

Hazards associated with the gas system and how to mitigate them

Do not enter the gas shack if the rotating red light at the entrance is on. This warns of an oxygen deficiency.

In General the Gas Mixing shack can be a hazardous place – BE AWARE OF YOUR ENVIRONMENT..

There are hazardous gas detectors that will cut off any gas flow at 10% of the lower explosive limit and oxygen deficiency monitors that will alarm if there is a less than 19% oxygen level.

Gas bottles are a hazard to move. Breaking the stem on a gas bottle can cause flying debris

Never move a bottle without the cap fastened. Always earthquake brace bottles at two points in the place they are to be used or stored. Always keep control of the bottle with two hands while moving.

The gases used in the calibration routine present a cryogenic hazard.

Be certain that the bottle is plumbed into the correct gas circuit and the fittings are tight before opening. When removing a bottle be certain to valve off the gas; At the bottle first, at the gas panel second. Slowly bleed the lines before disconnecting.

There is a marked step up both on to the gas pad and into the gas shack.

Be aware. It easy to trip while making a step into empty space when coming out of either one.

Side of racks must be removed.

To access some of the valves the side of the rack should be removed. This can fall rapidly and cause alarm or an injury. The rack side panel should be supported by one hand while turning the locking screw. Two hands should be used to lift and carry the side panel out of the way.

Nanoautomate Program Certification Checklist

The primary purpose of this procedure is to verify that safety alarms produce the expected output.

Tables “Gas Alarms” and “Nanoautomate Inputs & Outputs” summarize the expected outputs. Any difference between these tables and the observed outcome must be corrected BEFORE the program may be downloaded into the gas system nanoautomates.

Name: _____

Name: _____

Date: _____

Version number to be tested: _____

Changes: _____

1. Load Program

- ρ Download program into Ram memory of test nanoautomates.
Name of files downloaded (include path and date):

- ρ Start program
- ρ Disconnect PC

2. Verify Operating Modes and Correct Transitions

This section verifies that operating modes requests produce the desired outputs, that the system is in Rest Mode following a power outage, and that it is not possible to make a direct transition from an Alarm Mode to Running.

- ρ Set inputs to default position: all OFF for nanoautomate 1; all ON for nanoautomate 2 and 3 except 3–4 off.
- ρ Cycle power on nanoautomates (switch on back).
Verify Rest mode outputs.
Initial: _____
- ρ Select Run Mode by briefly switching 1–13.
Verify Run mode outputs.
Initial: _____
- ρ Select Rest Mode by briefly switching 1–12.
Verify Rest mode:
Initials _____

- ρ Select VME Mode by briefly switching 1–11.
Verify VME mode outputs.
Initial: _____
- ρ Place system in Alarm Mode 1 by activating 3–10, “Isobutane in front flush gas”.
Verify Alarm Mode 1.
Initial: _____
- ρ Turn off 3–10;
activate Run Mode 1–13.
Verify system remains in Alarm Mode 1.
Initial: _____
- ρ Select Rest Mode 1–12.
Verify Rest Mode.
Initials: _____

3. Verify Alarm Responses

Use the following sequence to test each input below in both Rest Mode and Running Mode:

- Select Rest Mode 1–12
- Set *Input* false (off)
- Verify correct input light on nanoautomate
- Verify delay is approximately correct (expected value is given)
- Verify correct outputs for expected Alarm Mode and initial “Rest Mode”
- Set *Input* true (on)
- Select Rest Mode 1–12
- Select Run Mode 1–13
- Set *Input* false (off)
- Verify correct outputs for expected Alarm Mode and initial “Run Mode”
- Set *Input* true (on)
- Select Rest Mode 1–12
- Select VME Mode 1–11
- Set *Input* false (off)
- Verify correct outputs for expected Alarm Mode and initial “Run Mode”
- Set *Input* true (on)

Any unexpected responses must be recorded and corrected before the program can be certified for use in the gas system.

The following inputs should produce “Alarm Mode 1”.

- ρ 3–10 “Isobutane in front flush gas”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____

- ρ 3-11 “Isobutane in rear flush gas”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 3-8 AND 3-7 “isobutane present” and “O2 present”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-11 “Bulkhead flows”:
30 sec Delay _____ Rest: _____ Running: _____ VME _____

The following inputs should produce “Alarm Mode 2”.

- ρ 2-0 “helium pressure”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-3 “chamber pressure”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-10 “inlet pressure”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-9 “compressed air”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-4 “iso temperature”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-12 “110V power”:
5 sec Delay _____ Rest: _____ Running: _____ VME _____

The following inputs should produce “Alarm Mode 2” in Running Mode ONLY. Initialing the Rest and VME Mode lines indicates NO Alarm.

- ρ 2-8 “iso concentration” and 1-10 “Valid Sample Point”:
90 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-7 “O2 concentration” and 1-10 “Valid Sample Point”:
90 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-1 “isobutane pressure”
15 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-6 “fresh gas flow”
30 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-2 “recirc pressure”
50 sec Delay _____ Rest: _____ Running: _____ VME _____
- ρ 2-5 “recirc flow”
30 sec Delay _____ Rest: _____ Running: _____ VME _____

The following inputs should produce “Alarm Mode 2” in VME mode if the pump is on.

- ρ 2-2 “recirc pressure” and 3-4 (on) “pump on”
50 sec Delay _____ VME_____
- ρ 2-5 “recirc flow” and 3-4 (on) “pump on”
30 sec Delay _____ VME_____

The following input should produce “Alarm Mode 3” (gas hut alarm).

- ρ 3-6 “gas hut”:
5 sec Delay _____ Rest: _____ Running: _____ VME_____

4. Verify Interlocks

- ρ Select VME Mode 1-11.
Activate isobutane interlock by setting 3-7 off, “O₂ Not Present”.
- ρ Verify output 3-4 “HV enabled” is OFF. Initials _____
- ρ Select 1-7 “Request Open VVPC_8”.
Verify that Output 1-7 “Open VVPC-8” remains OFF.
Initials _____
- ρ Set 3-7 ON “O₂ Not Present”;
- ρ Select 1-7 “Request Open VVPC_8”.
Verify that Output 1-7 “Open VVPC-8” is ON.
Initials _____
- ρ Select Rest Mode 1-12;
Select Running Mode 1-13;
- ρ Turn 3-7 OFF “O₂ Not Present”;
Verify that Output 1-7 “Open VVPC-8” goes OFF (5 sec delay)
Initials _____
- ρ Set 3-7 ON “O₂ Not Present”.
- ρ Activate gain chamber interlock by setting 3-12 off, “Gain Chamber Flow OK”.
- ρ Verify Output 3-0 “Gain Chamber Enabled” is OFF. Initials: _____
- ρ Select Run mode. Verify Output 3-0 is OFF. Initials: _____
- ρ Select VME mode. Verify Output 3-0 is OFF. Initials: _____
- ρ Select Rest Mode.
- ρ Set 3-12 ON. Verify Output 3-0 is ON.