Sioux Corporation
M-415 Water Heater

120-V AC Electric Motor Driven, Oil-Fired
Operator's Manual

SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE

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DANGER

DO NOT INSTALL, OPERATE, SERVICE OR REPAIR THIS EQUIPMENT UNLESS YOU HAVE READ AND FULLY UNDERSTAND ALL SECTIONS OF THIS MANUAL.

DO NOT ALLOW OTHERS TO OPERATE, SERVICE OR REPAIR THIS EQUIPMENT UNLESS THEY FULLY UNDERSTAND ALL RELATED SECTIONS OF THIS MANUAL.

FAILURE TO FOLLOW ALL APPLICABLE INSTRUCTIONS AND WARNINGS MAY RESULT IN SERVERE PERSONAL INJURY OR DEATH.

IF THE OPERATOR IS NOT FLUENT IN ENGLISH, THESE INSTRUCTIONS AND WARNINGS SHALL BE READ TO AND DISCUSSED WITH THE OPERATOR IN THEIR NATIVE LANGUAGE BY THE PURCHASER/OWNER, TO MAKE SURE THE OPERATOR UNDERSTANDS ITS CONTENTS.

1. SAFETY INSTRUCTIONS

WARNING

WHEN USING THIS PRODUCT, BASIC PRECAUTIONS SHOULD ALWAYS BE FOLLOWED, INCLUDING THE FOLLOWING:

- **-READ ALL INSTRUCTIONS BEFORE USING THE PRODUCT.**
- **-TO REDUCE THE RISK OF INJURY, CLOSE SUPERVISION IS NECESSARY WHEN PRODUCT IS USED NEAR CHILDREN.**
- **-KNOW HOW TO STOP THE MACHINE AND BLEED PRESSURES QUICKLY.**
- **-BE THOROUGHLY FAMILIAR WITH THE CONTROLS.**
- **-STAY ALERT - WATCH WHAT YOU ARE DOING.**
- **-DO NOT OPERATE THE UNIT WHEN FATIGUED OR UNDER THE INFLUENCE OF ALCOHOL OR DRUGS.**
- **-FOLLOW THE MAINTENANCE INSTRUCTIONS SPECIFIED IN THIS MANUAL.**
- **-NEVER OPEN ELECTRICAL BOX OR CHANGE ELECTRICAL CONNECTIONS UNLESS ELECTRICAL SYSTEM IS COMPLETELY DISCONNECTED.**
- **-DISCHARGE FROM THIS UNIT WILL CAUSE SEVERE BURNS.**
- **-BEFORE SERVICING OR REMOVAL OF ANY PART, SHUT OFF POWER, RELIEVE PRESSURE IN VESSEL, AND ALLOW THE MACHINE TO COOL DOWN.**
- **-THIS MANUAL SHOULD REMAIN WITH THIS MACHINE AND BE USED AS A REFERENCE FOR ORDERING PARTS AND MAINTAINING/SERVICING THIS MACHINE.**

DANGER

- **-RISK OF ASPHYXIATION.**
- **-USE THIS PRODUCT ONLY IN A WELL-VENTILATED AREA.**
- **-RISK OF EXPLOSION.**
- **-OPERATE ONLY WHERE OPEN FLAME OR TORCH IS PERMITTED.**
- **-EXPOSED PORTIONS OF THE UNIT ARE VERY HOT DURING OPERATION AND MAY CAUSE BURNS.**

2. GROUNDING INSTRUCTIONS

Electrical Shock Hazard

THIS PRODUCT MUST BE GROUNDED. IF IT SHOULD MALFUNCTION OR BREAKDOWN, GROUNDING PROVIDES A PATH OF LEAST RESISTANCE FOR ELECTRIC CURRENT TO REDUCE THE RISK OF ELECTRIC SHOCK. GROUNDED IN ACCORDANCE WITH THE US NATIONAL ELECTRICAL CODE AND ALL LOCAL, STATE AND NATIONAL CODES AND ORDINANCES.

CHECK WITH A QUALIFIED ELECTRICIAN OR SERVICE PERSONNEL IF YOU ARE IN DOUBT AS TO WHETHER THE OUTLET IS PROPERLY GROUNDED.
TO COMPLY WITH THE NATIONAL ELECTRICAL CODE (NFPA70)

3. UNPACKING

1. Unpack and inspect unit for damage in shipment.
2. Tighten fittings, as they may have loosened by vibration during shipment. Make sure all the components ordered have been included.

4. UTILITY REQUIREMENTS

A. ELECTRICAL REQUIREMENTS

1. Adequate electrical service is critical for satisfactory operation of the unit. Provide electrical connections compatible with the electrical rating on the machine nameplate.
2. Circuit breakers/fuses are designed to protect the equipment and customer's electrical service from over current.
3. Electrical installations for SIOUX Fuel Fired units should be made by a qualified electrician
4. Full load current rating (in amperes) is stamped on the equipment nameplate.

INSUFFICIENT ELECTRICAL CAPACITY COULD RESULT IN DAMAGE TO THE EQUIPMENT. CAPACITY MUST BE ADEQUATE TO CARRY THE FULL CURRENT RATING OF THE UNIT.

B. WATER SUPPLY REQUIREMENTS

1. Make sure water supply to the unit is not plugged, obstructed, or otherwise restricted. The pump needs a good supply of water for proper operation.
2. In some areas it may be necessary to condition the water. Contact your local water-conditioning representative for analysis or recommendations.
3. Do not use water that is rusty, sandy or containing any foreign matter.

C. FUEL OIL REQUIREMENTS

1. Use a good grade of kerosene, #1 fuel oil, or #2 fuel oil. Heavier fuels such as JP5 may be used, although they may cause the coil rings to fill with carbon, inhibiting the flow of combustion air, reducing heat transfer, causing erratic pressure and poor burner operation.
2. The machine is factory set for #2 fuel oil, unless otherwise noted on the Part List in Appendix A-4. If you are using #1 fuel oil or kerosene, you will need to adjust may need to adjust your burner to get the desired outlet temperature.

D. COMBUSTION AIR REQUIREMENTS

1. Equipment must be installed in an area with adequate fresh air available to support combustion.
2. SUFFICIENT OUTSIDE AIR MUST BE SUPPLIED TO THE WATER HEATER FOR PROPER COMBUSTION. A minimum of one square inch per 1000 Btu per hour of total input rating is required. Insufficient makeup air will produce localized heating beneath the burner and the combustion pattern will tend to extend too high up through the stack as the flame seeks oxygen.

E. EXHAUST STACK REQUIREMENTS

1. The flue pipe from the combustion chamber should generally be the same size as the stack hood on the machine. For lengths exceeding 10 feet, it may be necessary to increase the stack size to avoid excess stack loss.
2. Consult local codes and NFPA 31 for further information.

F. LOCATION

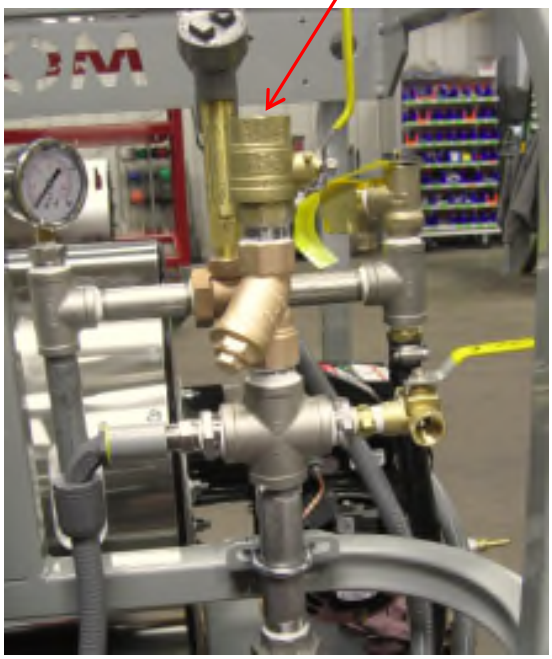
1. Level unit for best performance.
2. Protect heater from inclement weather.
3. LOCATE HEATER AWAY FROM:

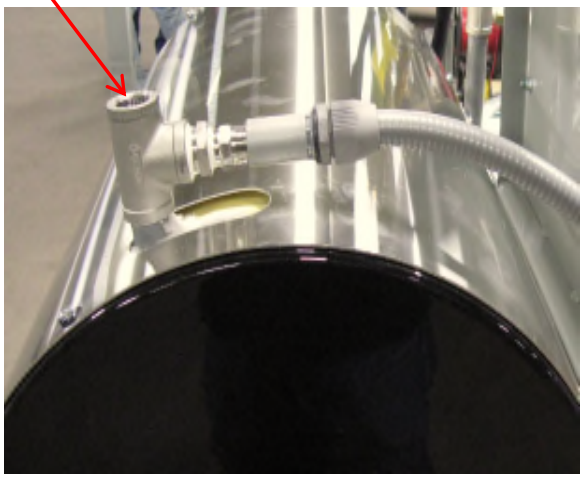
-FLAMMABLE LIQUIDS SUCH AS GASOLINE
-HAZARDOUS MATERIALS SUCH AS GASES
-COMBUSTIBLE LIQUIDS
-OTHER FLAMMABLE OR HAZARDOUS SUBSTANCES.

NOTICE

BE ABSOLUTELY CERTAIN UNIT HAS ADEQUATE ELECTRICALS AT THE MACHINE, STEADY SUPPLY OF WATER, SUFFICIENT AIR AND PROPER FUEL REQUIREMENTS BEFORE BEGINNING OPERATION.

WATER CONNECTIONS
INLET OUTLET





OPERATION

Basics of Water Heater:

Operation as a water heater: Water from the water tank is drawn to the suction line of the water pump. A shut off valve is located before the strainer to allow the water supply to be shut off to clean the strainer. There are two digital temperature control mounted on the electrical enclosure. One on the right "INLET PUMP" is to set the desired temperature of the water in the storage tank. The left digital control "OUTLET PUMP" is monitoring the water temperature exiting the heating coil and functions as a high temperature limit switch to prevent the discharge temperature from reaching steam. Typically this temperature is set at 205°F/96°C. The INLET PUMP adjustable temperature control will control the temperature of the water in the tank, and will stop the burner from firing once the tank temperature is above the set point temperature of the control. The pump then pumps the water through a low flow cut off switch, pressure relief valve, heat exchanger, high temperature limit, and back into the water tank. The flow switch senses the loss of water flow and will shut off fuel valve, thus extinguishing the flame if the water flow is stopped or too low. The high temperature limit switch will close the fuel valve if the outlet temperature exceeds approximately 205^{o} F. The pressure relief valve will vent excessive pressure. The diagram below illustrates the flow of the water heater.

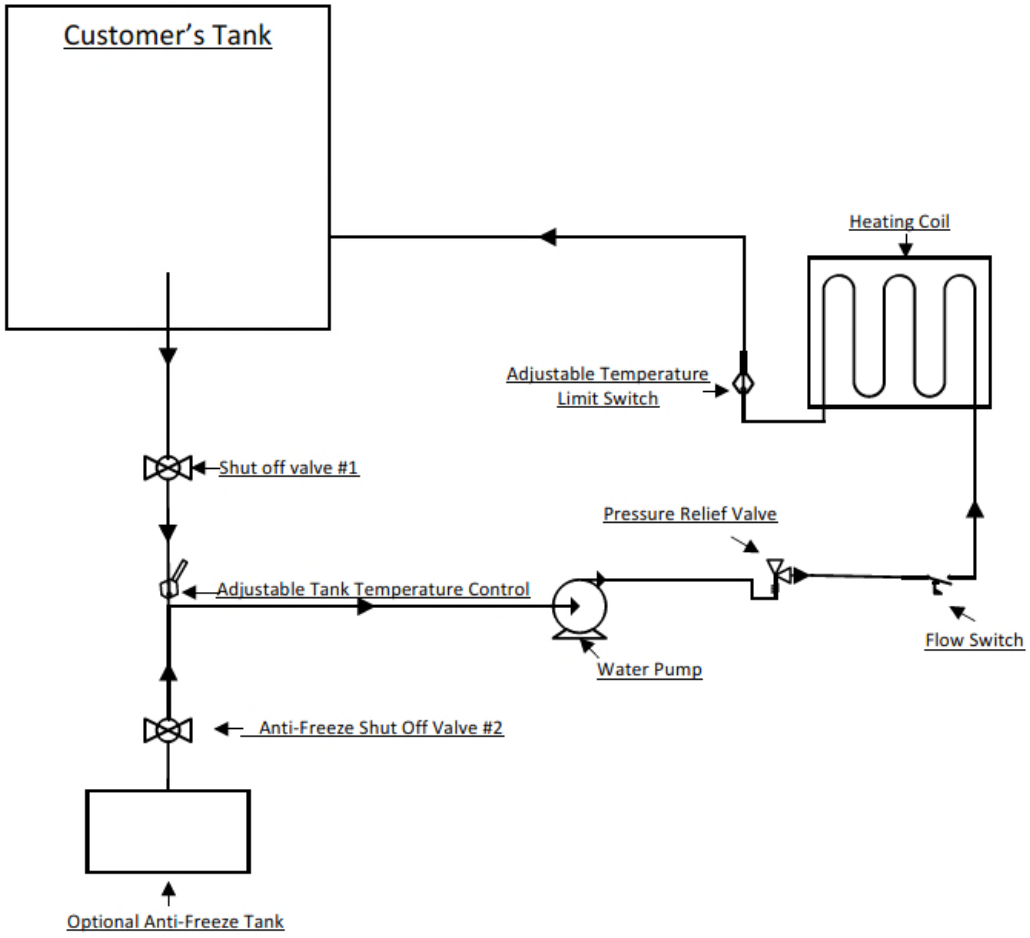


DIAGRAM A

NOTICE

NEVER RUN THE PUMP WITHOUT WATER. DO NOT DEAD END THE PUMPING SYSTEM.

1. Read this manual completely before starting the machine.
2. Make sure water supply valves are open and tank has water. KEEP WATER SUPPLY VALVES OPEN WHENEVER UNIT IS OPERATING.
3. Check fuel supply and ensure all lines are open. If necessary fill your fuel tank with a good grade of clean kerosene, #1 fuel oil, or #2 fuel oil. See "Fuel Requirements".
4. Turn water pump on and allow steady stream of water to flow through the system before turning on the burner.
5. This unit is supplied with a flow switch and therefore the burner will not start until water is flowing.
   a. Turn switch to the first position. Press the start button located below the rotary switch. This will turn on the pump. Allow the system to pump for 10-30 seconds before turning the switch to the second position. Then turn the switch to the second position and the burner should ignite.
   b. Should black smoke be noted while burner is operating, the air bands should be adjusted. See the Appendix for burner adjustment.
   c. Due to difference in altitude and inlet water temperatures, oil burners may need to be adjusted for local conditions. See the burner instructions in the appendix for burner adjustment.
6. To set the water temperature see appendix "Digital Temperature Control Parameter Setting Instructions for direction on how to set your tank temperature.

Shut Down Procedure

1. Turn pump/burner switch from the third position to the second position. This will shut off the burner ignition, allow the pump to continue to run for 1-2 minutes to cool the coil down.
2. Turn Pump switch to "OFF".
3. If necessary, protect unit from freezing. See Maintenance section.

6. MAINTENANCE/STORAGE

A - DAILY MAINTENANCE REQUIREMENTS

1. Maintain water pump and burner in accordance with manuals. See APPENDIX.
2. Check hoses and fittings for leaks.
3. Ensure water filters are not plugged.

B - PERIODIC MAINTENANCE REQUIREMENTS

1. Delime equipment to clear coil and water system of build-up. Refer to Section E.
2. Clean coil of excess carbonization. Remove coil from unit and clean with high-pressure washer and suitable detergent.
3. Tighten loose fittings and check electrical connections for tightness.
4. Replace relief valve when required.
5. Check inlet strainer. Clean, reinstall or replace as necessary.
6. Inspect pump for leaks and replace wearing parts as required.
7. Replace element in fuel filter as required.
8. Inspect flame. Adjust burner for optimum air/fuel ratio in combustion system (look for minimum smoke). Check electrode gap (refer to burner drawing in the appendix). Clean the electrode assembly, if necessary. Tighten setscrew on fan shaft. Check electric system and controls. Lubricate oil burner motor annually.
9. Check electrical connections. See SAFETY INSTRUCTIONS for precautions.
10. Pump Motor Maintenance, Lubrication of motor should be in accordance with instructions on nameplate or terminal box.

ANY OTHER SERVICING SHOULD BE PERFORMED BY AN AUTHORIZED SERVICE REPRESENTATIVE.

C - PROTECTION FROM FREEZING

FREEZING WILL CRACK AND SPLIT THE HEATING COILS. Therefore, for protection in cold weather, the unit must have anti-freeze added to the system.

To add anti-freeze, proceed as follows (if your truck has the anti-freeze option):

1. Fill Anti-freeze tank with at least 7 gallons of anti-freeze.
2. Drain water tank, water lines and water heater.
3. Turn Shut-off Valve #1 (see Diagram A) to the closed position. This closes the valve between the water tank and the water heater.
4. Open Anti-Freeze Valve #2 (see Diagram A). This will open the path from the anti-freeze tank to the inlet of the water heater.
5. Remove hose from discharge of heat exchanger and connect a hose from the discharge of the heat exchanger to the anti-freeze tank.
6. Turn on the pump and run until the unit is full of anti-freeze.
7. Turn off the pump and your unit should be protected from freezing.

To add anti-freeze, proceed as follows (if your truck does not have the anti-freeze option):

1. You will need a 10 gallon or larger container with approximately 7 gallons of anti-freeze.
2. Drain water tank, water lines and water heater.
3. Turn Shut-off Valve #1 (see Diagram A) to the closed position. Closes the valve between the water tank and the water heater.
4. Connect a hose from Anti-Freeze Valve #2 (see Diagram A) to your anti-freeze container.
5. Open Anti-Freeze Valve #2 (see Diagram A). This will open the path of from your anti-freeze container to the inlet of the water heater.
6. Remove hose from discharge of heat exchanger and connect a hose from the discharge of the heat exchanger to the anti-freeze container.
7. Turn on the pump and run until the unit is full of anti-freeze.
8. Turn off the pump and your unit should be protected from freezing.

D – MOVING AND STORING

1. If your operation is seasonal, or if the unit will be stored for a period of time, or if the unit will be moved, to assure proper operation of unit when needed again, proceed as follows:
   a. Drain unit and protect from freezing. See Section C.
   b. Disconnect from electrical source.
   c. Wipe off exterior surfaces.
   d. Secure all covers on unit.
   e. Cover with waterproof material to keep out dust and moisture.
   f. In high humidity environment, provide desiccant or calcium chloride within electrical enclosure to absorb excess moisture.

E – DE-LIMING

Due to differences in water conditions from one area to another, it is impossible to say how often a unit should be delimed. If the water in your area contains many minerals, you may have to delime on a regular maintenance schedule. You may want to contact your local water-conditioning expert for advice on water treatment to prevent lime build up.

To de-lime your coil, proceed as follows (if your truck has the anti-freeze tank):

1. Fill Anti-freeze tank with at least 5-7 gallons of water.
2. Drain water tank, water lines and water heater.
3. Turn Shut-off Valve #1 (see Diagram A) to the closed position. Closes the valve between the water tank and the water heater.
4. Open Anti-Freeze Valve #2 (see Diagram A). This will open the path from the anti-freeze tank to the inlet of the water heater.
5. Remove hose from discharge of heat exchanger and connect a hose from the discharge of the heat exchanger to the anti-freeze tank. This forms a closed system for recirculation of the acid solution.

6. Turn ON the pump and add 1 gallon of Sioux Descaler to the water in the Anti-freeze tank. Acceptable descaler/water ratios range from 1:1 to 1:3. The process will work with any dilution within this range, but will work faster when the solution is more concentrated.
7. Once recirculation has begun, check the pH level of the holding tank solution every 15 minutes using litmus paper. The coil is completely descaled when the pH level is acidic and constant. If the pH increases above 5 between litmus paper tests, add more Sioux Descaler to the holding tank. Once the solution pH remains constant below 5 between two 15 minute increments, the deliming complete. This can take up to 4 hours depending on the severity of the scale buildup.
8. Shut off pump. You will now need to drain the system and properly dispose of the consumed acid.
9. After the used acid has been removed from the system, flush the unit with clear water for about 5-10 minutes. If possible it is recommended to also flush the system with a detergent solution to neutralize any remaining acid.
10. Turn off the pump

To add delime, proceed as follows (if your truck does not have the anti-freeze option):

1. You will need a 5-10 gallon container with approximately 5-7 gallons of water.
2. Follow all of the instructions above, except instead of re-circulating the acid solution to the anti-freeze tank you will need to re-circulate the solution into your 5-10 gallon container.

ACID REMAINING IN EQUIPMENT WILL CAUSE CORROSION, SERIOUS DAMAGE TO METAL PLUMBING, RESULTING IN PINHOLES IN HEAT EXCHANGER AND DAMAGE TO PUMP. BE SURE TO COMPLETELY NEUTRALIZE AND PURGE SYSTEM OF ACID.

7. TROUBLESHOOTING

TROUBLESHOOTING CHECK LIST contains information to identify and correct most problems that could develop in your unit.

Each of the major problems is followed by a list of causes and remedies, which will help you to determine corrective actions.

We have listed most of the malfunctions that may occur, and the causes and remedies. If you go over the information on this sheet before using the troubleshooting guide, you will probably solve your problem.

A. Review UTILITY REQUIREMENTS, section 4. Be sure electrical capacity is sufficient; supply voltage matches that shown on unit nameplate, conductor size is correct, and the unit is properly grounded.
B. Check WATER SUPPLY.
C. Fill in the following data:

1. What is the printed rating of the fuses or breaker of the circuit-feeding unit (Amperes)? _____
2. How many gallons per minute (GPM) is pump producing? (Measure volume for specified time into a pail) _____
3. Has water supply been interrupted during operation of the unit? _____
4. Is all air purged from water system? _____
5. Have any changes or alterations been made to original unit? _____
6. Have you replaced any original parts? _____
7. Were all replaced parts furnished by SIOUX factory? _____

If you are not able to solve your problems after CAREFULLY answering the above questions and checking the following TROUBLESHOOTING section, feel free to call your local distributor or the Sioux factory (605) 763-3333 or (888) 763-8833 for help, most problems can be solved on the telephone if you can supply ACCURATE INSTALLATION BACKGROUND & DATA. We will need:

Model Number of your unit:_____

Serial Number: _____

Problem you are experiencing:_____

_____

You may wish to fill out this sheet and send it to your local distributor or to us via mail, e-mail or fax:

SIOUX CORPORATION

ONE SIOUX PLAZA

BERESFORD, SOUTH DAKOTA 57004

FAX: (605) 763-3334

E-Mail: email@sioux.com

On reverse side, outline your problem and we will review the information and offer assistance.

TROUBLESHOOTING:

PROBLEM	POSSIBLE CAUSE	REMEDY
PUMP MOTOR DOESN'T START OR STARTS SLOW	Insufficient voltage.	Have an electrician check the power supply for proper voltage.
	Manual overload switch tripped.	Allow motor to cool. Manually reset switch by depressing thermal switch on outside of motor or starter.
	Motor Wet and GFCI may have tripped.	Allow motor to dry. Check for proper grounding.
	Short in electrical wiring.	Wire contacts should be clean and tight with no breaks.
	Water pump causing binding.	Repair or replace pump.
PUMP RUNS BUT THERE IS NOT ENOUGH WATER	Insufficient water supply.	Use larger hose, clean strainer at inlet.
	Plumbing or hose leak.	Check plumbing system for leaks and re-tape with Teflon tape.
	Worn pump.	Repair pump per manual.
	Obstruction in coil.	Clean obstruction or scale deposits from coil with coil cleaner.
	Insufficient voltage	Check voltage with requirements.
RELIEF VALVE LEAKS OR SPRAYS OUT WATER	Obstruction in system	Clean out obstruction
	Defective or misadjusted relief valve	Adjust or replace
	Scale plugging inside of coils.	Clean obstruction or scale deposits from coil with coil cleaner.
PUMP MAKES EXCESSIVE NOISE	Air in suction line.	Check water supply and connections on suction line.
	Foreign matter in valves.	Check and clean if necessary.
	Worn bearings.	Check and replace as required.
	Insufficient water supply	Provide at least 150% of rating per minute of water.
BURNER WILL NOT LIGHT	Low fuel.	Fill tank with fuel.
	Improper fuel or water in fuel.	Drain fuel tank and fill with proper fuel.
	Plugged fuel filter.	Replace.
	Plugged fuel line.	Remove fuel line and clean.
	Misadjusted burner air bands.	Readjust air bands for clean burn.
	Low fuel pressure from pump.	Increase fuel pressure to specification and/or replace fuel pump.
	Faulty burner transformer.	Test transformer for proper arc between contacts. Replace as required. (see appendix B section D item 1)
	Disconnected or short in electrical wiring.	All wire contacts to be clean/tight with no breaks.
	Burner motor thermal protector tripped.	Check voltage/connections for cause. Check fuel pump shaft rotation for binding causing motor to overheat.
	Heavy sooting of coil/burner can cause restricted airflow and shorting of electrodes	Clean as required
	Improper electrode setting.	Clean & reset according to appendix B.
	Clogged burner nozzle.	Clean or Replace as required.
	Water not flowing thru flow	Make sure pump is on and working

	switch.	properly
PROBLEM	**POSSIBLE CAUSE**	**REMEDY**
	Flow/temperature switch malfunction.	Check electrical continuity with pump operating and burner on
	Fuel solenoid malfunction.	Replace if valve doesn't open with power on.
	On-off switch defective.	Check continuity thru burner switch.
	Cold fuel	Depending on outside air temperature, a blended fuel or straight #1 fuel maybe required for proper ignition and operation.
MACHINE SMOKES	Wrong fuel or water in fuel.	Drain tank and replace contaminated fuel.
	Wrong air adjustment.	Adjust air bands on burner assembly.
	Low fuel pressure.	Adjust fuel pressure to specs.
	Air leaks in fuel lines.	Check lines for leaks or air bubbles. Tighten/replace where required.
	Plugged/dirty burner nozzle.	Replace nozzle.
	Misaligned electrode.	Realign electrodes to specs.
	Heavy accumulation of soot on coils and burner assembly.	Remove coil/burner assembly and clean thoroughly.
LOW WATER TEMPERATURE	Improper fuel or water in fuel.	Drain fuel tank and add correct fuel.
	Low fuel pressure.	Adjust fuel pressure to specs or replace pump if needed.
	Fuel filter partially clogged.	Replace as needed.
	Soot builds up on coils.	Clean outside of coils with soot remover.
	Lime build up in coils.	Clean inside of coils with Sioux dry acid.
	Wrong burner nozzle.	Check specifications.
WATER TEMPERATURE TOO HOT	Burner input too high.	Decrease fuel pump pressure and/or fuel nozzle size.
	Defective high limit switch.	Replace as required.
	Insufficient water supplied.	Check that water supply is min of 150% of machine rating. Clean/replace nozzle of correct size. De-lime coil and clear obstructions.
	Water flow too low	Coil is limed up with scale and requires deliming. Follow the instructions listed above
BURNER STAYS ON WHEN THERE IS NO WATER FLOW IN SYSTEM	Flow switch defective.	Replace switch.
	Fuel solenoid defective.	Replace solenoid valve.

8. APPENDIX

- **A. Parts List**
- **B. Electrical Drawing**
- **C. Exploded View Drawings**
- **D. Burner Manual**
- **E. Centrifugal Pump Manual**
- **F. Other component information**
- **G. Sioux Liquid Descaler**
- **H. Maintenance Log**
- **I. Warranty Information**

Need Parts?

Although all Sioux equipment is built to last, sometimes repairs are needed.

To keep your Sioux equipment operating as designed, remember to use genuine Sioux replacement parts! Otherwise, you may void your warranty, damage your equipment, and/or no longer meet safety codes or OSHA requirements.

For information on ordering a replacement part for your machine, visit our website at www.sioux.com to find the Sioux Authorized Distributor nearest you.

For fast, convenient assistance diagnosing a problem or identifying the part you need, email your request to:

- **parts@sioux.com**

For customers who do not have access to email, please call the Sioux parts department

Please Note:
MODEL AND SERIAL NUMBER are **required** when ordering parts.
These numbers can easily be obtained from the machine nameplate.

SIOUX®
www.sioux.com

Toll-free 877-440-7700. Please have your Sioux model and serial number available.

THANK YOU FOR CHOOSING SIOUX.
WE APPRECIATE YOUR BUSINESS!

Sioux Corporation
Parts List

Parts List for Serial Number: 1906038

This parts list includes most items commonly required as replacement parts. Other parts may be available. Contact the parts department for further information.

A. Machine Description:

0WM-415 Sioux Model M-415 Horizontal Water Heater

415,000 BTU Water Heater

3/4" (2.5cm) sch 80 pipe heating coil vertical mounted

Direct driven bronze rotary gear pump

12 V DC FLA 50 Amps

Oil fired burner 3.6 GPH (13.6 LPH), with fuel filter/water separator

Adjustable tank temperature control

Electrical controls with ON/OFF switch

Stainless steel coil wrap

Stainless steel inlet/outlet fittings, 1" (2.5cm) Y-Strainer, ball valves for draining/antifreezing coil, and coil inlet pressure gauge

3/4" (1.9cm) outlet and 1" (2.5cm) inlet fittings

Adjustable inline water temperature control

Electrical ON/OFF controls

Stainless steel fittings on pump inlet, discharge and coil inlet

Pressure gauge on coil inlet

Frame will be painted Sioux standard grey

Control panel to be loose on skid with 7' of extra wire on conduit on all connections.

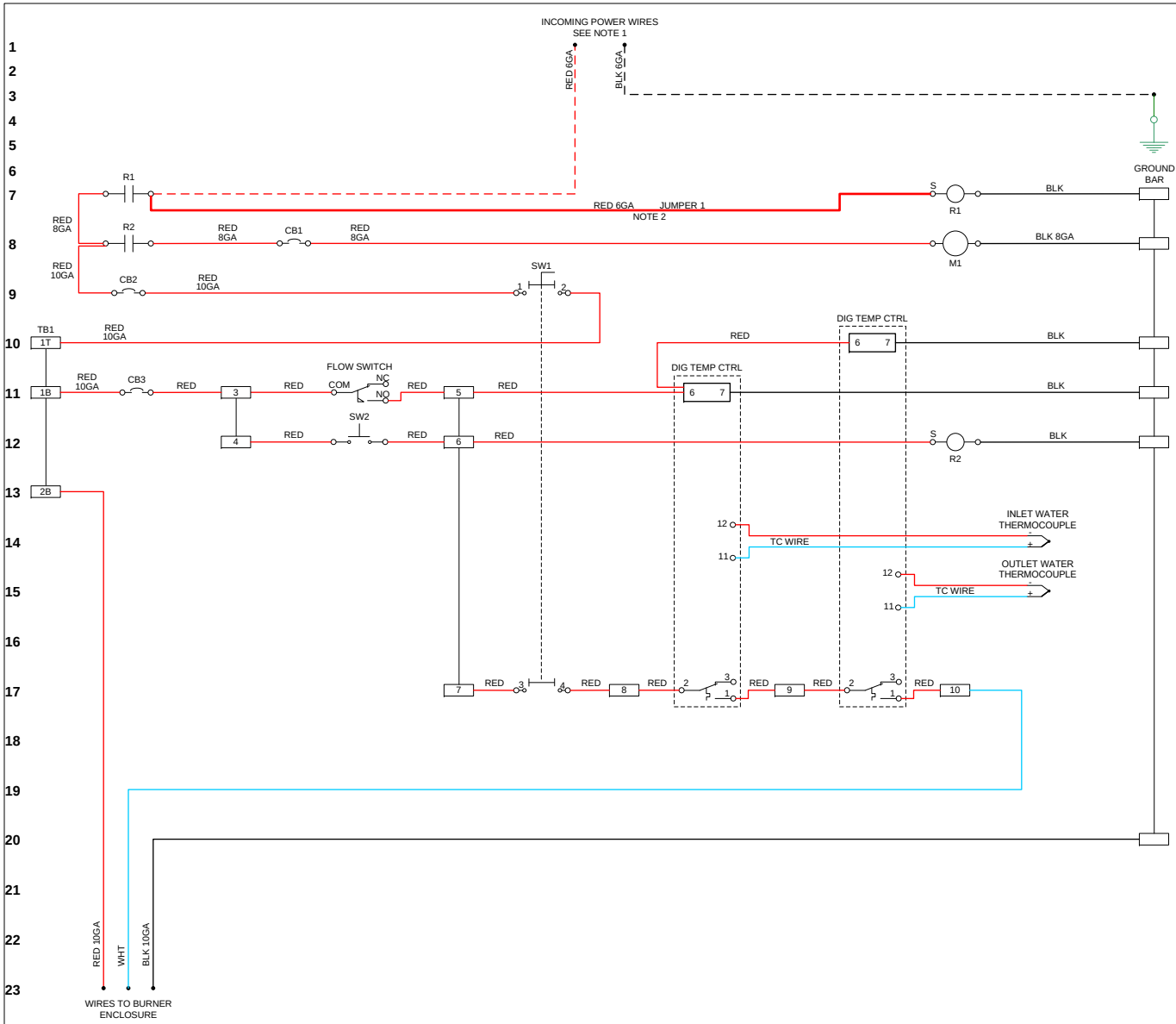
Job Number: 0043897-1-1

B. Spare Parts List:

Qty Per	IUM	Part Number	Description	Part Components
1	EA	BR00254	Fuel Filter	BR00255 - Replacement cartridge
1	EA	BR00456	Oil burner	BR00382 - Cad cell BR00505 - Electrodes (pair) BR00325 - Fuel pump (solenoid is part of pump) BR00769 - Ignitor Protectorelay - Contact factory BR01095 - Fuel Pump
1	EA	BR00471	Nozzle, 2.50, 80 Deg B	
1	EA	EC00366	3 Position Switch	
1	EA	EC01394.2	N/O Contact Block	
2	EA	EC01428	Thermocouple	
1	EA	EC01586.2	Collar	
2	EA	EC01783	Digital Temperature Switch	
1	EA	EC01791	Switch Flow	
1	EA	EC01877	Enclosure	
1	EA	EC02004	Push Button	
2	EA	EC02202	Solenoid/Relay	
1	EA	EC02231	Breaker Circuit 40A	

B. Spare Parts List:

Qty Per	IUM	Part Number	Description	Part Components
1	EA	EC02232	Breaker Circuit 30A	
1	EA	EC02233	Breaker Circuit 15A	
1	EA	FT00140	Pressure gauge, 160 PSI	
1	EA	FT00211.1	Ball valve, 3-way, 1/2"	
1	EA	FT00218.1	Ball valve, 1"	
1	EA	FT00264.2	Y-strainer, 1"	
1	EA	FT02231	Reducer Bell	
1	EA	FT02239	Valve Relief 150 PSI	
1	EA	MPW0108	Manufactured Parts	
1	EA	MT00239	1/2 HP Motor 12V DC	
1	EA	PM00860	Water pump	
1	EA	PM00861	Pump Adapter	
1	EA	SA21021	Heat Exchanger	



SWITCH	LINE	COLOR	LABEL	LIGHT	LINE
SW1	9, 17	3-POS	OFF-PUMP-BURNER	NO	
SW2	12	GREEN	START	NO	

NOTE 1: RED WIRE – BATTERY POSITIVE
BLACK WIRE – BATTERY NEGATIVE

NOTE 2: FOR AUXILIARY CONTROL OF MAIN POWER, REMOVE JUMPER 1 AND WIRE R1 COIL TO TRUCK IGNITION OR OTHER EXTERNAL SWITCH

NOTE 3: ALL WIRES 14GA UNLESS NOTED

DIG TEMP CTRL

LOAD	POWER	PROBE
1 2 3	6 7	11 12

LEGEND

FACTORY WIRING

FIELD WIRING

MODEL-SPECIFIC WIRING

1 2 3 4 5 6 7 8 9 10 TB1 MAIN TERMINAL STRIP

REV	REV'D	DATE
2 ADDED JUMPER WIRE FOR R1	MW	4/24/18
1 CHANGED FUSES TO CB'S	JL	4/19/18

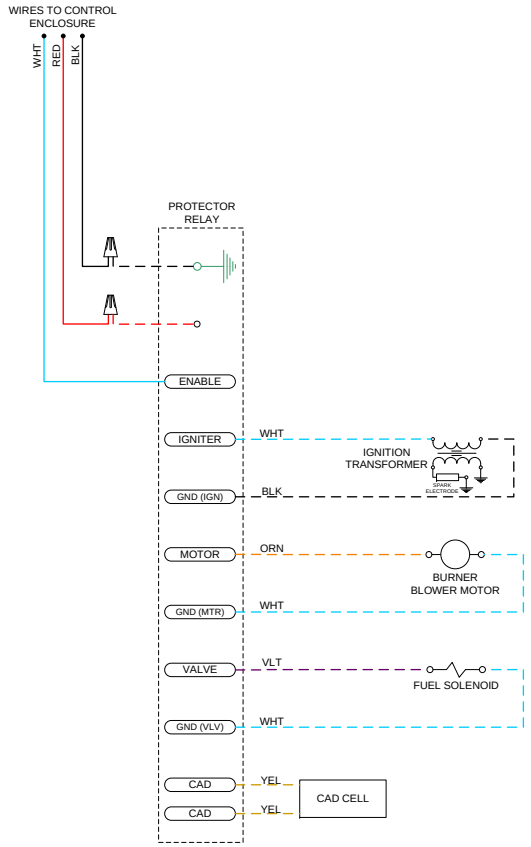
SIOUX CORPORATION

BERESFORD, SD 57004 (605)-763-3333

M-415 PANEL

DRN	JL	CHK	MW	V	12 VDC
DATE	10/18/18	DATE	10/18/2018	PH	HZ

DWG EL-WH-ST-535 REV 0 SHT 1 / 1



NOTE 1: REFER TO CONTROL PANEL SCHEMATIC FOR INCOMING WIRE SIZES

LEGEND

SIOUX FACTORY WIRING

BURNER FACTORY WIRING

ENABLE | MOTOR | IGNITER | VALVE | CAD | CAD — BURNER CONTROL TERMINALS

REV	REV'D	DATE

SIOUX CORPORATION

BERESFORD, SD 57004 (605)-763-3333

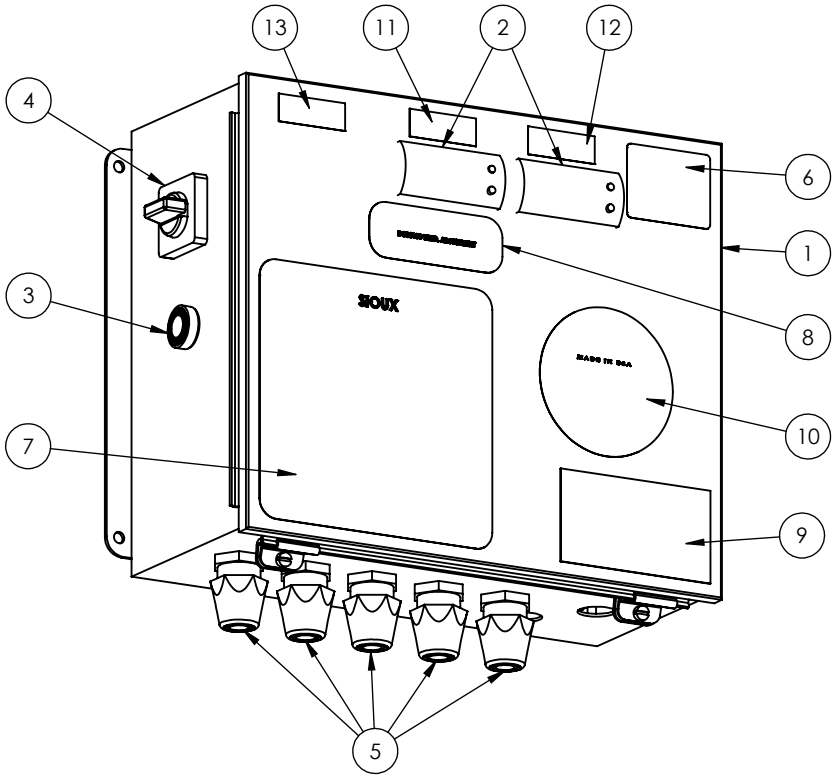
BECKETT MODEL SDC – ON/OFF

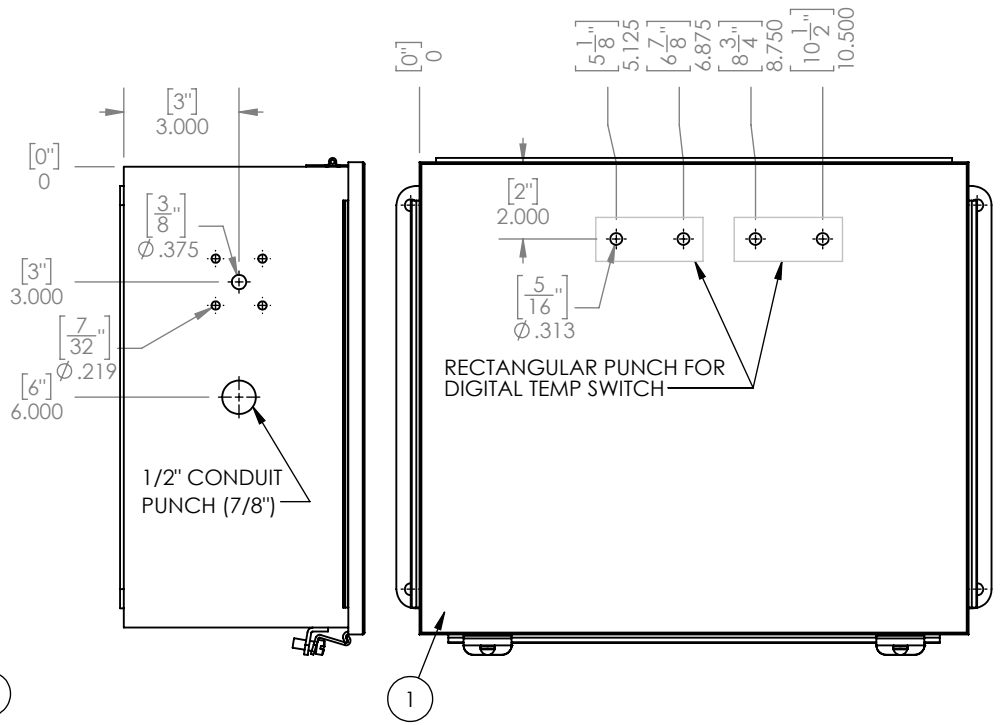
DRN	JL	CHK	MW	V	12 VDC
DATE	4/13/18	DATE	4/13/18	PH	HZ

DWG	EL-BR-ST-106	REV	0	SHT	1/1

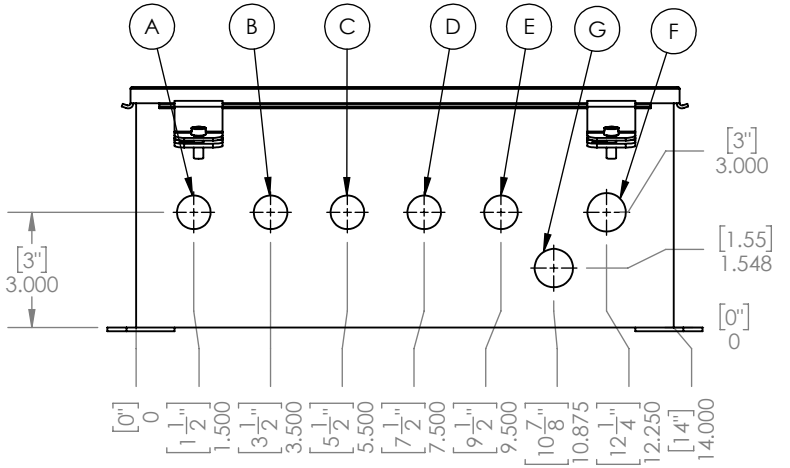
NO.	NUMBER	DESCRIPTION	QTY.
1	EC01877		1
2	EC01302	SWITCH DIGITAL TEMPERATURE 120V 15 AMP	2
3	EC01396.2	SWITCH PUSH BUTTON NON-ILLUMINATED MOMENTARY	1
4	EC00366	SWITCH 3 POSITION 2-POLE ROTARY	1
5	EC00409	CONDUIT FITTING 1/2" LNFC	5
6	DC00113	PATENTS	1
7	DC00116	DECAL SIOUX LOGO CLEAR BACK	1
8	DC00150	TEMP. CONTROL ADJUSTMENT	1
9	DC00131	NAMEPLATE 2.5" X 4.5"	1
10	DC00141	MADE IN USA	1
11	LABEL	OUTLET TEMP	1
12	LABEL	INLET TEMP	1
13	LABEL	VOLTAGE (CHECK TRAVELER)	1

TABLE 1: CONDUIT AND WIRE LENGTHS			
HOLE		LENGTH	WIRE
A	OUTLET THERMOCOUPLE	22"	THERMOCOUPLE WIRE
B	MOTOR	11"	8 AWG - RED, BLACK (30")
C	INLET THERMOCOUPLE	36"	THERMOCOUPLE WIRE
D	BURNER	40"	(10 AWG - RED, BLACK)(14 AWG - RED) (70")
E	FLOW SWITCH	48"	14 AWG - 2 X RED (70")





HOLES A - E BOTTOM ARE 1/2" CONDUIT PUNCH (7/8")
HOLES F & G ARE 1 - 1/8" FOR CUSTOMER SUPPLIED FITTINGS



DWG NO. AS21308 REV A-13 SHEET 1/2

REV.	DESCRIPTION	DATE	BY
A-13	ADDED DIMENSION TO ENCLOSURE HOLE	6/21/2018	AK
A-12	MOVED HOLE 'G' AWAY FROM EDGE	6/13/2018	AK
A-11	CHANGED CIRCUIT BREAKER MOUNTING STYLE	5/3/2018	DB
A-09	REPLACED FUSE HOLDER WITH CIRCUIT BREAKERS	4/20/2018	DB
A-08	ADDED NOTE FOR ENCLOSURE HOLES	4/5/2018	DB

UNLESS NOTED: DIMENSIONS INCHES TOLERANCES LINEAR: ±.0625 [1/16] ANGULAR: ±2°
THIRD-ANGLE PROJECTION

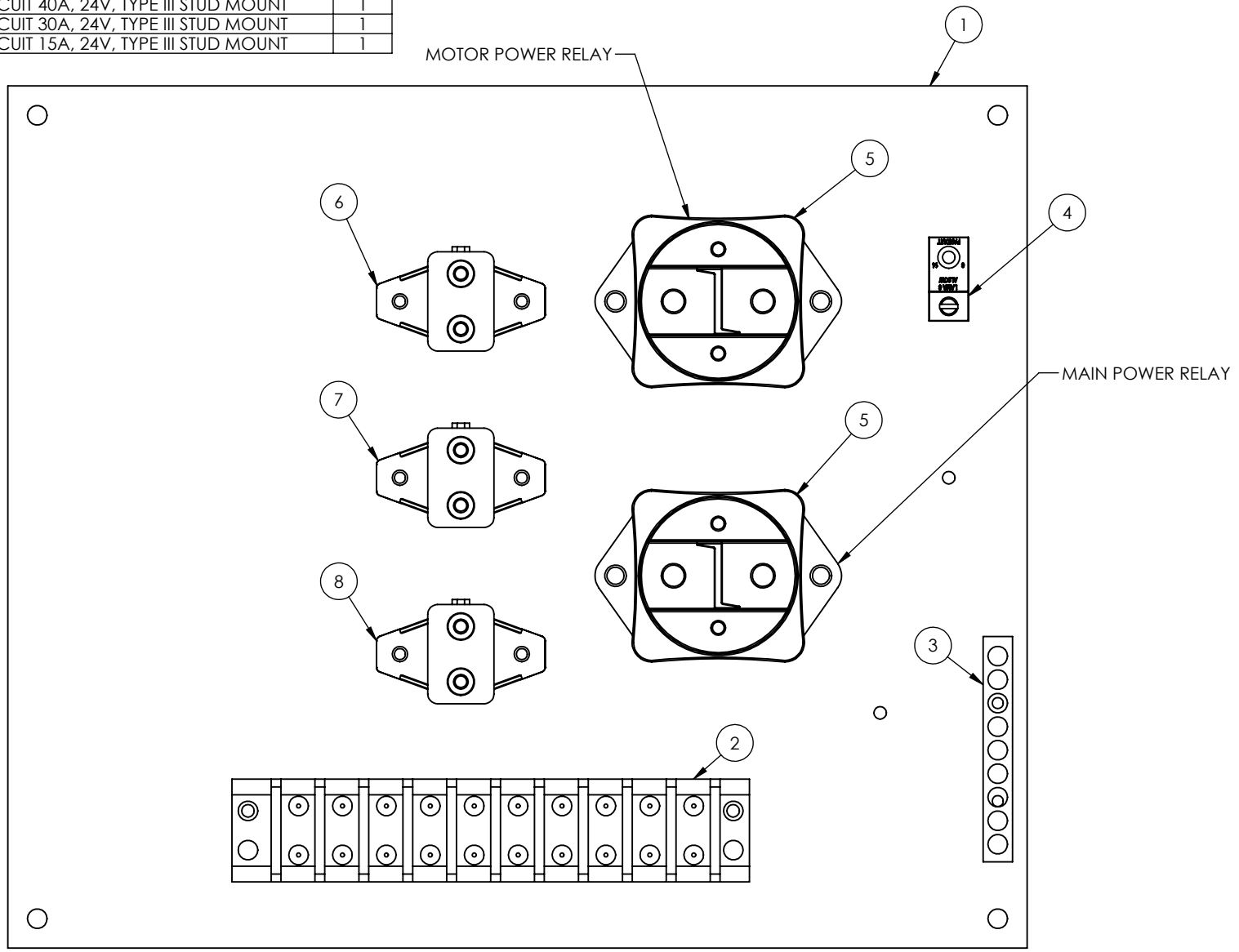
DRN LC 06-09-14
CHK
QC

SIOUX CORPORATION
ONE SIOUX PLAZA, BERESFORD, SD 57004

SIZE A SCALE 1:5 FILE AS21308 M-415 Enclosure Assembly

AS21308 REV A-13 SH 1/2

NO.	NUMBER	DESCRIPTION	QTY.
1	FR20080	BACK PLATE FOR M-415 ENCLOSURE	1
2	EC00381	STRIP TERMINAL 10 POLE	1
3	EC00382	BAR GROUNDING SQUARE D PK7GTA	1
4	EC00605	LUG GROUND	1
5	EC02202	SOLENOID RELAY, 12VDC, 100A CONTINUOUS	2
6	EC02231	BREAKER, CIRCUIT 40A, 24V, TYPE III STUD MOUNT	1
7	EC02232	BREAKER, CIRCUIT 30A, 24V, TYPE III STUD MOUNT	1
8	EC02233	BREAKER, CIRCUIT 15A, 24V, TYPE III STUD MOUNT	1



UNLESS NOTED:
DIMENSIONS
INCHES
TOLERANCES
LINEAR: ±.0625 [1/16]
ANGULAR: ±2°

DRN LC 06-09-14
CHK
QC
THIRD-ANGLE PROJECTION

SIOUX CORPORATION
ONE SIOUX PLAZA, BERESFORD, SD 57004

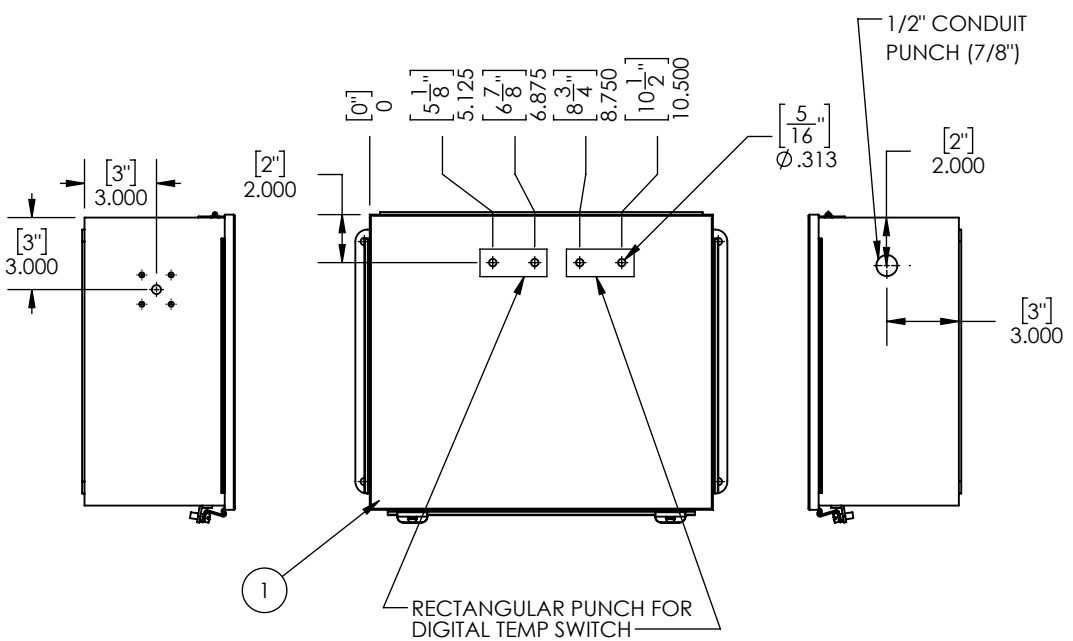
SIZE A SCALE 1:3 FILE AS21308 M-415 Enclosure Assembly

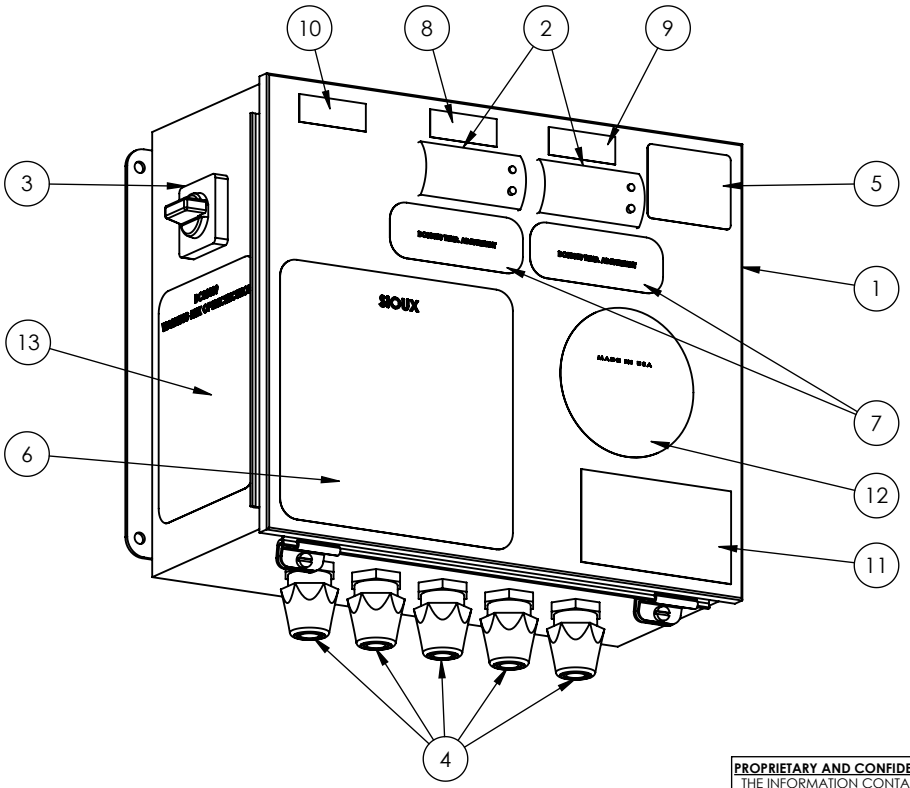
AS21308 REV A-13 SH 2/2

DWG NO. AS21308 REV A-13 SHEET 2/2

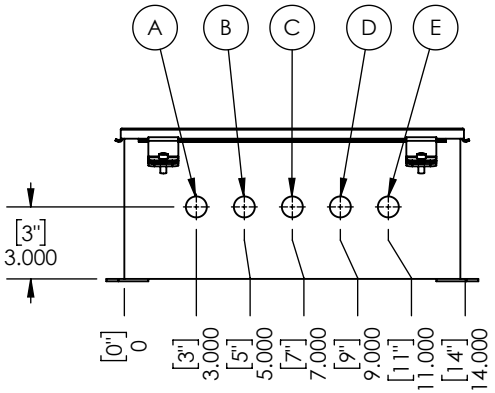
NO.	NUMBER	DESCRIPTION	QTY.
1	EC01877	ENCLOSURE 14 X 12 X 6	1
2	EC01302	SWITCH DIGITAL TEMPERATURE 120V 15 AMP	2
3	EC00366	SWITCH 3 POSITION 2-POLE ROTARY	1
4	EC00409	FITTING LIQUID TIGHT 1/2" CONDUIT CONNECTION	5
5	DC00113	PATENTS	1
6	DC00116	DECAL SIOUX LOGO CLEAR BACK	1
7	DC00150	TEMP. CONTROL ADJUSTMENT	2
8	LABEL	OUTLET TEMP	1
9	LABEL	INLET TEMP	1
10	LABEL	VOLTAGE (CHECK TRAVELER)	1
11	DC00131	NAMEPLATE 2.5" X 4.5"	1
12	DC00141	MADE IN USA	1
13	DC00109	DECAL WARNING RISK OF ELECTROCUTION	1

TABLE 1: CONDUIT AND WIRE LENGTHS			
HOLE		LENGTH	WIRE
A	INLET THERMOCOUPLE	36"	THERMOCOUPLE WIRE
B	MOTOR	11"	8 AWG - RED, BLACK (30")
C	OUTLET THERMOCOUPLE	22"	THERMOCOUPLE WIRE
D	BURNER	40"	(10 AWG - RED, BLACK)(14 AWG - RED) (70")
E	FLOW SWITCH	48"	14 AWG - 2 X RED (70")





HOLES IN BOTTOM ARE 1/2" CONDUIT PUNCH (7/8")



REV.	DESCRIPTION	DATE	BY
A-04	ADDED CONDUIT PUNCH NOTE	6/2/2016	WV
A-03	CHANGED FORMATTING	6/1/2016	WV

UNLESS NOTED:
DIMENSIONS INCHES
TOLERANCES
LINEAR: ±.0625 [1/16]
ANGULAR: ±2°
THIRD-ANGLE PROJECTION

DRN WV 06/01/16
CHK JL 06/02/16
QC

SIOUX CORPORATION
ONE SIOUX PLAZA, BERESFORD, SD 57004

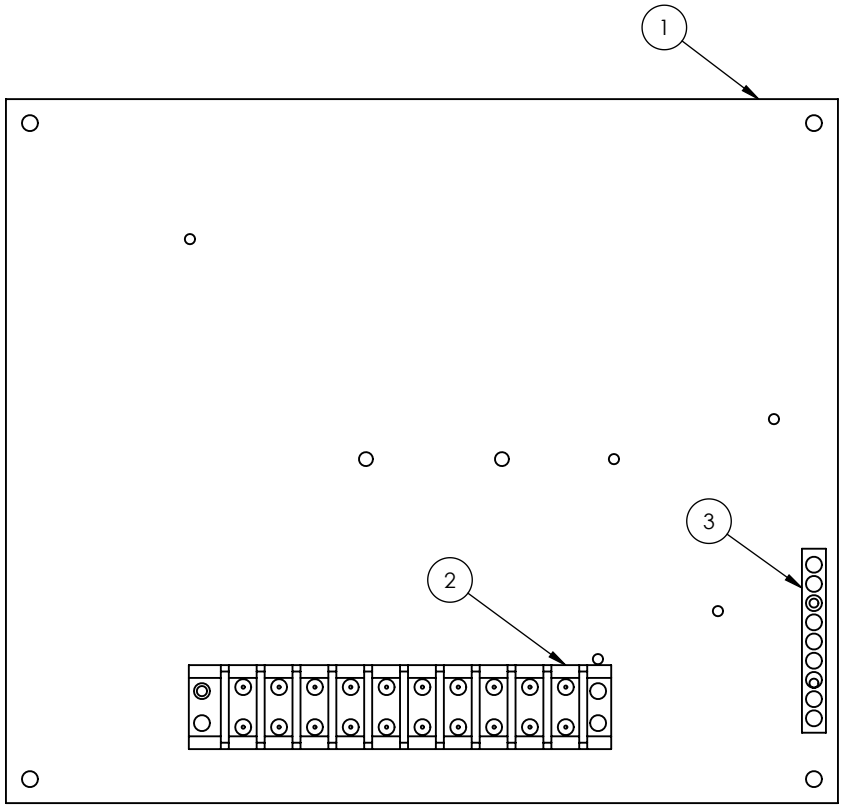
M-415 WATER HEATER ENCLOSURE ASSEMBLY - AC

SIZE A SCALE 1:5 FILE AS21808 M-415 Enclosure Assembly - AC

AS21808 REV A-04 SH 1/2

DWG NO. AS21808 REV A-04 SHEET 1/2

NO.	NUMBER	DESCRIPTION	QTY.
1	FR20080	BACK PLATE FOR M-415 ENCLOSURE	1
2	EC00381	STRIP TERMINAL 10 POLE	1
3	EC00382	BAR GROUNDING SQUARE D PK7GTA	1



DWG NO. AS21808 REV A-04 SHEET 2/2

UNLESS NOTED:
DIMENSIONS
INCHES
TOLERANCES
LINEAR: ±.0625 [1/16]
ANGULAR: ±2°

DRN WV 06/01/16
CHK JL 06/02/16
QC
THIRD-ANGLE PROJECTION

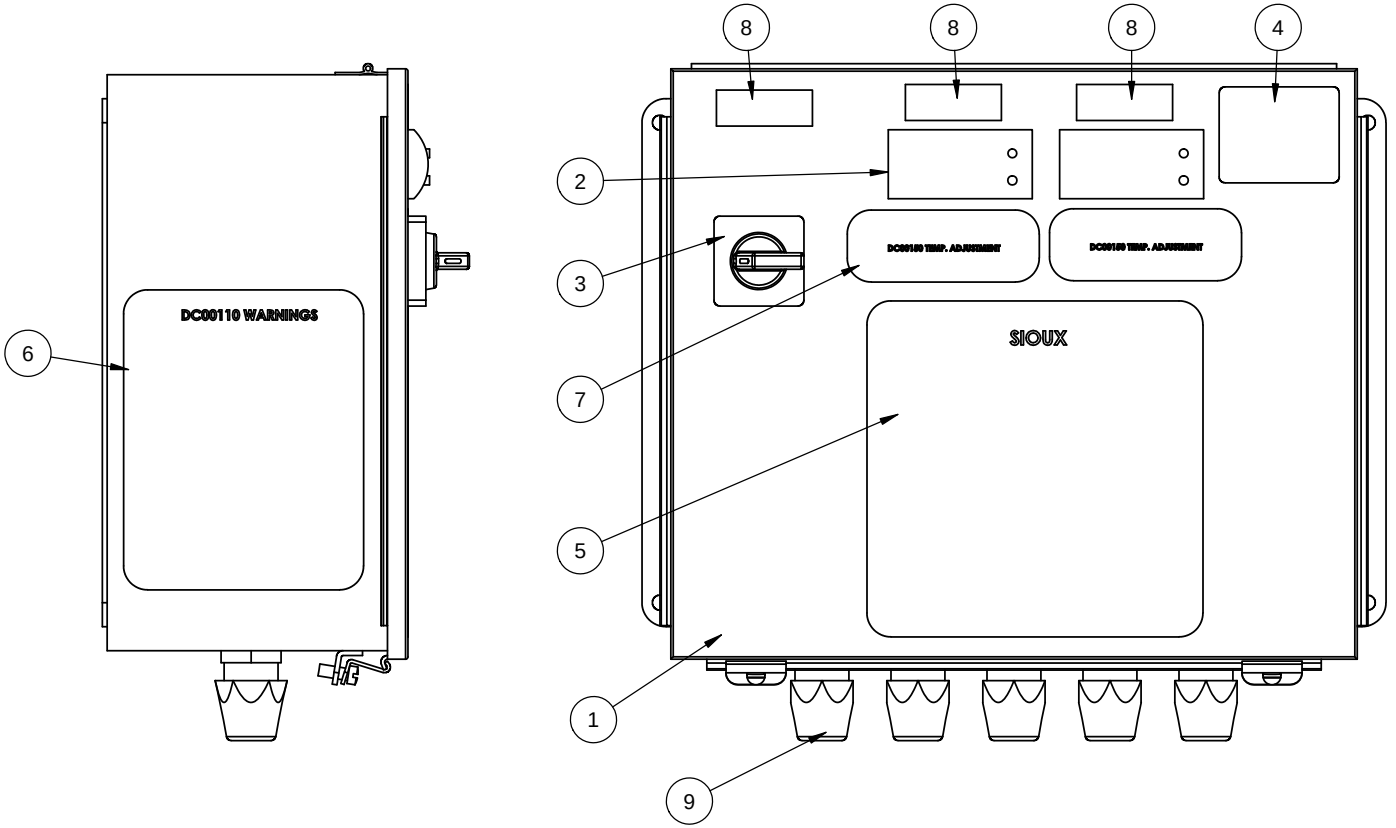
SIOUX CORPORATION
ONE SIOUX PLAZA, BERESFORD, SD 57004

M-415 WATER HEATER ENCLOSURE ASSEMBLY - AC

SIZE A SCALE 1:3 FILE AS21808 M-415 Enclosure Assembly - AC

AS21808 REV A-04 SH 2/2

NO.	NUMBER	DESCRIPTION	QTY.
1	EC00852	ENCLOSURE 14 X 12 X 6	1
2	EC01302	SWITCH DIGITAL TEMPERATURE 120V 15 AMP	2
3	EC00366	SWITCH ROTARY 3 POS 2 POLE	1
4	DC00113	PATENTS	1
5	DC00116	DECAL SIOUX LOGO CLEAR BACK	1
6	DC00110	DECAL WARNINGS	1
7	DC00150	TEMP. CONTROL ADJUSTMENT	2
8	PRINT	SEE NOTE	3
9	EC00409	FITTING LIQUID TIGHT 1/2" CONDUIT CONNECTION	5



UNLESS NOTED:
DIMENSIONS
INCHES
TOLERANCES
LINEAR: ±.0625 [1/16]
ANGULAR: ±2°

DRN LN 4-30-15
CHK BH 5-6-15
QC
THIRD-ANGLE PROJECTION

SIOUX CORPORATION
ONE SIOUX PLAZA, BERESFORD, SD 57004

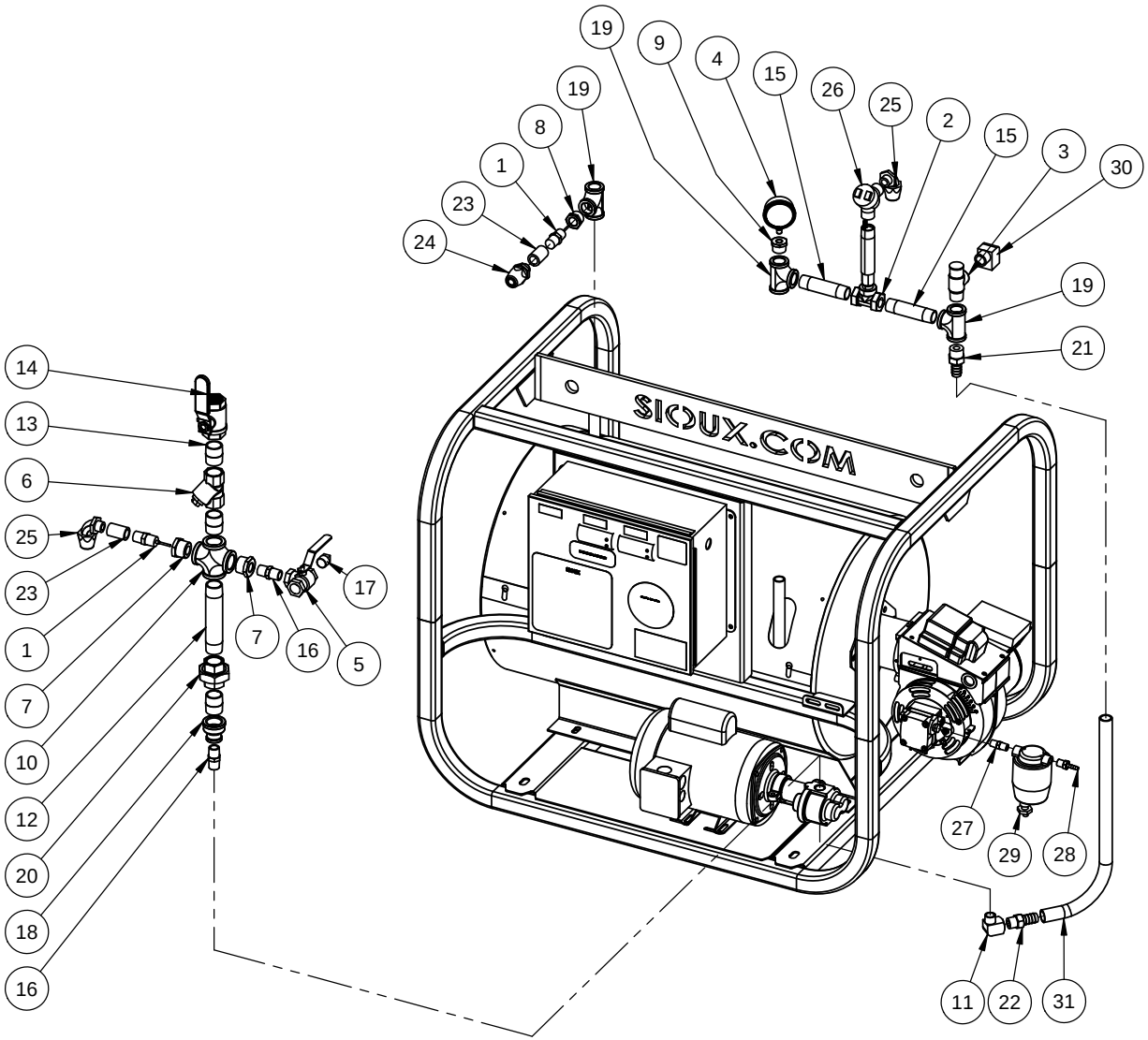
M-415 VERTICAL

SIZE A | SCALE 1:4 | FILE FR21455 M-415 VERTICAL MOUNT ASSBY.

FR21455-ASSBY | REV A-03 | SH 2/2

DWG NO. FR21455-ASSBY | REV A-03 | SHEET 2/2

NO.	NUMBER	DESCRIPTION	QTY.
1	EC01428	THERMOCOUPLE TYPE J UNGROUNDED	2
2	EC01791	SWITCH FLOW 3/4"	1
3	FT01107	VALVE RELIEF 3/4"	1
4	FT00140	GAUGE PRESSURE 160# BOTTOM MOUNTED	1
5	FT00211.1	VALVE BALL 1/2" 3-PORT 2-WAY	1
6	FT00264	STRAINER-Y 1" 150#	1
7	FT01543	BUSHING 1 X 1/2 304 SS	2
8	FT00471	BUSHING 3/4 X 1/2 304 SS	1
9	FT01523	BUSHING 3/4 X 1/4 304 SS	1
10	FT00308	CROSS 1" 150# 304 SS	1
11	FT00539	ELBOW 1/2" STREET BRASS	1
12	FT01600	NIPPLE 1" X 6" SCH 40 304 SS	1
13	FT00381	NIPPLE 1" X CLOSE SCH 40 304 SS	3
14	FT00218.1	VALVE BALL 1" 600 PSI CWP	1
15	FT00388	NIPPLE 3/4" X 4" SCH 40 304 SS	2
16	FT00603	NIPPLE 1/2" HEX BRASS	2
17	FT00616	PLUG 1/2" BRASS SQ HEAD	1
18	FT02231	REDUCER BELL 1 X 1/2 150# 304 SS	1
19	FT00374	TEE 3/4" 150# 304 SS	3
20	FT00376	UNION 1" 304 SS	1
21	FT00567	HOSE BARB BRASS 3/4" x 3/4" NPT	1
22	FT00566	HOSE BARB BRASS 3/4" x 1/2" NPT	1
23	FT00277	COUPLING 1/2" BLACK	2
24	EC00409	FITTING LIQUID TIGHT 1/2"	1
25	EC00410	FITTING LIQUID TIGHT ELBOW 1/2"	2
26	EC00466	ELBOW 1/2" CAPPED Y-1	1
27	FT00586	NIPPLE 1/4" HEX BRASS	1
28	FT00565	HOSE BARB BRASS 1/4" x 1/4" NPT	1
29	BR00254	FILTER FUEL WATER SEPARATOR	1
30	FT00540	ELBOW STREET 3/4" BRASS	1
31	AC00583	HOSE 3/4" WATER SUPPLY	1



REV.	DESCRIPTION	DATE	BY
B-05	ADDED STEET ELBOW TO RELIEF VALVE	8/24/2016	
B-04	TURNED BALL VALVE	12/7/2015	
B-03	UPDATED BALL VALVE SUPPLIER	6/11/2015	
B-02		6/4/2014	
B-01	FLOW SWITCH AND PLUMBING CHANGES	2/10/2014	

UNLESS NOTED:
DIMENSIONS
INCHES
TOLERANCES
LINEAR: ±.0625 [1/16]
ANGULAR: ±2°

DRN MW 11-15-13
CHK
QC
THIRD-ANGLE PROJECTION

SIOUX CORPORATION
ONE SIOUX PLAZA, BERESFORD, SD 57004

M-415 ASSEMBLY - PIPING

SIZE A SCALE 1:14 FILE SA21199 - M-415 ASSEMBLY

SA21199 REV B-05 SH 1/1

DWG NO. SA21199 REV B-05 SHEET 1/1

Sioux Part Number BR00456

SDC

12Vdc Oil Burner Manual

Beckett

RESIDENTIAL BURNERS

⚠ WARNING

Potential for Fire, Smoke and Asphyxiation Hazards

Incorrect installation, adjustment, or misuse of this burner could result in death, severe personal injury, or substantial property damage.

To the Homeowner or Equipment Owner:

- Please read and carefully follow all instructions provided in this manual regarding your responsibilities in caring for your heating equipment.
- Contact a professional, qualified service agency for installation, start-up or service work.
- READ THESE INSTRUCTIONS AND SAVE FOR REFERENCE.

To the Professional, Qualified Installer or Service Agency:

- Please read and carefully follow all manual instructions and any supplements provided, before installing, starting, or servicing this burner or heating system.
- The Installation must be made in accordance with all state and local codes having jurisdiction.

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Hazard Definitions

DANGER **Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.**

WARNING **Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.**

CAUTION **Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.**

Within the boundaries of the hazard warning, there will be information presented describing consequences if the warning is not heeded and instructions on how to avoid the hazard.

NOTICE Intended to bring special attention to information, but not related to personal injury or property damage.

Prepare Before Installing

WARNING **Owner's Responsibility**

Incorrect installation, adjustment, and use of this burner could result in severe personal injury, death, or substantial property damage from fire, carbon monoxide poisoning, soot or explosion.

Contact a professional, qualified service agency for the installation, adjustment and service of your oil heating system. This work requires technical training, trade experience, licensing or certification in some states and the proper use of special combustion test instruments.

Please carefully read and comply with the following instructions:

- Never store or use gasoline or other flammable liquids or vapors near this burner or appliance.
- Never attempt to burn garbage or refuse in this appliance.
- Never attempt to light the burner/appliance by throwing burning material into the appliance.
- Never attempt to burn any fuel not specified and approved for use in this burner.
- Never restrict the air inlet openings to the burner or the combustion air ventilation openings in the room.

WARNING **Impaired Burner Performance and Fire Hazard.**

Do NOT operate the burner beyond specifications outlined in the following Table.

- For applications beyond these limits, consult Beckett Technical Service at 1-800-645-2876.
- NOTE: Some packaged appliances with burners may be agency listed as a unit to operate beyond these limits. Consult the appliance manufacturer's specifications and agency approvals for verification.

General Specifications

Capacity	*'F' Head* Firing rate: 1.75 – 5.50 GPH Input: 245,000 - 770,000 Btu/h
Fuels	*USA:* No. 1 or No. 2 diesel fuel or kerosene; No.1 or No. 2 heating oil (ASTM D396) **CAUTION** **DO NOT USE GASOLINE, CRANKCASE OIL, OR ANY OIL CONTAINING GASOLINE.**
Electrical	*Power supply:* 13.5 VDC *Operating load:* 25 Amps (Actual draw could be less depending on application) *Motor:* 13.5 VDC, 1/4 hp, 3450 rpm,18.75 Amps (max.), NEMA "M" flange, rotation CCW when facing shaft end. *Ignition Secondary:* 20KVpk 25mA Interrupted duty OR optional continuous duty, solid-state ignition
Pump	*Outlet pressure:* Note 1
Air tube	*ATC code:* See ***Table 1***.
Dimensions	*Height (maximum):* 12-1/2 inches *Width (maximum):* 14-7/8 inches *Depth (chassis only):* 8-1/2 inches
Ambient Operating Temperature	+32° F. (0° C.) Minimum +115° F. (+46° C.) Maximum (See Warning on Impaired Burner Performance and Fire Hazard.)

Note 1. See equipment manufacturer's burner specifications for recommended outlet pressure. Pressure is 100 psig unless otherwise noted.

Notice Special Requirements

NOTICE If you discover damage to the burner or controls during unpacking, notify the carrier at once and file the appropriate claim.

NOTICE When contacting Beckett for service information — Please record the burner serial number (and have available when calling or writing). You will find the serial number on the silver label located on the left rear of the burner. See ***Figure 1***.

General Information

Your burner was designed, installed and adjusted at the factory prior to shipment and should not require additional adjustments. Refer to the Troubleshooting section of this manual when experiencing a possible fault condition.

WARNING **Adequate Voltage Required**

A low or erratic power supply could result in impaired burner operation, severe delayed ignition or an explosion inside the heat exchanger resulting in a burn and/or asphyxiation hazard.

- The Model SDC requires a continuous supply of 11 to 16 volts DC at 25 amps measured at the burner during operation.
- An automotive or small engine charging system that is capable of supplying the required continuous voltage/amperage is recommended with certain road equipment, such as asphalt hot patchers and similar applications.
- This is especially true while maintaining nominal load temperatures during idle periods.

WARNING **Adequate Combustion and Ventilation Air Supply Required**

Failure to provide adequate air supply could seriously affect the burner performance and result in damage to the equipment, asphyxiation, explosion or fire hazards.

- The burner cannot properly burn the fuel if it is not supplied with a reliable combustion air source.
- Follow the guidelines in the latest editions of the NFPA 31 and CSA-B139 regarding providing adequate air for combustion and ventilation.

Table 1. Combustion Head Firing Rates

Firing Rate GPH (min - max)	Head
1.75 - 3.25	F22/F220
2.50 - 5.50	F310

A. Equipment Located in Confined Space

The confined space should have two permanent openings: one near the top of the enclosure and one near the bottom of the enclosure. Each opening shall have a free area of not less then one square inch per 1,000 BTU's per hour of the total input rating of all equipment within the enclosure. The openings shall have free access to the building interior, which should have adequate infiltration from the outside.

B. Exhaust Fans and Other Air-Using Devices.

Size air openings large enough to allow for all air using devices in addition to the minimum area required for combustion air. If there is any possibility of the equipment room developing negative pressure (because of exhaust fans, for example), either pipe combustion directly to the burner or provide a sealed enclosure for the burner and provide it with its own combustion air supply.

C. Clearances to Burner and Equipment

Provide space around burner and equipment for easy service and maintenance. Check minimum clearances against those shown by the equipment manufacturer and by applicable codes.

D. Exhausting Hazardous Fumes

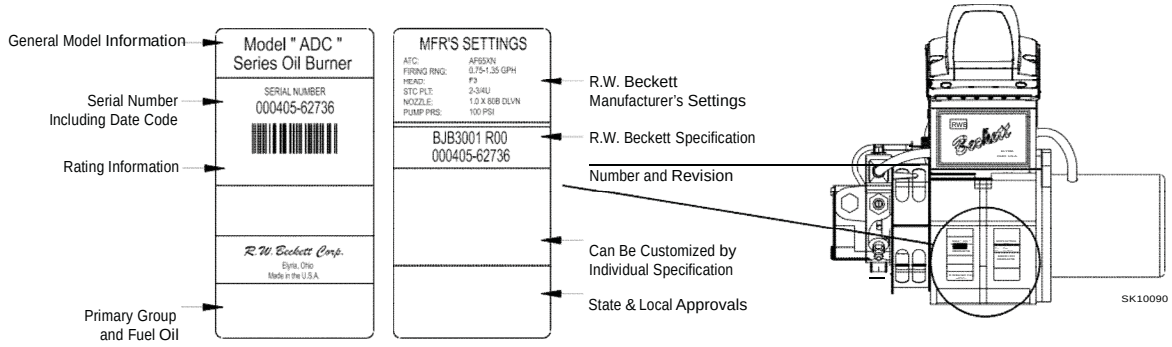
See warning on this page. Also be conscious of any fumes produced by the materials that are being heated. Always ensure adequate ventilation to exhaust all fumes.

Nozzle Assembly Maintenance

A. Replace the Burner Nozzle.

1. If applicable, remove the plastic plug protecting the nozzle adapter threads.
2. Place a 3/4" open-end wrench on the nozzle adapter. Insert the nozzle into the adapter and finger tighten. Finish tightening with a 5/8" open-end wrench.

Figure 1. Typical Burner Nameplate



⚠ WARNING **Correct Nozzle and Flow Rate Required**

Incorrect nozzles and flow rates could result in impaired combustion, under-firing, over-firing, sooting, puff-back of hot gases, smoke and potential fire or asphyxiation hazards.

Use only nozzles having the brand, flow rate (gph), spray angle and pattern specified by the appliance manufacturer.

Follow the appliance manufacturer's specifications for the required pump outlet pressure for the nozzle, since this affects the flow rate.

- Nozzle manufacturers calibrate nozzle flow rates at 100 psig.
- When pump pressures are higher than 100 psig, the actual nozzle flow rate will be greater than the gph stamped on the nozzle body. (Example: A 1.00 gph nozzle at 140 psig = 1.18 gph)

Securely tighten the nozzle (90 torque inch pounds). For typical nozzle flow rates at various pressures refer to ***Table 2***.

3. If the nozzle is already installed, remove the nozzle line assembly to verify that the nozzle size and spray pattern are correct for the application (per equipment manufacturer's information). Verify that the electrode tip settings comply with ***Figure 3***.

⚠ CAUTION **Use care when removing or installing an oil nozzle**

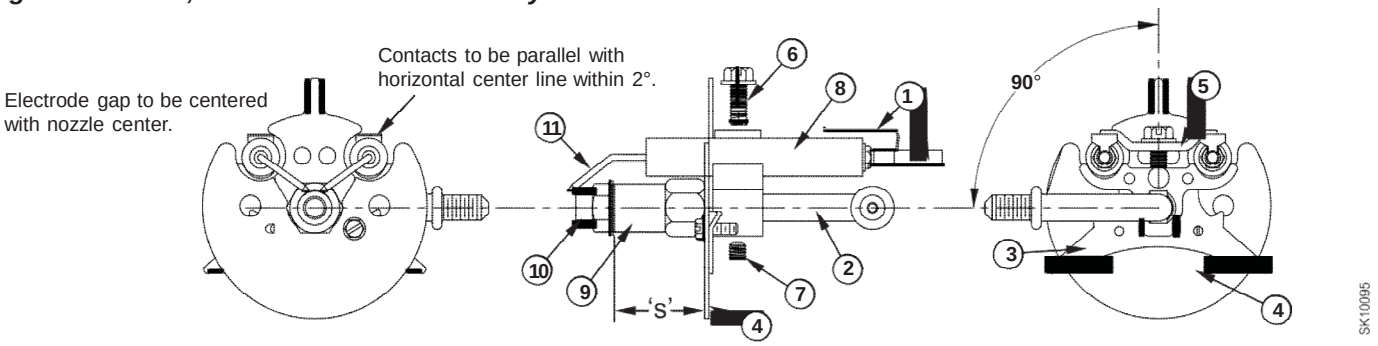
A damaged nozzle could cause impaired combustion, sooting, puffback of hot gases, oil leakage and potential fire or asphyxiation hazards.

- Inspect the nozzle adapter to insure that the sealing surface is not grooved or scratched.
- To insure that the nozzle functions properly, check the orifice and strainer for dirt, scratches or other damage before installation.
- Do NOT attempt to install or remove a nozzle without securing the adapter to prevent seriously damaging the alignment.
- Use care when handling the nozzle line assembly to prevent changing the electrode tip settings or damaging the ceramic electrode insulators.
- Insure that the electrode setting match the values shown in ***Figure 3***.

B. Check/Adjust Electrodes

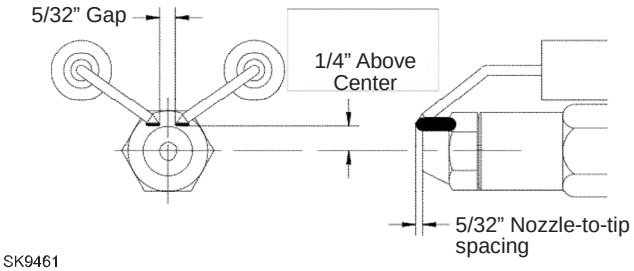
Check the electrode tip settings. Adjust if necessary to comply with the dimensions shown in ***Figure 3***. To adjust, loosen the electrode clamp screw and slide/rotate electrodes as necessary. Securely tighten the clamp screw when finished.

Figure 2. Nozzle, Line & Electrode Assembly



Item #	Description
1	Electrode Contact (3" ATC or extension over 3")
2	Nozzle Line
3	Spider spacer assembly
4	Static Plate
5	Electrode clamp
6	Electrode clamp retaining screws
7	Nozzle line setscrew
8	Electrode Insulator
9	Nozzle adapter
10	Nozzle tip
11	Electrode tip

Figure 3. Electrode Tip Setting



Air Tube Length	Dimension 'S'
2-5/8" to 3"	1-3/8"
3-5/8" to 4-1/2"	1-5/8"
over 4-7/8"	2-13/32"

C. Igniter Maintenance

The igniter assembly does not require any adjustments beyond making sure the springs and the burner electrode rods make solid contact when the igniter is in the closed position. The sealing surfaces of the gaskets should be checked and replaced at the first signs of any damage or deterioration. Clean any dirt or residue from the porcelain bushings, springs, and baseplate.

The simplest way to check igniter operation is by supplying voltage to the input and checking to see whether an arc is produced. Check by either looking or listening to see if there is an arc across the electrodes while the burner is running and the igniter is energized.

The igniter must be grounded to the burner before checking the following. To check the igniter, ensure all power to the burner is off and use an ohmmeter to check the resistance between the two springs. The meter should read between 480 - 580 ohms.

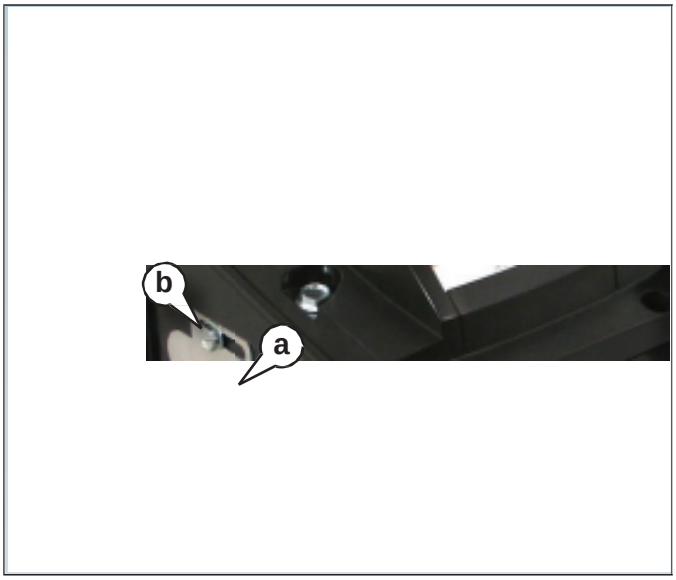
The igniter should be replaced if the meter indicates an open circuit, or the spring-to-spring resistance exceeds the 480 - 580 ohms range by more than 10%.

D. Servicing Nozzle Line Assembly

Before proceeding, turn off power to the burner.

1. Disconnect the oil connector tube from the nozzle line.
2. Referring to Figure 4, loosen the two screws securing the igniter retaining clips and rotate both clips to release the igniter baseplate. Then tilt the igniter back on its hinge.
3. Remove the splined nut.
4. Remove the nozzle line assembly from the burner, being careful not to damage the electrodes or insulators while handling. To ease removal of short assemblies, it may be necessary to loosen the escutcheon plate. Reset to the edge of the label.
5. To replace the nozzle line assembly, reverse the above steps.

Figure 4. Igniter Retainer Screws



E. Check/Adjust “Z” Dimension

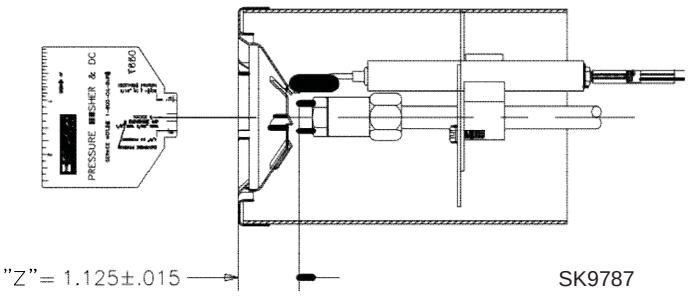
Refer to ***Figure 5***. The critical “Z” dimension is the distance from the face of the nozzle to the flat face of the head. This distance for F heads is 1-1/8”. The “Z” dimension is factory set for burners shipped with the air tube installed but should always be verified during service and installation. If the “Z” dimension is out of adjustment, perform the following steps.

Before proceeding, turn off power to the burner.

1. Disconnect the oil connector tube from the nozzle line.
2. Referring to ***Figure 4***, loosen the splined nut **(a)** from the nozzle line. Loosen the hex head screw **(b)** securing the escutcheon plate to the burner housing.
3. A Beckett T650 gauge should be used to set the Z dimension. See ***Figure 5***.
4. Place the end of a ruler at the face of the nozzle and, using a straight edge across the head, measure the distance to the face of the head.
5. Slide the nozzle line forward or back until this dimension for F heads is 1-1/8”.
6. Tighten the hex head screw to secure the escutcheon plate to the burner chassis. Then tighten the splined nut and attach the oil connector tube.
7. Recheck the “Z” dimension periodically when servicing to ensure the escutcheon plate has not shifted. You will need to reset the “Z” dimension if you replace the air tube or nozzle line assembly.

NOTICE The Beckett Z gauge (part number Z-2000) is available to permit checking the F head “Z” dimension without removing the burner.

Figure 5. ‘Z’ Dimensions Using Gauge



Fuel Supply

A. Connect Fuel Lines

For oil supply system specifications for tanks not mounted on machines, carefully follow the pump manufacturer's literature and the latest edition of the National Fire Protection Association (NFPA) 31 standard.

⚠ WARNING **Do Not Install Bypass Plug with 1-Pipe System**

Failure to comply could cause Immediate pump seal failure, pressurized oil leakage and the potential for a fire and injury hazard.

- The burner is shipped without the by-pass plug installed.
- Install the bypass plug in two-pipe oil supply systems ONLY.

⚠ CAUTION **Oil Supply Pressure Control Required**

Damage to the filter or pump seals could cause oil leakage and a fire hazard.

- The oil supply inlet pressure to the burner ***cannot exceed 3 psig***.
- Insure that a pressure limiting device is installed in accordance with the latest edition of NFPA 31.
- **Do NOT install valves in the return line.** (NFPA 31, Chapter 8.)
- **Gravity Feed Systems:** Always install an anti-siphon valve in the oil supply line or a solenoid valve (RWB Part # 21441U) in the pump/nozzle discharge tubing to provide backup oil flow cut-off protection.

⚠ CAUTION **Do Not Use Teflon Tape**

Damage to the pump could cause impaired burner operation, oil leakage and appliance soot-up.

- Never use Teflon tape on fuel oil fittings.
- Tape fragments can lodge in fuel line components and fuel unit, damaging the equipment and preventing proper operation.
- Use oil-resistant pipe sealant compounds.

B. Fuel Supply Level with or Above Burner

NOTICE Pumps with automatic bypass do not require a bypass plug. Verify by referring to the pump manufacturer's instructions.

The burner may be equipped with a single stage pump. If a one-pipe system is installed, insure that a bypass plug is not installed in the pump, then connect the fuel supply to the burner with a single supply line Note that manual bleeding of the pump is required on initial start-up or when the equipment runs out of fuel. When connecting a two-pipe fuel system, install the pump by-pass plug.

C. Fuel Supply Below Level of Burner

When the fuel supply is more than eight feet below the level of the burner, a two-pipe fuel supply system is required. Depending on the fuel line diameter and the horizontal and vertical length, the installation may also require a two-stage pump. Consult the fuel unit manufacturer's literature for lift and vacuum capability.

D. Fuel Line Replacement (Remote Tank Only)

When replacing fuel lines, continuous lengths of heavy wall copper tubing is recommended. To ensure a tight seal, always use flare fittings. Never use compression fittings. Always install fittings in an accessible location. To avoid vibration noise, fuel lines should not run against the appliance or the ceiling joists.

E. Fuel Line Valve and Filter

Shutoff valves should be located in the oil supply line. Do not install valves in the return line.

Burner Wiring

⚠ WARNING **Electrical Shock Hazard**

Electrical shock can cause severe personal injury or death.

- Disconnect electrical power before installing or servicing the burner.
- Provide ground wiring to the burner, metal control enclosures and accessories. (This may also be required to aid proper control system operation.)

A. Burner installed on equipment

Refer to appliance manufacturer's wiring diagram for electrical connections.

B. Burner Replacement

Burner wiring may vary, depending on the actual primary control and furnished options. Refer to Figure 6 for typical burner wiring, showing cad cell primary controls. Note that the relay and control, shown in the wiring diagram are optional features.

NOTICE The wiring diagrams in this manual are for general reference only. Refer to the equipment manufacturer's literature or the diagrams supplied with the equipment.

Figure 6A. Typical Wiring For Constant Duty Ignition - With No Primary Control

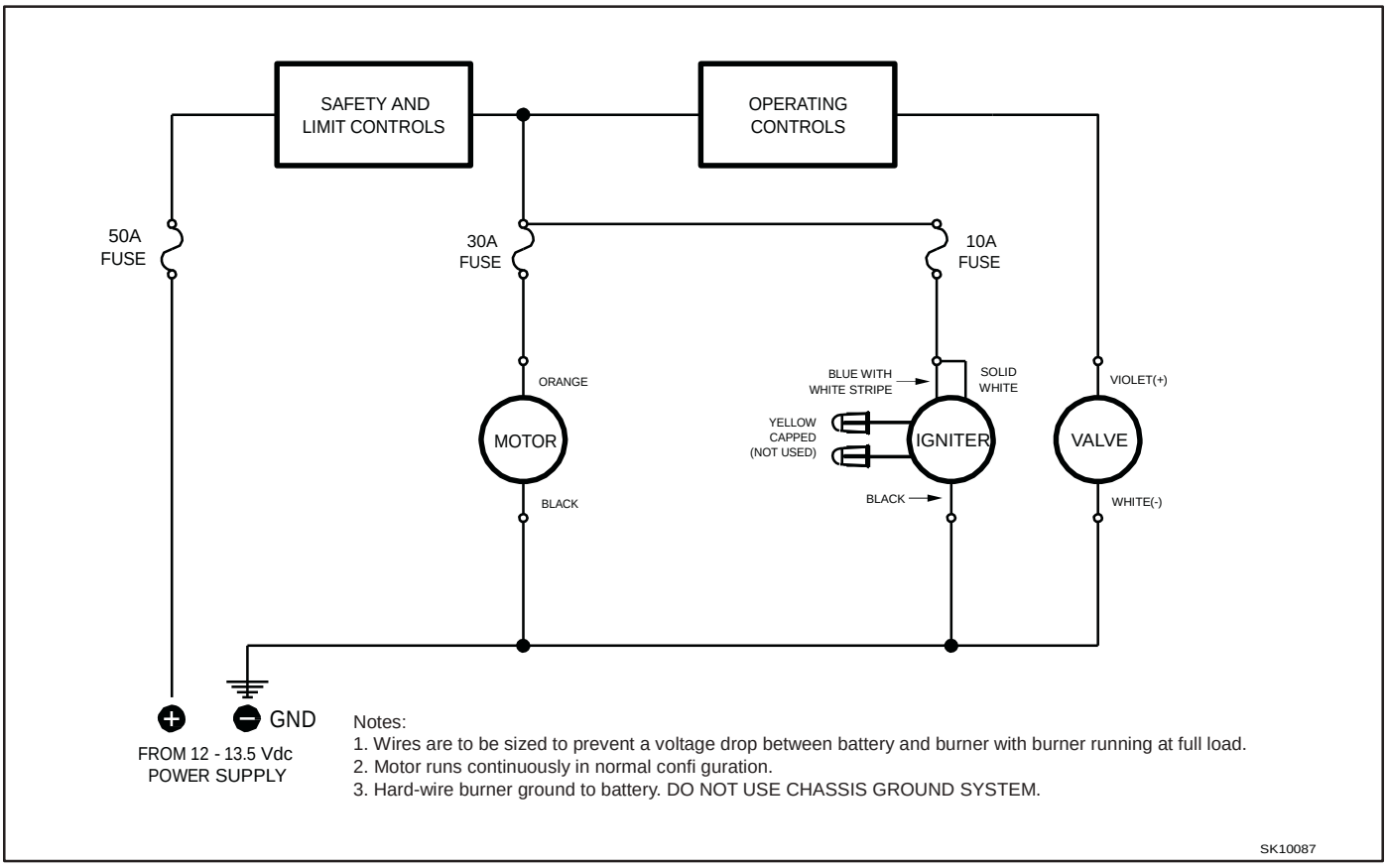


Figure 6B. Typical Wiring For Interrupted Ignition - With No Primary Control

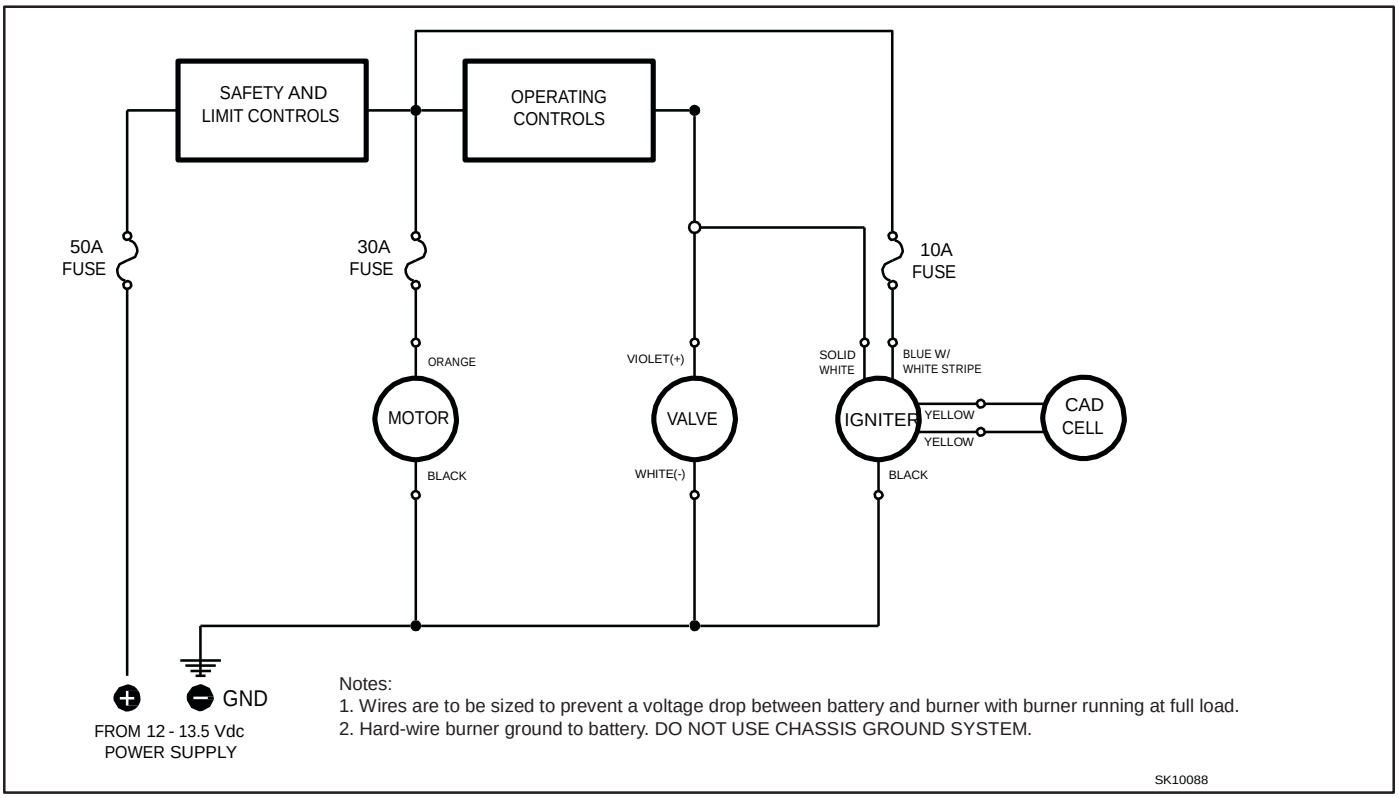
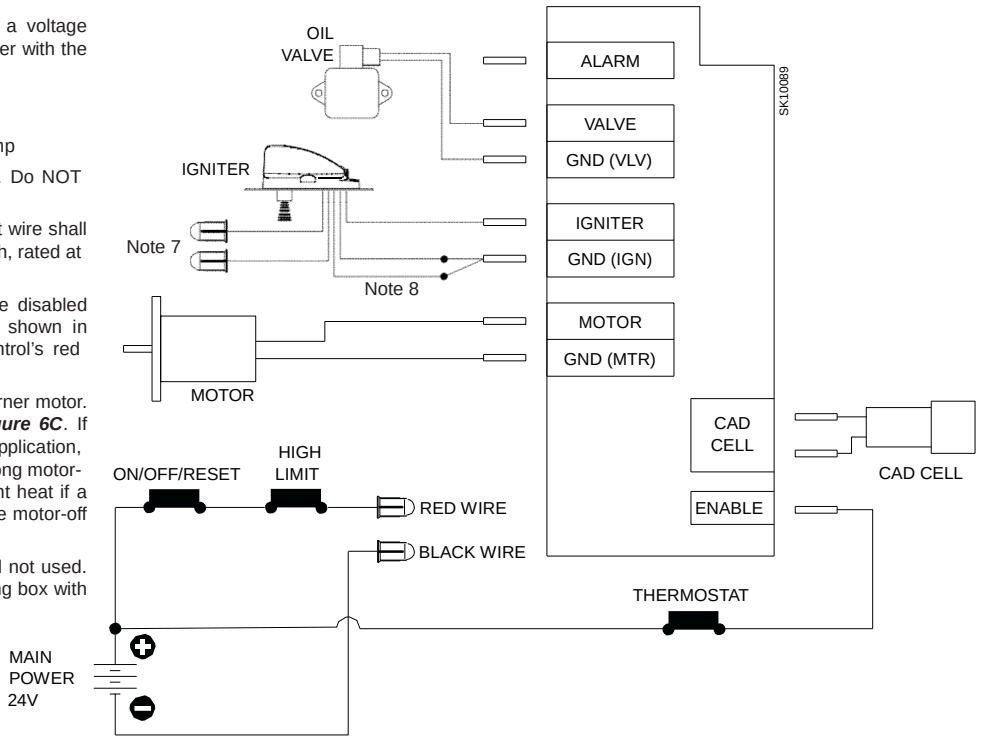


Figure 6C. Typical Wiring with 7556 Primary Safety Control

Notes:

1. Wires are to be sized to prevent a voltage drop between the battery and the burner with the burner running at full load.
2. Fuse Sizes (inside control):
Motor = 30 Amp
Igniter, Control, Valve, & Alarm = 10 Amp
3. Hard-wire burner ground to battery. Do NOT use chassis ground system.
4. Input power to the control's +12 Volt wire shall be provided from a fused service switch, rated at 50 amps or less.
5. Motor-off delay on a 7556P will be disabled if the safety and operating limits as shown in ***Figure 6C*** interrupt power to the control's red +12 Volt wire.
6. Do not wire power directly to the burner motor. Only wire the motor as shown in ***Figure 6C***. If instant burner heat is required by the application, purchase or program a control with a long motor-off delay time, which will ensure instant heat if a new call for heat is received within the motor-off delay time.
7. Igniter Yellow leads are capped and not used. Bundle with the other leads in the wiring box with a cable tie.
8. The igniter Blue-White striped and solid White leads are combined with the 3274001 "Y" connector and attached to the primary control igniter spade terminal.



Drive Component Maintenance

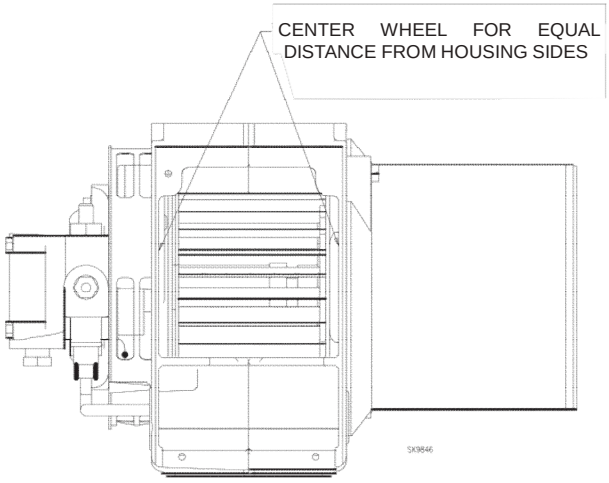
A. Motor, Blower Wheel, and Coupling Replacement

The motor will require replacement if the proper voltage is measured at the motor input, and the motor will either not run, or the current draw with a free running pump exceeds 10% of the rated current.

To replace the burner motor, coupling and/or blower wheel perform the following steps.

1. Before servicing, turn off and/or disconnect all power to the burner.
2. Disconnect the burner motor wires.
3. Remove the bolts securing the motor to the burner housing.
4. Remove the motor, coupling, and blower wheel.
5. Loosen the set screw on the blower wheel to slide the existing wheel off the shaft.
6. Slide the new blower wheel onto the old shaft (after thoroughly cleaning housing) and/or slide the old blower wheel onto the new motor shaft.
7. When replacing the blower wheel, ensure the wheel is centered between the two sides of the burner housing as shown.
8. Rotate the blower wheel until the setscrew is centered on the flat of the motor shaft. Tighten the setscrew to secure the wheel.
9. Slide the motor coupling on the motor shaft, then install the motor on the burner housing. Ensure that the motor coupling fits between the motor shaft and the pump shaft inside the housing. Tighten the motor retaining screws. Reconnect the wires.
10. Restore power, start the burner and perform the combustion test described previously in this manual.

Figure 7. – Blower Wheel



B. Pump Maintenance

General Pump Information

Important information - Long or oversized inlet lines may require the pump to operate dry during initial bleeding period. In such cases, the priming may be assisted by injecting fuel oil in the pump gear set. Under lift conditions, lines and fittings must be air tight. To assure this, “Pipe Dope” may be applied to both the used and unused inlet and return fittings. **Do NOT use Teflon tape or compression fittings**

Mounting Position

Beckett CleanCut pump may be mounted in any position (except upside-down in a single pipe installation).

Vacuum Check

A Vacuum Gauge may be installed in either of the 1/4” NPT inlet ports.

Pressure Check

When a pressure check is made use the nozzle port. If the bleed port is used, the reading on the gauge should be approximately 5 psig higher than the pressure reading on the nozzle port. See ***Figure 9***.

Cutoff Check

To check cutoff pressure dead head a pressure gauge in the nozzle port. Run the burner for a short period of time. Shut the burner off. The pressure will drop and hold above zero. Pressurized or gravity feed installations must not exceed 3 psi on inlet line or return line at the pump per NFPA 31. A pressure greater than 10 psi may cause damage to the shaft seal.

Pressurized or Gravity Feed Installations

Must not exceed 3 psi on inlet line or return line at the pump per NFPA 31. A pressure greater than 10 psi may cause damage to the shaft seal.

C. Solenoid Valve Testing

To check solenoid operation, perform the following.

1. Check for oil flow and operating pressure by removing the copper tubing from the nozzle line and installing a pressure gauge in the line. With the motor running and the coil energized, check the gauge. The pressure should read 100 psig unless otherwise stated.
2. To check the solenoid valve cutoff function, deadhead the pressure gauge onto the copper connector tube attached to the nozzle port. Run the burner for a short period of time. Shut the burner off. The solenoid valve should close and the pressure should drop and hold.
3. Replace the solenoid valve if it does not pass the steps above.

Start Up Burner & Set Combustion

A. Basic Burner Operation

Typical Constant Duty Ignition Configuration

With this Beckett ADC oil burner configuration, the motor and igniter operate continuously while the valve that controls oil flow is cycled by the switches on the power washer. The motor is used to drive the blower and pump. The rotational speed of the motor is determined by the voltage supplied and the load placed on the motor. Pump pressure and air settings are the main factors affecting the motor load. The igniter converts battery DC voltage into a high voltage spark to ignite the oil. The igniter is capable of running continuously as long as the blower wheel is circulating air across the igniter base. The pump and solenoid valve are used to control the flow of oil from the reservoir to the nozzle.

Igniter With Interrupted Duty Ignition

This optional control circuit is available to reduce current draw on the charging system by turning the igniter off after a flame has been established. This option controls igniter operation based on a signal from a light sensing cad cell. When light hits the cell the control will sense a decrease in resistance across the sensor. A few seconds delay will occur prior to the igniter switching off. As long as sufficient light is reaching the cell eye, the igniter will remain off. If light is removed from the sensor, the igniter will turn on until light is again sensed by the cad cell.

With 7556 Primary Safety Control

The 7556 control provides the same benefits as described above, as well as added safety, convenience, and performance features. It adds a valve on delay and motor-off delay to the burner’s operation sequence that promote clean burner operation. It has a lock-out function that shuts the burner down if it is not operating properly. The control adds fusing at the burner to protect against component failures. The control also has redundant motor relays that are checked for proper operation every heat cycle.

NOTICE Variations to the burner circuits may occur due to optional temperature, pressure, and vacuum switches that control burner operation. Note that when external switches are used to control motor operation they must be sized correctly for the rated current or a relay should be installed to isolate the switches from the motor’s full load current.

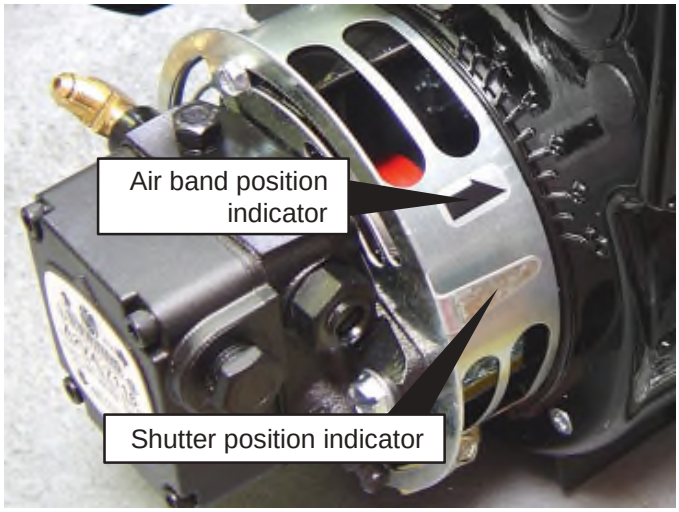
B. Combustion Set-up

WARNING **Explosion and Fire Hazard**

Failure to follow these instructions could lead to equipment malfunction and result in heavy smoke emission, soot-up, hot gas puff-back, fire and asphyxiation hazards.

- Do not attempt to start the burner when excess oil has accumulated in the appliance, the appliance is full of vapor, or when the combustion chamber is very hot.
- Do not attempt to re-establish flame with the burner running if the flame becomes extinguished during start-up, venting, or adjustment.
- **Vapor-Filled Appliance:** Allow the unit to cool off and all vapors to dissipate before attempting another start.
- **Oil-Flooded Appliance:** Shut off the electrical power and the oil supply to the burner and then clear all accumulated oil before continuing.
- If the condition still appears unsafe, contact the Fire Department. Carefully follow their directions.
- Keep a fire extinguisher nearby and ready for use.

Figure 9. – Air supply components



As soon as burner motor starts rotating bleed all the air from the pump. (Required with single-pipe systems.)

To bleed the pump, attach a clear plastic hose over the vent fitting. Loosen the fitting and catch the oil in an empty container. Tighten the fitting when all air has been purged from the supply system. Note: If the burner stops after a flame is established, the unit probably requires additional bleeding. Continue to bleed the system until the pump is primed and a flame is established when the bleed valve is closed.

C. Set Combustion with Instruments

WARNING **Professional Service Required**

Incorrect installation, adjustment, and use of this burner could result in severe personal injury, death, or substantial property damage from fire, carbon monoxide poisoning, soot or explosion.

Please read and understand the manual supplied with this equipment. This equipment must be installed, adjusted and put into operation only by a qualified individual or service agency that is:

- Licensed or certified to install and provide technical service to oil heating systems.
- Experienced with all applicable codes, standards and ordinances.
- Responsible for the correct installation and commission of this equipment.
- Skilled in the adjustment of oil burners using combustion test instruments.

The installation must strictly comply with all applicable codes, authorities having jurisdiction and the latest revision of the National Fire Protection Association Standard for the installation of Oil-burning Equipment, NFPA 31 (or CSA-B139 and CSA-B140 in Canada).
Regulation by these authorities take precedence over the general instructions provided in this installation manual.

1. Allow the burner to run for approximately 5 to 10 minutes.
2. Follow these four steps to properly adjust the burner:

   Step 1: Adjust the air until a trace smoke level is achieved..

   Step 2: At the trace of smoke level, measure the CO_2 (or O_2). This is the vital reference point for further adjustments.

   Step 3: Increase the air to reduce CO_2 by 1 percentage point (O_2 will be increased by approximately 1.4 percentage points).

   Step 4: Recheck the smoke level. It should be zero.
3. This procedure provides a margin of reserve air to accommodate variable conditions.
4. Once the combustion level is set, tighten the fasteners on the air band and air shutter.
5. Start and stop the burner several times to ensure satisfactory operation.
6. Test the equipment safety controls to verify that they function according to the manufacturer's specifications.

Maintain & Service Burner

A. Owner's Information

Have your equipment inspected at regular intervals by a qualified service agency to assure continued proper operation. The burner should be adjusted using dedicated combustion test equipment. Failure to properly set the burner could result in inefficient operation, and/or conditions that could potentially cause severe personal injury, death or substantial property damage.

B. Owner Service and Maintenance

Properly installed and maintained, your ADC burner will provide years of efficient, trouble-free operation. Please take care of your equipment by following the warnings provided and by immediately contacting your qualified service agency if your burner is not operating properly. This equipment should be serviced only by a qualified service agency. The appropriate test instruments must be used.

Daily

Check the area around your burner/equipment to make sure:

- nothing is blocking the burner inlet air openings
- air ventilation openings are clean and unobstructed and the exhaust is not crusted
- no combustible materials are stored near the equipment
- there are no signs of oil or water leakage around the burner or equipment.

Extended Down Time

If the equipment will be stored for an extended period of time, insure that the fuel tank is full and add a fuel stabilizer to the tank.

Regular Service/Maintenance

Have your burner, serviced annually by your qualified service agency. The following components/assemblies should be checked/adjusted/replaced on a regular basis.

Refer to the Replacement Parts exploded view for part locations.

- ☐ Replace the oil supply line filter if applicable. The line filter cartridge must be replaced to avoid contamination of the pump and nozzle.
- ☐ Inspect the oil supply system. All fittings should be leak-tight. The supply lines should be free of water, sludge and other restrictions.
- ☐ Remove and clean the pump strainer.
- ☐ Verify the nozzle is the one originally specified by the appliance manufacturer and replace the nozzle with one having the exact specifications from the same manufacturer.
- ☐ Clean and inspect the electrodes for damage, replacing any that are cracked or chipped.
- ☐ Check electrode tip settings. Replace electrodes if tips are rounded.
- ☐ Inspect the igniter spring contacts. Clean or replace if corroded.
- ☐ Clean the cad cell, if applicable.
- ☐ Make sure Low Firing Rate Baffle is in place, if required, for the burner application. Omitting the baffle can result in unacceptable burner combustion.
- ☐ Inspect all gasket including the igniter base plate gasket. Replace any that are damaged or missing.
- ☐ Clean the blower wheel, air inlet, air guide, retention head and static plate of any dirt, asphalt or other material.
- ☐ Check motor current. The amp draw should not exceed the nameplate rating. Check all wiring for loose connections or damaged insulation.
- ☐ Check the pump pressure and cutoff function.
- ☐ Check primary control safety lockout timing if applicable. Refer to the information supplied by the control manufacturer for procedures.
- ☐ Check ignition system for proper operation.
- ☐ Inspect the exhaust system for soot accumulation or other restriction.
- ☐ Clean the equipment thoroughly according to the manufacturer's recommendations.
- ☐ Check the burner performance using test instruments.
- ☐ It is good practice to make a record of the service performed and the combustion test results.

Troubleshooting

Oil burners that are designed for use in pressure washers are built to take temperature extremes, vibration, and rough handling. When performing the following troubleshooting steps, we assume that the oil burner motor and ignition transformer operate continuously and the oil solenoid valve, which controls oil flow, is cycled by the trigger in the wand. We also assume that there is power to the burner and fuel in the tank.

In addition to normal mechanics tools, it is recommended to have the following equipment on hand.

- Meter capable of measuring volts, ohms and amps,
- ignition transformer tester,
- smoke pump tester,
- combustion analyzer, and
- 0 to 200 psi pressure gauge.

See ***Table 3*** on following page for troubleshooting steps.

Table 2. Nozzle Flow Rate by Size

Nozzle flow rate U. S. gallons per hour of No. 2 fuel oil when pump pressure (psig) is:		
Nozzle size (rated at 100 psig)	**100 psi**	**140 psi**
1.75	1.75	2.07
2.00	2.00	2.37
2.25	2.25	2.66
2.50	2.50	2.96
2.75	2.75	3.24
3.00	3.00	3.55
3.50	3.50	4.13
4.00	4.00	4.70
4.50	4.50	5.30
5.00	5.00	-

Table 3. Troubleshooting Chart

Symptom	Possible Cause
Oil Not Igniting	**If the burner is not igniting, the burner motor, drive coupling, and oil pump are operating and oil is flowing to the nozzle through the solenoid valve, check the following possibilities.** 1. Check the air shutter adjustment. If the air shutter is opened too far, the flow of air may prevent the arc from reaching the oil spray. This may appear as a white vapor exhaust from the heater. [Refer to section *"Start up burner and set combustion"*] 2. The ignition system may have failed to supply an adequate arc to ignite the oil. Check the battery and charging system to insure a continuous supply of 11 to 16 volts DC (15 amps). [Refer to section *"Nozzle Assembly Maintenance"*] 3. Check the electrodes for wear and damage. Insure that the electrodes are adjusted properly. [Refer to section *"Nozzle Assembly Maintenance"*]
No Flame	**If there is no flame, the burner motor and igniter operate continuously and the oil solenoid valve is functional, check the following possibilities.** 1. Check for a plugged oil nozzle. [Refer to section 3] 2. If the coil on the solenoid valve is actuating, insure that the valve is opening or closing properly. [Refer to section *"Fuel Supply"*] 3. Check for sufficient fuel pressure. Pressure is 100 psig with valve energized, unless otherwise noted. [Refer to section *"Drive Component Maintenance"*] 4. Check the pump pressure. Check for air in fuel lines. 5. Check burner for broken motor coupling. If the coupling is broken check pump rotation prior to replacing the coupling. [Refer to section *"Drive Component Maintenance"*] 6. Check for contaminated fuel and/or partially plugged fuel filter. [Refer to section *"Fuel Supply"*]
Motor Not Operating	**If the blower motor is not operating, check the following possibilities.** 1. Check voltage at the motor to insure that switches and relays, in line with the motor, are operating properly. [Refer to section *"Burner Wiring"*] 2. Check pump and motor shaft operation. They should work freely without binding. [Refer to section *"Drive Component Maintenance"*]
No Oil Spray	**If the blower motor is operating, there is fuel in the tank, but oil does not spray out the end of the nozzle, check the following possibilities.** 1. Check for a broken or stripped coupling between the pump and the motor. [Refer to section *"Drive Component Maintenance"*] 2. Check the pump output for oil. [Refer to section *"Drive Component Maintenance"*] 3. Check operation of the oil valve. [Refer to section *"Drive Component Maintenance"*] 4. Check for a plugged nozzle. [Refer to section *"Nozzle Assembly Maintenance"*] 5. Check for air in the oil line. [Refer to section *"Nozzle Assembly Maintenance"*] 6. Check for fuel contamination or plugged filter. [Refer to section *"Nozzle Assembly Maintenance"*]
Fluctuating or No Pump Pressure	**If the pump pressure, as determined by a pressure gauge, is erratic or does not exist, check the following possibilities.** 1. Check motor rotational speed. Low rpm can cause erratic or no pump pressure. [Refer to section *"Drive Component Maintenance"*] 2. Check for a broken or worn motor coupling. [Refer to section *"Drive Component Maintenance"*] 3. Check that the pump turns freely. [Refer to section *"Drive Component Maintenance"*] 4. Check for air leaks in the lines. [Refer to section *"Fuel Supply"*] 5. Check for oil froth at the bleed point. [Refer to section *"Fuel Supply"*] 6. Check voltage at the motor. [Refer to section voltage rating on nameplate] 7. Check for fuel contamination or partially plugged filter.
Slow Motor Rotation	**If the blower motor is not operating at the rpm's listed on the nameplate, check the following.** 1. Check the supply voltage to the motor. [Refer to section voltage rating on nameplate] 2. Check for free operation of the motor shaft and pump assembly. [Refer to section *"Drive Component Maintenance"*]

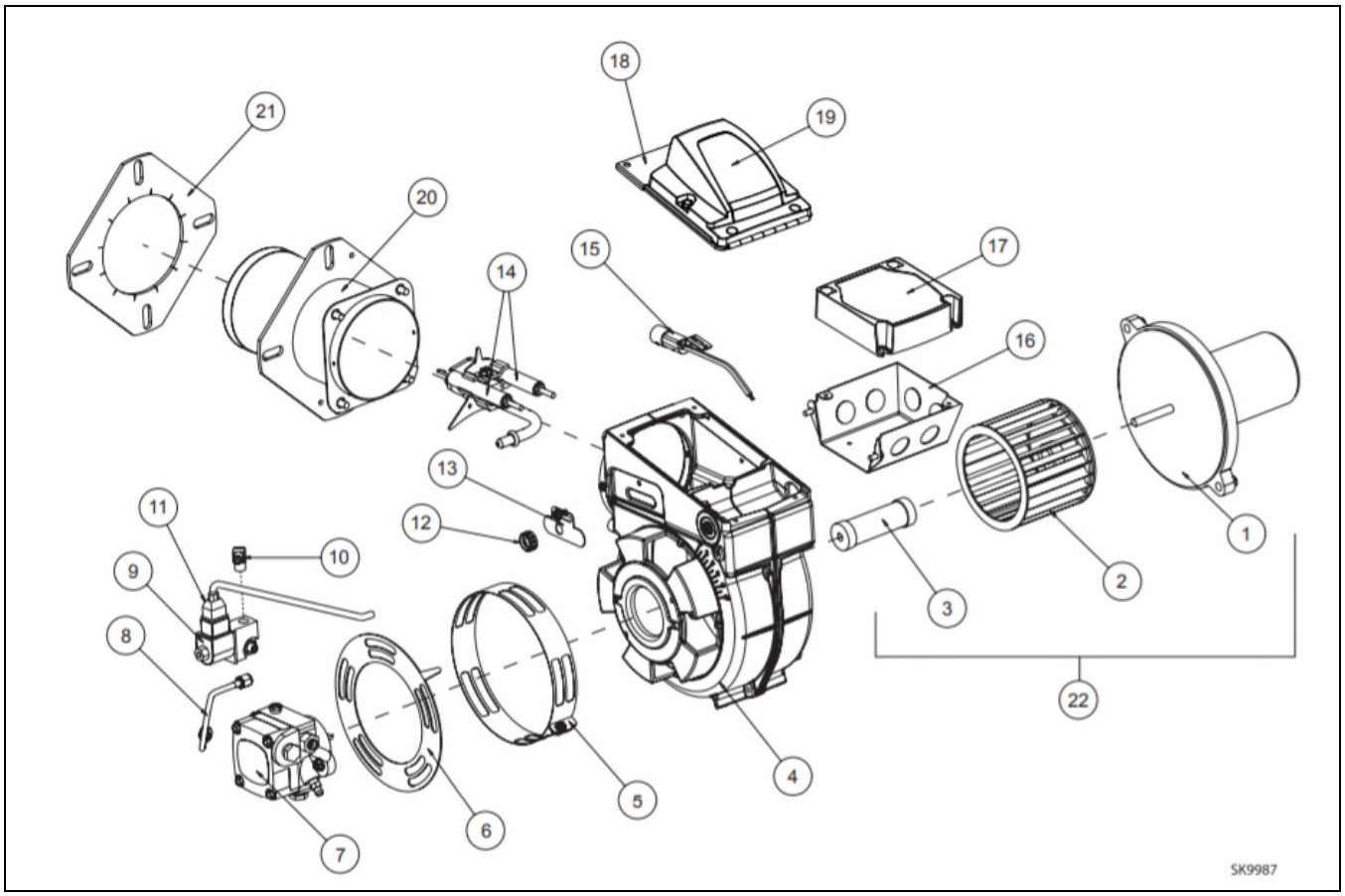


Illustration #	Description	Part#
1	DC Motor	x
2	Blower Wheel (6-1/4")	BR00880
3	Coupling	BR00603
4	Burner Housing	x
5	Air Band, 10 slot	x
6	Air Shutter, 10 slot	x
7	Pump	BR01095
8	Copper Fuel line	BR00572
9	Oil Valve (Built into pump)	
10	Brass Elbow	x
11	Cord Set, Valve	BR00435
12	Splined Nut	BR00474

Illustration #	Description	Part#
13	Escutcheon Plate	x
14	Electrode Kit over 3-5/8"	BR00505
15	Cad Cell Detector	BR00382
16	4X4 Wiring Box	x
17	Burner Control Kit	BR00749
18	Igniter Assembly With Base Plate	BR00769
19	Igniter only	x
20	Air Tube Assembly	x
21	Flange Mounting Gasket	BR00450
22	Motor Kit with Blower Wheel and Coupling	BR00602

* '**X**'s *indicate timing options. Contact Sioux for available part numbers*

Limited Warranty Information

The R. W. BECKETT CORPORATION ("Beckett") warrants to persons who purchase its "Products" from Beckett for resale, or for incorporation into a product for resale ("Customers"), that its equipment is free from defects in material and workmanship. To qualify for warranty benefits, products must be installed by a qualified service agency in full compliance with all codes and authorities having jurisdiction, and used within the tolerances of Beckett's defined product specifications.

To review the complete warranty policy and duration of coverage for a specific product, or obtain a written copy of warranty form 61545, please choose one of the following options:

1. Visit our website at: www.beckettcorp.com/warranty
2. Email your request to: rwb-customer-service@beckettcorp.com
3. Write to: R. W. Beckett Corporation, P. O. Box 1289, Elyria, OH 44036

NOTE: Beckett is not responsible for any labor cost for removal and replacement of equipment.

THIS WARRANTY IS LIMITED TO THE PRECISE TERMS SET FORTH ABOVE, AND PROVIDES EXCLUSIVE REMEDIES EXPRESSLY IN LIEU OF ALL OTHER REMEDIES, AND IN PARTICULAR THERE SHALL BE EXCLUDED THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT WILL BECKETT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE OF ANY NATURE. Beckett neither assumes, nor authorizes any person to assume for Beckett, any other liability or obligation in connection with the sale of this equipment. Beckett's liability and Customer's exclusive remedy is limited to the cost of the product.

Beckett CORPORATION

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Canada: R.W. Beckett Canada, Ltd. • Unit #3, 430 Laird Road • Guelph, Ontario N1G 3X7
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Form No. 6104 B12SDC2 R02, Printed in USA 04/12

Alternative Fuels and Beckett Burners

664860, Fuel & Supply Systems, R04

Beckett burners are developed and listed with petroleum fuel oil (burner fuel) meeting the national fuel standard, ASTM D396. From time to time, it is desirable or necessary to use alternative fuels that essentially meet this standard. The following list indicates the fuels that can be used without affecting your Beckett warranty.

Note: *This alternative fuel policy covers the burner supplied by Beckett from the pump inlet through the retention head. It does not cover tanks and storage, fuel lines, filters, appliances or any system components not supplied by Beckett. Appropriate due diligence is required for the use of these fuels. Please see additional recommendations on the reverse side of this bulletin.*

Fuel Type	Spec (ASTM unless otherwise noted)	Warranty Coverage	
		Beckett Warranty Honored	Not approved / No warranty
Heating Oil – No. 1	D396 Gr.1 (S5000)	**YES**	
Heating Oil – No. 2	D396 Gr.2 (S5000)	**YES**	
Heating Oil – No. 1 – Low Sulfur	D396 Gr.1 (S500)	**YES**	
Heating Oil – No. 2 – Low Sulfur	D396 Gr.2 (S500)	**YES**	
Diesel Fuel – No. 1 – (Off-road)	D975 Gr.1-D (S500)	**OK**	
Diesel Fuel – No. 2 – (Off-road)	D975 Gr.2-D (S500)	**OK**	
Diesel Fuel – No. 1 – (Highway)	D975 Gr.1-D (S15)	**OK**	
Diesel Fuel – No. 2 – (Highway)	D975 Gr.2-D (S15)	**OK**	
Kerosene – 1K (also called K-1)	D3699 Gr. 1	**OK**	
Kerosene – 2K (also called K-2)	D3699 Gr. 2	**OK**	
Gas Turbine Oil – No. 1	D2880 Gr. 1-GT	**OK**	

Gas Turbine Oil – No. 2	D2880 Gr. 2-GT	**OK**	
BioHeat®, B5 Biodiesel blends	Included in D396	**YES**	
B6 to B20 Biodiesel blends	D7467		NO
>B20 Biodiesel blends	(D396 + more than 20% D6751)		NO
B100 Biodiesel	D6751		NO
Vegetable oils, used oils	–		NO
Blends of vegetable oils & used oils with heating oil	–		NO
Jet A	D1655	**OK**	
Jet A-1	D1655	**OK**	
JP-5 (Military jet fuel)	MIL-DTL-5624, F44	**OK**	
JP-8 (Military jet fuel)	MIL-DTL-83133, F34	**OK**	
Heating Oil – No. 4, 5 or 6	D396 Gr. 4, 5, 6		NO
Jet B	D6615		NO
JP-4 (Military jet fuel)	MIL-DTL-5624, F40		NO
Gasoline, Avgas (any type)	Many		NO

Please note the following:

1. Fuels marked YES are fully listed with UL for use with Beckett burners
2. Fuels marked OK are not fully listed with UL. However, they have been used successfully, and in some cases may be used to address certain fuel or combustion issues. Their normal use will not void Beckett's warranty on the burner and components.
3. Fuels marked NO should not be used in Beckett burners. These fuels are specifically forbidden because of potential performance and/or safety problems.

Fuel standards

Know your fuel!

We recommend that you:

- Insist on certification for your fuel – certificates for your base fuel, and where appropriate, any biodiesel blend stock and finished blend, and the standards they meet.
- Use clean and stable fuels. It is recommended that you add an additive (FuelArmor™ or similar additive) to help maintain cleanliness and stability throughout the fuel system.
- Make sure your customers' tanks are clean and sound (see 'Tank' comments below).
- Use dual filtration – a coarser (typically, 30-100 micron) filter near the tank and a finer (10 micron) downstream, preferably at the burner.

For BioHeat™ Blends

The biggest cause of problems is off-spec blend stocks. B5 fuels must be made from the following materials:

- 5% biodiesel (B100) meeting the requirements of ASTM D6751. (D6751 is the standard specification for Biodiesel Blend Stock for BioHeat® blends.)
  The finished fuel meets the requirements of ASTM D396. (D396 is the standard specification for Fuel Oils.)
- Use suppliers that are BQ-9000 certified where possible. (BQ-9000 is a Quality Assurance system for certifying, distributing, blending, and maintaining the quality of biodiesel / BioHeat® products.)
- Beckett also recommends the following safeguards when using BioHeat® blends (although they are helpful with straight petroleum fuels too):
  Additives:
  Stability leads the list of things to watch for. During storage and handling, fuels may react with their surroundings and with materials in their environment to form undesirable by-products that can interfere with proper operation. Properly made B100 blend stocks are required to meet oxidation stability requirements to help minimize this effect. Good additive systems for petroleum fuels incorporating stabilizers, dispersants, and metal deactivators (FuelArmor™ or similar additive) will help to protect the fuel and fuel storage system. Additives can be especially helpful during the transition period from all-petroleum fuel to BioHeat® blends.
  Filtration:
  Filter plugging has been reported during the transition from all-petroleum fuel to BioHeat® blends, although it does not always occur. Watch for filter plugging (especially on older, untreated systems) and change filters as required during the early stages of the conversion.
  Tanks:
  Older tanks, that have not been serviced in many years, may be more susceptible to problems unless known clean fuels, or fuels that are regularly and consistently treated have been used. Inspect for tank bottom solids (sludge) and water, or if unsure, treat with a good additive before and/or as a part of the conversion.
  Yellow metals:
  Copper and its alloys (brasses, bronzes) are known to cause (catalyze) reactions with organic materials, including petroleum fuels. Biodiesels increase this reaction. The yellow metals have been used in heating systems for decades, and have a good track record. They do not enter into a reaction with the fuel and, therefore, are not consumed (unlike metal exposed to a strong acid) but this catalytic activity can cause the formation of precursors to sludge. Contact with copper should be minimized where possible, particularly when evidence of instability is found. If this is necessary, there are a number of actions that can be taken:

  - To minimize the problem, two-pipe systems should be converted to single-pipe. Where air in the oil is a problem, install a deaeration system (a Tigerloop™ or similar device).
  - Heat related after-drip can heat the fuel at the nozzle, making the problem worse. Add a valve or integrated pump /valve (a CleanCut® or similar pump) to give a clean cut-off. In persistent circumstances, add a post-time control (a GeniSys® 7505P or similar control) to help cool the nozzle during the off-cycle.

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Beckett
PARTS & ACCESSORIES

GeniSys® 120V

Model 7575

Advanced Burner Control

Description / Applications

The Beckett GeniSys® Advanced Burner Control is a 120 Vac primary safety control for residential and light commercial oil burners used in boiler, furnace, and water heater applications having firing rates less than 20 GPH. The GeniSys is used with a suitable cad cell flame sensor to control the oil burner motor, igniter, and optional solenoid valve. It has 24 Vac thermostat terminals compatible with both mechanical and many power stealing thermostats. It can also provide interrupted or intermittent duty ignition.

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Features

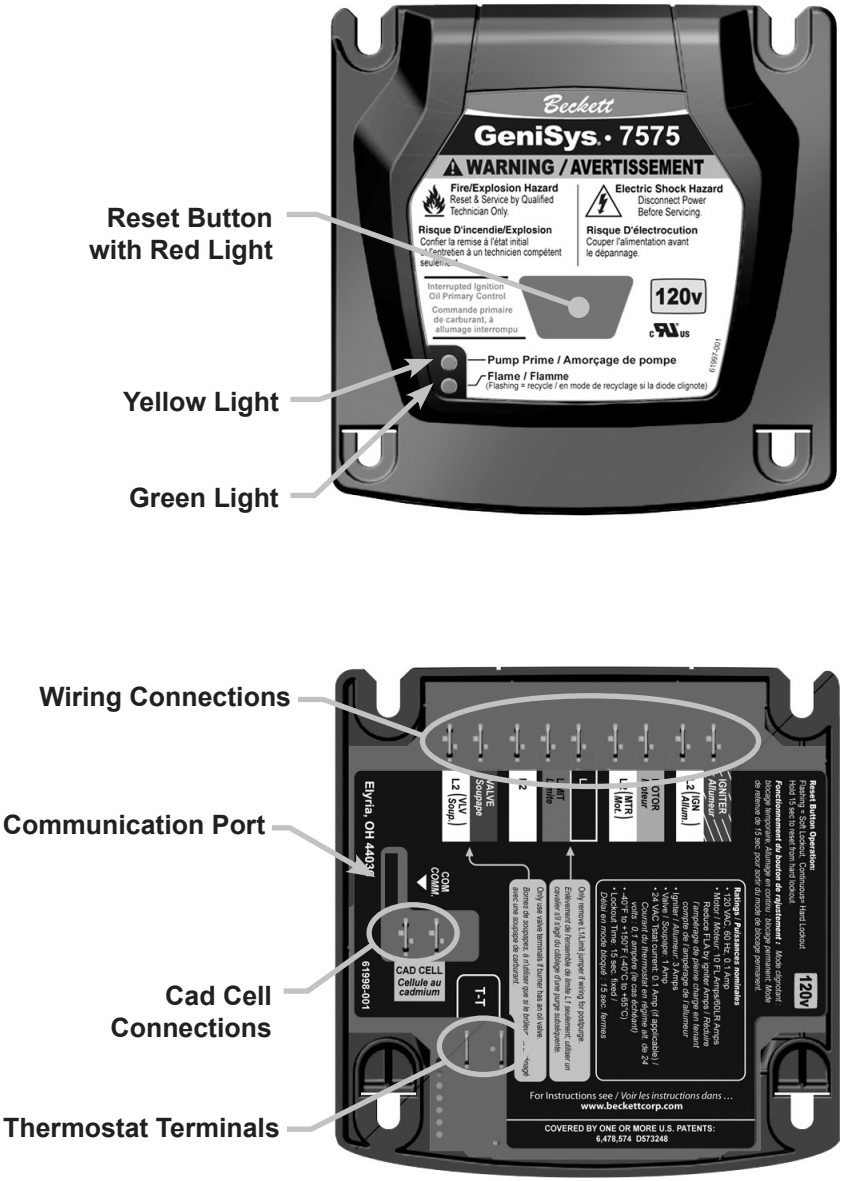
- Potted to protect components
- Water Resistant
- Thermostat / Operating and Limit Control Compatible
- Welded Relay Protection
- Limited Recycle
- Limited Reset
- 3 Status Lights
- Valve-On Delay / Motor-Off Delay (Field programmable with Beckett Contractor Tool)
- 15 Second Lockout Time
- Interrupted or Intermittent Duty Ignition
- Technician Pump Priming Mode
- Disable Function
- Communication Port

Table 1 - Models and Cross Reference Guide

Beckett GeniSys Control Part No.	Lockout Time	Valve-on delay time*	Motor-off delay time*
7575A0000	15 sec	-	-
7575P1515	15 sec	15 sec	15 sec
7575P054M	15 sec	5 sec	4 min

***** Valve-on delay and motor-off delay timings on all models are programmable with Beckett Contractor Tool. Other factory set timings are available. Contact Beckett for alternate timings.

Figure 1 – Getting to know the control



⚠ CAUTION **Do Not Use This Control in an Application that is Not Within the Ratings Listed in This Section. Improper Control Operation May Result.**

Electrical Ratings

Inputs:

- Voltage: 120 Vac nominal (102 to 132 Vac)
- Current: 100 mA nominal (150 mA max at 132 Vac)
- Frequency: 60 Hz

Outputs:

- Motor: 120 Vac, 10 full load amps (FLA), 60 locked rotor amps (LRA)
  **Note: Reduce motor FLA rating by igniter current*
- Igniter: 120 Vac, 3 A @ 0.7 PF min
- Solenoid Valve: 120 Vac, 1 A @ 0.7 PF min
- Thermostat Anticipator Current: 0.1 A
- Thermostat Voltage: 24 Vac

Environmental Ratings:

- Storage and Operating Ambient Temperature: -40°F to +150°F (-40°C to +65°C)
- Moisture: 5 to 95% RH, condensing.

Approvals

- Underwriters Laboratory Recognition per UL372 and UL1998, and CSA C22.2 No. 199

c UL® us

⚠ CAUTION **Do Not Use This Control Above 19.9 GPH**

Most codes and standards require additional safeguards and features for oil burner inputs above 19.9 gph. Consult the appliance manufacturer's instructions for control selection.

Installation/Operation/ Maintenance

⚠ WARNING **Professional Service Required**

Incorrect installation or misuse of this control could result in severe personal injury, death, or substantial property damage from heavy smoke, explosion or fire.

Please read and understand the manual supplied with this control. This control must be installed, adjusted and put into operation only by a qualified individual or service agency that is:

- Licensed or certified to install and provide technical service to oil heating systems.
- Experienced with all applicable codes, standards and ordinances.
- Responsible for the correct installation and commission of this equipment.
- Skilled in the adjustment of oil burners using combustion test instruments.

The installation must strictly comply with all applicable codes, authorities having jurisdiction and the latest revision of the National Fire Protection Association Standard for the Installation of Oil-Burning Equipment, NFPA 31 (or CSA-B139 and CSA-B140 in Canada).

Regulation by these authorities take precedence over the general instructions provided in this installation manual.

⚠ WARNING **Fire or Explosion Hazard**

Can cause severe injury, death, or property damage.

- Avoid prolonged exposure to water
- Never install the control where water will regularly flood or drip on the control.
- If the control is ever placed under water, replace it.

⚠ WARNING **Electrical Shock Hazard**

Electrical shock can cause severe personal injury or death.

- Disconnect ALL electrical power to the appliance/burner circuit before installing or servicing this control.
- Provide ground wiring to the appliance, burner and metal control mounting box.
- Perform all wiring in compliance with the National Electrical Code ANSI/NFPA 70 (Canada CSA C22.1).

⚠ WARNING **Explosion, Fire, Scald, and Burn Hazard**

All heating appliances must have HIGH LIMIT protection to interrupt electrical power and shutdown the burner if operating or safety controls fail and cause a runaway condition.

- Follow the appliance manufacturer's wiring diagrams and note all required safety controls.
- Typical safety controls include high temperature or pressure limits, low water cutoffs, pressure relief valves and blocked flue sensing switches.
- Verify all limit and safety controls are installed and functioning correctly, as specified by the manufacturer, applicable safety standards, codes and all authorities having jurisdiction.
- Ensure that the appliance is free of oil and oil vapor before starting or resetting the burner.

⚠ CAUTION **Incorrect Wiring Will Result in Improper Control Operation**

- GeniSys wiring label colors may not match the wire colors of the burner or other manufacturers' controls.
- The GeniSys Control should be wired according to the appliance manufacturer's instructions.

Mounting:

- Mount the control on a 4" x 4" junction box on the burner, or inside the appliance cabinet. In replacement applications, mount the new control in the same location as the old control. In some replacement applications, it may be necessary to rotate the control on the 4" x 4" box for best fit.
- Mounting orientation: any orientation is acceptable.

Wiring:

- Make sure all appliance wiring complies with all local codes and ordinances.
- Make connections to the control's terminals as shown in ***Figures 2 & 3***. Refer to the label on the underside of the control for wiring details.

Typical Wiring:

Figure 2 – 7575A

► Interrupted ignition, no valve-on or motor-off delay

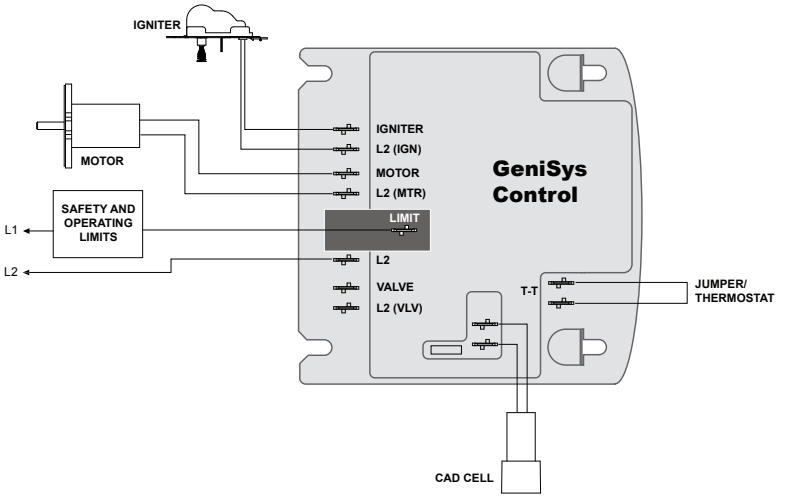
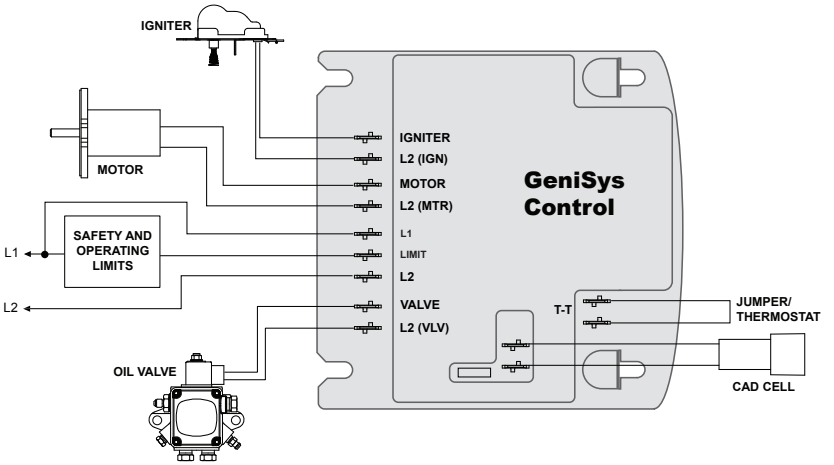


Figure 3 – 7575P

► Interrupted ignition, valve-on and motor-off delays



NOTES:

1.) Motor-off delay on a 7575P will be disabled if the safety and operating limits, as shown in this figure, interrupt power to the control terminal L1. Connect thermostat leads to the T-T terminals on the control or jumper the T-T terminals on the control as directed by the appliance wiring diagram.

2.) If the thermostat short cycles or operates improperly, it may require an isolation relay for proper operation.

Startup / Checkout

WARNING **Fire Hazard**

Reset and Service by Qualified Technician only.

If the burner or control fails any of the following tests, recheck control wiring. If the burner or control still fails any tests, replace the control.

Starting the System

1. Open the shut-off valves in the supply line from the oil tank.
2. Close the disconnect switch to supply power to the burner.
3. Adjust the thermostat to call for heat. *- If the pump has not been primed, refer to "Priming the Pump" in the "Operation" section of this manual.*
4. Monitor burner operation to ensure that the burner ignites.
5. End the call for heat. Verify that the burner turns off before leaving the installation site.

Check Safety Features

◦ Safe Start Check

1. Place a jumper across the cad cell terminals.
2. Refer to the steps for "Starting the System" and have the system call for heat.
3. Burner must not start. Verify that the green light is on continuously and that the control remains in Standby mode.
4. End the call for heat and remove the cad cell jumper.

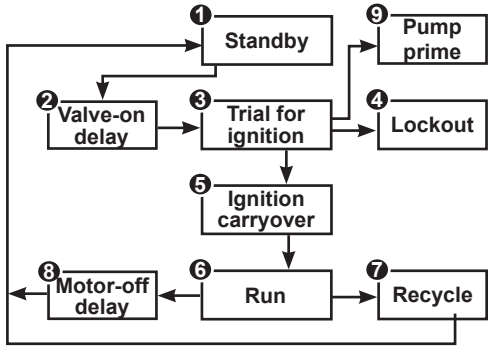
◦ Simulate Flame Failure and Ignition Failure

1. Refer to the steps for "Starting the System" and have the system call for heat.
2. After flame is established and the burner igniter turns off, close the hand valve in the oil supply line.
3. At flame loss, the control will enter Recycle mode. Verify that the green light is flashing. The control will remain in Recycle for 60 seconds.
4. After the 60 second recycle period, the control will try to restart the system.
5. After the 15 second lockout time, the control will lock out the burner and the reset button will flash. Verify that the burner motor and igniter are off and that the burner oil solenoid valve (if used) is not energized.
6. Open the hand valve in the oil line.
7. Click the reset button and verify that the red light in the reset button shuts off and that the burner lights.
8. End the call for heat.

◦ Before leaving the installation, verify that all control wiring is correct. Consult appliance manual for directions.

Sequence of Operation

Burner States



1. **Standby**: The burner is idle, waiting for a call for heat.
2. **Valve-On Delay**: The igniter and motor are on while the control delays turning on the oil solenoid valve for the programmed time.
3. **Trial For Ignition**: The oil solenoid valve is energized. A flame should be established within the factory set trial for ignition time ("lockout time").
4. **Lockout:** The control has shut down for one of the following safety reasons:

   a. The trial for ignition (lockout) time expired without flame being established.

   b. The cad cell detected flame at the end of the Valve On Delay state.

   c. Flame is lost while the burner is firing and the pre-set time allotment is expired. See "Recycle" (***Item 7***).

   To reset the control from lockout click the button 1-second.

   NOTE: A recurrence of the above failure modes or a failed welded relay check could cause the control to enter a **Hard Lockout** state that must be reset only by a qualified service technician.

   To reset from Hard Lockout, hold the reset button for 15 seconds until the yellow light turns on.

5. **Ignition Carryover:** Once flame is established, the igniter remains on for 10 additional seconds to ensure flame stability.
6. **Run:** The flame is sustained until the call for heat is satisfied. The burner is then sent to Motor-Off Delay, if applicable, or it is shut down and sent to Standby.
7. **Recycle:** If the flame is lost while the burner is firing, the control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. The control will continue to Recycle each time the flame is lost, until it reaches a pre-set time allotment. The control will then go into Lockout instead of recycle. This feature prevents excessive accumulation of oil in the appliance firing chamber.
8. **Motor-Off Delay:** If applicable, the oil solenoid valve is turned off and the control delays turning the motor off for the set motor-off delay time before the control returns to standby.
9. **Pump Prime:** The igniter and motor are on with the oil solenoid valve energized for 4 minutes. During Pump Prime mode, the cad cell is disregarded, allowing the technician to prime the pump without having to jumper the cad cell.

Reset Button Operation

Table 2 explains what action the control will take when the reset button is pressed for different lengths of time during the various burner operating states.

Priming the Pump

1. Prepare the burner for priming by attaching a clear plastic hose over the bleed port fitting and fully opening the pump bleed port. Use a suitable container to collect purged oil.

⚠ WARNING **Hot Gas Puff-Back and Heavy Smoke Hazard**

Failure to bleed the pump properly could result in unstable combustion, hot gas puff-back and heavy smoke.

- Do not allow oil to spray into a hot combustion chamber while bleeding air from the pump.
- Install a gauge in the nozzle discharge port tubing or fully open the pump bleed valve to prevent oil spray from accumulating in the combustion chamber during the air bleed procedure.
- Ensure that all bubbles and froth are purged from the oil supply system before tightening the pump bleed valve.
- Ensure that the appliance is free of oil and oil vapor before starting or resetting the burner.

2. Initiate a call for heat.
3. After the burner starts, press and hold the reset button for 15 seconds until the yellow light turns on. This indicates that the button has been held long enough.
4. Release the reset button. The yellow light will turn off and the burner will start up again.
5. At burner start up, click the reset button while the igniter is still on. This will transition the control to a dedicated Pump Prime mode, during which the motor, igniter, and valve are powered for four minutes. The yellow light will be on.
6. Bleed the pump until all froth and bubbles are purged. If desired, terminate the call for heat or hold the reset button for at least one second to exit Pump Prime mode and return to Standby.
7. At the end of 4 minutes, the yellow light will turn off and the control will

Table 2 - Reset Button Operation

If the burner is in the below state:	Pushing the reset button will:		
	Button Click (press < 1 second)	**Button Hold (press > 1 second)**	**Button Hold (press 15+ seconds)**
Lockout	Reset from Soft Lockout		Reset from Restricted (Hard) Lockout
Valve-on Delay, Trial for Ignition, Ignition Carryover	Go to Pump Prime (see "Priming the Pump" above)	Disable the Burner: Any time the burner is running, press and hold the reset button to disable the burner. The burner will remain off as long as the button is held.	Enables Pump Priming: After the reset button has been held for 15 seconds, the button can then be clicked during the next ignition sequence to enter Pump Prime mode.
Run (igniter is shut off)	No action		
Motor-Off Delay, Standby	No action		
Pump Prime	No action	Exit Pump Prime mode and return to Standby	

Table 3 - Status Lights

Light Color	On Continuously	Flashing
Red	Restricted (Hard) Lockout	Soft Lockout
Green	Flame Sensed during normal operation (Could be stray light during standby)	Recycle
Yellow	Control is in Pump Prime mode or Reset button currently held for 15+ seconds.	N/A

automatically return to standby mode.

8. If prime is not established during the four minute pump prime mode, return to step 5 to re-enter Pump Prime mode. Repeat steps 5 through 7 until the pump is fully primed and the oil is free of bubbles.
9. Terminate the call for heat, and the control will resume normal operation.

Cad Cell Resistance Measurement

The Beckett 7575 control cad cell resistance can be selected and read on the GeniSys Contractor Tool, part 52082U.

If the contractor tool is not available, the cad cell leads can be unplugged from the control and the resistance measured with a meter in the conventional way. Conduct these tests with flame present.

Flame Detection Range
Normal (0 - 1600 ohms)
Limited (1600 ohms to lockout)

Resetting From Restricted or Hard Lockout

⚠ WARNING **Fire & Smoke Hazard**

Before starting or resetting the control from restricted lockout state, troubleshoot the heating system for the root cause(s) of the lockout.

- Make necessary repairs or adjustment to ensure a safe start condition.
- Ensure that the appliance is free of oil and oil vapors before starting or resetting the burner.

◦ If the control continues to lock out without a satisfied call for heat, or fails the motor relay check, the control enters Hard (restricted) Lockout in order to limit accumulation of unburned oil in the combustion chamber.

◦ To reset, hold the button down for 15 seconds until the red light turns off and the yellow light turns on.

◦ Always verify the control functions according to all specifications before leaving the installation site.

◦ Replace the control if it does not operate as specified.

Disable Function

◦ Any time the burner is running, press and hold the reset button to disable the burner. The burner will remain off as long as the button is held.

Maintenance

Oil heating systems require annual service performed by a qualified, professional service agency. The 7575 primary control should be inspected during this service routine according to the following checklist:

- □ NOTE: The 7575 control has no serviceable internal parts.
- □ Inspect the exterior of the control. Replace the control if there is any sign of impact damage, prolonged exposure to water, or corrosion.
- □ Use a multimeter to test the line voltage at control L1 and L2. It should be 102 - 132 Vac.
- □ Inspect all external wiring for secure connections and verify insulation integrity.
- □ Verify the control lockout and operation sequence, (Reference Startup/Checkout section).
- □ Observe a full operating cycle to prove the sequence and timings are correct.
- □ Replace any control that does not meet listed specifications with an equivalent replacement unit.

Limited Warranty Information

The R. W. BECKETT CORPORATION ("Beckett") warrants to persons who purchase its "Products" from Beckett for resale, or for incorporation into a product for resale ("Customers"), that its equipment is free from defects in material and workmanship. To qualify for warranty benefits, products must be installed by a qualified service agency in full compliance with all codes and authorities having jurisdiction, and used within the tolerances of Beckett's defined product specifications.

To review the complete warranty policy and duration of coverage for a specific product, or obtain a written copy of warranty form 61545, please choose one of the following options:

1. Visit our website at: www.beckettcorp.com/warranty
2. Email your request to: rwb-customer-service@beckettcorp.com
3. Write to: R. W. Beckett Corporation, P. O. Box 1289, Elyria, OH 44036

NOTE: Beckett is not responsible for any labor cost for removal and replacement of equipment.

THIS WARRANTY IS LIMITED TO THE PRECISE TERMS SET FORTH ABOVE, AND PROVIDES EXCLUSIVE REMEDIES EXPRESSLY IN LIEU OF ALL OTHER REMEDIES, AND IN PARTICULAR THERE SHALL BE EXCLUDED THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT WILL BECKETT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE OF ANY NATURE. Beckett neither assumes, nor authorizes any person to assume for Beckett, any other liability or obligation in connection with the sale of this equipment. Beckett's liability and Customer's exclusive remedy is limited to the cost of the product.

Beckett CORPORATION

USA: P.O. Box 1289 • Elyria, OH 44036
Canada: R.W. Beckett Canada, Ltd. • Unit #3, 430 Laird Road • Guelph, Ontario N1G 3X7
www.beckettcorp.com

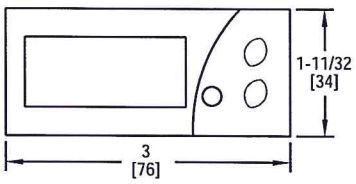
Form No. 61910 R2, Printed in USA 09/15

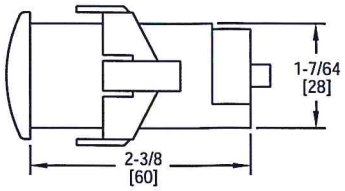
SIOUX PART NUMBER EC01302

Bulletin E-90-TCS

Series TCS Thermocouple Switch

Specifications - Installation and Operating Instructions





Monitor and control temperature in heating and cooling applications with the Series TCS Thermocouple Switch. The Series TCS offers a wide temperature range, two selectable alarm sets, and an internal buzzer indicating alarm condition or error. The user can define set point, heating/cooling regulation, cycle time, alarm configuration, load status, and ambient probe adjustment. The thermocouple switch features password protection and error/alarm messaging. Temperature and output status is indicated on the bright red LED display. Use the configuration key (sold separately) to quickly program multiple units. The Series TCS includes a fitting clip for panel mounting, gasket, rear terminal cover and instruction manual.

INSTALLATION

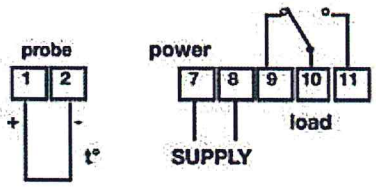
NOTE: Unit must be mounted away from vibration, impacts, water and corrosive gases.

- Cut hole in panel 2.80 x 1.14 inches (71 x 29 mm).
- Apply silicone (or rubber gasket) around the perimeter of the hole to prevent leakage.
- Insert unit into hole of panel.
- Slide removable fitting clips onto unit from the back until secure to panel.
- Remove back cover to wire unit.
- Wiring diagram is displayed on the top of the unit.
- (Note: PROBE CABLE LENGTH MUST NOT EXCEED 238 ft (100 m). DO NOT INSTALL PROBE CABLE NEAR POWER CABLES).
- Replace cover once wiring is complete.

SPECIFICATIONS

Probe Range: 0 to 700°C (32 to 999°F) for thermocouple J. 0 to 999°C (32 to 999°F) for thermocouples K, S.
Input: Type J, K or S thermocouple.
Output: 16A SPDT relay @ 250 VAC resistive.
Horsepower Rating (HP): 1 HP.
Control Type: ON/OFF.
Power Requirements: 110 VAC, 230 VAC, 12 VAC/VDC or 24 VAC/VDC (depending on model).
Accuracy: ±1% FS.
Display: 3-digit, red, 1/2˝ (12.7 mm) digits, plus sign.
Resolution: 1°.
Memory Backup: Nonvolatile memory.
Temperature Limits: Ambient: 32 to 158°F (0 to 70°C).
Storage Temperature: -4 to 176°F (-20 to 80°C).
Weight: 2.3 oz (65 g).
Front Panel Rating: IP64.
Agency Approvals: CE, UL, ULc.

WIRING DIAGRAM



LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46361, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

PARAMETERS

	Description	Units	Range
SP	Set Point	Degrees	r1 to r2
r0	Differential or Hysteresis	Degrees	1 to 99°
r1	Lower Value Set Point	Degrees	0 to 999°
r2	Higher Value Set Point	Degrees	0 to 999°
d0	Heating or Cooling Control	Option	Ht/Co
c0	Min. Stop Time for Load	Minutes	0 to 59
c2	Load Status During Probe Error	0/1	Off/On
P1	Ambient Probe Adjustment	Degrees	-10 to 10°
P5	Ambient Probe Type	Option	J, K, S
H5	Parameter Access code	Numeric	0 to 255 (SET AT 0 FROM FACTORY)
A0	Alarm 1 Hysteresis	Degrees	1 to 999°
A1	Alarm 1 Threshold	Degrees	0 to 999°
A2	Alarm 1 Exclusion Time	Seconds	0 to 999
A3	Alarm 1 Configuration	Option	0, 1, or 2
A4	Alarm 2 Hysteresis	Degrees	1 to 999°
A5	Alarm 2 Threshold	Degrees	0 to 999°
A6	Alarm 2 Exclusion Time	Seconds	0 to 999
A7	Alarm 2 Configuration	Option	0, 1, or 2

PARAMETER DESCRIPTIONS

SP= Set Point- Desired Regulation Temperature

r0= Differential or Hysteresis

r1= Lower Set Point Limit

r2= Higher Set Point Limit

d0= Heating or Cooling Control-Regulation cycles only performed, neither defrosting nor continuous cycles exist. ***Heating:*** *To choose Heating Control: Set d0=Ht (The output is active when TS1 (temperature of ambient probe) is less than or equal to Set Point.) TS1<=SP. It then disconnects when TS1>=SP-r0.* ***Cooling:*** *To choose Cooling Control: Set d0=Co (The output is activated when TS1>=SP+r0.) The display will switch off when TS1<=SP.*

c0= Minimum Time Between Start to Stop.

c2= Load Status During Probe Error. In the event of an open or short circuited probe, the unit will connect or disconnect the load as defined by this parameter.

P1= Ambient Probe Calibration. Offset degrees to adjust ambient probe. If the probe is not placed in the exact point that is to be measured, use a standard thermometer and adjust the difference with parameter.

P5= Ambient Probe Type. Select between J, K, or S Type Thermocouple.

H5= Access to Probe Parameters. (The code is set to 0 from the factory.)

A0= Alarm 1 Hysteresis. The differential associated with A1 parameter.

A1= Alarm 1 Threshold. Number of degrees to the working set point that initiates an alarm condition.

A2= Alarm 1 Exclusion Time. The amount of time the alarm is disabled from instrument activation.

A3= Alarm 1 Configuration. Determines the alarm type: A3=0 alarm is disabled; A3=1 alarm is activated if the ambient temperature >=SP+A1 and deactivated if <+SP+A1-A0; A3=2 alarm is activated if the ambient temperature <=SP+A1 and deactivated if >+SP+A1-A0.

A4= Alarm 2 Hysteresis. The differential associated with A5 parameter.

A5= Alarm 2 Threshold. Number of degrees to the working set point that initiates an alarm condition.

A6= Alarm 2 Exclusion Time. The amount of time the alarm is disabled from instrument activation.

A7= Alarm 2 Configuration. Determines the alarm type: A7=0 alarm is disabled; A7=1 alarm is activated if the ambient temperature >=SP+A5 and deactivated if <+SP+A5-A4; A7=2 alarm is activated if the ambient temperature <=SP+A5 and deactivated if >+SP+A5-A4.

PARAMETER PROGRAMMING

Set Point (SP) is the only parameter the user can access without code protection.

- Press SET. SP text will appear on the display.
- Press SET again. The real value is shown on the display.
- The value can be modified with the UP and DOWN arrows.
- Press SET to enter any new values.
- Press SET and DOWN at the same time to quit programming or wait one minute and the display will automatically exit programming mode.

**The keyboard code can be reset to ZERO by turning off the controller and turning it on again while keeping the SET key depressed.*

Access to all code protected parameters.

- Press SET for 8 seconds. The access code value 00 is shown on the display. (Unit comes with code set at 00 from factory).
- With the UP and DOWN arrows, code can be set to user needs.
- Press SET to enter the code. If code is correct, the first parameter label is shown on the display (SP).
- Move to the desired parameter with the UP and DOWN keys.
- Press SET to view the value on the display.
- The value can be modified with the UP and DOWN arrows.
- Press SET to enter the value and exit to text parameter.
- Repeat until all necessary parameters are modified.
- Press SET and DOWN at the same time to quit programming or wait one minute and the display will automatically exit programming mode.

BUZZER

In the event of alarm or error condition, the internal buzzer is activated. To silence the buzzer, press and hold the SET and Down keys.

LED INDICATIONS

OUT This indicates the load is connected. The system waits for the programmed minimum stop time of the load.

DISPLAY MESSAGES

In normal operation, the probe temperature will be shown on the display. In case of alarm or error, the following messages will be shown:

- **Er** = Memory Error
- **--** = Short-Circuit Probe Error (output determined by c2).
- **oo** = Open Probe Error (output determined by c2).

MAINTENANCE/REPAIR

After final installation of the TCS Series Digital Thermocouple Switch, no routine maintenance is required. A periodic check of system calibration is recommended. The devices are not field repairable and should be returned to the factory if recalibration or other service is required. After first obtaining a Returned Goods Authorization (RGA) number, send the material, freight prepaid, to the following address. Please include a clear description of the problem plus any application information available.

Dwyer Instruments
Attn: Repair Department
102 Highway 212
Michigan City, IN 46360 U.S.A

Printed in U.S.A. 10/09

FR# R7-443801-00

LOVE CONTROLS DIVISION
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Phone: 219/879-8000 www.love-controls.com
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Series V6 FLOTECT® Flow Switch

Specifications - Installation and Operating Instructions

The Series V6 FLOTECT® Flow Switch is an inexpensive, explosion-proof flow switch for use on air, water or other compatible gases and liquids. Three configurations are available - 1. Factory installed in a tee. 2. With a trimmable vane for field adjustment and installation in a suitable tee. 3. Low flow models with an integral tee and adjustable valve. All are available with an optional enclosure which is UL and CSA listed, or Directive 2014/34/EU (ATEX) compliant for
CE Ex II 2 G Ex d IIC T6 Gb
Process Temp≤75°C or IECEx compliant for Ex d IIC T6 Gb Process Temp ≤ 75°C.

INSTALLATION

Unpack and remove any packing material found inside lower housing or tee.

Switch can be installed in any position but the actuation/deactuation flow rates in the charts are based on horizontal pipe runs and are nominal values. For more precise settings, units can be factory calibrated to specific flow rates.

V6 Models with Tee are supplied in 1/2˝ - 2˝ NPT sizes. Install in piping with arrow pointing in direction of flow.

V6 Low Flow Models have 1/2˝ NPT connections and are field adjustable. Install in piping with arrow pointing in direction of flow. To adjust, loosen the four socket head cap screws on bottom. The adjustment valve rotates 90° between “O” (open) and “C” (closed). See flow charts for approximate ranges. Tighten screws once the required flow rate has been set.

V6 with Field Trimmable Vane. These models enable the installer to choose approximate actuation/deactuation points by trimming the full size vane at appropriate letter-designated marks on a removable template. Flows are defined in the following charts. Note that the charts are based on either brass or cast iron reducing tees or stainless or forged steel straight tees with bushings where necessary. Install in piping with arrow pointing in direction of flow.

When bushings are used, they must be back drilled to allow proper clearance for unrestricted vane travel. Bore the I.D. to 13/16˝ (20 mm) on 1/2˝ x 3/4˝ bushings or 1˝ (25 mm) on larger bushings. The depth of the bore must leave internal threads 9/16˝ (14 mm) high for proper engagement between the lower housing of the switch and the bushing. Check for proper vane travel and switch operation after installation.

SPECIFICATIONS

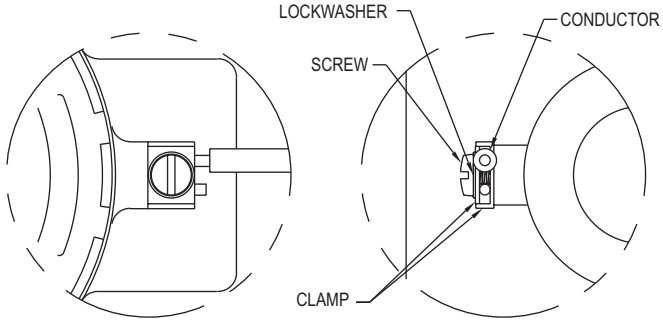
Service: Gases or liquids compatible with wetted materials.
Wetted Materials: Standard V6 Models: Vane: 301 SS; Lower Body: brass or 303 SS; Magnet: ceramic; Other: 301, 302 SS; Tee: brass, iron, forged steel, or 304 SS. V6 Low Flow Models: Lower Body: brass or 303 SS; Tee: brass or 304 SS; Magnet: ceramic; O-ring: Buna-N standard, Fluoroelastomer optional; Other: 301, 302 SS.
Temperature Limits: -4 to 220°F (-20 to 105°C) Standard, MT high temperature option 400°F (205°C) (MT not UL, CSA, ATEX, IECEx or KC) ATEX Compliant AT, IECEx IEC Option and KC (KC Option), Ambient Temperature -4 to 167°F (-20 to 75°C) Process Temperature: -4 to 220°F (-20 to 105°C).
Pressure Limit: Brass lower body with no tee models 1000 psig (69 bar), 303 SS lower body with no tee models 2000 psig (138 bar). Brass tee models 250 psi (17.2 bar), iron tee models 1000 psi (69 bar), forged and stainless steel tee models 2000 psi (138 bar), low flow models 1450 psi (100 bar).
Enclosure Rating: Weatherproof and Explosion-proof. Listed with UL and CSA for Class I, Groups A, B, C and D; Class II, Groups E, F, and G. (Group A on stainless steel body models only).
CE 0518 Ex II 2 G Ex d IIC T6 Gb Process Temp≤75°C Alternate Temperature Class T5 Process Temp≤90°C, 115°C (T4) Process Temp ≤105°C consult factory. EC-type Certificate No.: KEMA 04ATEX2128.
ATEX Standards: EN 60079-0: 2009; EN 60079-1: 2007.
IECEx Certified: For Ex d IIC T6 Gb Process Temp≤75°C Alternate Temperature Class T5 Process Temp≤90°C, 115°C (T4) Process Temp≤105°C consult factory.
IECEx Certificate of Conformity: IECEx DEK 11.0039; IECEx Standards: IEC 60079-0: 2007; IEC 60079-1: 2007; Korean Certified (KC) for: Ex d IIC T6 Gb Process Temp≤75°C; KTL Certificate Number: 2012-2454-75.
Switch Type: SPDT snap switch standard, DPDT snap switch optional.
Electrical Rating: UL models: 5 A @125/250 VAC. CSA, ATEX and IECEx models: 5 A @ 125/250 VAC (V~); 5 A res., 3 A ind. @ 30 VDC (V⎓). MV option: 0.1 A @ 125 VAC (V~). MT option: 5 A @125/250 VAC (V~). [MT option not UL, CSA, ATEX or IECEx].
Electrical Connections: UL models: 18 AWG, 18˝ (460 mm) long. ATEX/CSA /IECEx models: terminal block.
Upper Body: Brass or 303 stainless steel.
Conduit Connections: 3/4˝ male NPT standard, 3/4˝ female NPT on junction box models.
Process Connection: 1/2˝ male NPT on models without a tee.
Mounting Orientation: Switch can be installed in any position but the actuation/deactuation flow rates in the charts are based on horizontal pipe runs and are nominal values.
Set Point Adjustment: Standard V6 models none. Without tee models vane is trimmable. Low flow models are field adjustable in the range shown. See set point charts on opposite page.
Weight: 2 to 6 lb (.9 to 2.7 kg) depending on construction.
Options not Shown: Custom calibration, bushings, PVC tee, reinforced vane, DPDT relays.

ELECTRICAL CONNECTIONS

Connect wire leads in accordance with local electrical codes and switch action required. N.O. contacts will close and N.C. contacts will open when flow increases to the actuation point. They will return to “normal” condition when flow decreases to the deactuation point. Black = Common, Blue = Normally Open and Red = Normally Closed.

For units supplied with both internal ground and external bonding terminals, the ground screw inside the housing must be used to ground the control. The external bonding screw is for supplementary bonding when allowed or required by local code. When external bonding conductor is required, conductor must be wrapped a minimum of 180° about the external bonding screw. See below. Some CSA listed models are furnished with a separate green ground wire. Such units must be equipped with a junction box, not supplied but available on special order.

EC-Type Certificate, IECEx and KC Installation Instructions:



FRONT VIEW DETAIL SIDE VIEW DETAIL

W.E. ANDERSON DIV., DWYER INSTRUMENTS, INC.
P.O. BOX 358 • MICHIGAN CITY, INDIANA 46360 U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
e-mail: info@dwyermail.com

Cable Connection
The cable entry device shall be certified in type of explosion protection flameproof enclosure “d”, suitable for conditions of use and correctly installed. For Ta ≥ 65°C cable and cable gland rated ≥ 90°C shall be used.

Conduit Connection
An Ex d certified sealing device such as a conduit seal with setting compound shall be provided immediately to the entrance of the valve housing. For Ta ≥ 65°C wiring and setting compound, in the conduit seal, rated ≥ 90°C shall be used.

Note: ATEX, IECEx and KC units only: The temperature class is determined by the maximum ambient and or process temperature. Units are intended to be used in ambient of -20°C≤ Tamb ≤75°C. Units may be used in process temperatures up to 105°C providing the enclosure and switch body temperature do not exceed 75°C. The standard Temperature Class is T6 Process Temp ≤75°C. Alternate Temperature Class of T5 Process Temp ≤90°C and 115°C (T4) Process Temp ≤105°C are available consult factory.

Refer to Certificate No: IECEx DEK 11.0039 for conditions of safe use for IECEx compliant units.

All wiring, conduit and enclosures must meet applicable codes for hazardous areas. Conduits and enclosures must be properly sealed. For outdoor or other locations where temperatures vary widely, precautions should be taken to prevent condensation inside switch or enclosure. Electrical components must be kept dry at all times.

CAUTION: To prevent ignition of hazardous atmospheres, disconnect the device from the supply circuit before opening. Keep assembly tightly closed when in use.

MAINTENANCE
Inspect and clean wetted parts at regular intervals. The cover should be in place at all times to protect, the internal components from dirt, dust and weather and to maintain hazardous location ratings. Disconnect device from the supply circuit before opening to prevent ignition of hazardous atmosphere. Repairs to be conducted by Dwyer Instruments, Inc. Units in need of repair should be returned to the factory prepaid.

V6 With Tee

Cold Water - Factory Installed Tee
Approximate actuation/deactuation low Rates
GPM upper, **M³/HR** lower

1/2″ NPT		3/4″ NPT		1″ NPT		1-1/4″ NPT		1-1/2″ NPT		2″ NPT	
1.5	1.0	2.0	1.25	3.0	1.75	4.0	3.0	6.0	5.0	10.0	8.5
0.34	0.23	0.45	0.28	0.68	0.40	0.91	0.68	1.36	1.14	2.27	1.93

Air-Factory Installed Tee
Approximate actuation/deactuation flow rates
SCFM upper, **NM³/M** lower

1/2″ NPT		3/4″ NPT		1″ NPT		1-1/4″ NPT		1-1/2″ NPT		2″ NPT	
6.5	5.0	10.0	8.0	14	12	21	18	33	30	43	36
.18	.14	.28	.23	.40	.34	.59	.51	.93	.85	1.19	1.02

V6 Low Flow, Field Adjustable
Cold Water - Low Flow Models
Approximate actuation/deactuation flow rates
GPM upper, **M³/HR** lower

Minimum		Maximum	
.04	.03	.75	0.60
.009	.007	0.17	0.14

Air - Low Flow Models
Approximate actuation/deactuation flow rates
SCFM upper, NM³/M lower

Minimum		Maximum	
.18	.15	2.70	2.0
.005	.004	.08	.06

Example	V6	EP	B	B	S	2	B	MT		V6EPB-B-S-2-B-MT flow switch; brass upper housing, brass lower housing, brass tee with 3/4″ NPT connections, SPDT snap switch, and high temperature option
Series	V6									Series V6 flow switch
Construction		EP								Explosion Proof and Weatherproof
Upper Body Material			B S							Brass 303 Stainless Steel
Lower Body Material				B S						Brass 303 Stainless Steel
Circuit (Switch) Type					S D					SPDT DPDT
Process Connection Size						1 2 3 4 5 6 LF				1/2″ NPT 3/4″ NPT 1″ NPT 1-1/4″ NPT 1-1/2″ NPT 2″ NPT Low Flow Model (1/2″ NPT connections)
Process Connection Type							0 B FS MI PVC PVCSW S S150			No Tee, Male NPT Connection, Field Trimmable Vane Brass Tee Forged Steel Tee Iron Tee PVC Tee with NPT* PVC Tee with sweat joints* 304 Stainless Steel Tee 304 Stainless Steel 150# Tee (For LF Model no tee material chosen, tee material matches lower housing choice)
Switch Options								MV MT		Gold Contacts on snap switch for dry circuits (see specifications for ratings) High Temperature switch rated 400°F (205°C) (see specifications for ratings)*
Options									AT CSA IEC KC CV FTR GL ID JCTLH ORFB ORFS RV TBC VIT 018 020 022 022A 031	ATEX approved construction (weatherproof and explosion-proof junction box) CSA approved construction (weatherproof and explosion-proof junction box)* IECEx approved construction (weatherproof and explosion-proof junction box) Korean certified (KC) approved construction (with junction box standard) Custom Vane Flow Test Report Ground Lead* Customer Information on standard nameplate Weatherproof and explosion-proof junction box, left side Orifice Brass Orifice Stainless Steel Reinforced Vane Terminal Block Connector* Viton® O-rings in place of Buna-N on low flow models .018 Spring .020 Spring .022 Spring .022 Spring with Alnico® magnet .031 Spring

* Options that do not have ATEX, IECEx or KC.
Attention: Units without the “AT” suffix are not Directive 2014/34/EU (ATEX) compliant. These units are not intended for use in potentially hazardous atmospheres in the EU. These units may be CE marked for other Directives of the EU.

V6 With Field Trimmable Vane
Cold Water - Brass or Cast Iron Reducing Tee
Approximate actuation/deactuation flow rates
GPM upper, **M^3/HR** lower

Vane	1/2″ NPT		3/4″ NPT		1″ NPT		1-1/4″ NPT		1-1/2″ NPT		2″ NPT	
Full Size											9.0	8.5
											2.0	1.9
a											9.5	9.0
											2.2	2.0
b											10.0	9.3
											2.3	2.1
c											11.0	10.0
											2.5	2.3
d									6.2	5.5	12.0	10.0
									1.4	1.2	2.7	2.3
e									7.0	6.5	13.0	11.0
									1.6	1.5	3.0	2.5
f							4.3	3.9	7.6	7.1	14.0	12.0
							1.0	0.9	1.7	1.6	3.2	2.7
g							4.9	4.4	8.0	7.3		
							1.1	1.0	1.8	1.7		
h							5.5	5.0	9.0	8.2		
							1.2	1.1	2.0	1.9		
i					3.5	3.1	6.0	5.6	10.0	9.0		
					0.8	0.7	1.4	1.3	2.3	2.0		
j					4.0	3.5	7.0	6.6	13.0	11.0		
					0.9	0.8	1.6	1.5	3.0	2.5		
k					4.6	4.2	8.0	7.6	15.0	13.0		
					1.04	0.95	1.8	1.7	3.4	3.0		
l			2.6	2.3	5.6	5.2	10.0	9.0				
			0.6	0.5	1.3	1.2	2.3	2.0				
m	1.6	1.3	3.5	3.1	6.3	6.1	12.0	10.0				
	0.4	0.3	0.8	0.7	1.43	1.39	2.7	2.3				
n	2.2	1.8	4.3	3.8	8.0	7.5						
	0.5	0.4	1.0	0.9	1.8	1.7						
o	3.0	2.4										
	0.7	0.5										

Air - Brass or Cast Iron Reducing Tee
Approximate actuation/deactuation flow rates
SCFM upper, **NM^3/M** lower

1/2″ NPT		3/4″ NPT		1″ NPT		1-1/4″ NPT		1-1/2″ NPT		2″ NPT	
										39.0	37.0
										1.10	1.05
										40.0	38.0
										1.13	1.08
										42.0	40.0
										1.19	1.13
										50.0	44.0
										1.42	1.25
								27.0	25.0	55.0	46.0
								0.76	0.71	1.56	1.30
								30.0	28.0		
								0.85	0.79		
						20.0	18.0	32.0	30.0		
						0.57	0.51	0.91	0.85		
						21.0	19.0	34.0	32.0		
						0.59	0.54	0.96	0.91		
						23.0	21.0	37.0	34.0		
						0.65	0.59	1.05	0.96		
				16.0	15.0	24.0	22.0	39.0	36.0		
				0.45	0.42	0.68	0.62	1.10	1.02		
				18.0	16.0	28.0	25.0	51.0	45.0		
				0.51	0.45	0.79	0.71	1.44	1.27		
				19.0	17.0	33.0	30.0	69.0	57.0		
				0.54	0.48	0.93	0.85	1.95	1.61		
		13.0	12.0	22.0	20.0	38.0	35.0				
		0.37	0.34	0.62	0.57	1.08	0.99				
6.4	3.8	15.0	14.0	25.0	23.0	45.0	42.0				
0.18	0.11	0.42	0.40	0.71	0.65	1.27	1.19				
10.0	7.0	20.0	16.0	32.0	28.0						
0.28	0.20	0.57	0.45	0.91	0.79						
12.0	9.0										
0.34	0.25										

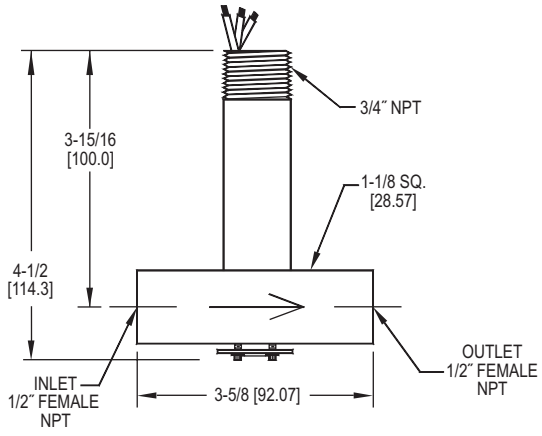
Cold Water - Stainless or Forged Steel Straight Tee and Bushing
Approximate actuation/deactuation flow rates
GPM upper, **M^3/HR** lower

Vane	1/2″ NPT		3/4″ NPT		1″ NPT		1-1/4″ NPT		1-1/2″ NPT		2″ NPT	
Full Size							5.0	4.5	8.5	7.8		
							1.1	1.0	1.9	1.8		
a							5.5	5.0	9.2	8.6		
							1.2	1.1	2.1	2.0		
b							6.2	5.7	9.8	9.0		
							1.4	1.3	2.2	2.0		
c							6.8	6.3	12.0	10.0		
							1.5	1.4	2.7	2.3		
d					2.8	2.4	8.5	7.8	13.0	11.0		
					0.6	0.5	1.9	1.8	3.0	2.5		
e					3.4	3.0	10.0	9.2				
					0.8	0.7	2.3	2.1				
f					4.0	3.6	12.0	10.0				
					0.91	0.82	2.7	2.3				
g			2.0	1.5	5.0	4.5						
			0.5	0.3	1.1	1.0						
h			2.5	2.0	6.5	6.1						
			0.6	0.5	1.48	1.39						
i			3.5	3.0	9.0	8.2						
			0.8	0.7	2.0	1.9						
j			7.0	5.5								
			1.6	1.2								
k			10.0	8.0								
			2.3	1.8								

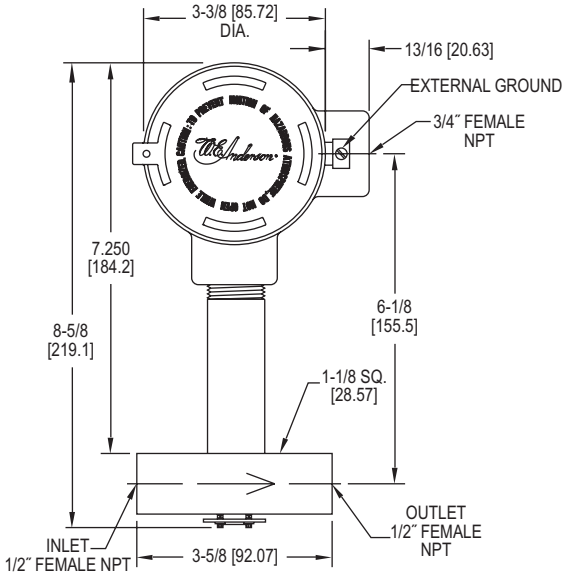
Air - Stainless or Forged Steel Straight Tee and Bushing
Approximate actuation/deactuation flow rates
SCFM upper, **NM^3/M** lower

1/2″ NPT		3/4″ NPT		1″ NPT		1-1/4″ NPT		1-1/2″ NPT		2″ NPT	
						21.0	18.0	33.0	30.0		
						0.59	0.51	0.93	0.85		
						22.0	20.0	39.0	36.0		
						0.62	0.57	1.10	1.02		
						24.0	22.0	42.0	38.0		
						0.68	0.62	1.19	1.08		
						28.0	26.0	51.0	46.0		
						0.79	0.74	1.44	1.30		
				12.0	10.0	33.0	30.0	55.0	50.0		
				0.34	0.28	0.93	0.85	1.56	1.42		
				14.0	12.0	37.0	34.0				
				0.40	0.34	1.05	0.96				
				16.0	14.0	43.0	40.0				
				0.45	0.40	1.22	1.13				
		8.0	6.5	19.0	17.0						
		0.23	0.18	0.54	0.48						
		11.0	10.0	26.0	24.0						
		0.31	0.28	0.74	0.68						
		14.0	13.0	32.0	30.0						
		0.40	0.37	0.91	0.85						
		27.0	24.0								
		0.76	0.68								
		39.0	36.0								
		1.10	1.02								

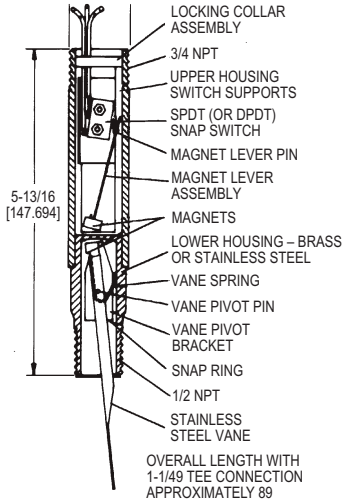
DIMENSIONS
Series V6 FLOTECT® Flow Switch



V6 Low Flow

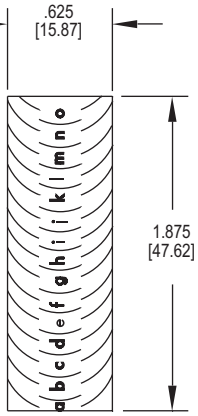


V6 Low Flow with CSA, ATEX Conduit Enclosure

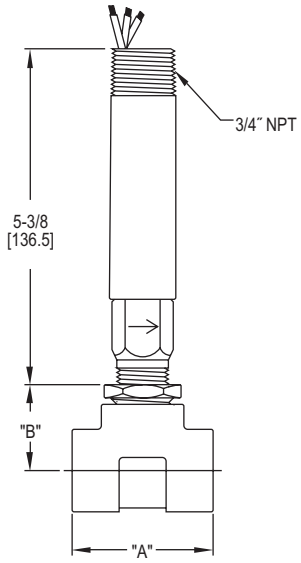


V6 with Field Trimmable Vane

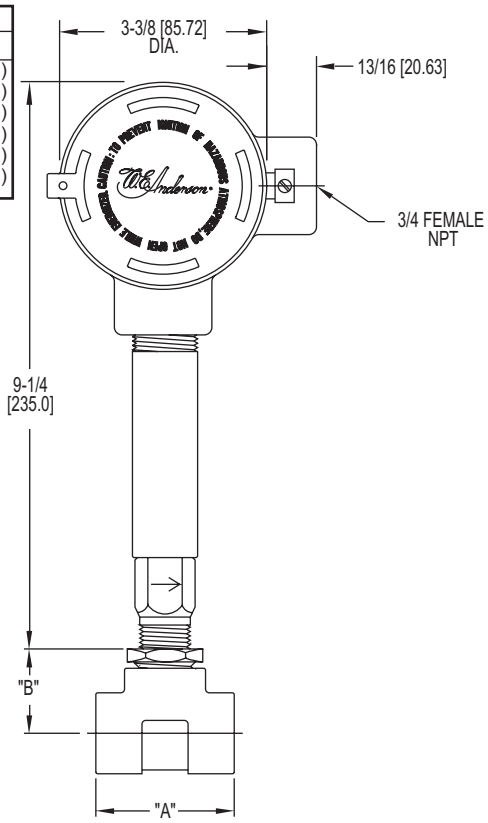
Pipe Size	Brass/Ductile Iron		Forged/Stainless Steel		Malleable Iron	
	Dim. A	Dim. B	Dim. A	Dim. B	Dim. A	Dim. B
1/2″	2-1/4 (57)	1-1/8 (29)	2-1/4 (57)	1-1/8 (29)	2-1/2 (64)	1-1/4 (32)
3/4″	2-3/8 (60)	1-1/4 (32)	2-5/8 (67)	1-7/8 (47)	2-5/8 (67)	1-3/8 (35)
1″	2-1/2 (64)	1-3/8 (35)	3 (76)	2-1/8 (54)	2-7/8 (73)	1-1/2 (38)
1-1/4″	2-5/8 (67)	1-1/2 (38)	3-1/2 (89)	2-1/2 (64)	3 (76)	1-3/4 (44)
1-1/2″	2-7/8 (73)	1-5/8 (41)	4 (102)	2-3/4 (70)	3-1/4 (83)	1-7/8 (48)
2″	3 (76)	1-7/8 (48)	4-3/4 (121)	3-1/8 (79)	3-1/2 (89)	2-1/8 (54)



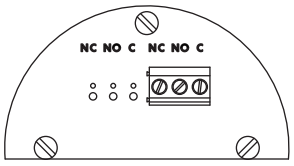
Trimmable Vane



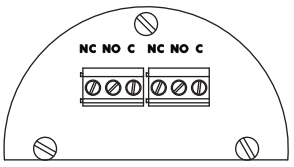
V6 with Tee



V6 with Tee and CSA, ATEX Conduit Enclosure



SPDT



DPDT

Terminal Connections CSA, ATEX Enclosures

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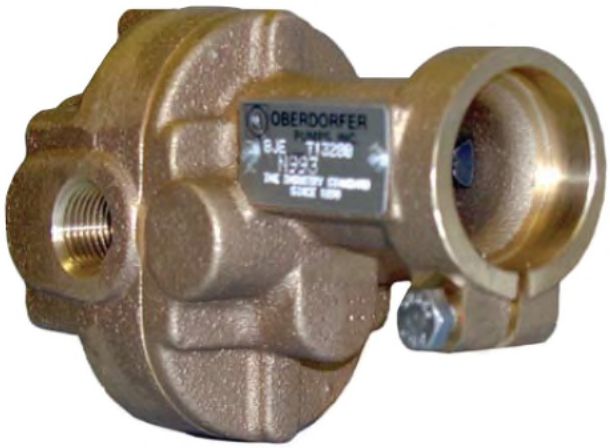
OBERDORFER PUMPS
A Gardner Denver Product

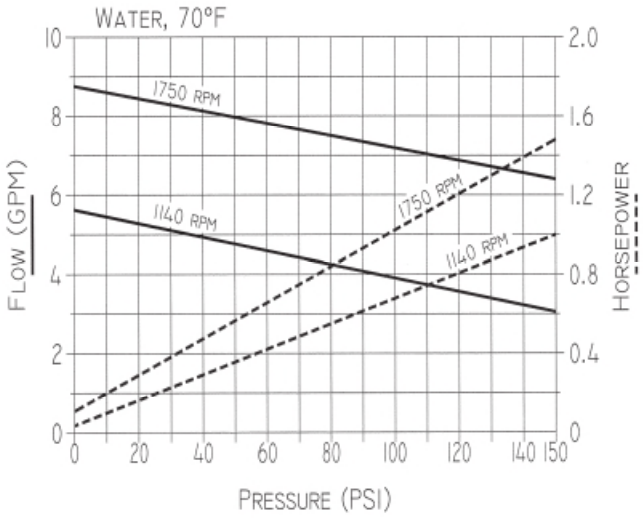
MODEL
PM00860

BRONZE CLOSE COUPLED ROTARY GEAR PUMPS

1/2" NPT PORTS STANDARD



PERFORMANCE



FEATURES

- Rugged corrosion resistant bronze construction
- Compact close-coupled design
- Stainless steel shafts
- Durable bronze helical gears provide quiet operation
- Process lubricated carbon graphite bearings
- O-ring cover seal for maximum leak protection
- Buna Lip Seal -standard
- Easy field assembly to a variety of motor frames
  - For compact AC motor pump units - see Close Coupled Bronze Adapterless Rotary Gear Pumps
  - For Danfoss hydraulic motor driven pump units - see adapter 9960
- For bronze pedestal pumps and mechanical seal styles - see model N3000
- For close-coupled ductile iron pumps - see model C993

GENERAL DESCRIPTION

Pump housings and gears are made of top quality bronze, shafts are 303 stainless steel. Bearings are designed of high performance carbon-graphite material selected for wear resistance and long service life.

Gear pumps are positive displacement pumps. Each shaft revolution displaces a definite amount of liquid relatively unaffected by the back pressure in the discharge line. Shaft speed and flow are directly proportional. Recommended pressure limits are 100 PSI for water and non-lubricants, 150 PSI for oil and other lubricants. The maximum shaft speed is 1750 RPM.

SHAFT SEALS

Close coupled gear pumps are normally supplied with a Buna N lip seal. A lip seal made of Viton(R)* is available as an option. For a Viton(R)* Seal, add S5 to the pump model number.

LIQUIDS AND TEMPERATURE

These pumps are suitable for all liquids that are compatible with bronze. Most common liquids are water, oil, and mild chemicals in the pH range of 4 to 11. Viscous liquids require reduced shaft speeds of 1140 RPM or lower. (Consult factory.)

Liquids containing solids, abrasives, powders, or paint pigments are definitely not recommended for gear pumps. If abrasives are unavoidable, use a very low shaft speed.

The recommended liquid temperature range is from 32 ^{0} F to 140^{0} F for best pump life. If more extreme temperature conditions exist, factory should be consulted. Freezing of water-filled pumps can cause damage and must be avoided. Oils at low temperatures are very viscous requiring a lower speed or extra power.

SUCTION LIFT

As a general rule, the suction lift should be kept at an absolute minimum by placing the pump as close to the liquid source as possible. A gear pump in new condition can lift 20 feet of water in the suction line. A foot valve (preferably with built-in strainer) is recommended at the beginning of the suction line. For a first start-up, the pump should be primed to avoid dry running. MInimum size of the suction pipe is the size of the pump inlet port. For longer suction lines (over 3 feet) or for viscous liquids, the pipe should be at least one size or two sizes larger than the pump inlet port.

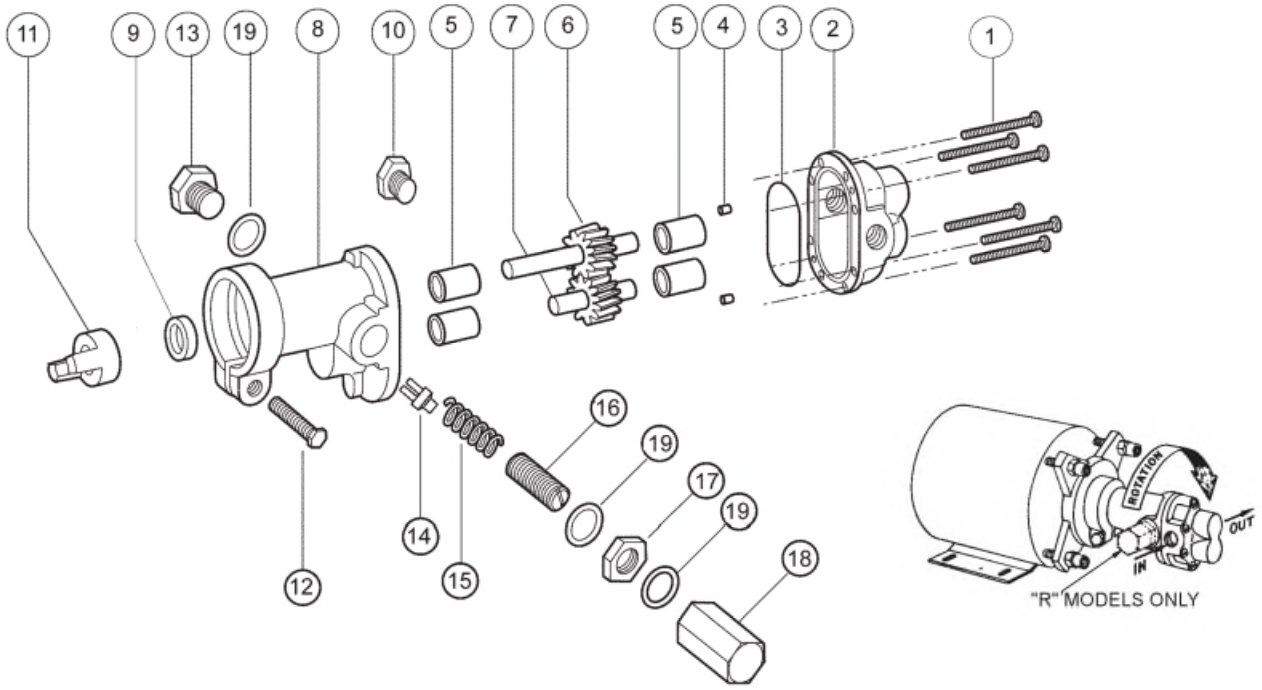
ROTATION AND RELIEF VALVE

If the discharge line contains any throttling devices such as a shut-off valve, a spray nozzle or other restrictive device, it is necessary to have a relief valve in the system which returns the liquid to the suction side or to the tank. The relief valve is also available as part of the pump itself (R-model pumps). However, built-in relief valves are only good for intermittent service. If used continuously, the pump will overheat. A built-in relief valve is strictly a safety device against overpressure. It will not work successfully as a pressure or flow control device. For this purpose a separate relief valve in the pressure line must be used.

Unless otherwise specified, the pump motor unit is supplied by the factory for shaft rotation counterclockwise from pump shaft end. Reversing motor will reverse "in and "out" ports and also requires changing relief valve location. The relief valve is always on the inlet side of this pump series. The factory pressure setting is 50 PSIG. To increase pressure, turn the relief valve adjusting screw in a clockwise direction.

BRONZE CLOSE COUPLED ROTARY GEAR PUMPS

EXPLODED VIEW AND PARTS LIST

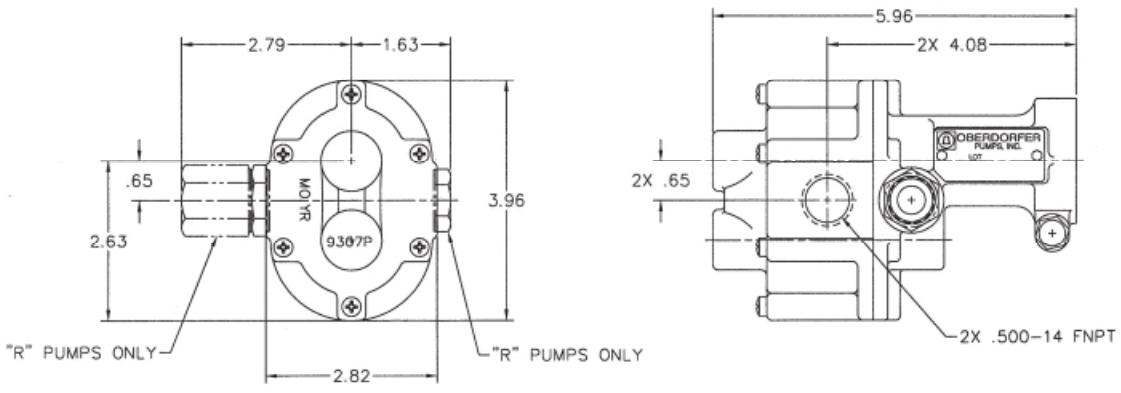


Pump No.	1	2	3[2]	4	5[2]	6[2]	7[2]	8	9[1,2]	10	11	12
	Screw	Body	O-Ring	Dowel Pin	Bearing	Drive Gear Assy.	Idle Gear Assy.	Cover	Lip Seal	Cap Plug	Coupling Half	Screw
	6 Req'd	1 Req'd	1 Req'd	2 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd
N993	**	**	**	**	PM001321	**	**	**	PM001322	**	PM00980	**
PM01105			*		*	*	*		*			

Contact the factory for correct part number

[2]Repair Kits contain items 3, 5, 6, 7 & 9. Repair Kit for PM00860 part number PM01105

DIMENSIONS

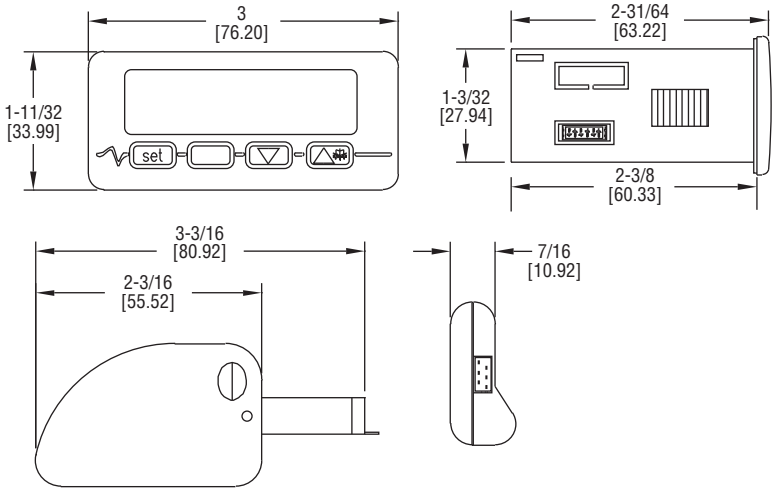


Sioux model EC01783

Bulletin T-40T

Series 40T/40M Digital Temperature Switch

Specifications - Installation and Operating Instructions



SPECIFICATIONS

Range: Current: -1999 to 1999;
Voltage: -1999 to 1999;
K T/C: -140 to 1999°F (-100 to 1300°C);
J T/C: -140 to 1450°F (-100 to 800°C);
RTD: -320 to 1200°F (-200 to 650°C);
PTC: -58 to 300°F (-50 to 150°C);
NTC: -40 to 230°F (-40 to 110°C);
N. RTD: -110 to 570°F (-80 to 300°C).

Input: RTD thermocouple, thermistor current and voltage (depending on model).
Output: 16A @ 250 VAC SPDT relay (max current allowed is 10A).
Control Type: On/off.
Power Requirements: 12 to 24 VAC/VDC, 115 VAC or 230 VAC (depending on model).
Accuracy: ±1% F.S.
Display: 3-1/2 digit red display.
Resolution: 0.1°C.
Memory Backup: Non-volatile memory.
Temperature Limits: 32 to 131°F (0 to 55°C).
Weight: 2.3 oz (65 g).
Front Panel Rating: IP 65.
Agency Approvals: UL, CE.

DISPLAYING ROOM TEMPERATURE
If the P5 parameter is set to display the temperature set point, the probe temperature can be displayed by pressing the DOWN ARROW key for two seconds until Pb1 is displayed. Next, hit the SET key. To return to the normal display, press SET key.

MANUAL DEFROST ACTIVATION/DEACTIVATION
To manually activate the defrost cycle, press the UP ARROW key for four seconds. This feature is disabled during heating operation.

PARAMETER LOCK OUT ACTIVATION/DEACTIVATION
The key pad lock out can be activated/deactivated by pressing the SET and DOWN ARROW keys simultaneously for two seconds. The display will flash Loc or UnL to signify the change in states.

ALARM BUZZER RESET
The audible alarm can be silenced by pressing any key.

RESTORING FACTORY DEFAULT SETTINGS
Factory settings can be restored by following the below procedure:
- Pressing the UP ARROW and DOWN ARROW keys for four seconds until PA is displayed
- Press the SET key
- Press the UP ARROW or DOWN ARROW to adjust the value to 743
- Press SET key
- Pressing the UP ARROW and DOWN ARROW keys for four seconds until dEF is displayed
- Press SET key
- Press the UP ARROW or DOWN ARROW to adjust the value to 149
- Press SET key
- Cycle the power after the flashing dEF goes away

Programming Device with Configuration Key
The Model 40X-K is not battery powered and requires that the device being programmed be powered. If a power source is not available, a 40X-PS power supply must be installed into the port on the edge of the key.

Copying Parameters to Configuration Key
1. Cut off power to the temperature switch
2. Connect the key to the temperature switch
3. Turn on power to the temperature switch or connect the power supply to the key (LED on key will be green and the temperature switch will flash “CIn”)
4. Press and hold the SET button on the temperature switch for 4 seconds (display will flash “St”)
5. Release the SET button on the temperature switch, the press and hold the SET button again for 4 seconds. (“St” on display will stop flashing and the LED on the key will turn red)
6. Do not disconnect the key while the LED is red, as it is copying the parameters
7. After LED on key returns to green, it is okay to disconnect the key. (If using 40X-PS power supply, disconnect the power supply before disconnecting the key)

Copying Parameters to Temperature Switch
1. Cut off power to the temperature switch
2. Connect the key to the temperature switch
3. Turn on power to the temperature switch or connect the power supply to the key (LED on key will be green and the temperature switch will read “CIn”)
4. Press and hold the button on the configuration key
5. After one second release the button on the key. Parameters will be copied from the key to the temperature switch. (LED will turn red)
6. The display on the temperature switch will read “PrG” and the LED will turn green once the temperature switch has been programmed successfully.
7. Do not disconnect the key while the LED is red, as it is copying the parameters
8. After LED on key returns to green, it is ok to disconnect the key. (If using 40X-PS power supply, disconnect the power supply before disconnecting the key)

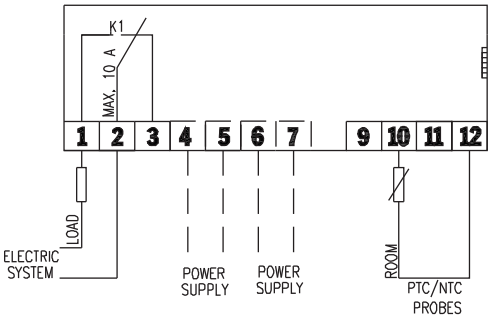
DISPLAY MESSAGES

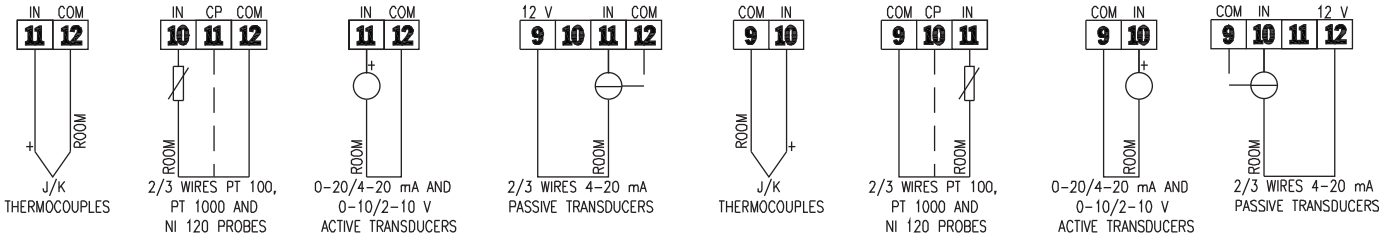
Out 1 solidly lit	Output 1 is active
Out 1 flashing	Either modification of set point or call for load during load protection (C1 or C2)
	Defrost cycle is active
	Alarm condition is present
°C	Temperature is measured in °C
°F	Temperature is measured in °F
Loc	Key pad is locked
Pr1	Probe 1 error

MAINTENANCE, CLEANING AND REPAIR
After final installation of the unit no routine maintenance is required. Clean the surface of the display controller with a soft and damp cloth. Never use abrasive detergents, petrol, alcohol or solvents. A periodic check of the system calibration is recommended. The Series 40T/40M is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

WIRING

Avoid installing the temperature probe cables in close proximity of any power cables. If the length of the probe cables is longer than 100 meters, a recalibration adjustment may be made using the CA1 parameter.





PARAMETER LIST

Parameter	Description	Units	Range	Factory Setting
SP	Set point	Degrees	r1 to r2	0.0
CA1	Ambient probe adjustment	Degrees	-25 to 25	0.0
P0	Type of input probe	Option	0 to 13	0
P1	Decimal point position	Option	0 or 1	1
P2	Display units	Option	0 or 1	0
P3	Minimum process input value	Counts	-999 to 1999	-20
P4	Maximum process input value	Counts	-999 to 1999	80
P5	Value displayed during normal operation	Option	0 or 1	0
r0	Set point differential	Degrees	0.1 to 99.0	2.0
r1	Minimum set point value	Degrees	-199.0 to r2	0.0
r2	Maximum set point value	Degrees	r1 to 1999	350.0
r3	Set point locked	Option	0 or 1	0
r5	Cooling or heating	Option	0 or 1	1
C1	Minimum time between compressor starts	Minutes	0 to 240	0
C2	Minimum compressor stoppage time	Minutes	0 to 240	0
C3	Minimum on time of compressor	Seconds	0 to 240	0
C4	Off time of fault cycle	Minutes	0 to 240	10
C5	On time of fault cycle	Minutes	0 to 240	10
d0	Interval between defrost	Hours	0 to 99	8
d3	Duration of defrost cycle	Minutes	0 to 99	0
d4	Defrost on power up	Option	0 or 1	1
d5	Defrost delay upon power up	Minutes	0 to 99	0
d6	Display during defrost cycle	Option	0 or 1	1
A1	Alarm set point 1	Degrees	-199 to 1999	0.0
A2	Alarm delay for A1	Minutes	0 to 240	0
A3	Alarm 1 type	Option	0 to 4	0
A4	Alarm delay upon set point modification	Minutes	0 to 240	0
A5	Alarm set point 2	Degrees	-199 to 1999	0.0
A6	Alarm delay for A2	Minutes	0 to 240	0
A7	Alarm 2 type	Option	0 to 4	0
E9	Reserved for future use	None	None	None

PARAMETER DESCRIPTION

SP Sets ambient temperature set point between r1 and r2

CA1 Ambient probe calibration adjustment

P0 Type of input probe

40T	40M
0 = J type thermocouple	0 = PTC
1 = K type thermocouple	1 = NTC
2 = 3 wire Pt100 RTD	2 = J Type Thermocouple
3 = 2 wire Pt100 RTD	3 = K Type Thermocouple
	4 = 3 wires Pt 100
	5 = 2 wires Pt 100
	6 = 3 wires Pt 1000
	7 = 2 wires Pt 1000
	8 = 4-20 mA
	9 = 0-20 mA
	10 = 2-10 V
	11 = 0-10 V
	12 = 3 wires Ni 120
	13 = 2 wires Ni 120

P1 Position of decimal place

P2 Display engineering units
0 = °C
1 = °F
2 = No units

P3 Minimum value for process input

P4 Maximum value for process input

P5 Value shown during normal operation
0 = Probe temperature
1 = Set point

r0 Set point differential or hysteresis

r1 Minimum value for set point

r2 Maximum value for set point

r3 Set point lock out
0 = Unlocked
1 = Locked

r5 Selection of heating/cooling operation
0 = Cooling
1 = Heating

C1 Minimum time between compressor starts

C2 Minimum time compressor must remain off before being restarted

C3 Minimum time compressor must remain on after being started

C4 During probe error, time compressor is off

C5 During probe error, time compressor is on

d0 Interval of time between defrost cycles (if 0, defrost will never be activated)

d3 Duration of defrost cycle

d4 Start defrost cycle upon power up
0 = No
1 = Yes

d5 Defrost delay time upon power up (d4 must be 1)

d6 Temperature shown during defrost
0 = Display probe temperature
1 = Display probe temperature up to (set point + r0) if probe temperature is below (set point + r0) at activation of defrost cycle. Display probe temperature if the probe temperature is above (set point + r0) at activation of defrost cycle.

A1 Alarm 1 temperature set point

A2 Alarm 1 not activated unless temperature remains in alarm state for this time

A3 Alarm 1 type
0 = Alarm disabled
1 = Absolute low alarm (A1)
2 = Absolute high alarm (A1)
3 = Deviation low alarm (SP - A1)
4 = Deviation high alarm (SP + A1)

A4 Temperature alarms not activated for this time after modifications to set point

A5 Alarm 2 temperature set point

A6 Alarm 2 not activated unless temperature remains in alarm state for this time

A7 Alarm 2 type
0 = Alarm disabled
1 = Absolute low alarm (A1)
2 = Absolute high alarm (A1)
3 = Deviation low alarm (SP - A1)
4 = Deviation high alarm (SP + A1)

E9 Reserved