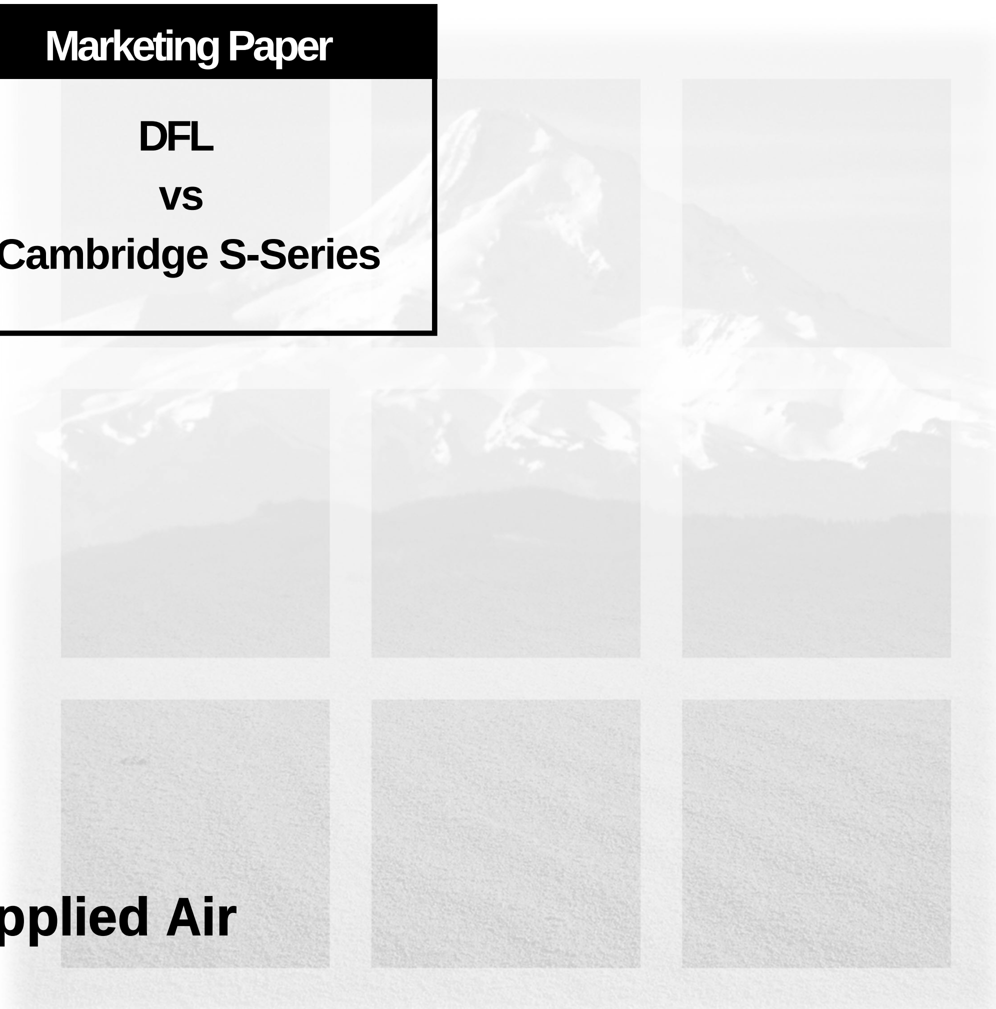

Marketing Paper

DFL
vs
Cambridge S-Series

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In the business of commercial and industrial design, accurate and understandable information is essential. Applied Air keeps you informed.

Since 1975, Applied Air has been providing cost-effective, reliable solutions for large, open spaces. Using proven Computational Fluid Dynamics modeling we can now add sophisticated analysis to our tools for assisting representatives in their selling process.

This Marketing Paper takes a point-by-point look at claims made in Cambridge Engineering sales literature.

If you have questions, please contact Applied Air's Marketing Department at 214-638-6010. We'll be glad to help.

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Cambridge S-Series Units versus Applied Air DFL- or DFM-Series Units

A common solution for warehouses has become the Cambridge S-Series direct gas fired unit. These units are most often suspended in the rafter space and discharge air through three, square nozzles. Cambridge makes a number of claims regarding this unit and it's advantages.

Applied Air has typically suggested that air turnover is a better solution for warehouses. While this is still true, many developers have been convinced that the S-Series is a better answer. One advantage to being an Applied Air rep is that our product line is broad enough to offer more than one solution to a problem. This document is designed to look at some other Applied Air products versus the Cambridge S-Series.

First, though let's examine the key claims by Cambridge:

- Direct gas fired equipment is more efficient, thus they save the tenant money.

  This is a true statement…but all direct fired equipment is more efficient than unit heaters and all will save the tenant money by comparison. The combustion efficiency is the same for the S-Series, the DFL and the DFM.

- Cambridge provides 100% fresh air to offset fumes from fork trucks and provides a cleaner operating environment.

  Again, this is true, but it is also true for the DFL and DFM in their pure make-up air mode.

- The Cambridge unit provides more Btuhs of heat because of it's high temperature rise.

  *This claim is probably one that grabs a developer's attention…"I get more for my money"…but all Btuhs are the same…the DFL and DFM simply require more air for the same Btuhs (23% more, but only at the full 160 degree temperature rise). This actually implies that the DFL and DFM will do a **better** job of diluting fork truck exhaust than the Cambridge unit. It is interesting to note that the Cambridge engineering literature indicates that the "standard" selections are for temperature rises between 110 and 140 degrees…and that the factory should be contacted for temperature rises over 145 degrees. Most of their sizing examples use a 100 to 120 degree rise.*

- The Cambridge unit pressurizes the building and prevents infiltration.

  Both the DFL and the DFM can be sized to accomplish the same thing. This is a matter of balancing the estimated infiltration cfm and Btuh against the total unit cfm and Btuh provided by the units. The DFL and DFM will end up providing more air than the Cambridge unit, but this will only serve to increase building pressure and can be easily controlled if it is excessive. Using some of Cambridge's own logic about air volume and building recovery rates, the DFL and DFM should actually perform better than the Cambridge ***because*** *they have more air volume to start with.*

- The Cambridge unit achieves a high induction rate (10:1) because it uses centrifugal blowers.

  Well, this one is interesting. It is a true statement, but not for the reason given. The high induction rate is a result of higher discharge air velocities than are possible from typical prop fan unit heaters. The DFL and DFM both also use centrifugal blowers and are actually capable of even higher discharge velocities than the Cambridge unit (see the comparison table for total static pressure). In any case however, the discharge velocity is a factor of the air distribution system that is attached to the unit…not the unit itself (assuming it has the static capacity to handle it). Using their own logic, the DFL could be capable of a 20:1 induction ratio. (If you refer to ASHRAE, the formula for calculating the air entrainment volume shows that the amount of air entrained is directly proportional to the core discharge velocity of the airstream…discharge at twice the velocity and you entrain twice as much air volume)

- The Cambridge system provides less stratification.

  This one defies physics. The density, and thus the buoyancy of air, is based upon temperature. The higher the temperature, the more buoyant the air. 160 degree air will rise faster than 130 degree air or 100 degree air. If Cambridge is suggesting that the supply air will mix with room air before it has a chance to rise, and it will be less buoyant at that point, then the same is true for any of the systems. Unit heater systems tend to stratify more because their prop fan blowers lack the energy to drive the warm, buoyant air to the floor. The taller the space, the worse the problem. This may be one reason why Cambridge discourages use of their system in very large buildings.

- The Cambridge system requires no floor space.

  Both the DFL and the DFM are designed to be suspended…just like the Cambridge unit…and also take up no floor space.

Now let’s look at some factoids:

Cambridge S-Series	**DFL**	**DFM**
Hot surface ignitor main flame	direct spark main flame	direct spark pilot flame
Note: the HIS system tries to light the entire gas flow…if it fails to light you get quite an influx of raw gas, and maybe a loud pop when it does light.		
Mechanical gas valve with sensing bulb and 9 settings up to 160 deg discharge is standard		
Note: this is similar to a unit heater control and is not always set at the top setting. This simple type of control does not apply to the DFL or DFM.		
Optional Maxitrol 14 with built-in override jumpered for 160 degree max. discharge temp.	standard Maxitrol 14 with 90 deg max discharge temp.; optional to 160	standard Maxitrol 14 with 90 deg max discharge temp.; optional to 160
Optional Maxitrol 44 <u>140</u> deg. max discharge temp	Optional Maxitrol 44 <u>140</u> deg. max discharge temp	Optional Maxitrol 44 <u>140</u> deg. max discharge temp
Note: If the Maxitol 44 is specified, then all systems are the same!		
FC blowers	FC blowers	FC blowers
Motor out of airstream	motor in airstream, but tested to ANSI code	Motor out of airstream
24 controls	24 controls	110 volt controls
600 lbs. C600	700 lbs DFL-035	665 lbs DFM-109
1,785 fpm discharge velocity @ 3,000 cfm	4,347 fpm discharge velocity @ 3,000 cfm	3,589 fpm discharge velocity @ 3,000 cfm
1.0 inch max static	3.5 inch max static	3.0 inch max static
60x25x25 cabinet	68x42x36 cabinet	84x45x29 cabinet
external control box	internal control box	external control box

160 deg.**rise**	130 deg.**rise**	130 deg.**rise**

note: the ANSI standard Z83.4 or Z83.18 limits discharge to 160 degrees for everyone, the manufacturer chooses to limit discharge to less than that available limit based upon component life considerations, unit skin temperatures, "smoother" performance…..no superhot blasts of air, just milder jets that are closer to skin temperature and not as objectionable.

integral discharge damper	integral intake damper	separate intake damper

note: the Cambridge discharge damper arrangement could possibly allow cold air to migrate all the way through unit, and in these indoor applications could cause the unit to "sweat" in some climates while in the "off" mode.

sheet metal corner posts	structural aluminum corner posts	sheet metal corner posts
optional service lights	optional full-time diagnostic system with auto-dial fault notification	optional full-time diagnostic system with auto-dial fault notification

If you look closely at these systems, the differences are not as great as Cambridge would have you believe…and they actually come up short in some cases.

One of the key points to consider is the difference between temperature *rise* and *maximum discharge temperature*. This is a point that is confusing enough to create a sales opportunity for Cambridge. ***All*** direct fired systems are limited by ANSI Z83.4 to a *maximum discharge temperature* of 160 degrees F.

The optional Maxitrol 44 control limits the DFL or DFM discharge temperature to 140 degrees F. That means that if your local winter design temperature is 10 deg. F., then a Cambridge unit with their standard mechanical discharge control, or optional, jumpered, Maxitrol 14 control, will *discharge* 160 degree air with a 150 degree *rise*, and the DFL and DFM will *discharge* 140 degree air with a 130 degree *rise… on the "design day"*. A Cambridge unit with their optional Maxitrol 44 control will discharge air at the same 140 degrees as the DFL or DFM. The difference in air volume under these conditions is just 14%…not as great as many people believe. Most of the time, on days other than the "design day" (98% of the year, by ASHRAE definition…or 54 hours out of 8,760), the Cambridge unit will be modulating it's burner back and operating with shorter and shorter burn cycles, and more and more "overshoot" on space temperature.

The standard Maxitrol 14 controls on the DFL or DFM would normally limit discharge temperature to 90 degrees. However, you have two options to consider. First, you can add a jumper to the Maxitrol TD114 setpoint controller (standard with the DFL or DFM)…just like Cambridge does…and set the discharge temperature to 160 degrees. A more interesting solution that will save a building tenant operating costs, and provide more even temperature control (and give you an item to specify) is to add an Applied Air part number 68.0200.20, room override stat, to the system. This will allow the unit to operate at a 160 degree discharge during periods of high demand (coldest weather with bay doors open, or after night/weekend setbacks), and then revert back to 90 degree discharge when the building is stable. This option will provide much more even heating in the space most of the time, with fewer hotspots and less buoyant air for reduced stratification. Keep in mind, though, that extended periods of operation at those elevated temperatures might reduce the operating life of the standard blower motor and belts in a DFL.

All direct fired heaters produce heat at the same efficiency and usually contain a blower component that provides the energy to deliver that heat to the space. The air distribution system that is attached to the outlet of the unit determines how well that heat is delivered to the room. The Cambridge S-Series units have so little total static pressure available that their air delivery options are limited to large open nozzles. These nozzles have no directional control and produce a high velocity jet that has a high core temperature. If you are standing under that jet and the unit is mounted too low…you will get pretty hot.

The DFL and DFM have sufficient static pressure capacity to let the engineer or contractor select directional grilles or diffusers (if they so desire) that provide better control of air direction, spread, and throw. The higher static pressure capacity of the DFL and DFM also allow the use of rain proof wall intake louvers that are much more appealing architecturally than the large open hood arrangement of the Cambridge unit.

The “Cambridge concept” has been widely successful…but that success is based more on the story-telling than the equipment itself. Applied Air has equipment that will accomplish the same mission, in much the same way; with several advantages in performance, options, and deliveries. The story just needs to be re-written.

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The premise of this Marketing Paper is that an Applied Air DFL can be an effective alternative to the Cambridge S-Series units that are so common in warehouses.

The key to selling against the Cambridge system is understandingtheir claims. This paper takes a look at each of their claims and provides a suggested response to those claims.

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Applied Air

www.appliedair.com

4830 Transport Drive Dallas TX   75247

Telephone 214.638.6010

Fax 214.905.0806