



**SURE FLAME®**

# S400 & S400T

## CONSTRUCTION HEATERS



September 16, 2004

**SERVICE AND MAINTENANCE MANUAL No. 934-6638**  
**PLEASE RETAIN FOR FUTURE REFERENCE**

**SURE FLAME® PRODUCTS**

A DIVISION OF HAUL-ALL EQUIPMENT LTD.  
LETHBRIDGE, ALBERTA



# S400 & S400T CONSTRUCTION HEATERS



## 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.



## 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.



## WARNING

Not for home or recreational vehicle use

# READ THIS WARNING FIRST!

The heater is designed and approved for use as a construction heater under CSA 2.14-2000. 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.

**Gas inspection authorities in Canada require that the installation and maintenance of heaters and accessories be accomplished by qualified gas fitters.**

**Installation must comply with the Natural Gas and Propane Installation Code, CSA B149.1.**

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.

# S400 & S400T CONSTRUCTION HEATERS

## FOR YOUR SAFETY

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

## CONTENTS

Specifications .....	6
Installation .....	7
Installation Using A Propane Supply Tank .....	8
Installation For Natural Gas Applications .....	8
Operating Instructions .....	9
Sequence Of Operation .....	10
Common Installation And Operational Problems .....	10
Safety Features .....	11
Design Related Additional Safety Features .....	12
On-site Safety Problems .....	12
Preventive Maintenance .....	13
Trouble Shooting S400/S400T .....	14
S400/S400T Heater Parts .....	18
S400 Connection Wiring Diagram .....	20
S400 Ladder Wiring Diagram .....	21
S400T Connection Wiring Diagram .....	22
S400T Ladder Wiring Diagram .....	23

# SPECIFICATIONS

Model No. S400 & S400T Construction Heaters

CSA Certified to CSA 2.14-2000 Gas Fired Unvented 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, 5 amps, single phase

## Gas Supply:

	Inlet Pressure		Manifold Pressure	
	Max.W.C.	Min.W.C.	Max.W.C.	Min.W.C
				(S400T only)
<u>Propane</u>	<u>14 inch</u>	<u>7 inch</u>	<u>1.3 inch</u>	<u>0.6 inch</u>
<u>Natural</u>	<u>14 inch</u>	<u>7 inch</u>	<u>4.0 inch</u>	<u>1.8 inch</u>

(Minimum inlet pressure is for purpose of input adjustment)

# INSTALLATION

The Sure Flame Models S400 & S400T are direct fired gas heaters 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 in a horizontal position at least 6 feet from any LP-gas container, and allow the following clearances from any combustible materials:

Front Outlet: 12 feet (3.6 M)                      Sides: 2 feet (0.6 M)

Intake: 2 feet (0.6 M)                                      Top: 4 feet (1.2 M)

Front Outlet must not be directed at any LP-gas container within 20 feet (6 M).

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

The installation of this heater **MUST** be in accordance with either of the appropriate following Standard:

Natural Gas and Propane Installation Code, CSA B149.1.

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 8. Excessive pressure (over 1/2" psi) 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 as specified on the rating plate. For protection against shock hazard the supply cord must be plugged directly into a properly grounded three-prong receptacle. The electrical installation of the heater **MUST** be in accordance with CSA Standard C22.1-1990 Safety Standard for Electrical Installations.
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.

# INSTALLATION USING A PROPANE SUPPLY TANK

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 a UL listed Gas Pressure Regulator. This is essential to reduce the gas pressure to a safe transmittable pressure. This pressure must further be reduced so the gas pressure does not exceed the maximum input pressure of the heater. This can be accomplished by placing a suitably sized second stage gas regulator on the valve train at the heater. This regulator should also be a UL listed LP Gas Pressure Regulator.
3. Arrange the propane supply system to provide for vapour withdrawal from the operating container. 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 container is adequate to provide the rated Btu/h input to the heater.
5. Turn off the propane supply valve at the container when the heater is not in use.
6. The installation must conform with local codes, or in the absence of local codes, with the Natural Gas and Propane Installation Code, CSA B149.1.
7. When the heater is to be stored indoors the propane container must be disconnected from the heater and the container moved away and stored in accordance with the above National Standard.

# 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 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 Natural Gas and Propane Installation Code, CSA B149.1.



# 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 FIRING VALVE (Manual Valve nearest the burner) is in the "ON" position.
3. Connect power - 115 volt supply.
4. Open gas supply.
5. Push "START" button and **hold for 5 seconds.**
6. Set heat selector switch to desired heating mode. ( S400T only )
7. Set thermostat to desired temperature. ( S400T only )
8. To stop, turn gas off and push "STOP" button.

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. In the absence of specific Local Codes the installation of this Construction Heater **MUST** conform with the following National Standards:

Safety Standard for Electrical Installations, CSA C22.1-1990

(Canadian Electrical Code Part 1)

Natural Gas and Propane Installation Code, CSA B149.1

General criteria for the use of construction heaters may be found in the applicable sections of either the following Standard:

Natural Gas and Propane Installation Code, CSA B149.1.

**NOTE:** S400 HEATERS WITH SERIAL NUMBER 5984 AND GREATER AND S400T HEATER WITH SERIAL NUMBER 11271 AND GREATER WILL HAVE A 3.3 SECOND DELAY BEFORE STARTING.

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

## **SEQUENCE OF OPERATION**

1. Push **AND HOLD** start button for 5 seconds.
2. Control relay closes.
3. Motor starting relay closes.
4. Fan starts.
5. Fan reaches full speed and air switch closes.
6. Solenoid valve opens.
7. Spark is generated.
8. Flame rod senses flame, and then maintains flame.

### **(The following is for S400T only)**

9. If selector switch is set on HI-LO, heater will cycle from lo to hi flame thermostatically.
10. If selector switch is set on ON-OFF, heater will cycle on and off thermostatically.

## **COMMON INSTALLATION AND 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 maintain 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 Models S400 & S400T incorporate devices to detect the following:

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

# 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 Models S400 & S400T use 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 common problem 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 request for trouble.

## 3. SUPPLYING LIQUID PROPANE TO HEATER

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

# PREVENTIVE MAINTENANCE

Sure Flame Construction Heaters are built to withstand the rigours 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.

## 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 S400 & S400T Heaters 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.

# TROUBLE SHOOTING S400/S400T

An AC Voltmeter is required to perform these checks. The control circuit is 24V, the motor power is 115V. Use extreme caution when checking voltage.

1. Push start button and release
2. Control relay should close. If not, check the following:
  - a) Check for 115V between terminals A & B of the control relay, if no power proceed to hi-limit switch terminals.
  - b) If 115V is present at both terminals of limit switch then control relay is faulty, or there are poor connections.
  - c) If there is 115V at only one terminal of the hi-limit switch, the limit switch is faulty.
  - d) If 115V is not present at either terminal of the hi-limit switch, check the stop switch terminals.
  - e) If there is 115V present at only one terminal of the stop switch, while start switch is depressed, then check dual wire assembly on control relay.
  - f) If there is no power at either terminal of stop switch then check start switch.
  - g) If there is 115V present at only one terminal of the start switch, while start switch is depressed, then replace start switch.
  - h) If there is no power at either terminal of the start switch, then check red wire leading from start switch to the motor starting relay.
3. Motor starting relay should close. If not, check the following:
  - a) Remove the 6 pin connector assembly from the side of the Fenwall module and clean both sides with electrical contact cleaner.
  - b) If there is 24V across the coil terminals of the motor relay then relay is faulty.
  - c) If there is no power between the coil terminals of the motor relay then check for 24V at terminal P of the Fenwall module.
  - d) If 24V is present at terminal P then the Fenwall module is faulty.

**For S400 proceed to j), steps e to i apply to S400T only.**

- e) If there is no power present at terminal P of the Fenwall module, then turn thermostat clockwise to maximum setting. Then check for power at terminal 1 of the thermostat.
- f) If there is 24V present at terminal 1 of the thermostat then the selector switch is faulty.
- g) If there is no power present at terminal 1 of thermostat, check for power on the output side of the secondary transformer, if there is

- power present then check wire.
- h) Turn thermostat knob to the extreme clockwise position, if 115V is detected between the input terminals of the secondary transformer, then transformer is faulty.
  - i) If there is not 24V on the output side, and not 115V on the output side of the transformer then check the black wire on the input side of transformer
  - j) If 120V is present at the black wire on the input side of the transformer then the transformer is faulty.
4. Fan starts. If motor does not run check the following:
- a) Check to see if the fan blade is turning freely.
  - b) If there is 115V between T1 & T2 on the motor starting relay then there is a bad connection or broken wire between motor and relay.
  - c) If there is no power at T1 & T2 the contact points are dirty or the relay is faulty.
  - d) Remove back plate on motor, if there is 115V between the incoming white and black wires, then the connection to the motor is incorrect or the motor is faulty.
5. Fan reaches full speed and air switch closes, if air switch does not close check:
- a) If there is 24V on only one of the airswitch terminals while motor is running, then airswitch is staying open, first check the airtubes.
  - b) If either upstream or downstream air tubes are plugged.
  - c) If both are free then check alignment ( tubes should be positioned parallel to the air flow direction).
  - d) If above procedures do not correct problem, then the adjusting screw located on the side of the airswitch can be rotated counter clockwise, just enough so that fan stays running.
  - e) If this does not help then bypass the airswitch by joining the two wires together, if heater now runs then the airswitch is faulty.
6. Solenoid valve opens, if valve fails to open check:
- a) If there is 24V between the wires of the solenoid valve and a sharp click is not heard, then the coil of the solenoid valve is faulty.
  - b) If a sharp click is heard, then the valve body is faulty.
7. Spark is generated, if no spark is present, check:
- a) If the ignition wire is burnt, or cracked it may be shorting out to the

heater.

- b) Spark plug, clean and gap to approximately 1/8".
  - c) If there is 24V at terminal P of the Fenwall module, check ignition wire, if good then spark plug or ignition module is defective.
8. Flame rod senses and maintains flame, if not check:
- a) If flame rod wire is connected to flame rod and not grounding out to the heater.
  - b) If flame rod wire is inserted into the correct position of the Fenwall module.
  - c) The flame rod should be screwed into the burner securely. The probe part should not be touching the burner in any way thus grounding out.

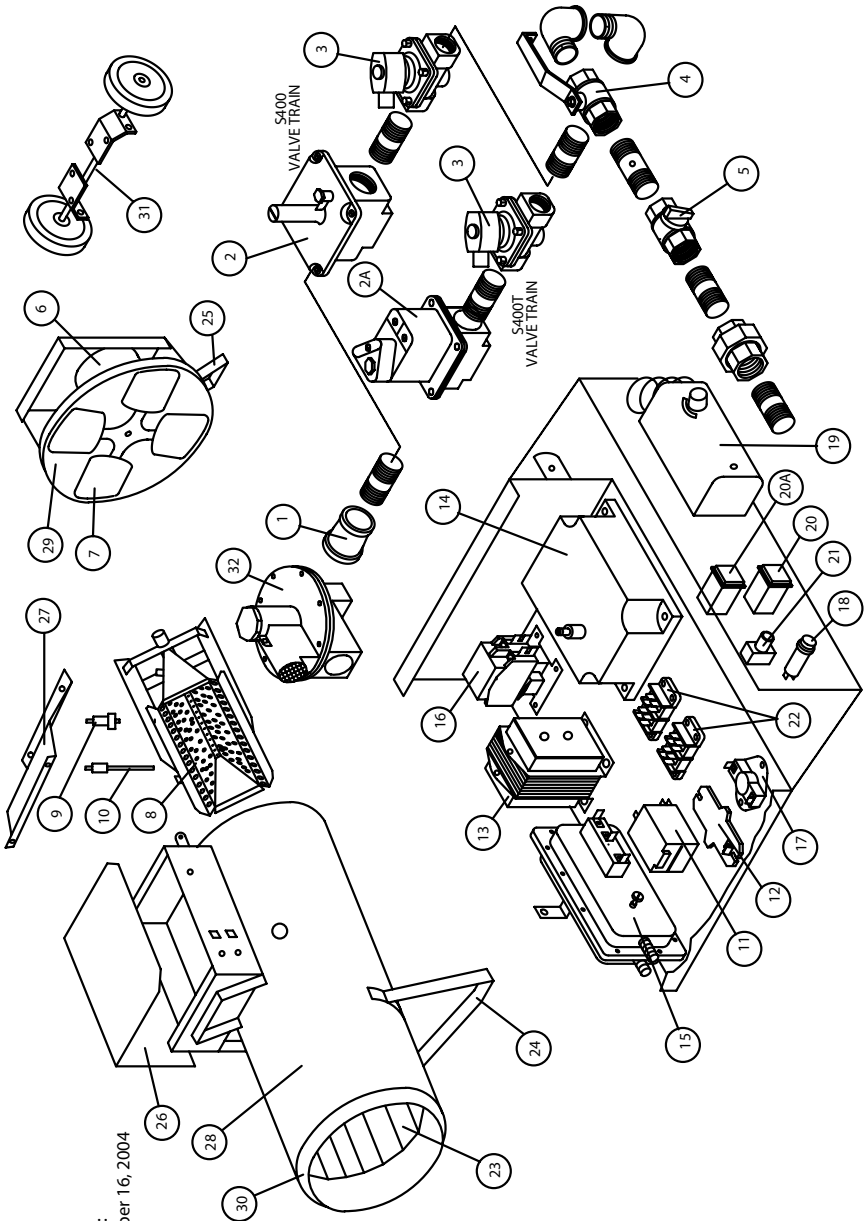
### **S400T Heaters Only**

9. Selector switch set on HI-LO position.
- a) If flame stays on low when thermostat is turned to the extreme clockwise position check for 24V at the 2 stage regulator terminals if 24V is present, then unit is wired wrong (refer to wiring diagram)
  - b) If it is wired correctly then 2-Stage regulator is faulty.
  - c) If flame stays on high when thermostat is turned to the extreme counter clockwise position check for 24V between the two terminals of the 2-Stage regulator if power is present then the regulator is adjusted wrong or faulty.
  - d) If there is no power between the terminals of the 2-stage regulator check for power at the top terminal (black wire) of the selector switch.
  - e) If no power at the top terminal (black wire) of the selector switch then thermostat is faulty.
10. Selector switch set to ON-OFF position.
- a) Firstly make sure that the white light is on signifying that unit is on.
  - b) If the heater does not start, check for power at terminal 3 of thermostat if power is present then the selector switch is faulty.
  - c) If there is no power present at terminal 3 of the thermostat then the transformer is faulty.
  - d) Turn thermostat to high setting, if no power is present at terminal #2 of the thermostat then the thermostat is faulty.





# S400/S400T HEATER PARTS



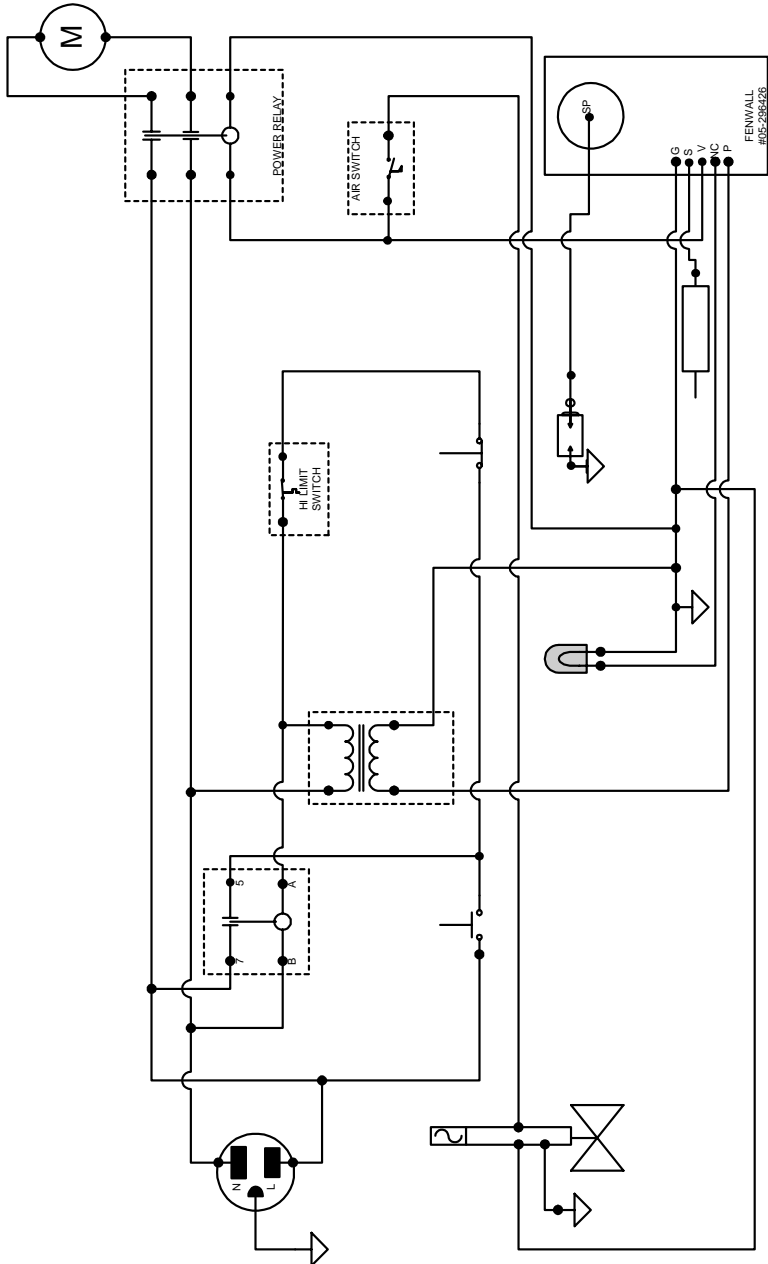
REVISED:  
September 16, 2004

# S400/S400T HEATER PARTS

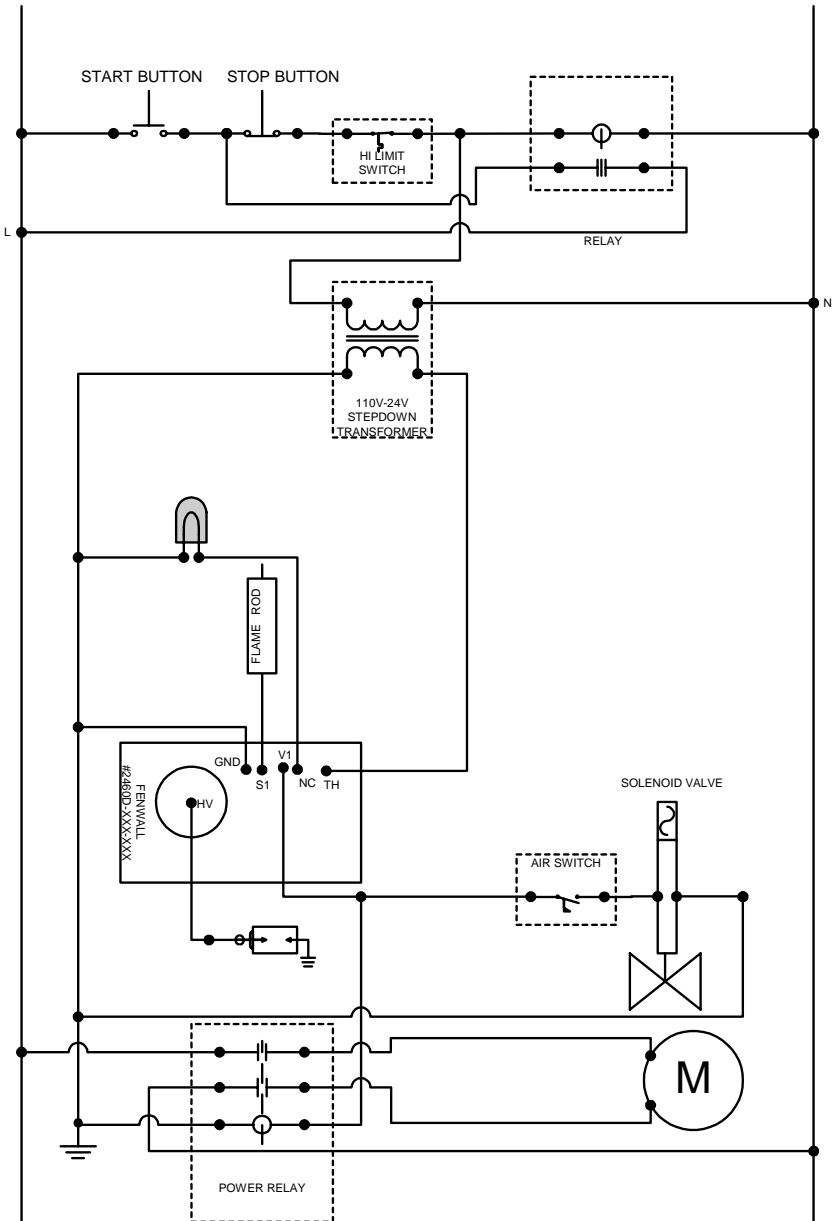
September 13, 2002

Ref. Part No	Description
1 S400-80	Strainer
2 2524	3/4" Appliance Regulator (S400 only)
2A 4517	2-Stage Regulator (S400T only)
3 4514	Solenoid Shut-Off Valve 24V
4 S400-73	Gas Selector Valve
5 5869	Manual Shut-Off Valve
6 2430	Motor 1/4 HP
7 2420	Fan Blade
8 BV45-50	Burner
9 2143	Spark Plug
10 S400-86	Flame Rod
11 4512	Control Relay with Clip 120V
12 6440	Relay Clip
13 4510	Transformer 24V
14 8264	Direct Spark Ignition Control
15 5124	Air Switch (0.2" W.C.)
16 4519	Motor Relay 24V
17 2446	HI Limit Thermoswitch
18 4518	Indicator Light 24V
19 2453	Thermostat (S400T only)
20 3337/8	OFF Switch (Red)
20A 3337/9	ON Switch (Green)
21 5545	Toggle Selector Switch (S400T only)
22 5768	Terminal Block
23 S400-16	Heat Shield
24 S400-57	Front Leg Assembly
25 S400-47	Rear Leg Assembly (less Motor Mount & Screen)
26 S400-7	Control Box Lid
27 S400-103	Valve Train Cover
28 S400-53	Heater Body includes: 23, 24 & 30
29 S400-502	Motor Mount (with Screen & Rear Legs)
30 S400-3	Nose Cone
31 S400-81	Wheel Kit (optional)
32 2527	3/4" Regulator (optional)

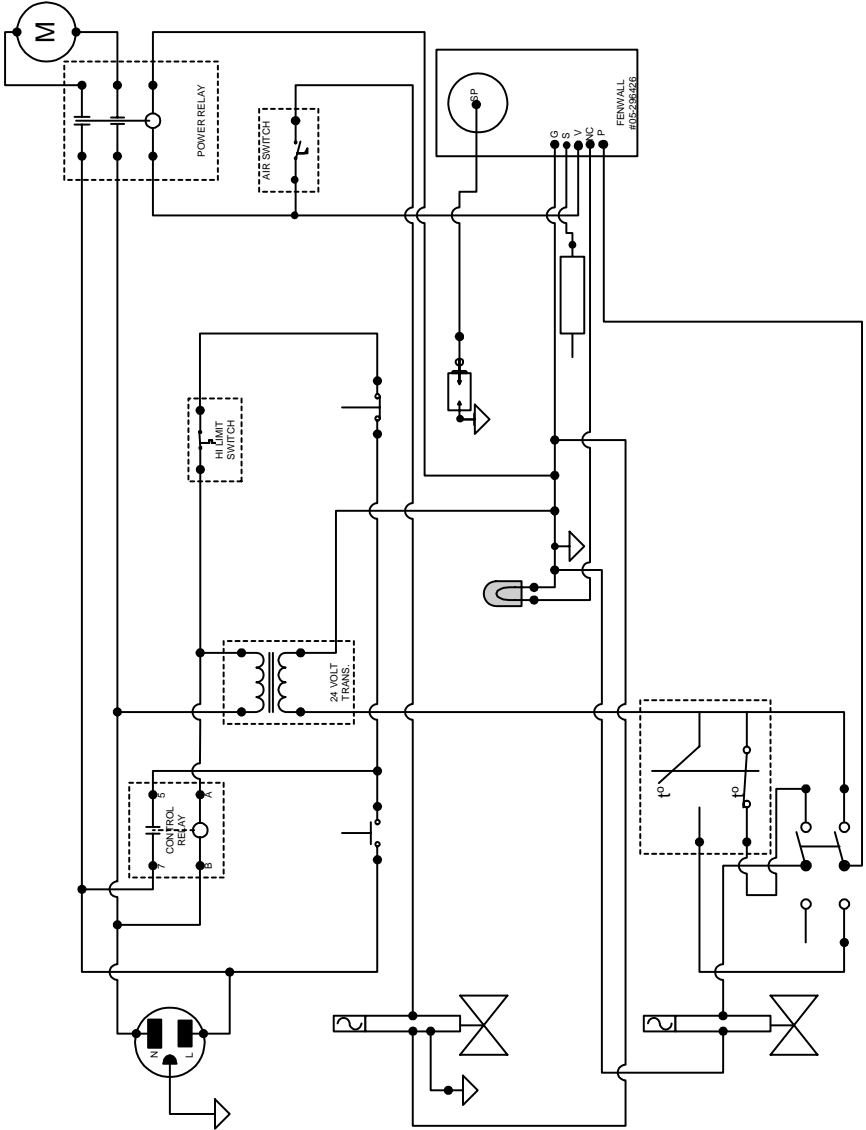
# S400 CONNECTION WIRING DIAGRAM



# S400 LADDER WIRING DIAGRAM



# S400T CONNECTION WIRING DIAGRAM



# S400T LADDER WIRING DIAGRAM

