

EDELHOFF TECHNOLOGIES USA LLC

6 Man / Quad Display

Inert Entry/S.A.R. Life Support Module

Control System

OPERATIONS MANUAL

Revision: A

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Contact Information:

Edelhoff Technologies USA LLC
9361 Winkler Dr.
Suite A
Houston, TX 77017
713—947-6469

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Preface

This manual is meant for those who operate or use the Edelhoff Technologies air supply module, and for those who perform minor maintenance and repairs. It is assumed that the module is maintained and repaired by competent maintenance personnel. It is advised to return the module to the manufacturer for maintenance and calibration every five years.

The module is built to supply breathing air for persons working in hazardous environments. Before using the module, always check that the unit is suitable for working in that environment. This includes a check of environmental influences such as temperature, or the resistance of the umbilical assemblies to any corrosive substance present in the working area.

1. Safety

1.1 Symbols

This manual includes a number of warnings for dangerous situations. These can be recognized by the following symbols:



Danger

This indicates a situation that is dangerous to life, or can cause severe injuries if not avoided.



Warning

This indicates a situation that can cause injuries to the user, or can cause severe damage to the equipment if not avoided.



Attention

This indicates a situation that can cause damage to the installation if not avoided.

1.2 General safety measures

The module should always be set up and used by personnel that have sufficient knowledge about working with air under high pressure.

Breathing air used with the safety unit should comply with CGA speciation G-7-1, Type 1, Grade D or better. Always check if the umbilical assemblies have sufficient resistance to any corrosive substance present in the working environment. A resistance chart is included in the appendix of this manual for checking against. If the resistance chart does not contain data about a certain substance the umbilical assembly would be exposed to, contact the manufacturer for information concerning that substance.

The module has only been tested and approved for use at temperatures between 21°F to 140°F, -6°C to +60°C



Danger

Only use breathing air that complies with CGA speciation G-7-1, Type 1, Grade D or better.



Danger

Always check if the air supply is sufficient for the planned activities.



Danger

Always check if the working environment contains any substances that can affect the life support umbilicals. This can be checked with the hose resistance chart in this manual's appendix.



Danger

Inspect hoses for signs of damage or wear. If evident, replace hose.

2. Scope of Supply

The purpose of this system is to operate and monitor a 6-Man Life Support System utilizing up to 4 touch screen PLC control monitors and a suite of advance sensors, valves and control algorithms to ensure safe and reliable air supply to all users.

This manual explains the theory of operations, user interface, setup, and shut down of the PLC Control system.

About this Manual

This manual is provided to document use and functionality of the control system. It is not intended to replace the experience of operators in such a critical operation. Users are encouraged to utilize industry standard safe practices to ensure all users have adequate air supply

3. System Description

The 6-Man Life Support System utilizes 4 Human Machine Interfaces (HMI's) integrated to a PLC system that allow the operator access to all necessary pressures, air statuses, temperatures, and a host of other data. The setup consists of 1 Master HMI/PLC and 3 Slave HMI's. Additionally, there are Input and Output modules connected to the Master HMI/PLC that monitors and controls all sensors, valves, alarms, etc.

The Master HMI is the primary user input device and can operate any of the HMI screens. The operator will setup all RFID login data on this display. User Names, user-adjustable temperature alarms and gas alarm values are also input on the Master HMI only. The data this is logged can be transferred from the on-board micro-SD card to a USB thumb drive using the Master HMI.

The three Slave HMI's allow the operator to monitor and control the primary breathing systems, the SAR breathing system, temperatures, and Gas Detection system. When properly logged in using the RFID system, the operator will have full control of the air supplies and the capability to monitor all pressures and statuses on any screen.

The input and output modules consist of Analog (variable) and Digital (On/Off status) modules. The input modules monitor the following inputs:

- Source Air Supply, users 1-6 (0-3000 PSI)
- Primary Air Out, users 1-6 (0-300 PSI)
- Secondary Air Out, users 1-6 (0-300 PSI)
- Secondary Source Air Supply (0-3000 PSI)
- SAR Source Air (0-3000 PSI)
- SAR User Air Out, SAR users 1-6 (0-300 PSI)
- Temperatures
 - Control Room
 - External (outside)
 - Remote Temperature 1
 - Remote Temperature 2
- Battery Voltage
- Gas Detection Sensors (*development in process*)
 - Oxygen (%)
 - H₂S (ppm)
 - LEL (%0)
 - CO (ppm)
- Electrical system status

Each of these inputs is displayed on their respective HMI screens. Additionally, the data is automatically logged to the Master HMI on-board micro SD card.

The output modules consist of Digital (On/Off) modules that control the following:

- Primary Air On/Off (users 1-6)
- Secondary Air On/Off (users 1-6)
- SAR Air On/Off (SAR users 1-6)
- Electrical system control and shutdown

The module has an initial self-diagnostic feature that will evaluate critical hardware component and software functions prior to starting work. This feature insures all valves and sensors are performing as required. A date-stamped document is generated each time the test is performed.

4. Module Self-Diagnostics

a. System Test #1:

Edelhoff

SYSTEM TEST #1

START TEST

PRIMARY AIR SUPPLIES LESS THAN 10 PSI		PRIMARY AIR OUT LESS THAN 10 PSI		SECONDARY AIR OUT LESS THAN 10 PSI		SAR AIR OUT LESS THAN 10 PSI	
1	PASS FAIL	1	PASS FAIL	1	PASS FAIL	1	PASS FAIL
2	PASS FAIL	2	PASS FAIL	2	PASS FAIL	2	PASS FAIL
3	PASS FAIL	3	PASS FAIL	3	PASS FAIL	3	PASS FAIL
4	PASS FAIL	4	PASS FAIL	4	PASS FAIL	4	PASS FAIL
5	PASS FAIL	5	PASS FAIL	5	PASS FAIL	5	PASS FAIL
6	PASS FAIL	6	PASS FAIL	6	PASS FAIL	6	PASS FAIL

SECONDARY AIR SUPPLY LESS THAN 10 PSI		SAR AIR SUPPLY LESS THAN 10 PSI	
1	PASS FAIL	1	PASS FAIL

RFID
TEST 1
RESET
NEXT

b. System Test #2:

Edelhoff

SYSTEM TEST #2

PRESSURE TEST

MM:SS

MM:SS

MM:SS

PRIMARY AIR SUPPLIES 500 - 3000 PSI		PRIMARY AIR OUT 90 - 125 PSI		SECONDARY AIR OUT 90 - 125 PSI		SAR AIR OUT 90 - 125 PSI	
1	PASS FAIL	1	PASS FAIL	1	PASS FAIL	1	PASS FAIL
2	PASS FAIL	2	PASS FAIL	2	PASS FAIL	2	PASS FAIL
3	PASS FAIL	3	PASS FAIL	3	PASS FAIL	3	PASS FAIL
4	PASS FAIL	4	PASS FAIL	4	PASS FAIL	4	PASS FAIL
5	PASS FAIL	5	PASS FAIL	5	PASS FAIL	5	PASS FAIL
6	PASS FAIL	6	PASS FAIL	6	PASS FAIL	6	PASS FAIL

SECONDARY AIR SUPPLY 500 - 3000 PSI		SAR AIR SUPPLY 500 - 3000 PSI	
1	PASS FAIL	1	PASS FAIL

RFID
TEST 2
RESET
NEXT

c. System Test #3:

SYSTEM TEST #3 **Edelhoff**

LEAK TEST

MM:SS

PRIMARY AIR SUPPLIES LEAK TEST STATUS			PRIMARY AIR OUT LEAK TEST STATUS			SECONDARY AIR OUT LEAK TEST STATUS			SAR AIR OUT LEAK TEST STATUS		
1	PASS	FAIL	1	PASS	FAIL	1	PASS	FAIL	1	PASS	FAIL
2	PASS	FAIL	2	PASS	FAIL	2	PASS	FAIL	2	PASS	FAIL
3	PASS	FAIL	3	PASS	FAIL	3	PASS	FAIL	3	PASS	FAIL
4	PASS	FAIL	4	PASS	FAIL	4	PASS	FAIL	4	PASS	FAIL
5	PASS	FAIL	5	PASS	FAIL	5	PASS	FAIL	5	PASS	FAIL
6	PASS	FAIL	6	PASS	FAIL	6	PASS	FAIL	6	PASS	FAIL

SECONDARY AIR SUPPLY
LEAK TEST STATUS
1 PASS FAIL

RFID TEST 3 RESET NEXT

SAR AIR SUPPLY
LEAK TEST STATUS
1 PASS FAIL

d. System Test #4:

SYSTEM TEST #4 **Edelhoff**

SENSOR TEST

SENSOR TESTS			TEMPERATURE PROBE 0 - 120°F		
BATTERY CHARGE	PASS	FAIL	CONTROL ROOM	PASS	FAIL
SURGE PROTECTOR	PASS	FAIL	EXTERNAL TEMP	PASS	FAIL
BATTERY FAULT STATUS	PASS	FAIL	REMOTE TEMP 1	PASS	FAIL
BREAKER STATUS	PASS	FAIL	REMOTE TEMP 2	PASS	FAIL
OVER CURRENT STATUS	PASS	FAIL			

RFID

TEST 4 RESET

COMPLETE

5. Setting up the system

- a. Check the air supply bottles contain breathing air complies with CGA speciation G-7-1, Type 1, Grade D or better
- b. Connecting the air supply
 - i. Connect the secondary air supply line via a CGA 346 fitting to the "SEC-AIR-SUPPLY" on the module.
 - ii. Connect the end of the High Pressure manifold to the CGA 346 fitting labeled "PRI-AIR SUPPLY" in each section labeled PRIMARY that is being used.
 - iii. Open cylinder valve momentarily to blow out any dust and dirt. Connect the High Pressure Manifold to the bottle bank.
- c. Connecting the life support umbilicals
 - i. Select the umbilical color that matches the color of the circuit color on the display screen.
 - ii. Remove the umbilical fitting cap (if applicable)
 - iii. Connect the Quick Disconnect Socket on the Secondary Airline to the Quick disconnect plug labeled SEC-AIRLINE on the module. Then connect the Quick disconnect plug on the Primary Airline to the Quick Disconnect

Socket Labeled PRI-AIRLINE.

- iv. Repeat steps for each desired umbilical line.



Attention

Before connecting the umbilical hose assembly to the life support system, purge the umbilical with clean dry breathing air to remove any trash or foreign matter and condensation.

- d. Connecting the communication fittings.
 - i. Install the communication fitting on the umbilical to the fitting on the module.
 - ii. Communication lines are not man specific.

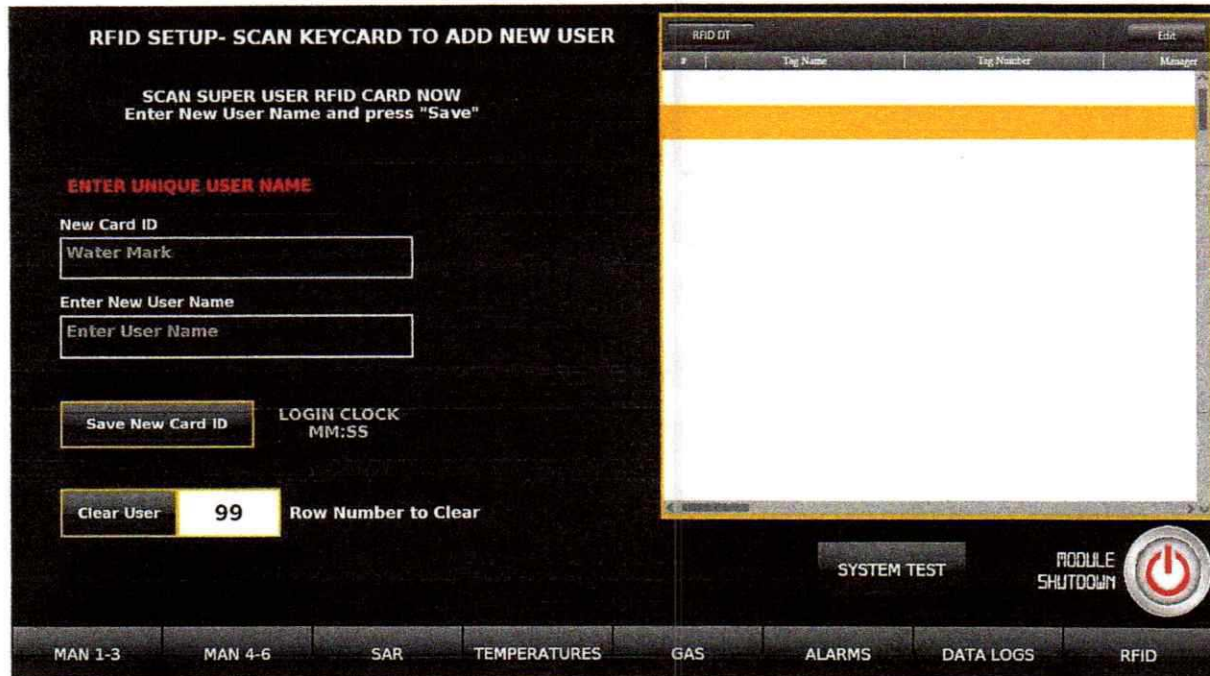
6. Startup RFID

Introduction

This section provides a description of the initial setup of the 6-man LSS control system using the RFID Login System.

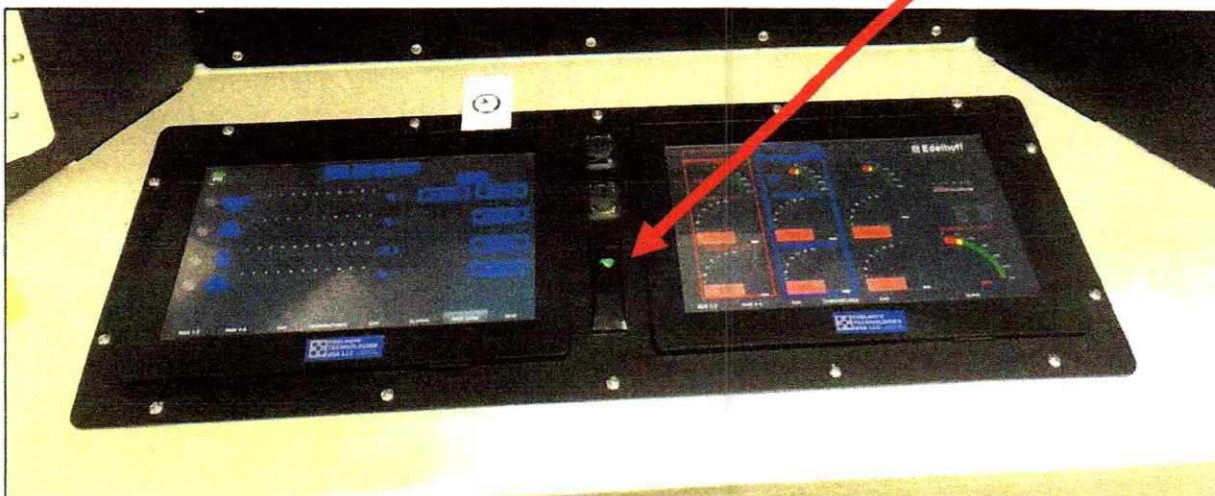
6.1. RFID Super User Setup

6.1.1. Upon initial power up, the Master HMI screen will display the RFID screen as shown below.



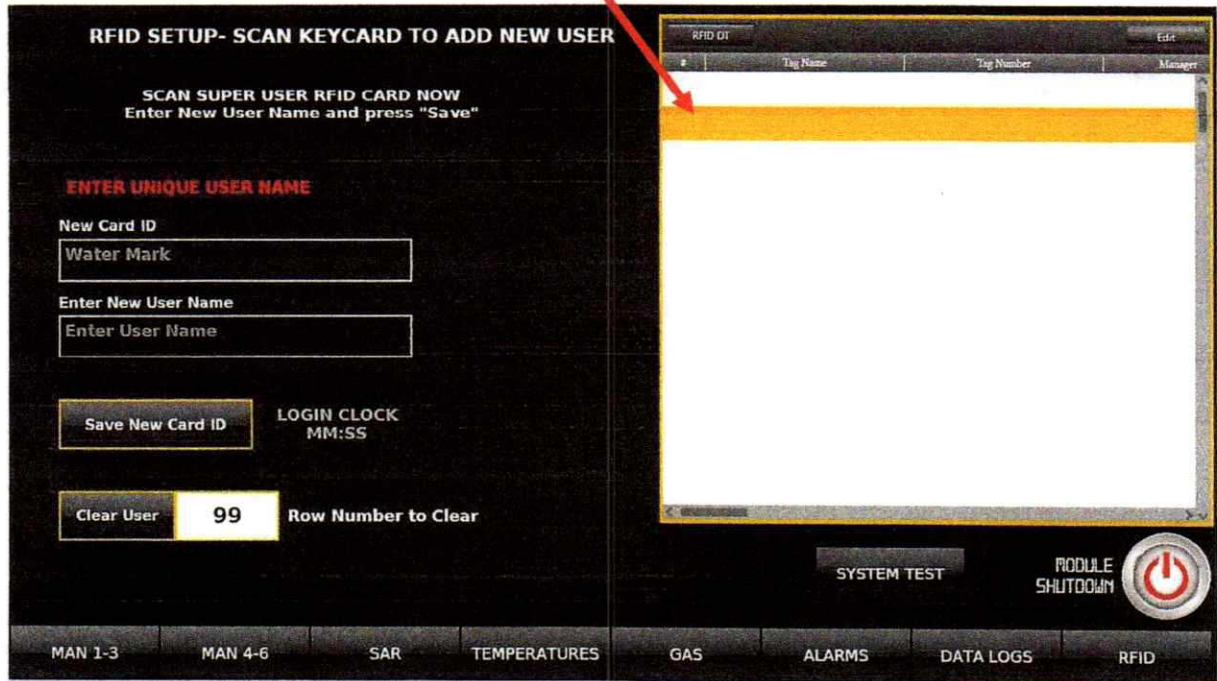
6.1.2. NOTE: BEFORE ANY OPERATIONS CAN BEGIN, A "SUPER USER" MUST SCAN AN RFID CARD AND CREATE A USER NAME.

6.1.3. Scan 1 RFID card against the RFID Card reader as shown below:



6.1.4. The "NEW CARD ID" text box will auto-fill with a random RFID text string.

- 6.1.5. Enter a unique USER NAME into the "ENTER NEW USER NAME" text box by touching inside the rectangle that says "ENTER USER NAME". A QWERTY keyboard will pop up on the display. Type the Super User name and press "OK" on the keyboard screen.
- 6.1.6. Press the "SAVE NEW CARD ID" button.
- 6.1.7. The RFID Data Table will now show the "Super User" as the first entry on the table.



- 6.1.8. Scan the same RFID Card again and notice the Login Clock is now displayed. The user has 30 seconds before the PLC system automatically logs him out. Simply touching any HMI screen anywhere will automatically reset the 30 second timer.

6.2. MANAGER ACCESS

6.2.1. Add a New User to the RFID Data Table by scanning a new RFID Card.

6.2.2. Enter a new user name and press "SAVE NEW CARD ID"

RFID SETUP- SCAN KEYCARD TO ADD NEW USER

SCAN SUPER USER RFID CARD NOW
Enter New User Name and press "Save"

ENTER UNIQUE USER NAME

New Card ID
Water Mark

Enter New User Name
Enter User Name

Save New Card ID LOGIN CLOCK MM:SS

Clear User 99 Row Number to Clear

SYSTEM TEST MODULE SHUTDOWN

MAN 1-3 MAN 4-6 SAR TEMPERATURES GAS ALARMS DATA LOGS RFID

6.2.3. To enable MANAGER ACCESS, ensure the Master HMI is on the RFID Screen.

6.2.4. Scan the SUPER USER RFID CARD.

6.2.5. On the RFID Data Table, press the "EDIT ON" button in the top right corner of the RFID Data Table. Notice the button changes to "EDIT OFF"

6.2.6. Under the "MANAGER" column, press the square box to place a check mark in the box. This enables a particular user to have Manager Access. Any user can be granted Manager access

RFID SETUP- SCAN KEYCARD TO ADD NEW USER

SCAN SUPER USER RFID CARD NOW
Enter New User Name and press "Save"

New Card ID
b:0110e%0a&e:c|

Enter New User Name
Dan G

Save New Card ID LOGIN CLOCK MM:SS

Clear User 0 Row Number to Clear

SYSTEM TEST

MAN 1-3 MAN 4-6 SAR TEMPERATURES GAS ALARMS DATA LOGS RFID

#	Tag Name	Tag Number	Manager
0	Chris	b:0110e%0a&e:c	<input checked="" type="checkbox"/>
1			<input type="checkbox"/>
2			<input type="checkbox"/>
3			<input type="checkbox"/>
4			<input type="checkbox"/>
5			<input type="checkbox"/>
6			<input type="checkbox"/>
7			<input type="checkbox"/>
8			<input type="checkbox"/>
9			<input type="checkbox"/>

6.3. RFID hierarchy

6.3.1. SUPER USER

- 6.3.1.1. Full access to the system
- 6.3.1.2. Add or remove additional RFID cards and users
- 6.3.1.3. Access the Data Logs screen
- 6.3.1.4. Transfer data from the onboard micro-SD card to user supplied USB memory stick
- 6.3.1.5. Shut down the system
- 6.3.1.6. Enable / Disable Gas Alarms
- 6.3.1.7. Operate all air valves for any user
- 6.3.1.8. The first login is automatically setup as the SUPER USER.
This cannot be changed.
- 6.3.1.9. No additional SUPER USER's can be setup

6.3.2. MANAGER

- 6.3.2.1. Access the Data Logs screen
- 6.3.2.2. Transfer data from the onboard micro-SD card to user supplied USB memory stick
- 6.3.2.3. Operate all air valves for any user

6.3.3. OPERATOR

- 6.3.3.1. Operate all air valves for any user
- 6.3.3.2. Edit User Names

7. Primary User Screens

This section describes the user inputs and controls for the Primary Users Screen.

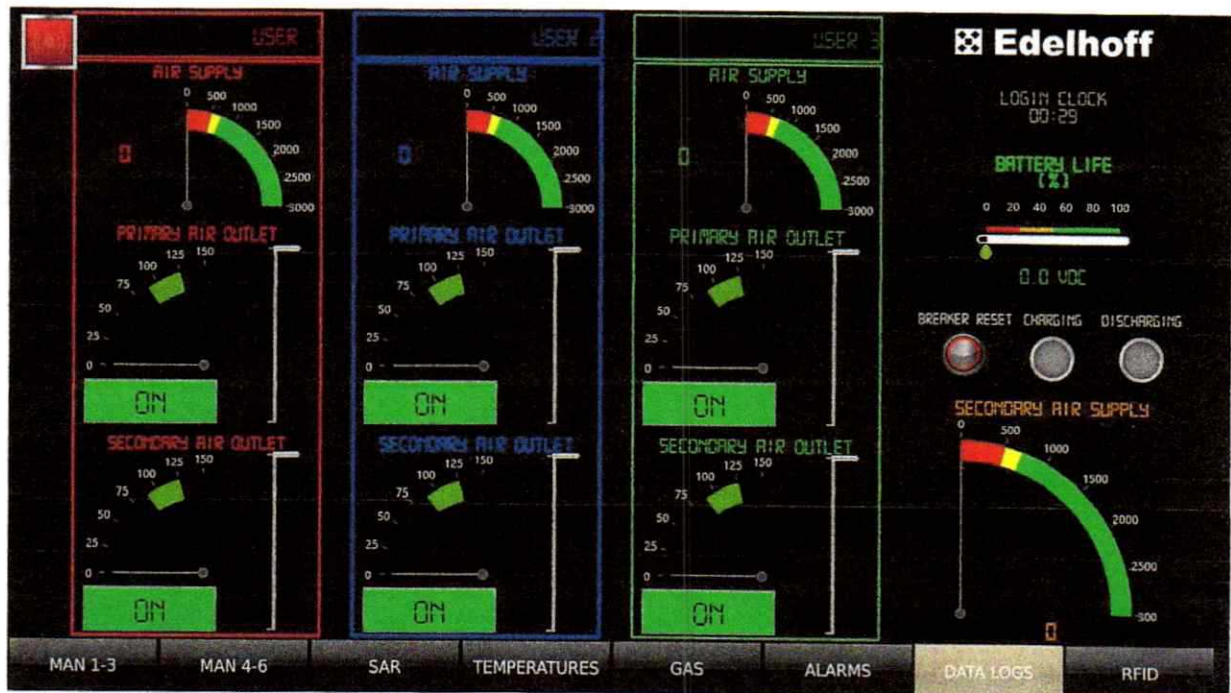
During normal operation, the system will automatically supply the Commander Helmets. Breathing activity can be monitored in the primary airlines via the display screen shown below. Each individual circuit displays primary supply pressure (0 to 3000 psi), primary helmet pressure (0 to 150 psi with the target pressure of 125 psi) and secondary helmet pressure (0 to 150 psi with the target pressure of 125 psi).

The normal operating pressure in the primary airline is 120/125 psig which will provide a maximum flow of 300 lpm. In the event that the helmet pressure in the oral/nasal cavity drops below 1.5 inches of water, the secondary regulator will be in function.

The screen also displays the "shared" secondary supply pressure (0 to 3000 psi).

The "LOW PRESSURE" alarm will sound if either the Primary or Secondary air supplies drop to 500 psi.

5. MAN 1-3 display is shown below:

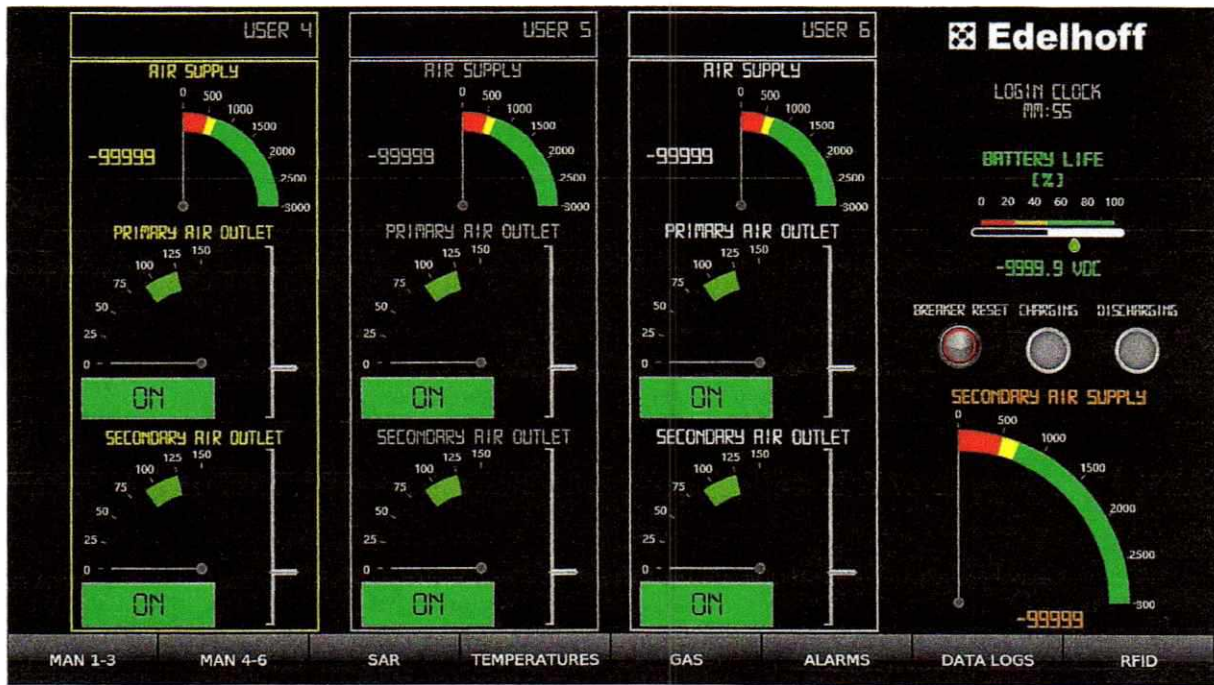


7.1. This screen displays the following:

- 7.1.1. USER 1 – Text Box for User 1 name entry
- 7.1.2. USER 2 – Text Box for User 2 name entry
- 7.1.3. USER 3 – Text Box for User 3 name entry
- 7.1.4. AIR SUPPLY (Users 1-3) shows the current pressure of the high pressure Primary Air Supply bottle
- 7.1.5. PRIMARY AIR OUTLET (Users 1-3) shows the current pressure of the reduced pressure air supply in the primary supply to the helmet
- 7.1.6. SECONDARY AIR OUTLET (Users 1-3) shows the current pressure of the reduced pressure air supply in the secondary supply to the helmet

- 7.1.7. SECONDARY AIR SUPPLY – Shows the current pressure of the high pressure Secondary Air Supply bottle, common to all 6 helmets
- 7.1.8. BATTERY LIFE [%] – shows an estimate of the remaining battery life. When plugged in to AC power, this will show 100%. When the AC power is removed, this will reduce until the battery backup has been consumed.
- 7.1.9. LOGIN CLOCK – Shows time remaining before a new RFID scan is required. Simply touching the screen anywhere will reset the LOGIN CLOCK to a fresh 30 second countdown. When the system times out, all gauges are displayed but the ability to enable / disable air supply to any helmet is disabled.
- 7.1.10. BREAKER RESET – This button displays if the trailer breaker is tripped and allows a remote reset.
- 7.1.11. CHARGING – indicates if the backup battery is charging
- 7.1.12. DISCHARGING – indicates if the backup battery is discharging (in the event of loss of AC power)
- 7.1.13. DISPLAY SELECT BUTTONS – Allows operators to view desired screens.
- 7.2. On this display, any logged in operator can edit a User Name by touching the appropriate box (i.e. "USER 1"). An on-screen keyboard will pop up and allow the operator to enter a name up to 20 characters.
- 7.3. Press OK to set the name.
- 7.4. Repeat for remaining users. This data is logged automatically to the on-board Micro-SD card.
- 7.5. To turn ON or OFF any air supply, any logged in operator can simply press the ON/OFF buttons to enable or disable Primary or Secondary Air supplies to the helmet.
- 7.6. NOTE: The Primary and Secondary air buttons must be matched within 10 seconds or an alarm will display.

7.7. MAN 4-6 display is shown below:



7.8. This screen displays the following:

- 7.8.1. USER 4 – Text Box for User 4 name entry
- 7.8.2. USER 2 – Text Box for User 5 name entry
- 7.8.3. USER 3 – Text Box for User 6 name entry
- 7.8.4. AIR SUPPLY (Users 4-6) shows the current pressure of the high pressure Primary Air Supply bottle
- 7.8.5. PRIMARY AIR OUTLET (Users 4-6) shows the current pressure of the reduced pressure air supply in the primary supply to the helmet
- 7.8.6. SECONDARY AIR OUTLET (Users 4-6) shows the current pressure of the reduced pressure air supply in the secondary supply to the helmet
- 7.8.7. SECONDARY AIR SUPPLY – Shows the current pressure of the high pressure Secondary Air Supply bottle, common to all 6 helmets
- 7.8.8. BATTERY LIFE [%] – shows an estimate of the remaining battery life. When plugged in to AC power, this will show 100%. When the AC power is removed, this will reduce until the battery backup has been consumed.
- 7.8.9. LOGIN CLOCK – Shows time remaining before a new RFID scan is required. Simply touching the screen anywhere will reset the LOGIN CLOCK to a fresh 30 second countdown. When the system times out, all gauges are displayed but the ability to enable / disable air supply to any helmet is disabled.
- 7.8.10. BREAKER RESET – This button displays if the trailer breaker is tripped and allows a remote reset.
- 7.8.11. CHARGING – indicates if the backup battery is charging

- 7.8.12. DISCHARGING – indicates if the backup battery is discharging (in the event of loss of AC power)
- 7.8.13. DISPLAY SELECT BUTTONS – Allows operators to view desired screens.
- 7.9. On this display, any logged in operator can edit a User Name by touching the appropriate box (i.e. "USER 4"). An on-screen keyboard will pop up and allow the operator to enter a name up to 20 characters.
- 7.10. Press OK to set the name.
- 7.11. Repeat for remaining users. This data is logged automatically to the on-board Micro-SD card.
- 7.12. To turn ON or OFF any air supply, any logged in operator can simply press the ON/OFF buttons to enable or disable Primary or Secondary Air supplies to the helmet.
- 7.13. NOTE: The Primary and Secondary air buttons must be matched within 10 seconds or an alarm will display.

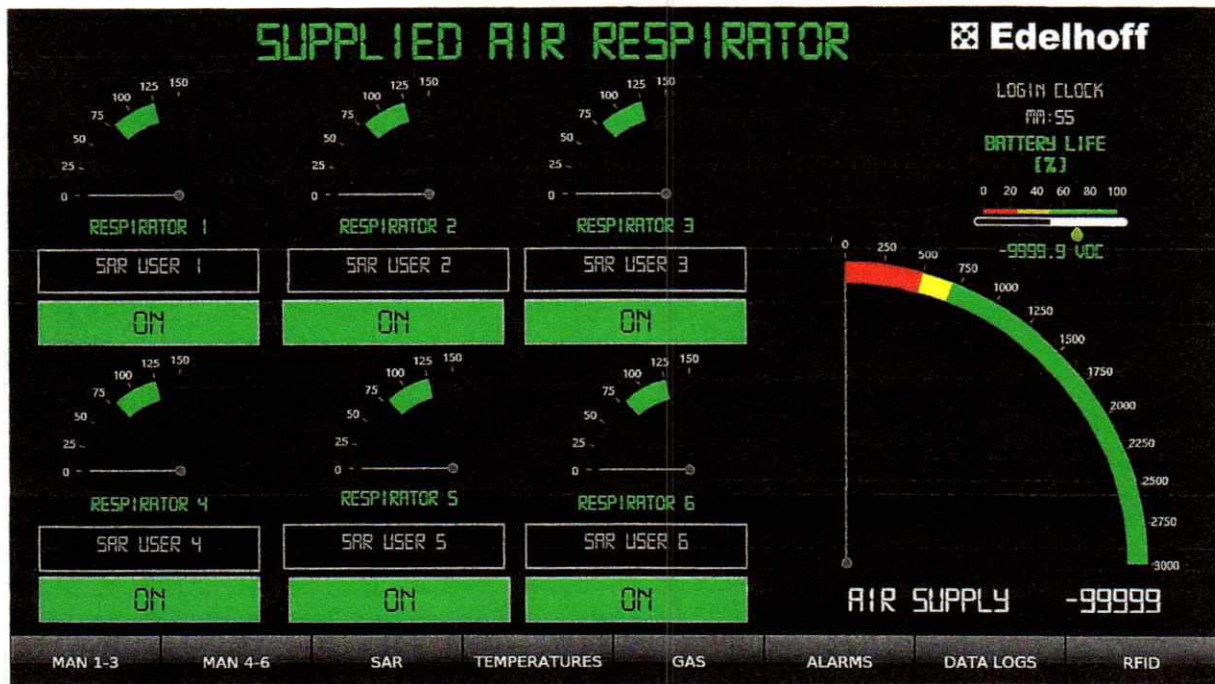
8. SAR User Screen

This section describes the user inputs and controls for the Supplier Air Respirator Users Screen.

During normal operation, the system will automatically supply air to up to 6 supplied air respirators. Breathing activity can be monitored to the airlines via the display screen shown below. Each individual circuit displays mask pressure (0 to 150 psi with a target range of 75 to 125 psi). This screen also displays the main SAR supply pressure (0 to 3000 psi).

The "LOW PRESSURE" alarm will sound if air supplies drop to 500 psi.

6. SAR display is shown below:



8.1. This screen displays the following:

- 8.1.1. SAR USER 1 – Text Box for SAR User 1 name entry
- 8.1.2. SAR USER 2 – Text Box for SAR User 2 name entry
- 8.1.3. SAR USER 3 – Text Box for SAR User 3 name entry
- 8.1.4. SAR USER 4 – Text Box for SAR User 4 name entry
- 8.1.5. SAR USER 5 – Text Box for SAR User 5 name entry
- 8.1.6. SAR USER 6 – Text Box for SAR User 6 name entry
- 8.1.7. AIR SUPPLY shows the current pressure of the high pressure SAR Air Supply bottle common to all SAR users
- 8.1.8. RESPIRATOR (Users 1-6) shows the current pressure of the reduced pressure air supply in the SAR supply to the helmet
- 8.1.9. BATTERY LIFE [%] – shows an estimate of the remaining battery life. When plugged in to AC power, this will show 100%. When the AC power is removed, this will reduce until the battery backup has been consumed.

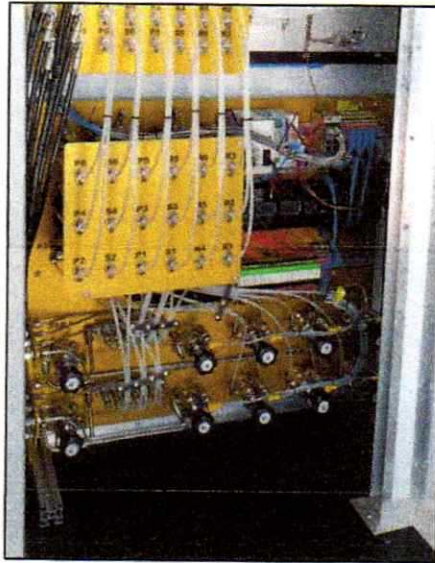
- 8.1.10. LOGIN CLOCK – Shows time remaining before a new RFID scan is required.
Simply touching the screen anywhere will reset the LOGIN CLOCK to a fresh 30 second countdown. When the system times out, all gauges are displayed but the ability to enable / disable air supply to any helmet is disabled.
- 8.1.11. DISPLAY SELECT BUTTONS – Allows operators to view desired screens.
- 8.2. On this display, any logged in operator can edit a User Name by touching the appropriate box (i.e. "SAR USER 1"). An on-screen keyboard will pop up and allow the operator to enter a name up to 20 characters.
- 8.3. Press OK to set the name.
- 8.4. Repeat for remaining users. This data is logged automatically to the on-board Micro-SD card.
- 8.5. To turn ON or OFF any air supply, any logged in operator can simply press the ON/OFF buttons to enable or disable Primary or Secondary Air supplies to the helmet.

9. Temperature Screen

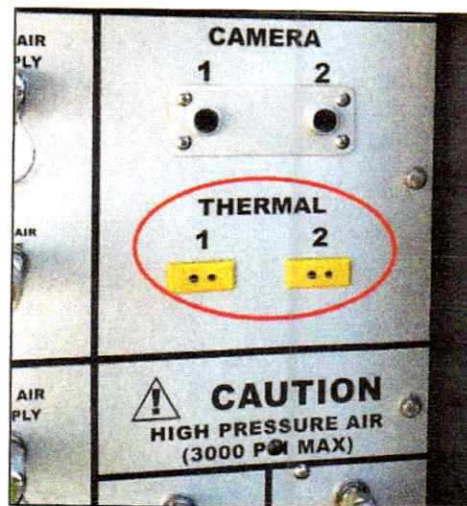
This section describes the user inputs and controls for the Temperature Screen.

This screen displays temperature monitoring outputs for the following:

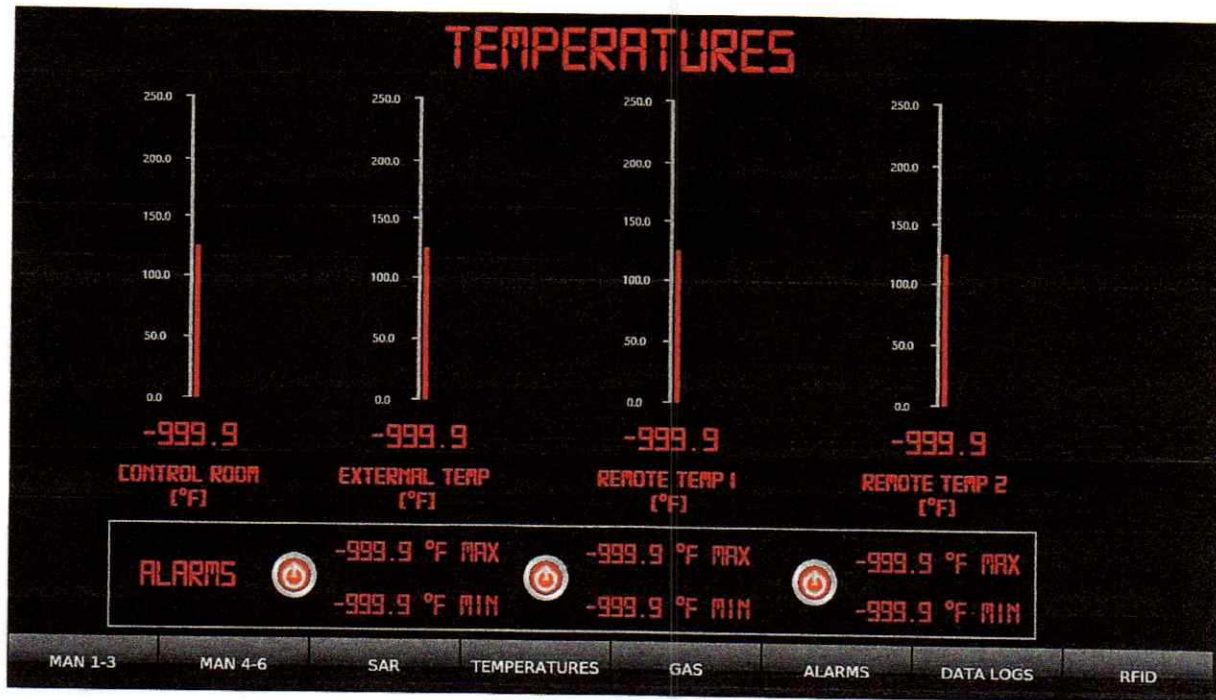
- Control Room: temperature inside the cabinet housing the module electronics)



- External Temperature: temperature outside of the Life Support Unit)
- Remote Temp 1 & 2: temperatures being monitored via the probes connected at the bulkhead panel.



- TEMPERATURES display is shown below:



9.1. This screen displays the following:

- 9.1.1. CONTROL ROOM – Temperature in the control (rear) room
- 9.1.2. EXTERNAL TEMP – Ambient outside temperature
- 9.1.3. REMOTE TEMP 1 – an external thermocouple can be connected and displayed here
- 9.1.4. REMOTE TEMP 2 - an external thermocouple can be connected and displayed here
- 9.1.5. ALARMS
 - 9.1.5.1. Alarms can be enabled and edited by SUPER USER or MANAGER access. To enable the alarms, press the red light next to each alarm range.



- 9.1.5.2. To edit the alarm value, touch the numbers to the left of °MAX or °MIN and enter a new value on the popup keypad.

10. Alarm Screen

This section describes the user inputs and controls for the Alarm Screen.

System alarm severities are categorized as follows:

- Warning:
- Minor:
- Major:
- Critical:

- ALARM display is shown below:

Severity	Alarm ID	Group ID	Name	Status	State	ACK Pending	Action
Warning	1	0	Alarm 1	Disabled	OFF	No	
Minor	2	0	Alarm 2	Enabled	ON	Yes	
Major	3	0	Alarm 3	Disabled	OFF	No	
Critical	4	0	Alarm 4	Disabled	OFF	No	

MAN 1-3 MAN 4-6 SAR TEMPERATURES GAS ALARMS DATA LOGS RFID

10.1. This screen displays the following:

10.1.1. Current Active Alarms

10.1.2. All alarms are logged automatically to the on-board Micro SD card

List of System Alarms		
General Alarms		
Description	Severity	Resolution
Battery Low	Minor	
Surge Device Tripped	Minor	
Battery Fault	Minor	
Breaker Tripped	Minor	
Current > 80%	Minor	
Breathing Alarms		
Primary Air 1 Breathing Alarm	Minor	
Primary Air 2 Breathing Alarm	Minor	
Primary Air 3 Breathing Alarm	Minor	
Primary Air 4 Breathing Alarm	Minor	
Primary Air 5 Breathing Alarm	Minor	
Primary Air 6 Breathing Alarm	Minor	

Pressure Alarms		
Primary Air Out 1 HIGH	Major	
Primary Air Out 2 HIGH	Major	
Primary Air Out 3 HIGH	Major	
Primary Air Out 4 HIGH	Major	
Primary Air Out 5 HIGH	Major	
Primary Air Out 6 HIGH	Major	
Primary Air Out 1 LOW	Major	
Primary Air Out 2 LOW	Major	
Primary Air Out 3 LOW	Major	
Primary Air Out 4 LOW	Major	
Primary Air Out 5 LOW	Major	
Primary Air Out 6 LOW	Major	
Primary Air Supply 1 LOW	CRITICAL	
Primary Air Supply 2 LOW	CRITICAL	
Primary Air Supply 3 LOW	CRITICAL	
Primary Air Supply 4 LOW	CRITICAL	
Primary Air Supply 5 LOW	CRITICAL	
Primary Air Supply 6 LOW	CRITICAL	
Secondary Air Supply LOW	CRITICAL	
SAR Air Supply LOW	CRITICAL	
Button Status Alarm		
User 1 Air Does Not Match	Warning	
User 2 Air Does Not Match	Warning	
User 3 Air Does Not Match	Warning	
User 4 Air Does Not Match	Warning	
User 5 Air Does Not Match	Warning	
User 6 Air Does Not Match	Warning	
Temperature		
Control Room Temp Alarm	Minor	
External Temp Alarm HIGH	Minor	
External Temp Alarm LOW	Minor	
Remote Temp 1 Alarm HIGH	Minor	
Remote Temp 1 Alarm LOW	Minor	
Remote Temp 2 Alarm HIGH	Minor	
Remote Temp 2 Alarm LOW	Minor	



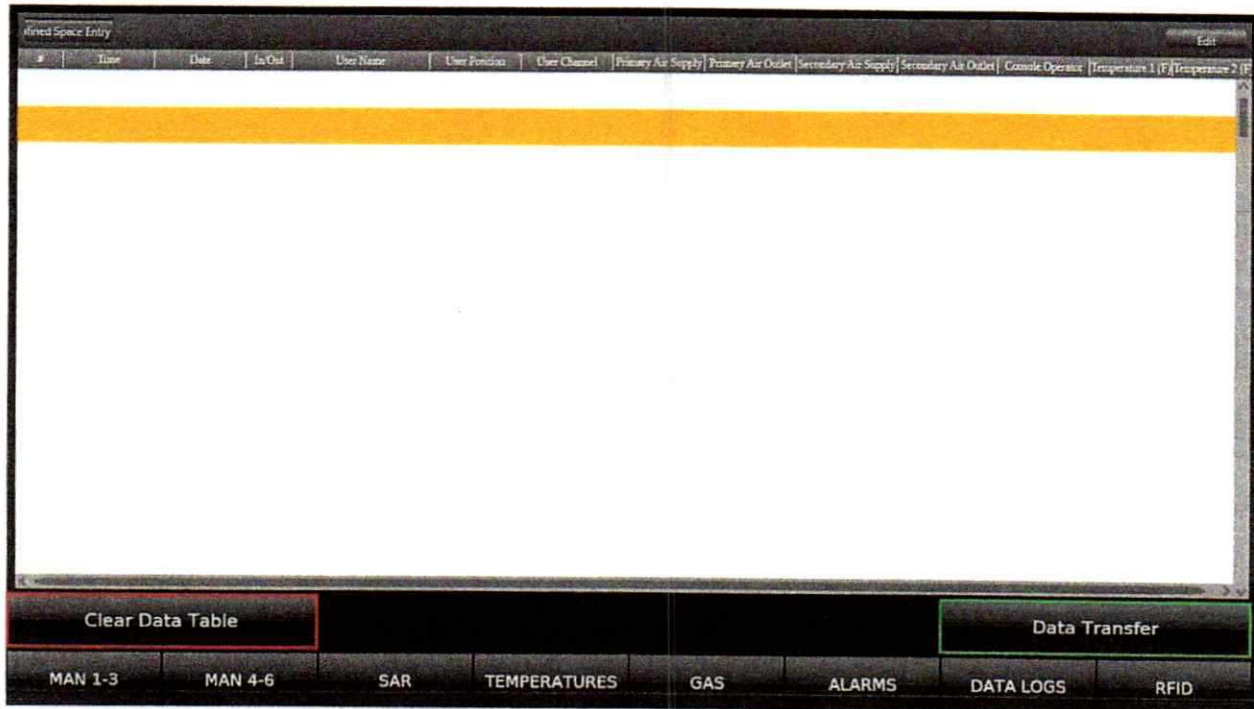
If the air bottle bank pressure drops below 500 psi, the alarms (audible and visual) will activate. The bottle banks shall be immediately replaced.

11. Data Log Screen

The system data logs all functions automatically. The operator does not need to activate any "record" function related to the air monitoring system [Inert Entry, SAR, Temperature and Gas Detection (when available)].

*The video and audio systems are **NOT** directly linked to air monitoring system. The recording features for these systems (if equipped) will need to be manually activated.*

Features/functions that data is recorded:



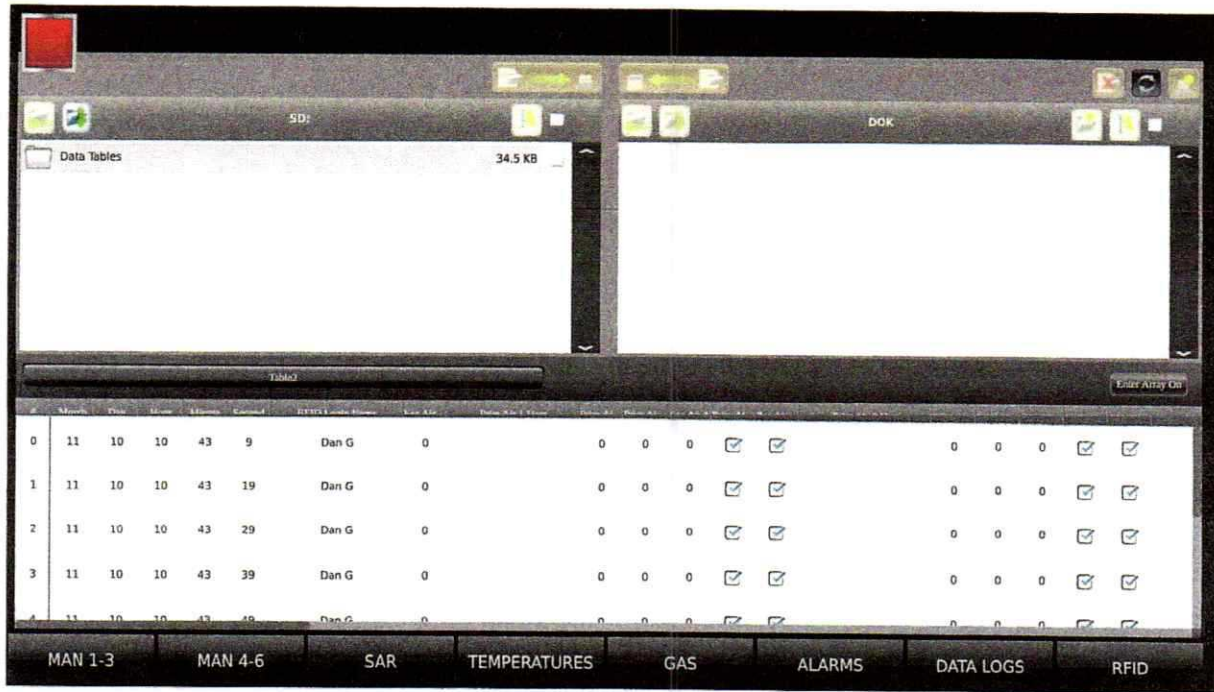
- Excel file format output

Helmet Test Log											
#	User Name	Helmet S/N	Time	Date	Primary Pass	Secondary Pass	Breathing Pass	Breathing Min	Breathing Max	Prim Test Flow Max	Sec Test Flow Max
0					0	0	0	0	0	0	0
1	AB	--	9:58:51	12/12/2018	1	1	0	1.6	1.4	140	235
2	CD	--	10:23:12	12/12/2018	1	1	0	1.7	2.5	145	236
3	EF	--	10:35:23	12/12/2018	1	1	0	2	2.1	147	231
4	GH	--	10:48:49	12/12/2018	1	1	0	2.2	2.8	136	231
5	IJ	--	10:49:49	12/12/2018	1	1	0	2.3	2.8	144	239
6	KL	--	10:53:44	12/12/2018	1	1	0	2.5	2.9	145	233
7	MN	--	10:59:55	12/12/2018	1	1	0	2.5	2.1	144	236
8	OP	--	11:06:46	12/12/2018	1	1	0	2.6	3.2	144	234
9	QR	--	11:08:43	12/12/2018	1	1	0	2.6	3.2	146	236
10	ST	--	11:39:55	12/12/2018	1	1	0	2.6	3.3	141	238
11	UV	--	11:48:25	12/12/2018	1	1	0	2.6	3.6	149	239
12	WX	--	11:49:50	12/12/2018	1	1	0	2.7	3.4	143	244
13	YZ	--	12:00:15	12/12/2018	1	1	0	2.6	3.3	143	232

"0" = NO

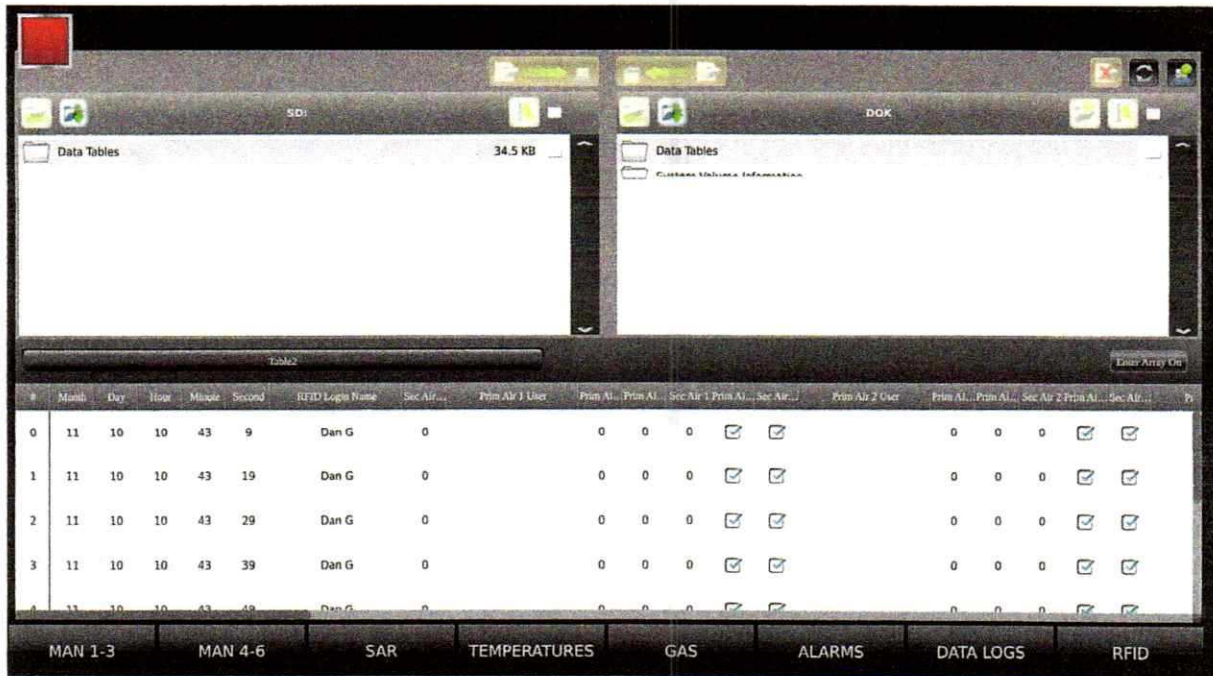
"1" = YES

- TEMPERATURES display is shown below:

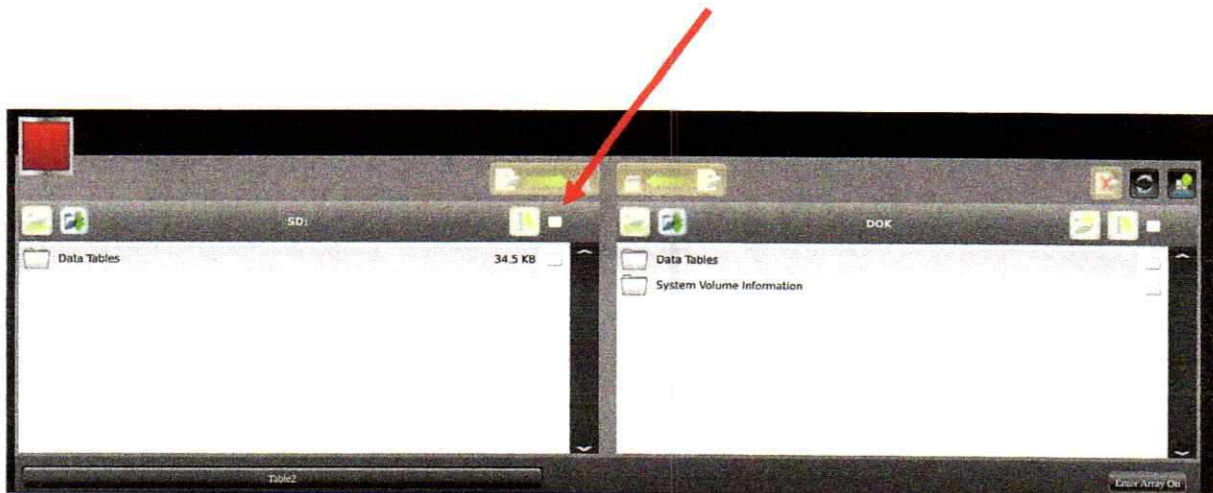


- 11.1. This screen displays the following:
- 11.1.1. TOP LEFT – Files located on the on-board Micro SD card
 - 11.1.2. TOP RIGHT – Files located on the user supplied USB memory stick (must be installed into the USB port located between the two lower HMI's.
 - 11.1.3. BOTTOM – This displays all data logged to the Micro SD card, a new line is added every 10 seconds of all data, status, names, alarms, etc.

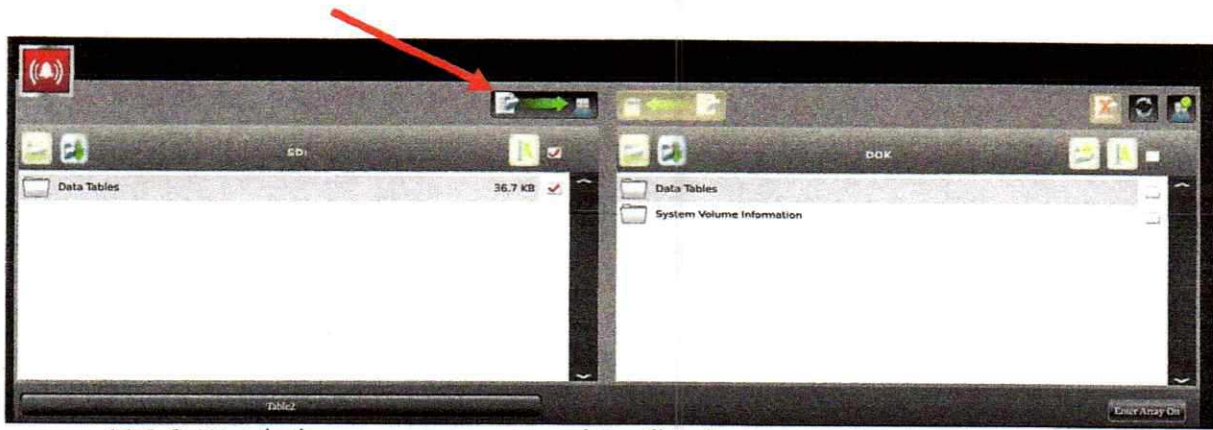
- 11.2. To transfer data from the onboard Micro SD card to the USB Memory Stick, perform the following
- 11.2.1. Insert a USB memory stick in the port located between the two lower HMI displays.
 - 11.2.2. Scan an RFID Card with SUPER USER or MANAGER access.
 - 11.2.3. Touch the DATA LOG screen button on the Main HMI display.



- 11.2.4. In the TOP LEFT display, the DATA TABLES file folder is displayed.
- 11.2.5. In the TOP RIGHT display, the files on the USB Memory Stick are displayed
- 11.2.6. Press the Select Files button here:



- 11.2.7. This selects the files to be transferred.



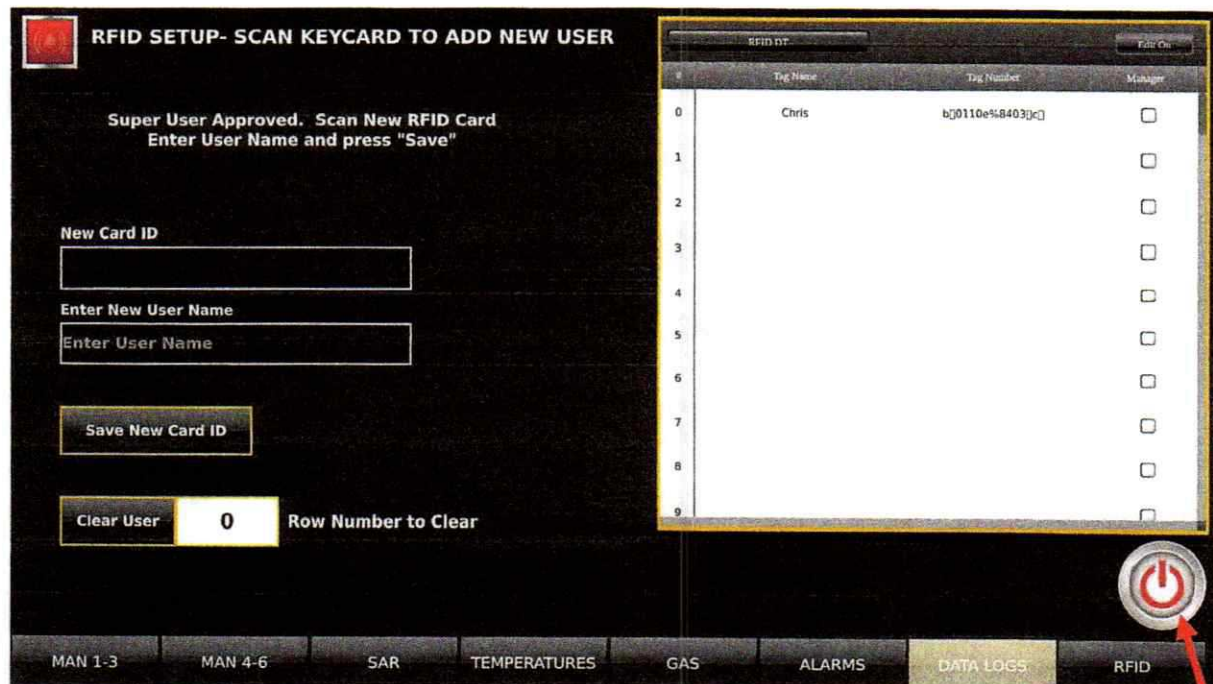
11.2.9. Watch the screen prompts and it will indicate once the data has been transferred to the USB Memory Stick. Remove the USB Memory Stick and the data can now be imported to most spreadsheet applications.

13. Shutdown sequence

This section describes the proper sequence of operations to safely shut down the PLC system.

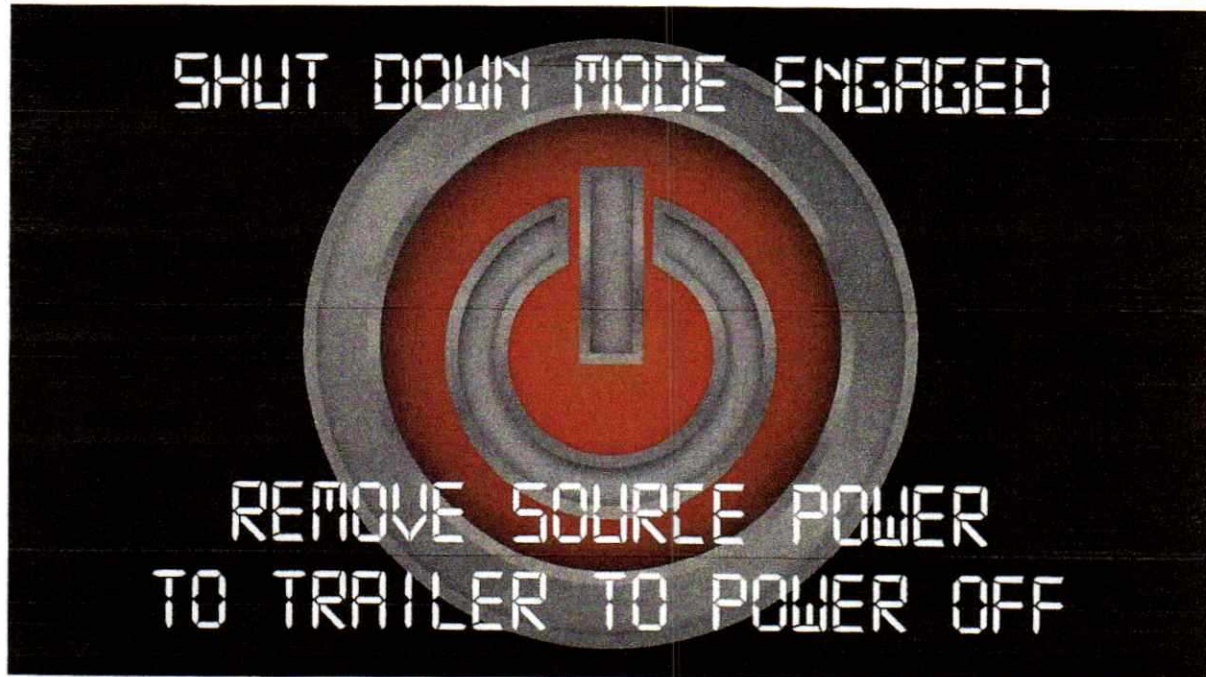
11. SHUT DOWN SEQUENCE

- 13.1. Ensure all users are not actively operating with supplied air
- 13.2. Badge in using any valid RFID card
- 13.3. Turn off all air supply including
 - 13.3.1. Primary Air Supply bottle
 - 13.3.2. Secondary Air Supply bottle
 - 13.3.3. SAR Supply bottle
- 13.4. Bleed any trapped air from the primary, secondary and SAR air lines by cycling air to a properly connected helmet.
- 13.5. Turn off all air supplies to Users 1-6 and SAR Users 1-6 using one of the PLC HMI screens.
- 13.6. Now the SUPER USER RFID BADGE must be scanned.
- 13.7. Touch the RFID screen on the Primary Display.



- 13.8. In the Bottom Right corner of the RFID Screen, a grey and red power button will be displayed, this is the SHUTDOWN button.

- 13.9. Touch the SHUTDOWN Button
- 13.10. A secondary screen will display, asking to confirm the shutdown process.
- 13.11. Press "OK"
- 13.12. The following screen will now be displayed. ALL AIR CONTROL FUNCTIONS ARE DISABLED.



- 13.13. UNPLUG THE POWER CORD TO THE TRAILER.
 - 13.13.1. This action will turn off all power to the PLC's. The screen will go dark.
 - 13.13.2. All control to air valves is inoperable.
- 13.14. To restart the system, simply plug in the Trailer power cable.

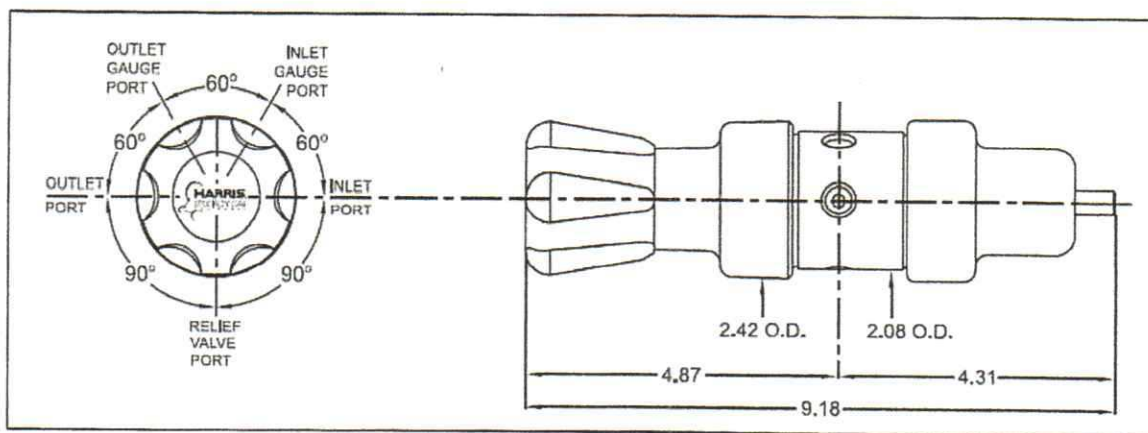
14. Appendix

- 14.1. Recommended Spare Part:
- 14.2. Harris Calorific High Pressure Regulator Introduction
- 14.3. Umbilical Air Supply Substance Resistance List

• Recommended Spare Parts:

Part Number	Description	Qty	U/M
3200B30CPS02E000-CAB	3200 SERIES PRESSURE TRANSDUCER (0-3000psi)	1	ea
3200B300PG02E000-CAB	3200 SERIES PRESSURE TRANSDUCER (0-300psi)	1	ea
BL203-01-LB-1-XX-H-B-X-G-PB-N-4	BL-LATCHING VALVE (24VDC)	1	ea
2903151	MODULE POWER SUPPLY UNIT	1	ea
2320238	UNINTERRUPTIBLE POWER SUPPLY	1	ea
400-084-PM	HARRIS 2-STAGE REGULATOR	1	ea

• Harris Calorific High Pressure Regulator Introduction



This section is adapted from Harris Calorific product information.

Introduction

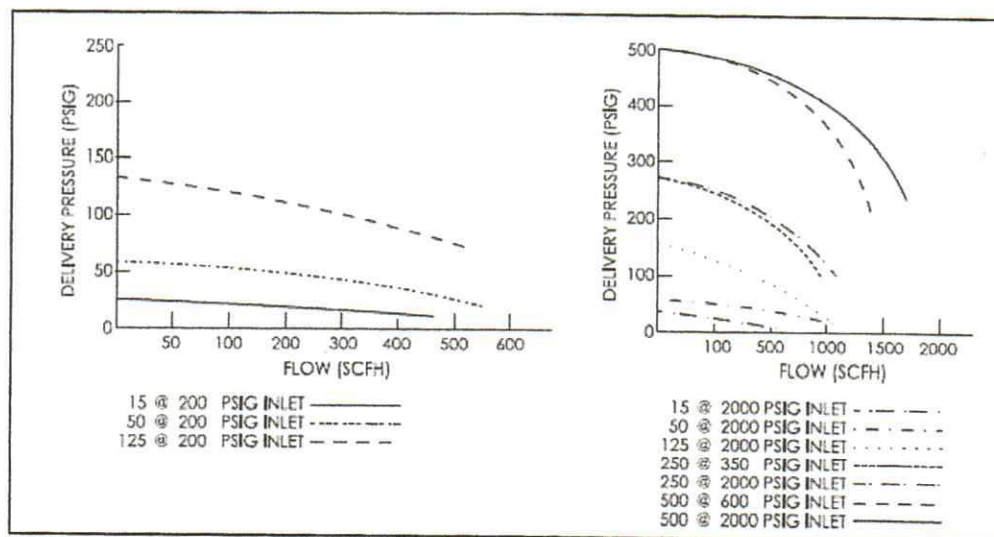
The Harris Calorific high pressure regulator is a chrome plated brass two stage cylinder regulator with a stainless steel diaphragm. The two stage regulator is two regulators in a series using a common body. The first stage (high pressure) reduces the inlet pressure approximately 90% and is preset at the factory. The second stage (low pressure) is adjustable to the desired delivery pressure and is set at the module manufacturing facility. The two stage design provides constant delivery pressure from a full to near empty cylinder. The diaphragm eliminates contamination from diffusion or out gassing. The one-piece encapsulated seat design protects the seat from particulate contamination. The relief valve vents at pressures over 500 psi and is mounted externally making replacement, when needed, easy.

Specifications

Performance Data:

Maximum Inlet Pressure	500 psi	34.47 bar	3.44 MPa
Maximum Outlet Pressure	125 psi	8.62 bar	0.86 MPa
Inlet / outlet ports	1/4" FNPT		
Gauge ports	1/4" FNPT		

Flow Rates:



Body

Chrome Plated Forged Brass

Bonnets	Chrome Plated Die Cast
Diaphragms	302 Stainless Steel
Nozzles	Brass
Seat	PTFE Teflon
Seals	PTFE Teflon
Filter	Nickel Plated Sintered Bronze - 10 Micron
Seat Return Spring	PH-17 Stainless Steel

Operation

The two stage regulator is two regulators in a series using a common body. High pressure air enters through the 1/4"NPT inlet port and goes into the first stage of the regulator where it is reduced by approximately 90%. The air then goes into the second stage of the regulator where it is reduced further. The outlet pressure is set to 125 psi.

Clockwise rotation of the adjusting knob (or key) increases the delivery pressure. Counter-clockwise rotation decreases the delivery pressure. The regulator inlet connections are designed for the gas to be used in accordance with CGA Standard V-11.

If the regulator malfunctions, the following steps must be taken:

1. Close the defective line's main supply valve on High pressure supply bottle banks.
2. Abort all activities and replace or repair the regulator. See 6.2.3 maintenance and repair.

Safety Instructions

- Handle cylinders with care. Chain or otherwise secure cylinders to a permanent fixture. Take care when moving. To transport cylinders (except when in cylinder carts), remove regulators and manifolds and replace with valve cap. Never use any cylinder in other than an upright position.
- Use "good housekeeping" in work areas. Keep sparks and flame away from combustibles. Prepare your work area before beginning work. Keep your equipment free of oils, greases, and flammable materials.
- Do not oil or grease equipment. The equipment does not require lubrication. Oil or grease is easily ignited and burns violently with oxygen.
- "Crack" cylinder valve before installing regulators or manifold. Open valve slightly and then close. This will clear valve of dust or dirt which may be carried to hoses and regulators and cause damage or accident. Do not discharge flow of gas at any person or flammable material.
- Be sure all connections are tight. Don't force connections. Never test for leaks with a flame. Use a soapy water solution to check for leaks.
- Use recommended pressure settings. Improper pressures are wasteful. Extreme pressure build-up in regulators is a warning they need repair.
- Do not work with damaged or leaking equipment. Use soapy water when checking for leaks. Do not use frayed or damaged hose.

- Handle equipment with care. Its continued good service and your safety depend upon it.

Maintenance and Repair:

Normally the Harris high pressure regulator will operate without problems in even the roughest conditions. We would however like to add some instructions for testing and replacement or small repairs and maintenance in the field.

These procedures should only be followed by persons with experience in operation and repair of pressure regulators.

- When not in use, store regulators in a clean and safe place
- Inspect and test at least every 6 months after first use
- Have only qualified repairmen service, test and clean regulators
- Use thread sealants that are compatible with the gas being used.

Functional Test of the Regulator:

An internal leak may be detected as follows:

1. Close the regulator by turning the adjusting key counterclockwise.
2. Close cylinder valve.
3. Drain downstream line.
4. The low pressure gauge will indicate zero. The cylinder (high pressure) gauge will read full pressure. Any pressure drop will indicate leakage. Repair before use, or replace with a properly functioning unit.
5. A gauge should read zero when all the pressure is removed. If it does not, it may be damaged. Locate and correct the cause of the damage and replace the gauge

Connection leak test of regulator:

To test for gas leakage, use a soapy water solution at all connections and check for bubbles. Tighten connections as required and wipe off the soap solution.

• **Umbilical Air Supply Substance Resistance List**

Corrosive attack abbreviation key:

- A. Resistant: Good for continuous exposure
- B. Partially resistant: Good for intermittent exposure
- X. Not resistant: DO NOT USE
- N. No Data Available

Liquid Substance	Corrosive Attack		Notes
	Outer Jacket	Supply Hoses	
ASTM Fuel A	B	B	
ASTM Fuel B	X	X	
ASTM Fuel C	X	X	
ASTM Oil No. 1	B	B	
ASTM Oil No. 2	N	B	
ASTM Oil No. 3	N	B	
Acetate solvents	N	N	
Acetic Acid (Glacial)	N	B	
Acetic Acid	A	B	40%, 10%
Acetone	N	X	
Acrytonitrite	A	N	
Air	A	A	
Hot Air	A	A	
Alcohol	N	N	
Aluminum Chloride	N	B	
Aluminum Sulfide	N	N	
Ammonia	N	B	
Ammonia (dry gas)	N	B	
Ammonium Chloride	N	B	
Ammonium Hydroxide	N	N	
Aniline	A	X	
Antifreeze Compounds	A	N	50/50 Mixture
Barium Chloride	N	N	
Barium Sulfide	N	N	
Benzene	X	X	
Benzyl	N	X	
Bitumen	N	N	
Boric Acid	N	A	
Brake Fluid	A	N	
Brake Fluid A	N	X	
Bromine	X	N	
Bromobenzene	X	N	
Butane	N	B	
Butyl Acetate	A	X	
Butyl Alcohol	N	X	
Calcium Chloride	A	B	20%, 10%
Carbon Tetrachloride	N	X	
Carbonic Acid	N	N	

Caustic Soda	N	A	
Chlorine	N	X	
Chlorine (Water Solution)	N	B	40% water mixture
Chlorobenzene	N	X	
Chloroform	N	X	
Chromic Acid	N	X	40%
Cyclohexane	X	X	
Detergents (dish washing)	A	N	
Diesel Fuel	N	B	
Diethyl Ether	A	N	
Dimethyl Formamide	A	N	
Dioctyl Phthalate (DOP)	A	A	
Dioxane	A	N	
Ether	N	X	
Ethyl Acetate	N	X	
Ethyl Alcohol (Ethanol)	A	X	
Ethylene Chloride	N	B	
Ethylene Glycol	N	B	50%
Ferric Chloride	N	B	
Formic Acid	N	X	85%, 40%, 10%
Freon	X	X	
Freon12	N	X	
Gasoline - 100 Octane	N	X	
Glycerine	A	A	
Glycol	N	A	
Heptane	N	B	
Hexane	B	B	
Hydrochloric Acid	A	N	10%, 1%
Hydrogen Chloride	N	B	
Hydrogen Peroxide	N	A	
Hydraulic fluid	N	B	
Iodine Solution	N	X	
Isopropyl Alcohol	N	X	
Kerosene	N	B	
Lactic Acid	N	X	90%, 50%, 5%
Lead Acetate	N	N	
Magnesium Chloride	N	B	
Methanol	N	X	
Methyl Acetate	N	X	
Methyl Alcohol	N	N	
Methyl Bromide	N	N	

Methylene Chloride	N	X	
Methyl Ethyl Ketone	A	X	
Methyl Glycol	N	X	
Mineral oil	N	B	
Motor Oil 20W	N	B	
Naptha	N	A	
Natural gas	N	N	
Nitric acid	N	X	70%, 35%, 10%
Nitrobenzene	A	N	
Oxalic acid	N	N	
Oxygen	N	N	
Paraffin Oil	N	B	
Perchloroethylene	N	X	
Petroleum	N	B	
Phosphoric Acid	N	X	85%, 50%, 10%
Potassium Chloride	N	B	40%
Potassium Hydroxide	N	B	50%
Potassium Hydroxide	A	B	10%
Potassium Permanganate	N	X	5%
Propanol	A	N	
Propyl Alcohol	N	N	
Pydraul	N	N	
Pydraul Oil	B	N	
Pyridine	A	X	
Sea Water	A	A	
Skydrol Oil - Type B	A	X	
Sodium Chloride	A	B	15%
Sodium Hydroxide	N	X	
Sodium Hydroxide	A	X	50%
Sodium Hydroxide	A	B	10%
Sodium Hypochlorite	N	A	PH 13
Sulfuric Acid	A	X	75%, 40%, 25%
Sulfuric Acid	A	B	10%
Tetra Hydro Furan	N	X	
Tetrachloroethylene	N	X	
Toluene	N	X	
Transmission Oil	X	N	
Trichlorethylene	X	X	
Tricresyl Phosphate (Skydrol)	N	X	
Water (cold)	A	X	

Xylene	X	X	
Zinc Chloride	A	N	
Zinc Sulfate	N	N	

Revision History				
Rev	Date	Description	Page	Approval
120418-01-draft	12/4/18	Draft manual	-	-
061818-01 draft	06/18/19	Add self-diagnostics test info		
A	03/18/2020	Document Release	-	PCL