

Ducted Systems Technical Services: Service Tips Letter

Letter: ST-013-22

Date: October 4, 2022 Effective: October 4, 2022

To: S1 HVAC Branch and Distributor Principal, Sales Manager, Service Manager, Parts Manager, Warranty Manager, Training Manager, Delegated Administrator.
Ducted Systems Technical Services, DS Parts/S1, ES Americas, ADTI Channel, Account Representatives, Marketing, Sales, Warranty teams.

Subject: **Furnace Safety Control Devices with diagnostics and inspection recommendations particularly for High-Temperature Limit and Flame Sensing Controls**

Product/s: 33" non-condensing furnace models GG8S, GGLS, RGF1L, RGF2L, TG8S, TGLS, TM8E, TM8T, TM8V, TM8X, TM8Y, TMLE, TMLT, TMLV, TMLX, YG8S

Summary: **The following information is provided to explain safety controls, various fault diagnostics, troubleshooting, and fault resolution for High-Temperature Limit and Flame Sensing Safety Controls**

Dear valued customer:

Johnson Controls takes product safety seriously. We provide safe and reliable products, designed, and manufactured to applicable quality and safety standards.

As an effort to improve consistency in diagnosing and resolving failures or faults related to Safety Controls and *specifically* to the high-temperature limit controls as well as the flame-proving sensor controls, the following troubleshooting guide is being promoted for future use and reference.

Note: Whenever working on HVAC equipment, ensure that all power is turned off to the unit, use appropriate personal protective equipment, i.e., gloves and protective goggles. Use required electrical protection equipment and tools suited for electrical operation purposes.

⚠ WARNING

Never bypass any safety control to allow furnace operation. To do so will allow furnace to operate under potentially hazardous conditions.
Do not touch or adjust any safety devices inside the indoor or outdoor units. All safety features, disengagement, and interlocks must be in place and functioning correctly for proper equipment performance
Do not try to repair controls. Replace defective controls with UPG Source 1 Parts

FURNACE SAFETY CONTROL DEVICES

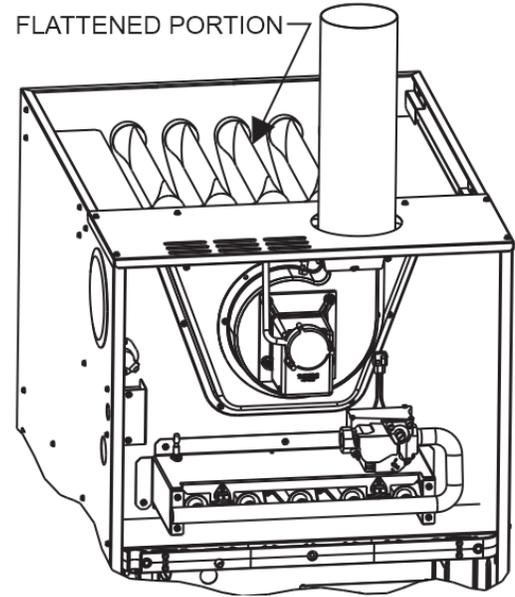
The following Safety Devices are included in the design of the furnace (* Depending on Age of the Unit)

- A. **HIGH-TEMPERATURE LIMIT CONTROLS** - This is an automatic reset control that provides over-temperature protection due to high temperatures typically caused by reduced airflow. If high-limit switch trips occur, the equipment must be inspected to diagnose and resolve failures or faults. Do not replace controls without ensuring that there are no other associated or underlying causes. Always replace defective controls with UPG Source 1 Parts. The high-temperature limit control is located on the furnace vestibule panel near the gas valve. The limit detects rising temperature in the airstream and opens at a specific temperature. Associated fault codes are either 4 (four) or 11 (eleven) RED FLASHES.
- a. 4 RED FLASHES: indicates that the main limit switch has opened its normally closed contacts. The control operates the supply air blower and inducer while the open limit condition exists. If the limit switch has not closed within 5 min, the control operates as if the blower is not functioning. The control starts a hard lockout and begins to flash the 11 Red Flashes error code. Power must be cycled off and on to reset the control after the problem is corrected.
 - b. 11 RED FLASHES: indicates that the main limit switch has opened its normally closed contacts and has remained open for more than 5 min. This condition is usually caused by a failed blower motor or blower wheel. The control enters a hard lockout and power must be cycled off and on to reset the control after the problem is corrected.

Diagnostics and Trouble Shooting Guide. This fault may be caused by one or more of the following, and each should be verified as to being either a potential cause or not:

- a. A dirty filter – check and replace as necessary.
- b. Improperly sized duct system or too many supply or return registers closed or blocked off – check and open or balance supply and return airflow as necessary.
- c. Improper indoor blower motor speed selection - Proper gas manifold pressure must be set and firing rate verified. Indoor heating blower motor speed must be set to maintain proper temperature rise as indicated on the unit rating plate. The heating blower speed is set at the factory to the default blower speed, which is the blower speed that delivers the correct airflow for proper heating operation in most applications. The default heating blower speed for each model is shown in its instruction manual. In certain circumstances, it may be necessary to change the heating blower speed to a different motor speed. Not all motor speeds are appropriate for gas heating operation. Also, do not energize more than one motor speed at a time (PSC motors only) or damage to the motor will result. A change in motor speed will typically require a remeasurement of the Temperature Rise (temperature difference between the return air and the supply air) from the furnace. Follow the instructions for Measurement of Temperature Rise in the instruction manual.
- d. Loose limit switch wiring or faulty limit switch – verify field wiring to the unit is properly grounded, re-verify ground wires and conductor connectors are tight and secure, and that the limit switch exhibits proper electrical continuity, and is not shorted to chassis.
- e. Faulty Blower Motor - Confirm line and in some cases low voltage (depending on motor type) to the motor to confirm if motor should be operating or not. Replace faulty blower motor as necessary.

- f. Obstructions in the heat exchanger / exhaust venting system – Examine the heat exchanger, vent pipe, combustion air passages, vent connectors, and chimney to be sure they are clear and free of obstructions. Note: proper orientation on the heat exchanger is for the compressed heat transfer blade portion to be up and away from the burner section and if applicable, towards the add-on indoor coil cabinet. If there are questions regarding the heat exchanger orientation, contact the Johnson Controls Field Service Support staff for further information and directions.



- g. Incorrect firing rate - Verify natural gas input rate by clocking meter. If clocked rate does not match the input rate from the unit nameplate, follow the steps in the manual to adjust the manifold pressure. In addition, examine the burner flames to make sure they are in good adjustment. Look to a pure blue flame with a light blue cone at its center that burns full, steady, and straight. If yellow or orange, partial, diverted, or unsteady flame is detected then turn off gas valve and clean any debris from nozzles and burners. If condition still

exists then check airflow, venting, gas pressure, etc. If condition still exists, contact the Johnson Controls Field Service Support staff for further information and directions.

- B. FLAME PROVING SENSOR – This sensor validates that there is flame present in the burner (flame allows for current flow) to ensure proper combustion. It helps protect the burner from buildup of gas without flame. If the flame is not detected within 7 s of the gas valve opening, the gas valve is shut off and a retry operation begins. Also, if the flame is lost for 2 s during the 10 s stabilization period, the gas valve is shut off and a retry operation begins. During a retry operation, the vent motor starts a 15 s inter-purge, and the ignitor warm-up time is extended to 27 s. If the flame is established for more than 10 s after ignition during a retry, the control clears the ignition attempt (retry) counter. If three retries occur during a call for heat, the furnace shuts down for 1 h. If at the end of the 1 h shut down there is a call for heat, the furnace initiates a normal start cycle. If the problem has not been corrected, the furnace locks out after three retries. Associated status/fault codes are CONTINUOUS / RAPID AMBER FLASH (not the same on all furnace models), 1 RED FLASH, 7 RED FLASHES, 8 RED FLASHES, or 9 RED FLASHES.

- a. CONTINUOUS AMBER FLASH: Flame sense current is below .28 microamps. Check and clean flame sensor. Check for proper gas flow. Verify that current is greater than .28 microamps at flame current test pad.
- b. RAPID AMBER FLASH: Flame sense current is below 1.5 microamps for more than 4.25 s after a successful trial for ignition. Check and clean flame sensor. Check for proper gas flow. Verify that current is greater than 1.5 microamps at flame current test pad.
- c. 1 RED FLASH: This indicates that flame was sensed when there was not a call for heat. The control will turn on both the inducer motor and supply air blower.

- d. 7 RED FLASHES: This fault code indicates that the flame could not be established during three trials for ignition. The furnace will lock out for one hour and then restart.
- e. 8 RED FLASHES: This fault is indicated if the flame is lost five times (four recycles) during the heating cycle. The furnace will lock out for one hour and then restart.
- f. 9 RED FLASHES: Indicates reversed line voltage polarity, grounding problem, or reversed low voltage transformer wires. Both heating and cooling operations will be affected. The furnace will not start the ignition sequence until this problem is corrected.

Diagnostics and Trouble Shooting Guide. This fault may be caused by one or more of the following, and each should be verified as to being either a potential cause or not:

- a. Malfunctioning Gas Valve - Check for a leaking or slow-closing gas valve. Correct for leaks and/or replace as necessary.
- b. Gas supply irregularities such as momentary loss of gas supply, flame blowout– these failures result in a disruption in the flame and are typically sensed within 1.0 s. The gas valve de-energizes and the control begins a recycle operation. A normal ignition sequence begins after a 15 s inter-purge. If during the five recycles the gas supply does not return, or the fault condition is not corrected, the ignition control locks out for 60 min. Check that the gas valve switch is in the ON position. Check for low or no gas pressure, faulty gas valve, dirty or faulty flame sensor, faulty hot surface ignitor, loose wires, or a burner problem. Verify natural gas input rate by clocking meter. If clocked rate does not match the input rate from the unit nameplate, follow steps in the manual to adjust the manifold pressure. In addition, examine the burner flames to make sure they are in good adjustment. Look to a pure blue flame with a light blue cone at its center that burns full, steady, and straight. If yellow or orange, partial, diverted, or unsteady flame is detected then turn off gas valve and clean any debris from nozzles and burners. If condition still exists then check airflow, venting, gas pressure, etc. If condition still exists, contact the Johnson Controls Field Service Support staff for further information and directions.
- c. A momentary loss of power for 50 ms or longer during burner operation, - this will typically de-energize the gas valve. When the power is restored, the gas valve will remain de-energized, and the ignition sequence will immediately restart. Check the IGNITION CONTROL FLAME SENSE LEVELS. Normal flame sense current is approximately 3.7 microamps DC (μa), Low flame signal warning starts at 1.5 microamps on most models. Low flame signal control lockout point is 0.5 to 0.1 microamps DC (μa) depending on furnace model.
- d. A faulty flame probe or flame probe circuit - verify field wiring to the unit is properly grounded, re-verify ground wires and conductor connectors are tight and secure. Check polarity at furnace and branch. Check that the flame probe exhibits proper electrical continuity and is not shorted to chassis. Only clean flame sensor using 0000 fine steel wool.
- e. Obstructions in the heat exchanger/exhaust venting system – Examine the heat exchanger, vent pipe, combustion air passages, vent connectors, and chimney to be sure they are clear and free of obstructions. Note: proper orientation on the heat exchanger is for the compressed heat transfer blade portion to be up and away from the burner section (as shown in the image above) and if applicable, towards the add-on indoor coil cabinet.

If there are questions regarding the heat exchanger orientation, contact the Johnson Controls Field Service Support staff for further information and directions.

Additional Safety Controls – These controls are included for reference but considered to be well covered in the Installation Manuals.

- C. **CONTROL CIRCUIT FUSE** - A 3-amp fuse is provided on the control circuit board to protect the 24-volt transformer from overload caused by control circuit wiring errors. This is an ATO 3, automotive type fuse and is located on the control board. Corrective Action is required. Recommended steps are to:
- Supply voltage field wiring to the unit must have a ground connection. Verify ground wires and conductor connectors are tight and secure.
 - Verify electrical continuity on service conductors and circuits.
 - Confirm no low voltage wiring or components are shorted to ground.
- D. **ELECTRICAL INTERLOCK SWITCH / BLOWER DOOR SAFETY SWITCH** - This unit is equipped with an electrical interlock switch mounted in the burner compartment. This switch interrupts all power at the unit when the panel covering the blower compartment is removed. Electrical supply to this unit is dependent upon the panel that covers the blower compartment being in place and properly positioned.
- E. **PRESSURE SWITCH** - This furnace is equipped with a pressure sensor in the burner compartment near the combustion blower. This sensor monitors combustion airflow through furnace and piping systems. If any of the conditions listed below are detected by the pressure sensor, the control board will prevent a hazardous condition from occurring by (depending on furnace model) shutting off the gas valve or speeding up the combustion blower motor (some models) to maintain adequate combustion airflow. If the combustion blower is already operating at full speed, the furnace control will then start reducing (some models) the input to the furnace to maintain proper combustion with the amount of combustion airflow available. The sensor will detect the following conditions:
- Blockage of vent piping or vent terminal,
 - Failure of combustion air blower motor or combustion air blower wheel.

If there are any questions or comments regarding these safety sensors and controls, please contact the Johnson Controls Field Service Support staff for further information and directions.

Warm regards,



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