TRIUMPH SERIES
AIR SUPPLY AND VENTING GUIDE

C.S.A Design-Certified
Complies with ANSI Z21.13/CSA 4.9
Gas-Fired Low Pressure Steam & Hot Water Boilers

ASME Code Section IV

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Complies with ANSI Z21.13/CSA 4.9
Gas-Fired Low Pressure Steam & Hot Water Boilers

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I  CODE COMPLIANCE

APPLICABLE CODES & STANDARDS

Codes
United States:
NFPA 54/ANSI Z223.1 - National Fuel Gas Code
NFPA/ANSI 211 - Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances
Canada
CAN/CSA B149.1 - Installation Codes for Gas Burning Equipment

Standards
UL 1738 - Venting Systems for Gas-Burning Appliances, Categories II, III, and IV
ULC S636-95 - Standard for Type BH Venting Systems
Sheet Metal and Air Conditioning Contractors - Thermoplastic Duct Construction Manual National Association (SMACNA)

These codes and standards contain information for the venting of gas fired appliances, including, but not limited to vent sizing, location, clearance to combustibles, and safe installation practices. The installation must comply with both the above Federal Codes and with state, provincial and local codes.

All installations of venting systems should be done only by qualified venting systems personnel and in accordance with vent system manufacturer's installation instructions. Installing a boiler or vent system using improper installation methods or materials can result in serious injury or death due to fire or asphyxiation.

For correct installation of vent system, read all of these instructions and refer to vent manufacturer's instructions.

Failure to use one of the venting systems described in this manual will void the boiler warranty and may result in rapid deterioration of the venting system, creating a health or life safety hazard.

Faulty vent installation can allow toxic fumes to be released into living areas. This may cause property damage, serious bodily injury or death.

Install separate vents for natural draft and forced draft appliances. Common venting of natural and forced draft appliances may cause toxic fumes to exhaust through the natural draft appliance rather than to outside air. Breathing exhaust fumes may cause serious personal injury or death.

Before connecting a boiler to a venting system, it must be determined whether the boiler is to be installed in a conventional or Direct Vent configuration.

See the TRIUMPH Operations and Maintenance Manual for specific safety requirements, warnings, installation requirements and diagrams.
GAS VENT CATEGORIES
Several codes and standards have categorized appliances in accordance with the flue gas temperature and pressure produced by the appliance. Categories are defined as follows:

Category I An appliance that operates with a non-positive vent static pressure and with a vent temperature that avoids excessive condensate production in the vent.
Category II An appliance that operates with a non-positive vent static pressure and with a vent temperature that may cause excessive condensate production in the vent.
Category III An appliance that operates with a positive vent static pressure and with a vent temperature that avoids excessive condensate production in the vent.
Category IV An appliance that operates with a positive vent static pressure and with a vent temperature that may cause excessive condensate production in the vent.
Direct Vent An appliance that is constructed and installed so that all air for combustion is derived directly from outdoors and all flue gases are discharged to the outdoors.

VENTING MATERIALS FOR FLUE PIPE SYSTEMS
TRIUMPH Series boilers are Category IV appliances, which vent with a positive exhaust pressure and with a temperature that is likely to cause condensation in the vent. Therefore, any venting system used with the TRIUMPH Series boiler must comply with the requirements for Category IV venting systems as specified in NFPA 54/ANSI Z223.1, Chapter 12 in the US or with CAN/CSA B-149.1, Chapter 8 in Canada.

The venting materials listed below are intended for the venting of gas burning appliances only. Do not use these venting materials for venting liquid or solid fuel (such as oil, kerosene, wood or coal). Maintain clearances to combustibles as listed in the vent manufacturer’s installation instructions or as set forth in the codes and standards listed in section 1.1.

Do not use these vent pipes for incinerators of any sort.
According to ANSI Z21.13./CSA 4.9, Gas-Fired Low Pressure Steam and Hot Water Boilers, Table XVII Maximum Allowable Temperatures of Typical Non-Metallic Vent Materials the maximum allowable temperature for PVC is 158°F (70°C) and for CPVC is 210°F (100°C).

This boiler is NOT certified for use with PVC venting. Use of PVC vent may result in vent failure and possible serious injury or death. It is certified for CPVC venting.

Acceptable Manufactured Venting Systems
US and Canada
Vent Systems listed and labeled as Category IV vent to UL1738 Venting Systems for Gas-Burning Appliances, Categories II, III, and IV
Vent systems listed and labeled as positive pressure, Class IIc or IId vent to ULC S636
CPVC Venting
US
CPVC pipe conforming to ASTM F441, fittings conforming to ASTM F439 (Sch 80). Joints are to be sealed with solvent conforming to ASTM F493.
Canada
CPVC Pipe, Fittings and Sealant listed and labeled to ULC S-636 Standard for Type BH Venting Systems
### Applicable Vent Materials By Boiler Model

<table>
<thead>
<tr>
<th>Models</th>
<th>UL 1738 or ULC S636 Metallic Vent</th>
<th>CPVC</th>
<th>ULC S636</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CANADA</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### II COMBUSTION AIR

Combustion air must be free from dust, lint, etc. The presence of such materials in the air supplied to the burner could cause nuisance "Low Air" shutdowns or premature burner failure. The boiler should not be operated during construction while the possibility exists of drywall dust, demolition dust, and other abnormal particulates.

The combustion air supply must be completely free of chemical fumes which may be corrosive when burned in the boiler. Common chemicals which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as freon, trichlorethylene, perchlorethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the boiler and the boiler vent. The result is improper combustion and premature boiler or vent failure.

Under no circumstances shall the boiler room ever be under a negative pressure. Particular care should be taken when exhaust fans, compressors, air-handling units or other equipment may rob air from the boiler. Note that this equipment may not be in the same space as the boiler(s).

### AIR INLET REQUIREMENTS – United States

When air is supplied from inside the building, the total required volume shall be the sum of the required volume for all the appliances located in the mechanical room. Adjacent rooms furnished with fixed openings communicating directly with the mechanical room are considered part of the required volume. The minimum volume is 50 ft³ per 1000 Btu/hr (4.8 m³/kW) of installed appliance input capacity.

Openings used to connect indoor spaces to obtain the required minimum volume shall be sized as follows:

- When rooms are on the same floor, each opening shall have an area equal to 1 square inch for each 1000 Btu/hr (2200 mm²/kW) of installed appliance input capacity, but not less than 100 square inches. One opening should be less than 12 inches above the floor and the other less than 12 inches below the ceiling. The minimum dimension of air openings shall be 3 inches.

- When rooms are on different floors, each opening shall have an area equal to 2 square inches for each 1000 Btu/hr (4400 mm²/kW) of installed appliance input capacity.

When combustion air is supplied from outside the building, the boiler room shall be provided with one or two openings to ensure adequate combustion air and proper ventilation.

When using one permanent opening, the opening shall commence within 12 inches of the ceiling and shall communicate directly with the outdoors or through a vertical or horizontal duct that communicates to the outdoors. The appliances shall have clearance(s) of at least 1 in. at the sides and back and 6 in. at the front of the appliance.
Minimum free area of the opening is 1 square inch for each 3000 Btu/hr (700 mm² / kW) of installed appliance input capacity, and

Not less than the sum of the areas of all vent connectors in the room.

When using two permanent openings, one opening shall be not more than 12 inches above the floor and the other not more than 12 inches below the ceiling, preferably on opposite walls. The openings shall communicate directly, or by way of ducts, with free outdoor air. The minimum net free area of the openings shall be calculated in accordance with the following:

When air is taken directly from outside the building, each opening (minimum of two, as outlined above), 1 square inch for each 4,000 Btu per hour (550 mm²/kW) of total boiler input is required.

When air is taken from the outdoors through a vertical duct into the mechanical room, 1 square inch per 4,000 Btu per hour (550 mm²/kW) of total boiler input is required.

When air is taken from the outdoors through a horizontal duct into the mechanical room, 1 square inch per 2,000 Btu per hour (1100 mm²/kW) of total boiler input is required.

NOTE:
1. The required size of openings for combustion, ventilation and dilution air shall be based on the net free area of the opening.
2. Screens shall be not smaller than ¼".
3. Motorized louvers shall be interlocked with the appliance so that they are proven open prior to main burner ignition and operation.

<table>
<thead>
<tr>
<th>US Minimum area of ventilation openings per boiler (sq inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

AIR INLET REQUIREMENTS – CANADA

Ventilation of the space occupied by fuel burning appliance(s) or equipment shall be supplied by a ventilation opening at the highest practicable point communicating with the outdoors. The total cross sectional area of the ventilation opening must be either 10% of the net free area required for combustion air or 10 sq. in. (6500 mm²), whichever is greater.

When combustion air is supplied for natural or fan-assisted burners by natural airflow from the outdoors, there shall be a permanent opening with a cross sectional area not less than 1 sq. in/7000 Btu/Hr (321 mm²/kW) up to and including 1,000,000 Btu/Hr plus 1 sq. in./14,000 Btu/Hr (155 mm²/kW) in excess 1,000,000 Btu/Hr. This opening must be either located at or ducted to a point not more than 18 in. (450 mm) nor less than 6 in. (150 mm) above floor level. This opening is in addition to the ventilation air opening defined in the prior paragraph.

When combustion air is supplied for a forced draft (power) burner by natural airflow from the outdoors and there is no draft regulator or draft hood in the same space, there shall be a permanent opening with a cross sectional area not less than 1 sq. in/30,000 Btu/Hr (70 mm²/kW) of the total rated input to the burner(s). This opening must not interfere with the ventilation air opening defined in the first paragraph.

When combustion air is supplied by natural airflow into a space containing both types of appliances described above (fan-assisted and forced draft burners), the cross sectional area of the opening shall be not less than the sum of the cross sectional areas for all appliances in the space as calculated by the applicable method. This opening is in addition to the ventilation opening described in the first paragraph.
When a duct is used to meet the requirement for combustion air supply, as described above, the opening of the duct shall be located so there is no possibility of cold air affecting steam or water piping, electrical equipment or mechanical equipment.

When combustion air is supplied by mechanical means, an airflow-sensing device must be installed. It must be wired into the pre-ignition limit string to prevent the burner from starting or to stop an operating burner in case of air supply failure.

When all combustion air is supplied through a make-up air heater, and the appliance is interlocked to the heater, the requirements of the paragraphs above do not apply.

NOTE:
1. The free area of a combustion air supply opening is calculated by deducting the blockage area of any fixed louvers, grilles or screens from the total area of the opening.
2. Screens shall be not smaller than ¼".
3. Motorized louvers shall be interlocked with the appliance so that they are proven open prior to main burner ignition and operation.

Canadian Minimum Area of Combustion and Ventilation Air Openings

<table>
<thead>
<tr>
<th>Input (Btu/Hr)</th>
<th>Required Combustion Air Opening</th>
<th>Ventilation Air Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-750 750,000</td>
<td>25 in² 15,382 mm²</td>
<td>10 in² 6,452 mm²</td>
</tr>
<tr>
<td>T-900 900,000</td>
<td>30 in² 18,459 mm²</td>
<td>10 in² 6,452 mm²</td>
</tr>
<tr>
<td>T-1000 1,050,000</td>
<td>35 in² 21,535 mm²</td>
<td>10 in² 6,452 mm²</td>
</tr>
</tbody>
</table>

III Flue Gas Venting

This boiler is not certified for use with Type "B" vent nor with PVC venting.

This boiler is a Category IV appliance (condensing positive pressure) as it is defined in ANSI Z21.13/CSA 4.9, latest edition. The vent material must be as listed in Table 1.31 and 1.3.2. The exhaust vent can be run horizontally or vertically. Vent installations shall be in accordance with ANSI Z223.1, the National Fuel Gas Code, or CAN/CSA-B149.1, the Natural Gas and Propane Installation Code, or applicable provisions of the local building codes.

VENT SIZING

The vent must be sized in accordance with the ASHRAE Systems and Equipment handbook, Chapter 30 or according to the vent manufacturer’s recommendations. When using manufactured venting systems, consult your vent supplier for correct sizing and structural support requirements.

Additional vent sizing information is available in the TRIUMPH Operations and Maintenance manuals.

Vent Design Parameters

<table>
<thead>
<tr>
<th>Model</th>
<th>Frictional Resistance</th>
<th>Stack Temperature</th>
<th>CO₂ Natural Gas</th>
<th>CO₂ LP Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>T750 T1000</td>
<td>0.440</td>
<td>210°F</td>
<td>9%</td>
<td>10.4%</td>
</tr>
</tbody>
</table>
**Do not use a barometric damper with this boiler. This is a positive pressure system. Flue gases may leak into the room.**

All boiler venting systems should be designed by a qualified venting professional experienced in venting system design. The information contained herein should be used as a guide only and is not intended to be used in lieu of qualified technical expertise.

**VENT SYSTEM INSTALLATION**

Install CPVC vent systems in accordance with this manual and the SMACNA Thermoplastic Duct Construction Manual. Install manufactured vent systems in accordance with the manufacturer's listing and instructions.

When venting this boiler using CPVC vent material, the following operating and installation conditions must be met:

**Operating Parameters**
- Maximum Water Temperature Set Point: 180°F
- Flue Gas Limiting Switch: 200°F

**Installation Parameters**
- Cement and primer must conform to ASTM F493
- Three feet of venting closest to the boiler must not be enclosed
- The vent shall not be insulated

**CPVC Support Spacing (Feet)**

<table>
<thead>
<tr>
<th>Vent Size</th>
<th>Sch 40</th>
<th>Sch 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4</td>
<td>4-1/2</td>
</tr>
<tr>
<td>6</td>
<td>4-1/2</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>5-1/2</td>
</tr>
<tr>
<td>10</td>
<td>5-1/2</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>6-1/2</td>
</tr>
</tbody>
</table>

A customer supplied adapter is required to be installed between the boiler and the CPVC venting. Below is a table containing the available adapter for each size TRIUMPH boiler. Installer should use Adapters listed below or equivalent.

**Stainless Steel Adapter for CPVC Part Numbers**

<table>
<thead>
<tr>
<th>Boiler Size</th>
<th>Nominal Stack Size</th>
<th>Stainless Adapter for CPVC Supplier / Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>T750</td>
<td>6&quot;</td>
<td>Heat-Fab / 9601PKCPVC</td>
</tr>
<tr>
<td>T900</td>
<td>8&quot;</td>
<td>Heat-Fab / 9801PKCPVC</td>
</tr>
<tr>
<td>T1000</td>
<td>8&quot;</td>
<td>Heat-Fab / 9801PKCPVC</td>
</tr>
</tbody>
</table>
CLEARANCES
Provide clearances between combustion air intake, exhaust vent, roof and wall surfaces, doors and window, and snow line. Refer to Fig 3.1 for details.

Fig 3.1 Termination Clearances – Forced Draft and Direct Vent Installations

Conventional Vent Systems
The vent system shall terminate at least 3 ft above a forced air inlet within 10 feet horizontally. The vent system shall terminate at least 4 ft below, 4 ft horizontally from or 1 ft above any door, operable window or gravity inlet into any building. The bottom of the vent terminal shall be at least 12 in. above grade or highest expected snow line (if applicable). Through the wall terminations shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves or other equipment.

Direct Vent (Sealed Combustion) Systems
The vent terminal shall be located at least 12 in. from any air opening into a building. The bottom of the vent terminal shall be at least 12 in. above grade. Both the vent and air intake terminals must be at least 12 in. above the highest expected snow line. Through the wall terminations shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves or other equipment.

Do not locate exhaust terminations directly above a walkway. Dripping of flue gas condensation may cause icing of the walking surface. Maintain a minimum clearance of 4 ft (1.22 m) horizontally from any electric of gas meter, regulator or relief equipment.
Interior Installation

All vent system components shall be installed so as to maintain the following required minimum clearances to combustibles:

- Unlisted single wall metal pipe 18 in.
- Single wall CPVC pipe 18 in.
- Factory built chimney Per manufacturer’s listing

**NOTE:** If the vent is erected directly behind the boiler, make sure that the weight of the vent is not supported by the boiler vent collar. The collar is not designed to support the weight of the vent. The CPVC or manufactured vent system shall be supported in accordance with the manufacturer’s instructions. Horizontal vent sections shall be supported in a manner to prevent sags or low spots where condensate can collect. Structural supports must be connected to building elements of sufficient strength to withstand the weight of the vent system and any bending forces imposed by the venting system.

Flue Connection

The connection from the boiler to the vent should be as direct as possible and the upward slope of any horizontal breaching should be at least 1/4 inch per linear foot.

The boiler vent should not be connected into any portion of another mechanical draft system without consulting the vent manufacturer. The boiler shall not be connected to any part of a vent system serving a Category I or II appliance, nor shall a Category I or II appliance be connected to any part of the vent system serving this appliance. Improper interconnection of venting systems may result in leakage of flue gases into occupied spaces.

**Fig. 3.2 Horizontal or Vertical Drain Fittings**
The appliance connector should incorporate provisions to drain condensate formed in the vent system before it gets back to the boiler. Acidity of the stack condensate can be very corrosive when getting concentrated in the wet/dry environment of the stack. The connector should include either a drained boot tee, a drained lateral tee or a drain section, horizontal or vertical (refer to Figures 3.2, 3.3 & 3.4.) The condensate shall be drained in accordance with local code requirements.

**NOTE:** The condensate formed from natural gas flue gases is acidic. A condensate neutralizer may be required by local code.

**Vent Terminations**

The vent should extend at least three feet above the roof, or at least two feet above the highest part of any structure within ten feet of the vent. To prevent the possible re-circulation of flue gases, your vent designer must take into consideration such things as prevailing winds, eddy zones, building configurations, etc. Triad Boiler Systems cannot be responsible for the effects such adverse conditions may have on the operation of the boilers. Dimensions listed above or those illustrated are minimum, and may not be sufficient for conditions at a specific job site.

Vertical vents should be terminated with plain, straight pipe, as shown below. Horizontal vents should be terminated with either plain, straight pipe, a tee, as illustrated in section 5 or an elbow, turned down. A birdscreen with 1"x 1" openings is recommended at the termination.

**VENTING FOR MULTIPLE BOILERS**

The venting instructions in this manual apply to a single boiler. Venting systems for multiple boilers must be designed by qualified professionals and verified by the stack manufacturer. The venting system must prevent backflow of exhaust gas through idle boilers which are not operating.
DIRECT VENT SYSTEMS

Direct vent or ‘sealed combustion’ systems are typically required in mechanical rooms where there is a likelihood that the combustion air may become contaminated with substances that can form corrosive fumes when burned or when the boiler room pressure may become negative.

TRIUMPH Series Boilers are certified as direct vent appliances, with a sealed ducted combustion air inlet and venting system. Air flow-through is maintained by the fan inside the boiler assembly. Allowable locations of vent and air intake terminations are shown in Fig. 3.1, above.

The combined pressure drop of the air supply duct and exhaust vent must not exceed 0.44” w.c. This total pressure drop can be distributed over the intake or exhaust as needed for the installation.

Intake Duct Materials and Sizes

The air intake duct can be fabricated from PVC, CPVC, single wall galvanized steel, or other suitable materials. The duct must be rigid enough to maintain the full required cross sectional area under all operating conditions. Proper sealing of the intake ductwork is necessary to prevent infiltration of air from conditioned space. Joints in PVC or CPVC must be cemented. For galvanized duct, wrap each joint and seam with adhesive aluminum tape or other sealant. Connect the air supply duct to the collar on the back of the boiler. Fasten the duct to the collar with sheet metal screws and seal with aluminum tape or sealant.

### Air Requirements – SCFM

<table>
<thead>
<tr>
<th>MODEL</th>
<th>Required SCFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>T750</td>
<td>175</td>
</tr>
<tr>
<td>T900</td>
<td>210</td>
</tr>
<tr>
<td>T1000</td>
<td>245</td>
</tr>
</tbody>
</table>

The installation of a bird screen on the intake termination is recommended. Make sure that the screen does not become blocked with snow, ice, etc.

IV REMOVING AN EXISTING BOILER

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

At the time of removal of an existing boiler, while the other appliances remaining connected to the common venting system are not in operation, the following steps should be followed with each appliance remaining connected to the common venting system placed in operation:

- Seal any unused openings in the common venting system.
- Visually inspect the venting system for proper size and horizontal pitch and determine that there is no blockage or restriction, leakage, corrosion or other deficiency which could cause an unsafe condition.
- If possible, close all building doors and windows, and all doors between where the appliances still connected to the common venting are located and other spaces of the building. Turn on any appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- Place the appliance being inspected in operation. Follow the lighting instructions. Adjust the thermostat so that the appliance will operate continuously.
- Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle or smoke from a cigarette, cigar or pipe.
After it has been determined that each appliance connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous conditions of use.

Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1 and CSA B149 Installation Code. When resizing any portion of the common venting system, the common vent system should be resized to approach the minimum size as determined using the appropriate tables.
Four basic configurations for the intake/exhaust may be used. Refer to Section 3.3 for required clearances for all terminations shown in the four following figures.
See TRIUMPH Operations & Maintenance Manual for specific safety requirements, warnings, installation requirements and diagrams. These instructions are a supplemental document which should be used in conjunction with the standard Operations & Maintenance Manual for your specific Triumph Boiler.