

Lube Oil Dispensing Checklist

Warning

Quick start guides should only be used once you are trained and familiar with operational procedures. Refer to *Section 4: Operations* of the operations manual for complete instructions.

- Reset meter to oil amount required.
- Turn on pump.
- Pull out hose and insert nozzle into engine oil port.
- Squeeze handle until meter is zero.
- Allow hose reel to rewind, then turn off pump.



Lube oil meter



Lube oil control



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Milne Port Jet A Operations MANUAL

2014 VERSION A

MILNE PORT JET A OPERATIONS MANUAL - Version A

Issue Date: January 2014

PLEASE READ BEFORE USING.

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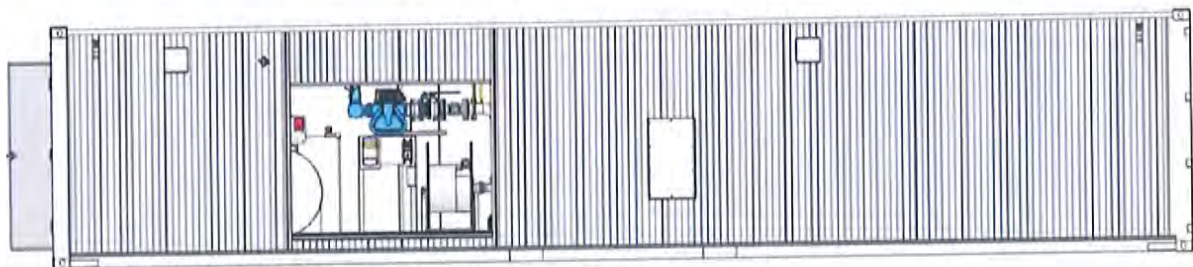
Section 1: Introduction

Milne Port Jet A Dispensing System

Overview

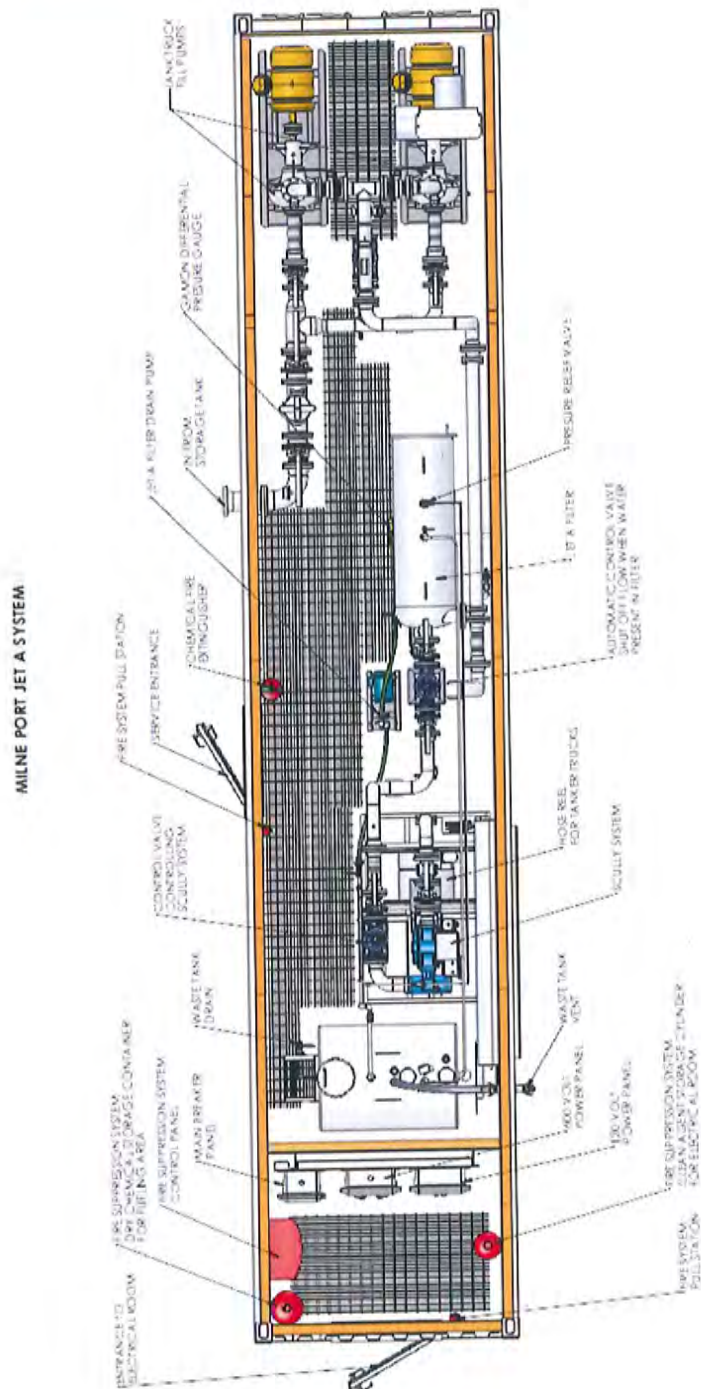
SEI Industries has provided three modules to Baffinland Iron Mines — one diesel and one Jet A system at Milne Port and a diesel system at the Mine Site. An operations manual has been supplied for each module as well as a separate maintenance manual. The maintenance manual provides details on all of the components used to create the systems as well as parts lists.

This specific manual is the operations manual for Milne Port Jet A. It includes instructions on the operation, lubrication and inspection of the Jet A dispensing fueling module. A list of all fueling module components is also included. A layout of this module, identifying all the major components, can be found on the inside of the module near the side man-door and on page 2 of this manual.



Milne Port Jet A Dispensing System

Milne Port Jet A Layout



Section 2: Safety

General Safety Procedures

Ensure work site safety by observing the following suggestions:

- Ensure you are aware of all safety and emergency information in this manual and all safety and emergency procedures regulations, procedures and guidelines provided at the work site.
- Obey "no smoking" signs.
- Familiarize yourself with the emergency stop switch locations.
- Ensure that an appropriate communications structure is in place before deployment to minimize confusion in an emergency.
- Anticipate emergencies before they happen and prepare a mini-response plan.
- Know the exact location of all fire extinguishers available at the site and how to summon emergency fire and medical assistance.
- Keep this manual and all enclosed manufacturer documentation readily available at the site for reference.

Caution

Do not operate any part of the system unless you have received training deemed appropriate by both SEI Industries and your employer. In particular, you must fully understand all general safety precautions with respect to refueling operations and the handling of flammable materials,

Pump Safety Procedures

Fire Procedure

If a fire occurs:

1. Press an emergency stop switch, cutting all power in the unit.
2. If the automatic fire suppression system (which has a battery backup allowing it to operate when the power supply is cut), fails to activate then a manual fire alarm must be pulled. To activate, lift the alarm door and pull the ring down. One alarm is located on the outside of the container. The other alarm stations are inside the module; one just inside the service entrance and the other just inside the electrical room door (see layout on page 2).
3. If needed, a manual fire extinguisher can be found just inside the service entrance door. Refer to the layout found in this manual if you are unfamiliar with the system.
4. Any vehicle or tanker truck should be removed from the immediate area.
5. Ensure that assistance has been requested from the site supervisor and/or the local fire emergency team.



To activate, lift the alarm station door and pull the ring down.

Fuel Fire Emergencies**Warning**

In the event of a fuel fire or spill, immediately stop all fill/discharge operations. Immediately press an emergency stop switch.

Warning

If a fuel spill from the fuel system occurs, as the result of mishandling of the equipment or a component failure, then it is likely that, without emergency assistance, you do not have the resources necessary to contain the spill. If the spilled fuel from the fueling system ignites, then clear the area immediately as you do not have the resources to control such a fire alone.

Baffinland Iron Mines is responsible for creating a training program that guides the user through adequate safety procedures in the event of a fuel fire.

The following items are essential elements of such procedures:

1. IMMEDIATELY STOP ALL FILL/DISCHARGE OPERATIONS.
2. Locate a fire extinguisher and extinguish any fires outside the fueling modules.
3. Clear the area of all non-essential personnel and request emergency response teams.
4. If possible, use the valves feeding the fuel system to shut off the flow, both upstream and downstream of the fire zone.
5. Await emergency response teams.

Warning

If an emergency stop switch has been pressed, it will stop all systems using electricity. If the system will not start up again, check all emergency stop switches and pull out the switch that was activated.

Fuel Spill Emergencies**Warning**

In the event of a fuel fire or spill, immediately stop all fill/discharge operations. Immediately press an emergency stop switch.

Warning

If a fuel spill from the fuel system occurs, as the result of mishandling of the equipment or a component failure, then it is likely that, without emergency assistance, you do not have the resources necessary to contain the spill. If the spilled fuel from the fueling system ignites, then clear the area immediately as you do not have the resources to control such a fire alone.

Baffinland Iron Mines is responsible for creating a training program that guides the user through adequate safety and clean-up procedures in the event of a fuel spill.

The following items are essential elements of such procedures:

1. IMMEDIATELY STOP ALL FILL/DISCHARGE OPERATIONS. IMMEDIATELY PRESS AN EMERGENCY STOP SWITCH.
2. SHUT DOWN OR REMOVE all potential ignition sources near the fuel spill and locate a fire extinguisher.
3. Clear the area of all non-essential personnel and request emergency response teams.
4. If ignition of the fuel spill is imminent, or if fuel vapour makes respiration difficult, evacuate every person from the area and await emergency response teams.
5. If possible, identify the source of the leak.
6. IMMEDIATELY SHUT OFF THE VALVE SUPPLYING THE REFUELING SYSTEM MODULE WITH FUEL.
7. If possible, use the ball valves inside the fuel system to shut off the flow both upstream and downstream of the fire zone.
8. Await emergency response teams.
9. Prepare for clean-up operations.

Section 3: Quick Start Guides

Warning

Quick start guides should only be used once you are trained and completely familiar with operational procedures. Please refer to *Section 4: Operations* of this manual.

Tanker Truck Filling Checklist

1. Check the electrical room to make sure all breakers are on.
2. Turn on lights, if not already on.
3. If lights will not come on, check emergency stop switches. Pull out any that are pushed in.
4. Plug in Scully control system cord. If tanker truck not equipped with Scully system, deactivate system with key and attach grounding reel.
5. Zero fuel meter.
6. Release hose reel clutch by pulling black knob out.
7. Start pump.
8. When full, turn off pump.
9. Engage hose reel clutch by pushing black knob in.
10. Retract the hose reel by pushing the rewind button and holding the button until rewound.
11. Zero fuel meter.



Tanker truck fuel meter

Warning

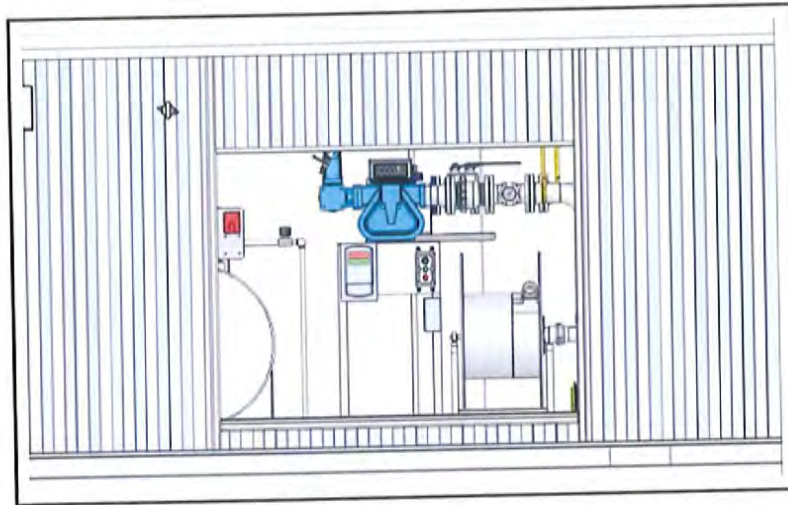
Filling Empty Tanks

The API RP 2003 recommends limiting the initial velocity to 1m/s (500 LPM) until the tanker truck inlet is submerged by two inlet pipe diameters. After that, the flow can increase up to 3m/s (1500 LPM). A gate valve on the truck will control the flow or the ball valve near the hose reel can be also used.

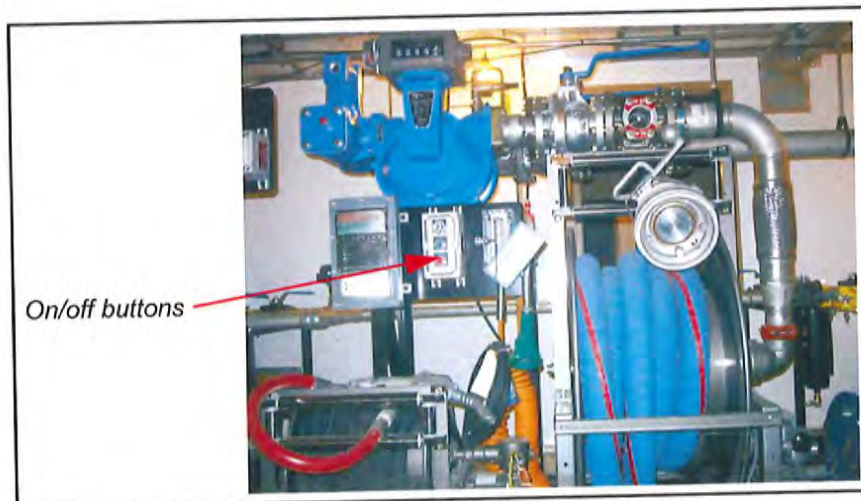
Section 4: Operations

Tanker Truck Filling

1. Locate the refueling side of the container.
2. Open the right-hand refueling door and locate emergency stop switch.



3. The large hose reel with a 3" hose and a bottom loading coupler is for filling tankers.

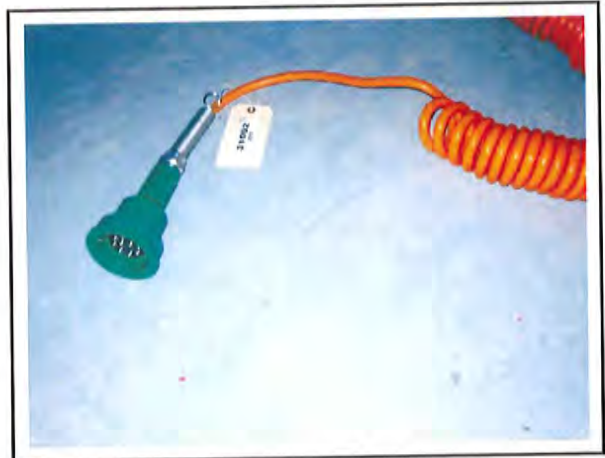


4. Reset fuel meter to zero, if required.

Tanker truck fuel meter



5. Connect the Scully system cord to the tanker truck.

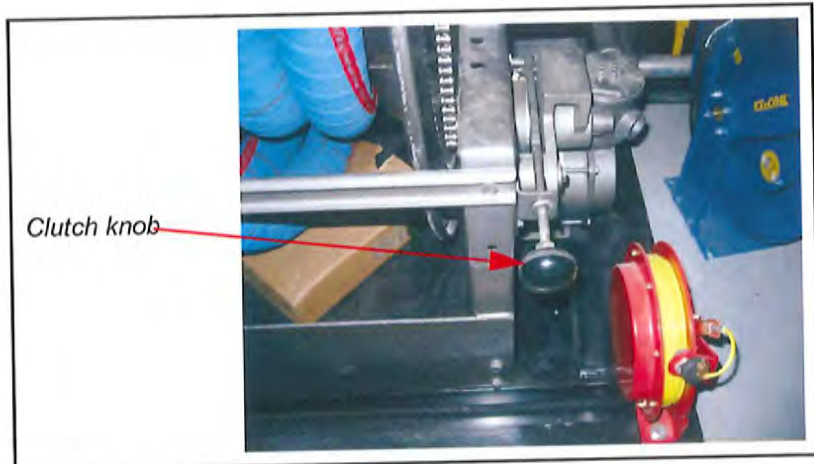


6. If the truck is not equipped with a receptacle for the Scully cord, please refer to the bypass instructions at the end of these steps.

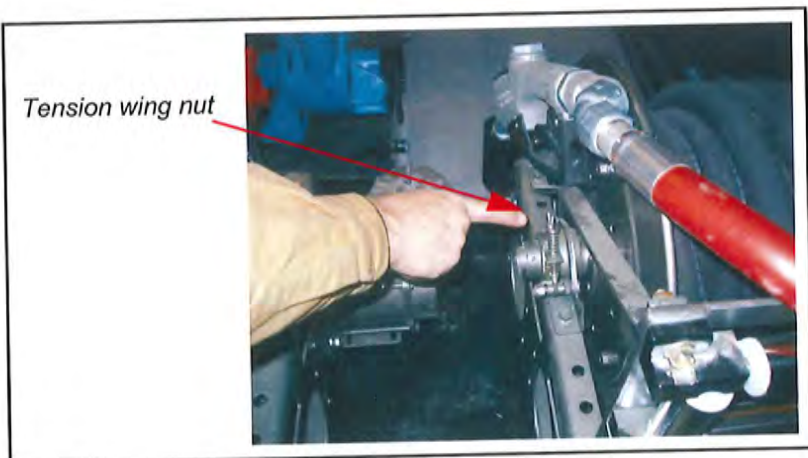
7. A green light should appear on the Scully panel.



8. To manually unwind the hose reel, pull the large black knob out to release the clutch.



9. Pull the supply hose out, carrying the dry break to keep it clean. Tension can be changed by adjusting the wing nut.



10. Connect the bottom loading coupler to the tanker truck.



11. The system's deadman switch must be held in the "on" position to activate the flow.

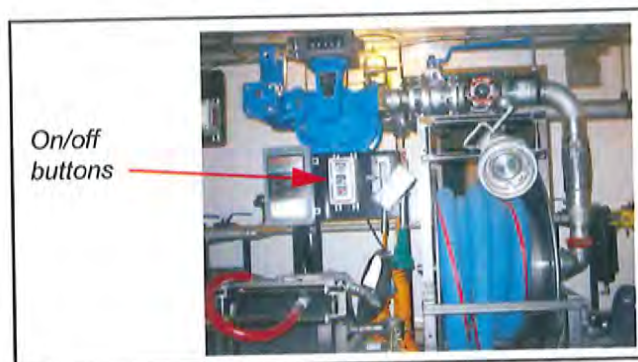


Warning

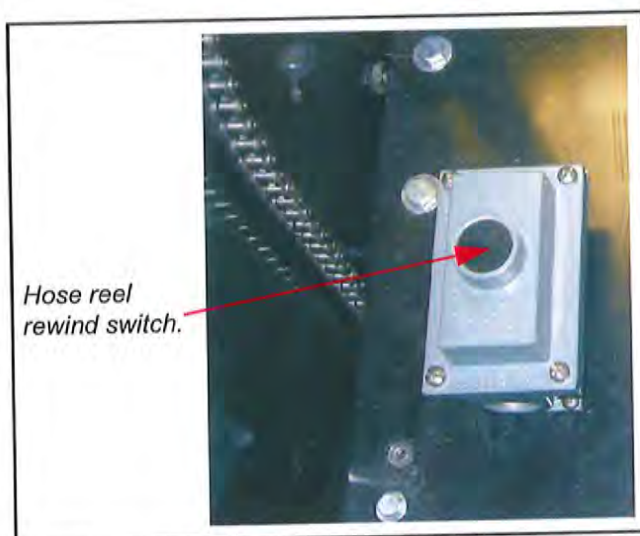
Filling Empty Tanks

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12. Start pump.



13. When the tanker truck has been filled or the Scully System has shut off the flow, turn off pump. Next, disconnect the dry break coupler from the tanker truck and push in the black knob on the hose reel. Activate the push button to rewind the hose, carrying the dry break back to the hose reel to keep it clean. The mount on top of the hose reel will hold the coupler in place. The rewind motor will continue to run while the button is being pushed.



14. Reset the meter to zero.

15. Disconnect the Scully system and place its cord back into the system module.

16. Close the refueling door.

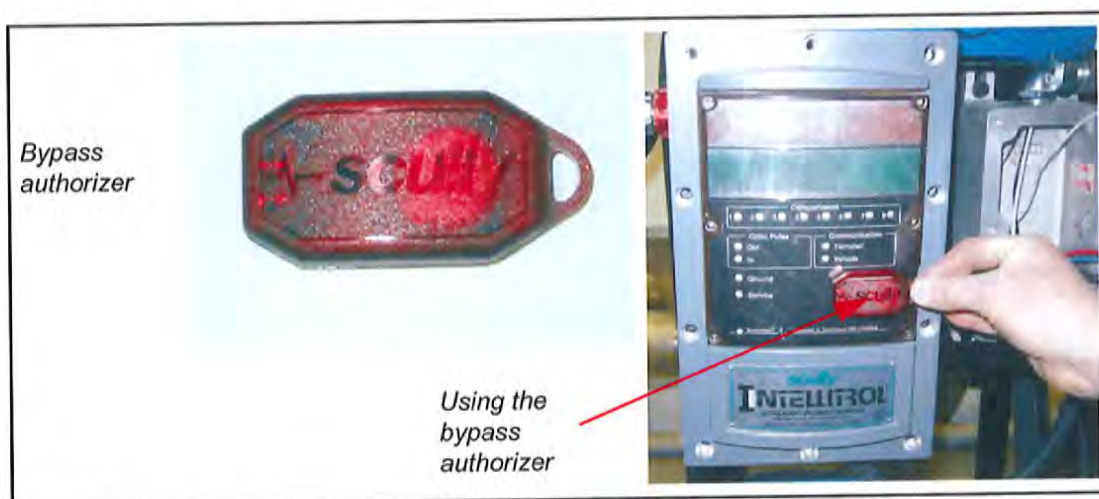
Important Note

If no fuel is dispensed for a period of five minutes, the dispensing pump will shut down. To reactivate the pump, press the pumping start button again.

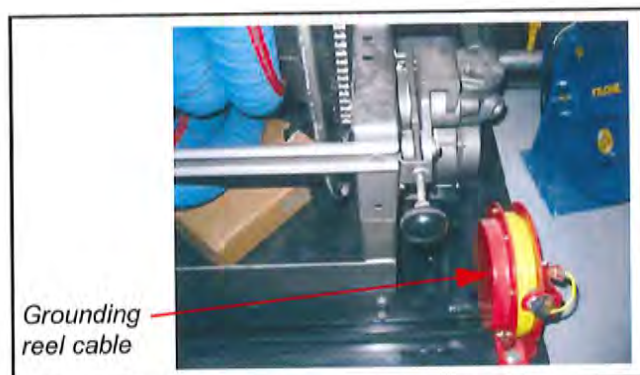
Scully Bypass Authorization Instructions

If the Scully system is not operational or if the tanker truck system is not working, the system can be bypassed.

1. Locate the bypass authorizer.
2. Place bypass authorizer with Scully logo facing out.
3. After 10 seconds, the Scully system will accept the bypass request



4. Attach the grounding reel clip to tank truck.
5. Keep in mind that the load sensors will not be functioning properly.
6. Connect dry break coupler and start pump, then activate deadman switch.
7. To eliminate overfilling of the tanker, monitor the level in tank with a dipstick or visually check the level.
8. Stop pumping before the tanker is overfilled by releasing the deadman switch.



All other tanker filling operations remain the same.

Air Heating Systems

Caution

The electrical room must never be allowed to freeze as this may cause the fire suppression system to fail.

The fueling modules contain heaters designed for hazardous locations. Each module has two heaters. The electrical room has a 120 volt heater (part number 010075, model XB2-4200T2D11T). The refueling area has a 600 volt heater (part number 010095, model FX5-SD-600360-200T). All heaters are controlled by a thermostat which is set at the time the units are commissioned. To change the temperature, adjust the thermostat.



Fueling area heater



Fueling area thermostat



Electrical room heaters

The Milne Port maintenance manual provides comprehensive information and instructions for each unit covering maintenance, troubleshooting, service and parts lists.

Fire Suppression System

The fire suppression system is made up of two sections — one in the electrical room and the other in the fuel dispensing area. Fire suppression chemical is stored in the electrical room.

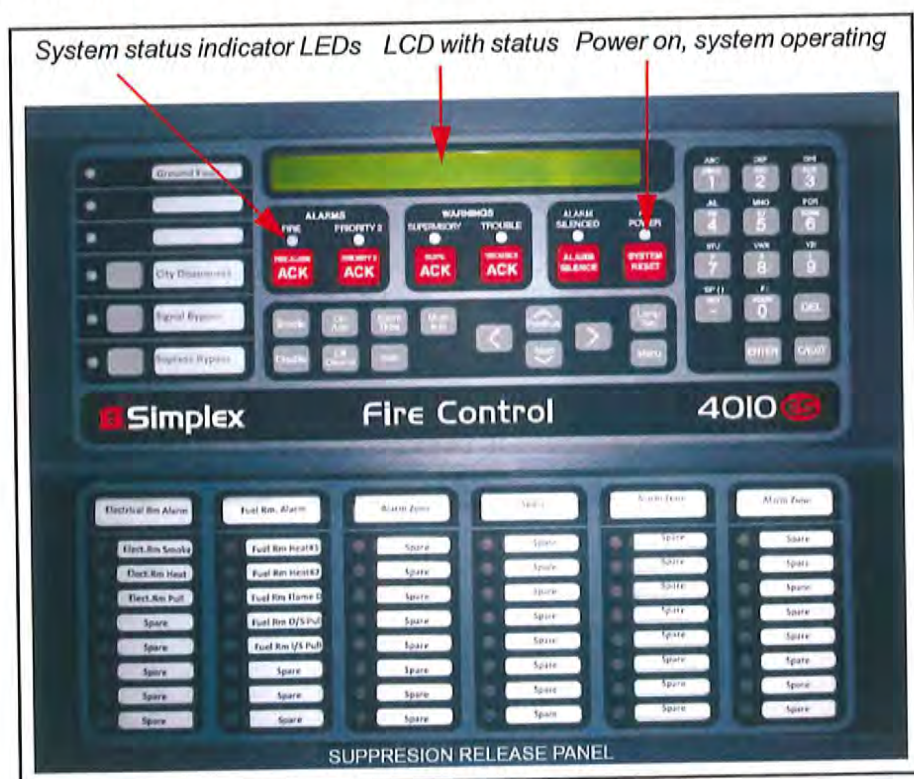
The system is triggered by smoke, heat, flame detectors or by manual pull stations located by the two service doors or between the fueling doors.

The system should be serviced annually and verification should be conducted by a qualified technician.

For service technician use only.



Fire Status Conditions



Normal Condition: Green power LED is on, indicating the panel is receiving AC power. All other LEDs off, display reports system is normal.

Alarm Condition: Red LED labelled FIRE ALARM flashes. Tone alert (buzzer) on panel sounds. The alarm strobe mounted on the outside of the unit will flash as well. The display reports FIRE.

Acknowledging an Alarm: Press the FIRE ALARM ACK button on the keypad. The red LED should change from flashing to steady on.

Silencing the Alarm: Press the ALARM SILENCE ACK button on keypad. The alarm silenced LED should turn on and the display will show ALARM SILENCE IN PROGRESS.

Resetting the System: Press the SYSTEM RESET button on the keypad. The display will show SYSTEM RESET IN PROGRESS. If all devices reset, the alarm LEDs will flash. Press the FIRE ALARM ACK or the PRIORITY 2 ACK button, or both, on the keypad and display should show SYSTEM IS NORMAL.

If the device remains in alarm and fails to reset, the display will show ALARM PRESET, SYSTEMS RESET ABORTED. This will require resetting the individual pull station or sensor, disabling the device or a hardware reset.

Trouble Conditions: The yellow LED labelled TROUBLE flashes, the tone will sound and the display will show TROUBLE. To acknowledge the trouble, press the TROUBLE ACK button located just below the Trouble LED. The device identified on the display must be checked and/or serviced.

Supervisory Conditions: The yellow LED labelled SUPERVISORY flashes, the tone will sound and the display will show SUPERVISORY. To acknowledge the trouble, press the SUPV ACK button located just below the LED. Read the display and investigate the problem to determine the cause.

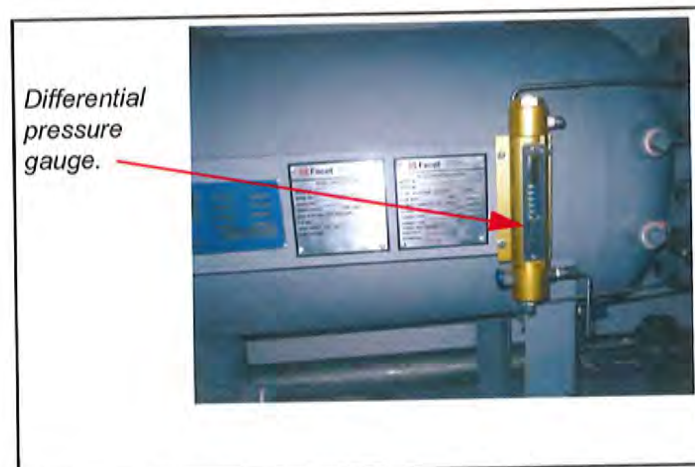
Filtration

Filtration is provided by a horizontal filter separator per API Group II Class B.

1. Drain water from the filter sump daily.



2. Check differential pressure gauge daily when system is pumping. If the pressure exceeds 15 PSI, the cartridges must be changed.



Bottom Loading Coupler

The bottom loading coupler is used along with the Scully system to prevent over filling. It connects to a standard API bottom loading adapter. Dual interlocks ensure that the bottom loading coupler cannot be opened unless it is properly connected to an API adaptor.



Scully System

Scully's electronic tanker truck system provides self-checking overfill protection as well as grounding verification for tanker trucks that carry/haul petroleum products.



The Scully IntelliCheck on-board provides overfill prevention and a "retained product" monitoring system. Once its plugged into the receptacle on the tanker truck and a green light has come on, the system will sense the level of fuel in the tanker and shut fuel flow off before the tank overflows.



It works in combination with the system's deadman switch which must be held in the "on" position to activate the flow. See *Tanker Truck Filling* in this manual for details on how to hook up and activate the system.



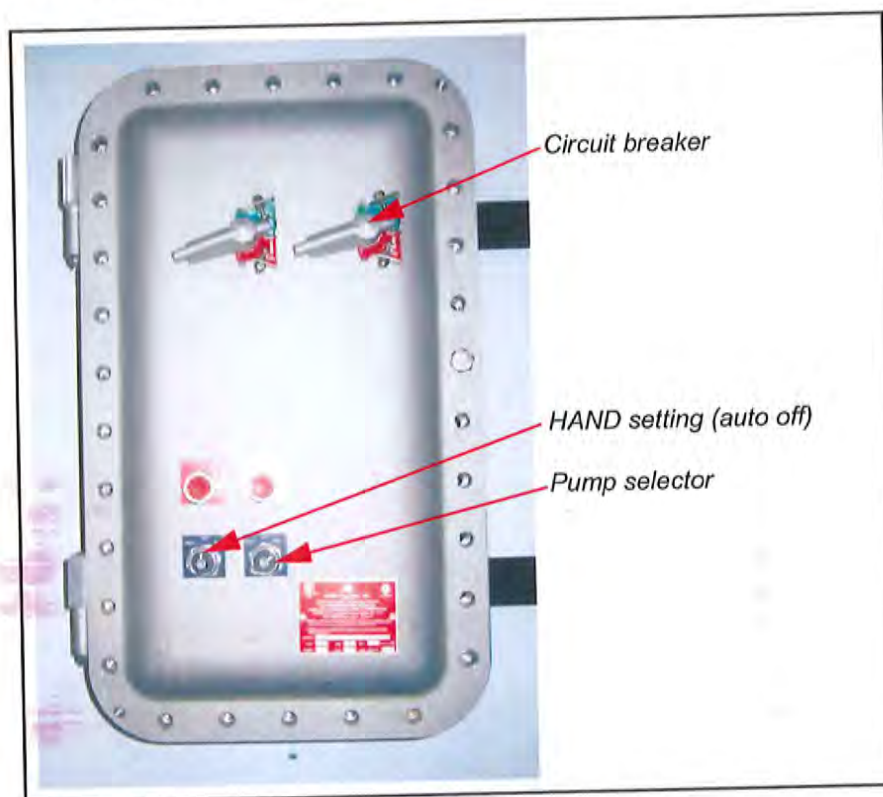
Deadman connector and switch.

Pumps

The system includes two 1500 litre pumps.

Tanker Truck Refueling Pumps

The 1500 LPM pumps are used to fill the tanker trucks. Only one pump runs at a time. Each time you start the system, it will start the opposite pump to the one that was used the last time. If a pump has to be serviced, it can be taken off line by using the switch box (shown below).



To eliminate one pump, turn the left knob to HAND and switch the right knob to number 1 or 2. Start the pump to make sure you've selected the pump you want to keep on line. If it isn't correct, stop the pump and switch to the opposite pump number.

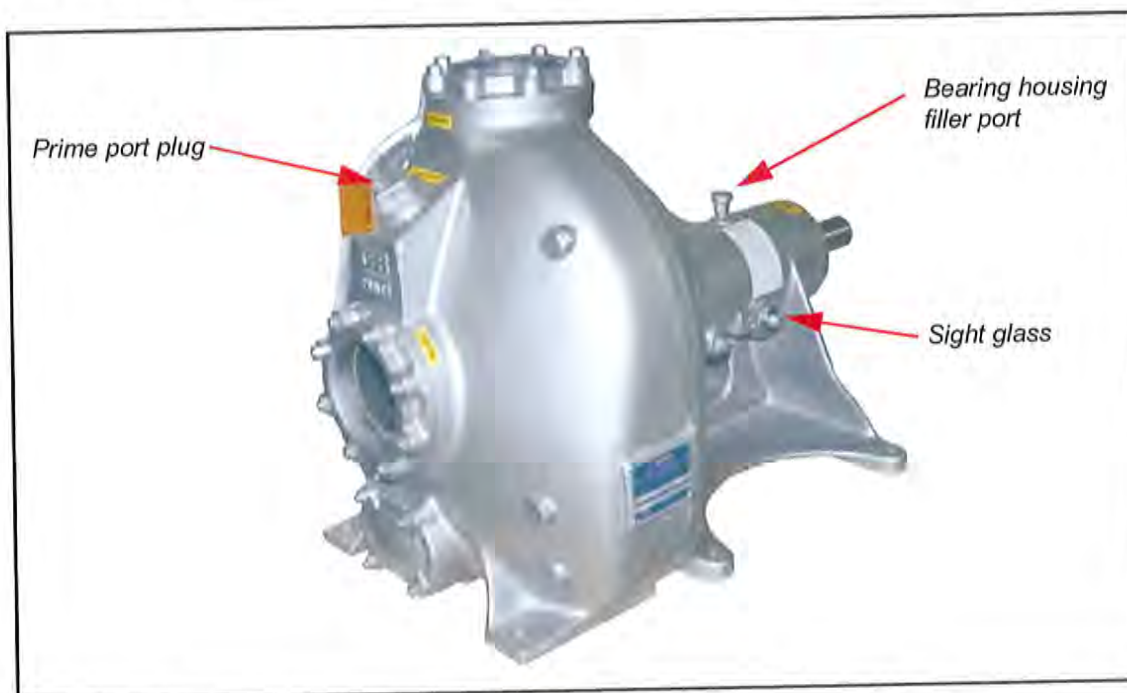
Use the circuit breaker handles to lock out the pump prior to servicing.

Pump Bearing Housing

If the pump oil level is low and oil has to be added, use SAE 30 non-detergent oil. Shut the pump down, remove the filler plug, then add oil until the sight gauge shows the correct level. **DO NOT OVERFILL.** Replace the filler plug and turn the left control panel switch back to AUTO.

Pump Priming

In most cases, the pumps should never have to be primed as the system should be normally flooded. However, if the fuel level is low in the main storage tanks, priming may be necessary if a pump has never been on line or if it has been off line for service. Before priming, make sure all inline valves are open.



If, upon start-up, the pump failed to pump fuel using the control panel, shut the pump down and close the inflow valve (this eliminates flow causing a spill). Remove the priming plug, add fuel to the housing until full, re-install the plug and bring the pump back on line. If it still does not pump, repeat the priming operation. If it still fails to pump, refer to the maintenance manual to service the pump.

Section 5: Specifications

Fuel Module Specifications

Container Specifications

Length: 40'

Width: 8'

Height: 8'

PSD-947 Tanker Truck Filling System (two pump assemblies)

- 1500 LPM Pump 4" Inlet
- Electric Motor 26 HP 600V 3 PH C/W Frame 284T
- Pump Base
- Hose Reel Frame PSD-968
- Hose Reel Hannay 346-33-34
- Flow Meter TCS 700-40-45
- Scully Over Fill Controller
- Bottom Loading Coupler
- Control Station
- Grounding Reel

Fire Suppression System

- Control Panel (in electrical room)
- Manifold Electric Room
- Fire Protection Fluid Container Electrical Room
- Manifold Fuel Pumping Area
- Fire Protection Fluid Container Fueling Area (in electrical room)

Electrical Room

- Fire Suppression System
- 600V Power Panel
- 120V Power Panel
- Main Breaker Panel
- Contactor Panel

PSD-947 Waste Tank System

- Tank Double-Wall 810 litre
- Pump 3 USGPM
- Motor Electric 1 HP
- Control Panel
- Over Fill Shut Off

Section 6: Maintenance Inspections

Inspection Schedule

Daily	Weekly	Monthly	Annually
Inspect to find problems requiring service.	Check oil level in pump bearing housing.	Inspect hoses for cracks or damage.	Change pump bearing housing oil.
Drain water in filters.			Replace all filter cartridges.
While pumping fuel, check filter pressure differential gauge. If exceeds 15 PSI, change cartridge.			
			Replace Scully system O-ring and corrosion pack.
Inspect for any evidence of leaks. Repair and clean spills.			
Inspect for any electrical cables frayed or pulled from strain including the Scully cable.			
Check the fire suppression system control panel to see if it's activated. Green light under AC power label should be ON.			
Inspect all surfaces of the dry break coupler to ensure cleanliness and lack of corrosion.	Check nozzle as per weekly inspection checklist.		
General clean up as needed.			

Appendix

Bill of Materials

Type	No.	Description 1	Description 2	Qty Per	Unit of Measure	Module
Item	010060	CONTAINER, 40', MODIFIED, AVIA	INSULATED, STL-FLOOR, DOORS, HATC	1.00	EACH	CONTAINER
Item	010074	LIGHT, FIXTURE, 4' FLOURESCENT	EXPLOSION, PROOF	4.00	EACH	
Item	010073	TRANSFORMER, CLS-1, ZONE-2	5KVA, 600-120/240	1.00	EACH	
Item	010093	HEATER, OVERHEAD, 600V	RUFFNECK, W/T-START	1.00	EACH	
Item	010075	HEATER, CONVECTION, 120V	EXPLOSION PROOF	1.00	EACH	
Item	010115	FIRE SUPPRESSION SYSTEM	AS PER QUOTE JUNE 25, 2013	1.00	EACH	
Item	006676	EXTINGUISHER, FIRE, 20LB ABC	DRY CHEMICAL	1.00	EACH	
Item	010123	PANEL BOARD, 600V, FUEL-MODULES	CXJ16426FC3H2-N4-E3-8C1-8RP3HL	1.00	EACH	
Item	010124	PANEL BOARD, 120/240V, FUEL-MODUL	CXJ6166-FC-H2-N4-E3-6C10	1.00	EACH	
Item	010126	LIGHT, EXTERIOR, EXP, LED-FLOOD	FMV9LCYUNV176	4.00	EACH	
Item	010117	SWITCH, LIGHT, ON-OFF, EXP	CX-1333-X1-N4-N5-N6	2.00	EACH	
Item	010118	BREAKER, MAIN, EXP, FUEL-MODULES	XC82-1636100	1.00	EACH	
Item	010119	CONTACTOR, ESTOP, FUEL-MODULE	CXJ6126-H1-N4-N5	1.00	EACH	TANKER LOADING MODULE
Item	010127	SLIPFITTER, SFA6	FOR LED-FLOODLIGHTS	4.00	EACH	
Item	010078	STRAINER, BASKET, 6" FLNG	SIMPLEX, MDL-72, 1/8" SS, MESH	1.00	EACH	
Item	010185	GAUGE, WIKA, 4", 0-160PSIG	1/2"NPT, LOWER-MOUNT	2.00	EACH	
Item	010221	PUMP, 400GPM, GR, 25HP		1.00	EACH	
Item	010098	VESSEL, FILTER, AVI, HORIZONTAL	1581, 5th ED, CAT-M, TYPE-S	1.00	EACH	
Item	010096	VALVE, RELIEF, PILOT-OPERATED, 4"	150# FLNG	1.00	EACH	
Item	010299	SCULLY, OVERFILL	INTELLITROLL, IC-OG	1.00	EACH	
Item	010300	SCULCON, JCT, W/30" WIRE	SC-8A	1.00	EACH	
Item	010301	BYPASS, AUTHORIZER, INTELLITROL		1.00	EACH	
Item	010095	VALVE, REDUCING, PILOT-OPERATED	4", 150# FLNG, W/DEADMAN	1.00	EACH	
Item	007584	HANDLE, DEADMAN, W/50' CORD	G2 MONITORING SYSTEM	1.00	EACH	TANKER LOADING MODULE
Item	010072	METER, FLOW, 4", REGIS-LITRES, AVI	RIGHT-LEFT, W/10-1PULSER	1.00	EACH	
Item	010077	INDICATOR, FLOW, 4", FLNG	VISI-FLO, 1621RF-0402	1.00	EACH	
Item	010063	REEL, HOSE, HANNAY, 3"x40'	ELECT, REWIND	1.00	EACH	
Item	003167	COUPLER, 3", VIC-STYLE-77	W/T-GASKET	1.00	EACH	
Item	010233	COUPLER, 4", VIC-STYLE-77	W/T-GASKET	1.00	EACH	
Item	010192	REEL, PLATE, STEEL, 3"		1.00	EACH	
Item	010120	STATIONS, CONTROL, START/STOP	CX1373-X3-N4-N5-3N6	1.00	EACH	
Item	010121	E-STOP, FUEL MODULE	CX1333-X1-N4-N5-N6	3.00	EACH	
Item	010122	BOX, JUNCTION, EXP, FUEL-MODULES	CXJ12128-H1-N1-N4-N5	1.00	EACH	
Item	010126	STARTER, 25HP, BAFFINLAND	CXJ14286-H2-N1-N5-2C1-4N6	1.00	EACH	
Item	010140	VALVE, 4", 150# FLANGED, SS	SPLIT-BODY	11.00	EACH	TANKER LOADING MODULE
Item	010142	VALVE, 6", 150# FLANGED, SS	UNI-BODY	2.00	EACH	
Item	010146	VALVE, WAFER-CHECK, 4", 150# FLNGD	SS	2.00	EACH	
Item	010176	VALVE, ON/OFF, 4" FLANGED	WATERSLUG, SHUT-OFF	1.00	EACH	
Item	010184	GAUGE, WIKA, 4", 30HG-30PSIG	1/2"NPT, LOWER-MOUNT	2.00	EACH	
Item	004886	COUPLER, 4" API, BOTTOM LOADING	W/TTMA 4"x3"NPT ADAPTER	1.00	EACH	
Item	010101	SWITCH, FLOW, 4" INLINE, EXP	120VAC, PADDLE-STYLE	1.00	EACH	
Item	010081	HOSE, AVI, ARC, 3"x40', 3" MNPT	CERTIFIED	1.00	EACH	
Item	010352	BLOCK, TERMINAL, M4/6	011511607	15.00	EACH	
Item	010353	BLOCK, TERMINAL, GROUND, M4/6P	016511316	2.00	EACH	
Item	010354	SECTION, END, FEM6	011836816	5.00	EACH	
Item	010355	STOP, END, BAM2	020635116	5.00	EACH	
Item	010356	CARD, MARKER, RC-610	023300001	1.00	EACH	
Item	010377	BLOCK, DISTRIBUTION, 3-POLE	CXJ10106-N1-N4-N5	1.00	EACH	
Item	010380	FLANGES, PUMP, BAFFINLAND		1.00	EACH	

Bill of Materials (continued)

Type	No.	Description 1	Description 2	Qty Per	Unit of Measure	Module
Item	010062	PUMP,3USGPM,1/2"NPT	TUTHILL,2RLEV-RH-7	1.00	EACH	JET A FILTER DRAIN MODULE
Item	010067	MOTOR,ELECT,EXP,1HP,1200RPM	600V,3PH,143T-FRAME	1.00	EACH	
Item	010378	STARTER,1-1/2HP,BAFFINLAND	CXJ12186-H2-N1-N4	1.00	EACH	
Item	010151	TANK,DOUBLE-WALL,810-LITRE	W/3/4"DRAIN,WELEDED-SADDLES	1.00	EACH	
Item	010344	BASE,PUMP,WASTE-FUEL,DRAIN		1.00	EACH	
Item	010326	VALVE,BALL,3/4",SS	SPRING-LOADED	1.00	EACH	
Item	010326	RELAY,OMRON	H3CR-A-AC100-240/DC100-125	3.00	EACH	
Item	010327	SOCKET,RELAY,OMRON	PCCF-11E	3.00	EACH	
Item	010333	COUPLER,L075x3/8"		1.00	EACH	
Item	010334	COUPLER,L075x7/8"		1.00	EACH	
Item	010335	ELEMENT,COUPLING,L075N		1.00	EACH	
Item	002629	VALVE,BALL,3/4"FNPT,SS		3.00	EACH	
Item	000773	BOX,JUNC,2-PORT,GRFC	GRFC50	2.00	EACH	
Item	002629	VALVE,BALL,3/4"FNPT,SS		2.00	EACH	
Item	002538	CAMLOCK,F,3/4"AL		2.00	EACH	
Item	010465	HOSE,ASSY,CHEM,3/4"x38"	W/SSKC&C	1.00	EACH	
Item	010466	HOSE,ASSY,CHEM,3/4"x54"	W/SSKC&C	1.00	EACH	
Item	010472	INDICATOR,FLOW,SIGHT,3/4"STL	VISI-FLO	1.00	EACH	
Item	007422	VALVE,BALL,1"SS		2.00	EACH	
Item	002233	HOSE,OIL,DSCH,3/4"x8",ASSY	RAINDRAIN	1.00	EACH	JET A FILTER DRAIN MODULE
Item	010407	VALVE,SOLENOID,3/4"NPT,120VAC	BAFFINLAND	1.00	EACH	
Item	010408	GAUGE,LEVEL,2"NPT,W/SS-FLOAT	BAFFINLAND	1.00	EACH	
Item	010525	SOCKET,RELAY,JET-MODULE,BAFFIN	OMRON,PYF 14A	3.00	EACH	
Item	010524	RELAY,JET-MODULE,BAFFINLAND	OMRON G2A-434A,110V	3.00	EACH	

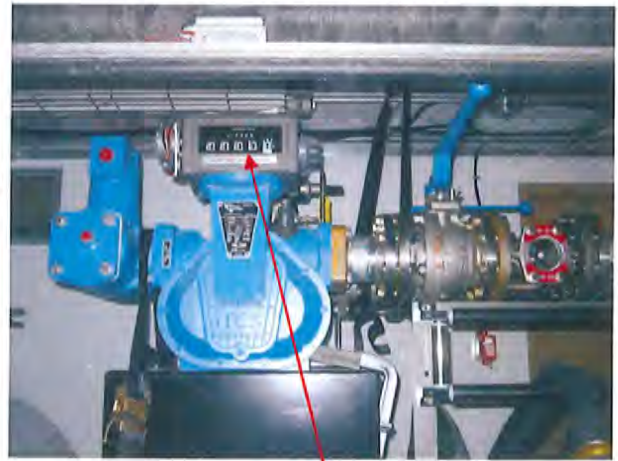
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Tanker Truck Filling Checklist

Warning

Quick start guides should only be used once you are trained and familiar with operational procedures. Refer to *Section 4: Operations* of the operations manual for complete instructions.

- Check the electrical room to make sure all breakers are on.
- Turn on lights, if not already on.
- If lights will not come on, check emergency stop switches. Pull out any that are pushed in.
- Plug in Scully control system cord. If tanker truck not equipped with Scully system, deactivate system with key and attach grounding reel.
- Zero fuel meter.
- Release hose reel clutch by pulling black knob out.
- Start pump.
- When full, turn off pump.
- Engage hose reel clutch by pushing black knob in.
- Retract the hose reel by pushing the rewind button and holding the button until rewound.
- Zero fuel meter.



Tanker truck fuel meter

Warning

Filling Empty Tanks

The API RP 2003 recommends limiting the initial velocity to 1m/s (500 LPM) until the tanker truck inlet is submerged by two inlet pipe diameters. After that, the flow can increase up to 3m/s (1500 LPM). A gate valve on the truck will control the flow or the ball valve near the hose reel can be also used.

BAFFINLAND MINES

OPERATION AND MAINTENANCE MANUAL

Supplier:
SimplexGrinnell
1485 Lindsey Place
Delta, B.C. V3M 6V1
Phone: 604-515-8872
Fax: 604-519-1477

HATCH		VENDOR DATA REVIEW	
Doc Number	E349000-PM004-02-118-0002	Sub	01
Date Received	06/04/2014		
Review Grade		Next Submittal Status	
☐ C1 - Proceed to next submission & status		☐ Internal Review	
☐ C2 - Proceed with exceptions as noted to next submission & status		☐ Certified Final	
☐ C3 - Do not proceed, revise as noted & resubmit		☐ Final	
		☐ As-Built	
		Next Submittal Date:	
No further submission required - Complete		☒	
☒ C4 - No further submission required - Cancelled		☐	
No further submission required - Superseded		☐	
Package Coordinator: Name, signature and Date:			
KEN INAI, Ken Inai, 23/09/2014			
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1

VERIFICATION REPORT

2

AS-BUILT / RECORD DRAWINGS

3

MAINTENANCE & INSPECTION

4

SHOP DRAWINGS / CUT SHEETS

APPENDIX C (INFORMATIVE) – FIRE ALARM SYSTEM VERIFICATION REPORTS

C1. FIRE ALARM SYSTEM VERIFICATION REPORT

(Reference: Clause 3.1.6, 3.1.7, 3.2.2)

Building Name: Baffinland Mines Fuel Modules Unit #1		Date: Aug 20 2013	
Address:			
System Manufacturer: SIMPLEXGRINNELL		Model Number: 4010ES	
		New FAS: ☒	Existing FAS:

A	System provides single-stage operation.	YES ☒	NO	
B	System provides two-stage operation.	YES	NO ☒	
C	The entire <i>fire alarm system</i> has been verified in accordance with, CAN/ULC-S537, standard for Verification of Fire Alarm Systems.	YES ☒	N/A	
D	This is a partial verification for a partial occupancy.	YES	NO ☒	N/A
E	This is a partial verification for a <i>fire alarm system</i> that has been replaced in stages.	YES	NO ☒	N/A
F	This is a verification of a portion of an existing <i>fire alarm system</i> verified in accordance with Section 6, System Modifications.	YES	NO ☒	N/A
G	Installed in accordance with the <i>design</i> and CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.	YES	NO ☒	N/A
H	The <i>fire alarm system</i> documentation is on site and includes a description of the system.	YES ☒	NO	N/A
I	The <i>fire alarm system</i> is fully functional.	YES ☒	NO	N/A
J	Comments			
K	A copy of this report will be given to the following, who is the owner or owner's representative for this <i>building</i> :	YES ☒	NO	
L	The Fire Alarm System is connected to an acceptable central monitoring station via a supervised circuit of an ULC-listed transmitter approved for the purpose. If "Yes", specify the name and location of the central monitoring station:	YES	NO ☒	

This is to certify that the information contained in this Fire Alarm System Verification Report is correct and complete.

Sami Samir

SimplexGrinnell
Company604.515.8872
TelephonePrinted Name and Signature of Qualified Person(s) conducting the Verification
(see list of acceptable verification organizations, Bulletin 2003-009-EL)

This report has been reviewed by designer and confirmed that it is consistent with the designed intent.

Printed Name and Signature of Designer

Company

Telephone

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

**CAN/ULC-S537-04
APPENDIXES**

The following Appendixes have been attached with his document:

C2.	DOCUMENTATION	YES ✓	N/A
C3.	FIELD DEVICE AND RELATED CIRCUITS – TEST AND INSPECTION	YES ✓	N/A
C4.	DATA COMMUNICATION LINK TEST	YES ✓	N/A
C5.1	CONTROL UNIT OR TRANSPONDER RECORD	YES ✓	N/A
C5.2	VOICE COMMUNICATION TEST	YES	N/A ✓
C5.3	REQUIRED SYSTEM RESPONSE TIMES	YES ✓	N/A
C5.4	CONTROL UNIT OR TRANSPONDER INSPECTION	YES ✓	N/A
C5.5	LARGE SCALE NETWORK SYSTEMS	YES	N/A ✓
C5.6	POWER SUPPLY INSPECTION	YES ✓	N/A
C5.7	EMERGENCY POWER SUPPLY TEST AND INSPECTION	YES	N/A ✓
C5.8	ANNUNCIATOR AND REMOTE TROUBLE SIGNAL UNIT TEST AND INSPECTION	YES	N/A ✓
C5.9	ANNUNCIATORS OR SEQUENTIAL DISPLAYS	YES	N/A ✓
C5.10	REMOTE TROUBLE SIGNAL UNIT TEST AND INSPECTION	YES	N/A ✓
C5.11	PRINTER TEST	YES	N/A ✓
C5.12	ANCILLARY DEVICE CIRCUIT TEST	YES ✓	N/A
C6.1	FIELD DEVICE TESTING – LEGEND AND NOTES	YES ✓	N/A
C6.2	INDIVIDUAL DEVICE RECORD	YES ✓	N/A
C6.3	SIGNALLING DEVICE SOUND LEVEL MEASUREMENT	YES	N/A ✓

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

Verification Comments:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Technician

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

C2. DOCUMENTATION

(Reference: Clause 3.2.3)

C2.1 Documentation for the fire alarm system is on site and includes the following description of the fire alarm system:

A	Instructions for resetting the system and silencing alarm signals.	YES ✓	NO	N/A
B	Instructions for silencing the trouble signal and action to be taken when the trouble signal sounds.	YES ✓	NO	N/A
C	Description of the function of each operating control and indicator on the fire alarm unit.	YES ✓	NO	N/A
D	Description of the area or fire zone protected by each alarm detection circuit (this may be in the form of a list or plan drawing).	YES ✓	NO	N/A
E	Description of alarm signal operation.	YES ✓	NO	N/A
F	Description of ancillary equipment controlled by the fire alarm system.	YES ✓	NO	N/A
G	The fire alarm system has a feature for connection for fire department signaling. If connected, indicate the fire signal receiving centre:	YES	NO ✓	N/A

Date: Aug 20 2013	Partial Verification	☒ Full Verification
Building Name: Baffinland Mines Fuel Modules		

C3. FIELD DEVICE AND RELATED CIRCUITS – TEST AND INSPECTION

(Reference: Clauses 3.3.1.1, 3.3.1.3, Subsections 3.3.1, 3.3.2, 3.3.3)

A	Correct field termination and wiring size.	YES ✓	NO	N/A
B	Correct circuit polarities.	YES ✓	NO	N/A
C	An open circuit fault on a conventional device circuit causes a trouble signal.	YES ✓	NO	N/A
D	Removal of any active or supporting field device circuit causes a trouble signal.	YES ✓	NO	N/A
E	One contact device and one non-contact device tested for operation and annunciation at the control unit or transponder, when using a field verifying device.	YES ✓	NO	N/A
F	Class A circuits serving conventional field devices tested for the capability of providing an alarm signal on each side of an open circuit fault connection at an electrically remote point in the circuit.	YES ✓	NO	N/A
G	Ground fault indications occur when tested at the electrically furthest field device, and do not result in normal to off-normal status change conditions.	YES ✓	NO	N/A
H	Field device at the electrically furthest point from the power source (in every circuit) receives rated power in accordance with manufacturer's specifications.	YES ✓	NO	N/A
I	Replaceable over-current devices are of correct rating.	YES ✓	NO	N/A
J	Wire type and gauge in accordance with equipment manufacturer's installation wiring at all system termination points.	YES ✓	NO	N/A

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

C4. DATA COMMUNICATION LINK TEST

(Reference: Clause 3.2.6, Subsection 3.3.4-Note)

Control unit or transponder location: ELECTRICAL ROOM
Control unit or transponder identification:
Data communication link identification:

A	Each system abnormal condition specified in Table 1, Abnormal System Conditions, tested for each data communication link at the control unit or transponder.	YES ✓	NO	N/A
B	Tests for alarm and trouble received under a single ground fault condition conducted on each conductor of that data communication link independently.	YES ✓	NO	N/A
C	Each conductor in a data communication link, Class A (DCLA) tested for the capability of providing an alarm signal on each side of a single open circuit fault condition.	YES	NO	N/A ✓
D	Where a data communication link serves devices on more than one floor area, impose a wire-to-wire short circuit fault within each floor area and confirm receipt of trouble and alarm condition from another floor area.	YES	NO	N/A ✓
E	Where fault isolation modules are installed in data communication links serving field devices, wiring shorted on the isolated side, annunciation of the fault confirmed, and then a device on the source side operated, and activation confirmed at the control unit or transponder.	YES	NO	N/A ✓
F	Where fault isolation in data communication links is provided between control units or transponders, the field wiring shorted between each pair of control units or transponders, in turn, annunciation of the fault confirmed and operation outside the shorted section confirmed.	YES	NO	N/A ✓

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

C5. CONTROL UNIT OR TRANSPONDER RECORD

(Reference: Clause 4.1.1)

C5.1 CONTROL UNIT OR TRANSPONDER TEST

(Reference: Clauses 3.2.4, 4.2.2.1)

Control unit or transponder location: ELECTRICAL ROOM

Control unit or transponder identification:

A	Power 'on' visual indicator operates.	YES ✓	NO	N/A
B	Common visual trouble signal operates.	YES ✓	NO	N/A
C	Common audible trouble signal operates.	YES ✓	NO	N/A
D	Trouble signal silence switch operates.	YES ✓	NO	N/A
E	Main power supply failure trouble signal operates.	YES ✓	NO	N/A
F	Ground fault tested on positive and negative initiates trouble signal.	YES ✓	NO	N/A
G	Alert signal operates.	YES	NO	N/A ✓
H	Alarm signal operates.	YES ✓	NO	N/A
I	Automatic transfer from alert signal to alarm signal operates.	YES	NO	N/A ✓
J	Manual transfer from alert signal to alarm signal operates.	YES	NO	N/A ✓
K	Automatic transfer from alert signal to alarm signal cancel (acknowledge) feature operates on a two-stage system.	YES	NO	N/A ✓
L	Alarm signal silence inhibit function operates.	YES ✓	NO	N/A
M	Alarm signal manual silence operates.	YES ✓	NO	N/A
N	Alarm signal silence visual indication operates.	YES ✓	NO	N/A
O	Alarm signal, when silenced, automatically reinitiates upon subsequent alarm.	YES ✓	NO	N/A
P	Alarm signal silence automatic cut-out timer.	Time: N/A		
Q	Audible and visual alarm signals programmed and operate per design and specification.	YES ✓	NO	N/A
R	Input circuit, alarm and supervisory operation, including visual indicator operates.	YES ✓	NO	N/A
S	Input circuit supervision fault causes a trouble indication.	YES ✓	NO	N/A
T	Output circuit alarm indicators operate.	YES	NO	N/A ✓

Continued C5.1...

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

... Continued C5.1

U	Output circuit supervision fault causes a trouble indication.	YES ✓	NO	N/A
V	Visual indicator test (lamp test) operates.	YES	NO	N/A ✓
W	Coded signal sequences operate not less than the required number of times and the correct alarm signal operates thereafter.	YES ✓	NO	N/A
X	Coded signal sequences are not interrupted by subsequent alarms.	YES	NO	N/A ✓
Y	Ancillary device control circuit is rated for the intended purpose.	YES ✓	NO	N/A
Z	Ancillary device by-pass results in trouble signal.	YES ✓	NO	N/A
AA	Input circuit to output circuit operation, including ancillary device circuits (Refer to Appendix C5.12, Ancillary Device Circuit Test), for correct program operation, as per design and specification.	YES ✓	NO	N/A
BB	Fire alarm system reset operates.	YES ✓	NO	N/A
CC	Main power supply to emergency power supply transfer operates.	YES ✓	NO	N/A
DD	Control unit or transponder bonded to ground.	YES ✓	NO	N/A
EE	Status change confirmation feature (smoke detectors only) verified.	YES ✓	NO	N/A
FF	Confirm that the alarm transmission to the remote fire signal receiving centre is received.	YES	NO	N/A ✓
GG	Confirm that the supervisory transmission to the fire signal receiving centre is received.	YES	NO	N/A ✓
HH	Confirm that the trouble transmission to the fire signal receiving centre is received.	YES	NO	N/A ✓
II	If connected, record the name and telephone number of the fire signal receiving centre.	Name: Phone:		
JJ	Operation of the fire signal receiving centre disconnect means results in a specific trouble indication at the control unit or transponder and transmits a trouble signal to the fire signal receiving centre.	YES ✓	NO	N/A ✓

Date: Aug 20 2013

Partial Verification

☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

C5.2 VOICE COMMUNICATION TEST

(Reference: Clauses 3.2.4, 4.2.3.1)

A	Power 'on' indicator operates.	YES		NO		N/A	✓
B	Common visual trouble signal operates.	YES		NO		N/A	✓
C	Common audible trouble signal operates.	YES		NO		N/A	✓
D	Trouble signal silence switch operates.	YES		NO		N/A	✓
E	All-call voice paging, including visual indicator, operates.	YES		NO		N/A	✓
F	Output circuits for selective voice paging, including visual indication operates.	YES		NO		N/A	✓
G	Output circuits for selective voice paging trouble operation, including visual indication, operates.	YES		NO		N/A	✓
H	Microphone, including press to talk switch, operates.	YES		NO		N/A	✓
I	Operation of voice paging does not interfere with initial inhibit time of alert signal and alarm signal.	YES		NO		N/A	✓
J	All-call voice paging operates (on emergency power supply).	YES		NO		N/A	✓
K	Upon failure of one amplifier, system automatically transfers to backup amplifier(s).	YES		NO		N/A	✓
L	Circuits for emergency telephone call-in operation, including audible and visual indication operates.	YES		NO		N/A	✓
M	Circuits for emergency telephones for operation, including two-way voice communication, operate.	YES		NO		N/A	✓
N	Circuits for emergency telephone trouble operation, including visual indication, operate.	YES		NO		N/A	✓
O	Emergency telephone verbal communication operates.	YES		NO		N/A	✓
P	Emergency telephone operable or in-use tone at handset operates.	YES		NO		N/A	✓

Date: Aug 20 2013

Partial Verification

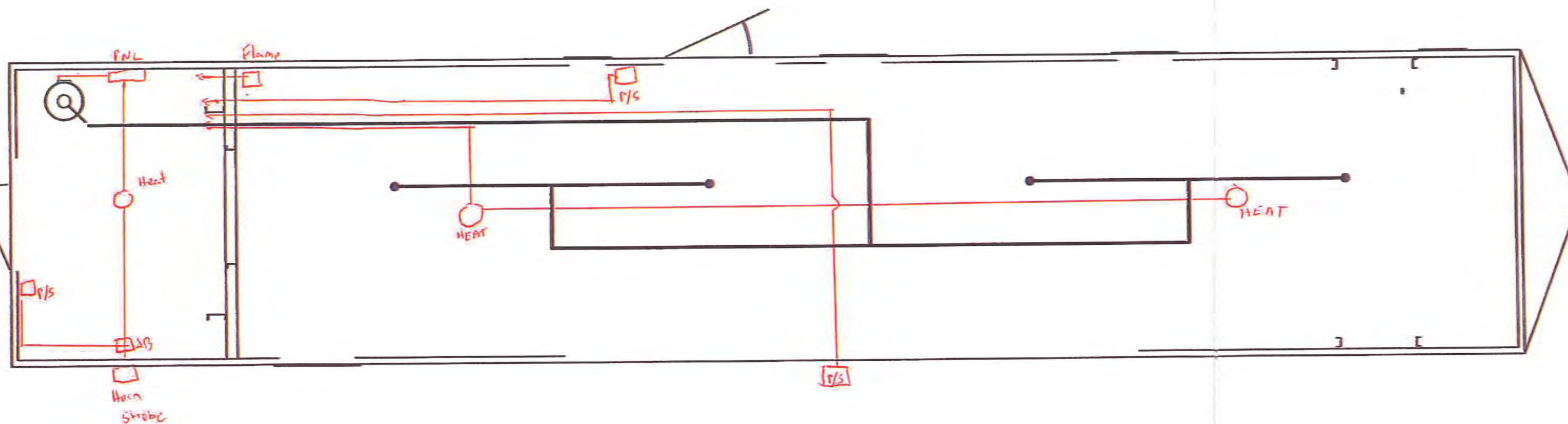
☒ Full Verification

Building Name: Baffinland Mines Fuel Modules

C5.3 REQUIRED SYSTEM RESPONSE TIMES

(Reference: Clause 4.2.4.1)

A	Audible signal devices and visible signal devices operated within 10 s. and Subsequent input operated within 10 s.	YES ✓	NO	
		YES ✓	NO	
B	Remote connection operated within 10 s.	YES	NO	N/A ✓
C	Releasing device start of sequence operated within 10 s.	YES ✓	NO	N/A
D	Required annunciation operated within 10 s. and Subsequent input operation within 10 s.	YES ✓	NO	
		YES ✓	NO	
E	Required central alarm and control facility operated within 10 s. and Subsequent input operation within 10 s.	YES	NO	N/A ✓
		YES	NO	
F	Ancillary Circuits operated within 10 s. and Subsequent input operation within 30 s.	YES	NO	N/A ✓
		YES	NO	

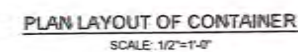
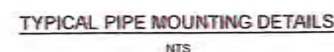


PLAN LAYOUT OF CONTAINER

SCALE: 3/8"=1'-0"

"AS BUILT"

NOV 21 2013



INSTALLATION NOTES:
REFER TO SAPPHIRE ENGINEERED SYSTEMS MANUAL FOR EQUIPMENT
AND INSTALLATION DETAILS

PIPING
 PIPING TO BE BLACK OR GALVANIZED SCHEDULE 40 AS FOLLOWS:
 ASTM A-53B OR A, A-108B OR A, SEAMLESS, THREADED
 AND WELDED IN SIZES FROM 3/8" TO 6"
 ASTM A-53B OR A, ERW, THREADED AND WELDED IN SIZES
 FROM 3/8" TO 6"
 ASTM FURNACE WELD CLASS F, THREADED AND WELDED
 IN SIZES FROM 3/8" TO 6".

FITTINGS

1. FITTINGS UP TO 3" TO BE CLASS 300 LB MALLEABLE OR DUCTILE IRON. FITTINGS OVER 3" TO BE 1000 LB DUCTILE IRON OR FORGED STEEL. FLANGED JOINTS SHALL BE CLASS 300 LB.
2. CLASS 150 LB AND CAST IRON FITTINGS NOT TO BE USED.
3. REDUCING FITTINGS OR COUPLINGS TO BE USED FOR CHANGES IN PIPE SIZE. REDUCING BUSHINGS ACCEPTABLE FOR REDUCTIONS ONLY, 3000 LB FORGED STEEL TO BE USED FOR A SINGLE PIPE SIZE REDUCTION AND CLASS 300 MALLEABLE IRON TO BE USED FOR TWO OR MORE SIZE REDUCTIONS. ALL UNIONS TO BE FORGED STEEL.

INSTALLATION

1. CYLINDER LOCATION TO BE MAINTAINED AT AN AMBIENT TEMPERATURE OF 0°C (32°F) TO 54°C (130°F).

2. SINGLE CYLINDER STRAPS WHEN ATTACHED TO SOLID WALLS SHOULD USE ALLOY EXPANSION SHIELDS OR EQUIVALENT WHEN USING MACHINE BOLTS. LEAD SHIELDS ARE NOT ACCEPTABLE. MINIMUM BOLT SIZE TO BE 1/2" DIAMETER.
3. PIPES TO BE SWABBED CLEAN INTERNALLY OF ALL CUTTING OIL AND DEBRIS PRIOR TO ASSEMBLY USING DEGREASING SOLUTION AND RAGS.
4. ALL THREADED JOINTS TO USE TEFLON TAPE OR SIMILAR MATERIAL APPLIED TO MALE THREADS ONLY.

5. PIPING TO BE HUNG SECURELY AS PER ANSI B-31.1 AND INSTALLED ACCORDING TO PROPER COMMERCIAL PRACTICES USING LISTED AND APPROVED HANGERS.

7. ALL TEES TO BE MOUNTED IN THE HORIZONTAL POSITION. TEE SIDES ARE NOT TO BE MOUNTED IN THE VERTICAL POSITION UNLESS SPECIFICALLY NOTED OR SHOWN OTHERWISE.

8. BEFORE INSTALLING NOZZLES, ALL PIPING TO BE PRESSURE TESTED AS PER NFPA 2001 FOR LEAKAGE, AND TO BE BLOWN OUT USING COMPRESSED AIR OR NITROGEN.

9. ALL NOZZLES TO BE MOUNTED WITH NOZZLE ORIENTATION AS SHOWN. NOZZLES TO BE A MAXIMUM OF 12" BELOW CEILING AND 2" TO 12" FROM A WALL FOR SIDEWALL NOZZLES. ALL NOZZLES TO END IN A DIRT TRAP CONSISTING OF A TEE FITTING WITH A NIPPLE AND CAP ON THE THROUGH PART OF THE TEE.

11. NO DEVIATION MAY BE MADE TO THE SYSTEM LAYOUT WITHOUT THE APPROVAL OF SIMPSONSTRONGTIE. DIMENSIONS ARE APPROXIMATE

12. DOORS, WINDOWS AND ANY OPENINGS TO BE SEALED AGAINST LOSS OF AGENT USING SUITABLE SEALS TO AID IN RETENTION OF AGENT.

13. CONCRETE BLOCK WALLS IN HAZARD AREAS SHALL BE PAINTED TO PREVENT LEAKAGE OF AGENT THROUGH WALL.

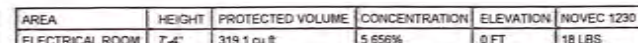
14. QUANTITY OF AGENT SUPPLIED IS BASED ON CALCULATIONS DONE

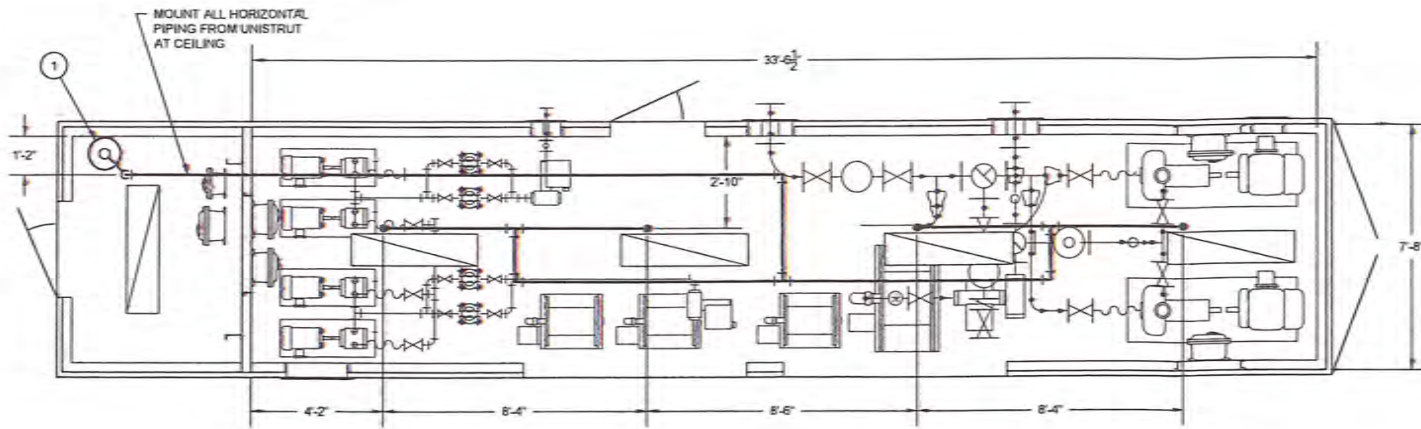
15. DIMENSIONS SHOWN ON DRAWINGS FOR ESTIMATION AND CALCULATION PURPOSES ONLY. ACTUAL SITE CONDITIONS MAY REQUIRE CHANGES TO SUBMITTALS.

16. ANY OUTSIDE VENTILATION SYSTEMS TO BE SHUTDOWN PRIOR TO DISCHARGE OF EXTINGUISHING AGENT TO AVOID LOSS OF AGENT. RECIRCULATING VENTILATION SYSTEMS CAN BE LEFT ON TO FACILITATE

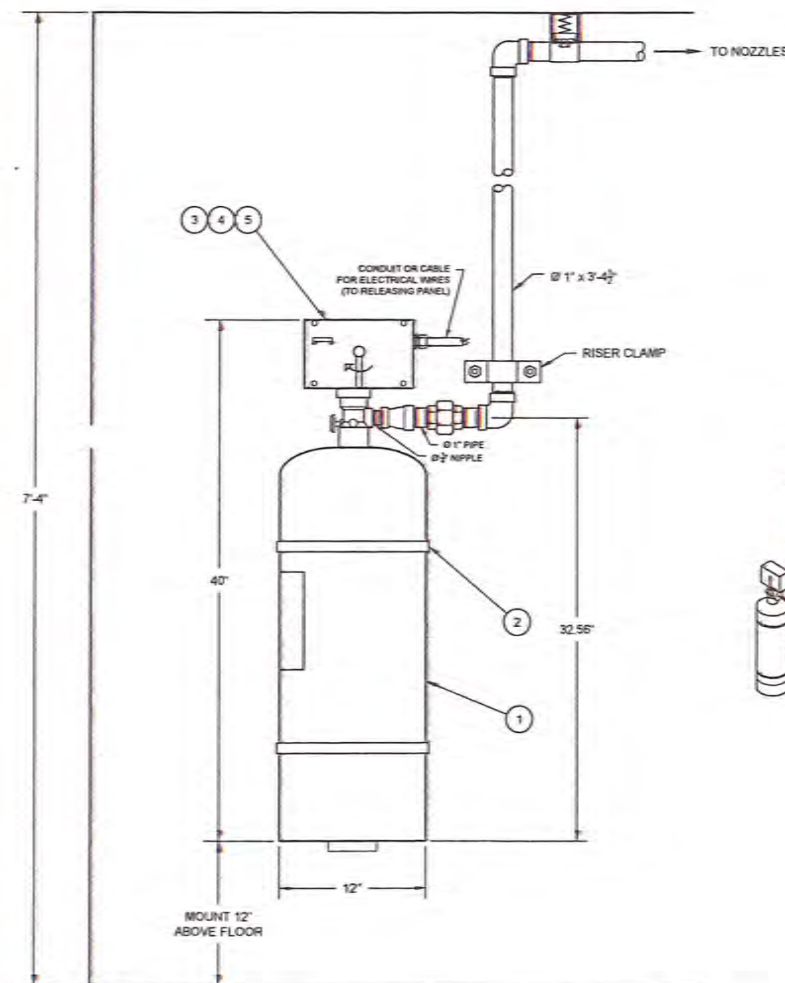
HOMOGENEOUS MIXING OF AGENT THROUGHOUT THE ENTIRE AREA IF THIS VOLUME HAS BEEN ADDED INTO THE ROOM AREA.

HANGERS MUST BE PLACED WITHIN 12" OF THE DISCHARGE NOZZLE.
HANGERS MUST BE PLACED BETWEEN ELBOWS THAT ARE MORE THAN 12" APART.
HANGERS MUST BE FIXED TO STRUCTURES CAPABLE OF SUPPORTING PIPE WORK.

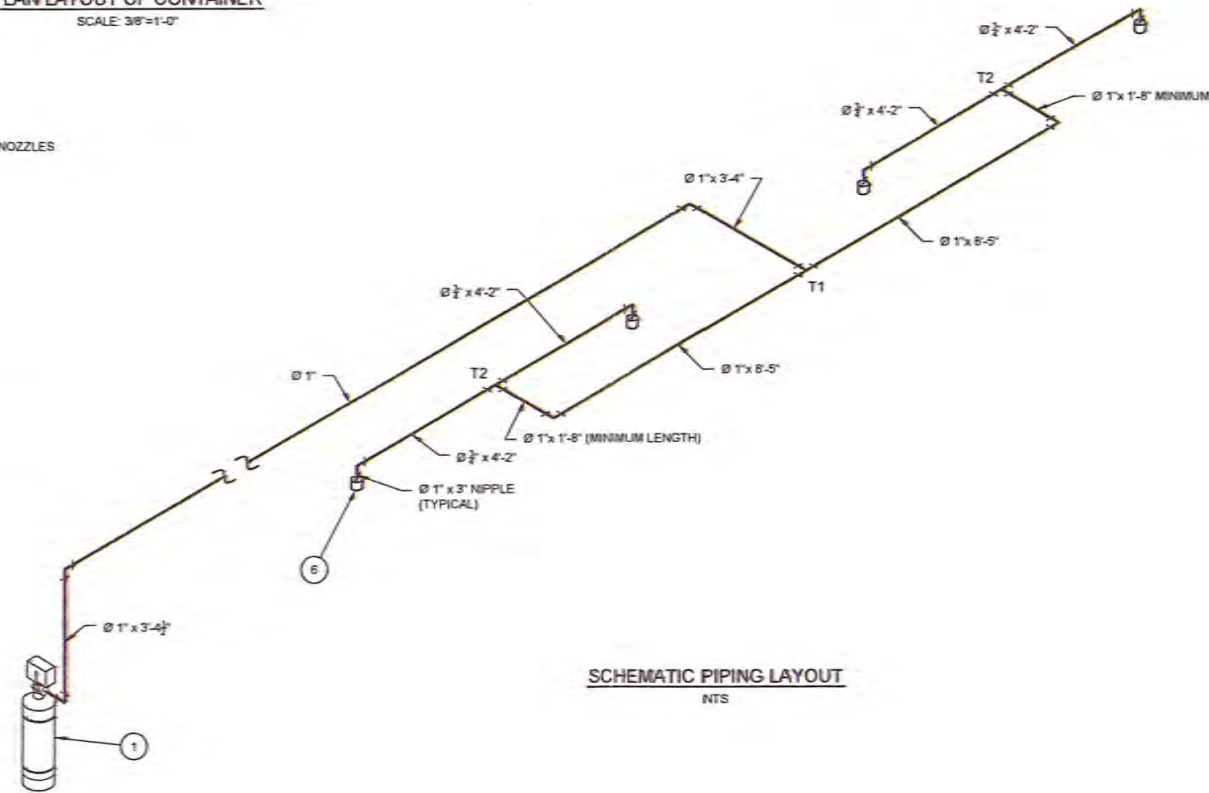




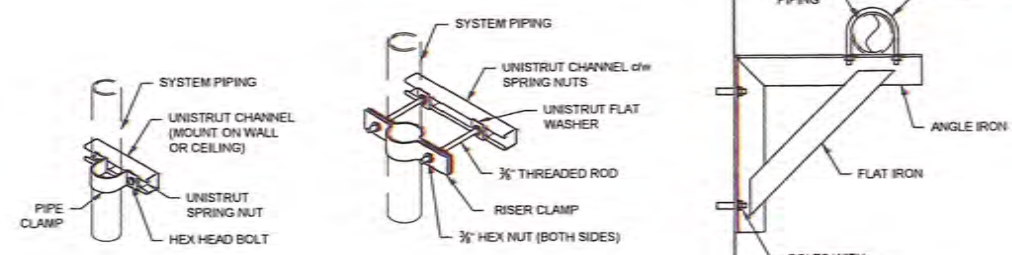
PLAN LAYOUT OF CONTAINER
SCALE: 3/8"=1'-0"



DETAIL AT CYLINDER
NTS



SCHEMATIC PIPING LAYOUT
NTS



TYPICAL PIPE MOUNTING DETAILS
NTS

ITEM	QTY	PART NO	DESCRIPTION
1	1	551124	PCI-70ABC-ULC 70 LB DRY CHEMICAL CYLINDER ASSY.- 3/4" FNPT
2	1	550965	MB-ATD MOUNTING BRACKET FOR 70 LB CYLINDER
3	1	551201	ECH3-24 ELECTRICAL CONTROL HEAD W/ LOCAL ACTUATION
4	1	550077	ALARM INITIATING SWITCH
5	1	552173	MICRO SWITCH EXTENSION KIT
6	4	551878	NF-ABC TOTAL FLOOD NOZZLE WITH CAP
7	1	551059	CO2-S CARBON DIOXIDE ACTUATION CARTRIDGE (PKG OF 8)
8			
9			
10			

- INSTALLATION NOTES:**
REFER TO MONARCH INDUSTRIAL FIRE SUPPRESSION MANUAL FOR EQUIPMENT AND INSTALLATION DETAILS (PART NO. 553565 - FEB 1, 2010)
REFER TO NFPA 17 FOR INSTALLATION, MAINTENANCE AND INSPECTION OF PRE-ENGINEERED DRY CHEMICAL SYSTEMS.
- PIPING**
FERROUS PIPING: BLACK OR GALVANIZED STEEL PIPE SHALL BE EITHER ASTM A-53 OR ASTM A-120 SCH 40. CAST IRON PIPE IS NOT ACCEPTABLE.
- FITTINGS**
ALL FITTINGS TO BE BLACK OR GALVANIZED CLASS 150 MALLEABLE OR DUCTILE IRON. REDUCING TEES ARE TO BE USED FOR ALL PIPE SPLITS. REDUCING BUSHINGS AND CAST IRON FITTINGS ARE NOT ACCEPTABLE.
- INSTALLATION**
1. OPERATING TEMPERATURE OF SYSTEM IS FROM A MINIMUM OF -20°F (-28°C) TO A MAXIMUM 120°F (49°C).
2. CYLINDER STRAPS TO BE SECURED USING BOLTS OR LAG SCREWS.
3. PIPES TO BE SWABBED CLEAN INTERNALLY OF ALL CUTTING OIL, METAL CHIPS ETC. PRIOR TO ASSEMBLY.
4. ALL THREADED JOINTS TO USE TEFLON TAPE OR SIMILAR MATERIAL APPLIED TO MALE THREADS ONLY.
5. PIPING TO BE HUNG SECURELY AS PER ANSI B-31.1 AND INSTALLED ACCORDING TO GOOD COMMERCIAL PRACTICES USING LISTED AND APPROVED HANGERS.
6. PIPING TO BE FASTENED SECURELY AND BRACED AGAINST THRUST FORCES AT ALL NOZZLES (WITHIN 1 FT) AND CHANGE OF DIRECTION FITTINGS.
7. ALL SYSTEM PIPING MUST COMPLY WITH SECTION A-3.9.1 OF NFPA-17.
8. ALL NOZZLES TO BE MOUNTED WITH NOZZLE ORIENTATION AS SHOWN WITH DISCHARGE HOLES TO BE WITHIN 6" OF CEILING.
9. PIPE LENGTHS ARE APPROXIMATE AND NOT TO BE USED FOR PREFABRICATION.
10. PIPE HANGER SPACING TO BE AS FOLLOWS:
1/2" PIPE 6 FEET
3/4" PIPE 8 FEET
1" PIPE 12 FEET
11. ANY CHANGES IN DIRECTION IN AN EXHAUST SYSTEM TO BE PROTECTED WITH ADDITIONAL NOZZLES.
12. REFER TO GENERAL PURPOSE TOTAL FLOODING DESIGN SECTION OF MANUAL FOR PIPE AND FITTING LIMITATIONS FOR PCI-70ABC WITH 4 NF-ABC NOZZLES.
13. IF APPLICABLE, ALL ACTUATION LINES TO CYLINDER HEADS TO BE 1/4" OD COPPER TUBING WITH FLARED FITTINGS AT ALL CONNECTIONS. REFER TO MANUAL FOR ACTUATION LINE TYPE AND LIMITATIONS. TUBING TO BE PROTECTED AGAINST MECHANICAL DAMAGE AND TO BE TESTED AS PER GUIDE LINES LISTED IN THE INSTALLATION MANUAL.
14. VENTILATION EQUIPMENT SHUTDOWNS AND DOOR CLOSURES TO BE INITIATED DURING RELEASING PANEL TIME DELAY PERIOD, BEFORE SYSTEM ACTIVATION.
15. REFER TO ELECTRICAL DRAWING FOR ELECTRICAL DEVICE LAYOUT AND WIRING DIAGRAM.

PIPING SECTION	SIZE	MAX LENGTH	MAX ELBOWS
CYL - T1	1"	30 FT	3
T1 - T2	1"	14 FT	2
T2 - NOZZLE	3/4"	9 FT	2

DESIGN PARAMETERS FOR PAINT BOOTH NV-WA NOZZLES
SIDE 1 - 8 FT, HEIGHT 8 FT, SIDE 2 = 14.97 FT
WIDTH 7.87 FT / 18 FT = 1 NOZZLE
LENGTH 33.82 FT / 14.97 FT = 3 NOZZLES
TOTAL FOR NOZZLES - 1 x 3 = 3 NOZZLES MINIMUM

"AS BUILT"

NOV 21 2013



tyco Fire & Security
SimplexGrinnell

1405 LINDSEY PLACE
DELTA, BC V3M 6V1
SALES: 604-518-1477
SERVICE: 604-518-1477
FAX: 604-518-1477

REVISION DESCRIPTION
NO. DATE ISSUED

DATE: JUL 18, 2013

NO. 00

LAYOUT OF MONARCH DRY CHEMICAL FIRE SUPPRESSION SYSTEM FOR PROTECTION OF MODULAR FUEL PUMP ROOM
BAYFINDLAND IRON MINES
611 QUEEN ELIZABETH WAY, SUITE 103 - CORPORATION / CALUIT / CALUIT, MANUUT X0A 010

DRAWN BY: PJB
DESIGNED BY: PJB
APPROVED BY:

DATE: JUL 18, 2013
DATE: JUL 18, 2013
DATE:

PROJECT NUMBER: 480267201

SHEET TITLE: MONARCH CYLINDER AND PIPING LAYOUT

SHEET NUMBER: 13-07-22-2

REV. CD:



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REV. 1



Material Safety Data Sheet

3M MATERIAL SAFETY DATA SHEET 3M(TM) Novec (TM) 1230 Fire Protection Fluid [FK-5-1-12] 04/09/2007



Material Safety Data Sheet

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SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: 3M(TM) Novec (TM) 1230 Fire Protection Fluid [FK-5-1-12]

MANUFACTURER: 3M

DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 04/09/2007

Supersedes Date: 09/11/2006

Document Group: 16-3425-2

Product Use:
Intended Use: STREAMING AND FLOODING FIRE PROTECTION

SECTION 2: INGREDIENTS

<u>Ingredient</u>	<u>C.A.S. No.</u>	<u>% by Wt</u>
1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE	756-13-8	> 99.9

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: Liquid

Odor, Color, Grade: clear colorless, low odor.

General Physical Form: Liquid

Immediate health, physical, and environmental hazards:

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:

Contact with the eyes during product use is not expected to result in significant irritation.

Skin Contact:

Contact with the skin during product use is not expected to result in significant irritation.

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Inhalation:

If thermal decomposition occurs:
May be harmful if inhaled.

Ingestion:

No health effects are expected.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

This substance has a high Henry's Law constant and therefore will be primarily found in the atmosphere where photolysis will be the dominant reaction pathway. The ultimate degradation products of the photolysis reaction are HF, CO₂ and trifluoroacetic acid (TFA).

This substance does not contribute to ozone depletion; it has an atmospheric lifetime of approximately 5 days and a Global Warming Potential (GWP) of 1 (IPCC 2001 Method).

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: No need for first aid is anticipated.

Skin Contact: No need for first aid is anticipated.

Inhalation: If signs/symptoms develop, remove person to fresh air. If signs/symptoms persist, get medical attention.

If Swallowed: No need for first aid is anticipated.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature

Flash Point

Flammable Limits - LEL

Flammable Limits - UEL

Not Applicable

Not Applicable

[Details: Nonflammable]

[Details: Nonflammable]

5.2 EXTINGUISHING MEDIA

Product is a fire-extinguishing agent.

5.3 PROTECTION OF FIRE FIGHTERS

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3M MATERIAL SAFETY DATA SHEET 3M(TM) Novec (TM) 1230 Fire Protection Fluid [FK-5-1-12] 04/09/2007

Special Fire Fighting Procedures: Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: Not applicable.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M-HELPS line (1-800-364-3577) for more information on handling and managing the spill. Ventilate the area with fresh air. Contain spill. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Clean up residue. Place in a metal container approved for transportation by appropriate authorities. Seal the container. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING

For industrial or professional use only. Contents may be under pressure, open carefully. Avoid breathing of vapors, mists or spray. Do not breathe thermal decomposition products.

7.2 STORAGE

Keep container in well-ventilated area. Store out of direct sunlight. Store away from heat. Store away from strong bases, amines, and alcohols.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Provide appropriate local exhaust ventilation on open containers. Provide appropriate local exhaust when product is heated.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

As a good industrial hygiene practice:

Avoid eye contact with vapors, mists, or spray.

8.2.2 Skin Protection

Gloves are not required.

8.2.3 Respiratory Protection

Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.

As a good industrial hygiene practice:

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Material Safety Data Sheet

3M MATERIAL SAFETY DATA SHEET 3M(TM) Novec (TM) 1230 Fire Protection Fluid [EK-5-1-12] 04/09/2007

Avoid breathing of vapors, mists or spray.

If thermal decomposition occurs, wear supplied air respiratory protection.

8.2.4 Prevention of Swallowing

Not applicable.

8.3 EXPOSURE GUIDELINES

<u>Ingredient</u>	<u>Authority</u>	<u>Type</u>	<u>Limit</u>	<u>Additional Information</u>
1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE	3M	TWA	150 ppm	

SOURCE OF EXPOSURE LIMIT DATA:

ACGIH: American Conference of Governmental Industrial Hygienists

CMRG: Chemical Manufacturer Recommended Guideline

OSHA: Occupational Safety and Health Administration

AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	Liquid
Odor, Color, Grade:	clear colorless, low odor.
General Physical Form:	Liquid
Autoignition temperature	Not Applicable
Flash Point	Not Applicable
Flammable Limits - LEL	[Details: Nonflammable]
Flammable Limits - UEL	[Details: Nonflammable]
Boiling point	49 °C
Vapor Density	11.6 [Ref Std: AIR=1]
Vapor Pressure	244 mmHg [@ 20 °C]
Specific Gravity	1.6 [Ref Std: WATER=1]
pH	Not Applicable
Melting point	-108 °C
Solubility in Water	Nil
Evaporation rate	> 1 [Ref Std: BUOAC=1]
Volatile Organic Compounds	1600 g/l [Test Method: calculated SCAQMD rule 443.1]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	1600 g/l [Test Method: calculated SCAQMD rule 443.1]
Viscosity	0.6 centipoise [@ 25 °C]

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases; Amines; Alcohols Additional Information: Listed materials to avoid should not be mixed with liquid Novec 1230 fluid. Avoid direct sunlight and ultraviolet light.

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Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

<u>Substance</u>	<u>Condition</u>
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion
Hydrogen Fluoride	During Combustion

Hazardous Decomposition: Hydrogen fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time-Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Please refer to existing literature on TFA

CHEMICAL FATE INFORMATION

Photolytic half-life: 3-5 days.

Photolytic degradation products may include Trifluoroacetic acid (TFA)

NOTE: Hydrolysis is not expected to be a significant degradation pathway. Product is highly insoluble in water and volatile, and use as a clean extinguishing agent would not typically result in releases to aquatic environments.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF. Facility must be capable of handling halogenated materials.

As a disposal alternative, dispose of waste product in a facility permitted to accept chemical waste. Reclaim if feasible. For information on product return, contact your distributor.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14: TRANSPORT INFORMATION

ID Number(s):

98-0212-3031-7, 98-0212-3201-6, 98-0212-3203-2, 98-0212-3217-2, 98-0212-3371-7, 98-0212-3414-5

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3M MATERIAL SAFETY DATA SHEET 3M(TM) Novec (TM) 1230 Fire Protection Fluid [FK-5-1-12] 04/09/2007

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS

Contact 3M for more information.

311/312 Hazard Categories:

Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - No Delayed Hazard - No

STATE REGULATIONS

Contact 3M for more information.

CHEMICAL INVENTORIES

The components of this product are in compliance with the chemical notification requirements of TSCA.

One or more of the components of this product have been notified to ELINCS (European List of Notified or New Chemical Substances). Certain restrictions apply. Contact the selling division for additional information.

All the components of this product are listed on China's Inventory of Chemical Substances.

The components of this material are in compliance with the new chemical notification requirements for the Korean Existing Chemicals Inventory.

Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical notification requirements of the National Industrial Chemical Notification and Assessment Scheme (NICNAS) of Australia, the Canadian Environmental Protection Act (CEPA) and the Ministry of Economy, Trade and Industry of Japan.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

ADDITIONAL INFORMATION

U.S. EPA. Significant New Alternatives Policy Program (SNAP) approved for uses is streaming and flooding fire protection

Material Safety Data Sheet

3M MATERIAL SAFETY DATA SHEET 3M(TM) Novec (TM) 1230 Fire Protection Fluid [FK-5-1-12] 04/09/2007

application.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION**NFPA Hazard Classification**

Health: 3 Flammability: 0 Reactivity: 1 Special Hazards: None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification

Health: 0 Flammability: 0 Reactivity: 1 Protection: X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:

Section 1: Product use information was modified.

Copyright was modified.

Section 14: ID Number(s) was modified.

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3M MSDSs are available at www.3M.com

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Material Safety Data Sheet

NOTES:



General Information

3M™ NOVEC™ 1230 FIRE PROTECTION FLUID

General Information

3M™ Novec™ 1230 Fire Protection Fluid has been developed as an alternative to Halon 1301, production of which has ceased at the end of 1993, under the agreed adjustments made to the Montreal Protocol in Nov. 1992.

Novec 1230 contains no Bromine or Chlorine and has no ozone depleting potential.

Novec 1230 systems utilize one or more storage containers arranged to provide the protected area with a pre-determined quantity of agent.

Novec 1230 storage containers are designed to hold Novec 1230 in liquid form. Nitrogen is used to super-pressurize the container to 360 psi (24.8 bar) at 70 °F (21 °C).

Handling and installation of Novec 1230 equipment should only be conducted by persons trained in dealing with this type of equipment.

Under normal conditions Novec 1230 is a colorless and low odor fluid with a density around 11 times greater than air. It has negligible vapor pressure and is super-pressurized with nitrogen to 360 psi (24.8 bar) when used in fire suppression applications.

It contains no particulates or oily residues and is produced under ISO 9001 guidelines to strict manufacturing specifications ensuring product purity.

Present understanding of Novec 1230 is that fire suppression is through heat absorption and chemical means.

Novec 1230 decomposes at temperatures in excess of 932 °F (500°C) and it is therefore important to avoid applications involving hazards where continuously hot surfaces are involved. Upon exposure to the flame, Novec 1230 will decompose to form halogen acids. Their presence will be readily detected by a sharp, pungent odor before maximum hazardous exposure levels are reached.

Storage and Handling Recommendations

The unique properties of Novec 1230 fluid necessitate the user to follow certain handling and storage guidelines. Failure to follow these recommendations may result in contamination of the agent and potential failure of the system in which it is used. Contact with water or solvents either polar or hydrocarbon could render Novec 1230 fluid ineffective. Novec 1230 fluid should not be mixed with other extinguishing agents (liquid, powder, or foam) without consulting ANSUL to determine compatibility.

Novec 1230 fluid should be stored indoors, out of direct sunlight at temperatures below 104 °F (40 °C). If container must be stored outdoors, confirm that all openings are fully closed. Protect container from direct sunlight and precipitation to every extent possible, and fully dry the exterior of the container prior to opening.

Based on the results of accelerated aging studies, Novec 1230 fluid is expected to have a shelf life and perform as a clean agent for at least 30 years in a properly designed, maintained, and operating fire suppression system, provided the agent has been stored and handled in accordance with the information provided in this manual.

Novec 1230 fluid is a liquid at room temperature allowing it to be transferred using conventional pumping or gravity transfer through a closed system. Novec 1230 fluid has a viscosity similar to water. Consequently, it can be transferred using any pump that would be used to transport a low viscosity, nonflammable liquid. A gravity feed method may also be used to fill the system tanks, in lieu of pumping. If using a pump, it is recommended that an inline filter (equal to or less than 20 microns) be used when filling container.

Standards used by the fire protection industry typically specify that clean agents meet certain standards of quality. In order to maintain the low water content of the original Novec 1230 fluid, procedures must be used to prevent the entry of moist, ambient air into the storage containers. When transferring fluid, the receiving containers should be free of water and purged with dry nitrogen prior to filling with Novec 1230 fluid to remove moisture-laden air. The end of the fluid dispensing pipe must extend into the receiving container. The dispensing container should be fitted with a vent drier or nitrogen purge to prevent the influx of moist air as Novec 1230 fluid is withdrawn. Vent driers employing disposable or refillable desiccant cartridges are available from vendors such as W.A. Hammond Drierite Co. Ltd. Alternatively, a nitrogen purge can be set up by installing a "tee" onto the vent bung of the dispensing container and establishing flow of dry nitrogen at a volumetric flow rate that is in excess of the rate of withdrawal of Novec 1230 fluid from the container.

Good industrial hygiene practices should be followed when handling Novec 1230 fluid. Novec 1230 fluid must be used in a well-ventilated area. Provide local exhaust ventilation at transfer points. If adequate ventilation cannot be accomplished to maintain air concentrations below the recommended exposure guideline, use respiratory protection. The use of vented goggles for eye protection is required when handling Novec 1230 fluid. Always wear gloves when handling Novec 1230 fluid. Gloves made from butyl rubber are recommended. For more specific information regarding the use of Novec 1230 fluid, refer to the Material Safety Data Sheet.

Disposal Recommendations

Novec 1230 fluid may be disposed using an approved industrial or commercial incinerator. Since Novec 1230 fluid is nonflammable, it must be burned in the presence of a combustible material. Refer to the Material Safety Data Sheet, Section II, for additional details.

SECTION III

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REV. 3

General Information

3M™ NOVEC™ 1230 FIRE PROTECTION FLUID (Continued)

Health and Safety

A properly designed and installed suppression system should not present any significant health or safety problems. However, there are basic precautions to be taken to avoid accidents, and aspects of the system operation that should be understood.

Reference should be made to NFPA 2001 for the toxic and asphyxiating hazards of clean agent replacement.

Novec 1230 agent has acceptable toxicity for use in occupied spaces when used as specified in the United States Environmental Protection Agency (EPA) proposed Significant New Alternative Policy (SNAP) program rules and NFPA 2001, "Clean Agent Fire Extinguishing Systems."

Novec 1230 fluid extinguishes fires via its cooling effect, not by displacement of oxygen as is the extinguishment mechanism of CO₂, thus providing the ability to utilize Novec 1230 fluid in occupied areas.

Therefore, exposure to Novec 1230 at the design concentration of up to 10.0% is not a hazard to health. Exposure to higher concentrations is permissible for limited periods. Refer to NFPA 2001 for exposure requirements. As with halons, the EPA and the National Fire Protection Association (NFPA) recommend that unnecessary exposure to any agent be avoided and that personnel evacuate protected areas as quickly as possible to avoid the decomposition products of the fire.

Novec 1230 can decompose at high temperatures to form acids. If so, their presence is readily detected as a sharp, pungent odor long before hazardous maximum exposure levels are reached.

The noise created by the Novec 1230 agent discharging can be loud enough to startle people in the vicinity, but is unlikely to cause any permanent injury. Turbulence caused by the high velocity discharge can dislodge substantial objects directly in its path, and cause general turbulence within the protected area to move paper and light objects.

Direct contact with the vaporizing liquid discharged from a Novec 1230 nozzle has a chilling effect on objects and in extreme cases can cause frostbite to the skin. The liquid phase vaporizes rapidly when mixed with air and therefore limits the risk to the immediate vicinity of the nozzle. Reduction in visibility will occur due to the condensation of water vapor.

CAUTION

The discharge of clean agent systems to extinguish a fire can result in a potential hazard to personnel from the natural form of the clean agent or from the products of combustion that result from exposure of the agent to the fire or hot surfaces. Unnecessary exposure of personnel either to the products of decomposition shall be avoided.

DESCRIPTION OF SAPPHIRE SYSTEMS

SAPPHIRE systems are designed to suppress fires in Class A, B, and C hazards.

Novec 1230 suppress fires by a combination of physical and chemical means. It does not significantly deplete the oxygen content in the room.

A system comprises one or more containers connected to a system of piping and nozzles. Novec 1230 is liquid under pressure and is stored in steel containers, each of which is fitted with a valve specially designed to allow the contents of the container to discharge within 10 seconds. When the valve opens, Novec 1230 flows into the distribution piping to the discharge nozzles where it is rapidly dispersed as a vapor.

Discharged Novec 1230 gives the appearance of a fog which may reduce visibility. This normally clears rapidly and should not obstruct the ability of personnel to safely exit the protected area.

SAPPHIRE Engineered Fire Suppression Systems are particularly valuable in extinguishing fires in enclosures containing hazards or equipment where a clean, electrically non-conductive medium is essential or where the cleaning up of foam, water or dry chemical would be a problem.

APPROVALS

The SAPPHIRE Fire Suppression System has been tested and listed by Underwriters Laboratories, Inc. (EX-4510) and Underwriters Laboratories of Canada (CEX1151) as well as Factory Mutual (FM) as an engineered system for Class A, B, and C fire suppression, at temperatures between 32 °F to 130 °F (0 °C to 55 °C).

General Information

TYPE OF SYSTEM

Total flooding is the approved type of system available. A total flooding system normally consists of a fixed supply of Novec 1230 agent connected to piping with nozzles to direct the agent into an enclosed hazard space. In a total flooding system, the enclosure around the hazard must be tight enough to hold the required percentage of Novec 1230 agent concentration for a period of time to extinguish the fire.

TYPES OF ACTUATION

There are three basic types of actuation for the SAPPHIRE systems: pneumatic, mechanical, and electric.

Electrical

Automatic electric actuation of the cylinder valve, through an approved control panel, can be accomplished by using an electric actuator. The actuator is energized by an electric signal from the detection/control panel. When using the electric actuator, a mechanical actuating device can be attached as a secondary means of actuation. When using electric actuation, a means of manual release must also be provided.

Mechanical

Mechanical actuation is accomplished by means of a local manual actuator mounted on top of the tank valve or on top of the electric actuator. The tank is actuated by removing the safety pin on the actuator and depressing the strike knob. The pin in the actuator opens the tank valve, allowing the tank to discharge the agent.

Pneumatic

Pneumatic actuation utilizes nitrogen gas pressure from a cartridge located in a releasing device such as an ANSUL AUTOMAN II-C release. The gas pressure forces the pneumatic actuator, located on the tank valve, down, which in turn forces the cylinder valve open, releasing the Novec 1230 agent from the tank, through the piping and out the nozzles.

TYPES OF DETECTION

There are two approved types of detection available for the SAPPHIRE system: electronic control panel and electric releasing device.

Electronic Control Panel

Electric actuation of the SAPPHIRE system is obtained through the use of electronic control systems that monitor and control various system functions. All detection equipment must be installed according to NFPA 70 and NFPA 72. detection devices available are: ionization smoke detectors, photoelectric smoke detectors, flame detectors, and rate compensated heat detectors. Note: When designing the system, make certain the type of detector used is appropriate for the type of hazard so proper response is attained in a fire situation. When a detector senses a fire, a signal is sent to the control panel. The panel in turn sends an electrical signal to the actuator located on the master tank valve. The actuator opens the master valve, actuating that tank and causing pneumatic actuation of the remaining tanks from the pressure of the master tank.

Electric Release Device

The ANSUL AUTOMAN II-C electric releasing device uses approved thermal detectors and actuates the SAPPHIRE tanks pneumatically, utilizing high-pressure nitrogen to open the tank valve.

SYSTEM LIMITATIONS

SAPPHIRE engineered systems are based on a Hydraulic Flow Program developed by Hughes Associates Inc. The program predicts the two-phase flow of Novec 1230 agent and nitrogen through a pipe network. Information detailing the enclosure is entered and the program calculates the required pipe sizes, nozzle drill sizes, average nozzle pressures and discharge time.

As system design calculations are critical to the success of the suppression system, only ANSUL or ANSUL trained personnel are authorized to perform system calculations.

NOTICE

The calculation method has been designed for specific types of fittings, pipe, and pipe I.D. When these limitations are not maintained, there is a risk that the system will not supply the required quantity of extinguishing agent.

SECTION III

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REV. 2

General Information

SYSTEM LIMITATIONS (Continued)

Design/Flow Calculation Limitations

- System Operating Temperature: 32 °F to 130 °F (0 °C to 54 °C)
- Minimum Design Concentration: Class A, 4.2% – Class B, contact Ansul Technical Services for specific fuel design concentrations
- Fill Density: Maximum 75 lb/ft³ (34.0 kg/m³), Minimum 31.0 lb/ft³ (14.1 kg/m³)
- Discharge Time: Maximum 10 seconds, Minimum 6 seconds
- Maximum Arrival Imbalance: 1 second
- Maximum Runout Imbalance: 2 seconds
- Maximum Pipe Volume to Cylinder Liquid Volume: 80%
Minimum Pipe Volume Ratio Before First Tee: 10%

Nozzle Area Ratio:

Maximum All Size Nozzles	Minimum 1/2 in. Nozzle	All Other Sizes
80%	10%	20%

- Minimum Nozzle Pressure: 73 psi (5.0 bar)
- Flow Rate Limit:

Pipe Diameter	Minimum Flow Rate		Maximum Flow Rate	
	lb/s	(kg/s)	lb/s	(kg/s)
1/2 in.	1.0	(0.5)	3.0	(1.4)
3/4 in.	2.0	(0.9)	5.5	(2.5)
1 in.	3.5	(1.6)	8.5	(3.9)
1 1/4 in.	6.0	(2.7)	12.5	(5.7)
1 1/2 in.	9.0	(4.1)	20.0	(9.1)
2 in.	14.0	(6.4)	30.0	(13.6)
2 1/2 in.	20.0	(9.1)	55.0	(24.9)
3 in.	30.0	(13.6)	90.0	(40.8)
4 in.	55.0	(24.9)	125.0	(56.7)
5 in.	90.0	(40.8)	200.0	(90.7)
6 in.	120.0	(54.4)	300.0	(136.1)

- Maximum Allowed Split Through a Tee:

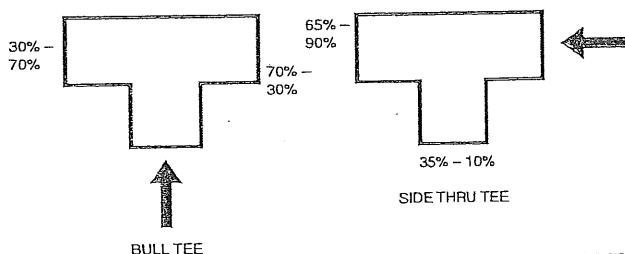


FIGURE 1
002201

- Maximum nozzle height above floor level for a single row of nozzles is 14 ft (4.3 m). For ceiling heights over 14 ft (4.3 m), additional rows of nozzles may be added.
- Nozzles to be located a maximum of 12 in. (30.5 cm) down from the ceiling, positioned vertically (either up or down). Exception: Sub-floor nozzles may be positioned either vertically down from the top of the sub-floor or vertically up from the bottom of the sub-floor.
- Maximum Area Nozzle Coverage: 1800 ft² (167.2 m²)
- Minimum Ceiling Height: 12 in. (30.5 cm)
- Piping/Tee Orientation:

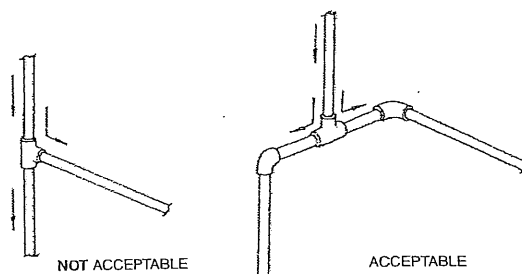
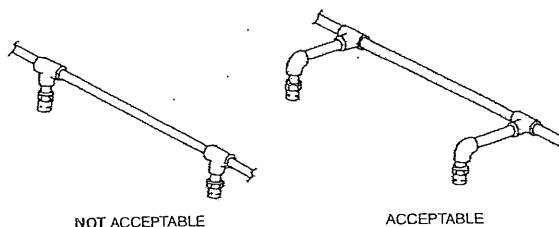
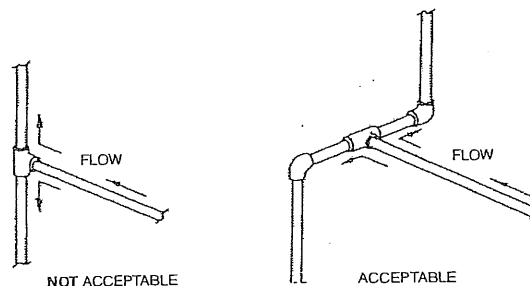


FIGURE 2
006903

- Critical Pipe Length Before and After a Tee Split:
Minimum of 10 pipe diameters

SECTION III

UL EX-4510 4-1-05 Page 3-5
REV. 1

General Information

SYSTEM LIMITATIONS (Continued)

Design/Flow Calculation Limitations (Continued)

• Maximum Elevation Difference in Pipe Runs:

- Statement No. 1. If nozzles are only located **above** the tank outlet, then the maximum elevation difference between the tank outlet and the furthest horizontal pipe run or discharge nozzle (whichever is furthest) shall not exceed 30 ft. (9.1 m). See Figure 3.
- Statement No. 2. If nozzles are only located **below** the tank outlet, then the maximum elevation difference between the tank outlet and the furthest horizontal pipe run or discharge nozzle (whichever is furthest) shall not exceed 30 ft. (9.1 m). See Figure 3.
- Statement No. 3. If nozzles are located both **above and below** the tank outlet, then the maximum elevation difference between the furthest horizontal pipe runs or discharge nozzles (whichever is furthest) shall not exceed 30 ft. (9.1 m). See Figure 3.

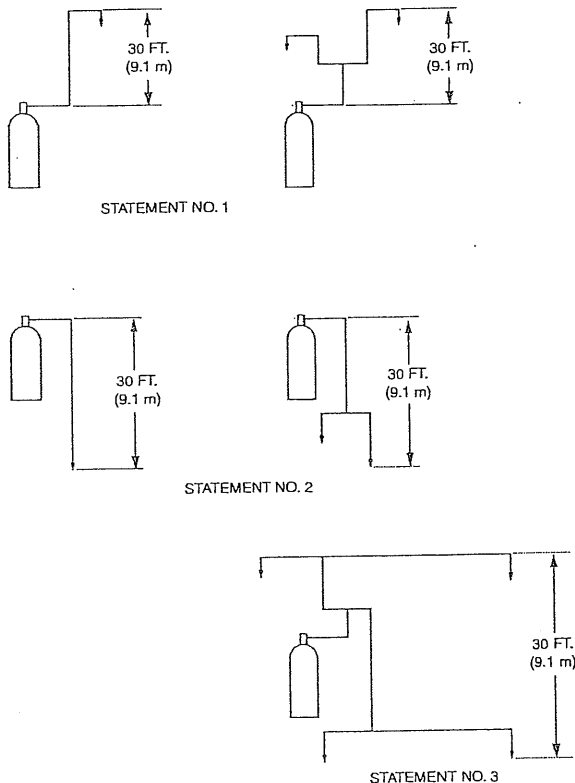


FIGURE 3
006050

- Manifolding: All tanks on the same manifold must be the same size and fill weight.
- The calculation method has been designed for specific types of fittings, pipe, and pipe inside diameter. When these limitations are not maintained, there is a risk that the system will not supply the required quantity of extinguishing agent.
- Minimum Class A design concentration: 4.2%
- Maximum design concentration for occupied spaces: 10%
- The SAPPHERE Designer Program is designed for a +70 °F (+21 °C) tank operating/storage temperature. Therefore, the tank operating/storage temperature must be in the range of +60 °F to +80 °F (+15.5 °C to 26.7 °C) for a single system protecting two or more separate hazards. If the tank operating/storage temperature is outside this range, an insufficient or excessive quantity of agent may be discharged from one or more discharge nozzles. If tanks cannot be stored within this range, then each hazard must be protected with its own individual system.



Inspection

Inspection is a "quick check" that a system is operable. It is intended to give reasonable assurance that the system is fully charged and will operate. This is done by seeing that the system has not been tampered with and there is no obvious physical damage, or condition, to prevent operation. The value of an inspection lies in the frequency, and thoroughness, with which it is conducted. Systems should be inspected at regular monthly intervals, or at more frequent intervals when circumstances require.

The following visual checks should be performed during a SAPPHIRE system inspection:

- Visually inspect the hazard area to verify that it has not changed. Look for different fuels, new equipment, blocked open doors or dampers.
- Check detectors to make certain they are in place, not damaged or coated with dirt, grease, paint, or any contaminating substance.
- Check all manual pull stations to assure they have not been tampered with and are not blocked from use.
- Check all alarm devices for damage, dirt, corrosion, etc.
- Check that the piping is secure and nozzles are in place. Make certain the nozzles are not covered with dirt, grease, or paint and that there is nothing structural blocking the discharge.
- Visually inspect all components for signs of damage, such as disconnected or loose parts, corrosion, twisted or dented components, etc.
- Check each SAPPHIRE tank gauge to determine that tank pressure is in the operable range.
- Visually verify that the control panel and/or releasing device is functioning properly.
- Perform any other checks that may be required by the authority having jurisdiction.
- Record that the system has been inspected and inform the proper personnel.



SECTION VIII

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REV. 1

Maintenance

ANNUAL MAINTENANCE EXAMINATION

Systems shall be maintained at regular intervals, not more than one year apart, or when specifically indicated by an inspection. **Exception:** Tank pressure and agent quantity shall be checked every six months per NFPA 2001.

Maintenance is a "thorough check" of the system. It is intended to give maximum assurance that a system will operate effectively and safely. It includes a thorough examination and any necessary repair, recharge, or replacement. It will reveal if there is a need for hydrostatic testing of the tank. The procedures listed in this section are the minimum that are necessary to maintain a system. If circumstances warrant them, a more thorough procedure should be followed to assure system performance. Make certain that all people affected by the maintenance are informed before you start. This may include the owner, security personnel, the local Fire Department, and possibly local workers that may be affected by equipment shutdown or start up.

NOTICE

If the system includes an ANSUL AUTOMAN II-C releasing device, before proceeding with annual maintenance examination, insert lock pin in ANSUL AUTOMAN II-C release and remove nitrogen cartridge. Install safety shipping cap on cartridge.

1. Survey the hazard to make certain it has not changed from what the system was designed to protect. While surveying the hazard, look for different fuels, loss of hazard integrity, new hazards, etc.
2. Check all nozzles to make certain they are in place. Check the condition of the nozzle for corrosion or damage and make certain it is not obstructed internally or externally.
3. Check the condition of the piping to make certain that it is properly secured in the hangers and that all fittings are connected tightly.
4. Check all warning nameplates (signs) throughout the area. Make certain they are in place, mounted securely, readable, and are not damaged.
5. Check all tank bracketing. Make certain all tanks are secured in the brackets. Check for corrosion, damage, or missing components.

6. Check the condition of all tanks. Look for signs of damage or corrosion, and check the tank's last hydro date. (NFPA 2001 states "Cylinders continuously in service without discharging shall be given a complete external visual inspection every five years or more frequently if required. The visual inspection shall be in accordance with Compressed Gas Association Pamphlet C-6, Section 3; except that the cylinders need not be emptied or stamped while under pressure.") Refer to NFPA 2001, Chapter 4 Inspection, Maintenance, Testing, and Training, for hydro requirements.

7. Check condition of all tank discharge hoses. Look for signs of structural problems like abrasions or weather checking. Make certain all hoses are connected properly. All hoses must be tested every 5 years. Refer to NFPA 2001, Chapter 4 Inspection, Maintenance, Testing, and Training, for detailed testing requirements.

8. Check condition of all actuators by completing the following:

- Remove all actuators from the tank valves (electric, manual, and pneumatic) and leave them off until the final step in Maintenance Section.
- For pneumatic actuators, check the condition of each actuator to make certain they operate freely. When finished, reset the pin in the up position. **Do not install on tank valves.**
- For electric actuators, make certain all wires are properly connected. **Do not install on tank valves.**

NOTICE

Before proceeding with Step No. 9, make certain all electric actuators have been removed from all valves and that the nitrogen cartridge has been removed from the ANSUL AUTOMAN II-C release and that the locking pin in the release mechanism has also been removed.

SECTION VIII

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Maintenance

ANNUAL MAINTENANCE EXAMINATION (Continued)

9. Tank Weighing – Option 1

Tanks must be weighed (without liquid level indicator) to determine agent quantity. The weighing procedure is as follows:

- Remove all manual controls, actuators and actuation pipe or tubing and flexible electrical connectors.
- Disconnect and remove discharge piping/discharge hoses from tank valves.
- Install Safety Outlet Caps onto tank valves.
- Remove tanks from bracketing and weigh tanks. Any tank showing more than the maximum allowable weight loss must be recharged by a qualified recharge agent.
- Record weight of tank on record tag.
- Replace tanks in bracketing and remove Safety Outlet Caps.
- Reconnect discharge piping/discharge hoses and all control heads, pressure actuators, pressure actuation pipe or tubing and flexible electric connectors.

9a. Tank Weighing – Option 2

Determine agent quantity using liquid level indicator. The liquid level indicator is used to determine the liquid level in 280, 390, 450 and 850 lb. tanks. During a maintenance examination, the indicator will enable a service representative to convert a linear measurement to agent weight in order to determine if the tank has any weight loss. This measurement is accomplished without removing the tank from the fire suppression system.

To measure the liquid agent level:

- a. Remove the protective cap from the measuring device housing.
- b. Lift the measuring tape to the end (or approximately 3 in. above the expected level). Slowly lower the tape until a magnetic interlock is felt. See Figure 1.

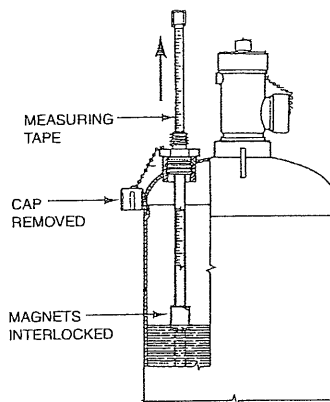


FIGURE 1
006255

- c. Read the measurement on the tape directly at the top of the plastic sleeve in the measuring device housing (see Figure 2). Record this measurement and note the temperature of the tank module.

NOTICE

The tank module temperature can be determined by measuring the ambient temperature at the tank location. The tank must be stored at this temperature for at least 24 hours to obtain an accurate liquid level reading.

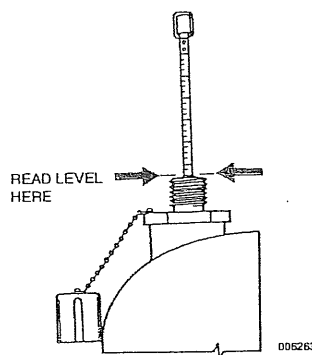


FIGURE 2
006263

- d. To reinstall tape, quickly pull on the tape to disengage the magnetic interlock. Then slide the tape into the housing and replace the protective cap.

SECTION VIII

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Maintenance

ANNUAL MAINTENANCE EXAMINATION (Continued)

- e. Using the Agent Quantity Table(s) located in this section, determine the weight of charge as follows:
 - Find the liquid level reading along the left hand vertical line of the table.
 - From that point, follow the horizontal line to the point where it intersects with the temperature column (using the tank temperature noted in Step c).
 - Read the weight of Novec 1230 agent at the level/temperature column intersection.
- f. Compare the weight from the table to the weight of charge stamped on the tank nameplate. If the measurement shows a net weight loss of more than 5%, the tank must be weighed to verify the liquid level measurement. If the weight loss still exceeds 5% of the weight of charge, the tank requires recharging.
10. Check condition of control panel for tampering, corrosion, or damage. Test panel at this point by referring to the appropriate AUTOPULSE Control System manual. Note: If system includes an ANSUL AUTOMAN II-C release, make certain cartridge is removed, release is cocked, and locking pin is not in place before each test.
11. Check all detectors. Make certain they are in place, clean, and not damaged. If required, check the sensitivity of each per the instructions of the detector manufacturer. See appropriate AUTOPULSE Control System manual for detailed instructions.
12. Check all pull stations. Make certain they are in place, that they are not blocked or damaged. Operate each pull station to make certain that they operate the control panel. Reset each pull station.
13. While checking the detectors and electric pull stations, inspect each alarm device. Check the alarm's condition and verify that they operate properly when energized. Reset the alarm circuit after each test.
14. If the system includes an ANSUL AUTOMAN, check release by completing the following:
 - Make certain locking pin is not in place, and manually test release by operating the "STRIKE" button on the release mechanism.
 - Cock ANSUL AUTOMAN II-C release using cocking lever, Part No. 26310, and install locking pin.
 - Remove gasket from cartridge receiver in ANSUL AUTOMAN II-C release mechanism. Check gasket for elasticity or cuts and replace if necessary. Clean and coat gasket lightly with a good grade of extreme temperature grease such as Dow Corning No. 4. Reinstall gasket into cartridge receiver. **Do not install cartridge at this time.**
15. When all tests are complete, reset control panel and all accessory electrical equipment.
16. Make certain all electric and pneumatic actuators are reset.
17. Install all electric and pneumatic actuators on tank valves. Hand tighten.
18. Install nitrogen cartridge in ANSUL AUTOMAN II-C release by completing the following:
 - Make certain release mechanism is cocked and locking bar is in place.
 - Remove shipping cap and weigh nitrogen cartridge. Replace if weight is 1/2 oz. (14.2 g), or more, below the weight stamped on the cartridge.
 - Screw cartridge into release mechanism, hand tighten.
 - Remove locking pin.
 - Close cover on enclosure, install locking pin through "STRIKE" button, and secure with visual seal, Part No. 197.
19. Record annual maintenance date on tag attached to unit and/or in a permanent file.
20. Inform proper personnel that the system is back in service.

SECTION VIII

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Maintenance

280 POUND NO. 2 TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
6	110.7	109.1	107.5	105.9	104.3	102.8	101.2	99.6	98.0	96.3	94.7	93.0	91.4	89.8
6.25	113.3	111.8	110.2	108.6	107.0	105.5	103.9	102.3	100.7	99.0	97.4	95.7	94.0	92.4
6.5	116.0	114.4	112.9	111.3	109.8	108.2	106.6	105.1	103.4	101.7	100.0	98.4	96.7	95.0
6.75	118.7	117.1	115.6	114.0	112.5	110.9	109.4	107.8	106.1	104.4	102.7	101.0	99.3	97.6
7	121.3	119.8	118.2	116.7	115.2	113.6	112.1	110.5	108.8	107.1	105.4	103.7	102.0	100.3
7.25	124.0	122.5	120.9	119.4	117.9	116.3	114.8	113.3	111.5	109.8	108.1	106.3	104.6	102.9
7.5	126.7	125.1	123.6	122.1	120.6	119.0	117.5	116.0	114.2	112.5	110.8	109.0	107.3	105.5
7.75	129.3	127.8	126.3	124.8	123.3	121.8	120.2	118.7	117.0	115.2	113.4	111.7	109.9	108.1
8	132.0	130.5	129.0	127.5	126.0	124.5	123.0	121.5	119.7	117.9	116.1	114.3	112.5	110.8
8.25	134.7	133.2	131.7	130.2	128.7	127.2	125.7	124.2	122.4	120.6	118.8	117.0	115.2	113.4
8.5	137.3	135.8	134.4	132.9	131.4	129.9	128.4	126.9	125.1	123.3	121.5	119.6	117.8	116.0
8.75	140.0	138.5	137.0	135.6	134.1	132.6	131.1	129.7	127.8	126.0	124.1	122.3	120.5	118.6
9	142.7	141.2	139.7	138.3	136.8	135.3	133.9	132.4	130.5	128.7	126.8	125.0	123.1	121.2
9.25	145.3	143.9	142.4	141.0	139.5	138.0	136.6	135.1	133.3	131.4	129.5	127.6	125.7	123.9
9.5	148.0	146.6	145.1	143.7	142.2	140.8	139.3	137.9	136.0	134.1	132.2	130.3	128.4	126.5
9.75	150.7	149.2	147.8	146.4	144.9	143.5	142.0	140.6	138.7	136.8	134.9	132.9	131.0	129.1
10	153.3	151.9	150.5	149.0	147.6	146.2	144.8	143.3	141.4	139.5	137.5	135.6	133.7	131.7
10.25	156.0	154.6	153.2	151.7	150.3	148.9	147.5	146.1	144.1	142.2	140.2	138.3	136.3	134.4
10.5	158.7	157.3	155.8	154.4	153.0	151.6	150.2	148.8	146.8	144.9	142.9	140.9	139.0	137.0
10.75	161.3	159.9	158.5	157.1	155.7	154.3	152.9	151.5	149.5	147.6	145.6	143.6	141.6	139.6
11	164.0	162.6	161.2	159.8	158.4	157.0	155.7	154.3	152.3	150.3	148.3	146.2	144.2	142.2
11.25	166.7	165.3	163.9	162.5	161.1	159.8	158.4	157.0	155.0	153.0	150.9	148.9	146.9	144.9
11.5	169.3	168.0	166.6	165.2	163.8	162.5	161.1	159.7	157.7	155.6	153.6	151.6	149.5	147.5
11.75	172.0	170.6	169.3	167.9	166.6	165.2	163.8	162.5	160.4	158.3	156.3	154.2	152.2	150.1
12	174.7	173.3	172.0	170.6	169.3	167.9	166.5	165.2	163.1	161.0	159.0	156.9	154.8	152.7
12.25	177.3	176.0	174.6	173.3	172.0	170.6	169.3	167.9	165.8	163.7	161.6	159.5	157.5	155.4
12.5	180.0	178.7	177.3	176.0	174.7	173.3	172.0	170.7	168.5	166.4	164.3	162.2	160.1	158.0
12.75	182.7	181.3	180.0	178.7	177.4	176.0	174.7	173.4	171.3	169.1	167.0	164.9	162.7	160.6
13	185.3	184.0	182.7	181.4	180.1	178.8	177.4	176.1	174.0	171.8	169.7	167.5	165.4	163.2
13.25	188.0	186.7	185.4	184.1	182.8	181.5	180.2	178.9	176.7	174.5	172.4	170.2	168.0	165.9
13.5	190.7	189.4	188.1	186.8	185.5	184.2	182.9	181.6	179.4	177.2	175.0	172.9	170.7	168.5
13.75	193.3	192.1	190.8	189.5	188.2	186.9	185.6	184.3	182.1	179.9	177.7	175.5	173.3	171.1
14	196.0	194.7	193.4	192.2	190.9	189.6	188.3	187.1	184.8	182.6	180.4	178.2	176.0	173.7

SECTION VIII

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Maintenance

280 POUND NOVEC TANK AGENT QUANTITY TABLES (Continued)

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
14.25	198.7	197.4	196.1	194.9	193.6	192.3	191.1	189.8	187.6	185.3	183.1	180.8	178.6	176.4
14.5	201.3	200.1	198.8	197.6	196.3	195.0	193.8	192.5	190.3	188.0	185.8	183.5	181.2	179.0
14.75	204.0	202.8	201.5	200.3	199.0	197.8	196.5	195.3	193.0	190.7	188.4	186.2	183.9	181.6
15	206.7	205.4	204.2	203.0	201.7	200.5	199.2	198.0	195.7	193.4	191.1	188.8	186.5	184.2
15.25	209.3	208.1	206.9	205.6	204.4	203.2	202.0	200.7	198.4	196.1	193.8	191.5	189.2	186.8
15.5	212.0	210.8	209.6	208.3	207.1	205.9	204.7	203.5	201.1	198.8	196.5	194.1	191.8	189.5
15.75	214.7	213.5	212.3	211.0	209.8	208.6	207.4	206.2	203.8	201.5	199.1	196.8	194.4	192.1
16	217.3	216.1	214.9	213.7	212.5	211.3	210.1	208.9	206.6	204.2	201.8	199.5	197.1	194.7
16.25	220.0	218.8	217.6	216.4	215.2	214.0	212.9	211.7	209.3	206.9	204.5	202.1	199.7	197.3
16.5	222.7	221.5	220.3	219.1	217.9	216.8	215.6	214.4	212.0	209.6	207.2	204.8	202.4	200.0
16.75	225.3	224.2	223.0	221.8	220.6	219.5	218.3	217.1	214.7	212.3	209.9	207.4	205.0	202.6
17	228.0	226.8	225.7	224.5	223.4	222.2	221.0	219.9	217.4	215.0	212.5	210.1	207.7	205.2
17.25	230.7	229.5	228.4	227.2	226.1	224.9	223.7	222.6	220.1	217.7	215.2	212.8	210.3	207.8
17.5	233.3	232.2	231.1	229.9	228.8	227.6	226.5	225.3	222.9	220.4	217.9	215.4	212.9	210.5
17.75	236.0	234.9	233.7	232.6	231.5	230.3	229.2	228.1	225.6	223.1	220.6	218.1	215.6	213.1
18	238.7	237.5	236.4	235.3	234.2	233.0	231.9	230.8	228.3	225.8	223.3	220.7	218.2	215.7
18.25	241.3	240.2	239.1	238.0	236.9	235.8	234.6	233.5	231.0	228.5	225.9	223.4	220.9	218.3
18.5	244.0	242.9	241.8	240.7	239.6	238.5	237.4	236.3	233.7	231.2	228.6	226.1	223.5	221.0
18.75	246.7	245.6	244.5	243.4	242.3	241.2	240.1	239.0	236.4	233.9	231.3	228.7	226.2	223.6
19	249.3	248.3	247.2	246.1	245.0	243.9	242.8	241.7	239.1	236.6	234.0	231.4	228.8	226.2
19.25	252.0	250.9	249.9	248.8	247.7	246.6	245.5	244.5	241.9	239.3	236.6	234.0	231.4	228.8
19.5	254.7	253.6	252.5	251.5	250.4	249.3	248.3	247.2	244.6	241.9	239.3	236.7	234.1	231.5
19.75	257.3	256.3	255.2	254.2	253.1	252.0	251.0	249.9	247.3	244.6	242.0	239.4	236.7	234.1
20	260.0	259.0	257.9	256.9	255.8	254.8	253.7	252.7	250.0	247.3	244.7	242.0	239.4	236.7
20.25	262.7	261.6	260.6	259.6	258.5	257.5	256.4	255.4	252.7	250.0	247.4	244.7	242.0	239.3
20.5	265.3	264.3	263.3	262.2	261.2	260.2	259.2	258.1	255.4	252.7	250.0	247.3	244.6	242.0
20.75	268.0	267.0	266.0	264.9	263.9	262.9	261.9	260.9	258.1	255.4	252.7	250.0	247.3	244.6
21	270.7	269.7	268.7	267.6	266.6	265.6	264.6	263.6	260.9	258.1	255.4	252.7	249.9	247.2
21.25	273.3	272.3	271.3	270.3	269.3	268.3	267.3	266.3	263.6	260.8	258.1	255.3	252.6	249.8
21.5	276.0	275.0	274.0	273.0	272.0	271.0	270.1	269.1	266.3	263.5	260.8	258.0	255.2	252.4
21.75	278.7	277.7	276.7	275.7	274.7	273.8	272.8	271.8	269.0	266.2	263.4	260.6	257.9	255.1
22	281.3	280.4	279.4	278.4	277.4	276.5	275.5	274.5	271.7	268.9	266.1	263.3	260.5	257.7
22.25	284.0	283.0	282.1	281.1	280.2	279.2	278.2	277.3	274.4	271.6	268.8	266.0	263.1	260.3

SECTION VIII

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Maintenance

280 POUND NOVOL TANK AGENT QUANTITY TABLES															
Liquid Level Inches	Temperature Degrees F (Degrees C)														
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)	
22.5	286.7	285.7	284.8	283.8	282.9	281.9	280.9	280.0	277.2	274.3	271.5	268.6	265.8	262.9	
22.75	289.3	288.4	287.5	286.5	285.6	284.6	283.7	282.7	279.9	277.0	274.1	271.3	268.4	265.6	
23	292.0	291.1	290.1	289.2	288.3	287.3	286.4	285.5	282.6	279.7	276.8	273.9	271.1	268.2	
23.25	294.7	293.7	292.8	291.9	291.0	290.0	289.1	288.2	285.3	282.4	279.5	276.6	273.7	270.8	
23.5	297.3	296.4	295.5	294.6	293.7	292.8	291.8	290.9	288.0	285.1	282.2	279.3	276.4	273.4	
23.75	300.0	299.1	298.2	297.3	296.4	295.5	294.6	293.7	290.7	287.8	284.9	281.9	279.0	276.1	
24	302.7	301.8	300.9	300.0	299.1	298.2	297.3	296.4	293.4	290.5	287.5	284.6	281.6	278.7	
24.25	305.3	304.5	303.6	302.7	301.8	300.9	300.0	299.1	296.2	293.2	290.2	287.2	284.3	281.3	
24.5	308.0	307.1	306.3	305.4	304.5	303.6	302.7	301.9	298.9	295.9	292.9	289.9	286.9	283.9	
24.75	310.7	309.8	308.9	308.1	307.2	306.3	305.5	304.6	301.6	298.6	295.6	292.6	289.6	286.6	
25	313.3	312.5	311.6	310.8	309.9	309.0	308.2	307.3	304.3	301.3	298.3	295.2	292.2	289.2	
25.25	316.0	315.2	314.3	313.5	312.6	311.8	310.9	310.1	307.0	304.0	300.9	297.9	294.8	291.8	
25.5	318.7	317.8	317.0	316.2	315.3	314.5	313.6	312.8	309.7	306.7	303.6	300.6	297.5	294.4	
25.75	321.3	320.5	319.7	318.8	318.0	317.2	316.4	315.5	312.4	309.4	306.3	303.2	300.1	297.1	
26	324.0	323.2	322.4	321.5	320.7	319.9	319.1	318.3	315.2	312.1	309.0	305.9	302.8	299.7	

SECTION VIII

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Maintenance

390 POUND NOVECTANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
7	147.8	146.0	144.2	142.5	140.7	138.9	137.1	135.4	134.5	133.7	132.8	132.0	131.1	130.3
7.25	150.7	148.9	147.1	145.3	143.5	141.7	139.9	138.1	137.2	136.3	135.4	134.6	133.7	132.8
7.5	153.6	151.8	150.0	148.1	146.3	144.4	142.6	140.8	139.9	139.0	138.1	137.2	136.3	135.4
7.75	156.6	154.7	152.8	151.0	149.1	147.2	145.3	143.5	142.5	141.6	140.7	139.8	138.9	137.9
8	159.5	157.6	155.7	153.8	151.9	150.0	148.1	146.2	145.2	144.3	143.3	142.4	141.4	140.5
8.25	162.5	160.5	158.6	156.6	154.7	152.7	150.8	148.9	147.9	146.9	146.0	145.0	144.0	143.1
8.5	165.4	163.4	161.5	159.5	157.5	155.5	153.5	151.6	150.6	149.6	148.6	147.6	146.6	145.6
8.75	168.4	166.3	164.3	162.3	160.3	158.3	156.3	154.3	153.2	152.2	151.2	150.2	149.2	148.2
9	171.3	169.2	167.2	165.2	163.1	161.1	159.0	157.0	155.9	154.9	153.9	152.8	151.8	150.8
9.25	174.2	172.2	170.1	168.0	165.9	163.8	161.7	159.7	158.6	157.5	156.5	155.4	154.4	153.3
9.5	177.2	175.1	172.9	170.8	168.7	166.6	164.5	162.4	161.3	160.2	159.1	158.0	157.0	155.9
9.75	180.1	178.0	175.8	173.7	171.5	169.4	167.2	165.0	163.9	162.8	161.7	160.6	159.5	158.4
10	183.1	180.9	178.7	176.5	174.3	172.1	169.9	167.7	166.6	165.5	164.4	163.2	162.1	161.0
10.25	186.0	183.8	181.6	179.3	177.1	174.9	172.7	170.4	169.3	168.2	167.0	165.9	164.7	163.6
10.5	189.0	186.7	184.4	182.2	179.9	177.7	175.4	173.1	172.0	170.8	169.6	168.5	167.3	166.1
10.75	191.9	189.6	187.3	185.0	182.7	180.4	178.1	175.8	174.6	173.5	172.3	171.1	169.9	168.7
11	194.8	192.5	190.2	187.9	185.5	183.2	180.9	178.5	177.3	176.1	174.9	173.7	172.5	171.2
11.25	197.8	195.4	193.1	190.7	188.3	186.0	183.6	181.2	180.0	178.8	177.5	176.3	175.0	173.8
11.5	200.7	198.3	195.9	193.5	191.1	188.7	186.3	183.9	182.7	181.4	180.2	178.9	177.6	176.4
11.75	203.7	201.2	198.8	196.4	193.9	191.5	189.1	186.6	185.4	184.1	182.8	181.5	180.2	178.9
12	206.6	204.1	201.7	199.2	196.7	194.3	191.8	189.3	188.0	186.7	185.4	184.1	182.8	181.5
12.25	209.5	207.0	204.5	202.0	199.5	197.0	194.5	192.0	190.7	189.4	188.0	186.7	185.4	184.1
12.5	212.5	210.0	207.4	204.9	202.3	199.8	197.3	194.7	193.4	192.0	190.7	189.3	188.0	186.6
12.75	215.4	212.9	210.3	207.7	205.1	202.6	200.0	197.4	196.1	194.7	193.3	191.9	190.6	189.2
13	218.4	215.8	213.2	210.6	207.9	205.3	202.7	200.1	198.7	197.3	195.9	194.5	193.1	191.7
13.25	221.3	218.7	216.0	213.4	210.7	208.1	205.5	202.8	201.4	200.0	198.6	197.1	195.7	194.3
13.5	224.3	221.6	218.9	216.2	213.6	210.9	208.2	205.5	204.1	202.6	201.2	199.7	198.3	196.9
13.75	227.2	224.5	221.8	219.1	216.4	213.6	210.9	208.2	206.8	205.3	203.8	202.4	200.9	199.4
14	230.1	227.4	224.6	221.9	219.2	216.4	213.7	210.9	209.4	207.9	206.5	205.0	203.5	202.0
14.25	233.1	230.3	227.5	224.7	222.0	219.2	216.4	213.6	212.1	210.6	209.1	207.6	206.1	204.5
14.5	236.0	233.2	230.4	227.6	224.8	221.9	219.1	216.3	214.8	213.2	211.7	210.2	208.6	207.1
14.75	239.0	236.1	233.3	230.4	227.6	224.7	221.9	219.0	217.5	215.9	214.3	212.8	211.2	209.7
15	241.9	239.0	236.1	233.3	230.4	227.5	224.6	221.7	220.1	218.6	217.0	215.4	213.8	212.2

Maintenance

390 POUND NOVOL TANK AGENT QUANTITY TABLES

Liquid Level Inches		Temperature Degrees F (Degrees C)													
		0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
15.25	244.8	241.9	239.0	236.1	233.2	230.2	227.3	224.4	222.8	221.2	219.6	218.0	216.4	214.8	
15.5	247.8	244.8	241.9	238.9	236.0	233.0	230.1	227.1	225.5	223.9	222.2	220.6	219.0	217.4	
15.75	250.7	247.7	244.8	241.8	238.8	235.8	232.8	229.8	228.2	226.5	224.9	223.2	221.6	219.9	
16	253.7	250.7	247.6	244.6	241.6	238.6	235.5	232.5	230.8	229.2	227.5	225.8	224.2	222.5	
16.25	256.6	253.6	250.5	247.4	244.4	241.3	238.3	235.2	233.5	231.8	230.1	228.4	226.7	225.0	
16.5	259.6	256.5	253.4	250.3	247.2	244.1	241.0	237.9	236.2	234.5	232.8	231.0	229.3	227.6	
16.75	262.5	259.4	256.2	253.1	250.0	246.9	243.7	240.6	238.9	237.1	235.4	233.6	231.9	230.2	
17	265.4	262.3	259.1	256.0	252.8	249.6	246.5	243.3	241.5	239.8	238.0	236.3	234.5	232.7	
17.25	268.4	265.2	262.0	258.8	255.6	252.4	249.2	246.0	244.2	242.4	240.6	238.9	237.1	235.3	
17.5	271.3	268.1	264.9	261.6	258.4	255.2	251.9	248.7	246.9	245.1	243.3	241.5	239.7	237.9	
17.75	274.3	271.0	267.7	264.5	261.2	257.9	254.7	251.4	249.6	247.7	245.9	244.1	242.2	240.4	
18	277.2	273.9	270.6	267.3	264.0	260.7	257.4	254.1	252.2	250.4	248.5	246.7	244.8	243.0	
18.25	280.2	276.8	273.5	270.1	266.8	263.5	260.1	256.8	254.9	253.0	251.2	249.3	247.4	245.5	
18.5	283.1	279.7	276.4	273.0	269.6	266.2	262.9	259.5	257.6	255.7	253.8	251.9	250.0	248.1	
18.75	286.0	282.6	279.2	275.8	272.4	269.0	265.6	262.2	260.3	258.3	256.4	254.5	252.6	250.7	
19	289.0	285.5	282.1	278.7	275.2	271.8	268.3	264.9	262.9	261.0	259.1	257.1	255.2	253.2	
19.25	291.9	288.4	285.0	281.5	278.0	274.5	271.1	267.6	265.6	263.6	261.7	259.7	257.7	255.8	
19.5	294.9	291.4	287.8	284.3	280.8	277.3	273.8	270.3	268.3	266.3	264.3	262.3	260.3	258.3	
19.75	297.8	294.3	290.7	287.2	283.6	280.1	276.5	273.0	271.0	269.0	266.9	264.9	262.9	260.9	
20	300.7	297.2	293.6	290.0	286.4	282.8	279.3	275.7	273.6	271.6	269.6	267.5	265.5	263.5	
20.25	303.7	300.1	296.5	292.8	289.2	285.6	282.0	278.4	276.3	274.3	272.2	270.1	268.1	266.0	
20.5	306.6	303.0	299.3	295.7	292.0	288.4	284.7	281.1	279.0	276.9	274.8	272.8	270.7	268.6	
20.75	309.6	305.9	302.2	298.5	294.8	291.1	287.5	283.8	281.7	279.6	277.5	275.4	273.3	271.2	
21	312.5	308.8	305.1	301.4	297.6	293.9	290.2	286.5	284.3	282.2	280.1	278.0	275.8	273.7	
21.25	315.5	311.7	307.9	304.2	300.4	296.7	292.9	289.2	287.0	284.9	282.7	280.6	278.4	276.3	
21.5	318.4	314.6	310.8	307.0	303.2	299.4	295.7	291.9	289.7	287.5	285.4	283.2	281.0	278.8	
21.75	321.3	317.5	313.7	309.9	306.0	302.2	298.4	294.6	292.4	290.2	288.0	285.8	283.6	281.4	
22	324.3	320.4	316.6	312.7	308.8	305.0	301.1	297.3	295.0	292.8	290.6	288.4	286.2	284.0	
22.25	327.2	323.3	319.4	315.5	311.6	307.8	303.9	300.0	297.7	295.5	293.2	291.0	288.8	286.5	
22.5	330.2	326.2	322.3	318.4	314.4	310.5	306.6	302.7	300.4	298.1	295.9	293.6	291.3	289.1	
22.75	333.1	329.1	325.2	321.2	317.3	313.3	309.3	305.4	303.1	300.8	298.5	296.2	293.9	291.6	
23	336.1	332.1	328.1	324.1	320.1	316.1	312.1	308.1	305.7	303.4	301.1	298.8	296.5	294.2	
23.25	339.0	335.0	330.9	326.9	322.9	318.8	314.8	310.8	308.4	306.1	303.8	301.4	299.1	296.8	

SECTION VIII

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Maintenance

390 POUND NOVEC TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
23.5	341.9	337.9	333.8	329.7	325.7	321.6	317.5	313.5	311.1	308.7	306.4	304.0	301.7	299.3
23.75	344.9	340.8	336.7	332.6	328.5	324.4	320.3	316.2	313.8	311.4	309.0	306.6	304.3	301.9
24	347.8	343.7	339.5	335.4	331.3	327.1	323.0	318.8	316.5	314.1	311.7	309.3	306.9	304.5
24.25	350.8	346.6	342.4	338.2	334.1	329.9	325.7	321.5	319.1	316.7	314.3	311.9	309.4	307.0
24.5	353.7	349.5	345.3	341.1	336.9	332.7	328.5	324.2	321.8	319.4	316.9	314.5	312.0	309.6
24.75	356.6	352.4	348.2	343.9	339.7	335.4	331.2	326.9	324.5	322.0	319.5	317.1	314.6	312.1
25	359.6	355.3	351.0	346.8	342.5	338.2	333.9	329.6	327.2	324.7	322.2	319.7	317.2	314.7
25.25	362.5	358.2	353.9	349.6	345.3	341.0	336.7	332.3	329.8	327.3	324.8	322.3	319.8	317.3
25.5	365.5	361.1	356.8	352.4	348.1	343.7	339.4	335.0	332.5	330.0	327.4	324.9	322.4	319.8
25.75	368.4	364.0	359.6	355.3	350.9	346.5	342.1	337.7	335.2	332.6	330.1	327.5	324.9	322.4
26	371.4	366.9	362.5	358.1	353.7	349.3	344.9	340.4	337.9	335.3	332.7	330.1	327.5	325.0
26.25	374.3	369.8	365.4	360.9	356.5	352.0	347.6	343.1	340.5	337.9	335.3	332.7	330.1	327.5
26.5	377.2	372.8	368.3	363.8	359.3	354.8	350.3	345.8	343.2	340.6	338.0	335.3	332.7	330.1
26.75	380.2	375.7	371.1	366.6	362.1	357.6	353.1	348.5	345.9	343.2	340.6	337.9	335.3	332.6
27	383.1	378.6	374.0	369.5	364.9	360.3	355.8	351.2	348.6	345.9	343.2	340.5	337.9	335.2
27.25	386.1	381.5	376.9	372.3	367.7	363.1	358.5	353.9	351.2	348.5	345.8	343.1	340.5	337.8
27.5	389.0	384.4	379.8	375.1	370.5	365.9	361.3	356.6	353.9	351.2	348.5	345.8	343.0	340.3
27.75	391.9	387.3	382.6	378.0	373.3	368.6	364.0	359.3	356.6	353.8	351.1	348.4	345.6	342.9
28	394.9	390.2	385.5	380.8	376.1	371.4	366.7	362.0	359.3	356.5	353.7	351.0	348.2	345.4
28.25	397.8	393.1	388.4	383.6	378.9	374.2	369.4	364.7	361.9	359.1	356.4	353.6	350.8	348.0
28.5	400.8	396.0	391.2	386.5	381.7	376.9	372.2	367.4	364.6	361.8	359.0	356.2	353.4	350.6
28.75	403.7	398.9	394.1	389.3	384.5	379.7	374.9	370.1	367.3	364.5	361.6	358.8	356.0	353.1
29	406.7	401.8	397.0	392.2	387.3	382.5	377.6	372.8	370.0	367.1	364.3	361.4	358.5	355.7
29.25	409.6	404.7	399.9	395.0	390.1	385.3	380.4	375.5	372.6	369.8	366.9	364.0	361.1	358.3
29.5	412.5	407.6	402.7	397.8	392.9	388.0	383.1	378.2	375.3	372.4	369.5	366.6	363.7	360.8
29.75	415.5	410.5	405.6	400.7	395.7	390.8	385.8	380.9	378.0	375.1	372.1	369.2	366.3	363.4
30	418.4	413.5	408.5	403.5	398.5	393.6	388.6	383.6	380.7	377.7	374.8	371.8	368.9	365.9
30.25	421.4	416.4	411.4	406.3	401.3	396.3	391.3	386.3	383.3	380.4	377.4	374.4	371.5	368.5
30.5	424.3	419.3	414.2	409.2	404.1	399.1	394.0	389.0	386.0	383.0	380.0	377.0	374.1	371.1
30.75	427.3	422.2	417.1	412.0	406.9	401.9	396.8	391.7	388.7	385.7	382.7	379.6	376.6	373.6
31	430.2	425.1	420.0	414.9	409.7	404.6	399.5	394.4	391.4	388.3	385.3	382.3	379.2	376.2
31.25	433.1	428.0	422.8	417.7	412.5	407.4	402.2	397.1	394.0	391.0	387.9	384.9	381.8	378.7
31.5	436.1	430.9	425.7	420.5	415.3	410.2	405.0	399.8	396.7	393.6	390.6	387.5	384.4	381.3

SECTION VIII

JUL EX-4510 12-1-03 Page 8-10

Maintenance

390 POUND NON-HALONATED TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
31.75	439.0	433.8	428.6	423.4	418.1	412.9	407.7	402.5	399.4	396.3	393.2	390.1	387.0	383.9
32	442.0	436.7	431.5	426.2	421.0	415.7	410.4	405.2	402.1	398.9	395.8	392.7	389.6	386.4
32.25	444.9	439.6	434.3	429.0	423.8	418.5	413.2	407.9	404.7	401.6	398.4	395.3	392.1	389.0
32.5	447.8	442.5	437.2	431.9	426.6	421.2	415.9	410.6	407.4	404.2	401.1	397.9	394.7	391.6
32.75	450.8	445.4	440.1	434.7	429.4	424.0	418.6	413.3	410.1	406.9	403.7	400.5	397.3	394.1
33	453.7	448.3	442.9	437.6	432.2	426.8	421.4	416.0	412.8	409.6	406.3	403.1	399.9	396.7
33.25	456.7	451.2	445.8	440.4	435.0	429.5	424.1	418.7	415.4	412.2	409.0	405.7	402.5	399.2
33.5	459.6	454.2	448.7	443.2	437.8	432.3	426.8	421.4	418.1	414.9	411.6	408.3	405.1	401.8
33.75	462.6	457.1	451.6	446.1	440.6	435.1	429.6	424.1	420.8	417.5	414.2	410.9	407.7	404.4
34	465.5	460.0	454.4	448.9	443.4	437.8	432.3	426.8	423.5	420.2	416.9	413.5	410.2	406.9

SECTION VIII

UL EX-4510 12-1-03 Page 8-11

Maintenance

450 POUND NOVEC TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
10	179.2	177.5	175.8	174.1	172.4	170.6	168.9	167.2	165.3	163.3	161.3	159.4	157.4	155.4
10.25	182.1	180.4	178.7	177.0	175.2	173.5	171.8	170.0	168.1	166.1	164.1	162.1	160.1	158.1
10.5	185.1	183.4	181.6	179.9	178.1	176.4	174.6	172.9	170.8	168.8	166.8	164.8	162.8	160.7
10.75	188.1	186.3	184.5	182.8	181.0	179.2	177.5	175.7	173.6	171.6	169.5	167.5	165.5	163.4
11	191.0	189.2	187.5	185.7	183.9	182.1	180.3	178.5	176.4	174.4	172.3	170.2	168.1	166.1
11.25	194.0	192.2	190.4	188.6	186.8	184.9	183.1	181.3	179.2	177.1	175.0	172.9	170.8	168.7
11.5	197.0	195.1	193.3	191.5	189.6	187.8	186.0	184.1	182.0	179.9	177.8	175.6	173.5	171.4
11.75	199.9	198.1	196.2	194.4	192.5	190.7	188.8	187.0	184.8	182.7	180.5	178.4	176.2	174.0
12	202.9	201.0	199.1	197.3	195.4	193.5	191.6	189.8	187.6	185.4	183.2	181.1	178.9	176.7
12.25	205.9	204.0	202.1	200.2	198.3	196.4	194.5	192.6	190.4	188.2	186.0	183.8	181.6	179.4
12.5	208.8	206.9	205.0	203.1	201.2	199.2	197.3	195.4	193.2	190.9	188.7	186.5	184.3	182.0
12.75	211.8	209.8	207.9	206.0	204.0	202.1	200.2	198.2	196.0	193.7	191.5	189.2	186.9	184.7
13	214.7	212.8	210.8	208.9	206.9	205.0	203.0	201.0	198.8	196.5	194.2	191.9	189.6	187.4
13.25	217.7	215.7	213.8	211.8	209.8	207.8	205.8	203.9	201.6	199.2	196.9	194.6	192.3	190.0
13.5	220.7	218.7	216.7	214.7	212.7	210.7	208.7	206.7	204.3	202.0	199.7	197.3	195.0	192.7
13.75	223.6	221.6	219.6	217.6	215.6	213.5	211.5	209.5	207.1	204.8	202.4	200.1	197.7	195.3
14	226.6	224.6	222.5	220.5	218.4	216.4	214.4	212.3	209.9	207.5	205.2	202.8	200.4	198.0
14.25	229.6	227.5	225.4	223.4	221.3	219.3	217.2	215.1	212.7	210.3	207.9	205.5	203.1	200.7
14.5	232.5	230.4	228.4	226.3	224.2	222.1	220.0	218.0	215.5	213.1	210.6	208.2	205.8	203.3
14.75	235.5	233.4	231.3	229.2	227.1	225.0	222.9	220.8	218.3	215.8	213.4	210.9	208.4	206.0
15	238.5	236.3	234.2	232.1	230.0	227.8	225.7	223.6	221.1	218.6	216.1	213.6	211.1	208.6
15.25	241.4	239.3	237.1	235.0	232.8	230.7	228.5	226.4	223.9	221.4	218.9	216.3	213.8	211.3
15.5	244.4	242.2	240.1	237.9	235.7	233.6	231.4	229.2	226.7	224.1	221.6	219.0	216.5	214.0
15.75	247.3	245.2	243.0	240.8	238.6	236.4	234.2	232.0	229.5	226.9	224.3	221.8	219.2	216.6
16	250.3	248.1	245.9	243.7	241.5	239.3	237.1	234.9	232.3	229.7	227.1	224.5	221.9	219.3
16.25	253.3	251.0	248.8	246.6	244.4	242.1	239.9	237.7	235.1	232.4	229.8	227.2	224.6	221.9
16.5	256.2	254.0	251.7	249.5	247.2	245.0	242.7	240.5	237.8	235.2	232.5	229.9	227.2	224.6
16.75	259.2	256.9	254.7	252.4	250.1	247.9	245.6	243.3	240.6	238.0	235.3	232.6	229.9	227.3
17	262.2	259.9	257.6	255.3	253.0	250.7	248.4	246.1	243.4	240.7	238.0	235.3	232.6	229.9
17.25	265.1	262.8	260.5	258.2	255.9	253.6	251.3	248.9	246.2	243.5	240.8	238.0	235.3	232.6
17.5	268.1	265.8	263.4	261.1	258.8	256.4	254.1	251.8	249.0	246.3	243.5	240.7	238.0	235.2
17.75	271.1	268.7	266.4	264.0	261.6	259.3	256.9	254.6	251.8	249.0	246.2	243.5	240.7	237.9
18	274.0	271.6	269.3	266.9	264.5	262.1	259.8	257.4	254.6	251.8	249.0	246.2	243.4	240.6

SECTION VIII

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Maintenance

450 POUND NON-HALON TANK AGENT QUANTITY TABLES

Liquid Level - 0 Inches	Temperature Degrees F (Degrees C)												
	10	20	30	40	50	60	70	80	90	100	110	120	130
	(-12.2)	(-6.7)	(-1.1)	(4.4)	(10)	(15.6)	(21.1)	(26.7)	(32.2)	(37.8)	(43.3)	(48.9)	(54.4)
18.25	277.0	274.6	272.2	269.8	267.4	265.0	262.6	260.2	257.4	254.6	248.9	246.1	243.2
18.5	279.9	277.5	275.1	272.7	270.3	267.9	265.5	263.0	260.2	257.3	251.6	248.7	245.9
18.75	282.9	280.5	278.0	275.6	273.2	270.7	268.3	265.9	263.0	260.1	254.3	251.4	248.5
19	285.9	283.4	281.0	278.5	276.0	273.6	271.1	268.7	265.8	262.8	257.0	254.1	251.2
19.25	288.8	286.4	283.9	281.4	278.9	276.4	274.0	271.5	268.6	265.6	259.7	256.8	253.9
19.5	291.8	289.3	286.8	284.3	281.8	279.3	276.8	274.3	271.3	268.4	262.5	259.5	256.5
19.75	294.8	292.2	289.7	287.2	284.7	282.2	279.6	277.1	274.1	271.1	265.2	262.2	259.2
20	297.7	295.2	292.6	290.1	287.6	285.0	282.5	279.9	276.9	273.9	267.9	264.9	261.8
20.25	300.7	298.1	295.6	293.0	290.4	287.9	285.3	282.8	279.7	276.7	270.6	267.5	264.5
20.5	303.7	301.1	298.5	295.9	293.3	290.7	288.2	285.6	282.5	279.4	273.3	270.2	267.2
20.75	306.6	304.0	301.4	298.8	296.2	293.6	291.0	288.4	285.3	282.2	276.0	272.9	269.8
21	309.6	307.0	304.3	301.7	299.1	296.5	293.8	291.2	288.1	285.0	278.7	275.6	272.5
21.25	312.6	309.9	307.3	304.6	302.0	299.3	296.7	294.0	290.9	287.7	281.4	278.3	275.1
21.5	315.5	312.8	310.2	307.5	304.8	302.2	299.5	296.8	293.7	290.5	284.2	281.0	277.8
21.75	318.5	315.8	313.1	310.4	307.7	305.0	302.4	299.7	296.5	293.3	286.9	283.7	280.5
22	321.4	318.7	316.0	313.3	310.6	307.9	305.2	302.5	299.3	296.0	289.6	286.4	283.1
22.25	324.4	321.7	318.9	316.2	313.5	310.8	308.0	305.3	302.0	298.8	292.3	289.0	285.8
22.5	327.4	324.6	321.9	319.1	316.4	313.6	310.9	308.1	304.8	301.6	295.0	291.7	288.5
22.75	330.3	327.6	324.8	322.0	319.2	316.5	313.7	310.9	307.6	304.3	297.7	294.4	291.1
23	333.3	330.5	327.7	324.9	322.1	319.3	316.5	313.8	310.4	307.1	300.4	297.1	293.8
23.25	336.3	333.4	330.6	327.8	325.0	322.2	319.4	316.6	313.2	309.9	303.1	299.8	296.4
23.5	339.2	336.4	333.6	330.7	327.9	325.1	322.2	319.4	316.0	312.6	305.9	302.5	299.1
23.75	342.2	339.3	336.5	333.6	330.8	327.9	325.1	322.2	318.8	315.4	308.6	305.2	301.8
24	345.2	342.3	339.4	336.5	333.7	330.8	327.9	325.0	321.6	318.2	311.3	307.8	304.4
24.25	348.1	345.2	342.3	339.4	336.5	333.6	330.7	327.8	324.4	320.9	314.0	310.5	307.1
24.5	351.1	348.2	345.2	342.3	339.4	336.5	333.6	330.7	327.2	323.7	316.7	313.2	309.7
24.75	354.0	351.1	348.2	345.2	342.3	339.4	336.4	333.5	330.0	326.5	319.4	315.9	312.4
25	357.0	354.0	351.1	348.1	345.2	342.2	339.3	336.3	332.8	329.2	322.1	318.6	315.1
25.25	360.0	357.0	354.0	351.0	348.1	345.1	342.1	339.1	335.5	332.0	324.8	321.3	317.7
25.5	362.9	359.9	356.9	353.9	350.9	347.9	344.9	341.9	338.3	334.7	327.6	324.0	320.4
25.75	365.9	362.9	359.9	356.8	353.8	350.8	347.8	344.8	341.1	337.5	330.3	326.7	323.0
26	368.9	365.8	362.8	359.7	356.7	353.7	350.6	347.6	343.9	340.3	333.0	329.3	325.7
26.25	371.8	368.8	365.7	362.6	359.6	356.5	353.4	350.4	346.7	343.0	335.7	332.0	328.4

Maintenance

450 POUND NOVEC TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
26.5	374.8	371.7	368.6	365.5	362.5	359.4	356.3	353.2	349.5	345.8	342.1	338.4	334.7	331.0
26.75	377.8	374.6	371.5	368.4	365.3	362.2	359.1	356.0	352.3	348.6	344.8	341.1	337.4	333.7
27	380.7	377.6	374.5	371.3	368.2	365.1	362.0	358.8	355.1	351.3	347.6	343.8	340.1	336.3
27.25	383.7	380.5	377.4	374.2	371.1	367.9	364.8	361.7	357.9	354.1	350.3	346.6	342.8	339.0
27.5	386.6	383.5	380.3	377.1	374.0	370.8	367.6	364.5	360.7	356.9	353.1	349.3	345.5	341.7
27.75	389.6	386.4	383.2	380.0	376.9	373.7	370.5	367.3	363.5	359.6	355.8	352.0	348.1	344.3
28	392.6	389.4	386.2	382.9	379.7	376.5	373.3	370.1	366.3	362.4	358.5	354.7	350.8	347.0
28.25	395.5	392.3	389.1	385.8	382.6	379.4	376.2	372.9	369.0	365.2	361.3	357.4	353.5	349.6
28.5	398.5	395.2	392.0	388.7	385.5	382.2	379.0	375.7	371.8	367.9	364.0	360.1	356.2	352.3
28.75	401.5	398.2	394.9	391.6	388.4	385.1	381.8	378.6	374.6	370.7	366.8	362.8	358.9	355.0
29	404.4	401.1	397.8	394.6	391.3	388.0	384.7	381.4	377.4	373.5	369.5	365.5	361.6	357.6
29.25	407.4	404.1	400.8	397.5	394.1	390.8	387.5	384.2	380.2	376.2	372.2	368.3	364.3	360.3
29.5	410.4	407.0	403.7	400.4	397.0	393.7	390.4	387.0	383.0	379.0	375.0	371.0	367.0	362.9
29.75	413.3	410.0	406.6	403.3	399.9	396.5	393.2	389.8	385.8	381.8	377.7	373.7	369.6	365.6
30	416.3	412.9	409.5	406.2	402.8	399.4	396.0	392.7	388.6	384.5	380.5	376.4	372.3	368.3
30.25	419.2	415.8	412.5	409.1	405.7	402.3	398.9	395.5	391.4	387.3	383.2	379.1	375.0	370.9
30.5	422.2	418.8	415.4	412.0	408.5	405.1	401.7	398.3	394.2	390.1	385.9	381.8	377.7	373.6
30.75	425.2	421.7	418.3	414.9	411.4	408.0	404.5	401.1	397.0	392.8	388.7	384.5	380.4	376.2
31	428.1	424.7	421.2	417.8	414.3	410.8	407.4	403.9	399.8	395.6	391.4	387.2	383.1	378.9
31.25	431.1	427.6	424.1	420.7	417.2	413.7	410.2	406.7	402.5	398.3	394.2	390.0	385.8	381.6
31.5	434.1	430.6	427.1	423.6	420.1	416.6	413.1	409.6	405.3	401.1	396.9	392.7	388.4	384.2
31.75	437.0	433.5	430.0	426.5	422.9	419.4	415.9	412.4	408.1	403.9	399.6	395.4	391.1	386.9
32	440.0	436.4	432.9	429.4	425.8	422.3	418.7	415.2	410.9	406.6	402.4	398.1	393.8	389.5
32.25	443.0	439.4	435.8	432.3	428.7	425.1	421.6	418.0	413.7	409.4	405.1	400.8	396.5	392.2
32.5	445.9	442.3	438.8	435.2	431.6	428.0	424.4	420.8	416.5	412.2	407.8	403.5	399.2	394.9
32.75	448.9	445.3	441.7	438.1	434.5	430.9	427.3	423.6	419.3	414.9	410.6	406.2	401.9	397.5
33	451.8	448.2	444.6	441.0	437.3	433.7	430.1	426.5	422.1	417.7	413.3	408.9	404.6	400.2
33.25	454.8	451.2	447.5	443.9	440.2	436.6	432.9	429.3	424.9	420.5	416.1	411.7	407.3	402.9
33.5	457.8	454.1	450.4	446.8	443.1	439.4	435.8	432.1	427.7	423.2	418.8	414.4	409.9	405.5
33.75	460.7	457.0	453.4	449.7	446.0	442.3	438.6	434.9	430.5	426.0	421.5	417.1	412.6	408.2
34	463.7	460.0	456.3	452.6	448.9	445.2	441.4	437.7	433.3	428.8	424.3	419.8	415.3	410.8
34.25	466.7	462.9	459.2	455.5	451.7	448.0	444.3	440.6	436.0	431.5	427.0	422.5	418.0	413.5
34.5	469.6	465.9	462.1	458.4	454.6	450.9	447.1	443.4	438.8	434.3	429.8	425.2	420.7	416.2

SECTION VIII

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Maintenance

450 POUND NOV. TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
34.75	472.6	468.8	465.0	461.3	457.5	453.7	450.0	446.2	441.6	437.1	432.5	427.9	423.4	418.8
35	475.6	471.8	468.0	464.2	460.4	456.6	452.8	449.0	444.4	439.8	435.2	430.7	426.1	421.5
35.25	478.5	474.7	470.9	467.1	463.3	459.5	455.6	451.8	447.2	442.6	438.0	433.4	428.8	424.1
35.5	481.5	477.6	473.8	470.0	466.1	462.3	458.5	454.6	450.0	445.4	440.7	436.1	431.4	426.8
35.75	484.4	480.6	476.7	472.9	469.0	465.2	461.3	457.5	452.8	448.1	443.5	438.8	434.1	429.5
36	487.4	483.5	479.7	475.8	471.9	468.0	464.2	460.3	455.6	450.9	446.2	441.5	436.8	432.1
36.25	490.4	486.5	482.6	478.7	474.8	470.9	467.0	463.1	458.4	453.7	448.9	444.2	439.5	434.8
36.5	493.3	489.4	485.5	481.6	477.7	473.7	469.8	465.9	461.2	456.4	451.7	446.9	442.2	437.4
36.75	496.3	492.4	488.4	484.5	480.5	476.6	472.7	468.7	464.0	459.2	454.4	449.6	444.9	440.1
37	499.3	495.3	491.3	487.4	483.4	479.5	475.5	471.5	466.8	462.0	457.2	452.4	447.6	442.8
37.25	502.2	498.3	494.3	490.3	486.3	482.3	478.3	474.4	469.5	464.7	459.9	455.1	450.2	445.4
37.5	505.2	501.2	497.2	493.2	489.2	485.2	481.2	477.2	472.3	467.5	462.6	457.8	452.9	448.1
37.75	508.2	504.1	500.1	496.1	492.1	488.0	484.0	480.0	475.1	470.2	465.4	460.5	455.6	450.7
38	511.1	507.1	503.0	499.0	494.9	490.9	486.9	482.8	477.9	473.0	468.1	463.2	458.3	453.4
38.25	514.1	510.0	506.0	501.9	497.8	493.8	489.7	485.6	480.7	475.8	470.8	465.9	461.0	456.1
38.5	517.0	513.0	508.9	504.8	500.7	496.6	492.5	488.5	483.5	478.5	473.6	468.6	463.7	458.7
38.75	520.0	515.9	511.8	507.7	503.6	499.5	495.4	491.3	486.3	481.3	476.3	471.3	466.4	461.4
39	523.0	518.9	514.7	510.6	506.5	502.3	498.2	494.1	489.1	484.1	479.1	474.1	469.1	464.0
39.25	525.9	521.8	517.6	513.5	509.4	505.2	501.1	496.9	491.9	486.8	481.8	476.8	471.7	466.7
39.5	528.9	524.7	520.6	516.4	512.2	508.1	503.9	499.7	494.7	489.6	484.5	479.5	474.4	469.4
39.75	531.9	527.7	523.5	519.3	515.1	510.9	506.7	502.5	497.5	492.4	487.3	482.2	477.1	472.0
40	534.8	530.6	526.4	522.2	518.0	513.8	509.6	505.4	500.2	495.1	490.0	484.9	479.8	474.7
40.25	537.8	533.6	529.3	525.1	520.9	516.6	512.4	508.2	503.0	497.9	492.8	487.6	482.5	477.3
40.5	540.8	536.5	532.3	528.0	523.8	519.5	515.2	511.0	505.8	500.7	495.5	490.3	485.2	480.0
40.75	543.7	539.5	535.2	530.9	526.6	522.4	518.1	513.8	508.6	503.4	498.2	493.0	487.9	482.7
41	546.7	542.4	538.1	533.8	529.5	525.2	520.9	516.6	511.4	506.2	501.0	495.8	490.5	485.3
41.25	549.7	545.3	541.0	536.7	532.4	528.1	523.8	519.5	514.2	509.0	503.7	498.5	493.2	488.0
41.5	552.6	548.3	543.9	539.6	535.3	530.9	526.6	522.3	517.0	511.7	506.5	501.2	495.9	490.6
41.75	555.6	551.2	546.9	542.5	538.2	533.8	529.4	525.1	519.8	514.5	509.2	503.9	498.6	493.3
42	558.5	554.2	549.8	545.4	541.0	536.7	532.3	527.9	522.6	517.3	511.9	506.6	501.3	496.0

SECTION VIII

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Maintenance

850 POUND NOVEC TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
5	362.1	358.7	355.3	352.0	348.6	345.3	341.9	338.6	335.6	332.5	329.5	326.5	323.5	320.5
5.25	368.5	365.1	361.7	358.3	354.9	351.5	348.1	344.7	341.6	338.5	335.4	332.4	329.3	326.2
5.5	375.0	371.5	368.1	364.6	361.1	357.7	354.2	350.7	347.6	344.5	341.3	338.2	335.1	331.9
5.75	381.5	378.0	374.4	370.9	367.4	363.8	360.3	356.8	353.6	350.4	347.2	344.1	340.9	337.7
6	388.0	384.4	380.8	377.2	373.6	370.0	366.4	362.9	359.6	356.4	353.1	349.9	346.7	343.4
6.25	394.4	390.8	387.1	383.5	379.9	376.2	372.6	368.9	365.6	362.3	359.0	355.8	352.5	349.2
6.5	400.9	397.2	393.5	389.8	386.1	382.4	378.7	375.0	371.7	368.3	365.0	361.6	358.3	354.9
6.75	407.4	403.6	399.9	396.1	392.3	388.6	384.8	381.1	377.7	374.3	370.9	367.5	364.0	360.6
7	413.9	410.0	406.2	402.4	398.6	394.8	391.0	387.1	383.7	380.2	376.8	373.3	369.8	366.4
7.25	420.3	416.5	412.6	408.7	404.8	401.0	397.1	393.2	389.7	386.2	382.7	379.2	375.6	372.1
7.5	426.8	422.9	418.9	415.0	411.1	407.1	403.2	399.3	395.7	392.1	388.6	385.0	381.4	377.9
7.75	433.3	429.3	425.3	421.3	417.3	413.3	409.3	405.3	401.7	398.1	394.5	390.9	387.2	383.6
8	439.8	435.7	431.7	427.6	423.6	419.5	415.5	411.4	407.7	404.1	400.4	396.7	393.0	389.3
8.25	446.2	442.1	438.0	433.9	429.8	425.7	421.6	417.5	413.7	410.0	406.3	402.6	398.8	395.1
8.5	452.7	448.5	444.4	440.2	436.0	431.9	427.7	423.5	419.8	416.0	412.2	408.4	404.6	400.8
8.75	459.2	455.0	450.7	446.5	442.3	438.1	433.8	429.6	425.8	421.9	418.1	414.3	410.4	406.6
9	465.7	461.4	457.1	452.8	448.5	444.2	440.0	435.7	431.8	427.9	424.0	420.1	416.2	412.3
9.25	472.1	467.8	463.5	459.1	454.8	450.4	446.1	441.8	437.8	433.9	429.9	426.0	422.0	418.0
9.5	478.6	474.2	469.8	465.4	461.0	456.6	452.2	447.8	443.8	439.8	435.8	431.8	427.8	423.8
9.75	485.1	480.6	476.2	471.7	467.3	462.8	458.3	453.9	449.8	445.8	441.7	437.7	433.6	429.5
10	491.6	487.0	482.5	478.0	473.5	469.0	464.5	460.0	455.8	451.7	447.6	443.5	439.4	435.3
10.25	498.0	493.5	488.9	484.3	479.7	475.2	470.6	466.0	461.9	457.7	453.5	449.3	445.2	441.0
10.5	504.5	499.9	495.2	490.6	486.0	481.4	476.7	472.1	467.9	463.6	459.4	455.2	451.0	446.8
10.75	511.0	506.3	501.6	496.9	492.2	487.5	482.9	478.2	473.9	469.6	465.3	461.0	456.8	452.5
11	517.5	512.7	508.0	503.2	498.5	493.7	489.0	484.2	479.9	475.6	471.2	466.9	462.6	458.2
11.25	523.9	519.1	514.3	509.5	504.7	499.9	495.1	490.3	485.9	481.5	477.1	472.7	468.4	464.0
11.5	530.4	525.5	520.7	515.8	511.0	506.1	501.2	496.4	491.9	487.5	483.0	478.6	474.2	469.7
11.75	536.9	532.0	527.0	522.1	517.2	512.3	507.4	502.4	497.9	493.4	488.9	484.4	480.0	475.5
12	543.4	538.4	533.4	528.4	523.4	518.5	513.5	508.5	504.0	499.4	494.9	490.3	485.7	481.2
12.25	549.8	544.8	539.8	534.7	529.7	524.7	519.6	514.6	510.0	505.4	500.8	496.1	491.5	486.9
12.5	556.3	551.2	546.1	541.0	535.9	530.8	525.7	520.6	516.0	511.3	506.7	502.0	497.3	492.7
12.75	562.8	557.6	552.5	547.3	542.2	537.0	531.9	526.7	522.0	517.3	512.6	507.8	503.1	498.4
13	569.3	564.1	558.8	553.6	548.4	543.2	538.0	532.8	528.0	523.2	518.5	513.7	508.9	504.2

SECTION VIII

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Maintenance

850 POUND NO₂ TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
13.25	575.7	570.5	565.2	559.9	554.7	549.4	544.1	538.9	534.0	529.2	524.4	519.5	514.7	509.9
13.5	582.2	576.9	571.6	566.2	560.9	555.6	550.2	544.9	540.0	535.2	530.3	525.4	520.5	515.6
13.75	588.7	583.3	577.9	572.5	567.1	561.8	556.4	551.0	546.1	541.1	536.2	531.2	526.3	521.4
14	595.2	589.7	584.3	578.8	573.4	567.9	562.5	557.1	552.1	547.1	542.1	537.1	532.1	527.1
14.25	601.6	596.1	590.6	585.1	579.6	574.1	568.6	563.1	558.1	553.0	548.0	542.9	537.9	532.9
14.5	608.1	602.6	597.0	591.4	585.9	580.3	574.8	569.2	564.1	559.0	553.9	548.8	543.7	538.6
14.75	614.6	609.0	603.4	597.7	592.1	586.5	580.9	575.3	570.1	565.0	559.8	554.6	549.5	544.3
15	621.1	615.4	609.7	604.0	598.4	592.7	587.0	581.3	576.1	570.9	565.7	560.5	555.3	550.1
15.25	627.5	621.8	616.1	610.3	604.6	598.9	593.1	587.4	582.1	576.9	571.6	566.3	561.1	555.8
15.5	634.0	628.2	622.4	616.6	610.8	605.1	599.3	593.5	588.1	582.8	577.5	572.2	566.9	561.6
15.75	640.5	634.6	628.8	622.9	617.1	611.2	605.4	599.5	594.2	588.8	583.4	578.0	572.7	567.3
16	647.0	641.1	635.2	629.2	623.3	617.4	611.5	605.6	600.2	594.8	589.3	583.9	578.5	573.0
16.25	653.4	647.5	641.5	635.5	629.6	623.6	617.6	611.7	606.2	600.7	595.2	589.7	584.3	578.8
16.5	659.9	653.9	647.9	641.8	635.8	629.8	623.8	617.7	612.2	606.7	601.1	595.6	590.1	584.5
16.75	666.4	660.3	654.2	648.1	642.1	636.0	629.9	623.8	618.2	612.6	607.0	601.4	595.9	590.3
17	672.9	666.7	660.6	654.4	648.3	642.2	636.0	629.9	624.2	618.6	612.9	607.3	601.6	596.0
17.25	679.3	673.1	666.9	660.7	654.5	648.3	642.1	635.9	630.2	624.5	618.8	613.1	607.4	601.7
17.5	685.8	679.6	673.3	667.0	660.8	654.5	648.3	642.0	636.3	630.5	624.8	619.0	613.2	607.5
17.75	692.3	686.0	679.7	673.4	667.0	660.7	654.4	648.1	642.3	636.5	630.7	624.8	619.0	613.2
18	698.8	692.4	686.0	679.7	673.3	666.9	660.5	654.2	648.3	642.4	636.6	630.7	624.8	619.0
18.25	705.3	698.8	692.4	686.0	679.5	673.1	666.7	660.2	654.3	648.4	642.5	636.5	630.6	624.7
18.5	711.7	705.2	698.7	692.3	685.8	679.3	672.8	666.3	660.3	654.3	648.4	642.4	636.4	630.4
18.75	718.2	711.7	705.1	698.6	692.0	685.5	678.9	672.4	666.3	660.3	654.3	648.2	642.2	636.2
19	724.7	718.1	711.5	704.9	698.2	691.6	685.0	678.4	672.3	666.3	660.2	654.1	648.0	641.9
19.25	731.2	724.5	717.8	711.2	704.5	697.8	691.2	684.5	678.4	672.2	666.1	659.9	653.8	647.7
19.5	737.6	730.9	724.2	717.5	710.7	704.0	697.3	690.6	684.4	678.2	672.0	665.8	659.6	653.4
19.75	744.1	737.3	730.5	723.8	717.0	710.2	703.4	696.6	690.4	684.1	677.9	671.6	665.4	659.1
20	750.6	743.7	736.9	730.1	723.2	716.4	709.5	702.7	696.4	690.1	683.8	677.5	671.2	664.9
20.25	757.1	750.2	743.3	736.4	729.5	722.6	715.7	708.8	702.4	696.1	689.7	683.3	677.0	670.6
20.5	763.5	756.6	749.6	742.7	735.7	728.7	721.8	714.8	708.4	702.0	695.6	689.2	682.8	676.4
20.75	770.0	763.0	756.0	749.0	741.9	734.9	727.9	720.9	714.4	708.0	701.5	695.0	688.6	682.1
21	776.5	769.4	762.3	755.3	748.2	741.1	734.0	727.0	720.5	713.9	707.4	700.9	694.4	687.9
21.25	783.0	775.8	768.7	761.6	754.4	747.3	740.2	733.0	726.5	719.9	713.3	706.7	700.2	693.6

SECTION VIII

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Maintenance

850 POUND NOVEC TANK AGENT QUANTITY TABLES

Liquid Level Inches	Temperature Degrees F (Degrees C)													
	0 (-17.8)	10 (-12.2)	20 (-6.7)	30 (-1.1)	40 (4.4)	50 (10)	60 (15.6)	70 (21.1)	80 (26.7)	90 (32.2)	100 (37.8)	110 (43.3)	120 (48.9)	130 (54.4)
21.5	789.4	782.2	775.1	767.9	760.7	753.5	746.3	739.1	732.5	725.9	719.2	712.6	706.0	699.3
21.75	795.9	788.7	781.4	774.2	766.9	759.7	752.4	745.2	738.5	731.8	725.1	718.4	711.8	705.1
22	802.4	795.1	787.8	780.5	773.2	765.9	758.6	751.2	744.5	737.8	731.0	724.3	717.6	710.8
22.25	808.9	801.5	794.1	786.8	779.4	772.0	764.7	757.3	750.5	743.7	736.9	730.1	723.3	716.6
22.5	815.3	807.9	800.5	793.1	785.6	778.2	770.8	763.4	756.5	749.7	742.8	736.0	729.1	722.3
22.75	821.8	814.3	806.9	799.4	791.9	784.4	776.9	769.5	762.6	755.6	748.7	741.8	734.9	728.0
23	828.3	820.7	813.2	805.7	798.1	790.6	783.1	775.5	768.6	761.6	754.6	747.7	740.7	733.8
23.25	834.8	827.2	819.6	812.0	804.4	796.8	789.2	781.6	774.6	767.6	760.6	753.5	746.5	739.5
23.5	841.2	833.6	825.9	818.3	810.6	803.0	795.3	787.7	780.6	773.5	766.5	759.4	752.3	745.3
23.75	847.7	840.0	832.3	824.6	816.9	809.2	801.4	793.7	786.6	779.5	772.4	765.2	758.1	751.0
24	854.2	846.4	838.6	830.9	823.1	815.3	807.6	799.8	792.6	785.4	778.3	771.1	763.9	756.7
24.25	860.7	852.8	845.0	837.2	829.3	821.5	813.7	805.9	798.6	791.4	784.2	776.9	769.7	762.5
24.5	867.1	859.3	851.4	843.5	835.6	827.7	819.8	811.9	804.6	797.4	790.1	782.8	775.5	768.2
24.75	873.6	865.7	857.7	849.8	841.8	833.9	825.9	818.0	810.7	803.3	796.0	788.6	781.3	774.0
25	880.1	872.1	864.1	856.1	848.1	840.1	832.1	824.1	816.7	809.3	801.9	794.5	787.1	779.7
25.25	886.6	878.5	870.4	862.4	854.3	846.3	838.2	830.1	822.7	815.2	807.8	800.3	792.9	785.4
25.5	893.0	884.9	876.8	868.7	860.6	852.4	844.3	836.2	828.7	821.2	813.7	806.2	798.7	791.2
25.75	899.5	891.3	883.2	875.0	866.8	858.6	850.5	842.3	834.7	827.2	819.6	812.0	804.5	796.9
26	906.0	897.8	889.5	881.3	873.1	864.8	856.6	848.3	840.7	833.1	825.5	817.9	810.3	802.7
26.25	912.5	904.2	895.9	887.6	879.3	871.0	862.7	854.4	846.7	839.1	831.4	823.7	816.1	808.4
26.5	918.9	910.6	902.2	893.9	885.5	877.2	868.8	860.5	852.8	845.0	837.3	829.6	821.9	814.1
26.75	925.4	917.0	908.6	900.2	891.8	883.4	875.0	866.5	858.8	851.0	843.2	835.4	827.7	819.9
27	931.9	923.4	915.0	906.5	898.0	889.6	881.1	872.6	864.8	857.0	849.1	841.3	833.5	825.6
27.25	938.4	929.8	921.3	912.8	904.3	895.7	887.2	878.7	870.8	862.9	855.0	847.1	839.3	831.4
27.5	944.8	936.3	927.7	919.1	910.5	901.9	893.3	884.8	876.8	868.9	860.9	853.0	845.0	837.1
27.75	951.3	942.7	934.0	925.4	916.8	908.1	899.5	890.8	882.8	874.8	866.8	858.8	850.8	842.8
28	957.8	949.1	940.4	931.7	923.0	914.3	905.6	896.9	888.8	880.8	872.7	864.7	856.6	848.6
28.25	964.3	955.5	946.8	938.0	929.2	920.5	911.7	903.0	894.9	886.7	878.6	870.5	862.4	854.3
28.5	970.7	961.9	953.1	944.3	935.5	926.7	917.8	909.0	900.9	892.7	884.5	876.4	868.2	860.1
28.75	977.2	968.3	959.5	950.6	941.7	932.8	924.0	915.1	906.9	898.7	890.5	882.2	874.0	865.8
29	983.7	974.8	965.8	956.9	948.0	939.0	930.1	921.2	912.9	904.6	896.4	888.1	879.8	871.5
29.25	990.2	981.2	972.2	963.2	954.2	945.2	936.2	927.2	918.9	910.6	902.3	893.9	885.6	877.3
29.5	996.6	987.6	978.6	969.5	960.5	951.4	942.4	933.3	924.9	916.5	908.2	899.8	891.4	883.0

SECTION VIII

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Maintenance

850 POUND NOVA L TANK AGENT QUANTITY TABLES														
Liquid Level Inches	0	Temperature Degrees F (Degrees C)												
		10	20	30	40	50	60	70	80	90	100	110	120	130
		(-12.2)	(-6.7)	(-1.1)	(4.4)	(10)	(15.6)	(21.1)	(26.7)	(32.2)	(37.8)	(43.3)	(48.9)	(54.4)
29.75	1003.1	994.0	984.9	975.8	966.7	957.6	948.5	939.4	930.9	922.5	914.1	905.6	897.2	888.8
30	1009.6	1000.4	991.3	982.1	972.9	963.8	954.6	945.4	937.0	928.5	920.0	911.5	903.0	894.5
30.25	1016.1	1006.9	997.6	988.4	979.2	970.0	960.7	951.5	943.0	934.4	925.9	917.3	908.8	900.3
30.5	1022.6	1013.3	1004.0	994.7	985.4	976.1	966.9	957.6	949.0	940.4	931.8	923.2	914.6	906.0
30.75	1029.0	1019.7	1010.3	1001.0	991.7	982.3	973.0	963.6	955.0	946.3	937.7	929.0	920.4	911.7
31	1035.5	1026.1	1016.7	1007.3	997.9	988.5	979.1	969.7	961.0	952.3	943.6	934.9	926.2	917.5



SECTION IX

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REV. 1

Resetting and Recharge

CLEARING ELECTRICAL EQUIPMENT

Refer to AUTOPULSE Installation, Operation, and Maintenance manuals for detailed instructions on resetting the electric detection system.

NOTICE

If AUTOPULSE Control System is utilizing an ANSUL AUTOMAN II-C releasing device for pneumatic actuation, AUTOPULSE panel will remain in trouble condition until ANSUL AUTOMAN II-C release is cocked.

CHECK MECHANICAL AND ELECTRICAL EQUIPMENT

Piping and Nozzles

A fire condition could cause damage to the piping and nozzles and possibly support members. Check all rigid pipe supports and all fitting connections. Take the nozzles off the piping, inspect for damage, corrosion, or obstructions, clean and re-install.

Electric Detection System

ANSUL AUTOMAN II-C RELEASING DEVICE – For complete resetting instructions, refer to Installation, Operation, and Maintenance manuals, Part No. 17788 and 31496.
Note: Before resetting release mechanism, bleed pressure from actuation piping by pulling ring on safety relief valve located on actuation piping.

AUTOPULSE Control System – For complete resetting instructions, refer to the appropriate installation, operation, and maintenance manual.

RECHARGING



CAUTION

Make certain tanks contain no pressure before removing valves. If tank contains pressure, removing valve could cause violent tank movement, causing personnel injury or property damage.

Valve Teardown

Note: In order to maintain Factory Mutual approval, factory filled SAPPHIRE tanks must be used.

1. Remove empty SAPPHIRE tanks by removing the actuators (either electric or pneumatic).
2. Remove piping and discharge hose from valve outlet and remove empty tanks from brackets.

3. Tank valves must be rebuilt and all O-rings replaced prior to tanks being recharged. Follow instructions listed in Step No. 4 and 4a.
4. **1 in and 2 in. Valves** – Valve cleaning/O-ring replacement instructions. Refer to Figure 1 for component descriptions.

The following components are required for valve rebuilding:

- Bonnet assembly, Part No. 570543 for 1 in., Part No. 570541 for 2 in.
- Piston assembly, Part No. 570551 for 1 in., Part No. 570552 for 2 in.
- O-ring kit, Part No. 570559 for 1 in., Part No. 570584 for 2 in.
- If necessary, recoil cap assembly, Part No. 570553 for 1 in., Part No. 570554 for 2 in.
 - a. Remove the valve from the tank.
 - b. Remove the siphon tube locking screw to allow removal of the siphon tube from the valve.
 - c. Remove the socket head cap screw that holds the recoil cap chain to the valve body.
 - d. Remove bonnet locking screw from the same port as socket head cap screw mentioned in Step "c" and unscrew the bonnet assembly, using the spanner wrench, Part No. 570574. Remove and discard O-ring from bonnet assembly.
 - e. Remove the piston assembly by pushing up on it from the bottom of the valve. Discard complete piston assembly.
 - f. Remove collar O-ring, and siphon tube O-ring. Discard both.
 - g. Clean all internal valve surfaces. Use caution not to cause any scratching to surfaces.
 - h. Use O-ring kit, Part No. 570559 for 1 in. or Part No. 570584 for 2 in., to replace with all new O-rings. Apply Dow Corning No. 4 lube to all O-rings before installing on components.
 - i. Push in new piston assembly.
 - j. Screw in bonnet assembly, including new O-ring. Tighten with spanner wrench.
 - k. Thread in bonnet locking screw followed by washer, chain and socket head cap screw. The cap screw holds the recoil cap chain to the tank valve body.
 - l. Install collar and siphon tube O-ring. Before installing, coat with Dow Corning No. 4 lube.

SECTION IX

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REV. 1

Resetting and Recharge

RECHARGING (Continued)

Valve Teardown (Continued)

- m. Push siphon tube into base of valve and rotate until locking screw hole in the siphon tube is aligned with the siphon tube locking screw hole in the valve base. Install siphon tube locking screw.
- n. Do not install valve into tank until Step "1g" in "Filling Instructions."

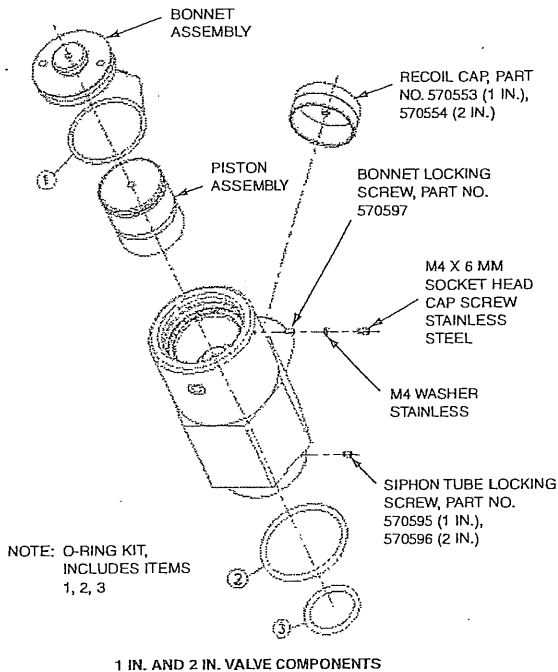


FIGURE 1
006768

- 4a. **3 in. Valve** – Valve cleaning/O-ring replacement instructions. Refer to Figure 2 for component descriptions.

The following components are required for valve rebuilding:

- Top cap assembly, Part No. 570598
- Piston assembly, Part No. 570601
- O-ring kit, Part No. 570599
- If necessary, recoil cap assembly, Part No. 570600
 - a. Remove valve from tank. Note: Siphon tube for 3 in. valve stays in the tank collar.
 - b. Unscrew top cap.
 - c. Remove body and collar O-rings. Replace with new O-rings in a later Step.
 - d. Remove the piston from the valve body and discard.

- e. Clean inside surfaces of valve body. Be careful not to scratch surface. Spray a small quantity of PTFE silicone into the inside of the valve.
- f. Lubricate top cap O-ring with PTFE silicone and install into upper groove on valve body.
- g. Lubricate collar O-ring with PTFE silicone and install on valve collar threads.
- h. Lubricate piston O-rings with PTFE silicone and install piston in valve body.
- i. Install top cap on valve body. Hand tighten.
- j. Valve assembly is now ready to be leak tested. See Testing Section.

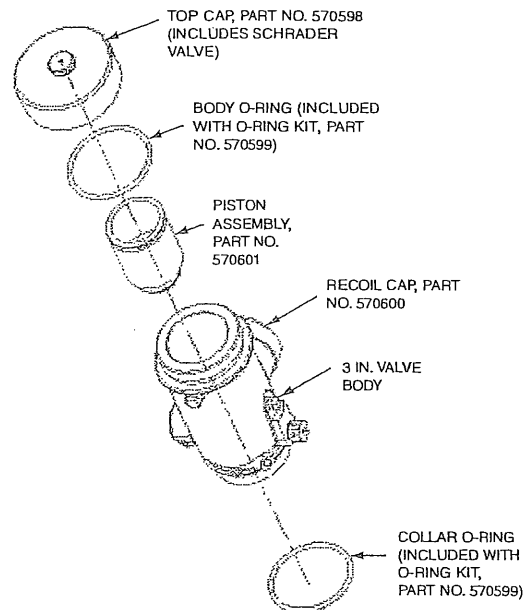


FIGURE 2
006904

TESTING

On completion of the valve tear down, the valve assembly requires two tests – Leak Test and Pre-Dome Test (Pre-Dome Test is required only if burst disc had been changed).

The tests must be conducted using a nitrogen source, a test bottom cap, close down adaptor, and an outlet filling adaptor. See Figure 3 for Test Station Component Layout.

Valve Size	Bottom Test Cap Part No.	Top Closing Adaptor Part No.	Outlet Filling Adaptor Part No.
1 in.	570272	570579	570576
2 in.	570276	570579	570592
3 in.	570374	570579	69891

Resetting and Recharge

TESTING (Continued)

1. The valve assembly is assembled to the test bottom cap. The outlet adaptor is assembled to the valve outlet. Attach the nitrogen line and make certain the vent valve on the outlet adaptor is closed.
2. Burst Disc Pre-Dome Procedure – Open the nitrogen regulator to 580 psi (40 bar) and slowly allow pressure to the valve through the bottom test cap. This is to pre-dome the burst disc. Hold this pressure for 1 minute to ensure that there is no drop in pressure indicated by the rest gauge on the nitrogen test set-up.
3. Pour water/soap solution into the top cap Schrader valve and apply leak detection spray to all ports on the valve. If no leaks are detected, the pressure to the valve must be reduced to 363 psi (25 bar) and the close down adaptor must be attached. To close the valve piston, increase the nitrogen pressure to the close down adaptor to 580 psi (40 bar).
4. Check for leaks.
5. Slowly release the gas pressure from the nitrogen test set-up, vent the close down adaptor, and make certain that the outlet filling adaptor is opened before removing the adaptors.
6. If a leak had been detected, it must be rectified and retested. If the leak persists, the valve assembly must be rejected.

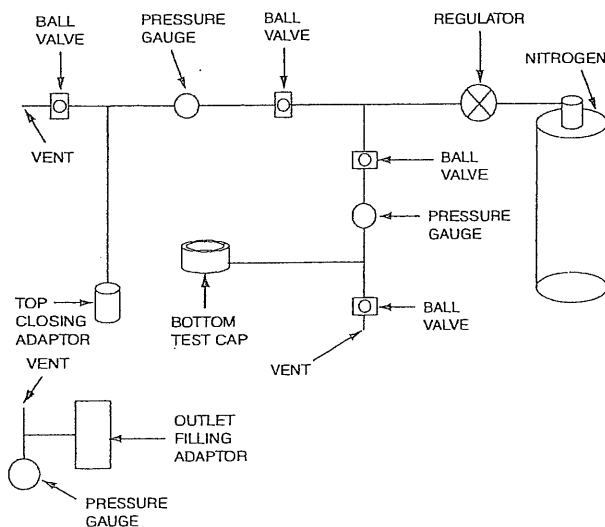


FIGURE 3
004977

FILLING INSTRUCTIONS

1. Recharging Instructions:
 - a. See Figure 4 for a typical recharge station configuration.
 - b. Install a drier (such as a Hammond DRIERITE filter) in a threaded port on the Novec 1230 agent container. A drier is required because humid air may cause the agent to convert to an acid.
 - c. The outlet of the container requires an inline (20 micron or smaller) filter.
 - d. The agent can either be pumped or gravity fed to the tank.
 - e. Tank must be visually inspected and clean inside. **IMPORTANT – No moisture is allowed in the tank. It must be completely dried. Water mixed with agent will cause acid.**
 - f. Rebuild valve. See "Valve Rebuild Instructions," Step 4 and 4a.
 - g. Reinstall valve and siphon tube assembly into tank. Tighten securely.
 - h. Purge tank by pressurizing through a Outlet Fill Adaptor Assembly (see chart on Page 9-2) to 100 psi (6.9 bar) with dry nitrogen, then vent pressure. This process will remove humid air from the tank.
 - i. Fill tank with correct amount of agent by weight. See nameplate for this information.
 - j. Set regulator to 20 psi (1.4 bar) lower than the required tank pressure based on ambient temperature. Refer to pressure vs. temperature chart in this section. Pressurize tank. Agitate tank while pressurizing.
 - k. After correct pressure is reached, close valve near tank valve outlet.
 - l. Close tank valve by using Top Adaptor Assembly, Part No. 570579, as follows. Set regulator to 450 psi (31.0 bar). Pressure Top Adaptor Assembly. Open and close the valve rapidly to prevent over-pressurizing of tank.
 - m. Vent pressure from tank valve outlet.
 - n. Remove Fill Adaptor Assembly and install recoil cap on valve outlet.
 - o. Agitate tank by rolling or inverting so that the agent can absorb the nitrogen.

SECTION IX

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REV. 1

Resetting and Recharge

FILLING INSTRUCTIONS (Continued)

- p. Add more nitrogen through the Top Adaptor Assembly. Using the pressure vs. temperature chart at ambient temperature, set the regulated pressure at the corresponding pressure plus 8 psi (0.6 bar). It takes 8 psi (0.6 bar) to overcome the spring force in the valve core.
Note: Do not use gauge on valve to determine recharge pressure.
- q. Repeat Steps "o" and "q" until the agent has fully absorbed the nitrogen.
- r. Let tank assembly sit for 3 hours.
- s. Check the tank valve for leaks by using soap and water solution.
- t. Check tank gauge pressure based on pressure vs. temperature chart.
- u. Repeat Step "o."
- v. Recheck gauge pressure. If gauge reading decreased, repeat Step "p."

- w. Once tank pressure is correct, remove from fill station.

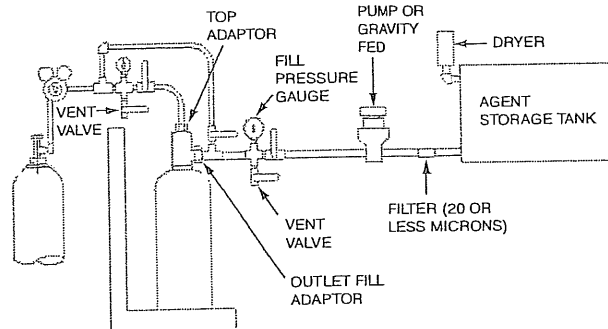
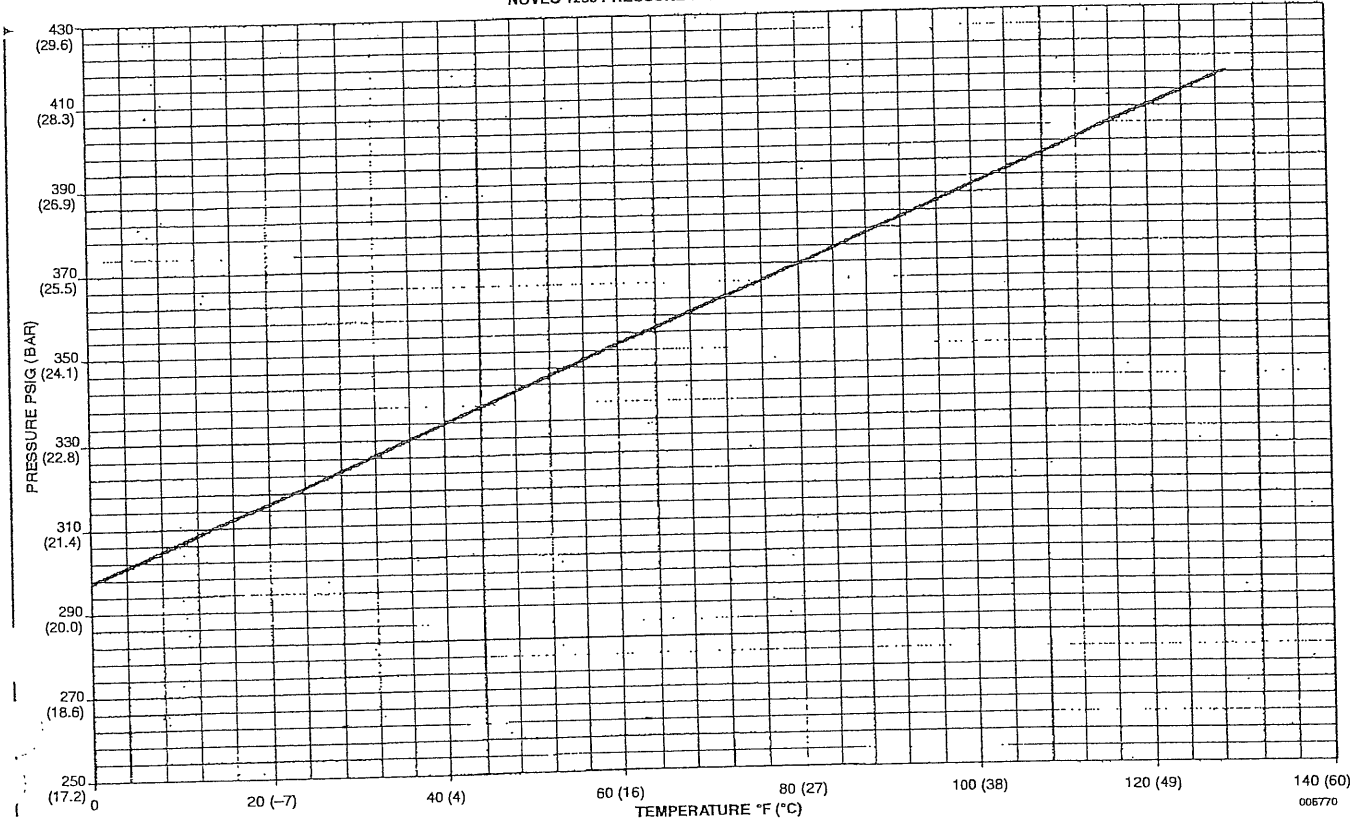


FIGURE 4
006767

2. Replace recharged tanks in bracket and follow "Installation" procedures to put system back in service.
3. Inform proper personnel that the system is back in service.

NOVEC 1230 PRESSURE VS. TEMPERATURE CHART



006770



HARDWARE WARRANTY

1) SIMPLEXGRINNELL WARRANTY STATEMENT:

- a) SIMPLEXGRINNELL WARRANTS TO THE PURCHASER OF NEW SIMPLEXGRINNELL PRODUCT(S) THAT THE PRODUCTS SHALL BE FREE FROM DEFECTS IN WORKMANSHIP AND MATERIAL.

2) WARRANTY PERIOD:

- a) THE WARRANTY PERIOD WILL TERMINATE IMMEDIATELY FOLLOWING THE EARLIEST OCCURRENCE OF EITHER OF THE FOLLOWING:
- i) 18 MONTHS HAVE ELAPSED FOLLOWING SHIPMENT OF ANY SYSTEM OR SUB-SYSTEM FROM SIMPLEXGRINNELL TO THE CUSTOMER, OR
 - ii) 12 MONTHS HAVE ELAPSED FOLLOWING THE FINAL CONNECTION OPERATION AND BENEFICIAL USE OF ALL OR ANY PART OF THE SYSTEM.
 - iii) AS STATED IN THE SPECIFICATIONS AND/OR CONTRACT DRAWINGS

3) SIMPLEXGRINNELL OBLIGATION UNDER THE TERMS OF THE WARRANTY:

- a) SIMPLEXGRINNELL'S SOLE RESPONSIBILITY SHALL BE TO REPAIR, ADJUST OR REPLACE, AT ITS OPTION, ANY SIMPLEXGRINNELL PRODUCT WHICH FAILS DURING THIS PERIOD PROVIDING PURCHASER HAS PROMPTLY REPORTED SUCH FAILURE TO SIMPLEXGRINNELL IN WRITING. REPLACEMENT PARTS WILL BE WARRANTED ONLY FOR THE BALANCE OF THE EQUIPMENT WARRANTY. SIMPLEXGRINNELL AGREES TO CONTINUE TO HONOR ALL OF THE UNEXPIRED EXPRESSED WARRANTIES SPECIFIED ABOVE ON DEFECTIVE EQUIPMENT AFTER TRANSFER OF THE EQUIPMENT TO PURCHASER'S CUSTOMER, PROVIDED PURCHASER'S CUSTOMER ASSUMES THE PURCHASER'S OBLIGATIONS SPECIFIED BELOW.
- b) EXCEPT FOR THE EXPRESSED WARRANTIES STATED HEREIN, SIMPLEXGRINNELL DISCLAIMS ALL WARRANTIES ON PRODUCTS FURNISHED HEREUNDER, INCLUDING WITHOUT LIMITATION, ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND THE STATED WARRANTIES ARE IN LIEU OF ALL OBLIGATIONS OR LIABILITIES ON THE PART OF THE SIMPLEXGRINNELL ARISING OUT OF OR IN CONNECTION WITH THE PERFORMANCE OF THE PRODUCTS. THE SELLER SHALL NOT BE LIABLE FOR ANY DIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE TO THE PRUCHASER OR USER OF THIS EQUIPMENT ARISING OUT OF THE FAILURE OF THE EQUIPMENT TO OPERATE IN EXCESS OF THE PURCHASE PRICE OF SAID EQUIPMENT.
- c) SIMPLEXGRINNELL MAKES NO WARRANTY AND NO WARRANTY SHALL BE DEEMED TO EXIST, THAT PURCHASER HOLDS THE GOODS FREE OF THE CLAIM OF ANY THIRD PERSON BYWAY OF PATENT INFRINGEMENT OR THE LIKE.

4) PURCHASER'S OBLIGATIONS UNDER THE TERMS OF THE WARRANTY.

- a) THIS WARRANTY IS CONTINGENT UPON THE PROPER INSTALLATION AND USE OF THE PRODUCT(S). SUCH WARRANTY SHALL NOT APPLY IF THE PRODUCT FAILURE IS THE RESULT OF ACCIDENT, UNUSUAL PHYSICAL, ELECTRICAL OR ELECTROMECHANICAL STRESS, NEGLIGENCE, MISUSE, USER PROGRAMMING ERRORS, FAILURE OF ELECTRICAL POWER, AIR CONDITIONING OR HUMIDITY CONTROL, CONSTRUCTION DUST, DAMAGING FOREIGN SUBSTANCES, TRANSPORTATION OR CAUSES OTHER THAN MANUFACTURING DEFECT. PURCHASER AGREES TO PROVIDE FULL AND FREE ACCESS TO AUTHORIZED SIMPLEXGRINNELL EMPLOYEES.



5) WARRANTY SERVICE HOURS:

- a) SERVICES PROVIDED UNDER THIS WARRANTY WILL BE PERFORMED DURING THE HOURS OF 8:00A.M. TO 5:00P.M., MONDAY THROUGH FRIDAY, EXCLUDING LOCALLY OBSERVED SIMPLEXGRINNELL HOLIDAYS. OFF HOURS RESPONSE IS AVAILABLE AS AN EXTRA COST SERVICE OPTION.

6) WARRANTY EXCLUSIONS:

- a) LABOR, TRAVEL, AND MILEAGE FOR:
 - i) SERVICE OUTSIDE OF SIMPLEXGRINNELL NORMAL BUSINESS HOURS.
 - ii) PROGRAMMING AND/OR LABEL CHANGES.
 - iii) FAILURE DUE TO EXTERNAL CAUSES (LIGHTNING SURGES, CONSTRUCTION DUST, ETC.) OTHER THAN MANUFACTURING DEFECT.
- b) ELECTRICAL WORK EXTERNAL TO THE EQUIPMENT SUPPLIED BY SIMPLEXGRINNELL OR MAINTENANCE OF ACCESSORIES, ALTERATIONS, ATTACHMENTS OR OTHER DEVICES NOT FURNISHED BY SIMPLEXGRINNELL.
- c) BATTERIES
- d) COVERAGE OF EQUIPMENT CLASSSED AS A WATER FLOW MONITORING/CONTROL DEVICES INSTALLED IN OR ON WATER PIPING.