

Commercial Building Energy Alliance Technical Specification
Gas Unit Heaters
Space Conditioning Project Team
Version 1.0
April 2, 2012

Summary

This draft specification provides a description of required performance characteristics for high-efficiency Gas Unit Heaters. Commercial buildings with large open spaces use gas unit heaters as a localized heating source, often in addition to central heating systems. The final specification will be developed with Commercial Building Energy Alliance (CBEA) member and manufacturer input and include minimum requirements that will be of interest to a critical number of CBEA members.

This draft specification is not intended to be a comprehensive purchase specification. It is intended to supplement a purchase specification by outlining energy-related product requirements.

1. Acronyms and Definitions

Automatic Flue Damper – a device intended for installation in the venting system of an individual, automatically operated, fossil fuel-fired appliance either in the outlet or downstream of the appliance draft control device, which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby or shutdown condition

Intermittent Ignition Device – an ignition device in which the ignition source is automatically shut off when the appliance is in an off or standby condition

Power Venting – a venting system that uses a separate fan, either integral to the appliance or attached to the vent pipe, to convey products of combustion and excess or dilution air through the vent pipe

Unit Heater – a self-contained fan-type heater designed to be installed within the heated space system

2. Specification Scope

2.1. Covered Equipment

This specification covers unit heaters with the following characteristics:

- Unit heaters that provide heated air through the combustion of natural gas or propane.
- Unit heaters that have a rated capacity between 25,000 and 5,000,000 Btu/hr.
- Unit heaters that are designed for wall or ceiling installations.
- Unit heaters that distribute heated air without ducts.

Question: What gas unit heater capacity range should be included in this specification?

2.2. Non-Covered Equipment

This specification does not cover unit heaters that provide heating using fuels other than natural gas or propane.

Question: Should this specification be expanded to include other non-ducted heating equipment such as oil-fired or infrared heaters?

2.3. Relevant Codes, Standards, or Specifications

This specification builds on the existing U.S. Department of Energy (DOE) performance guidelines set forth in 71 FR 71374 [December 8, 2006] that require commercial unit heaters to be equipped with an intermittent ignition device, and have power venting or an automatic flue damper.

3. Energy-Efficiency Requirements

3.1. Gas Unit Heater Efficiency Requirements & Test Method

Products meeting this specification shall meet or exceed a thermal efficiency of 90% when tested in accordance with ANSI/CSA Test Procedure, *ANSI Z83.8-2009 / CSA 2.6-2009 – Standard for Gas Unit Heater and Gas-Fired Duct Furnaces* [January 1, 2010].

Products meeting this specification shall incorporate electric motors that meet DOE efficiency standards set forth in 75 FR 17036 [April 5, 2010].

Question: Although seasonal efficiency measures real-world performance more accurately than steady-state thermal efficiency, no test procedure currently exists that measures seasonal efficiency. Should this specification require a seasonal efficiency rating in addition to thermal efficiency?

Question: Should this specification address parasitic energy consumption from fans, pumps, and controls in addition to combustion efficiency?

Question: Given the extended lifetime of gas unit heaters (20 years and greater) what would be the preferred and maximum payback period for this equipment type?

Question: Are there any other features that should be included in this specification, such as enclosure ratings, vent piping design, etc., or should the specification be limited to energy performance and other critical requirements?

4. Warranty Requirements

Products meeting this specification shall carry a warranty for a period of at least three years from the date of manufacturer covering material and workmanship defect.

Question: Should this specification detail warranty requirements? If so, for which components and for what length of time?

5. References

- a. Subpart N of 10 CFR Part 431- Unit Heaters, 71 FR 71374 [December 8, 2006].
- b. ANSI Z83.8-2009 / CSA 2.6-2009 – Standard for Gas Unit Heaters and Gas-Fired Duct Furnace [January 1, 2010].
- c. Subpart B of 10 CFR Part 431 – Electric Motors, 75 FR 17036 [April 5, 2010].

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Appendix A: Example Full System Specification

Note: The full system specification will be developed once energy guidelines are finalized.

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Appendix B: Accompanying Document and Energy Savings Analysis

Note: Included as an attachment

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Sources: Sterling, Reznor, Modine

Gas Unit Heaters

Supplementary Information for Technical
Specification

April 2, 2012

- 1 » Technology Specification Overview**
- 2 » Market Analysis
- 3 » Specification Analysis

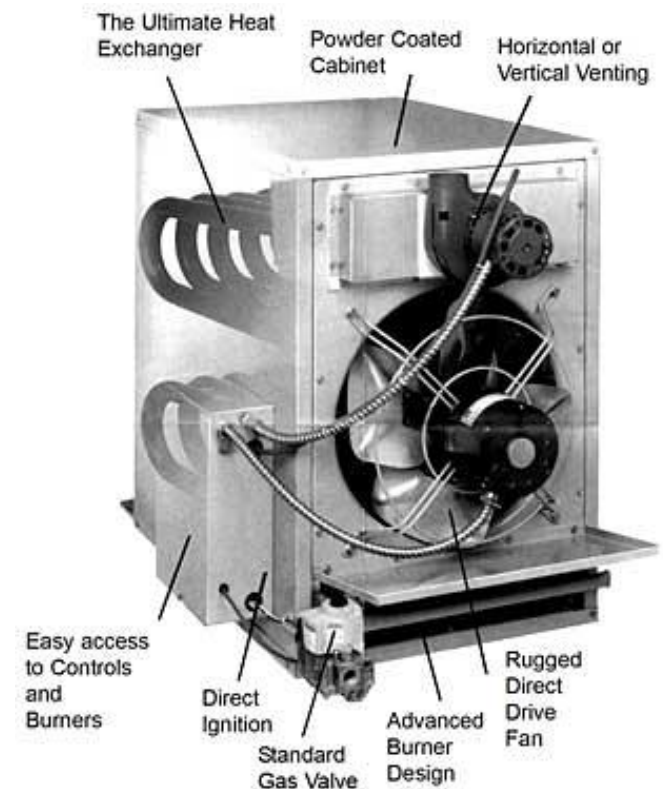
With assistance from CBEA members, DOE is pursuing technology specifications to help pull innovative, energy-saving technologies to market.

- This report supplements the technology specification for **Gas Unit Heaters**.
- CBEA members across all sectors use gas unit heaters throughout their retail, warehouse, and distribution operations.

- 1 » Technology Specification Overview
- 2 » Market Analysis**
- 3 » Specification Analysis

Gas unit heaters are self-contained space-heating systems designed to be installed within large open facilities with high ceilings, often exposed to outdoor conditions.

- Common characteristics for gas unit heaters include:
 - Typically rely on directional louvers to distribute heating without ducts.
 - Most units use natural gas but can be converted to propane.
 - Rated output between from 25,000 Btuh to over 5,000,000 Btuh.
 - Depending on capacity and design, gas unit heaters weigh between 150-400 lbs.
 - Average life of approximately 20 years.



Source: Lennox

For gas unit heaters, efficiency metrics are based on the steady-state and seasonal thermal performance.

- Thermal efficiency measures the steady-state combustion efficiency through the following equation:

$$\eta_{thermal} = \frac{\text{heating energy converted during combustion}}{\text{heating energy contained in the fuel}}$$

- Seasonal efficiency measures the actual heating performance once accounting for losses:

$$\eta_{seasonal} = \frac{\text{heating energy converted during combustion} - \text{losses}}{\text{heating energy contained in the fuel}}$$

- Losses include:
 - Start-up/shut-down inefficiencies
 - Off-cycle losses to the flue
 - Electrical consumption

While there is no federal thermal efficiency standard, Canadian and state efficiency standards drive the gas unit heater market in North America.

- DOE Commercial Unit Heater Standard – 71 FR 71374 [Dec. 8, 2006]
 - Required features includes an intermittent ignition device, and either, an automatic flue/vent damper, or power venting.
 - Does not specify a thermal efficiency.
- Various state and Canadian gas unit heater standards require thermal efficiencies of :
 - 80% at maximum rated capacity
 - 74% at minimum rated capacity.

Most gas unit heater regulations specify testing according to ANSI Z83.8 / CSA 2.6 - Standard for Gas Unit Heaters and Gas-Fired Duct Furnaces.

- Because federal requirements do not regulate efficiency, there is no DOE test procedure.

The majority of gas unit heaters installed today equal minimum efficiency standards.

- Estimated annual shipments are on the order of 200,000 units per year with an installed base of over 3,000,000 in the U.S.*
- Less than 5% of gas unit heater shipments meet the requirements of this specification*.
 - We have identified only two manufacturers (Reznor and Modine) currently offering high-efficiency gas unit heaters in the U.S.
 - Condensing unit heaters are more popular in Europe with additional manufacturers such as Robur offering high-efficiency models.
 - High-efficiency units rated from 130,000 – 310,000 Btuh.

*Davis Energy Group. 2004. “Analysis of Standards Options for Unit Heaters and Duct Furnaces.”

High-efficiency gas unit heaters improve efficiency with condensing heat exchangers, separated combustion, and modulating burners.

- Condensing heat exchangers capture a portion of the latent heat present in the exhaust gases that would otherwise be lost out of the vent.
- Rather than using indoor air for combustion, separated combustion units bring in outdoor air with more oxygen and less particulates for higher thermal efficiency.
- Burners that can match heating loads with modulating controls reduce energy consumption during part-load conditions.

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This specification improves gas unit heater seasonal efficiency by an estimated 20+% over older installations and 10+% over current standards.

Gas Unit Heater Efficiency for Different Equipment Types

Equipment Type	Main Characteristic	Thermal Efficiency (%)*	Estimated Seasonal Efficiency (%)*
Older Installed Equipment	Gravity Venting	78-82%	63-66%
Current Industry Standard	Power Venting	80-83%	80%
CBEA Specification	Condensing Heat Exchanger	>90%	>90%

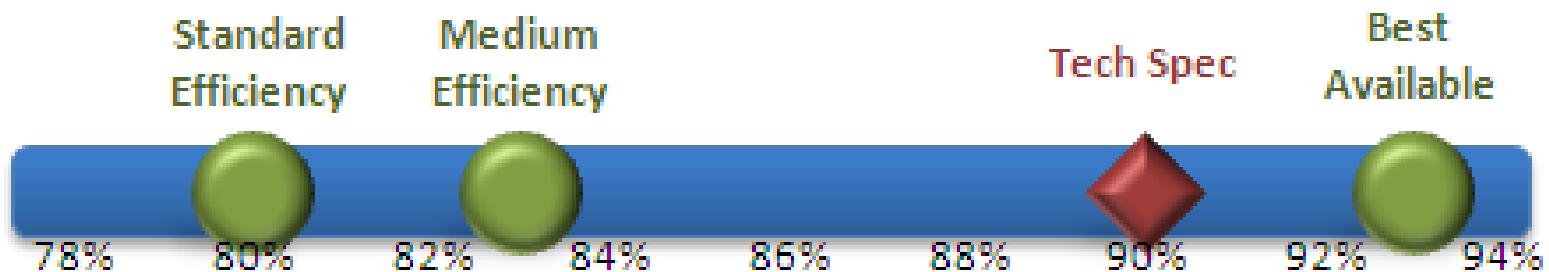
*Davis Energy Group. 2004. "Analysis of Standards Options for Unit Heaters and Duct Furnaces."

Gas unit heaters meeting this specification would have higher efficiency than what is typically installed today.

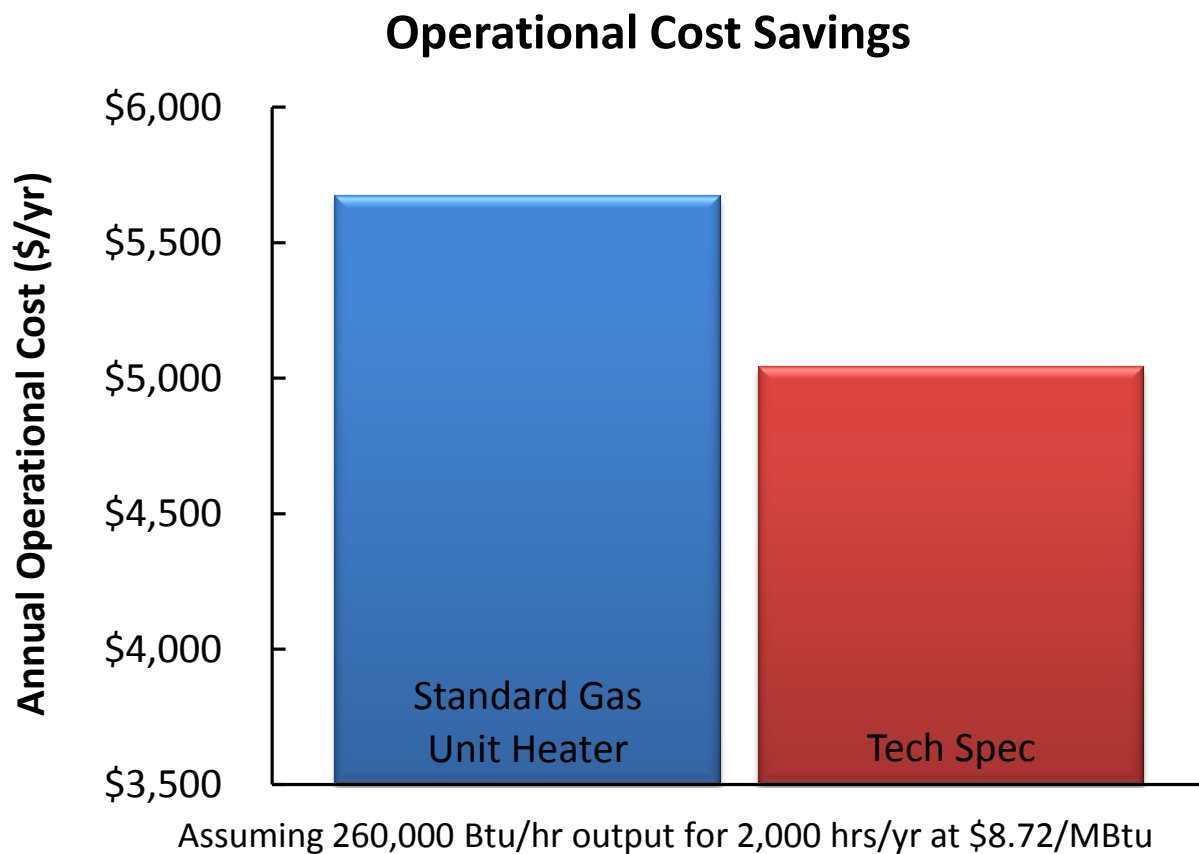
- Standard- and medium-efficiency equipment make up 95% of shipments.

Tech Spec Efficiency Level in Perspective

Scale is in terms of Thermal Efficiency (%)



Gas unit heaters meeting this specification would save over \$630 per year compared to standard-efficiency units.



Based on a simple payback of three years, spec'd gas unit heaters could be allowed moderate price premiums.

- The table below provides the allowable price premium for representative GUHs meeting this specification over current standards that results in a two year simple payback.
 - Assuming Medium operating conditions (2,000 hours) at \$0.9-\$1.0 per therm of natural gas.
 - High (3,000 hours) would have a shorter payback.
 - Low (1,000 hours) would have a longer payback.

Allowable Price Premium for Representative GUHs (\$)

Rated Capacity (BTU/hr)	Energy Savings of CBEA Specification (therms/yr)	Allowable Price Premium for 3-year Payback (\$)
135,000	375	\$650-\$750
180,000	500	\$900-\$1,000
260,000	722	\$1,300-\$1,500
310,000	861	\$1,500-\$1,750