U-Phos® HiFlo Fumigant System

Operations Manual

Specialty Gases

GAA
GasApps Australia P/L

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Contents

1. Safety

U-Phos® Phosphine Fumigant Hazards

- Extremely toxic and flammable gas – Dangerous Goods 2.3 (2.1)
- Contains gas under pressure; may explode if heated.
- Fatal if inhaled.
- Causes severe skin burns and eye damage.
- Very toxic to aquatic life.

Precautionary Statements

- Keep cylinders away from heat/sparks/open flames/hot surfaces - No smoking. Do not spray on an open flame or other ignition source.
- Pressurized container: Do not pierce or burn, even after use.
- Do not breathe gas. Use only outdoors or in a well-ventilated area.
- Wear respiratory protection.
- Wash exposed skin thoroughly after handling.
- Wear protective gloves/protective clothing/eye protection/face protection.
- Avoid release to the environment.

U-Phos® only to be used in accordance with USEPA label attached.
U-Phos® only to be used by Trained and Licensed fumigators.
Read U-Phos® HiFlo System Operations Manual before use.

System only to be used with U-Phos® phosphine. Other phosphine may damage the System and create hazardous situations.

Refer and read SDS attached before using the System. (Current SDS can be found at www.degeschamerica.com)

2. System Overview

The U-Phos® HiFlo System comprises:

1. 2 x U-Phos® phosphine gas cylinders (17 kg ((37.4lbs.)) pure phosphine per cylinder)

2. U-Phos® HiFlo phosphine mixer

3. Carbon Dioxide (gas withdraw) with less than 50 ppm oxygen.

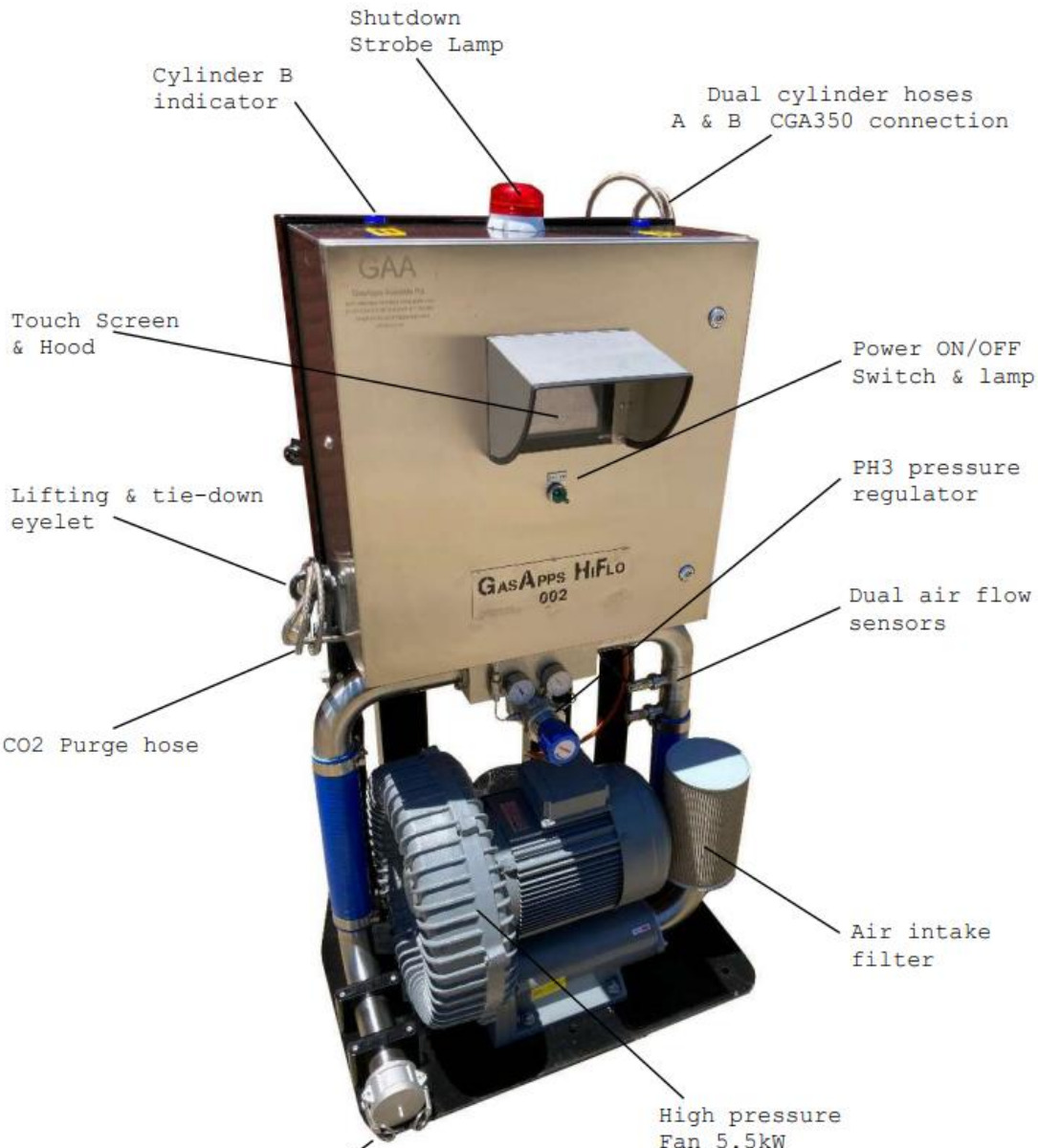
The System produces a non-flammable phosphine and air mixture which can be further diluted by an external fan. The System can safely dispense phosphine at 100 grams/minute or 6 kilograms per hour in air at 1% (v/v) or 10,000 ppm.

A 3 phase 20 amp 480 volt power source is required for the HiFlo system.

Features of the System:

- Multiple interlocks that will shut the System down in adverse situations.
- Easy to use Touch Screen allowing input of target phosphine weight to be dispensed.
- Automatic change over allows cylinders to be completely emptied resulting no part cylinders.
- High purity phosphine providing superior fumigation performance.
- Automatic pre and post system purges using carbon dioxide
- Automatic high pressure leak test
- Integrated dual weighing platforms.

U-Phos HiFlo System



Power requirements
3-phase + N, 20A

Use clean CO2 Purge Gas
<50ppm of oxygen

Output 6kg/hr @1%

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3. Safety Interlocks

The System will shut down in the situations listed in the table below. These are detailed in the PLC screens listed later in the Manual.

SAFETY INTERLOCK
System air flow below required flowrate
System Variable Speed Drive tripped
High Temperature in System mixing head
Power failure
Leak test failure
U-Phos® cylinders empty
Carbon Dioxide cylinder pressure low
U-Phos® cylinder valve open while trying to Post Purge

4. Product Specifications

PHOSPHINE PURITY	>99% (weight)
CYLINDER	
Material & Water Capacity	Steel & 49 litres (12.9 gal)
PH3 Fill Capacity	17 kg (37.4 lb)
Pressure @ 25 C (77 F)	40 bar
Tare Weight	63 kg (138.8 lb)
Dimensions (HxD) (excludes cap)	1500 x 235 mm (59 x 9.2 in)
Manufacturing Specification	DOT 3AA
Valve	
Material & Type	Brass & Stainless Steel Diaphragms
Valve outlet	CGA 350
Pallet Rack	
Dimensions (HxWxL)	1065 x 1050 x 815 mm (42 x 41 x 32 in)
Weight (approx)	100 kg (220lb)
Cylinder Capacity	12

	HiFlo	LoFlo
PH3 Flowrate	100 grams/minute	3 grams/minute
Air Flowrate	250 Cubic ft/minute	9 Cubic ft/minute
PH3/Air Concentration	1% v/v	1% v/v
Dimensions H x W x L (approx. & excludes cylinders)	1400 x 800 x 800mm (55 x 32 x 32 in)	1200 x 750 x 700mm (47 x 30 x 28 in)
Weight (approx. & excludes cylinders)	250kg (551lb)	100kg (220lb)
Power Supply	3 phase, 20 amp	Single phase, 10 amp
PH3 Dispensing	Method= Weight	Method= Time/ Concentration
Saferty Interlock & Alarms	Yes	Yes
Touch Screen Control	Yes	Yes
U-Phos Cylinders	2	2
Purging Gas (<50 ppm oxygen)	CO2	CO2
Remote Messaging	No	Yes (SMS)
Cylinder Auto change over	Yes	Yes

5. U-Phos® Cylinder & Valve

U-Phos® is a cylinderized source of phosphine gas packaged in a high pressure steel cylinder.

The high pressure (40 bar) U-Phos® Cylinder (Tare weight: 63kg, or 138.8 lb) is fitted with a CGA350 outlet brass valve and has capacity of 17 kg, or 37.4 lb of PH_3 (Gross weight: 80kg, or 176.3 lb).

6. U-Phos® Cylinder Opening /Closing / Connection Instructions

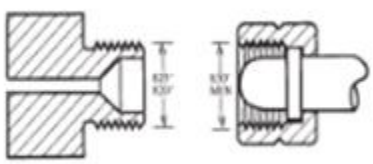
BEFORE HANDLING U-PHOS® CYLINDERS REFER SDS FOR APPROPRIATE PPE TO BE USED

A. Connecting Phosphine Hose from HiFlo System to Cylinder Valve Outlet

Phosphine Hose Torque Wrench

This torque wrench is used with CGA 350 valve outlet and bull nose inlet connection attached to the HiFlo Phosphine Hose Nut. The torque wrench is set to 60 Nm to meet the Guidelines for Sealing CGA Valve Outlet Connections by the US Compressed Gas Association.

U-Phos® Valve Outlet **HiFlo Phosphine Hose**



Connection CGA 350
0.825-14NGO RH EXT
(Round Nipple)

Instructions A

1. Position U-Phos® cylinders securely on the weighing platforms using the chain provided before connection to HiFlo System.
2. Remove the Cylinder Caps.
3. Ensure the valve is closed using the Valve Handwheel Torque Wrench (Instructions C below).
4. Remove the Valve Outlet Cap with the 29 mm short wrench or alternative wrench (Instructions D below).
5. Check there is no damage to the threads of the Valve Outlet and Phosphine Hose Nut and they are clean.
6. Connect the Phosphine Hose Nut to the valve outlet and tighten anti clockwise by hand for approximately 4 turns.
7. When unable to tighten further by hand use the Phosphine Hose Torque Wrench (60 Nm) to tighten anti clockwise until the operator hears a "click" from the torque wrench. The "click" indicates the correct amount of torque has been reached ensuring a gas tight seal. Do not tighten further or damage to the valve can occur.
8. An alternative torque wrench can be used set to 60 Nm.

B. Opening U-Phos® Cylinder Valve

Instructions B

1. Do not open U-Phos® cylinder valves until the HiFlo System PLC screen instructs the operator to open.
2. To open the valves turn the handwheel to the fully open position on both cylinders which is approximately ¾ of a turn and then close ¼ turn leaving the Valve Handwheel to freely turn in either direction. This allows the operator to know the position of the valve is open. Never lock the valve in the fully open position.

C. Closing U-Phos® Cylinder Valve

Handwheel Torque Wrench

This torque wrench is set to 8 Nm to meet the valve manufacturer's requirement for tightening of the handwheel when closing the valve after use. The valve consists of a soft seat and over tightening will damage the valve and can result in the valve leaking.

Instructions C:

1. The cylinder valves are ready to be closed when the HiFlo System PLC screen instructs the operator to do so.
2. Check handwheel is free to rotate in both directions before closing. This ensures the valve is not locked open.
3. Operator places the torque wrench in position on the valve handwheel and then turns the torque wrench clockwise until the operator hears a "click" from the torque wrench. The "click" indicates the valve is closed with the correct amount of torque applied. Do not tighten further or damage to the valve seat will occur.

D. Valve Outlet Cap Removal & Tightening

Short wrench 29 mm

The Short wrench 29 mm is to be used for tightening the Valve Outlet Cap after use and can be used for removing the Valve Outlet Cap. This wrench is used to minimize the risk of over tightening.

Instructions D

1. Check there is no damage to the valve outlet or Valve Outlet Cap threads and they are clean.
2. Hand tighten the Valve Outlet Cap for approximately 4 turns anti-clockwise until unable to tighten further.
3. Use the short wrench 29 mm to tighten the Valve Outlet Cap at the final stage.
4. An alternative wrench can be used.

7. System Procedures

Set Up

Before operating the U-Phos® HiFlo System, the following Set Up procedure is to be followed.

1. **Position HiFlo System**
    a. System to be in a well ventilated area
    b. Out of direct sunlight.
    c. Located on stable surface.
2. **Connect 2 U-Phos® Cylinders**
    a. Always connect 2 U-Phos® cylinders. Locate and secure the 2 cylinders on the weighing platforms using the chains provided.
    b. Remove Cylinder Caps.
    c. Check the cylinder handwheel is in the closed position using the Handwheel Torque Wrench.
    d. Remove Valve Outlet Cap by turning clockwise.
    e. Hand Tighten HiFlo System connecting hoses to the cylinder valve outlet by turning anticlockwise for 4 turns. If resistance is encountered while tightening by hand disconnect the hose and re connect to avoid potential cross threading damaging the valve outlet. Continue tightening nut with Phosphine Hose Torque Wrench or alternative. **NEVER USE EXCESSIVE FORCE.**
3. **Connect Carbon Dioxide Cylinder**
    a. Hand tighten carbon dioxide connecting hose to the carbon dioxide cylinder valve outlet by turning clockwise for 4 turns. Continue tightening nut with suitable wrench to recommended torque by carbon dioxide cylinder supplier.
    b. Open carbon dioxide cylinder valve.
4. **Connect U-Phos®/Air Delivery Hose to HiFlo System & External Storage**
    a. Connect U-Phos®/air delivery hose to the Camlock fitting on the HiFlo System . The hose is 21.6 feet long and diameter of 2.5 inches nominal. If the length of the hose needs to be extended a larger diameter is required. Consult manufacturer.

b. Connect delivery hose to the external storage and ensure no air blockages or restrictions.

5. Power Connection

a. Connect power lead to 3 phase + 20 amp power source.

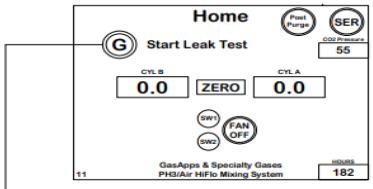
b. Turn on power switch.

6. Follow HiFlo System Screen Instructions

Main HiFlo System Screens

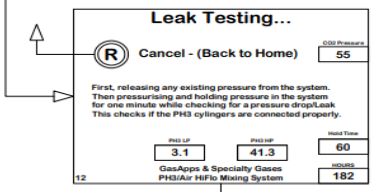
The System allows the operator to control the fumigation process via a PLC touch screen. The 8 main system screens are shown in the following flow chart.

GasApps PH3/Air HiFlo Mixing System



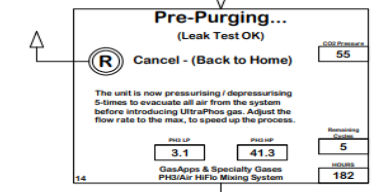
#11 Home Screen

Place two PH3 cylinders onto the two scales A & B and connect (tightening torque 60N-m) the appropriate hoses, ie hose A connect to Scale A and so on. Connect (tightening torque 30N-m) a Purge CO2 cylinder (082) to the Co2 hose & turn ON. Power up the machine using the 20A 5-pin Plugtop with 4m power lead. Insert and Seal the 2½" x 6.6m long fumigant delivery hose into the storage. Press the Green FAN ONLY button to check that SW1 & SW2 indicators turn green. Now press the Green Start Leak Test button. Note: The Blue button will take you directly to Post Purge #21 if required.



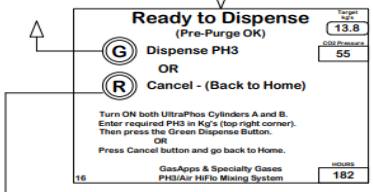
#12 Leak Testing

First, releasing any existing pressure from the system. Then pressurising and holding pressure in the system for one minute while checking for a pressure drop/leak. This checks if the PH3 cylinders are connected properly. It does not check for CO2 connection leaks.
Once Leak Testing has successfully completed the system will automatically move onto the next stage Pre-Purging #14. At any time press the Red button to return back to home.



#14 Pre-Purging

The unit is now pressurising / depressurising 10-times to evacuate all air from the system before introducing UltraPhos gas.
At any time press the Red button to return back to home.
The bottom right corner indicates the purge cycles which counts down from ten (10).
Once complete the system will automatically move onto the next screen #16 Ready to Dispense.

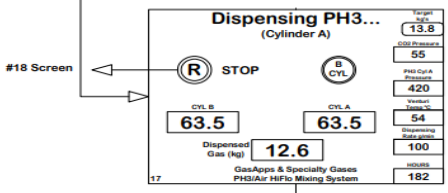


#15 Ready to Dispense

Press the Red button to return back to home

OR

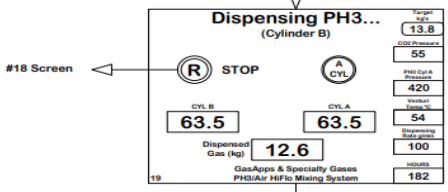
Turn ON both UltraPhos Cylinders A and B. Enter required PH3 in Kg's (top right corner).
Then press the Green Dispense Button (move onto the next screen #17).



#17 Dispensing PH3 - Cylinder A

The system is programmed to always draw gas from cylinder A first. The middle lower box displays the total gas (KG's) dispensed. Once this number reached the Target kg's the system will move to #20 Fumigation Complete screen.
The system will move to Screen #19 once Cylinder A is empty.

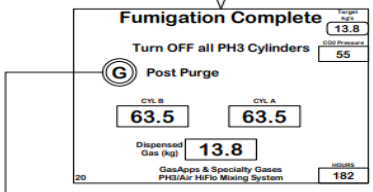
The bottom right corner indicates the machine hours run.
Press the Red STOP to pause/stop dispensing.



#19 Dispensing PH3 - Cylinder B

The middle lower box displays the total gas (KG's) dispensed. Once this number reached the Target kg's the system will move to #20 Fumigation Complete screen.

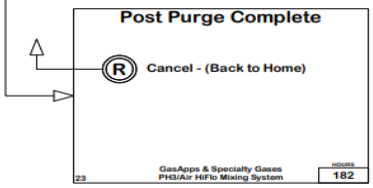
The bottom right corner indicates the machine hours run.
Press the Red STOP to pause/stop dispensing.



#20 Fumigation Complete

Turn OFF all PH3 Cylinders.
The middle lower box displays the total gas (KG's) dispensed.
The bottom right corner indicates the machine hours run.
Press the Green Post Purge button to start the post purge process.

Always Post Purged before disconnecting cylinders.



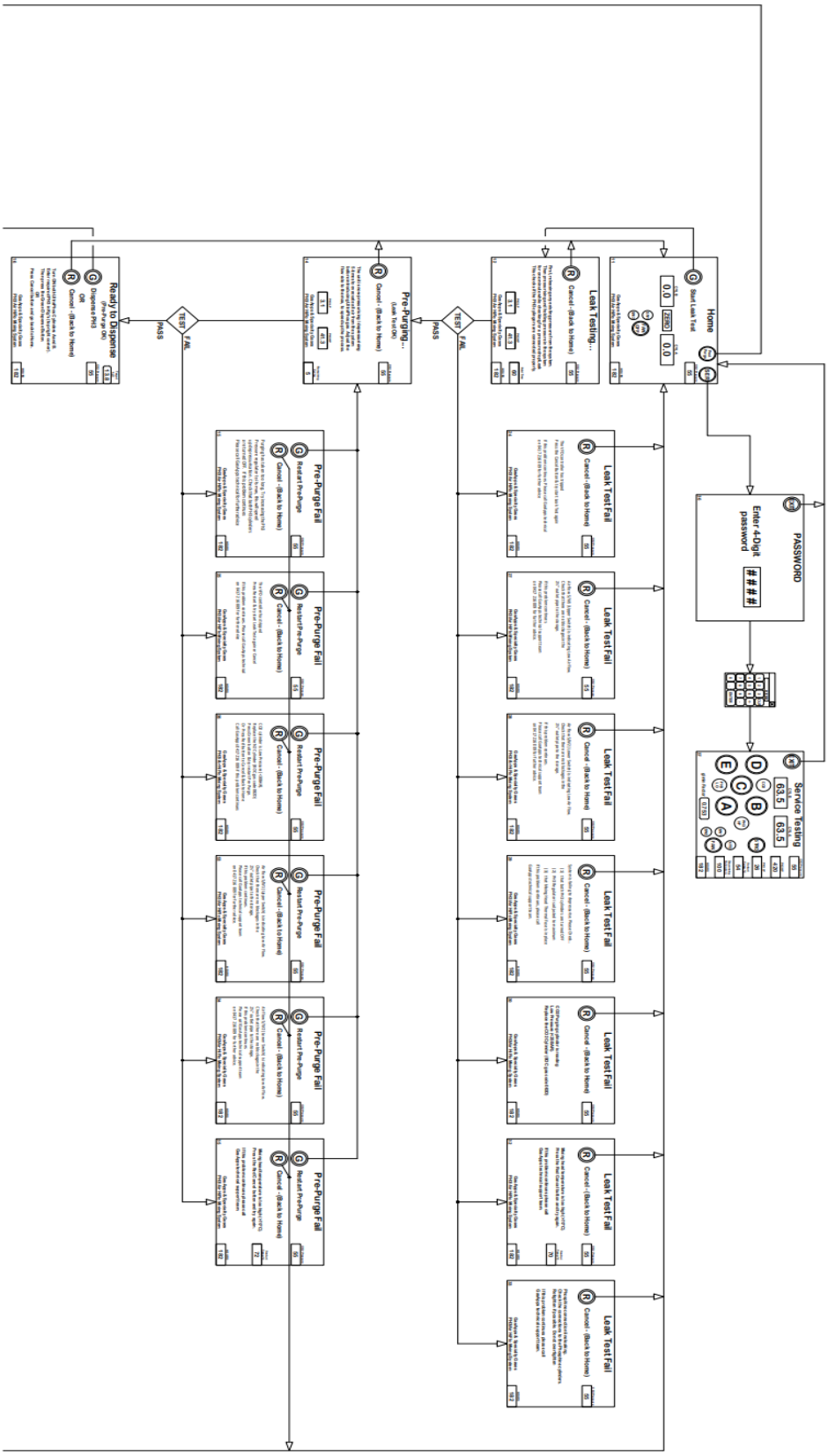
#23 Post Purge Complete

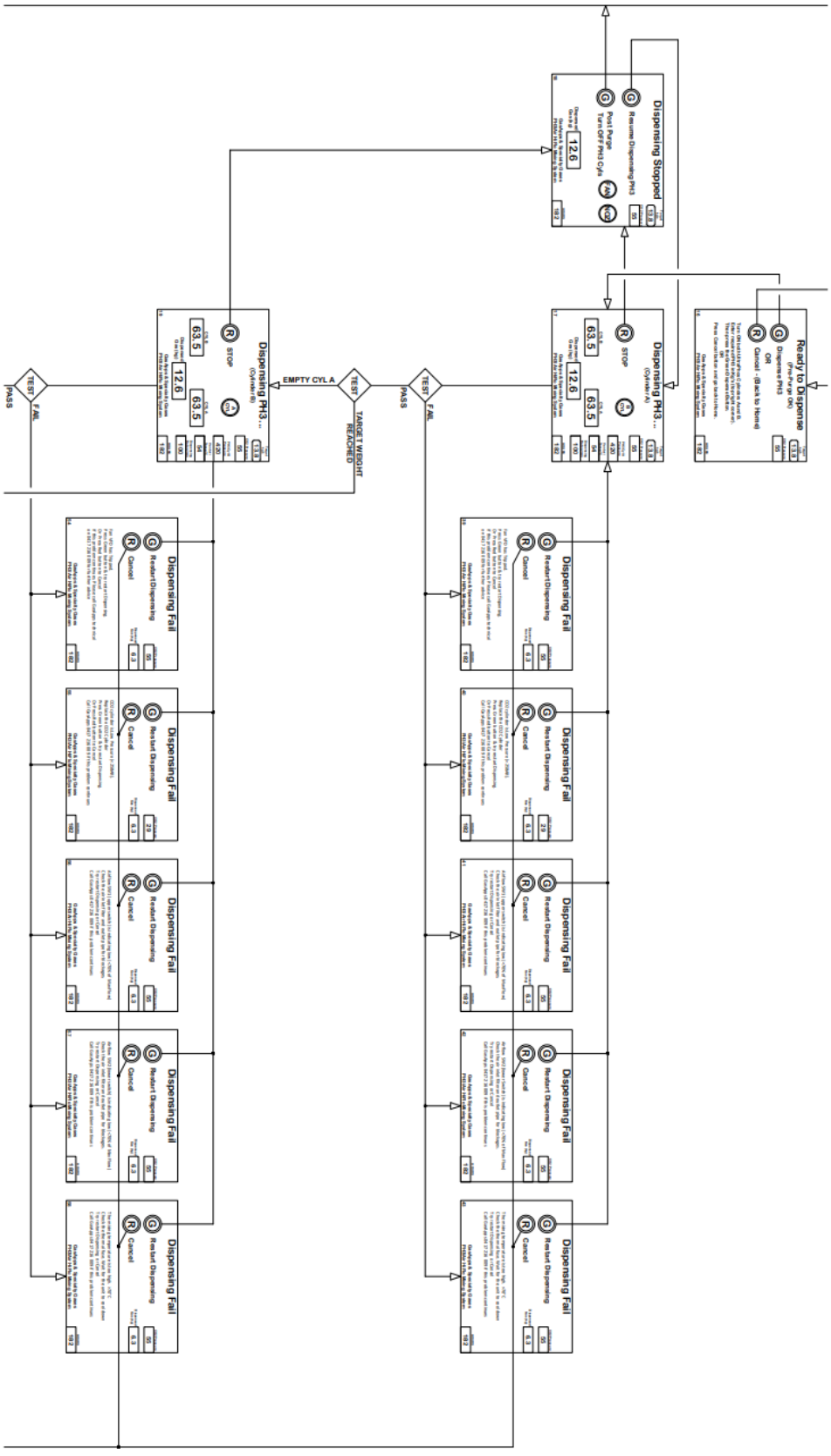
Its now safe to disconnect both PH3 cylinders.
Press the Red Cancel to return back to Home.

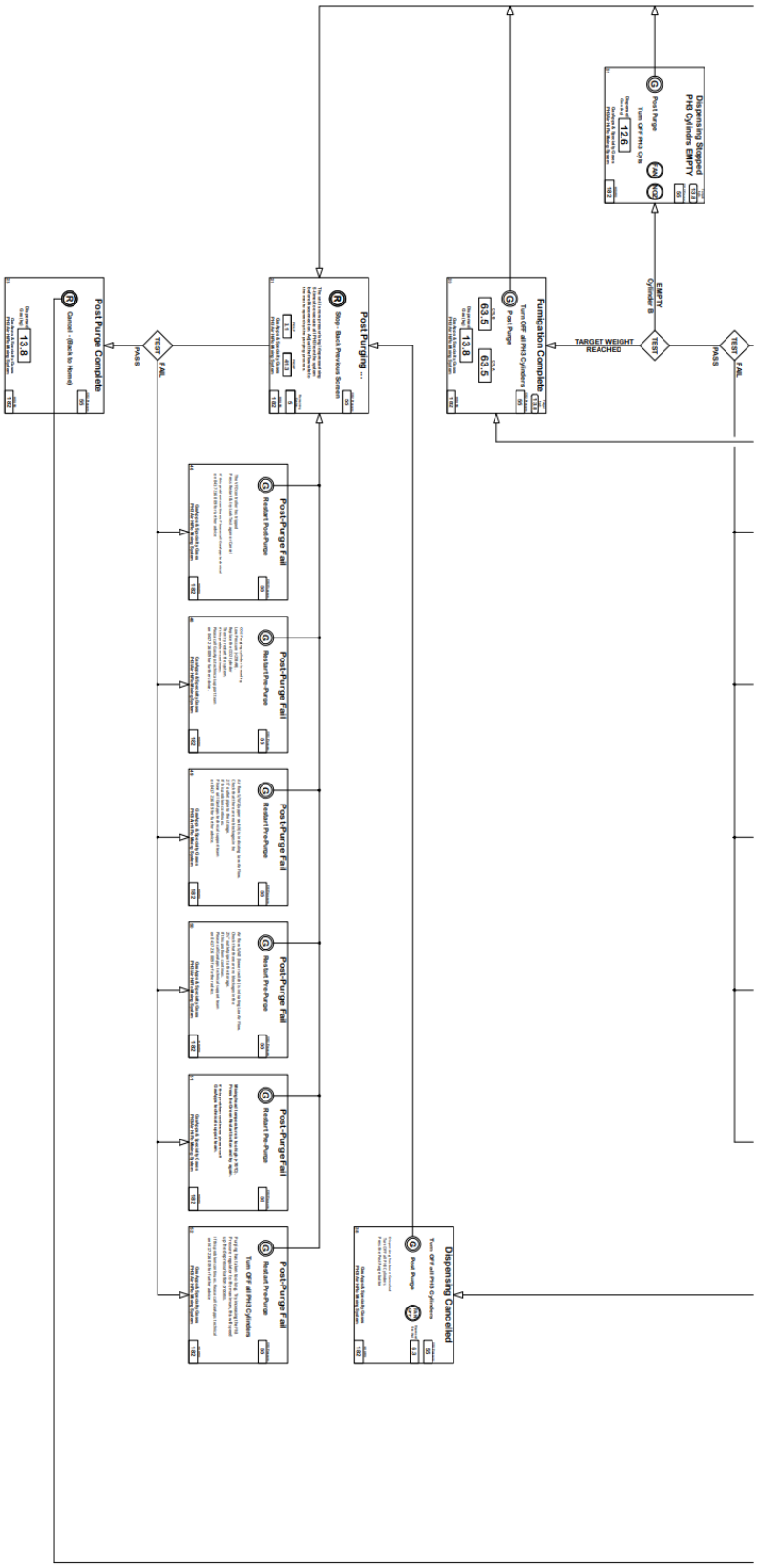
The CO2 cylinder can be turned OFF and disconnect now.
The panel green OFF-ON Switch can now be turned OFF. Power supply can also be turned OFF and disconnected.

Complete HiFlo System Screens

The following 3 flow charts show all the System Screens including errors.


Home
Start Leak Test
PASSWORD
Enter 4-Digit password
####
Service Testing
63.5
63.5
Leak Testing...
Cancel - (Back to Home)
Pre-Purging...
Cancel - (Back to Home)
TEST
PASS
FAIL
Ready to Dispense
Dispense Pill3
Off
Cancel - (Back to Home)
Leak Test Fail
Restart Pre-Purge
Pre-Purge Fail


Dispensing Stopped
Post Purge
Turns OFF PH3 Cyls
Resume Dispensing PH3
Ready to Dispense
(Post-Purge OK)
Dispensing PH3
OR
Cancel - (Back to Home)
Dispensing PH3...
(Cylinder A)
STOP
Dispensing PH3...
(Cylinder B)
STOP
EMPTY CYL A
TEST
PASS
FAIL
TARGET WEIGHT
REACHED
Restart Dispensing
Cancel
Dispensing Fail


Dispensing Stopped
PHB Cylinders EMPTY
Post Purge
Turn OFF PH3 Cyls
12.6
EMPTY
Cylinder B
TEST
PASS
FAIL
TARGET WEIGHT
REACHED
Fumigation Complete
Turn OFF all PH3 Cylinders
Post Purge
63.5
13.8
63.5
Post Purging ...
Stop - Back Previous Screen
Post Purge Complete
Cancel - (Back to Home)
Dispensing Cancelled
Turn OFF all PH3 Cylinders
Post Purge
Post-Purge Fail
Restart Post-Purge
Restart Pre-Purge
Turn OFF all PH3 Cylinders

Shutdown Instructions

Follow instructions for shutdown of the System when Fumigation Complete screen reached (20).

a. Close U-Phos® cylinder valves (refer instructions in section 5 C) and then press Post Purge button.

b. On Post Purge Complete screen (23) press red Cancel button to return to Home screen (11).

c. Turn off power.

d. Disconnect U-Phos® cylinders A & B and replace hose plugs tightening using wrenches. (Do not leave hand tightened as air can enter the hoses).

e. Replace Valve Outlet Caps following Cylinder Handling Instructions in section 6 D.

f. Replace Cylinder Caps.

g. Turn off carbon dioxide cylinder and disconnect hose and replace carbon dioxide hose plug.

h. Disconnect U-Phos®/air delivery line from the external storage.

i. Remove delivery line from HiFlo System and replace Camlock Cap.

j. Prior to moving HiFlo System ensure cylinders are unchained and removed from weighing platforms. Never transport the HiFlo System with cylinders connected or on the weighing platforms.

Cylinder Warming Instructions

In situations where the gas flowrate is reducing due to the cylinder cooling down and frost forming on the lower section of the cylinder it is possible to warm the cylinders ensuring the cylinders and valve temperature does not exceed the operating temperature specified by the manufacturers.

The maximum temperature for the cylinder and valve is 122 F. The temperature at the cylinder and valve should be monitored regularly using an infrared thermometer and recorded. **THE TEMPERATURE SHOULD NEVER EXCEED THESE LIMITS.**

8.U-Phos SDS