



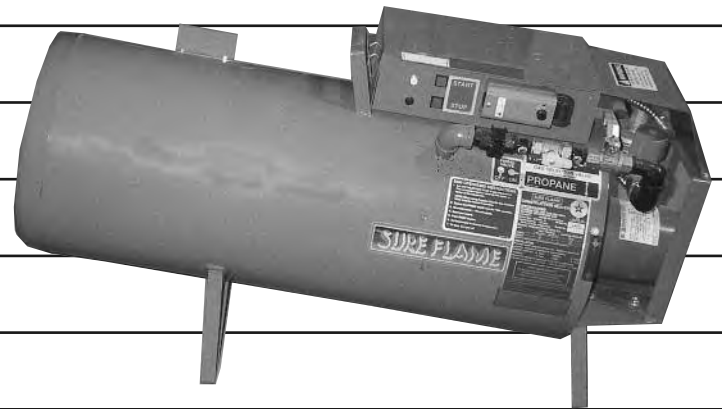
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Valparaiso, IN 46383
219-464-8818 • Fax 219-462-7985
www.heatwagon.com

Installation and Maintenance Manual

Please retain this manual for future reference.

S405

Construction Heater



***For Models with Serial#0001
through #11952 see Pages 2-16***



***For Models with Serial#11953
and Beyond see Pages 17-26***

*For your safety: Do not use this heater in
a space where gasoline or other liquids
having flammable vapors are stored.*

IMPORTANT INFORMATION! READ FIRST

The heater is designed for use as a construction heater under ANSI Z83.7a-1993. Heater is not intended for use in pest remediation. The primary purpose of construction heaters is to provide temporary heating of buildings under construction, alteration, or repair and to provide emergency heat. Properly used, the heater provides safe, economical heating. Products of combustion are vented into the area being heated.

The heater **IS NOT** designed as an Unvented Gas Fired Room Heater under ANSI-Z21.11.2 and **SHOULD NOT** be used in the home.

ANSI A119.2(NFPA 501C)-1987 Recreational Vehicle Standard prohibits the installation or storage of LP-gas containers even temporarily inside any recreational vehicle. The standard also prohibits the use of Unvented Heaters in such vehicles.

NFPA-58 1989 STANDARD FOR THE STORAGE AND HANDLING OF LIQUEFIED PETROLEUM GASES

Use of the heater must be in accordance with this Standard and in compliance with all governing state and local codes. Storage and handling of propane gas and propane cylinders must be in accordance with NFPA 58 and all local governing codes.

We cannot anticipate every use which may be made for our heaters. **CHECK WITH YOUR LOCAL FIRE SAFETY AUTHORITY IF YOU HAVE QUESTIONS ABOUT LOCAL REGULATIONS.**

Other standards govern the use of fuel gases and heat producing products in specific applications. Your local authority can advise you about these.

FOR YOUR SAFETY

DO NOT USE THIS HEATER IN A SPACE WHERE GASOLINE OR OTHER LIQUIDS HAVING FLAMMABLE VAPORS ARE STORED OR USED.

CONSTRUCTION HEATER GENERAL HAZARD WARNING:

Failure to comply with the precautions and instructions provided with this heater, can result in death, serious bodily injury and property loss or damage from hazards of fire, explosion, burn, asphyxiation, carbon monoxide poisoning, and/or electrical shock.

Only persons who can understand and follow the instructions should use or service this heater.

If you need assistance or heater information such as an instruction manual, labels, etc. Contact your local Heat Wagon dealer or the manufacturer.

W A R N I N G

Fire, burn, inhalation, and explosion hazard. Keep solid combustibles, such as building materials, paper or cardboard, a safe distance away from the heater as recommended by the instructions. Never use the heater in spaces which do or may contain volatile or airborne combustibles, or products such as gasoline, solvents, paint thinner, dust particles or unknown chemicals.

Not for home or recreational vehicle use!

Installation and Maintenance Manual

Model S405

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WARRANTY

All new Heat Wagon and Sure Flame heaters and fans are guaranteed against defective materials and workmanship for one (1) year from Heat Wagon invoice date.

Warranty repairs may be made only by an authorized, trained and certified Heat Wagon dealer. Warranty repairs by other entities will not be considered. Warranty claims must include model number and serial number.

LIMITATIONS

Warrant claims for service parts (wear parts) such as spark plugs, igniters, flame rods will not be allowed. Diagnostic parts such as voltage meters and pressure gauges are not warrantable.

Evidence of improper fuel usage, fuel pressures outside of manufacturer's specification, poor fuel quality, and improper electric power, misapplication or evidence of abuse may be cause for rejection of warranty claims.

Travel time, mileage and shipping charges will not be allowed. Minor adjustments of heaters are dealers' responsibility. Defective parts must be tagged and held for possible return to the factory for 60 days from date of repair. The factory will provide a return goods authorization, (RGA) for defective parts to be returned.

No warranty will be allowed for parts not purchased from Heat Wagon.



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DESIGN RELATED SAFETY FEATURES

1. Locking position for LPG on gas selector lever: Units used with LPG while the gas selector valve is positioned for Natural Gas will throw significantly more heat than the rated Btu/h. This is definitely a safety hazard.
2. Low Skin Temperature: Sure Flame Heaters are designed to have a low skin temperature. This provides added safety in the workplace.
3. Durable Construction: The Model S405 uses a stainless steel burner for long life and consistent performance.

In order to maintain the highly efficient combustion of the Sure Flame Heater, the combustion chamber must remain as manufactured. Any change or distortion could alter the fuel/air mixture and create unwanted gases.

SAFETY FEATURES

Servicing of Sure Flame Construction Heaters normally involves one of several built-in safety features. The Model S405 incorporates devices to detect the following:

1. LOSS OF FLAME Gas supply is shut off if flame is lost to prevent raw gas from leaving heater
2. OVERHEATING a) Thermal overload protection in the motor
b) High temperature limit switch in the control box
3. LOSS OF POWER Total shutdown with manual reset required. Any one of the safety devices will create a loss of power situation
4. BLOCKED AIR SUPPLY An airflow switch detects the differential pressure in the combustion chamber and shuts down when insufficient

SPECIFICATIONS

Model No. S405

Designed to ANSI Z83.7a-1993 Construction Heater

Gases: Natural or Propane Vapor
Capacity: 400,000 Btu/hr maximum
Orifice Size: 42 DMS (x18)
Blower: 2,000 CFM
Electrical Rating: 115V 60Hz 12 amps, single phase
Minimum Temperature Rating: Minus 40 degrees F

| Gas Supply: | Inlet Pressure | | Manifold Pressure |
|-------------|----------------|----------|-------------------|
| | Max W.C. | Min W.C. | W.C. |
| Propane | 14" | 7" W.C. | 1.3" |
| Natural Gas | 14" | 7" W.C. | 4.0" |

(Minimum inlet pressure is for purpose of input adjustment)

Inlet Connection: Weight (approximate): 100 lbs.
Model S405 1" NPT

INSTALLATION

The **Sure Flame S405** is a direct fired gas heater intended to be used primarily for the temporary heating of buildings under construction, alteration, or repair. Since all the products of combustion are released into the area being heated, it is imperative that adequate ventilation is provided. The flow of supply air and combustion gases must not be obstructed in any way. Do not use the heater with ductwork as this will restrict the flow supply air.

1. Install the heater in a horizontal position and allow the following clearances from any combustible material or fuel containers:

| | | | |
|---------------|---------|--------|--------|
| Front Outlet: | 12 feet | Sides: | 2 feet |
| Intake: | 2 feet | Top: | 5 feet |

Front outlet must not be directed at any LP-Gas container within 20 feet.

Also make sure that no flammable vapors are present in the space where the heaters is being used.

2. When connecting the heater to a natural gas or propane supply line ensure that the pressure at the heater inlet is within the specified range. Please refer to Propane and Natural Gas installation sections on page 6.

EXCESSIVE PRESSURE (OVER 1/2" PSIG) WILL DAMAGE THE CONTROLS AND VOID THE WARRANTY. SEE ITEM 31, PAGE 12.

3. Visually inspect the hose assembly and ensure that it is protected from traffic, building materials, and contact with hot surfaces. If it is evident that there is excessive abrasion or wear, or the hose is cut, it must be replaced.
4. After installation, check the hose assembly for gas leaks by applying a water and soap solution to each connection. Bleeding the gas hose supply of air before starting is recommended with long installations of hose.
5. Connect the heater to an adequate 115 volt electrical supply and in compliance with the National Electrical Code ANSI/NFPA 7.0. For protection against shock hazard the supply cord should be plugged directly into a properly grounded three-prong receptacle.
NOTE: CONTROL BOARD IS POLARITY SENSITIVE
6. In all applications, install the heater in such a manner that it is not directly exposed to water spray, rain, and/or dripping water.

PROPER LP GAS SET-UP

- 1) When installing the heater for use with propane gas, set the gas selector to "Propane" and lock in position.
- 2) Arrange the cylinder supply system to provide for vapor withdrawal from the operating cylinder. Supplying liquid propane to the heater is dangerous and will damage the components.
- 3) The supply container **must** be equipped with an LP Gas Regulator that complies with ANSI/UL 144 Standard for Pressure Regulating Valves for LP Gas. Another regulator must be installed on the heater to reduce the pressure from this regulator down to a maximum inlet pressure of 1/2 psig (14" W.C.). See optional regulator and install kit on page 25.
- 4) Ensure that for the surrounding temperature the size and capacity of the propane supply cylinder is adequate to provide the rated BTU/H input to the heater. See charts page 9.
- 5) Turn off the propane supply valve at the cylinder when the heater is not in use.
- 6) The installation must conform with local codes, or in the absence of local codes, with the Standard for Storage and Handling of Liquefied Petroleum Gases ANSI/NFPA 58-1989.
- 7) When the heater is to be stored indoors the propane cylinder must be disconnected from the heater and the cylinder moved away and stored in accordance with Chapter 5 of the above National Standard.

INSTALLATION USING NATURAL GAS APPLICATIONS

- 1) When installing the heater for use with natural gas, set the gas selector valve to the "Natural" position.
- 2) A regulator must be installed on the heater only if the line pressure to the heater is greater than 1/2 psi. (14"W.C.). See optional regulator on page 28.
- 3) The installation of this heater to a natural gas supply must conform with all applicable local codes or, in the absence of local codes, with the National Fuel gas Code, ANSI Z223.1/NFPA 54.

COMMON INSTALLATION AND OPERATIONAL PROBLEMS

- 1) **LOW VOLTAGE AT THE HEATER**
This is one of the most common problems and is usually the result of the supply cord having too small a wire gauge for its length, or low voltage at the power source. Low voltage results in the motor overheating, burnt relay contacts, or a relay that will not make contact. Check supply voltage at heater (105 V Min at heater). Heater should be installed by itself on dedicated 15amp supply. **Note: Control board is polarity sensitive. L1 to ground 105 V min. L2 to ground 0 V.**
- 2) **GAS SUPPLY LINE UNDERSIZED** - See page 9
- 3) **INSUFFICIENT VAPORIZATION AT SUPPLY**
Normally caused by undersized supply tank. - See page 8

- 4) **IMPROPER GAS SUPPLY PRESSURE**
Usually a result of propane supply pressure being too high because of improper or lack of regulation or too low of natural gas pressure at meter.
- 5) **DIRTY GAS SUPPLY**
Dirty gas can cause strainers to plug or form a build-up in the burner orifice.
- 6) **LACK OF PREVENTIVE MAINTENANCE**
Heaters must be cleaned as required, especially when used in a dirty environment.
(Fan blade, air switch tubes, spark plug and flame rod)
- 7) **IMPROPER SUPPLY OF FRESH AIR**
It is normally recommended that the intake air of the heater be taken from outside the enclosed area. This provides a slight pressurization and prevents any problems associated with re-circulation.

ON SITE SAFETY PROBLEMS & OPERATING INSTRUCTIONS

- 1) Set the **gas selector valve** for fuel being used. The conversion shall be done by the owner or lessor of the equipment.
NOTE: When using Propane Gas the Selector Valve **MUST** be locked in the "PROPANE" position.
- 2) Ensure the **manual shut-off valve** (valve nearest the burner) is in the "ON" position.
- 3) Connect power supply (115 volt). Check voltmeter to confirm voltage (min 105 required at heater).
- 4) **SLOWLY** open shut-off valve at gas meter or propane tank. Check for leaks.
- 5) Push **START** button
- 6) Set **thermostat** for desired room temperature.
- 7) **TO STOP TURN GAS OFF.**
Do not disconnect power to turn off heater.

The appliance area should be kept clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

Ensure that the flow of supply air and combustion gases is not obstructed.

The installation and operation of this heater shall comply with the code requirements specified by the authorities having jurisdiction.

General criteria for the use of construction heaters may be found in the applicable sections of American National Standard A-10.10-1987, Safety Requirements for Temporary and Portable Space Heating Devices and Equipment Used in the construction industry.

THE INSTALLATION AND MAINTENANCE OF THE HEATER MUST BE ACCOMPLISHED BY A QUALIFIED SERVICE PERSON.

ON-SITE SAFETY PROBLEMS

1) SHORTING OUT OF DEFECTIVE COMPONENTS

This is a very common problem which saves short term expense at the risk of a large future cost. Any heaters found in this condition should be removed immediately.

2) IMPROPER ENCLOSURES

When heaters are installed partially to the outside for fresh air intake, strict adherence must be made to the minimum clearance to combustibles given on the instruction plate. Wood framing around a heater can cause a safety hazard.

3) SUPPLYING LIQUID PROPANE TO HEATER

This problem has occurred from time to time. To minimize the damage, shut off the gas supply and let the heater run until all of the liquid in the lines had been consumed.

PREVENTIVE MAINTENANCE

Sure Flame construction heaters are built to withstand the rigors of operating on construction sites, for mining applications, and a multitude of other locations where heaters are used. To maintain the reliable performance required it is necessary to do a certain amount of regular maintenance.

A) VISUAL CHECKS

The following items should be checked for excessive wear or damage:

- 1) Wheels (if installed)
- 2) Cords and Connectors
- 3) Wiring and Conduit
- 4) Heater shell (including heat shield) and control box

It is recommended that units purchased as spares be rotated periodically, so that each unit will be placed in operation at least once every 90 days.

B) BURNER

Flame rod and insulator - Clean with soap and water or solvent on a routine basis. Any build up on burner should also be removed at this time.

Spark Plug - Clean with solvent and check spark gap, approximately .070 to .085 (1/8")

C) CONTROL BOX

The inside of the control box should be cleaned using a dry cloth or by blowing compressed air. Do not use any liquid or aerosol spray cleaners. Also check that all electrical connections are snug and tight.

D) MOTOR

The electric motor on the S405 heater is fitted with sealed bearings and no oiling required. Keep the motor clean by blowing or wiping off dust or dirt in order to prevent the motor from over heating.

F) FAN

Check for dust or dirt build up on fan blades. Check the tightness of the set screws and run the heater to check for fan vibration.

VAPORIZATION RATES IN BTUH @ 0 DEG. F

| TANK SIZE | NUMBER OF TANKS MANIFOLDED | PERCENTAGE OF TANK FILLED | | | | | |
|-----------|----------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|
| | | 10% | 20% | 30% | 40% | 50% | 60% |
| Gallons | | | | | | | |
| 250 | | | | | | | |
| | 1 | 12,690 | 169,200 | 197,400 | 225,600 | 253,800 | 282,000 |
| | 2 | 279,180 | 372,240 | 434,280 | 496,320 | 558,360 | 620,400 |
| | 3 | 486,027 | 648,036 | 756,042 | 864,048 | 972,054 | 1,080,060 |
| 325 | | | | | | | |
| | 1 | 160,650 | 214,200 | 249,900 | 285,600 | 321,300 | 357,000 |
| | 2 | 353,430 | 471,240 | 549,780 | 628,320 | 706,860 | 785,400 |
| | 3 | 615,289 | 820,386 | 957,117 | 1,093,848 | 1,230,579 | 1,368,842 |
| 500 | | | | | | | |
| | 1 | 198,135 | 264,180 | 308,212 | 352,240 | 396,270 | 440,300 |
| | 2 | 435,897 | 581,196 | 687,066 | 774,928 | 871,794 | 968,660 |
| | 3 | 758,857 | 1,011,809 | 1,180,451 | 1,349,079 | 1,517,714 | 1,686,349 |

NOTE: USE FOLLOWING MULTIPLIERS FOR OTHER AIR TEMPERATURES

- For -10° F multiply x 0.50
- For + 10°F multiply x 1.5
- For +20°F multiply x 2.0
- For +40°F multiply x 3.0
- For +50°F multiply x 3.5
- For +60°F multiply x 4.0

| | Hose Length in Feet | BTU 400,000 | | | Hose Length in Feet | BTU 400,000 | | | |
|--|---------------------|---|-------|--|---------------------|-------------|-------|---|------|
| | | 1/2PSI | 10PSI | | | 1/2PSI | 1PSI | 2PSI | 5PSI |
| | | VAPOR PROPANE QUICK REFERENCE HOSE CHART | 10 | | | 3/4 | 3/8 | NATURAL GAS QUICK REFERENCE HOSE CHART | 10 |
| | 25 | 1 | 3/8 | | 25 | 1-1/4 | 3/4 | 3/4 | 3/4 |
| | 35 | 1 | 3/8 | | 35 | 1-1/4 | 3/4 | 3/4 | 3/4 |
| | 50 | 1-1/4 | 3/8 | | 50 | 1-1/4 | 3/4 | 3/4 | 3/4 |
| | 75 | 1-1/4 | 1/2 | | 75 | 1-1/2 | 3/4 | 3/4 | 3/4 |
| | 100 | 1-1/4 | 1/2 | | 100 | 1-1/2 | 3/4 | 3/4 | 3/4 |
| | 125 | 1-1/4 | 1/2 | | 125 | 1-1/2 | 1 | 3/4 | 3/4 |
| | 150 | 1-1/4 | 1/2 | | 150 | 2 | 1 | 3/4 | 3/4 |
| | 175 | 1-1/2 | 3/4 | | 175 | 2 | 1-1/4 | 3/4 | 3/4 |
| | 200 | 1-1/2 | 3/4 | | 200 | 2 | 1-1/4 | 3/4 | 3/4 |
| | 225 | 1-1/2 | 3/4 | | 225 | 2 | 1-1/4 | 3/4 | 3/4 |

TROUBLE SHOOTING

S405 TROUBLESHOOTING (SERIAL# 2438-11952)

Follow these steps AFTER correct set up conditions are met as to proper voltage (and polarity) and correct fuel pressures and volumes!

(Do not attempt to fix or troubleshoot a heater until these conditions are met and satisfied!)

| SEQUENCE | PROBLEM | CHECK | CAUSE | TEST |
|--------------------|--|--|----------------------------------|---|
| Press START | Power relay does not close | If no power between L1 and L2 (on control relay) | No Power at plug | Check outlet for 120V |
| | | If no power at start switch | Faulty control (24v) transformer | Check for 24V on load side (black wire) of control transformer |
| | | If no power at limit switch | Faulty start/stop switch | Check for continuity thru green start switch when depressed, thru red stop switch under normal run |
| | | If no power at thermostat | Faulty limit switch | Check for continuity thru limit switch |
| | | If no power at "Power" wire on ignition control | Faulty thermostat | Turn thermostat all the way up, if room temperature is below 110 degrees, thermostat should show continuity |
| | | If no power at #3 post on D.O.B. timer | Faulty ignition control | If 24 volts on "power" wire on ignition control on start up but not on "valve" wire during the first 5 seconds, replace ignition control |
| | | If no power at #6 post on D.O.B. timer | Faulty D.O.B. Timer | If 24 volts on #1 and #3 post on timer but not on #6 post, replace timer |
| | | If 24v on A1 (magnet) of power relay | Faulty power relay | If 24 volts at A1 (magnet) of control relay and 120 volts on L1 of control relay, replace relay |
| Power relay closes | Motor does not start (or turns slowly) | Check for 120V off of T1 post on power relay | Bad motor | If 120 volts is present on T1 post of power relay and fan blade is unobstructed, replace motor (or if heater amp draw rises above 6 amps) |

TROUBLE SHOOTING

S405 TROUBLESHOOTING (SERIAL# 2438-11952)

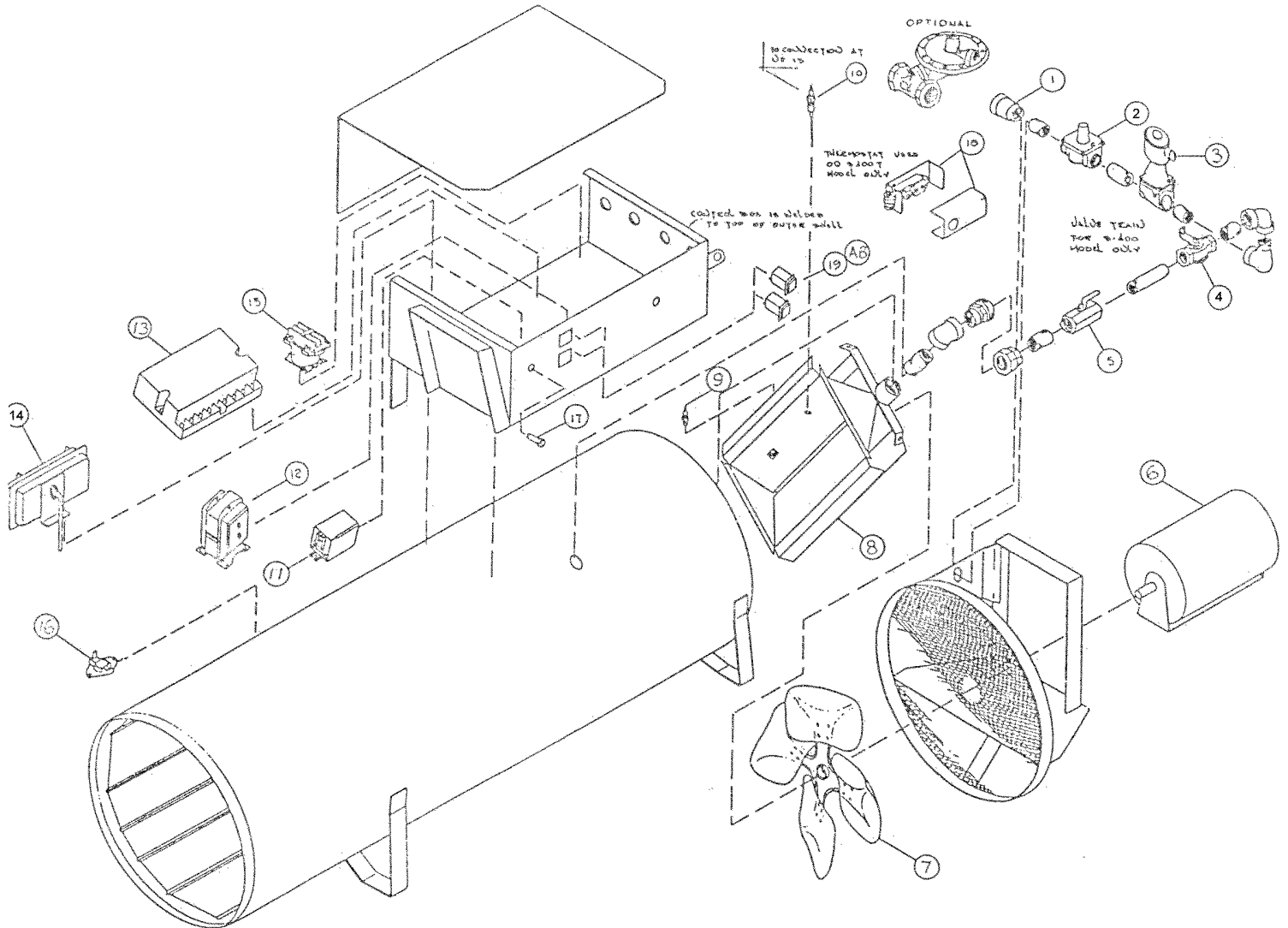
Follow these steps AFTER correct set up conditions are met as to proper voltage (and polarity) and correct fuel pressures and volumes!

(Do not attempt to fix or troubleshoot a heater until these conditions are met and satisfied!)

| SEQUENCE | PROBLEM | CHECK | CAUSE | TEST |
|--|---------------|------------------------------------|---|---|
| Fan motor starts | No spark | Spark plug type, gap and condition | Improper plug or gap | Make sure plug is part# 2142 (Champion J8C), gapped at 1/8" not cracked and clean |
| | | Ignition wire | Bad connection or melted / broken wire | Replace |
| | No gas | Airflow switch | Bad airflow switch or blocked air tubes | Check for 24v on the "com" (common) terminal of airflow and 24v on the "no" (normally open) terminal, clean air tubes |
| | | Solenoid shut offvalve | Bad solenoid shut | Check for 24 volts from airflow switch. If 24 volts is present, valve should electronically close and allow gas flow to burner |
| | | Low pressure regulator | Bad low presure regulator | If proper inlet gas pressure and volume is deliverred to the regulator and no flow is deliverred on the output, replace regulator |
| Heater lights and shuts down after 5 seconds | Flame proving | Flame rod | Bad flame rod | Check flame rod for any cracks in ceramic and that sensing metal is clean and not malleable (soft) |
| | | Flame rod wire | Bad wire | Replace |
| | | Ignition control | Bad ignition control | If all above requirements are met, change ignition control |

S405 Heater Parts

Serial #0001 through #2737



Ref. Part No. Description

VALVE TRAIN

- 1 SFP 40SV01 Strainer (S400-80)
- 2 SFP 2524 Low Pressure Regulator
- 3 SFP 4514 Solenoid Shut Off Valve 24V
- 4 SFP S400-73 Gas Selector Valve (S400-73)
- 5 SFP 2538 Manual Shut Off Valve

BLOWER

- 6 SFP 2430 Motor 1/4 H.P.
- 7 SFP 2420 Fan Blade

BURNER SECTION

- 8 SFP BV4-50 Burner
- 9 SFP 2142 Ignition Plug
- 10 SFP SL11B86 Flame Rod

Ref. Part No. Description

CONTROL BOX

- 11 SFP 4512 120V Control Relay
- 12 SFP 4510 24V Transformer
- 13 SFP 40SC29R Flame Control
- 14 SFP 5124 Air Switch
- 15 SFP 4519 Motor Relay 24V
- 16 SFP 2446 Hi Limit Thermoswitch
- 17 SFP 4518 Indicator Light 24V
- 18 SFP 2453 Thermostat
- 19A SFP 3337G ON Switch (Red)
- 19B SFP 3337R OFF Switch (Red)

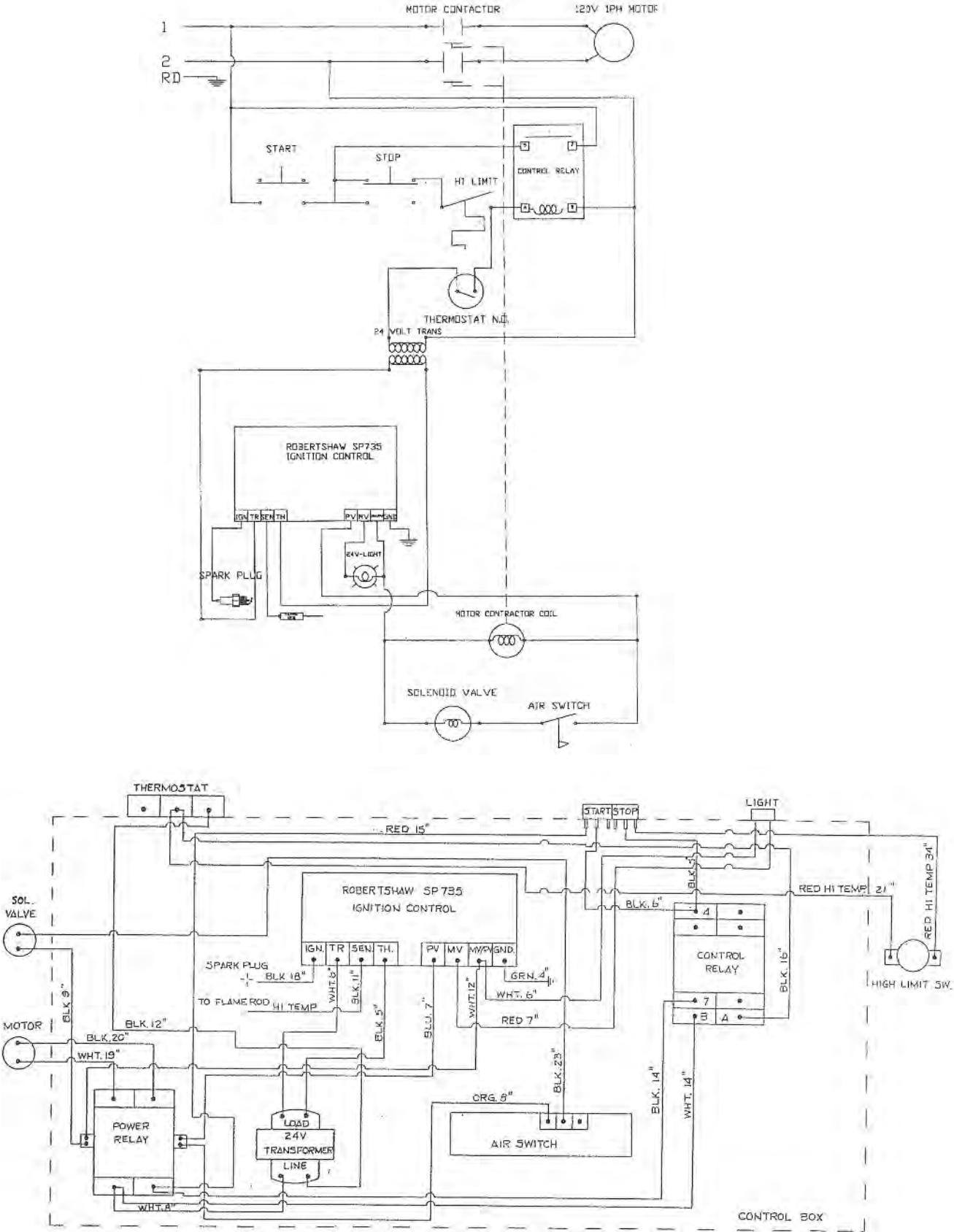
ACC-40SV06 Hi Pressure Regulator (optional)

Not Shown

- SFP HC1008 Kit, Wire Ignition
- SFP 2144 Spark Plug Nut
- HWP HC1020 Power Cord
- SFP S405-84 Airtube Upstream-Copper
- SFP S405-85 Airtube Downstream-Copper

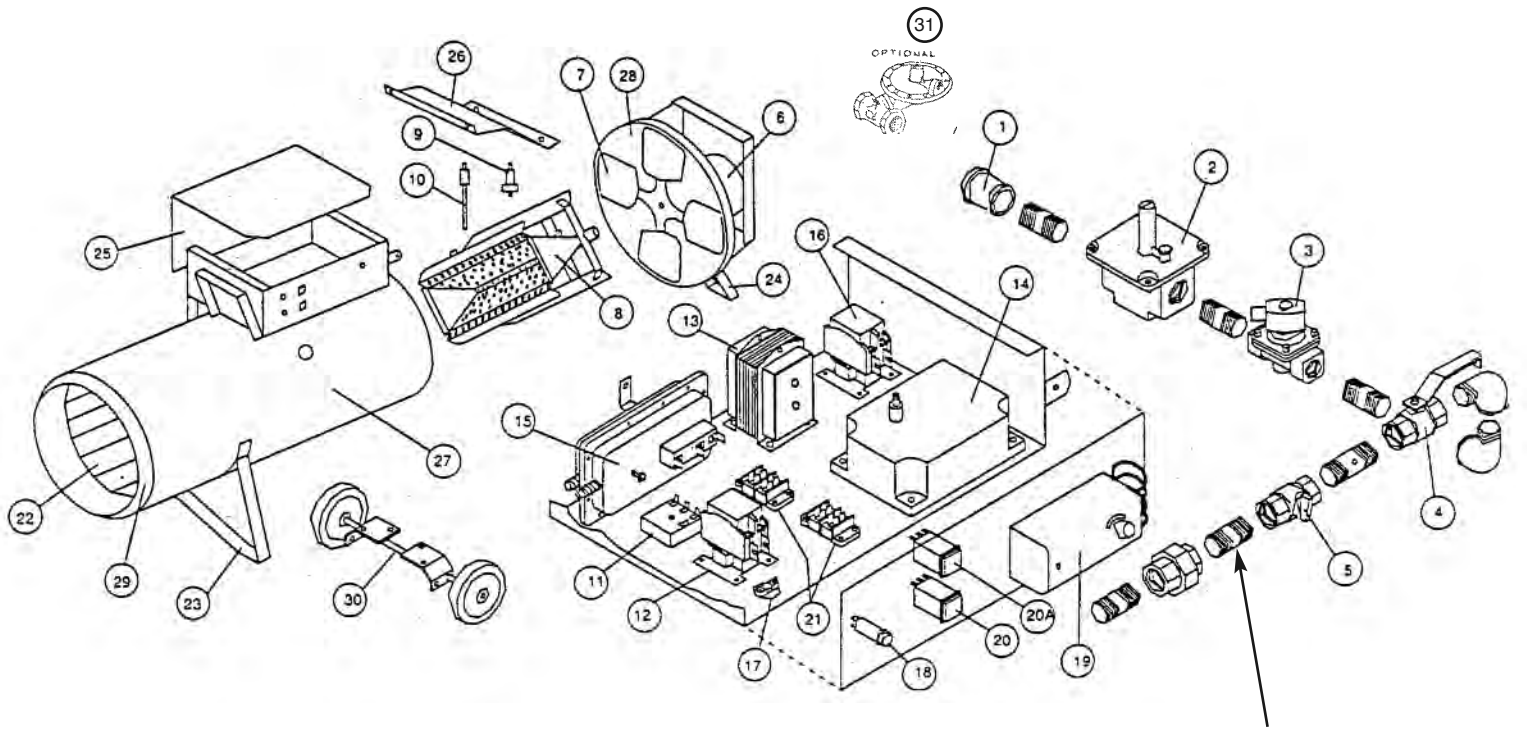
S405 CONSTRUCTION HEATER WIRING DIAGRAM

NOTE: This wiring diagram applies to most heaters with serial number up to #2737



S405 Heater Parts

Serial #2738 through #11952



Port for measuring manifold pressure 1/4 FNPT

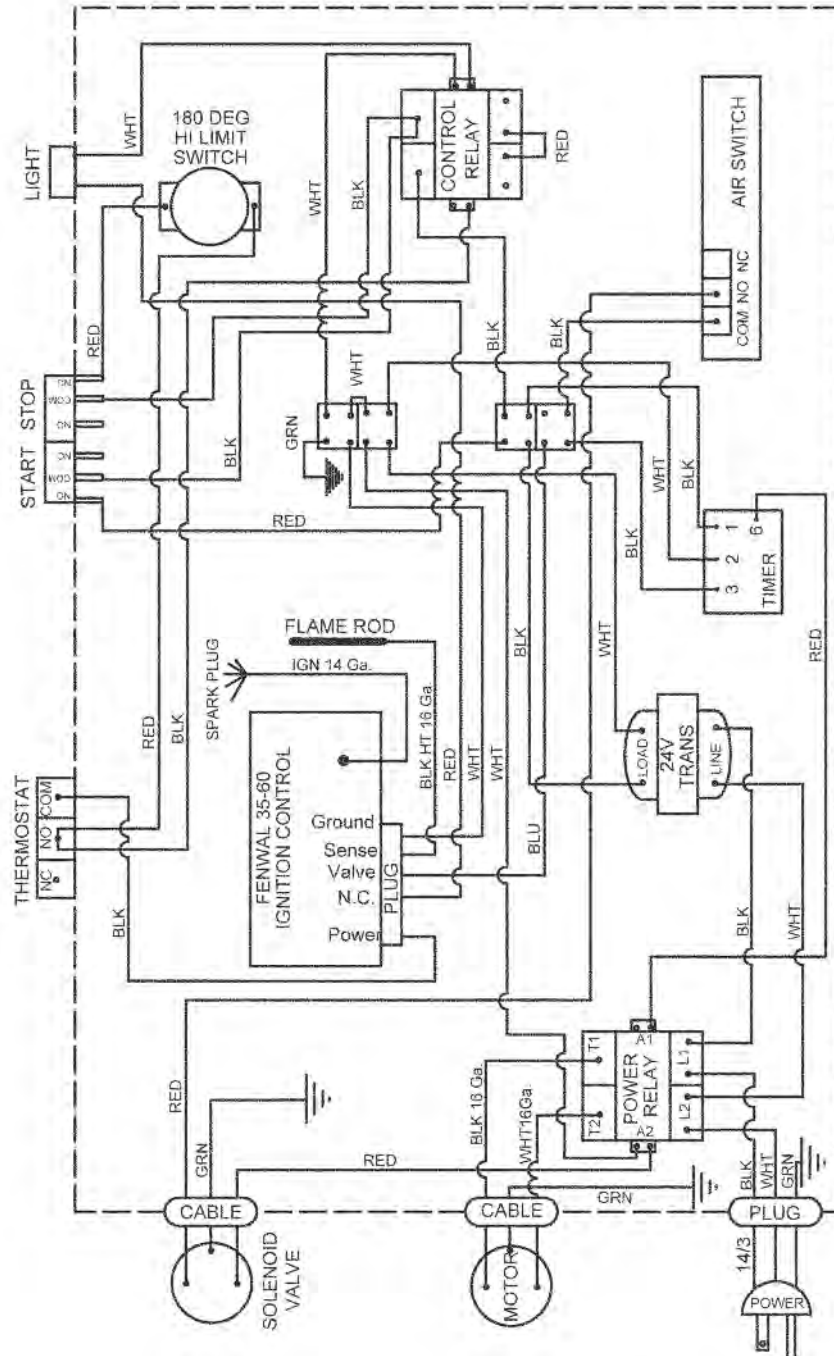
| Ref. | Part No. | Description |
|------|-------------|-------------------------------------|
| 1 | SFP 40SV01 | Strainer (S400-80) |
| 2 | SFP 2524 | Low Pressure Regulator |
| 3 | SFP 4514 | Solenoid Shut Off Valve 24V |
| 4 | SFP S400-73 | Gas Selector Valve |
| 5 | SFP 2538 | Manual Shut Off Valve 3/4" valve |
| 6 | SFP 2430 | Motor 1/4 H.P. |
| 7 | SFP 2420 | Fan Blade |
| 8 | SFP BV4-50 | Burner |
| 9 | SFP 2142 | Spark Plug |
| 10 | SFP SL11B86 | Flame Rod |
| 11 | SFP 7465 | 24VAC 5-Second Delay-ON-Break Timer |
| 12 | SFP 4519 | Control Relay 24V |
| 13 | SFP 4510 | Transformer 24V |
| 14 | SFP 5943 | Direct Spark Ignition Control |
| 15 | SFP 5124 | Air Switch |
| 16 | SFP 4519 | Motor Relay 24V |
| 17 | SFP 2446 | Hi Limit Thermoswitch |
| 18 | SFP 4518 | Indicator Light 24V |
| 19 | SFP 2453 | Thermostat |
| 20 | SFP 3337R | OFF Switch (Red) |

| Ref. | Part No. | Description |
|------|--------------|--|
| 20A | SFP 3337G | On Switch (Green) |
| 21 | SFP 9823 | Terminal Block |
| 22 | SFP S400-2 | Heat Shield |
| 23 | SFP S400-57 | Front Leg Assembly |
| 24 | SFP S400-47 | Rear Leg Assembly (less motor mount & screen) |
| 25 | SFP 4517 | Control Box Lid |
| 26 | SFP SC400-38 | Valve Train Cover |
| 27 | SFP S400-53 | Heater Body Includes 22, 23 & 29 |
| 28 | SFP S400-502 | Motor Mount (with screen & rear legs) |
| 29 | SFP S400-3 | Nose Cone |
| 30 | ACC-SWK1 | Wheel Kit (Optional) |
| 31 | ACC-40SV06 | Regulator (Optional) |

| Not Shown | | |
|-----------|-------------|---------------------------|
| | SFP HC1008 | Kit, Wire Ignition |
| | SFP 40SC29W | Wire Harness |
| | SFP 2144 | Spark Plug Nut |
| | HWP HC1020 | Power Cord |
| | SFP S405-84 | Airtube Upstream-Copper |
| | SFP S405-85 | Airtube Downstream-Copper |

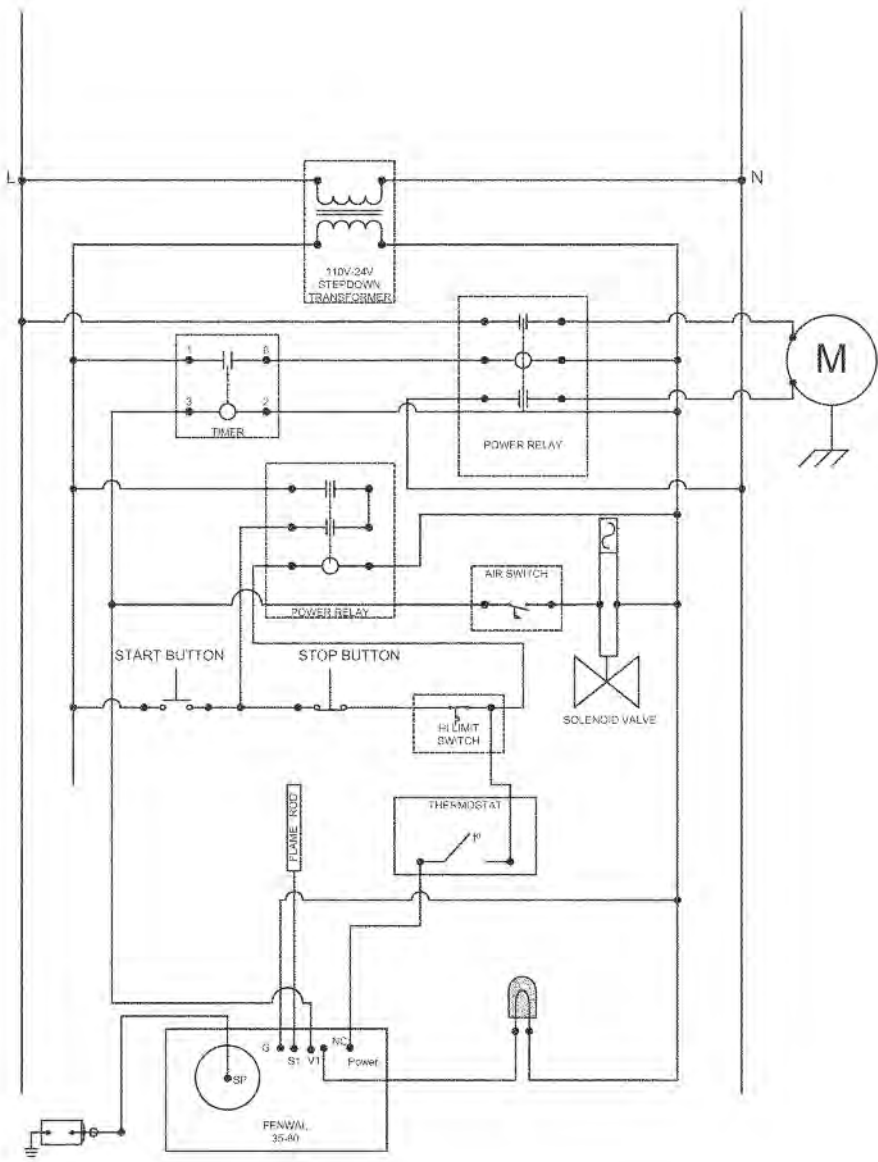
S405 CONSTRUCTION HEATER WIRING DIAGRAM

NOTE: This wiring diagram applies to heaters with serial #2738 to #11952



S405 CONSTRUCTION HEATER WIRING DIAGRAM

NOTE: This wiring diagram applies to heaters with serial #2738 to #11952





SURE FLAME[®]

S405

CONSTRUCTION HEATER



June 15, 2011, Rev: 4.4

SERVICE AND MAINTENANCE MANUAL No. 934-5731

PLEASE RETAIN FOR FUTURE REFERENCE

SURE FLAME[®] PRODUCTS

A DIVISION OF HAUL-ALL EQUIPMENT LTD.

4115 - 18 Avenue North
Lethbridge, Alberta T1H5G1
www.sureflame.ca

Serial #11953 and Beyond

S405 CONSTRUCTION HEATER

READ THIS WARNING

GENERAL HAZARD WARNING

Failure to comply with the precautions and instructions provided with this heater, can result in death, serious bodily injury and property loss or damage from hazards of fire, explosion, burn, asphyxiation, carbon monoxide poisoning, and/or electrical shock.

Only persons who can understand and follow the instructions should use or service this heater.

If you need assistance or heater information such as an instruction manual, labels, etc. Contact the manufacturer.

FIRST !

The heater is designed and approved for use as a construction heater under ANSI Z83.7-2000 Construction Heater. The primary purpose of construction heaters is to provide temporary heating of buildings under construction, alteration, or repair and to provide temporary emergency heat. Properly used the heater provides safe economical heating. Products of combustion are vented into the area being heated.

The heater is not designed as an Unvented Gas Fired Room Heater under ANSI-Z21.11.2 and should not be used in the home.

ANSI A119.2(NFPA 501C)-1987 Recreational Vehicle Standard prohibits the installation or storage of LP-Gas containers even temporarily inside any recreational vehicle. The Standard also prohibits the use of Unvented Heaters in such vehicles.

WARNING

Fire, burn, inhalation, and explosion hazard. Keep solid combustibles, such as building materials, paper or cardboard, a safe distance away from the heater as recommended by the instructions. Never use the heater in spaces which do or may contain volatile or airborne combustibles, or products such as gasoline, solvents, paint thinner, dust particles or unknown chemicals.

NFPA-58 1989 STANDARD FOR THE STORAGE AND

HANDLING OF LIQUEFIED PETROLEUM GASES

Use of the heater must be in accordance with this Standard and in compliance with all governing state and local codes. Storage and handling of propane gas and propane cylinders must be in accordance with NFPA 58 and all local governing codes.

We cannot anticipate every use which may be made for our heaters. CHECK WITH YOUR LOCAL FIRE SAFETY AUTHORITY IF YOU HAVE QUESTIONS ABOUT LOCAL REGULATIONS.

Other standards govern the use of fuel gases and heat producing products in specific applications. Your local authority can advise you about these.

WARNING

Not for home or recreational vehicle use

FOR YOUR SAFETY

**DO NOT USE THIS HEATER IN A SPACE WHERE
GASOLINE OR OTHER LIQUIDS HAVING
FLAMMABLE VAPOURS ARE STORED OR USED.**

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S405 SPECIFICATIONS

Certified to ANSI Z83.7-2000 Construction Heater

Gases: Natural or Propane
Capacity: 400,000 Btu/h maximum

Orifice Size: 42 DMS (x18)

Blower: 2,000 cfm

Electrical Rating: 115 volts, 60 Hz, 12 amps, single phase

Minimum Temperature Rating: Minus 40 degrees F

| Gas Supply: | Inlet Pressure | | Manifold Pressure |
|-------------|----------------|----------|-------------------|
| | Max W.C. | Min W.C. | |
| Propane | 14 inches | 7 inches | 1.3 inches |
| Natural | 14 inches | 7 inches | 4.0 inches |

(Minimum inlet pressure is for purpose of input adjustment)

INSTALLATION

The Sure Flame Model S405 is a direct fired gas heater intended to be used primarily for the temporary heating of buildings under construction, alteration, or repair. Since all the products of combustion are released into the area being heated, it is imperative that adequate ventilation is provided. The flow of supply air and combustion gases must not be obstructed in any way. Do not use the heater with ductwork as this will restrict the flow of supply air.

- 1 Install the heater properly in a horizontal position at least 10 ft. (3 m) from any propane-gas container. Front Outlet must not be directed toward any propane-gas container within 20 ft. (6 m). Allow the following clearances from any combustible material:

| | | | |
|---------------|---------|--------|--------|
| Front Outlet: | 12 feet | Sides: | 2 feet |
| Intake: | 2 feet | Top: | 5 feet |

Also make sure that no flammable vapours are present in the space where the heater is being used.

- 2 When connecting the heater to a natural gas or propane supply line ensure that the pressure at the heater inlet is within the specified range. Please refer to Propane and Natural Gas Installation sections in this manual. Excessive pressure (over 1/2" psig) will damage the controls and void the warranty.
- 3 Visually inspect the hose assembly and ensure that it is protected from traffic, building materials, and contact with hot surfaces. If it is evident that there is excessive abrasion or wear, or the hose is cut, it must be replaced.
- 4 After installation, check the hose assembly for gas leaks by applying a water and soap solution to each connection.
- 5 Connect the heater to an adequate 115 volt electrical supply and in compliance with the *Natural Electrical Code ANSI/NFPA 70*. For protection against shock hazard the supply cord should be plugged directly into a properly grounded three-prong receptacle.
- 6 In all applications install the heater in such manner it is not directly exposed to water spray, rain and/or dripping water.

INSTALLATION USING A PROPANE SUPPLY CYLINDER

- 1 When installing the heater for use with propane gas, set the gas selector valve to "Propane" and lock in position.
- 2 The supply container MUST be equipped with an LP Gas Regulator that complies with ANSI/UL 144 Standard for Pressure Regulating Valves for LP Gas. Another regulator must be installed on the heater to reduce the pressure from this regulator down to a maximum inlet pressure of 1/2 psi.
- 3 Arrange the cylinder supply system to provide for vapour withdrawal from the operating cylinder. Supplying liquid propane to the heater is dangerous and will damage the components.
- 4 Ensure that for the surrounding temperature, the size and capacity of the propane supply cylinder is adequate to provide the rated Btu/h input to the heater.
- 5 Turn off the propane supply valve at the cylinder when the heater is not in use.
- 6 The installation must conform with all local codes, or in the absence of local codes, with the Standard for the *Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58*.
- 7 When the heater is to be stored indoors, the propane cylinder(s) must be disconnected from the heater and the propane cylinder(s) removed from the heater and stored in accordance with the National Standard for the *Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58*.

INSTALLATION FOR NATURAL GAS APPLICATIONS

- 1 When installing the heater for use with natural gas, set the GAS SELECTOR VALVE to the "Natural" position.
- 2 A regulator must be installed on the heater to ensure that the pressure to the heater does not exceed 1/2 psi (14" W.C.) inlet pressure.
- 3 The installation of this heater to a natural gas supply must conform with all applicable local codes or, in the absence of local codes, with the *National Fuel Gas Code ANSI Z223.1/NFPA 54*.

OPERATING INSTRUCTIONS

1 Set GAS SELECTOR VALVE to gas being used. The conversion shall be done by the owner or lessor of the equipment.

NOTE: When using Propane Gas the Selector Valve **MUST** be locked in position.

- 2 Ensure the MANUAL VALVE (valve nearest the burner) is in the "ON" position.
- 3 Connect power - 115 volt supply.
- 4 Open gas supply.
- 5 Push and release START button.
- 6 Set thermostat to desired temperature.
- 7 To stop, turn gas off.

The appliance area should be kept clear and free from combustible materials, gasoline, and other flammable vapours and liquids.

Ensure that the flow of supply air and combustion gases is not obstructed.

The installation and operation of the heater shall comply with the code requirements specified by the authorities having jurisdiction.

General criteria for the use of construction heaters may be found in the applicable sections of American National Standard A10.10-1987, Safety Requirements for Temporary and Portable Space Heating Devices and Equipment Used in the Construction Industry.

INSTALLATION AND MAINTENANCE OF THE HEATER MUST BE ACCOMPLISHED BY A QUALIFIED SERVICE PERSON

COMMON INSTALLATION & OPERATIONAL PROBLEMS

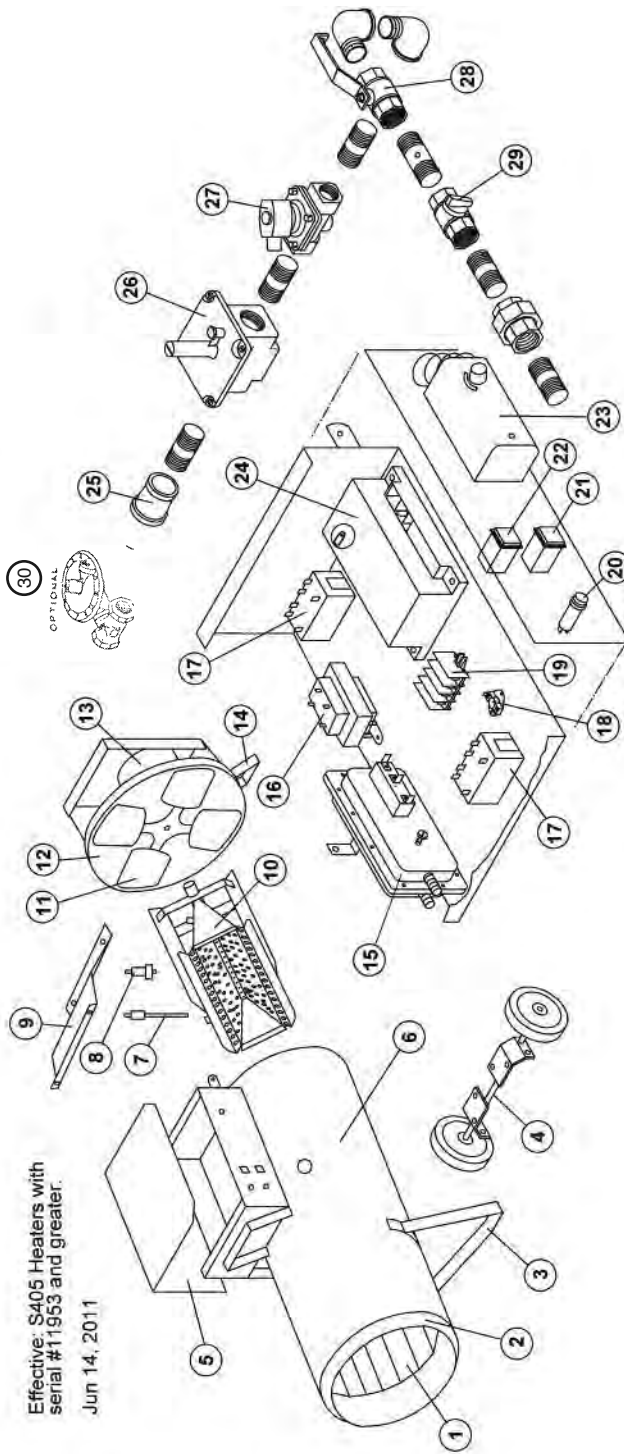
- 1 **LOW VOLTAGE** - This is one of the most common problems and is usually the result of the supply cord having too small a wire gauge for its length. Low voltage results in the motor overheating, burnt relay contacts, or a relay that will not make contact.
- 2 **SUPPLY LINE TOO SMALL**
- 3 **INSUFFICIENT VAPORIZATION AT SUPPLY** - Normally caused by too small size of supply tank.
- 4 **IMPROPER GAS SUPPLY PRESSURE** - Usually a result of supply pressure being too high because of improper or lack of regulation.
- 5 **DIRTY GAS SUPPLY** - Dirty gas can cause strainers to plug or form a build-up in the burner orifice.
- 6 **LACK OF PREVENTATIVE MAINTENANCE** - Heaters must be cleaned as required, especially when used in a dirty environment.
- 7 **IMPROPER SUPPLY OF FRESH AIR** - It is normally recommended that the intake air of the heater be taken from outside the enclosed area. This provides a slight pressurization and prevents any problems associated with recirculation.

SAFETY FEATURES

Servicing of Sure Flame Construction Heaters normally involves one of several built-in safety features. The Model S405 incorporates devices to detect the following:

- 1 **LOSS OF FLAME**
Gas supply is shut off if flame is lost to prevent raw gas from leaving the heater.
- 2 **OVERHEATING**
(a) Thermal overload protection in the motor.
(b) High temperature limit switch in the combustion chamber.
- 3 **LOSS OF POWER**
Total shutdown with manual reset required. Any one of the safety devices will create a loss of power situation.
- 4 **BLOCKED AIR SUPPLY**
A switch detects the differential pressure in the combustion chamber and shuts down when insufficient.

S405 HEATER PARTS



Effective: S405 Heaters with
 serial #11953 and greater.
 Jun 14, 2011

S405 HEATER PARTS

| Ref. | Part No. | Description |
|------|--------------|---|
| 1 | SFP S400-2 | Heat Shield |
| 2 | SFP S400-3 | Nose Cone |
| 3 | SFP S400-57 | Front Leg Assembly |
| 4 | ACC SWK1 | Wheel Kit (optional) |
| 5 | SFP 4517 | Control Box Lid |
| 6 | SFP S400-503 | Heater Body Includes 1,2,3 |
| 7 | SFP SL11B86 | Flame Rod |
| 8 | SFP 2142 | Spark Plug |
| 9 | SFP SC400-38 | Valve Train Cover |
| 10 | SFP BV4-50 | Burner |
| 11 | SFP 2420 | Fan Blade |
| 12 | SFP S400-502 | Motor Mount (with screen & rear legs) |
| 13 | SFP 2430 | Motor 1/4 H.P. |
| 14 | SFP S400-47 | Rear Leg Assembly (less motor mount & screen) |
| 15 | SFP 5124 | Air Switch |
| 16 | SFP 4510 | 24V Transformer |
| 17 | SFP 9872 | Relay 24V (two required) |
| 18 | SFP 2446 | Hi Limit Thermoswitch |
| 19 | SFP 9823 | Terminal Block |
| 20 | SFP 4518 | Indicator Light 24V |
| 21 | SFP 3337R | OFF Switch (Red) |
| 22 | SFP 3337G | ON Switch (Red) |
| 23 | SFP 2453 | Thermostat |
| 24 | SFP 1331 | Direct Spark Ignition Control |
| 25 | SFP 40SV01 | Strainer |
| 26 | SFP 2524 | Low Pressure Regulator |
| 27 | SFP 4514 | Solenoid Shut Off Valve 24V |
| 28 | SFP S400-73 | Changeover Valve |
| 29 | SFP 2538 | Manual Shut Off Valve |
| 30 | ACC-40SV06 | Hi Pressure Regulator (optional) |

Not Shown

| | |
|-------------|---------------------------|
| SFP HC1008 | Kit, Wire Ignition |
| SFP 2144 | Spark Plug Nut |
| HWP HC1020 | Power Cord |
| SFP S405-84 | Airtube Upstream-Copper |
| SFP S405-85 | Airtube Downstream-Copper |

DESIGN RELATED ADDITIONAL SAFETY FEATURES:

- 1 LOCKING POSITION FOR LPG ON GAS SELECTOR LEVER
Units used with LPG while the gas selector valve is positioned for Natural Gas will throw significantly more heat than the rated Btu/h. This is definitely a safety hazard.
- 2 LOW SKIN TEMPERATURE
Sure Flame Heaters are designed to have a low skin temperature. This provides added safety in the workplace.
- 3 DURABLE CONSTRUCTION
The Model S405 uses a stainless steel burner for long life and consistent performance.
In order to maintain the highly efficient combustion of the Sure Flame Heater, the combustion chamber must remain as manufactured. Any change or distortion could alter the fuel/air mixture and create unwanted gases.

ON-SITE SAFETY PROBLEMS

- 1 SHORTING OUT OF DEFECTIVE COMPONENTS
This is a very common problem which saves short term expense at the risk of a large future cost. Any heaters found in this condition should be removed immediately.
- 2 IMPROPER ENCLOSURES
When heaters are installed partially to the outside for fresh air intake, strict adherence must be made to the minimum clearance to combustibles given on the instruction plate. Wood framing around a heater is a hazard and should not be used.
- 3 SUPPLYING LIQUID PROPANE TO HEATER
This heater is not intended to burn liquid propane. To minimize the damage, shut off the gas supply and let the heater run until all of the liquid in the lines has been burnt.

PREVENTATIVE MAINTENANCE

Sure Flame Construction Heaters are built to withstand the rigours of operating on construction sites, mining applications, and a multitude of other locations where heaters are used. To maintain reliable performance it is necessary to perform regular maintenance.

A VISUAL CHECKS

The following items should be checked for excessive wear or damage:

- 1) Wheels (if installed)
- 2) Cords and Connectors
- 3) Wiring and Conduit
- 4) Heater Shell (including heat shield) and Control Box

It is recommended that units be purchased as spares be rotated periodically, so that each unit will be placed in operated at least every 90 days.

B BURNER

Flame Rod and Insulator - Clean with soap and water or solvent on a routine basis. Any build up on burner should also be removed at this time.

Spark Plug - Clean with solvent and check spark gap.

C CONTROL BOX - The inside of the control box should be cleaned using a dry cloth or by blowing compressed air. Do not use any liquid or aerosol spray cleaners. Also check that all electrical connections are snug and tight.

D MOTOR - The electric motor on the S405 Heater is fitted with sealed bearings and no oiling is required. Keep the motor clean by blowing or wiping off dust or dirt in order to prevent it from over heating.

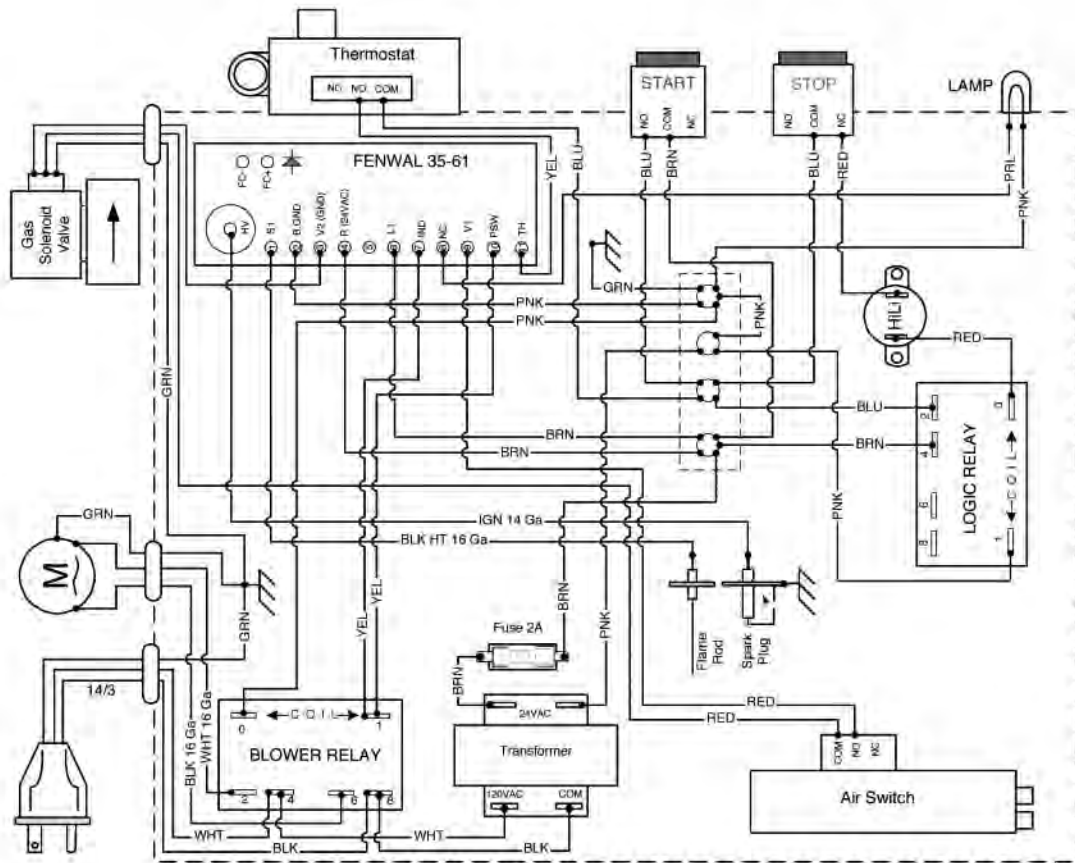
E FAN - Check for dust or dirt build up on fan blades. Check the tightness of the set screw and run the heater to check for fan vibration.

S405 TROUBLE SHOOTING CHART

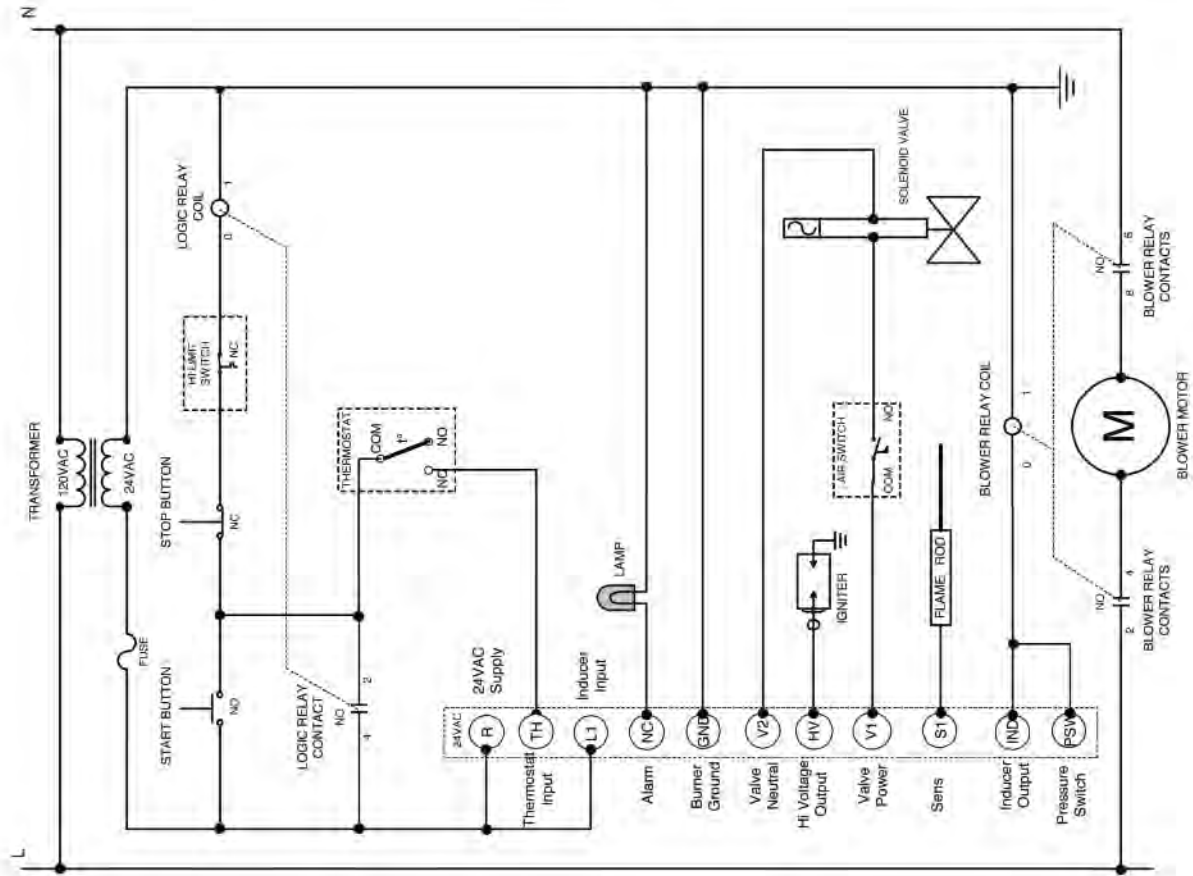
| SEQUENCE | PROBLEM | CHECK | CAUSE |
|----------|--|---|--|
| 1 | <p>Press START</p> <p>Power relay closes indicated by a "Click" sound (adjust thermostat clockwise for S405 & S400T OFF/ON model only)</p> <p>Fan motor starts</p> | <ul style="list-style-type: none"> - If no power between L1, L2 - If no power at limit switch - If no power at transformer - If no power at relay coil - If power at relay coil - If no power between T1, T2 - If power between T1, T2 | <p>No power at plug</p> <p>Faulty stop/start switch</p> <p>Faulty limit switch</p> <p>Faulty ignition control</p> <p>Faulty relay</p> <p>Faulty relay contacts</p> <p>Faulty motor</p> |
| 2. | <p>Ignition control produces spark</p> <p>Short delay until fan reaches full RPM</p> <p>Air Switch closes</p> <p>Safety shut-off gas valve open indicated by "Click" sound</p> | <ul style="list-style-type: none"> - If power between POWER & GND on ignition control - If NO power between POWER & GND on ignition control | <p>Faulty ignition control or spark plug.</p> <p>Faulty transformer</p> |
| 3. | <p>Gas ignites, flame is proven,</p> <p>Light ON</p> | <ul style="list-style-type: none"> - If NO power at air switch pressure differential to close air switch or faulty air switch - If power at air switch - Recheck sequence #2 - Check gas supply - Press STOP Button to reset return to Sequence #1 above - If NO power at hi fire valve | <p>Insufficient air</p> <p>Faulty solenoid</p> <p>Insufficient gas pressure.</p> |
| 4. | <p>Thermostat controlled operation on S400T (HI/LO)</p> <p>Hi fire valve does not close</p> | | <p>Faulty thermostat or setting too high</p> |

CAUSE Sept 27, 1989

S405 CONNECTION WIRING DIAGRAM



S405 LADDER WIRING DIAGRAM



Optional Accessories

Note: If your incoming gas supply pressure is greater than 1/2 psi you will need a regulator to reduce the incoming pressure before installation to heater.



REGULATOR

ACC 40SV06
Handles up to 60 psi

For NG pressure
1-5 lbs. Call Heat Wagon



GAS HOSE

ACC 7525 - 3/4" x 25'
CSA certified for NG
and Propane

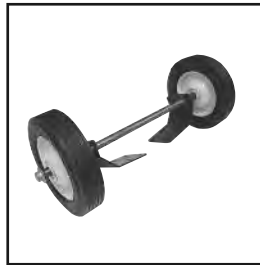
Female Swivel Fittings
Included



PRESSURE GAUGE

HWP HV1169
W.C. 0-15"

1/4" MNPT



WHEEL KIT

ACC WK1P



ACC-INSTKIT

*Everything you need for installation of
propane tank to heater.
(Includes 25' of 3/4" hose)*