

ACCELERATOR DIVISION DEPARTMENTAL PROCEDURE

CRYOGENICS/CENTRAL HELIUM LIQUEFIER

ADDP-CH-1002

PRESSURE RELIEVING DEVICES MAINTENANCE/TEST PROCEDURE

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1.0 PURPOSE AND SCOPE

The purpose of this Accelerator Division Departmental Procedure (ADDP) is to outline and detail the conduct of inspection, repair or maintenance, and isolation operations of all pressure relieving devices, including relief valves, safety valves, safety relief valves, pressure relief valves, rupture disks, and parallel plate reliefs. This procedure is written to comply with the requirements of Chapter 5120 ("Lockout/Tagout" of the Fermilab ES&H Manual (FESHM)). Occasional maintenance or repair of these reliefs is required if proper plant operation is to be maintained. Some of these maintenance and repair activities may require working on systems not completely de-energized, especially in terms of pressure or cold temperature cryogenics. Operational considerations sometimes do not allow complete shutdown of such systems.

Additionally, as per FESHM Chapter 5032.2, all vessels' primary pressure reliefs must be periodically inspected and tested in order to assure proper operation. Inspection must be conducted every three years from the date of installation. Testing must be conducted every six years from the date of installation. All redundant pressure relief devices must be tested every $n \times 6$ years, where n - a degree of redundancy. This requirements is mandatory for all "primary" pressure reliefs, which fall under the scope of ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Div.1 and FESHM chapters 5031, 5032.

2.0 PRECAUTIONS & LIMITATIONS

Vessels may contain pressurized gases or fluids. Serious injury or death could result from attempts to remove a relief device while vessel is still pressurized.

Vessels may contain substances hazardous to health and/or the environment. Failure to consult and observe precautions listed in relevant Material Safety Data Sheets (MSDS) may result in personal injury or environmental damage.

Opening a cryogenic vessel to atmosphere without warming to ambient temperature may result in system contamination and/or total blockages from cryo-pumped atmospheric moisture.

Improper relief maintenance procedure may render a relief inoperative. Only qualified personnel may perform testing and/or repair on relief devices. The appropriate training should be provided by the line management for the personnel involved in pressure relief testing. The extent of this testing is determined by the line management, but with the mandatory provision of the formal training "Pressure Safety" received by the involved personnel. The personnel may perform repair on relief devices only if trained and qualified by the relief manufacturer to follow all provisions established by the BPVC. Otherwise all pressure relief devices should be repaired, altered, or rerated by a qualified outside contractor.

3.0 PREREQUISITE ACTIONS

3.1 The Necessity of Written Procedure

FESHM Chapter 5120 defines seven conditions that must be met such that a written Lockout/Tagout (LOTO) procedure is not required. If a written LOTO procedure is not required per the chapter, than the Accelerator Division ES&H Procedure ADSP-05-1201 ("General Lockout/Tagout Procedure") must be followed. Determination of the necessity of a written LOTO procedure involves defining the scope of work to be performed. For example, work on a rupture disk with a diverter valve upstream typically falls under the general LOTO

procedure. Each maintenance activity must be evaluated on its own merits to determine the procedural requirements of FESHM Chapter 5120.

However, by the very nature of process relief valves, the following conditions may exist thus requiring a written LOTO procedure:

- a) the equipment has potential for stored or residual hazardous energy,
- b) the equipment has multiple energy sources requiring multiple lockout devices,
- c) the servicing, maintenance, and modification can create a hazard for other employees.

If a LOTO procedure already exists, such as one for the Worthington Helium Compressors A, B, and C (ADDP-CH-0018), that would encompass the system containing the relief device and has no additional sources of hazardous energy, that procedure should be used or referenced in the one developed per the requirements of this ADDP.

Hot-tap operations involve working on process gases or fluids where it is documented that (1) the continuity of service is essential, (2) shutdown of the system is impractical, and (3) there are documented procedural steps that use special equipment to provide proven protection for employees. Some maintenance operation may involve such hot-tap work and the procedure requirements defined in this ADDP applies to such operations.

3.2 Authorized Personnel

An Accelerator Division employee or subcontractor designee is authorized to perform this procedure if he/she has necessary knowledge and current training.

Only authorized employees or approved subcontractors are allowed to work on this equipment. The authorized employee will understand the hazards involved and how to control them. If an authorized employee or approved subcontractor does not have this knowledge, he/she is not qualified to perform the LOTO procedure or maintenance activity.

3.3 Planning & Coordination

3.3.1 *Visual Inspection:*

- a) Obtain an approved "Relief Device Inspection/Test Record" for the appropriate relief device.
- b) Schedule an inspection date where personnel safety is least compromised during any inspection.

3.3.2 *Relief Device Testing:*

- a) Meet with users of the portion of the system to be affected to determine the appropriate scheduling windows when the work will have the minimum adverse impact to the program, and still comply with the requirements of FESHM 5032.2.
- b) Determine the requirements for written LOTO procedures per FESHM 5120. The Group Leader's approval is required if written procedure is necessary. Refer to ADDP-CH-4008 "Lockouts and Tagouts" for further discussion.
- c) Assess the need for conservation & recovery of vessel contents. Included in this are environmental and economic considerations, as well as spill control precautions, if necessary. Refer to MSDS sheets for content considerations.
- d) For cryogenic vessels, determine the need for warm-up or alternate method for contamination control.
- e) Verify that calibration of equipment referenced in subsection 3.4.2 is current.

- f) Obtain the proper manufacturer data sheet and recommended maintenance procedure for reference.

3.4 Tools and Material

3.4.1 *Visual Inspection:* No special equipment.

3.4.2 *Relief Device Testing:*

- a) Test gauge with valid calibration traceable to the National Institute of Standards and Testing (N.I.S.T.) having a range no less than 1.5 times, nor more than 4.0 times the nominal set pressure of the device to be tested. The gauge shall be accurate to within 1% full scale. The smallest division shall be no greater than 1% of full scale.
- b) The gauge shall be protected by a relief set at no more than 75% of the gauge upper limit.
- c) Compressed gas source (air, helium or nitrogen) with manifold set up as per FESHM 5034TA-3 pneumatic test diagram (less the barrier).
- d) Test volume constructed of piping components rated at a minimum of 125% of the highest expected testing pressure. This volume should have connections for the following:
 - 1) Test gauge
 - 2) Device to be tested
 - 3) Gas source manifold
 - 4) Test volume protection relief set at or below the rated pressure of volume components. (This may also serve as the gauge protection relief if it also satisfies paragraph 3.4.2b).

4.0 STEPS PRIOR TO MAINTENANCE OR TESTING

The following steps are guidance for the performance of the maintenance activity. The approved written LOTO procedure defined by use of FESHM 5120 shall be followed (see subsection 3.3.2).

4.1 Prepare:

4.1.1 *Visual Inspection:* Assemble access equipment: ladders, mirrors, lights, etc.

4.1.2 *Relief Device Testing:*

- a) Determine the relief testing method required, as recommended by the device manufacturer.
- b) Assemble recovery and/or spill control materials as required.
- c) If relief device is to be exchanged with a device of the same type, setting & rating, previously tested; verify the device is on hand and properly tested per the requirements of FESHM 5032.2.
- d) Verify spare gaskets or seals of the correct size and type are on hand. It is very important that gaskets be dimensionally correct for the specific flange, and that they fully clear the valve inlet and outlet openings. Gaskets and bolting should meet the service requirements for the pressure and temperature involved, refer to the manufacturer technical manuals or consultants.
- e) Assemble any required lifting and positioning equipment. The use of proper handling devices, where valves are too heavy for lifting by hand, will avoid damage to flange gasket surfaces as well as to personnel back muscles.
- f) Assemble access equipment: ladders, manlifts, etc. meeting requirements of OSHA.

4.2 Notify:

Notify the CHL shift crew chief, the on-call staff, and Group Leader to the degree required by the approved LOTO procedure.

4.3 Shut Down:

- a) Transfer vessel contents to approved alternate containment if required.
- b) Shut down any pumps/compressors included into the system to be isolated per standard operating procedure.

4.4 Isolate:

Isolate the vessel/piping volume of the immediate vicinity of the relief to be tested by closing isolation valves. See subsection 3.3.2.b of this procedure.

4.5 Lock and Tag Out:

Lock and tag all isolation devices and equipment within the isolated volume, which may introduce an energy if activated. This should be done as per ADDP-CH-4008.

4.6 Relieve/Restrain Stored Hazardous Energy:

Where exposure to the atmosphere is undesirable, control contamination with one of the following steps:

- a) Replace with previously tested spare device of same type, setting, and rating, **or**
- b) Cover opening with material which will seal the opening, but not hold significant pressure, e.g.: lightweight plastic bag taped in place, or lightweight flat plate (less than 1 pound) not fastened in any way, **or**
- c) Put under the purge of inert gas.

Warning: Use of an inert gas purge in a confined space may produce an oxygen deficient condition which can be harmful or fatal. Where nature of contents permit, purge with helium or nitrogen, as appropriate, to maintain slight positive pressure (less than 1/2 psi). This method is NOT to be used for work in confined spaces and must be source limited so as to be incapable of pressures exceeding 1/2 psi.

4.7 Verify:

- a) Verify any necessary warm-up has been performed and determine temperature of vessel contents.
- b) Verify the vessel has been depressurized.

5.0 MAINTENANCE/TESTING OF RELIEF DEVICE

5.1 Visual Inspection:

- a) Make sure the relief device is the same as described in its associated Pressure Vessel Engineering Note.
- b) Make sure the relief device outlet or discharge piping has remained unrestricted and no reduction of relieving capacity has been introduced per the Engineering Note.
- c) Make sure the relief device has not undergone severe corrosion or tempering.
- d) Make sure the company ID tag shows the proper pressure setting.

- e) Make sure the relief device does not leak. Make sure the seals protecting the spring setting have not been broken.
- f) Make sure the relief device vents are routed to the safe location.

5.2 Field Testing:

Pressure relief device may be tested in the field, or removed and tested in the bench. If the test pressure introduced at maximum pressure source capacity (120% of relief nominal set pressure) is less than MAWP of any vessel/piping, or equipment component within the isolated test volume, then the relief may be tested in the field. This may facilitate the pressure test by eliminating removal of the relief device. Note that the test procedure is always the same for the field and bench testing (as described in 5.3.2).

5.3 Bench Maintenance/Testing/Repair:

5.3.1 *Removal of Relief Device:*

Relief devices should be handled carefully and not subject or heavy shocks. Considerable internal damage or misalignment can result and proper operation may be adversely affected. Replace with previously tested spare device of same type, setting, and rating, **or**

Cover opening with material which will seal the opening but not hold significant pressure, e.g.: lightweight plastic bag taped in place, or lightweight flat plate (less than 1 pound) not fastened in any way, **or**

Put under the purge of inert gas. **Warning:** Use of an inert gas purge in a confined space may produce an oxygen deficient condition which can be harmful or fatal. Where nature of contents permit, purge with helium or nitrogen, as appropriate, to maintain slight positive pressure (less than 1/2 psi). This method is NOT to be used for work in confined spaces and must be source limited so as to be incapable of pressures exceeding 1/2 psi.

5.3.2 *Testing:*

- a) Select test gauge and gauge protection relief (See 3.3.2a and 3.3.2b).
- b) Connect test gauge and gauge protection relief to test volume.
- c) Connect pressure source and manifold to test volume.
- d) Connect device to be tested to test volume.
- e) Pressurize test volume to 50% of device marked set pressure.
- f) Check for leaks in test set up with bubble solution leak check fluid. If leaks are present, mark locations, depressurize and correct leaks; then return to step 5.3.2.
- g) Increase pressure to 110% of marked set pressure or until device begins to discharge. If it does not discharge by 110%, increase by another 6%; if it still has not discharged, the device is to be rejected. Depressurize and tag with reject tag marked: DO NOT USE - DISCHARGE EXCEEDS SET BY: >116% .
- h) Decrease pressure until the device reseats: Record reseat pressure on Relief Device Maintenance/Test Record form.
- i) Increase pressure to 90% of device marked set pressure.
- j) Continue to increase pressure slowly, while watching test gauge reading until device begins to discharge.
- k) Record the Start-to-Discharge pressure reading on the Relief Device Maintenance/Test Record.
- l) Depressurize the test volume.
- m) Remove tested relief device.
- n) Clean connecting surfaces, threads, flanges, seals, etc.

- o) A calibration sticker/tag may be applied indicating such information as may be useful: e.g.: test date or retest due, actual start-to-discharge pressure, reseal pressure, tester's initials.

5.3.3 *Repair:*

Repair work involving machining, grinding, welding, or other alterations shall be performed only by the device manufacturer, or by their designee. If a trained specialist is available, the seating surfaces of metal-to-metal seat valves may be lapped. The flat gasket face on a valve body mounting surface may be machined to remove nicks and burrs, but the tolerances on the gasket tongue must not be exceeded per manufacturers recommendations.

The personnel may perform repair/alterations/rerating on relief devices only if trained and qualified by the relief manufacturer to follow all provisions established by the BPVC. Otherwise all pressure relief devices should be repaired, altered, or rerated by a qualified outside contractor. Consult preparer of this procedure or appropriate engineer for the requirements for relief valve test/repair by subcontractor and list of local companies providing certified test/repair of relief valves.

Only replacement parts or assemblies provided and identified by the manufacturer of the pressure relief device shall be used.

5.3.4 *Reinstallation:*

- a) Remove temporary covers, tape, etc. from vessel side of relief device connection.
- b) Clean sealing surfaces on vessel side connection: threads, flanges, O-rings, (for non-reusable seals: install new seal at this point.).
- c) Reinstall relief device.

Caution: If care is not taken in handling and tightening the relief device during reinstallation its proper operation can be adversely affected. Additionally, certification may be voided if lockwires and/or seals are broken.

- d) Pressurize the vessel to 10-25% of operating pressure.
- e) Leak check the relief device connection with bubble solution leak check fluid. (If leaks are observed, depressurize, re-execute lock/tag out before removing device to correct leaks. When leaks are corrected, begin at step 5.3.4 again).
- f) Obtain approval from Group Leader or designee before using backflushing as a contaminant removal method. Apply contamination control measures applicable to this vessel prior to refilling; e.g.: purging, pumping, backflushing, etc.

Caution: Spill control measures are required when using substances potentially harmful to the environment for backflushing. Such practice is strongly discouraged unless no other means are possible.

6.0 ACCEPTANCE CRITERIA

6.1 Visual Inspection

- a) relief device is the same as described in its associated Pressure Vessel Engineering Note.
- b) relief device outlet or discharge piping has remained unrestricted and no reduction of relieving capacity has been introduced per the Engineering Note.

- c) relief device has not undergone severe corrosion or tempering, and lockwires and seals are unbroken.

6.2 Relief Device Testing

- a) Relief Device shall first pass Visual Inspection Acceptance Criteria (subsection 6.1).
- b) Relief Device start-to-discharge pressure shall be within +/-3% of marked value for settings above 70 psi, or within 2 psi for settings up to and including 70 psi. [per ASME BPVC Section VIII DIV.1, UG-126(d), 1989].

Caution: Relief devices which will not reseal at a pressure above the normal operating pressure of the vessel, but below relief set pressure, should not be returned to service without prior consultation with the group leader.

7.0 SPECIAL REQUIREMENTS FOR SHIFT/PERSONNEL CHANGE

No special instructions are required for shift/personnel changes. An orderly exchange of locks and tags shall ensue with transfer of responsibility and information about the system status to ensure continued personnel protection.

8.0 STEPS FOR RETURN TO SERVICE

8.1 Check Equipment:

Check the immediate area of the pressure device installation to ensure that nonessential items and tools are cleared, and process equipment and piping are not obstructed.

8.2 Check Work Area:

Check the work area to ensure that all employees are safely positioned, or removed from the area as necessary. Return all tools and equipment to proper storage locations. Dispose of all used seals, gaskets, saturated spill absorbents according to Material Safety Data Sheets as directed by the Fermilab ES&H Manual.

8.3 Verify:

Verify that all isolation valves for the tested relief/volume are in closed position.

Verify that the test data has been recorded properly in the Relief Valve Test & Inspection record book. Log all testing activities in the CHL Operations Logbook and/or equipment maintenance log. Be sure to indicate the "as found" and "as left" condition of the equipment, including serial numbers (if any) of devices removed and/or installed and their condition.

8.4 Remove Locks and Tags:

Discuss the appropriateness of opening the isolated vessel/volume back to the process system. Only after that the authorized employee(s) who install the lock(s) and tag(s) shall remove them. All locks & tags should be returned and logged back in at the Lockout/Tagout station. See ADDP-CH-4008 (LOTO) for the step-by-step instructions. If a LOTO procedure was used, any checklists should be turned in to the Task Manager.

8.5 Notify:

Notify all affected persons and each person whose approval was required.

8.6 Operations Restoration:

Consult standard operating procedures for start-up and restoration-to-service instructions and checklists. Complete any required checklists. If the tested vessel/volume is clean then all isolation valves should be positioned in the configuration which is normal for the present status of associated equipment.

Caution: This action may result in the immediate pressurization of the vessel or piping volume.

9.0 PROCEDURE TRAINING REQUIREMENTS

All authorized employees require LOTO Level 2 training as provided by the Division and shall meet the requirements of Chapter 5120 of the Fermilab ES&H Manual. The extent of the special training on pressure devices testing is determined by the line management, but with the mandatory provision of the formal training "Pressure Safety" received by the involved personnel. The personnel may receive an additional training on pressure relief devices repair from relief manufacturer to qualify to perform repairs/alterations. The authorized employee(s) should review the steps of this procedure to assure themselves an understanding of the hazards involved and precautions necessary.

10.0 REFERENCES

- a) CGA S-1.2 (1980), "Pressure Relief Device Standards- Part 2: Cargo and Portable Tanks for Compressed Gases", Compressed Gas Association, Inc.
- b) ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 1989.
- c) "Guide for Inspection of Refinery Equipment", Chapter XVI: Pressure Relieving Devices, American Petroleum Institute, July 1985.
- d) API RP520 (1973), "Recommended Practice for the Design and Installation of Pressure Relieving Systems in Refineries, Part II: Installation", American Petroleum Institute.
- e) ASME/ANSI "Safety and Relief Valves. Performance Test Codes.", PTC 25.3-1988.

11.0 EXTRA-DEPARTMENTAL DISTRIBUTION

None

RELIEF DEVICE MAINTENANCE/TEST RECORD

APPROVED: _____ **DATE** _____

SPECIFICATION DATA

Valve No. _____ Vessel(s) No. FMS _____

Description

Type: ___ spring operated, ___ pilot operated, ___ parallel plate, ___ rupture disc, ___
other: describe _____

Manufacturer: _____

Mfg's model#: _____ mfg's serial #: _____

Inlet size: _____ Outlet size: _____ Orifice size: _____
rated flow (& units): _____ set pressure(psig): _____

Is this a National Board (NB-UV) code-stamped & wired valve? (Y/N) _____

Simplified Flow schematic of inlet and outlet piping, and associated vessel(s):

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HISTORICAL RECORD for Relieving Device No.

Date installed: _____

NOMENCLATURE:
INSPECTION TYPE: VISUAL OR TEST
CONDITION: LEAKING, FOULED, STUCK, CORRODED,
DISPOSITON: OK, REPLACED, CLEANED, ETC.
COMMENTS: TAGS, ETC MISSING.

DATE	INSPECTION TYPE	START-TO DISCHARGE	RESEAT PRESSURE	CONDITION	DISPOSITION	COMMENTS