# Hall B MVT Gas Mixing System Operators Manual

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# Operators Manual for the MVT Gas Mixing System

## 1.0 Introduction

## 1.1 The MVT gas mixing system produces 2 flammable gas mixtures;

10% C4H10 (isobutane) in Argon

10% CF4 (carbon flouride) 10% C4H10 (isobutane) in Argon

These mixtures are sent to the MVT and FT gas controls chassis in Hall B. The MVT gas chassis is supplied with both flammable mixtures. The FT chassis is supplied with a single gas mixture, 10% C4H10 in argon.

## 1.2 The gasses are supplied as follows;

Ar (argon) is supplied from the boil off of the 1500 gallon liquid argon (LAr) dewar at the 96B gas shed. A pressure regulator is used to reduce gas to 40 psi to supply the mixing system.

C4H10 (isobutane) is supplied from an FX type gas cylinder containing 116 lbs (52.6 kg) of gas at saturation temperature and pressure. A gas cylinder heater blanket is used to maintain cylinder temperature at 89F resulting is pressure of 55 psi. Pressure is reduced to 40 psi by a pressure regulator attached to the gas cylinder. Cylinder fill levels are monitored by weight using a scale with analog output. Isobutane, C4H10, is a Flammable Gas with explosive limits of 1.4% to 8.3%

Cf4 (carbon flouride) is supplied from high pressure K size cylinders containing 65 lbs (29.5 kg) of gas at saturation temperature and pressure. Pressure is reduced to 40 psi by a pressure regulator attached to the gas cylinder. Cylinder fill levels are monitored by weight using a scale with analog output.

## 1.3 The Gas Mixing System

The MVT gas mixing system consists of two independent mixing systems, one for each of the gas mixtures produced. These systems operate continuously to maintain mixed gas supply pressure in the 12-16 psi range.

MKS mass flow controllers meter the gas at the programmed ratios. Pressures in the mixing buffers are monitored by the control system. The usage rate of the gas by the controls chassis is also monitored by the control system. The gas mixing flowrate is adjusted to maintain mixed gas supply pressure in the proper range.

# 2.0 Controls Overview

## 2.1 Components

### 2.1.1 Mix1

- Argon MFC

- C4H10 MFC

- Mix1 Pressure Transducer

### 2.1.2 Mix2

- Argon MFC

- C4H10 MFC

- CF4 MFC

- Mix2 Pressure Transducer

### 2.1.3 Gas Supply

- C4H10 scale 1

- C4H10 scale 2

- CF4 scale 1

- CF4 scale 2

- C4H10 heater 1

- C4H10 heater 2

### 2.1.4 Pressure Control

Mixture pressure is controlled by varying mixing flow rates to maintain pressure within the 12-16 psi operating band.

### 2.1.4.1 Mix 1 Pressure Control

- Mix 1 – 10% C4H10 in Argon

- Pressure is monitored by an MKS absolute Baratron transducer

- Maintain line pressure 12-16 psi

- Normal detector flow is 750 sccm

    - Vary flowrate between 400-900 sccm

    - @ 16 psi flow is reduced to 400 sccm

    - @ 12 psi flow is increased to 900 sccm

    - @ 17.2 psi flow is turned off

- Purge flow of 1000 sccm

    - Vary flowrate between 500-1500 sccm

    - @ 16 psi flow is reduced to 500 sccm

    - @ 12 psi flow is increased to 1500 sccm

    - @ 17.2 psi flow is turned off

### 2.1.4.2 Mix 2 Pressure Control

- Mix 2 – 10% CF4 10% C4H10 in argon

- Pressure is monitored by an MKS transducer

- Maintain line pressure 12-16 psi

- Normal detector flow is 250 sccm

    - Vary flowrate between 200-300 sccm

    - @ 16 psi flow is reduced to 200 sccm

    - @ 12 psi flow is increased to 300 sccm

    - @ 17.2 psi flow is turned off

- Purge flow of 325 sccm

    - Vary flowrate between 200-400 sccm

    - @ 16 psi flow is reduced to 200 sccm

    - @ 12 psi flow is increased to 400 sccm

    - @ 17.2 psi flow is turned off

## 3.0 Operator Training

Only properly trained personnel may operate the components of this system. The Hall B Engineer will determine which personnel are authorized to operate this mixing system

## 4.0 System Operation

The gas mixing system is automatic. System operation is controlled by the software running on the cRIO. For safety reasons, inert gas purging is required to prevent flammable gas mixtures in the system. System startup and shutdown
is controlled from the 96B gas shed.

### 4.0.1 System Startup Process

System StartUp Process Time Duration - 6 hours

When the System Startup Button is clicked the cRio runs the startup program

1) Argon Purge is initiated – The C4H10 and CF4 MFCs close, the argon MFCs flow at the purge rate of 650 sccm and 325 sccm.

2) Argon Purge continues for 4 hours or 156 liters total flow for MIX1 and 78 liters total flow for MIX2

3) Mixed gas purge begins and continues for 2 hours or 78 liters total flow for MIX1 and 39 liters total flow for MIX2.

4) Then the cRio program switches to normal mixing and pressure control operation

### 4.0.2 System ShutDown Process

System Shut Down Process Time Duration - 4 hours

When the System Shut Down Button is clicked the cRio runs the shut down program

1) Argon Purge is initiated – The C4H10 and CF4 MFCs close, the argon MFCs flow at the purge rate of 650 sccm and 325 sccm

2) Argon Purge continues for 4 hours or 156 liters total flow for MIX1 and 78 liters total flow for MIX2

3) The cRio turns off the argon purge and turns off all the MFCs

## 4.1 Manual Inert Gas Purge of the System

A manual inert gas purge of the system must be performed after maintenance and prior to initial system startup.

### 4.1.1 Procedure for Manual Purge

1) Isolate the C4H10 and CF4 gas cylinders by closing the cylinder valves

2) Open the argon supply valve and check that the argon pressure regulator is supplying 40 psi

3) Open the 3 manual argon purge valves in the 96B gas shed, MVT03, MVT04, and MVT05.

4) Close or check closed the MVT and FT gas controls chassis isolation valves, MVT17, MVT18, and MVT19.

5) Open the 3 manual purge valves at the inlet of FT and MVT gas controls chassis in Hall B, MVT14, MVT15, and MVT16

6) Set the flow controls to manual and change the MFC flow setpoints to 500 sccm for the argon, 100 sccm for the CF4 and C4H10 units and flow for 90-100 minutes.

6) Close the 3 manual purge valves in the 96B gas shed.

8) Close the 3 manual purge valves in Hall B

9) Open the C4H10 and CF4 gas cylinder supply valves

10) Set the flow controls to automatic

## 4.2 Procedure to replace empty CF4 or C4H10 gas cylinders

1) Inform the counting house that you are changing out cylinders and they may receive EPICS alarms for gas supply low level.

2) Close the cylinder supply valve on the cylinder that is to be changed out.

3) Remove the pressure regulator from the cylinder; use a non-sparking wrench for the C4H10 gas cylinder

4) Remove the cylinder heater blanket for C4H10 cylinder change out

5) Remove the empty cylinder from the scale and place in the empty cylinder rack

6) Place the full cylinder on the cylinder scale

7) Install the heater blanket for the C4H10 cylinder

8) Attach the pressure regulator to the new cylinder

9) Open the cylinder supply valve on the new cylinder

10) Inform the counting house that the cylinder has been replaced and they should no longer have the alarm

## 5.0 Equipment Operation

The gas system is controlled from the GUI on the cRIO in the 96B gas shed

## 5.1 Gas Mixing System Startup

1) Click the system start up button on the GUI

2) Monitor gas flows and pressure to verify proper operation during the 6 hour process

## 5.2 Gas Mixing System Shut Down

1) Click the system shut down button on the GUI

2) Monitor gas flows and pressures to verify proper operation during the 4 hour process

# Hall B MVT Gas Mixing System Operators Manual Appendixes

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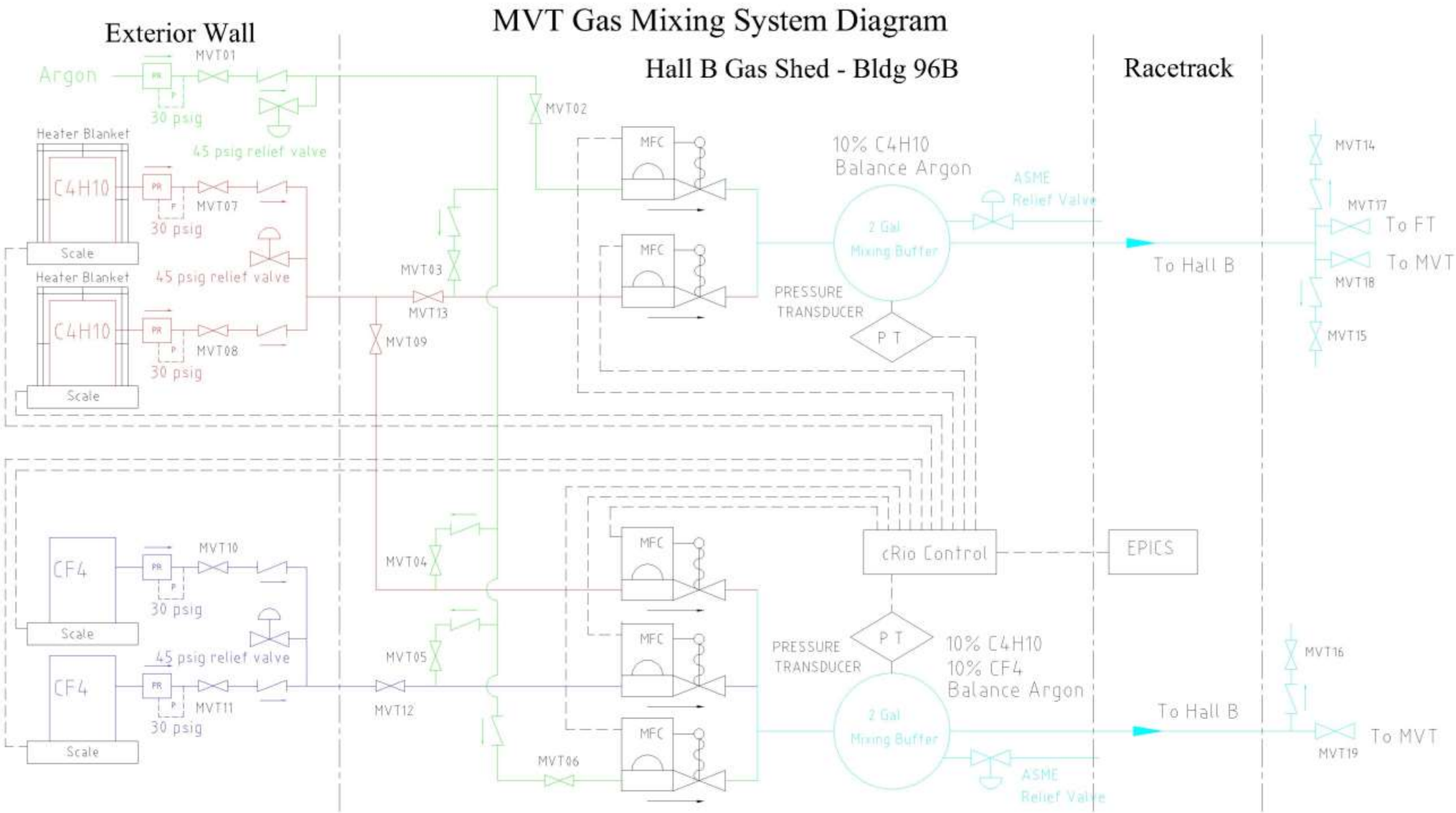
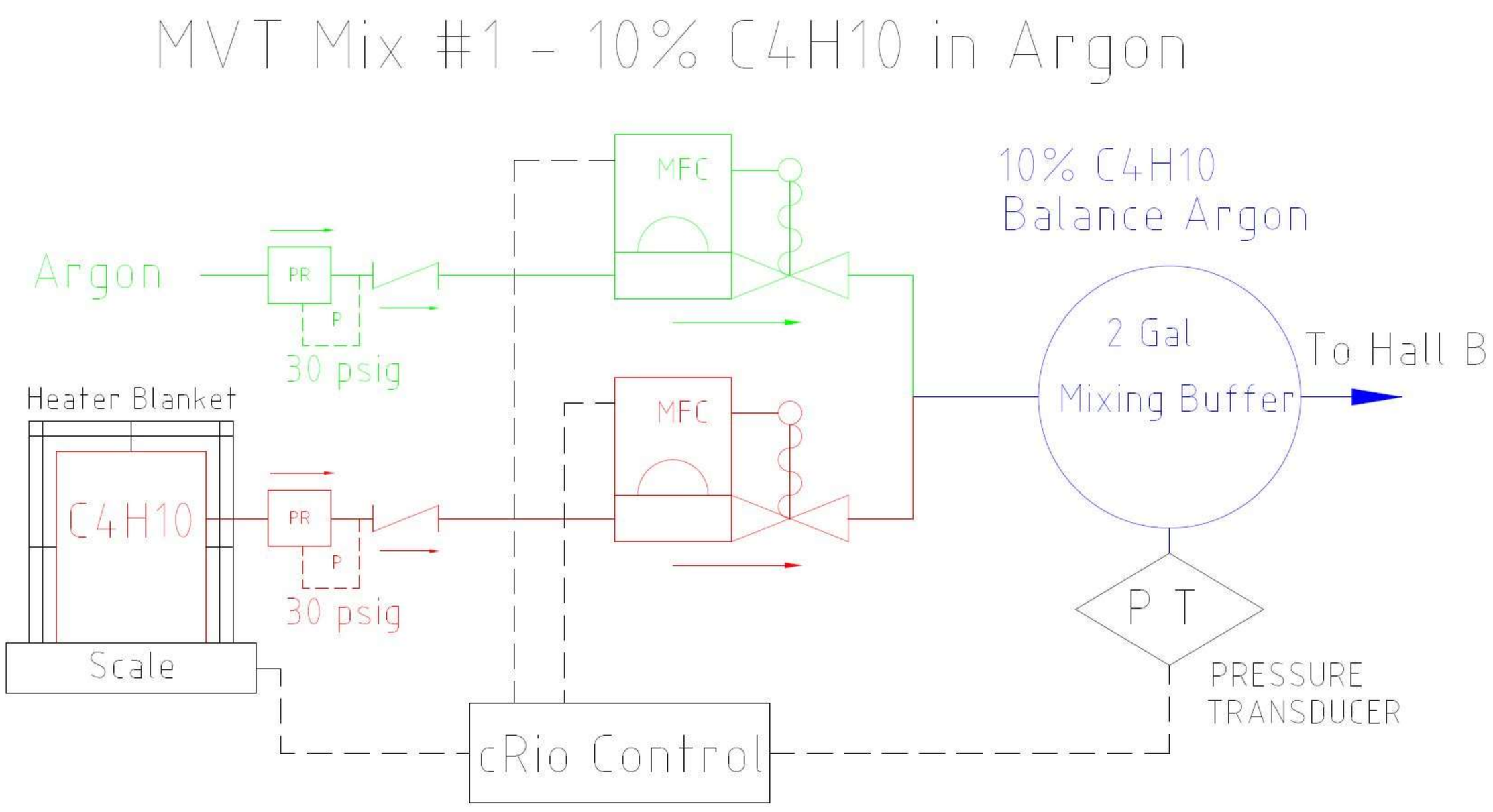
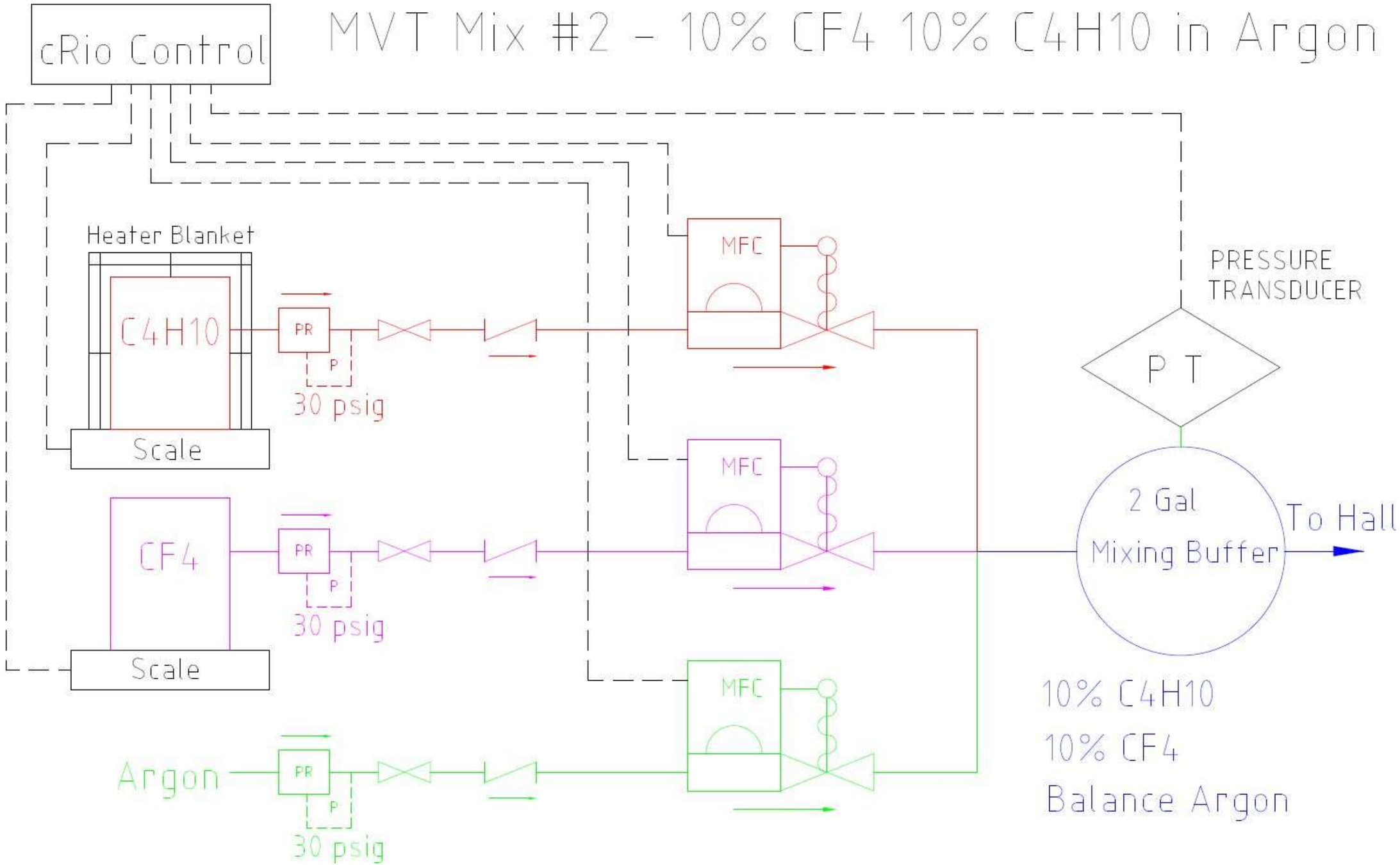
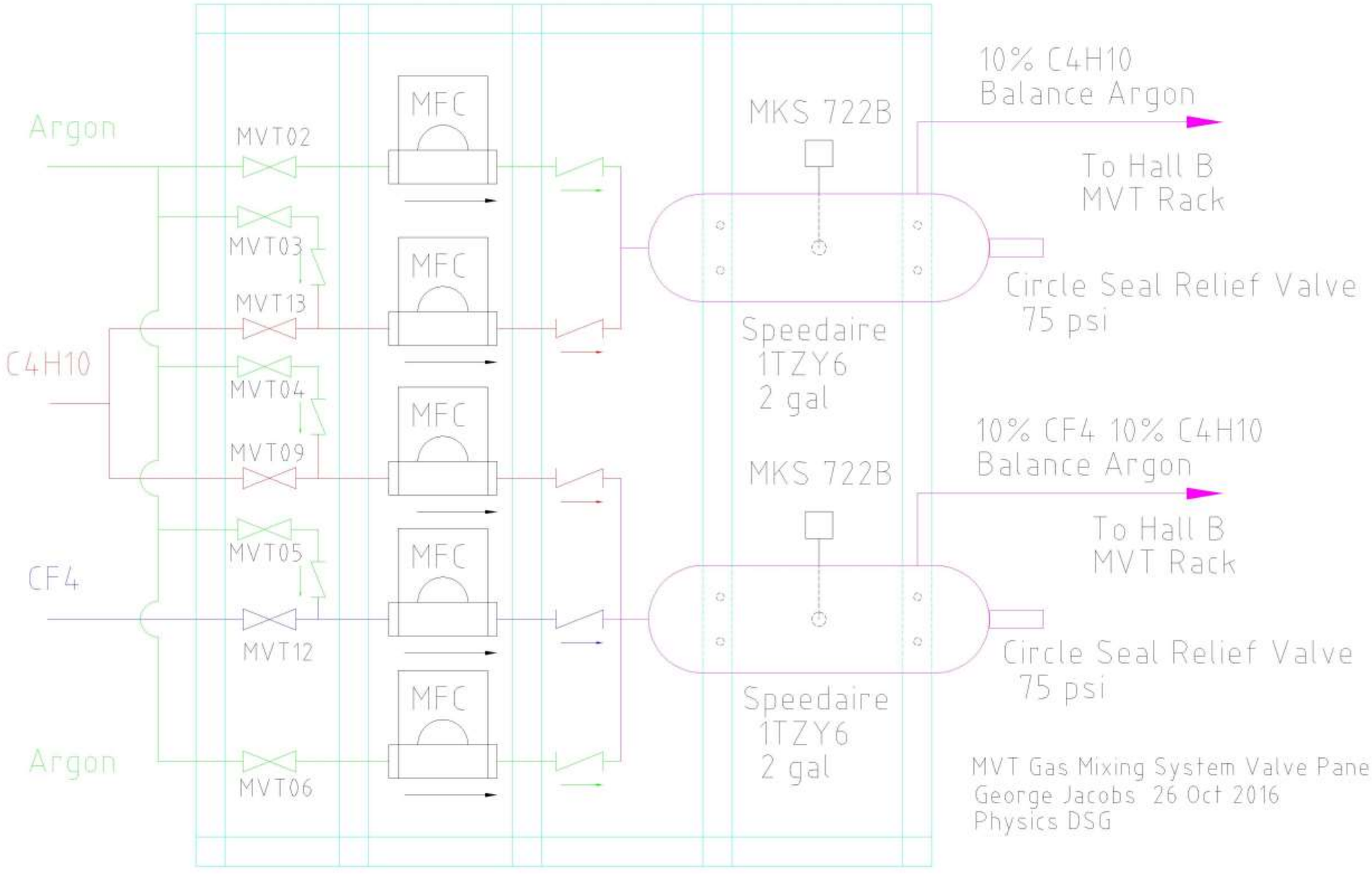

MVT Gas Mixing System Diagram
Exterior Wall
Hall B Gas Shed - Bldg 96B
Racetrack
Argon
MVT01
30 psig
45 psig relief valve
Heater Blanket
C4H10
MVT07
30 psig
Scale
Heater Blanket
45 psig relief valve
C4H10
MVT08
30 psig
Scale
MVT02
MVT03
MVT13
MVT09
MFC
MFC
10% C4H10
Balance Argon
2 Gal
Mixing Buffer
ASME
Relief Valve
PRESSURE
TRANSDUCER
P T
To Hall B
MVT14
MVT17
To FT
To MVT
MVT18
MVT15
CF4
MVT10
30 psig
Scale
45 psig relief valve
CF4
MVT11
30 psig
Scale
MVT04
MVT05
MVT12
MVT06
MFC
MFC
MFC
cRio Control
EPICS
PRESSURE
TRANSDUCER
P T
10% C4H10
10% CF4
Balance Argon
2 Gal
Mixing Buffer
To Hall B
ASME
Relief Valve
MVT16
MVT19
To MVT


MVT Mix #1 – 10% C4H10 in Argon
10% C4H10
Balance Argon
Argon
PR
P
30 psig
MFC
MFC
2 Gal
Mixing Buffer
To Hall B
Heater Blanket
C4H10
PR
P
30 psig
Scale
P T
PRESSURE
TRANSDUCER
cRio Control


cRio Control
MVT Mix #2 – 10% CF4 10% C4H10 in Argon
Heater Blanket
C4H10
PR
P
30 psig
Scale
CF4
PR
P
30 psig
Scale
Argon
PR
P
30 psig
MFC
MFC
MFC
PRESSURE
TRANSDUCER
P T
2 Gal
Mixing Buffer
To Hall
10% C4H10
10% CF4
Balance Argon


Argon
MVT02
MFC
MVT03
MFC
MVT13
C4H10
MVT04
MFC
MVT09
MVT05
MFC
CF4
MVT12
MFC
Argon
MVT06
MKS 722B
Speedaire
1TZY6
2 gal
MKS 722B
Speedaire
1TZY6
2 gal
10% C4H10
Balance Argon
To Hall B
MVT Rack
Circle Seal Relief Valve
75 psi
10% CF4 10% C4H10
Balance Argon
To Hall B
MVT Rack
Circle Seal Relief Valve
75 psi
MVT Gas Mixing System Valve Panel
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Physics DSG