 8621.1. *Close Call and Mishap Reporting and Investigation Program*.

7.0 Attachments, Data, Reports, and Forms

7.1 Attachments

7.1.1. Striker Pin Boxing Guide

This section describes the proper procedure for boxing strike pins for LOX cleaning. When two or more boxes of pins (~600) accumulate, they shall be sent for LOX cleaning, reducing the amount of batch testing that must occur. This boxing guide has been developed to allow:

- shipping boxes to be stacked without the bottom boxes being crushed
- ease of handling
- moving by hand truck
- quick count of pins.

The test operator shall perform the following steps:

7.1.1.1. **Mark** the number of pins in each rack with a permanent marker on the side of each rack.

7.1.1.2. **Pack** the racks in the special-purpose fiberboard shipping box, FSN 8815-00-117-8249, a white file folder box with hand holes on the sides.

7.1.1.3. **Place** two rows of five racks across the width of the box. **Orient** the racks so that the pins are on their sides.

7.1.1.4. **Place** two racks flat on top of the two lower rows. This makes a maximum of 12 racks per box.

7.1.1.5. **Do not tape or seal** the boxes, since the pin count shall be verified before the box is accepted at LOX cleaning.

7.1.2. Test Reaction Flowchart. Figure 7-1 presents reaction scenarios and the actions they require. **See** the test engineer for additional direction.

7.2 Forms

Table 7-1 provides the free-fall times for the High Pressure Impact Tester, and Figures 7-2, 7-3, and 7-4 illustrate forms used in the conduct of Test 13B.

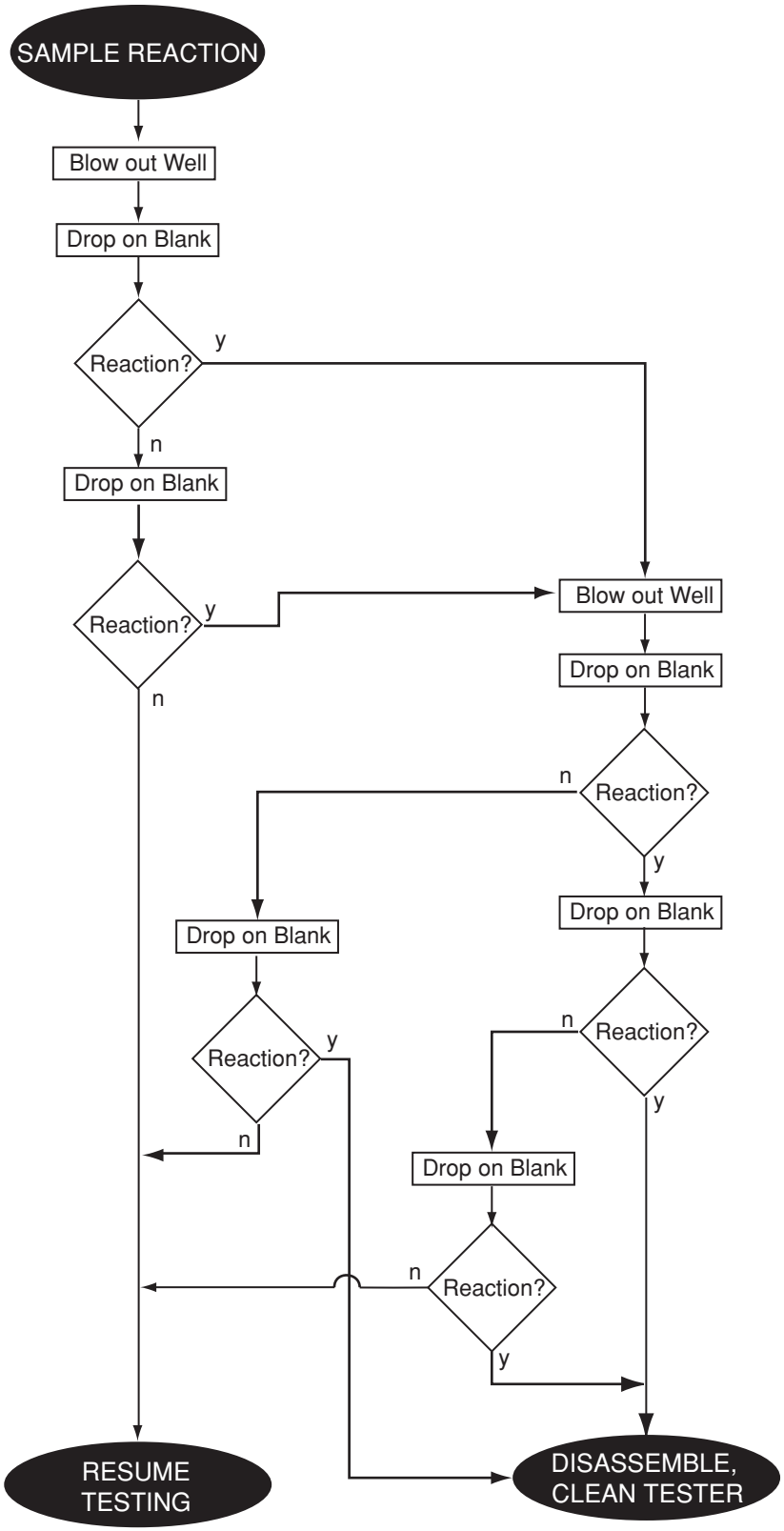


Figure 7-1.
Reaction Scenario Flow

Table 7-1. Free-Fall Times for the High Pressure Impact Tester

Delta Time vs. Energy with Calculated 3% Time Error				
Drop Height (in.)	**Impact Energy (ft-lbf)**	**Free Fall Time (s)**	**2-in. Gate Time (ms)**	**Gate Time +3% Error (ms)**
43.3	72.0	0.474	11.1	11.5
39	65.0	0.450	11.7	12.1
36	60.0	0.432	12.2	12.6
33	55.0	0.413	12.8	13.2
30	50.0	0.394	13.5	13.9
27	45.0	0.374	14.2	14.7
24	40.0	0.353	15.1	15.6
21	35.0	0.330	16.3	16.8
18	30.0	0.305	17.7	18.2
15	25.0	0.279	19.6	20.1
12	20.0	0.249	22.2	22.8
9	15.0	0.216	26.2	27.0
6	10.0	0.176	33.9	34.9

High-Pressure Impact Tester Pre-Test Checklist

Request No. _____

	Initial	
1.	☐	NASA-STD-6001 reviewed within the last year?
2.	☐	OWI reviewed within the last year?
3.	☐	Samples prepared per NASA-STD-6001?
4.	☐	Minimum of 20 samples?
5.	☐	Test cups are Inconel alloy?
6.	☐	Pins checked for surface roughness/contamination?
7.	☐	Cups checked for surface roughness/contamination?
8.	☐	Inserts required?
9.	☐	Pre-test photographs taken and in test folders?
10.	☐	Test samples concur with the test request?
11.	☐	Adequate supplies of LOX and liquid nitrogen?
12.	☐	Equipment (detectors, timer, magnet, beacon, alarms, fan) checked out per OWI?
13.	☐	Appropriate pressure transducers in place?
14.	☐	Omniseals in correct position?
15.	☐	Facility warning beacon activated?
16.	☐	Sample MSDS read?

_____ _____

Sample Preparation Technician Date

_____ _____

Test Operator Date

Remarks/Discussion of Discrepancies:

_____

_____

_____

1/05 EM10-F-CHM-029

Note: Representative Data Sheet. Refer to Forms Master list for current version.

Figure 7-2.
Typical Test 13B Pre-Test Checklist.

Figure 7-3.
Typical Test 13B Test Data Sheet.

TEST 13B TEST DATA SHEET

Sample preparation information

Test No.: _____ Date: _____ Project: _____
Request ID No.: _____ Requestor: _____

Manufacturer's Designation: _____
Manufacturer: _____ Batch: _____ Lot: _____

Composition: _____
Specification: _____

Substrate Thickness (in.): _____
Substrate Material: _____ Insert Cup Material: _____
Cure Time: _____ Cure Temperature (F): _____ Cure Pressure (psia): _____
Ave. sample diameter (in.) _____ Sample length (in.) _____ Inserts Used: Y ☐ N ☐
Ave. sample weight (g) _____ Sample thickness (in.) _____

Test operator information

Drop Height (in.): _____ (kgm): _____ Environment (check one): LOX ☐ GOX ☐
Pressure (psia): _____ Temperature (˚F): _____

Test results

Sample #	Delta Time (ms)	Energy (ft-lbf)	Temp (˚F)	Pressure (psi)	Flash* North	Flash* South	Char S/C/P**	Comments
1								1
2								2
3								3
4								4
5								5
blank								blank
6								6
7								7
8								8
9								9
10								10
blank								blank
11								11
12								12
13								13
14								14
15								15
blank								blank
16								16
17								17
18								18
19								19
20								20

* 0 = No; 1 = Yes **S = sample; C = cup; P = pin

Excess Sample?: Y ☐ N ☐ Quantity of Excess: _____ HIPIT Tester #: _____
Test Summary (reactions/test): _____ at (ft-lb): _____ Test Conductor: _____

1/05 EM10-F-CHM-027

Note: Representative Data Sheet. Refer to Forms Master list for current version.

CHECK THE MASTER LIST -- ONLY THE LATEST VERSION IS VALID

Calibration Statement: Categories IV and V Equipment

Calibration is required before use per MPR-8730.5.

(Calibration before use for each test series and periodic testing by the Using LIne Organization)

Calibration Contacts: EM10/James Perkins, EM10/Mark Griffin

User Name:_____

Equipment Description:_____

(attach multiple components sheets if necessary)

Manufacturer:_____

ECN:_____ Serial No.:_____ Model No.:_____

Date of Calibration:_____

Type of Software and Version:_____

_____

Listing of Standards Associated with Calibration:

_____

_____

_____

_____

_____

Are standards National Institute of Standards and Technology (NIST) traceable? ☐ Y ☐ N

Did calibration meet equipment manufacturer's specifications? ☐ Y ☐ N

Calibration was performed by:_____

Remarks:

_____

_____

_____

_____

_____

_____

_____

_____

1/05 EM10-F-CHM-018

Note: Representative Data Sheet. Refer to Forms Master list for current version.

Figure 7-4. Typical Calibration Statement.

8.0 Records

Records for the High Pressure Impact Tester shall consist of (a) memoranda that contain test results and that are stored electronically in the Materials and Processes Technical Information System (MAPTIS) and (b) calibration records.

8.1 Memoranda

Memoranda containing test results shall be retained indefinitely by EM10 These memoranda shall be stored electronically in the MAPTIS database and shall be accessible by test request number or memorandum number.

8.2 Calibration Records

8.2.1. All equipment requiring calibration shall be in current calibration, in accordance with EM10-OWI-CHM-050 (current revision), *Building 4623 Guidelines for General Operations.*

8.2.2. Form EM10-F-CHM-018, current revision (Figure 7-4, section 7), shall be used to document the calibration of all Category IV and V equipment.

8.3 Maintenance of Records

8.3.1. Memoranda less than 10 years old shall be maintained in ready-access files in MAPTIS; memoranda 10 years old or older shall be automatically transferred to historical files.

8.3.2. Calibration records shall be maintained on site for a minimum of 10 years, filed and indexed by test request number. These shall be stored in a manner that will protect them, *e.g.*, in a test folder stored in a metal file cabinet. After 10 years, calibration records shall be transferred to historical files.

8.3.3. The original test records shall be saved for a minimum of 5 years.

9.0 Tools, Equipment, and Materials

9.1 Tester Standard Configuration

The High Pressure Impact Tester resides in Building 4623. The tester is fastened to a 2-ft x 2-ft x 2-ft concrete pedestal with a 4-in. thick, stainless-steel, level, baseplate attached (Figure 9-1). Three vertical columns, placed 120 degrees from one another, are attached to the baseplate, providing a free-fall path for a 20-lb (±0.05-lb) plummet assembly.

The columns are perfectly vertical, approximately 66 in. long, and stabilized at the top by a metal plate. An electromagnet attached to a fourth column holds the plummet assembly between the three columns. The plummet assembly is guided by Delrin wheels attached to triangular webs at the top and bottom of the plummet body. A catcher triggered by phototransistors limits the plummet assembly to one impact and then returns it to the magnet. The phototransistors, located on the fourth column, also start and stop the timer, which is used to measure the plummet drop time.

An Inconel 718 pressure chamber (Figure 9-2) capable of pressures up to 12,000 psia, is attached mechanically to the baseplate, which is centered between the three vertical columns. The pressure chamber utilizes one of two bases, depending on test parameters: one base is for LOX or GOX tests, and the other is for high-temperature GOX tests. The first base has four 1-in. ports for connecting LN_2 lines, which can be used to chill the chamber and to condense GOX to LOX. The second base has four 1-in. recessed holes for placement of heaters to achieve elevated chamber temperature. The bases also contain a pressure transducer port, one thermocouple port (minimum), a fill port, a vent port, and two photocell ports. Some of the photocell ports are angled for better observation of light emissions. Each base has four threaded holes for studs that allow attachment of the pressure head and the chamber. Both bases have a 1.44-in. deep cavity at the center for holding a test specimen cup (Figure 9-3). (There are currently two versions of this cup: the shorter-in-height cup is for use with the base with angled viewports.) Figures 9-4 and 9-5 show specimen hardware that may be used in high-pressure impact testing, as described in EM10-OWI-CHM-042, *Test Sample Preparation for Testing in Building 4623*

The head assembly of the pressure chamber has two sections. The top section houses a balance piston, which extends through the top and bottom sections of the head assembly and into the base cavity. The piston transfers the impact energy from the plummet to the sample in the specimen cup. The top part of the head has a port to allow GN_2 input, which displaces the balance piston downward, ensuring pin contact with the sample before plummet release. This displacement is referred to as a counter loading, and it applies a pressure equal to 1/10 of the total test pressure. This applied pressure is the damping force that offsets the upward force on the impact pin when the chamber is pressurized. The bottom section of the head assembly is the portion exposed to or wetted by the test environment. The balance piston extends through this section, sealed with PTFE spring-energized seals. The balance pistonhas a threaded hole for attachment of striker pins (Figure 9-6).

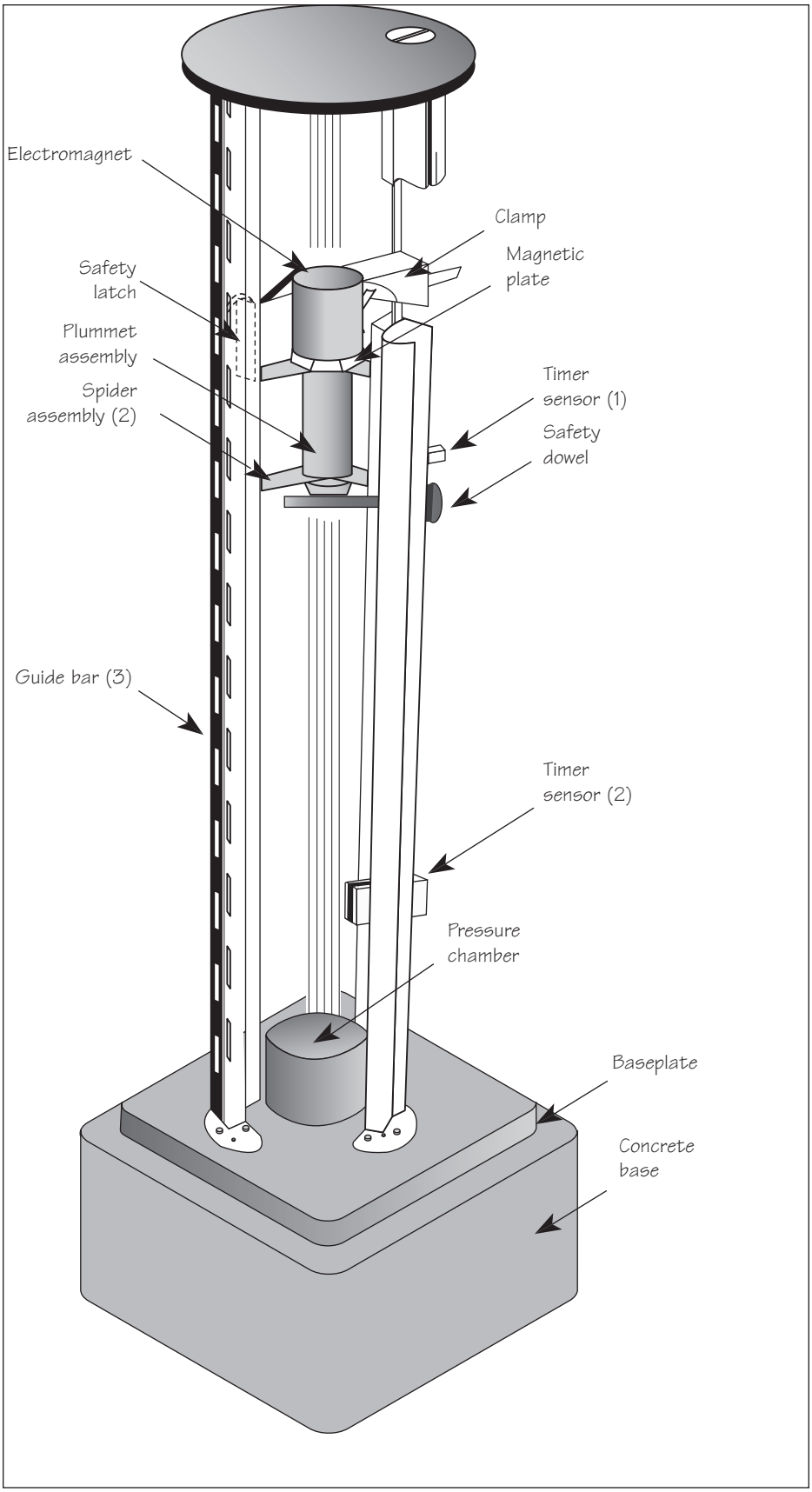


Figure 9-1.
Typical High-Pressure Mechanical Impact Tester.

Note: Illustration is representative. Actual appearance may vary.

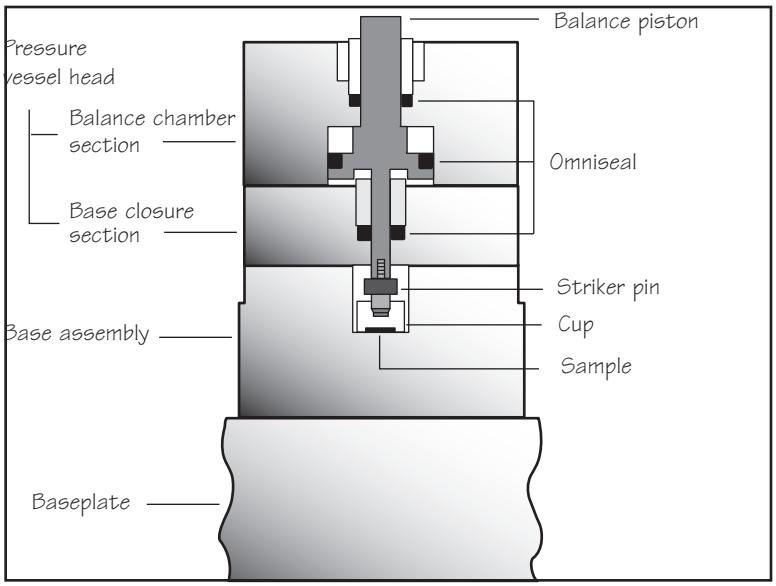


Figure 9-2.
Typical Pressure Chamber.

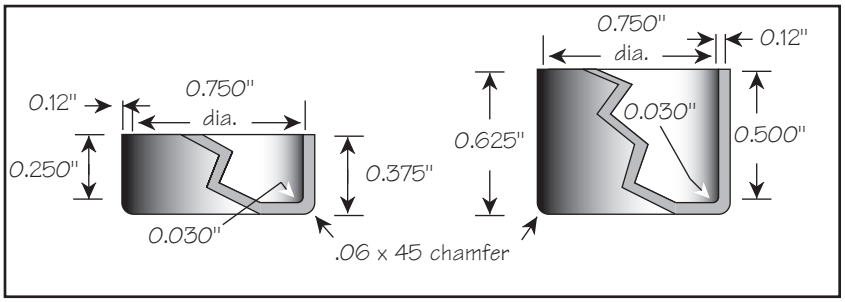


Figure 9-3.
One-piece Specimen Cups.

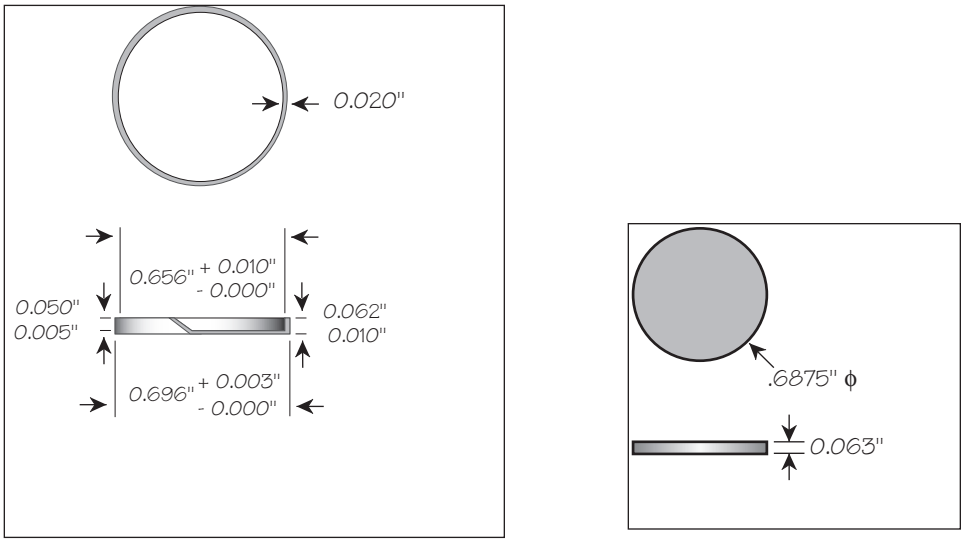
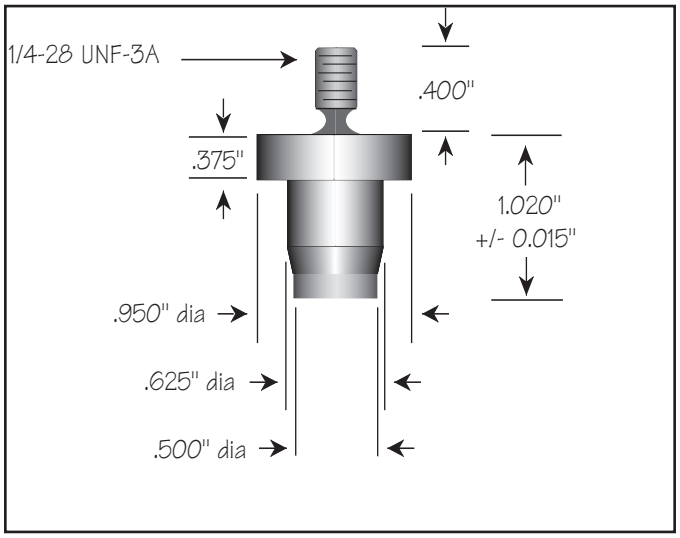


Figure 9-4.
Insert Cup.

Figure 9-5.
Disk/Substrate/Insert.

Note: Illustrations are representative. Actual appearances may vary.

Figure 9-6.
Striker pin.



Note: Illustration is representative. Actual appearance may vary.

A GOX generator provides the oxygen (MIL-PRF-27210F, Technical Grade) for tests, and an intensifier provides the means to achieve pressures above GOX generator pressures. The Newport Scientific intensifiers are 10:1 pressure ratio output-to-input electric and pneumatic-driven intensifiers. The Haskel intensifiers are 20:1 pressure ratio output-to-input pneumatic-driven intensifiers. Viewdac® software controls the system remotely, while the operator observes temperature, pressure, and photocell response from the control area.

Figure 9-7 illustrates the Astro-Med® Dash IV recorder.

The *High-Pressure Mechanical Impact Tester Configuration Control Book* controls the hardware standard configuration. **Refer** to this book for electrical and mechanical schematics. For location of this book, **see** the test engineer.

9.2 Procedure for Deviations

Deviations to the baselined tester configuration shall require NASA written approval. It is the responsibility of the test engineer to obtain the written approval. After written approval is received, the change shall be added to the appropriate *High-Pressure Mechanical Impact Tester Configuration Control Book*.

9.3 Required Tester Maintenance

The standard maintenance program for the HIPIT testers and related control equipment is divided into weekly, monthly, as-required, and yearly service. In addition, the program involves a maintenance log, calibration, and a required spare parts inventory.

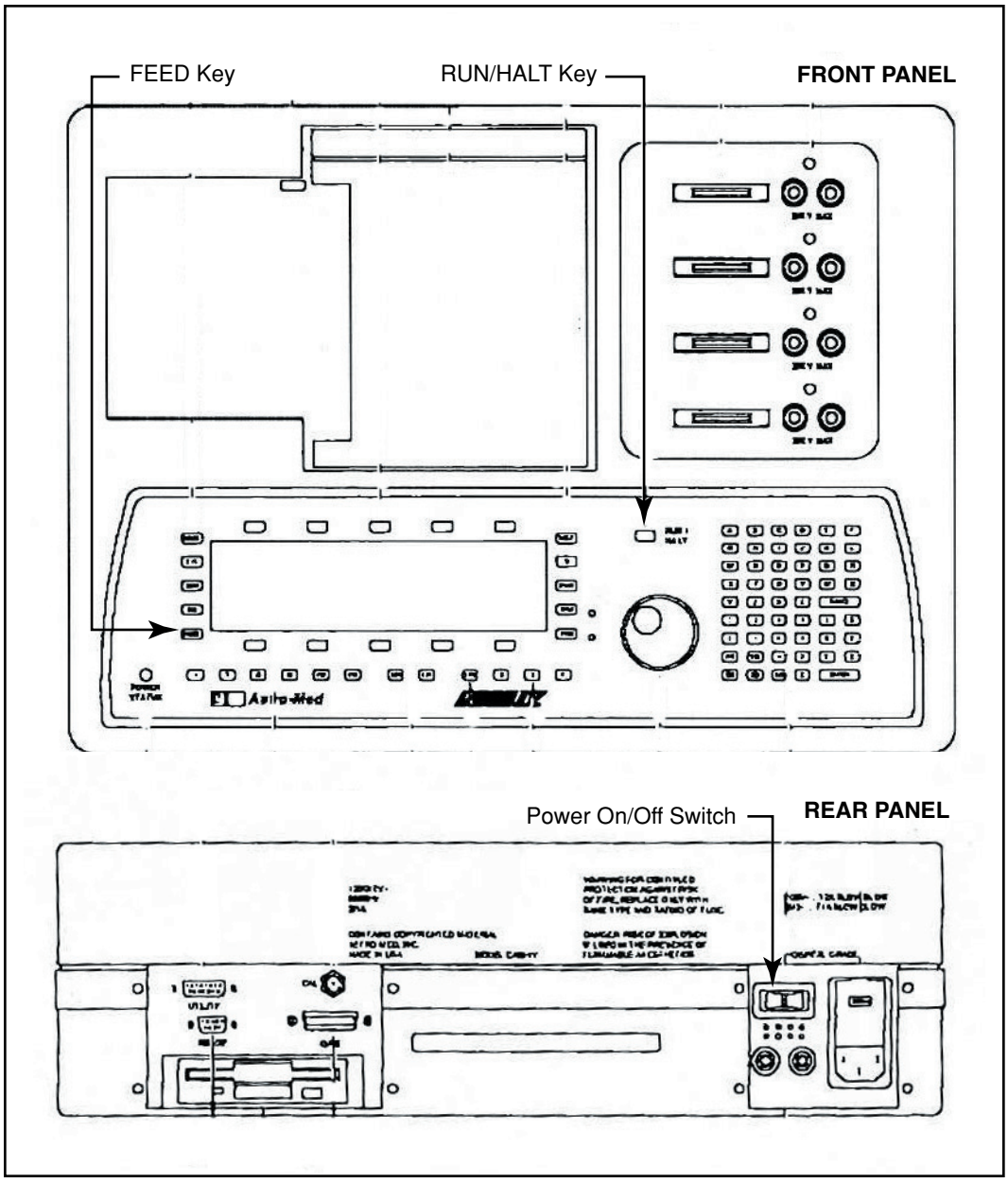


Figure 9-7.
Astro-Med® Dash IV recorder.

9.3.1. Weekly Maintenance. The test operator shall **check** the LN_2 dewar fill tube weekly to make sure there are no obstructions or kinks in the fill tube that would hinder proper operation and shall e**nsure** the cleanliness of this area of the test cell weekly.

9.3.2. Monthly Maintenance.

The test operator shall perform the following procedures:

9.3.2.1. **Check** the finish of the impact surfaces of the post-test striker pins and specimen cups. *If necessary*, **send** these to the Fabrication Group for re-surfacing. Pins shall always remain in their original rack, unless they are

damaged or out of specification; damaged or out of specification pins shall be discarded. (Specifications are that the minimum shoulder-to-striking surface be 1.005 in.) **Do not replace** a discarded pin with a pin not in the tolerance range of the rack.

9.3.2.2. **Place** post-test pins in their original racks, **bag** them, and **tape** the bags closed. **Count** the pins. **Label** the bag with the number of pins using a permanent marker. As required, **prepare** a minimum batch of 600 used pins to go to the Cleaning Facility. Before use or re-use, pins shall be cleaned to MSFC-SPEC-164B, *Specification for Cleanliness of Components for Use in Oxygen, Fuel, and Pneumatic Systems,* Class 1, Level A. **Refer** to section 7.1 for striker pin boxing instructions.

9.3.2.3. **Lubricate** pulleys and wheels on the impact tower with a light machine oil monthly or as necessary.

9.3.3. As-Required Maintenance. The test operator shall perform the following procedures every time a reaction has occurred on a blank and when changing test requests.

9.3.3.1. **Disassembl**e the head assembly as outlined below. **Clean** all pieces as outlined below, and then **reassemble** the head assembly in accordance with section 4.4.10. **Refer** to the configuration control manual diagrams as needed.

9.3.3.1.1. Disassembly:

- **Remove** the bushing from the balance chamber section. (*If the nut does not slide off easily*, the top of the balance pin may have mushroomed from repeated impact during previous testing.) **Polish** the surface with emery cloth. *If the surface roughness is severe*, **machine** the surface.

- **Remove** the spring-energized seal and washer. The spring-energized seal may be reused if removed carefully and cleaned. The PTFE washer can be reused many times if it is removed carefully and cleaned.

- **Separate** the balance chamber section from the base closure section by sliding these sections apart.

- **Remove** the balance piston from balance chamber section, by sliding these apart.

- **Remove** the retainer nut on the balance piston.

- **Remove** the large spring-energized seal from the balance piston.

- **Remove** the bushing from the base closure section of the head.

- **Remove** the spring-energized seal and PTFE washer. The spring-energized seal may be reused if removed carefully and cleaned. The PTFE washer can be reused many times if it is removed carefully and cleaned.

- **Remove** the GN_2 balance pressure line fitting from the balance chamber section.

9.3.3.1.2. Cleaning:

- **Clean** parts contaminated with grease with trichlorotrifluoroethane. Trichloroethylene or Brulin® 815 MX may be substituted for trichlorotrifluoroethane, provided the cleaning is performed in a well-ventilated area.

Note: Discard any rags and debris soaked with trichloro-trifluoroethane (or organic materials) in the *Organic Rags and Debris* hazardous control drum, located in Room 128 (in the fenced area south) of Building 4623. **Do not discard these rags in any other receptacle.**

- **Scrub** all metal parts with a solution of non-ionic soap and distilled or deionized water (1 part soap to 128 parts water), cleaning all cavities. **Use** brushes with nylon bristles or plastic scouring pads. **Rinse** with distilled or deionized water. **Allow** to dry before assembly or use.

- **Place** all other parts in the ultrasonic cleaner with a solution of non-ionic soap and distilled or deionized water (1 part soap to 128 parts water) for 1.5 hr at 40 ˚C. **Extend** time, or **repeat c**ycle if parts need more cleaning. **Do not leave** any parts in the bath overnight. **Rinse** parts with distilled or deionized water, and **allow** to dry.

9.3.3.2. **Brush** and **wipe clean** the chamber base using a solution of non-ionic soap and distilled or deionized water (1 part soap to 128 parts water) as the solvent. **Use** brushes with nylon bristles or plastic scouring pads. **Clean** all ports. *If the soap solution appears not to be cleaning grime and particles*, **wait** for the base to dry, and then **wipe** it with a three-ply tissue dampened with trichlorotrifluoroethane. Trichloroethylene or Brulin® 815 MX may be substituted for trichloro-trifluoroethane, provided the cleaning is performed in a well-ventilated area.

Note: Discard any rags and debris soaked with trichloro-trifluoroethane (or organic materials) in the *Organic Rags and Debris* hazardous control drum,

located in Room 128 in the fenced area south of Buildling 4623. **Do not discard these rags in any other receptacle.**

9.3.4. Yearly Maintenance. The test operator shall **lubricate** the air cylinder on the plummet catcher with halocarbon oil every 12 months or as necessary.

9.3.5. Maintenance Log. The test operator shall **document** any maintenance to the test chamber or setup in the applicable *High-Pressure Mechanical Impact Tester's Maintenance Log* to provide a history of the tester. Any deviation to standard maintenance shall be documented and approved on the maintenance log by the test engineer.

9.4 Calibration

Calibrated equipment lists of all categories for this OWI shall be kept by the primary calibration contact for Building 4623. These lists include software for each item of Categories III, IV, and V equipment.

Before an instrument is used to perform an actual analysis, its software shall be calibrated by test methods through which the expected results are produced. Self-calibration of some equipment shall be performed. This self-calibration shall be recorded and placed in the test folder.

Pressure transducers require calibration **yearly** and shall be in calibration before testing. These items shall be submitted to the calibration laboratory through the Building 4623 calibration contact, as required. The test operator shall **verify** that all transducers returning from the Calibration Laboratory have a male, four-pin, XLR connector that is fitted and wired to the manufacturer's specification. In addition, the test operator shall **calculate** the calibration slope and offset for each new pressure transducer (as follows) using the calibration data received from the calibration laboratory and shall **input** this information into the control software:

.

Note: Six transducers on the panel to the east of the tester shall be replaced when calibration expires. The test operator shall **change** only the chamber pressure transducer, PT3, when test pressures dictate.

The test operator **shall perform** the following steps:

9.4.1. **Make sure** the Viewdac® is on, in accordance with section 4.5.1.4. **Select** the soft key labeled **EDIT OFFSET** on the Viewdac® test screen.

9.4.2. **Calculate** the slope and offset in accordance with Equation 1, and **input** this information into the software:

Equations for pressure transducer offset and slope

$$\text{Offset} = V_{os}$$

$$\text{Slope} = \frac{P_{fs}}{V_{fs} - V_{os}}$$

P_{fs}	Pressure at full scale*
V_{fs}	Volts at full scale*
V_{os}	Volts at 0 psi*

*These values are provided by the calibration laboratory.

Equation 1.
Equations for Viewdac® Offset and Slope.

9.4.3. Click on the soft key **SAVE AS DEFAULT** and then on **EXIT** to return to the test screen represented in Figure 1.

9.5 Required Spare Parts Inventory

Before beginning each test request, the test operator **shall ensure** that there are spares for all pieces of test equipment, as listed in Table 9-2.

Note: Table 9-2 contains all variations of the bases, seals, and transducers. All are test dependent, so that not all are needed in every test.

Table 9-2. Spare Part Inventory Required for Test 13B.

PART	QUANTITY	DRAWING #
Base, Tilt Dual Flash Detector Oxygen Impact Cell (LOX/GOX)	1	EH42-11A
Base, Tilt Dual Flash Detector Oxygen Impact Cell (High-Temperature GOX)	1	EH42-11B
Base, Dual Flash Detector Oxygen Impact Cell (LOX)	1	EH02-01
Base, Dual Flash Detector Oxygen Impact Cell (High-Temperature GOX)	1	EH02-02
Bolt, Base-to-Base Anvil	4	50F150HCS3
Stud, Pressure Head Assembly, 7/8" 14 x 5/8" 18	4	EH32-75-05
Stud, Pressure Head Assembly, 5/8" 18 x 5/8" 18	4	EH32-75-06
Stud, Pressure Head Assembly, 5/8" 18 x 5/8" 11	4	EH32-73-07
Stud, Pressure Head Assembly, 7/8" 14 x 5/8" 11	4	EH32-73-05
Nut, Pressure Head Retainer, 5/8" x 11	8	MCRF-HPI-1006
Nut, Pressure Head Retainer, 5/8" x 18	8	MCRF-HPI-1005
Washer, Pressure Head Retainer, Flat	8	NSN5310-00-823-8803
Pressure Head Assembly, High-Pressure Oxygen Impacter	3	RS005269
Spring-Energized Seal, Striker Piston (white)	10	AR10103-326AH
Spring-Energized Seal, Pressure-Balanced Impact Striker (white)	20	AR10103-315AH
Backing Washer, Pressure-Balanced Impact Striker (white)	20	AR190155D00625A
Spring-Energized Seal, Striker Piston (black)	5	AR103D00601PIH
Spring-Energized Seal, Pressure-Balanced Impact Striker (black)	10	AR103D01604PIH
Backing Washer, Pressure-Balanced Impact Striker (black)	10	AR190155D00625P
Thermocouple Probe, type K, 0.125" dia., grounded sheath	2	MCRF-HPI-1004
Thermocouple Feedthrough, 1/8" NPT male to 0.125" female	2	MCRF-HPI-1003
Heater element, 115 VAC, 750 W, (1" x 1.5") Incoloy™ sheath	4	T1J9A
Gasket, Pressure Head Assembly to Base	20	50887
Roller, Plummet, High-Pressure Oxygen Impacter	12	RS005253-X
Bushing, Plummet Roller, High-Pressure Impact Tester	12	RS005260-X
Roller Retainer Bolt, Plummet, High-Pressure Oxygen Impacter	12	MCRF-HPI-1002
Timing Flag Retaining Bolts, High-Pressure Oxygen Impacter	2	MCRF-HPI-1001
Transducer, Cell Base Pressure, High-Pressure Oxygen Impacter	1/range	2406xx2AAA20*

*Applicable code (xx) for test range:

AN = 0 - 150 psi	BA = 0 - 2,000 psi
AR = 0 - 300 psi	BC = 0 - 3,000 psi
AU = 0 - 500 psi	BF = 0 - 5,000 psi
AZ = 0 - 1,500 psi	BP = 0 - 15,000 psi

10.0 Personnel Training

The nature of testing that occurs in Building 4623 is complex and involves potential hazards; therefore, all test operators shall complete the requirements for Category 1 Credentials before conducting any test, and all tester maintenance personnel shall complete the requirements for Category 2 Credentials.

- **Category 1 Credentials** qualify personnel to perform basic test operations.
- **Category 2 Credentials** qualify personnel to maintain and modify testing apparatus.

Category 1 Credentials - Basic Operations

To obtain Category 1 Credentials, the test operator **shall complete training** in following areas

- Compressed Gases and Working with Compressed Gas Lines and Fittings
- Safe Handling of Cryogenic Fluids (LN_2 and LOX)
- Oxygen Compatibility
- Use of Personal Protective Equipment
- General Safe Laboratory Practices
- Hazardous Waste Disposal
- Use of Intensifiers
- Use of the Viewdac® system.

Category 1 Credentialling also requires:

- Successful completion of an annual physical examination conducted by the medical facility at Marshall Space Flight Center (or equivalent), including a hearing exam
- A demonstration of knowledge of the test and equipment by the completion of two successful test sets under the supervision of the test engineer.
- A demonstration of knowledge of the OWI. Candidate test operators shall thoroughly read the test OWI and sign a statment confirming that they have read and understand the OWI. Each shall be issued a personal copy of the OWI.
- Passing of a written test covering the OWI. The test shall be administered by the test engineer.

A copy of the written test, along with the signed statement and the training record, shall constitute verification of credentials. Training records shall be kept on file as proof of training. These records shall include training expiration dates and required refresher courses.

Category 1 Credentials shall expire after a period of 2 years. After that time, recredentialling shall be required..

Category 2 - Tester Maintenance and Modifications

Personnel seeking **Category 2 Credentials** shall become qualified and credentialled through training classes approved by the candidate's supervisor or through training classes completed during previous employment. Training in the following area shall be required:

- Basic Electrical Wiring.

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EMERGENCY PHONE NUMBERS

Emergency..... 911

Medical Center..... 4-2390

Industrial Safety..... 4-0046

Chemical Spills..... 4-4357

Safety Monitor
Building 4623..... 5-0358