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C-A OPERATIONS PROCEDURES MANUAL

7.1.27 Warm Expander Purge Procedure

Text Pages 2 through 12

Hand Processed Changes

<u>HPC No.</u>	<u>Date</u>	<u>Page Nos.</u>	<u>Initials</u>
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Approved: _____ *Signature on File* _____
Collider-Accelerator Department Chairman Date

D. Lederle

7.1.27 Warm Expander Purge Procedure

1. Purpose

This procedure provides the instructions for purging the expander trains with the brake assembly installed. This procedure contains the following sections:

- 5.1 Purge of Expander 1A/2A
- 5.2 Expander 3A/4A
- 5.3 Heat Exchange HX3A
- 5.4 Expanders 1A, 2A, 3A, 4A and Heat Exchanger HX3A
- 5.5 Expander 1B/2B
- 5.6 Heat Exchange HX3B
- 5.7 Expander 3B/4B
- 5.8 Expanders 1B, 2B, 3B, 4B and Heat Exchanger HX3B

2. Responsibilities

- 2.1 The shift supervisor, or an operator designated by the shift supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log.
- 2.2 Should a problem arise in the process of purging an expander, the shift supervisor shall report to the technical supervisor for instructions before continuing.

3. Prerequisites

- 3.1 The expander must be offline while purging.
- 3.2 The oil system must not be operation during purging.
- 3.3 The pure helium supply line must be pressurized.

4. Precautions

If there is liquid helium in the refrigerator pots, all personnel entering the refrigerator wing of Bldg.1005R must have a Personal Oxygen Monitor (POM) and carry an emergency escape pack.

5. Procedure

5.1 Expander 1A/2A:

- _____ 5.1.1 Install brake assembly per [C-A-OPM 7.1.26](#), Expander Brake System Installation and Removal.

- _____ 5.1.2 Ensure regulator PR9169 is installed.
- _____ 5.1.3 Close valve H328A _____. Disable the valve in the closed position by closing the air supply valve and disconnecting the air line.
- _____ 5.1.4 Ensure closed valves H338M____ H266M____ and H405M_____.
- _____ 5.1.5 Apply LOTO to H338M.
- _____ 5.1.6 Back off regulator PR9169M.
- _____ 5.1.7 Open expander vane valves H330A____ and H339A_____.
- _____ 5.1.8 Open valves H407M____ and H373M_____.
- _____ 5.1.9 Crack open valve H400M. This valve will be adjusted during the purge operation for adequate flow.
- _____ 5.1.10 Open valves H9169M____ and H266M_____.
- _____ 5.1.11 Adjust regulator PR9169M to 40 psi as read on outlet pressure gauge PI 9207H.
- _____ 5.1.12 Purge expander for a minimum of 15 minutes.
- _____ 5.1.13 Close valves H400M____ H373M____ and H266M_____.
- _____ 5.1.14 Close valves H9169M____ and H407M_____.
- _____ 5.1.15 Close vane valve H330A____ and set vane valve H339A_____ to 15% open.
- _____ 5.1.16 Restore air supply to valve H328A.
- _____ 5.1.17 Remove LOTO from H338M.

5.2 Expander 3A/4A

- _____ 5.2.1 Install brake assembly per [C-A-OPM 7.1.26](#).
- _____ 5.2.2 Ensure regulator PR9175M is installed.
- _____ 5.2.3 Close valves H352A____ and H380A_____. Disable the valves in the closed position by closing the air supply valves and disconnecting the air lines.

- _____ 5.2.4 Ensure closed valves H360M____ H377M____ H428M____ and H415M_____.
- _____ 5.2.5 Apply LOTO to H360M.
- _____ 5.2.6 Back off regulator PR9175M.
- _____ 5.2.7 Open expander vane valves H354A____ and H357A_____.
- _____ 5.2.8 Open valves H429M and H378M_____.
- _____ 5.2.9 Crack open valve H427M. This valve will be throttled during the purge operation for adequate flow.
- _____ 5.2.10 Open valves H9175M____ and H377M_____.
- _____ 5.2.11 Adjust regulator PR9175M to 40 psi as read on outlet pressure gage PI9209H.
- _____ 5.2.12 Purge expander for a minimum of 15 minutes.
- _____ 5.2.13 Close valves H427M____ H378M____ and H377M_____.
- _____ 5.2.14 Close valves H9175M____ and H429M_____.
- _____ 5.2.15 Set vane valves H354A____ and H357A____ to 25% open.
- _____ 5.2.16 Restore air supply to valves H352A____ and H380A_____.
- _____ 5.2.17 Remove LOTO from H360M.

5.3 Heat Exchange HX3A

- 5.3.1 Ensure expander 1A/2A and 3A/4A brake assemblies are installed per C-A OPM 7.1.26.
- 5.3.2 Ensure regulator PR9175 is installed.
- 5.3.3 Close valves H328A____, and H380A____. Disable the valves in the closed position by closing the air supply valves and disconnecting the air lines.

5.3.4 Ensure the following valves are closed:

Process:

H330A_____ (Vane)	H341M_____
H339A_____ (Vane)	H376M_____
H354A_____ (Vane)	H346M_____
H357A_____ (Vane)	H426M_____
H344A_____	H360M_____

Other:

H428M_____	H773M_____
H6182M_____	H243M_____
H777M_____	

_____ 5.3.5 Apply LOTO to H346M, H360M and H376M.

_____ 5.3.6 To avoid spinning the turbines, ensure pressure in HX3A is approximately equal to expander pressure (within 0.5 atm).

_____ 5.3.7 Open process valves H338M_____ and H352A_____ (air line must be jumpered at valve).

_____ 5.3.8 Back off regulator PR9175M.

_____ 5.3.9 Open the following valves:

H373M_____	H377M_____
H9175M_____	H429M_____

_____ 5.3.10 Crack open valve H400M. This valve will be throttled during the purge operation for adequate flow.

_____ 5.3.11 Adjust regulator PR9175M to 45 psig as read on outlet pressure gauge PI9209H.

_____ 5.3.12 Purge heat exchanger at an audible level for a minimum of 20 minutes.

_____ 5.3.13 Stop purge by closing the following valves:

H400M_____	H377M_____
H373M_____	H429M_____
H9175M_____	

- _____ 5.3.14 Back off regulator PR9175M.
- _____ 5.3.15 Close process valves H338M_____ and H352A_____ (restore air line to normal).
- _____ 5.3.16 Purge expanders 1A/2A and 3A/4A per this procedure.
- _____ 5.3.17 Restore air supply to valves H328A _____ and H380A _____.
- _____ 5.3.18 Remove LOTO from H346M, H360M, and H376M.

5.4 Expanders 1A, 2A, 3A, 4A and Heat Exchanger HX3A

- _____ 5.4.1 Ensure brake assemblies are installed per [C-A-OPM 7.1.26](#).
- _____ 5.4.2 Ensure regulator PR9169M is installed.
- _____ 5.4.3 Close valves H328A_____, and H380A_____. Disable the valves in the closed position by closing the air supply valves and disconnecting the air lines.
- _____ 5.4.4 Ensure the following valves are closed:

Process:

H346M_____	H376M_____
H426M_____	H360M_____

Other:

H405M _____	H9175M_____
H703M _____	H415M_____
H9171M_____	H778M_____
H373M _____	

- _____ 5.4.5 Apply LOTO to H346M, H360M, and H376M.
- _____ 5.4.6 To avoid spinning the turbines, ensure pressure in HX3A is approximately equal to expander pressure (within 0.5 atm).
- _____ 5.4.7 Open process valves H338M_____ and H352A_____ (air line must be jumpered at valve).
- _____ 5.4.8 Back off regulator PR9169M.
- _____ 5.4.9 Open the following valves:

H378M_____	H330A_____ (vanes)
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H9169M_____ H339A_____ (vanes)
H266M_____ H354A_____ (vanes)
H407M_____ H357A_____ (vanes)

- _____ 5.4.10 Crack open valve H427M. This valve will be throttled during the purge operation for adequate flow.
- _____ 5.4.11 Adjust regulator PR9169M to 40 psig as read on outlet pressure gauge PI9207H.
- _____ 5.4.12 Purge expander train at an audible level for a minimum of 30 minutes.
- _____ 5.4.13 Stop the purge by closing the following valves:

H427M_____ H266M_____
H378M_____ H407M_____
H9169M_____

- _____ 5.4.14 Back off regulator PR9169M.
- _____ 5.4.15 Close vane valve H330A_____.
- _____ 5.4.16 Set vane valves H339A_____, H354A_____, and H357A_____ to 25%.
- _____ 5.4.17 Close process valves H338M_____ and H352A_____ (restore air line to normal).
- _____ 5.4.18 Restore air supply to valves H328A _____ and H380A _____.
- _____ 5.4.19 Remove LOTO from H346M, H360M, and H376M.

5.5 Expander 1B/2B

- _____ 5.5.1 Install brake assembly per [C-A-OPM 7.1.26](#).
- _____ 5.5.2 Ensure regulator PR9166M is installed.
- _____ 5.5.3 Close valve H728A _____. Disable the valve in the closed position by closing the air supply valve and disconnecting the air line.
- _____ 5.5.4 Ensure closed valves H738M_____ H703M_____ and H405M_____.
- _____ 5.5.5 Apply LOTO to H738M.
- _____ 5.5.6 Back off regulator PR9166M.

- _____ 5.5.7 Open expander vane H730A_____ and H739A_____.
- _____ 5.5.8 Open valves H407M_____ and H773M_____.
- _____ 5.5.9 Crack open valve H400M. This valve will be throttled during the purge operation for adequate flow.
- _____ 5.5.10 Open valves H9166M_____ and H703M_____.
- _____ 5.5.11 Adjust regulator PR9166M to 40 psi as on outlet pressure gauge PI9214H.
- _____ 5.5.12 Purge expander of a minimum of 15 minutes.
- _____ 5.5.13 Close valves H400M_____ , H773M_____ and H703M_____.
- _____ 5.5.14 Close valves H9166M_____ and H407M_____.
- _____ 5.5.15 Close vane valve H730A_____ and set vane valve H739A_____ to 25% open.
- _____ 5.5.16 Restore air supply to valve H728A.
- _____ 5.5.17 Remove LOTO from H738M.

5.6 Heat Exchange HX3B

- 5.6.1 Ensure expander 1B/2B and 3B/4B brake assemblies are installed per C-A OPM 7.1.26.
- 5.6.2 Ensure regulator PR9172 is installed.
- 5.6.3 Close valves H728A_____, and H780A_____. Disable the valves in the closed position by closing the air supply valves and disconnecting the air lines.
- 5.6.4 Ensure the following valves are closed:

Process:

H730A_____ (Vane)	H741M_____
H739A_____ (Vane)	H776M_____
H754A_____ (Vane)	H746M_____
H757A_____ (Vane)	H826M_____
H744A_____	H760M_____

Other:

H428M____ H773M____
H6182M____ H243M____
H377M____

- ____ 5.6.5 Apply LOTO to H746M, H760M, H776M.
- ____ 5.6.6 To avoid spinning the turbines, ensure pressure in HX3B is approximately equal to expander pressure (within 0.5 atm).
- ____ 5.6.7 Open process valves H738M____ and H752A____ (air line must be jumpered at valve).
- ____ 5.6.8 Back off regulator PR9172M.
- ____ 5.6.9 Open the following valves:
- H773M____ H777M____
H9172M____ H429M____
- ____ 5.6.10 Crack open valve H400M. this valve will be throttled during the purge operation for adequate flow.
- ____ 5.6.11 Adjust regulator PR9172M to 45 psig as read on outlet pressure gauge PI9209H.
- ____ 5.6.12 Purge heat exchanger at an audible level for a minimum of 20 minutes.
- ____ 5.6.13 Stop purge by closing the following valves:
- H400M____ H777M____
H773M____ H429M____
H9172M____
- ____ 5.6.14 Back off regulator PR9172M.
- ____ 5.6.15 Close process valves H738M____ and H752A____ (restore air line to normal).
- ____ 5.6.16 Purge expanders 1B/2B and 3B/4B per this procedure.
- ____ 5.6.17 Restore air supply to valves H728A ____ and H780A ____.
- ____ 5.6.18 Remove LOTO from H746M, H760M, H776M.

5.7 Expander 3B/4B

- _____ 5.7.1 Install brake assembly per [C-A-OPM 7.1.26](#).
- _____ 5.7.2 Ensure regulator PR91722 is installed.
- _____ 5.7.3 Close valves H752A_____ and H780A_____. Disable the valves in the closed position by closing the air supply valves and disconnecting the air lines.
- _____ 5.7.4 Ensure closed valves H760M_____ H777M_____ H428M_____ and H415M_____.
- _____ 5.7.5 Apply LOTO to H760M.
- _____ 5.7.6 Back off regulator PR9172M.
- _____ 5.7.7 Open expander vane valves H754A_____ and H757A_____.
- _____ 5.7.8 Open valves H429M_____ and H778M_____.
- _____ 5.7.9 Crack open valve H427M. This valve will be throttled during the purge operation for adequate flow.
- _____ 5.7.10 Open valves H9172M_____ and H777M_____.
- _____ 5.7.11 Adjust regulator PR9172M to 40-psi as read on outlet pressure gauge PI9208H.
- _____ 5.7.12 Purge expander for a minimum of 15 minutes.
- _____ 5.7.13 Close valves H427M_____, H778M_____ and H777M_____.
- _____ 5.7.14 Close valves H9172M_____ and H429M_____.
- _____ 5.7.15 Set vane valves H754A_____ and H757A_____ to 25% open.
- _____ 5.7.16 Restore air supply to valves H752A_____ and H780A_____.
- _____ 5.7.17 Remove LOTO from H760M.

5.8 Expanders 1B, 2B, 3B, 4B and Heat Exchanger HX3B

_____ 5.8.1 Ensure brake assemblies are installed per [C-A-OPM 7.1.26](#).

_____ 5.8.2 Ensure regulator PR9166M is installed.

_____ 5.8.3 Close valves H728A_____ and H780A_____. Disable the valves in the closed position by closing the air supply valves and disconnecting the air lines.

_____ 5.8.4 Ensure the following valves are closed:

Process:

H746M_____ H776M_____
H826M_____ H760M_____

Other:

H405M _____ H9172M_____
H266M _____ H415M_____
H9168M_____ H378M_____
H773M _____

_____ 5.8.5 Apply LOTO to H746M, H760M, and H776M.

_____ 5.8.6 To avoid spinning the turbines, ensure pressure in HX3B is approximately equal to expander pressure (within 0.5 atm).

_____ 5.8.7 Open process valves H738M_____ and H752A_____ (air line must be jumpered at valve).

_____ 5.8.8 Back off regulator PR9166M.

_____ 5.8.9 Open the following valves:

H778M_____ H730A_____ (vanes)
H9166M_____ H739A_____ (vanes)
H703M_____ H754A_____ (vanes)
H407M_____ H757A_____ (vanes)

_____ 5.8.10 Crack open valve H427M. This valve will be throttled during the purge operation for adequate flow.

_____ 5.8.11 Adjust regulator PR9166M to 40 psig as read or outlet pressure gauge PI9214H.

_____ 5.8.12 Purge expander train at an audible level for a minimum of 30 minutes.

_____ 5.8.13 Stop the purge by closing the following valves:

H427M_____ H703M_____

H778M_____ H407M_____

H9166M_____

_____ 5.8.14 Back off regulator PR9166M.

_____ 5.8.15 Close vane valve H730A_____.

_____ 5.8.16 Set vane valves H739A_____, H754A_____, and H757A_____ to 25%.

_____ 5.8.17 Close process valves H738M_____ and H752A_____ (restore air line to normal).

_____ 5.8.18 Restore air supply to valves H728A_____ and H780A_____.

_____ 5.8.19 Remove LOTO from H746M, H760M, H776M.

6. **Documentation**

6.1 The check off lines on the procedure are for place keeping only. The procedure is not to be initialed or signed, it is not a record.

6.2 The shift supervisor shall document the completion of the procedure in the Cryogenics Control Room Log.

7. **References**

7.1 [C-A-OPM 7.1.26](#) "Expander Brake System Installation and Removal".

7.2 Drawing 3A995009, 25KW Helium refrigerator P&ID

8. **Attachments**

None