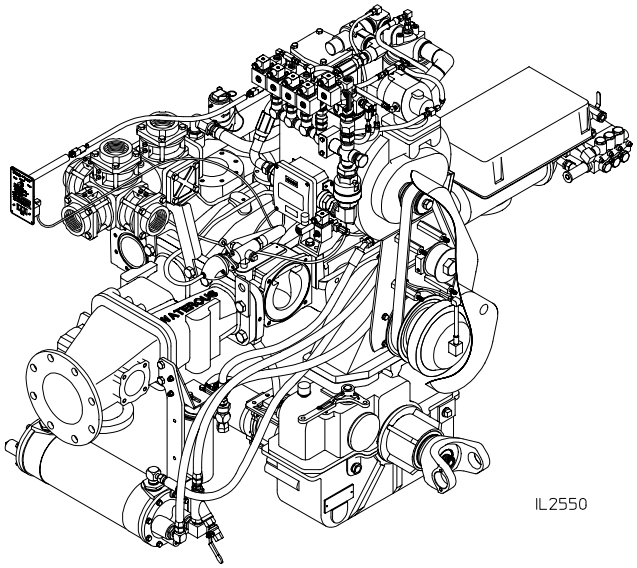
Eclipse™ CAFSystem with Electric Auto−Sync

Operation and Maintenance

Form No.	Section	Issue Date	Rev. Date
F−1031	2121	02/01/05	09/23/05



Illustrations

1. Component Location 2
2. Electric Auto Sync Control Panel 3
3. Oil Cooler Drain Locations 8
4. Pneumatic Clutch 8
5. Air Control Circuit / Air Inlet Trim Valve / Balance Trim Valve 9

Table of Contents

Safety Information 1
General Description 2
General Information 3
Electric Auto Sync Control Panel 3
Unload / Fixed / Auto Control Switch 3
Unload Control Valve 3
CAFS Nozzle / Flow Rate / Hose Combinations 3
Nozzles 3
Foam Concentrate Ratios 3
Hose 3
Operation 4
Water Pumping Operations 4
Foam Solution Operations 4
Compressed Air Foam Operations 5
Compressed Air Only 5
Shut Down Procedure 6
Compressed Air Foam Operations 6
Compressed Auto Shut Down (Overheat) 6
Service and Maintenance 7
Calibration − Control Air Circuit 8
CAFS Customer's Troubleshooting Guide 10

Read through the safety information and operating instructions carefully before using your Waterous Fire Pump.

WATEROUS

Fire Pumps – Since 1886

Visit us at www.waterousco.com

Safety Information

Read through the safety information and operating instructions before using your Waterous Fire Pump.

⚠ WARNING

Death or serious personal injury might occur if proper operating procedures are not followed. The pump operator, as well as individuals connecting supply or discharge hoses to the apparatus must be familiar with these pump operating instructions as well as other operating instructions and manuals for the apparatus, water hydraulics and component limitation.

⚠ WARNING

Pressure Hazard. May result in personal injury.

Prior to connection or removal of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains or bleeder valves. Bleeder valves should also be used while filling a hose connected to an intake with water.

⚠ WARNING

Scalding Water Hazard. May result in serious burns.

When operating the pump, be sure to open at least one discharge valve slightly to prevent the pump from overheating. If the pump runs for a few minutes completely closed, it may heat the water enough to scald someone when the valve is opened. Overheating can damage the packing, seals and other pump parts. If the apparatus builder has installed a by−pass system or other provision designed to prevent overheating, opening a discharge valve may be unnecessary.

⚠ WARNING

Hose Pressure Hazard.
May cause serious personal injury.

Use only fire hose that is rated at 200 PSI or higher working pressure.

⚠ WARNING

Air Source Hazard.
May cause serious personal injury or death.

Do not use the compressed air foam unit as an air source for any self−contained breathing apparatus (SCBA) or any breathing air supply.

⚠ WARNING

“Slug Flow” Hazard.
May cause personal injury to the hose operator.

Foam concentrate must be present before the presence of compressed air to prevent the condition known as “slug flow.” If foam concentrate is not present, unmixed water and air will be discharged through the nozzle in an erratic matter.

⚠ WARNING

Pressure Hazard.
May cause serious personal injury.

Discharge outlets that are capped, hose lines that are valved and charged and the air compressor sump may contain compressed air. Relieve all pressure before attempting to remove any caps, fittings, nozzles or to perform maintenance to prevent serious injury.

⚠ WARNING

Nozzle Reaction Force Hazard.
May cause personal injury to the hose operator.

Nozzle reaction force is significantly increased at the time the nozzle is opened in compressed air foam operation. Open CAFS nozzles slowly.

⚠ WARNING

Air Discharge Hose and Nozzle Heat Hazard.
May cause severe burns.

Hose and nozzle used for air discharge will become hot due to the hot air flowing through it. Wear protective gloves. Also be prepared for nozzle reaction when air discharge and nozzle are opened.

General Description

NOTE: Read and understand the operating instructions for the Eclipse™ compressed air foam unit and individual components prior to operating. (Refer to Figure 1 for component location.)

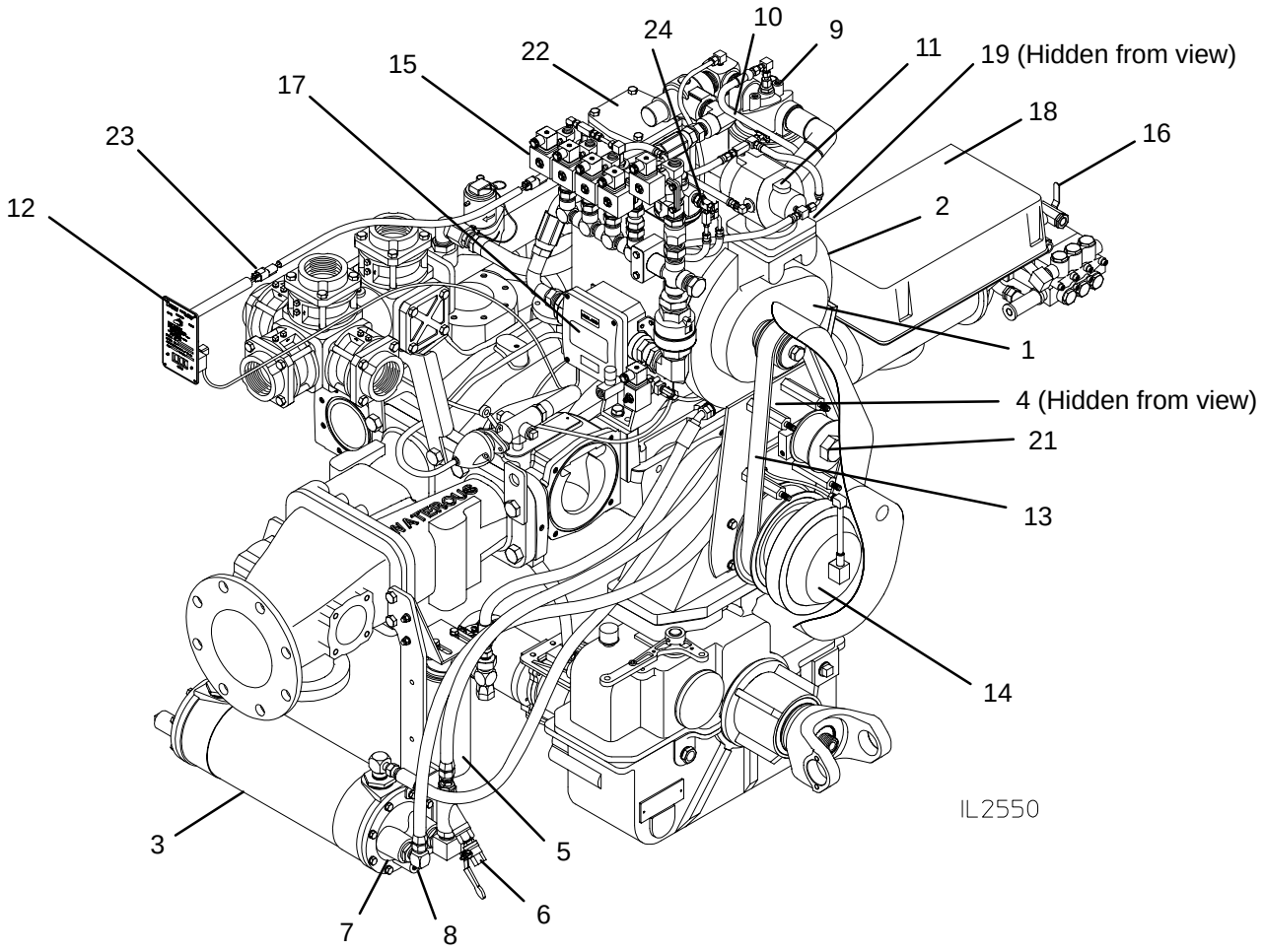
The air compressor system used by the Waterous Eclipse™ is a Pneumax / GHH Rand model CF75ED, oil flooded rotary screw type. Rotary screw air compressors are very common in industrial applications. This type of compressor injects oil into itself, where it lubricates, seals, cools and silences the compressor. The oil is then entrained into the air discharge from the compressor. This air/oil mixture is discharged into the sump tank where most of the oil separates from the air. The oil is then sent via hydraulic hose to a combination filter/cooler unit. It is filtered and cooled to remove compression and friction heat, and sent to the oil injection port on the compressor. The cycle is then repeated.

The oil mist that remains in the airstream is recovered by an air/oil separator system. This system recovers the oil mist in a spin−on cartridge that has a siphon tube that picks−up the recovered oil for return to the air compressor.

Table 1. Component Descriptions

Ref. No.	Description
1	Rotary Screw Compressor (Air End)
2	Encapsulating Sump Tank
3	Cooler Oil / Water
4	Oil Temperature Sensor
5	Oil Filter
6	Water Strainer
7	Oil Drain
8	Water Drain
9	Air / Oil Separator Cartridge
10	Siphon Tube / Return
11	Modulating Inlet Valve
12	Electric Auto Sync Control Panel (see Figure 2)
13	Polychain®
14	Pneumatic Clutch
15	Air Distribution Manifold with Electric Solenoids
16	FoamPro™ Proportioner
17	Air Flow Meter
18	Electric Relay Panel
19	Oil Fill and Level Sight Glass
21	Polychain® Tension Adjustment − Locking Bolt and Adjusting Bolt
22	Foam Manifold Built−In Check Valve
23	(500 GPM only) CAFS in−Line Check Valves
24	Piloted Balance Valve

Figure 1. Component Location



The compressor's air output is controlled by a modulating inlet valve. The inlet valve is opened and closed by the Auto Sync pressure control system.

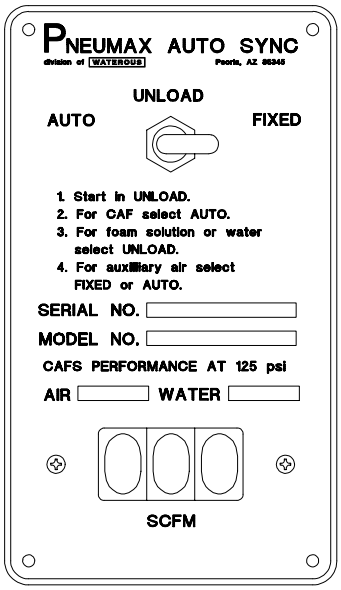
The compressor cooling system circulates water from the fire pump through the compressor oil cooler and back to the pump inlet to remove heat from the compressor oil system. The compressor oil temperature is typically in the 200 − 225°F range. Under maximum running condition, the compressor oil temperature may reach 235°F. If the oil temperature exceeds 235°F, check the water supply, water strainer, pump prime, restrictions in the cooling water system and for low oil level in the sump.

The air compressor (air end) is driven via a PolyChain® and pneumatic clutch through the pump transmission utilizing an extended impeller shaft. **It is important to ensure that there is a water supply from the fire pump whenever the compressor is running. Pump and/or compressor damage may result from running the pump without adequate water flow.**

General Information

Electric Auto Sync Control Panel

Figure 2. Electric AutoSync Control Panel



IL2556

Unload / Fixed / Auto Control Switch

The Unload/ Fixed / Auto control switch allows the operator to select between three air compressor pressure modes:

1. Unload (Standby) − The air compressor essentially idles, producing a minimal pressure (40 PSI) to maintain compressor oil flow. The compressor's clutch shall only be engaged when the Unload / Fixed / Auto switch is in the "Unload" position and master air pressure gauge reads "0" PSI.
2. Fixed − air pressure is maintained at a preset pressure setting (150 PSI).
3. Auto − air pressure matches water discharge pressure.

CAFS Nozzle/Flow Rate/Hose Combinations

Nozzles

Compressed air foam can be discharged through various types and sizes of nozzles. Fog nozzles break−down the bubble structure of the foam, resulting in a "wetter" or reduced expansion foam. Similarly, when utilizing smooth bore nozzles with a given hose diameter, smaller tips will discharge "wetter" foam.

Foam Concentrate Ratios

Proportioner settings of 0.2% and 0.3% are typically adequate to produce compressed air foam that is formed in a hoseline and used on Class A combustibles. Higher settings will result in a "drier" appearing foam. Lower settings may result in "slug flow" or discharge pulsation caused by insufficient foam concentrate in the solution to form foam in the hoseline.

For Class B or other type foam ratio settings, follow instructions provided by the foam concentrate manufacturer.

Hose

Utilize fire hose that is rated by the hose manufacturer for use with CAFS. Since the foam is formed during its transition through the hoseline, it is important to utilize the minimum recommended hose lengths, unless a static mixer is used. There is significantly less friction and head loss with compressed air foam as compared to water or foam solution; therefore, effective fire streams can be achieved with longer hose lays. Refer to the Suggested Guidelines for the Production of Mid−Range Compressed Air Foam (Tables 2 and 3).

⚠ WARNING

Hose Pressure Hazard.
May cause serious personal injury.

Use only fire hose that is rated at 200 PSI or higher working pressure.

NOTE: CAFS has the ability to produce a foam of shaving cream consistency. While this type of foam is highly stable and possesses a long drain time, it is essential to ensure that the foam will release sufficient water to extinguish a fire in a direct attack situation. This type of foam is typically suited for defensive operations such as exposure protection, barriers or fuels pretreatment.

Table 2. Suggested Guidelines for the Production of Mid−Range Compressed Air Foam

Hose Diameter	Tip Size	Water Flow	Air Flow	Discharge Pressure	Minimum Hose Length
1”	1/2”	15 GPM	15 CFM	125−150 PSI	35’
1”	3/4”	20 GPM	20 CFM	125−150 PSI	35’
1−1/2”	1”	30−40 GPM	30−40 CFM	110−150 PSI	100’
1−1/2”	1−3/8”	50−60 GPM	50−60 CFM	110−150 PSI	100’
1−3/4”	1”	30−40 GPM	30−40 CFM	110−150 PSI	100’
1−3/4”	1−3/8”	50−90 GPM	50−80 CFM	110−150 PSI	100’

NOTE: With 1−3/4” hose lengths of 100’ to 250’, up to 90 GPM of water and 80 CFM of air may be utilized as a highly effective initial attack flow.

Table 3. Suggested Guidelines for the Production of Mid−Range Compressed Air Foam − Master Stream

Tip Size	Water Flow	Air Flow	Discharge Pressure
1”	90−120 GPM	60−80 CFM	125−150 PSI
1−3/8”	100−150 GPM	70−100 CFM	125−150 PSI
1−1/2”	120−200 GPM	80−120 CFM	120−150 PSI
1−3/4”	180−250 GPM	120−150 CFM	120−150 PSI
2”	250−450 GPM	200 CFM	120−150 PSI

NOTE: Typical master stream operations utilize lower foam expansion ratios (“wetter” foam) for increased foam density and longer stream reach.

Operation

A pumper equipped with an Eclipse™ compressed air foam unit can be operated in several pumping modes; water only, foam solution without compressed air, compressed air foam and compressed air only for support operation such as operating air tools, filling rescue air bags, etc. It is possible to pump water from one discharge, foam solution from another discharge while pumping compressed air foam from yet another, or varying foam consistencies (expansion ratios) from different discharges simultaneously.

NOTE: Monitor compressor instruments during all operations.

Water Pumping Operations

All unit operations begin with pumping water. See the following instruction for details on how to operate and pump water from your Waterous fire pump:

- F−1031, Section 2114, *Operation and Maintenance Instructions for Waterous CMU Series Centrifugal Fire Pumps*

  or

- F−1031, Section 2115, *Operation and Maintenance Instructions for Waterous CS and CSU Series Centrifugal Fire Pumps*

For water only operations, the compressor switch should be in the “OFF” position which disengages the air compressor.

CAUTION

Overheating hazard.
May cause damage to the pump and/or compressor.

Running the unit without adequate water flow can cause damage to the pump and/or the air compressor system.

Foam Solution Operations

To begin using a foam solution, follow the instructions above for Water Pumping Operations.

After the pump is operating, turn on the foam proportioner to inject foam concentrate into the water stream. Refer to *FoamPro® Systems 2001 and 2002 Installation and Operation Manual,* P/N L−0825, for instructions on how to properly operate the installed proportioning system.

Compressed Air Foam Operations

The Eclipse™ CAFS design provides a minimum air flow of 80−90 SCFM @ 125 PSI whether the pump operates from draft, tank or hydrant. At a typical engine idle speed (600−700 RPM) and a pump transmission ratio of 2.27, the air compressor is capable of delivering 80−90 SCFM of 125 PSI air.

CAUTION

Operating Speed Limit.
May cause damage to the pump and/or air compressor.

The Eclipse™ compressor has a maximum operating speed of 8950 RPM. Do not allow the compressor to run beyond 8950 RPM.

Compressor speed can be calculated by **(Engine Speed) x (Pump Transmission Ratio) x 2.5 .**

CAUTION

Compressor Starting Hazard.

Starting compressor under pressure may cause damage to the clutch and/or kill the engine.

Allow ample time for the compressor to bleed down before engaging the compressor.

⚠ WARNING

“Slug Flow” Hazard.
May cause personally injury to the hose operator.

Foam concentrate must be present before the presence of compressed air to prevent the condition known as “slug flow.” If foam concentrate is not present, unmixed water and air will be discharged through the nozzle in an erratic matter.

To begin compressed air foam operations, follow the instructions above for Foam Solution Operations.

NOTE: Discharge pressure for compressed air foam operations typically range between 80 and 120 PSI in a flow state. Set the water discharge pressure at the desired level.

NOTE: Compressed air foam does not have the hydraulic characteristics of plain water or foam solution; therefore, standard pump hydraulics practices do not apply to CAFS operations.

⚠ WARNING

Nozzle Reaction Force Hazard.
May cause personally injury to the hose operator.

Nozzle reaction force is significantly increased at the time the nozzle is opened in compressed air foam operation. Open CAFS nozzles slowly.

After the pump and foam proportioner are operating, perform the following:

1. Place the Auto Sync control in the “UNLOAD” position and check master air pressure gauge reads “0” PSI.
2. Engage the air compressor by moving the compressor switch to the “ON” position.
3. Move the Auto Sync control to the “AUTO” position. The air pressure should rise to within plus or minus 5% of the water discharge pressure. The Auto Sync system will balance the air and water pressures plus or minus 5% throughout a range of 40 PSI and up to 150 PSI .
4. Set proportioner at 0.2% − 0.4% for normal Class A combustibles. Proportioning rates are dictated by the type and brand of foam concentrate used and the tactical objective.
5. Open desired discharge valve(s) to a half−open position. The foam expansion ratio is set by controlling the amount of foam solution entering the discharge stream. High solution flows (discharge valve fully open) restrict the amount of air admitted and result in lower expansion or “wet” foam. To produce higher expansion or “drier” foam, simply reduce the amount of solution admitted by gating back the discharge valve.
6. Open the air valve(s) to the desired discharge(s). Adjust the solution flow (discharge valve setting) to produce the desired foam consistency.

Compressed Air Only

For compressed air only operation, the fire pump must be equipped with a discharge bypass system designed to re−circulate booster tank water through the fire pump for cooling. The bypass system must be in operation before running compressed air only.

Air compressor cooling is via water from the booster tank that is circulated by the fire pump through the compressor cooler and returned back to the pump inlet. Compressed air only operation time is limited by the amount of available cooling water. The water in the booster tank will eventually become heat saturated and ineffective at cooling the air compressor.

CAUTION

Overheating Hazard.
May cause damage to the pump and/or compressor.

Pump water may overheat when using the Eclipse™ as an air compressor for an extended period of time. Limit the amount of time the Eclipse™ is used as an air compressor to prevent damage to the pump or air compressor. Monitor the compressor temperature gauge closely. Compressor system overheat is also indicated by the panel mounted warning light system.

NOTE: Extended compressed air only operations necessitate connection of an external water source to the pump inlet and closing of the tank to pump valve for proper compressor cooling.

After engaging the fire pump, ensure that the water pressure rises on the panel mounted master pressure gauge.

1. Place the Auto Sync control in the “UNLOAD” position and check master air pressure gauge reads “0” PSI.
2. Engage the air compressor by moving the compressor switch to the “ON” position.
3. Move the Auto Sync control to the “FIXED” position. Air pressure will rise to the preset pressure setting on the air compressor, approximately 150 PSI (10 bar) with the engine throttled−up.

⚠ WARNING

Air Source Hazard.
May cause serious personally injury or death.
Do not use the compressed air foam unit as an air source for any self−contained breathing apparatus (SCBA) or any breathing air supply.

4. ***For lower operating pressures:*** Move the Auto Sync controls to the AUTO position and use the engine throttle to control the air pressure.
5. Connect the air discharge hose to the fitting on the pump operator’s panel and open the air supply valve.

Shut Down Procedure

Compressed Air Foam Operations

To shut down compressed air foam operations, follow the instructions below:

1. Close air valve(s) to the discharge(s).
2. Turn off foam proportioner.
3. Flow clear water through discharge hose(s) until no bubbles are present.
4. Close discharge valve(s).
5. Place the Electric Auto/Sync control in the “UNLOAD” position.
6. Move the air compressor switch to the “OFF” position.

After the compressor is disengaged, the system will vent itself, creating an audible hiss as compressed air is evacuated from the pressure vessel/sump.

Compressor Auto Shut Down (Overheat)

The Eclipse™ air compressor is equipped with a compressor overheat auto shut down. This auto shut down is present to protect the compressor system from severe damage if such an event should occur.

Compressor Overheat

If high oil temperature (250° and above) is detected in the compressor, the compressor clutch will disengage, the *compressor will stop* and the Compressor Overheat light will illuminate. *The water pump and foam proportioning systems will continue to operate and are not affected by the compressor shut down.* To re−start perform the following:

1. Correct the fault, check oil level, cooling lines, recirculation line (if operating from tank), etc.
2. Reset auto shut down circuit by:
   a. Placing the Electric Auto Sync Control to “Unload”.
   b. Move the compressor engage switch to the “OFF” position.

The compressor can now be restarted by following the standard instruction found in the “Operation” section. If for any reason the fault has not been corrected when turning the compressor engage switch “ON”, the auto shut down will activate immediately and the Compressor Overheat light will illuminate.

Service and Maintenance

(Refer to Figures 1 and 3)

⚠ WARNING

Pressure Hazard.
May cause serious personally injury.

Discharge outlets that are capped, hose lines that are valved and charged and the air compressor sump may contain compressed air. Relieve all pressure before attempting to remove any caps, fittings, nozzles or to perform maintenance to prevent serious injury.

Excessive heat build−up and oil system contamination are the most common causes of compressor system problems and premature wear. With proper operation and maintenance, the compressor system should far outlast the vehicle it is mounted on. Adherence to the following guidelines will prevent potentially costly damage.

1. There is a sight gauge provided on the oil reservoir/sump tank. The oil level should be at approximately half−way up the window. Check the oil on level ground, prior to system start up (system holds approximately 2 to 3 gallons of oil). If the system has recently been run, wait 10 minutes after shut−down for the oil to stabilize before checking the oil level. The compressor uses a non−foaming hydraulic oil. This oil is classified by an ISO standard as ISO 68 viscosity and is sold under various trade names. Many are sold as an “anti−wear” hydraulic oil and are available from auto parts or lubricating oil suppliers.
2. The compressor needs to be cycled on a regular basis. Run the compressor with air flowing, weekly for 15−20 minutes. This will insure the compressor rotors are coated with lubricant and eliminate any moisture that may be present in the compressor.
3. The oil should be changed after the first 30 hours of system operation. After that, the oil should be changed annually. There is a drain plug located at the bottom of the oil cooler (see Figure 3). The oil fill cap is located on top of the sight gauge.
4. Change the compressor system spin−on oil filter at the same time as the oil is changed.
5. Run the compressor for two minutes after changing the oil, then re−check the oil level and add oil as necessary. **Do not overfill**.
6. Visually inspect the compressor oil system weekly for signs of leaks.
7. A water strainer is installed on the oil/water cooler inlet (see Figure 3). The water strainer should be checked and cleaned weekly. A plugged strainer will restrict cooling water and cause overheating of the compressor system.
8. Check the air compressor PolyChain® drive for proper tension and signs of wear semi−annually or more frequently as dictated by the amount of use. Belt tension may be checked by applying a 10 lb. load to the belt, mid−span between drive and driven sprocket. The belt should deflect .250 to .313”.

CAUTION

Belt Tightening Hazard.
May cause excessive wear or breakage.

Overtightening the belt on the Eclipse™ may result in excessive wear or breakage.

9. Whenever checking the air compressor PolyChain® also inspect the pneumatic clutch. Check that the set screws are tight and secure (See Figure 4). These screws locate and hold the clutch to the stub shaft. If any set screw is loose, remove the screw, clean and apply Loctite 243 blue thread lock. Reinstall screw and tighten. The set screw must engage the shaft groove for proper location.
10. Inspect the compressor air intake filter and replace as necessary. The environment in which the unit operates will determine the frequency of air filter replacement. In any situation, replace at least annually.
11. Replace the air/oil separator cartridge every 24 months or if the unit’s oil consumption suddenly increases. A sudden increase may be caused by a hole in the internal media of the cartridge allowing oil to carry through and discharge with the compressed air.
12. Completely drain the water from the compressor oil/water cooler in cold weather to prevent freeze damage (see Figure 3).

Table 4. Maintenance Schedule

Check Oil Level/Oil Leaks	Change * Compressor Oil & Filter	Check PolyChain® & Clutch	Change Air/Oil Separator Cartridge	Check Air Intake Filter	Check & Clean Water Strainer
Daily or After Each Use	Annually	Semi−Annually	Every 24 Months	Monthly	Weekly

**** Use ISO 68 Hydraulic Oil***

Figure 3. Oil Cooler Drain Locations

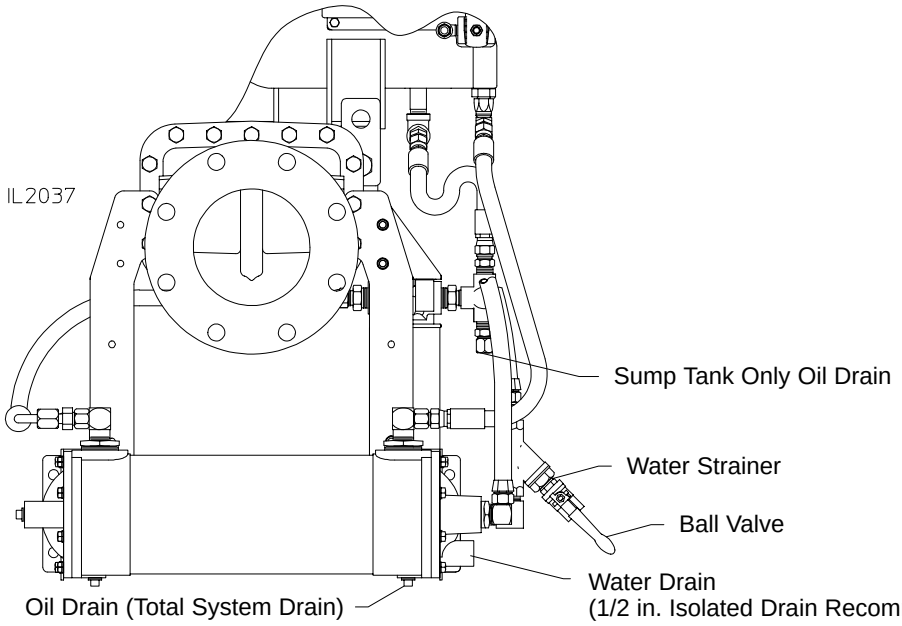
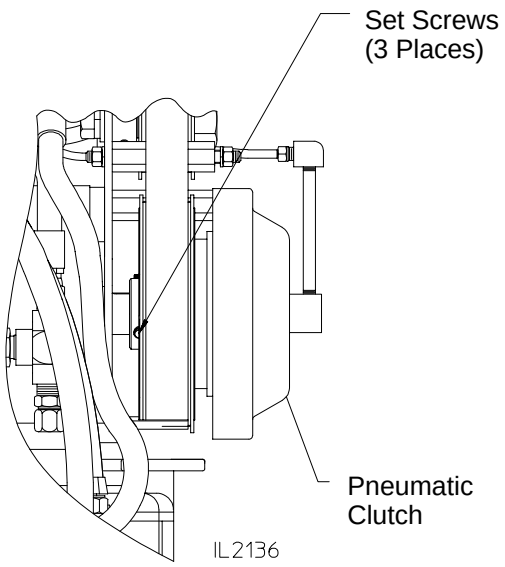


Figure 4. Pneumatic Clutch



Calibration − Control Air Circuit

The Eclipse™ Air Control circuit is preset and adjusted at the factory prior to shipment. In most cases, the factory settings will provide satisfactory performance for typical CAFS and auxiliary air applications. The FIXED air operation is factory set at 145−150 P.S.I.G. The AUTO air operation is set (or trimmed) to match the fire pump discharge pressure (+/− 5%).

If the air control circuit requires changing or the circuit has lost its factory setting, the following procedure can be used to “fine tune” the system.

Refer to Figure 4 for component locations.

1. Preset the Air Inlet Trim Valve (AITV) by closing the valve, then opening the valve three turns.
2. Preset the Balance Trim Valve (BTV) to full open.
3. Start the fire pump, remaining at idle speed, and establish water flow either through a discharge or tank recirculation.
4. Set the Electric Auto Sync Control Panel to UNLOAD mode and close all discharges.
5. Start the air compressor by placing the compressor engage switch to “ON”.
6. Read the main air pressure gauge (should read 40−50 P.S.I.G.). In the UNLOAD mode, this minimum pressure is always present to provide compressor oil circulation.

Final Adjustments for the FIXED and AUTO Modes

FIXED Air Mode

1. Locate the Fixed Pressure Regulator. Note that the regulator has an adjustment screw with a lock nut.
2. Loosen the regulator’s lock nut.
3. Place the controls to FIXED position on the Electric Auto Sync Panel. The compressor will build pressure to some value and hold (regulate).
4. Adjust the screw on the Fixed Pressure Regulator, while monitoring the air pressure gauge, until the desired pressure is reached. Turning the screw in will INCREASE the pressure. Turning the screw out will DECREASE the pressure.
5. Tighten down the locknut once the desired regulated pressure is achieved.
6. Verify the fixed regulator is performing by varying the compressor speed and monitoring the air pressure gauge. The pressure should remain steady at the fixed pressure setting.

With the final adjustments to the FIXED air mode complete, proceed with setting the AUTO air mode.

AUTO Air Mode

1. Place the Electric Auto Sync controls to the AUTO position with the fire pump operating at 100 P.S.I.G. main discharge and minimal flow.
2. Monitor main water discharge pressure gauge and the air pressure gauge. The pressure readings should be the same. If not, go to Step 3.

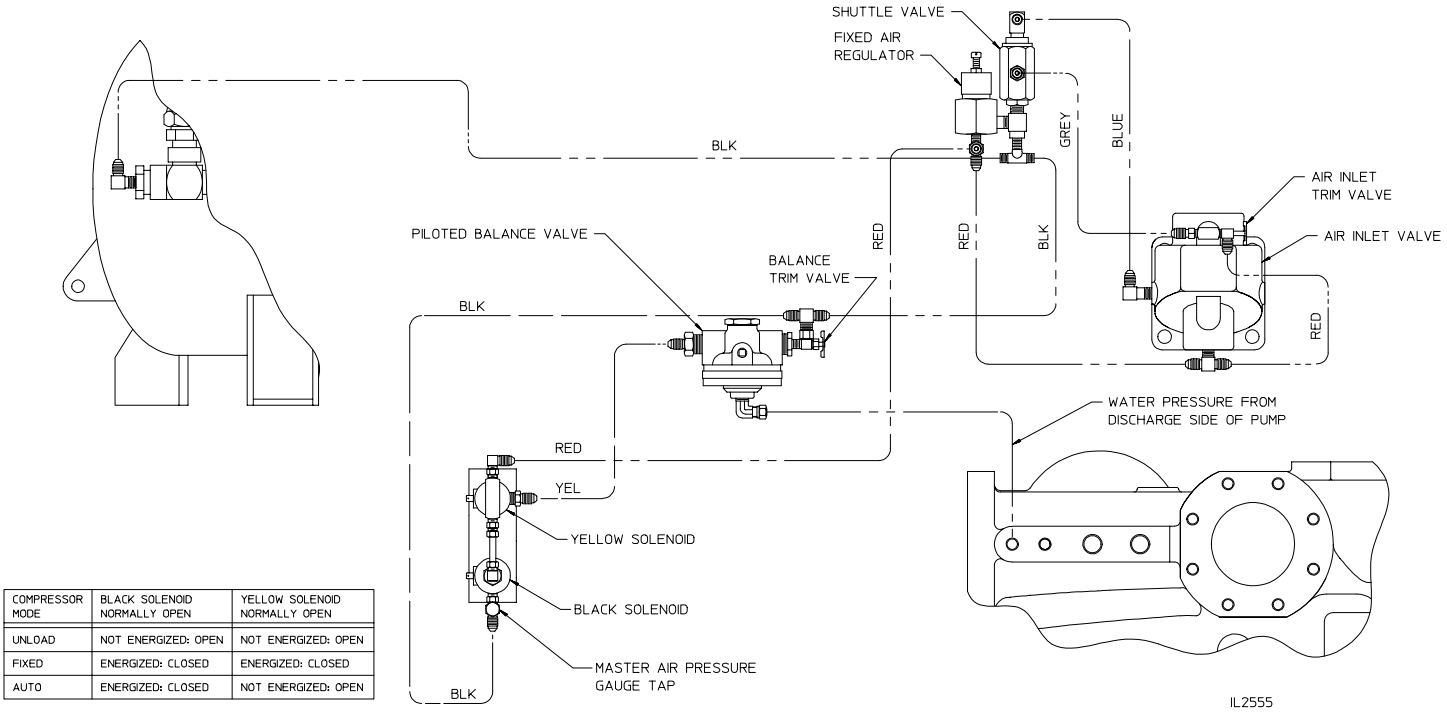
Air Inlet Trim Valve (AITV)

3. Close the trim valve in half turn increments if the air pressure is too high. Monitor both water and air pressure gauges until the pressures match. Once the pressures match, no further adjustments are needed and go to Step 5. If the air pressure is too low, open the trim valve a half turn then check water and air pressure gauges. If the air pressure is still too low, open the trim valve a half turn. If the air pressures match, no further adjustments are needed and go to Step 5. However, if air pressure is still too low, go to Step 4.

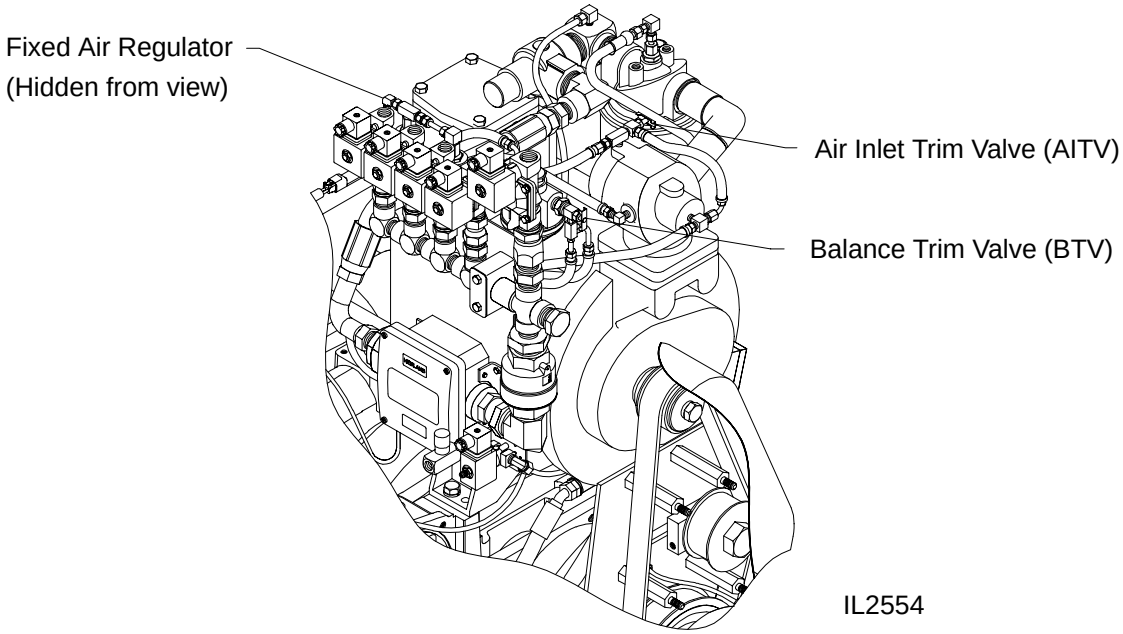
Note that the Air Inlet Trim Valve is now four turns open from fully closed. It is not desirable to have the trim valve open more than four turns. To extend the trim valve's range, use the Balance Trim Valve (BTV).

4. Close the BTV one turn from the fully open position. Check the water and air pressure gauges. If the air is still too low, again close the BTV one turn and check the gauges. Keep repeating the process until the air pressure matches or is slightly higher than the water pressure. The final adjustment can be done using the AITV and Step 3.
5. Verify the piloted balance valve is performing by varying the fire pump discharge pressure and monitoring the water and air pressure gauges. The air pressure should follow and match the water pressure. If not, repeat the final adjustment procedure.

Figure 5. Air Control Circuit / Air Inlet Trim Valve / Balance Trim Valvet



COMPRESSOR MODE	BLACK SOLENOID NORMALLY OPEN	YELLOW SOLENOID NORMALLY OPEN
UNLOAD	NOT ENERGIZED: OPEN	NOT ENERGIZED: OPEN
FIXED	ENERGIZED: CLOSED	ENERGIZED: CLOSED
AUTO	ENERGIZED: CLOSED	NOT ENERGIZED: OPEN



Waterous CAFS Customer's Troubleshooting Guide

It is important to know what to do if your compressed air foam system in not operating properly. This troubleshooting guide should help you diagnose, isolate and fix the problem encountered.

Problem	Cause	Fix
Lack of air supply from air compressor		
Is the air compressor engaging?	No − Lack of air supply to air clutch (Eclipse)	Repair air leak or re−establish air supply to air clutch. Check operation of the electric 3−way solenoid valve.
	No − No PTO engagement	Confirm "OK TO PUMP" light is illuminated. If not, repair as needed.
	Yes − Confirm Electric Auto−Sync settings	Pressures should be as follows: Air PSI of 20−50 when in UNLOAD Air PSI of 45−150 when in FIXED Air PSI to match pump discharge PSI in AUTO (+/− 5%)
Air compressor operating properly, no air supply to discharges		
	Malfunctioning air discharge solenoid(s)	Verify power and operation of discharge solenoid(s). Repair or replace as needed. Verify proper wiring to solenoid (polarity sensitive) − See F−1031, Section 3022.
	Malfunctioning air check valve(s)	Verify direction of check valve (arrow to discharge) and correct as needed.
	Air inlet trim valve out of adjustment	Reference "Control Air Circuit Calibration Instructions" on Page 8.
	Debris in air inlet trim valve (AITV)	Clean debris from air inlet trim valve (AITV).
	Minimum Pressure Valve stuck	Disassemble and clean or replace as required.
FIXED and RUN develops PSI but AUTO and RUN fails to develop PSI		
	Lacking water supply to balance trim valve	Reference "Control Air Circuit Calibration Instructions" Page 8.
Air discharge PSI does not match water PSI (+/− 5%)		
	Air discharge pressure higher than water discharge pressure	Circuit has an air leak or is uncoupled. Trace the red hose circuit to locate leaks and repair as needed.
	Air PSI gauge is not tapped into correct location	Verify that the air PSI gauge is tapped into the Master Air Pressure tap on the black solenoid of the Electric AUTO/SYNC control.
	Water PSI gauge is not tapped into correct location	Verify that the water PSI gauge is tapped into location shown on the dimensional assembly.
	Air inlet trim valve out of adjustment	Reference "Control Air Circuit Calibration Instructions" on Page 8.
	Air or water gauge not calibrated	Recalibrate and/or replace as required.
Safety pop−off valve opening		
	Balance trim valve completely closed	Reference "Control Air Circuit Calibration Instructions" on Page 8.

Problem	Cause	Fix
System overheating		
	Oil level in the air compressor is low	Check for oil leaks and repair as needed. Use ISO 68 viscosity hydraulic oil, filling to the middle of the sight glass.
	Plugged water strainer at oil cooler	Remove strainer and clean screen.
	Inadequate water supply	Verify that water is being circulated within the pump (TANK TO PUMP valve completely open with the TANK FILL valve 1/4 open).
	Overheated water supply	Supply the pump with fresh cool water and open a discharge valve or TANK FILL valve, allowing the heated water to be dumped to atmosphere.
	Compressor overspeeding in UNLOAD mode	Do not run compressor in excess of 8950 RPM. Compressor speed can be calculated as follows: drive line (engine) speed x 2.5 x gear ratio in the pump transmission.
Temperature gauge inoperative		
	Wires unconnected	Check wire connections at the gauge, sending unit and power supply.
	Wires improperly connected	Check wiring for proper sequence (green to large terminal; yellow to small terminal) − See F−1031, Section 3022.
Excessive oil consumption		
	Reservoirs overfilled with oil	Check oil level while on a level surface. Reduce level to middle of the sight glass.
	Flowing in excess of 200 CFM	Reduce RPM and flow CAFS and recheck oil level.
	Oil/Air filter torn or damaged	Result of flowing air in excess of 200 CFM. Replace air filter, flow CAFS, shut down the pump for 15 minutes and check oil level.
	Oil siphon line and check valve	Check oil siphon line for obstruction and inspect check valve for operation.
Excessive compressor bleed down time (time may vary)		
	Inlet air trim valve closed too far	Reference “Control Air Circuit Calibration Instructions” on Page 8.
	Debris in inlet air trim valve	Clean valve and reference “Control Air Circuit Calibration Instructions” on Page 8.
Engine stalls upon compressor engagement		
	Electric Auto−Sync in FIXED or AUTO	Place the Electric Auto−Sync in the UNLOAD setting.
	Engaging compressor when under load	Operating under this condition causes the compressor oil to accumulate in the compressor creating a condition similar to a hydraulic pump. To correct, allow air to bleed off, restart the compressor and immediately begin flowing air through a discharge.
	Air compressor locked up	Due to a lack of compressor oil/lubrication. Repair or replace the compressor.
Air flow digital display stuck at “0” CFM or inoperative		
	Digital display cable defective/or disconnected	Check cable connections at the meter and digital display.
	Air flow meter not powered	Check for damaged connectors in the meter or cable. Check pin connections for tightness and proper fit.

Problem	Cause	Fix
Poor foam solution (wet or dry)		
	Using wetting agent in place of foam	Flush system and install Class “A” foam.
	Lack of foam	Check if the Foam Pro system in on. Check if there is foam in the reservoir. Make sure the foam supply valve is on and the Y strainer clean. Reference the Foam Pro instruction manual.
	Incorrect size air lines to discharges	Refer to “Air Distribution Hose Size Guidelines” in F−1031, Section 3022.
Foam in water system		
	Foam dumped into the water tank	Flush water tank and pump until foam is cleared.
	Foam cell is leaking into water tank	Condition applies to tanks utilizing a common wall(s) between the foam tank and the water tank. If a leak is confirmed, repair the foam tank and flush the water tank and pump until foam is cleared.
	Foam proportioning manifold check valve malfunction	If the above conditions have been corrected, the final cause for foam in the water tank may be the result of a malfunctioning foam manifold check valve. To troubleshoot, cap off one foam discharge that is plumbed to the foam manifold, open that discharge valve and increase the pump discharge to 30−40 PSI. Disengage the pump and monitor the corresponding discharge PSI gauge, looking for a drop in discharge pressure. If the PSI drops, it indicates the foam manifold check valve is leaking and requires repair.
Water in compressors oil/air		
	Leaking oil cooler	Isolate the heat exchanger and check for leaks. Replace if necessary. (Typical cause is freezing.)
	Discharge air check valve(s) malfunctioning	Confirm direction (arrow towards discharge valve). Replace if necessary.
Clutch smoking		
	Engaging compressor with the Electric Auto−Sync in the Fixed or Auto Mode	Disengage compressor and place Electric Auto−Sync setting to UNLOAD, allow compressor to bleed off, then engage the compressor.
	High RPM engagement	Reduce engine RPM and engage in the UNLOAD position with the Master Air Pressure gauge reading “0”.
	Not allowing for compressor to bleed down prior to re−engaging	Allow ample time for compressor to bleed down. Re−engage the compressor in the UNLOAD position.
	Contaminated clutch disc or plate	Inspect the clutch disc and plate for contaminants (oil, dirt, foam, etc.). Clean or replace as necessary.
	Low air pressure or supply leak to clutch	Check pressure at supply side. Check supply line for leaks.
	Compressor locked up	Check entire system and repair as needed.
Safety pop−off valve opening at low pressure		
	Sump fire damaged pop−off valve	Check the system and oil level. Replace the pop−off valve. Once repaired, operate the compressor watching for air or oil being discharged from the pop−off valve. One indication of a pop−off valve failure is oil present throughout the pump compartment. Check for signs of sump fire.
Compressor locked up		
	Debris in the compressor	Check entire system and repair as needed.