

USGBC LEED Program

A GUIDE FOR SUSTAINABLE BUILDING DESIGN



SCOPE

This document presents air distribution technologies that contribute to green construction and can help achieve or retain LEED® Green Building Status. It is an introduction to how specific air distribution technologies can be employed when designing a green building. Please refer to the specific LEED® manuals for actual requirements as this document does not guarantee qualification for the credits described herein.

WHAT IS LEED®, THE USGBC AND HOW DOES PRICE FIT IN?

The U.S. Green Building Council (USGBC) is a consensus-based institution, comprised of members from across the building industry, committed to promoting and producing sustainable buildings that meet or exceed a standard for performance and efficiency.

The Leadership in Energy and Environmental Design (LEED®) Green Building Rating System represents the U.S. Green Building Council's effort to provide a national guideline for what constitutes a "green building". The LEED® guideline is intended to be used as a design guide and third party certification tool for rating new and existing commercial, institutional and high-rise residential buildings.

The USGBC has developed the guideline Leadership in Energy & Environmental Design (LEED®) to:

- Establish a guideline to help in the design of more energy efficient and sustainable buildings.
- Provide recognition to designs that embody this guideline and provide innovative solutions for reducing environmental impacts inherent in the building process.
- Increase the public's knowledge and awareness of the "green building" movement and methods for reducing energy and resource consumption.
- Push the building industry into being more environmentally conscious by promoting competition in design.

PRICE'S COMMITMENT TO GREEN BUILDING CONSTRUCTION

Price Industries works hard to promote the use of sustainable building materials and innovative air distribution technologies to improve the air quality and environmental integrity in the built environment. Price has a long history of designing and promoting products and product systems that are energy efficient and ideal for use in "green building" designs. Price is committed to the continual introduction of new products and systems that further the goals outlined by the USGBC.

* LEED® is a registered trademark of the U.S. Green Building Council

THE LEED® RATING SYSTEM

The LEED® program focuses exclusively on an individual building structure, not a specific product. The purpose of the guideline is to evaluate the whole building from an environmental performance perspective over the building's life cycle to determine if the building is a "green building". Therefore, **specific products** cannot be "LEED® certified".

There are currently six LEED® Programs operating or Under Development:

- New Construction & Major Renovations (LEED – NC) v.2.2
- Existing Building Operations (LEED – EB) v.2.0
- Commercial Interiors Projects (LEED – CI) v.2.0
- Core and Shell Projects (LEED – CS) v2.0
- Homes (LEED – H) under development
- Neighborhood Developments (LEED-ND) under development

Many of the topics covered in this document apply to all guidelines, but as the New Construction & Major Renovation (Version 2.0) guideline is the most mature, it will be the focus of this discussion.

The LEED® initiative has led to the establishment of a rating system that defines that which constitutes a "green building" and rates them according to the level of commitment demonstrated in the building design. Buildings are deemed LEED® buildings if they earn a certain number of points. The four levels of LEED-NC certification are:

- General Certification 26 – 32 points
- Silver Certification 33 – 38 points
- Gold Certification 39 – 51 points
- Platinum Certification 52 – 69 points

Each category has several points available as well as certain prerequisites that are required for LEED® certification.

SUSTAINABLE SITES (8 credits, 14 possible points)

Sustainable Sites is intended to reduce the disturbance to the natural environment, reclaim sites, reduce urban sprawl and promote alternate transportation.

Prerequisite: Erosion and Sedimentation Control

WATER EFFICIENCY (3 credits, 5 possible points)

Water Efficiency is intended to promote a reduction in water used for site and building management.

ENERGY AND ATMOSPHERE (6 credits, 17 possible points)

Energy and Atmosphere is intended to promote the use of renewable energy sources and reduced consumption.

Prerequisites:

Fundamental Building Systems Commissioning
Minimum Energy Performance: Compliance with ASHRAE 90.1-2004, air delivery is required for certification in

the LEED-NC program. For LEED-EB, demonstration of building energy efficiency and performance as required by the EPA ENERGY STAR label benchmarking tool for buildings (minimum score of 60) OR compliance in ASHRAE 90.1-1999 or local code, whichever is more stringent.

Fundamental Refrigerant Management

Credits:

Optimize Energy Performance: Demonstrate a reduction in energy consumption below the requirements of ASHRAE 90.1.

MATERIALS AND RESOURCES (7 credits, 13 possible points)

Materials and Resources is intended to promote building reuse and retrofits, recycling/waste management and building materials.

Prerequisite:

Storage and Collection of Recyclables

Credits:

Building Reuse

Extend the life cycle of existing building stock, reduce waste and requirement for new materials, retain cultural resources and the environmental impact from material manufacturing and transport.

Recycled Content

Increase demand for building products that incorporate materials with recycled content, therefore reducing impacts resulting from extraction and processing of virgin materials.

Regional Materials

Increase demand for building materials and products that are extracted and manufactured within the region. Thereby supporting the regional economy and reducing the environmental impacts resulting from transportation.

INDOOR ENVIRONMENTAL QUALITY (8 credits, 15 possible points)

Indoor Environmental Quality is intended to promote excellent air quality and reduce odors and emissions from materials.

Prerequisites:

Minimum IAQ Performance

The Indoor Air Quality Procedure provides a direct solution by restricting the concentration of all known contaminants of concern to some specified acceptable levels. It incorporates both quantitative and subjective evaluation. Minimum Indoor Air Quality is defined as meeting the minimum requirements as described in ASHRAE standard 62-1999.

Environmental Tobacco Smoke (ETS) Control

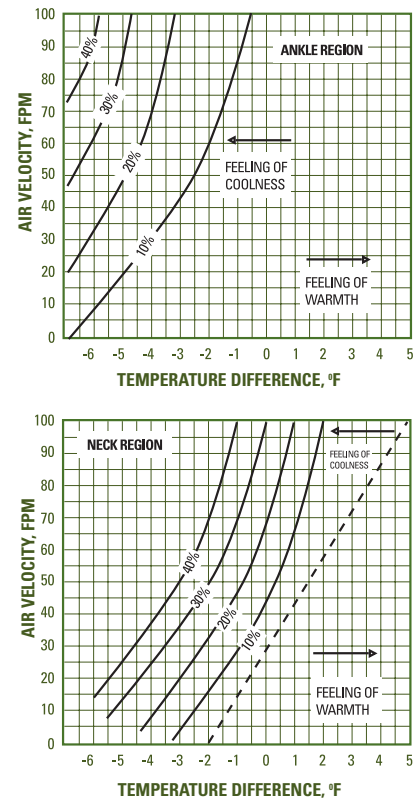
Credits:

Increased Ventilation

The intent of this credit is to "provide for the effective delivery and mixing of fresh air to support the safety, comfort and well being of building occupants". As such, one credit is available if the ventilation rate is increased by 30% over ASHRAE 62.1-2004.

Thermal Comfort: Design

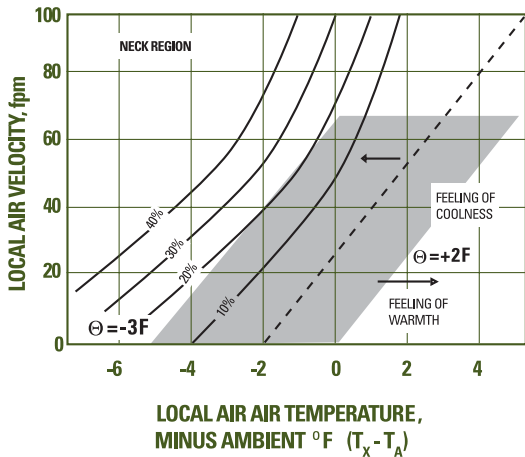
Provide for a thermally comfortable environment that supports the productive and healthy performance of the building occupants in accordance with ASHRAE standard 55-1992. Under ASHRAE 55, 80% of the occupants must be comfortable in their environment according to Figures 1 and 2.



(Figure 1) Percentage of Occupants Objecting to Drafts in Air-Conditioned Rooms

INNOVATION AND DESIGN PROCESS (2 credits, 5 possible points)

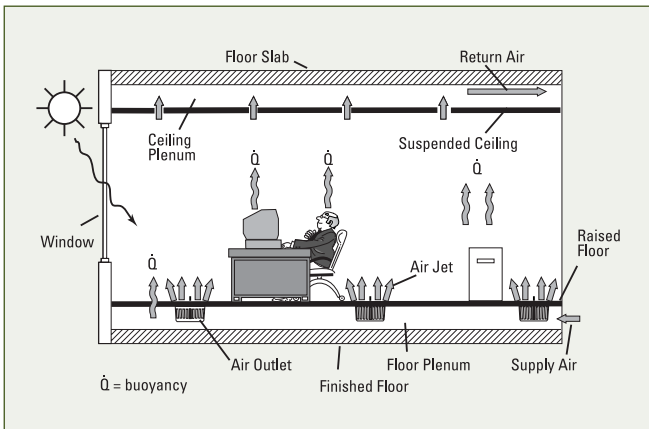
Innovation can take many forms, innovative use of waste water, solar heat and choice of ventilation technology. These credits are awarded for excelling in any of the other categories to a level beyond which points can be awarded and for innovative design of building systems leading to further reduction in operating costs and waste.



(Figure 2) Target Zone for Compliance with ASHRAE Standard 55

DESIGNING FOR LEED® CERTIFICATION

There are several emerging technologies that can be employed to ventilate a Green Building. The USGBC recommends Underfloor Air Delivery and Displacement Ventilation systems as ventilation systems that will meet the stringent requirements for ventilation effectiveness, energy consumption and air quality. Price offers comprehensive product lines in both systems that are among the most diverse in the industry.



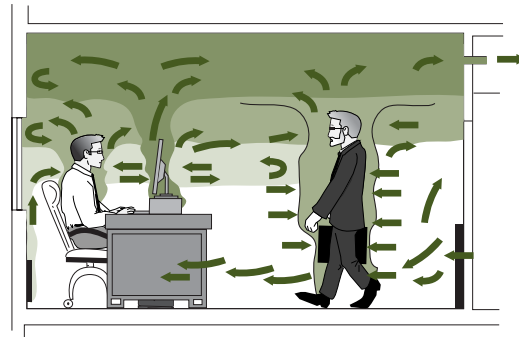
(Figure 3) Underfloor Air Distribution (UFAD)

UNDERFLOOR AIR DISTRIBUTION

Underfloor Air Distribution (UFAD) serves the same purpose as conventional overhead systems: to provide a comfortable environment while maintaining the required ventilation to meet fresh air requirements and dissipate heat loads. The underfloor air supply system creates a general upward flow of air in the space that while, working with the natural buoyancy of the air heated by loads in the space, allows an effective removal of heat, pollutants and odors. These, together with the room air, are exhausted through the building return

system located in the ceiling (Figure 3). The diffusers are installed in the floor tiles of the conventional raised floor system. If the room layout is changed, the floor tiles are interchangeable and air distribution can be customized as required, dramatically reducing reconfiguration or churn costs.

There are several credits in the LEED program that can be earned by implementing a UFAD system, which will be discussed here.



(Figure 4) Displacement Ventilation

DISPLACEMENT VENTILATION

A relatively new technology to the North American market is Displacement Ventilation (Figure 4). Displacement Ventilation systems introduce air at low velocities which causes minimal induction and mixing. The displacement outlets are usually located at or near the floor. The system utilizes buoyancy forces (generated by heat sources such as people, lighting, computers, electrical equipment, etc.) in a room to move contaminants and heat from the occupied zone into a higher stratified region, where they can be exhausted. By so doing, the air quality in the occupied zone is generally superior to that achieved with mixing ventilation.

RADIANT SYSTEMS

Radiant systems have been used for some time but they are becoming more and more the preferred choice for handling heating and cooling loads due to their inherent efficiency. Water and glycol, two common working fluids in radiant systems, have a much higher capacity for transferring heat than air does. As such, a small pipe can take the place of a large duct, allowing for lower floor to floor heights and a significant reduction in the system BHP. See Figure 5 for a typical radiant system layout.

ENERGY AND ATMOSPHERE

MINIMUM ENERGY PERFORMANCE (Prerequisite)

UFAD

UFAD provides many opportunities for reducing the energy consumption typical of a traditional overhead air delivery system. Due to the sources being at floor level, the mixing zone usually only extends from the floor to ~ 6 ft above the floor.

ASHRAE standard 55 limits the combination of air velocity and temperature according to Figures 1 and 2. As a result, the typical cooling supply air temperatures should be approximately 10oF higher than with overhead mixing flows in order to maintain comfort conditions. The decreased mixing zone dramatically reduces the cooling air requirement to satisfy the cooling load in the space as the warmest air has naturally risen to the ceiling level and remains there, outside of the mixed zone. The lesser cooling requirements and higher supply temperatures often lead to similar supply air volumes as in overhead air distribution. Due to the higher supply air temperature and stratification above the mixing zone, the return air temperature of a UFAD system is substantially higher than for a mixed system. The increased return air temperature and supply air temperature contribute to an increased chiller COP providing energy savings.

Higher supply temperatures extend the free cooling band, the hours in the day where the ventilation system can use outdoor air to cool the building; in some climates (where humidity is less of an issue) this leads to increased use of the economizer, an excellent way to reduce energy consumption. Further energy savings are realized with the reduced air pressure required for the system. UFAD installations typically work at a plenum pressure of < .1" wg, reducing duct static pressure and the fan requirements for the system. Reducing the fan requirements usually means that smaller equipment can be sized, a nice secondary benefit is a reduction in initial capital cost of the HVAC system.

DISPLACEMENT VENTILATION

Displacement Ventilation affords many of the energy savings that UFAD does. Due to the sources being at floor level and low inlet velocities, the mixing zone is virtually eliminated. With little or no entrainment of room air, the supply air flows along the floor until it is caught in a thermal plume from a person, machinery or other heat source, delivering air only to the areas that require it, dramatically reducing the cooling load in the space.

As there is limited entrainment of room air, the temperatures at the floor level in the space are often very near supply air temperature. Thermal comfort criteria stipulate that the supply air temperature be similar to those of UFAD, leading to the same types of energy savings due to equipment size and efficiencies. Displacement diffusers generally have low face velocities and very low static pressure losses. Further energy savings can be realized by lower duct static pressures as discussed in the UFAD section.

As with a UFAD system, there is an increased opportunity for free cooling and use of an economizer due to the higher supply temperatures. These provide an excellent opportunity for energy savings in that the ventilation air can be used for conditioning the space directly, so long as the relative humidity of the outdoor air is acceptable.

RADIANT SYSTEMS

Energy savings with radiant systems can be found in a reduction of fan horsepower. When a radiant system is employed, it is typical to use the airside system for ventilation air and humidity control only. This leads to a dramatic reduction in the air volume requirement by 50 – 85%, depending on the application. Because water is much more efficient than air at transporting heat, the power required to pump the equivalent heat throughout the building is typically much less than the power saved in the reduction in the fan size, leading to a net power benefit, typically on the order of 30%. On top of the reduced air volume, further savings can be realized by minimizing the air side load fraction, or the fraction of the load that the ventilation air handles. This can be done by increasing the supply air temperature to be nearly isothermal, increasing further the economizer band for the supply air.

OVERHEAD AIR DISTRIBUTION

Energy saving strategies for overhead air distribution are currently employed by most consultants and are mostly on the system design side. One of the areas where energy savings can be realized is in the elimination of short circuiting and by proper diffuser selection.

ECM™ MOTORS

Electrically Commutated Motors have a minimum efficiency of 70% throughout their entire operating range. Conventional induction motors become less efficient at the reduced speeds that are typically selected for fan powered applications. Energy savings of 50 – 60% can be achieved with the ECM™ motor at normal operating conditions providing a great opportunity for LEED™ points. The ECM™ motor life is extended due to its low operating temperature and ball bearing design.

Price Industries offers ECM™ motors on all fan powered terminals for overhead and underfloor systems.

TABLE 1 - OPPORTUNITIES FOR ADDITIONAL CREDITS DUE TO EXCEPTIONAL ENERGY CONSERVATION

ASHRAE SCALE (NC) BUILDING RENOVATIONS	EASTING SCALE (EB)	ASHRAE SCALE (EB)	LEED POINTS	ENERGY STAR LABEL SCALE (EB)
10.5%	3.5		1	
14%	7	10%	2	70 Score
17.5%	10.5		3	
21%	14	20%	4	75 Score
24.5%	17.5		5	
28%	21	30%	6	85 Score
31.5%	24.5		7	
35%	28	40%	8	90 Score
38.5%	31.5		9	
42%	35	50%	10	95 Score

OPTIMIZE ENERGY PERFORMANCE (*Up to 10 points*)

Under the category of "Optimized Energy Performance" up to 10 points are available for strategies to reduce energy consumption below the levels specified by ASHRAE Standard 90.1-2004 as shown in Table 1 for LEED-NC and LEED-EB. Displacement Ventilation, UFAD and radiant systems can reduce energy consumption due to increased chiller efficiency, increased hours of free cooling and a reduction fan power. As stated above, these technologies may afford energy consumption reductions beyond those required for Minimum Energy Performance, especially when coupled with the use of ECM™ motors and traditional energy saving strategies. Overhead air distribution systems may also qualify for these credits, depending on the extent of the reduction in energy consumption. The number of possible points will vary by building and location.

MATERIALS AND RESOURCES

BUILDING REUSE (*up to 3 points*)

UFAD

UFAD is an ideal system for retrofitting buildings, building for easy future expansion/re-organization and for leased spaces. If building reuse is an option then UFAD is an easy system to install in the current space. Many older buildings have architectural details on the wall and ceiling space that is desired. UFAD systems allow these details to remain intact. Depending on the amount of the original structure that is reused, credits MRc11, MRc12 and MRc13 may be achievable.

RADIANT SYSTEMS

Radiant systems offer unique advantages in building retrofits. They are typically low profile and can accommodate increased cooling or heating loads by supplementing the ventilation provided by the airside system. Radiant panels, sails and chilled beams can provide many of the advantages of fan coils but require much less space, allowing more of the original structure and finishing to be retained. Radiant product can also be easily integrated into the building architecture.

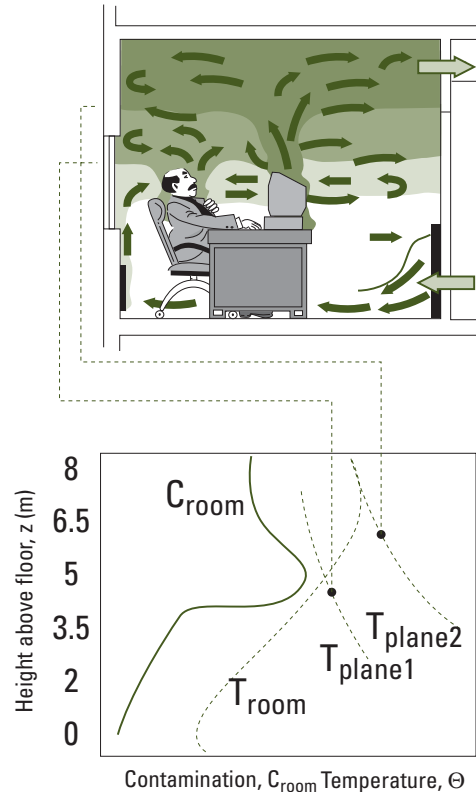
INDOOR ENVIRONMENTAL QUALITY

INCREASED VENTILATION EFFECTIVENESS (*1 Point*)

Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality, Sections 4 through 7, using the Ventilation Rate Procedure or the applicable local code, whichever is more stringent.

UFAD

Underfloor air distribution generally mixes the occupied zone, while having sufficiently low penetration levels to cause a stratification layer above it. This promotes a general



(Figure 6) Typical Contamination Concentration in an Environment that Employs Displacement Ventilation

upward movement of air as warm, contaminated air is exhausted from the stratified zone, being replaced by fresh supply air.

DISPLACEMENT VENTILATION

Displacement ventilation presents an opportunity to improve both the thermal comfort and indoor air quality (IAQ) of the occupied space. Displacement ventilation takes advantage of the difference in air density between an upper contaminated zone and a lower clean zone as illustrated in Figure 5. Cool air is supplied at low velocity into the lower zone. Convection from heat sources creates vertical air motion into the upper zone where high level return outlets extract the air. In most cases these convection heat sources are also the contamination sources, i.e. people or equipment, thereby carrying the contaminants into the upper zone, away from the occupants (Figure 6).

CONTROLLABILITY OF SYSTEMS: THERMAL COMFORT (*1 Point*)

UFAD

Price offers many options for local air delivery control. One of the easiest ways to earn this credit is the use of Price RFTDA or RFID, which allows occupants to adjust the flow out of each outlet in the interior zone or direction of primary jet, respectively. These units are typically installed at each workstation, allowing employees to individually control the supply air to their space.

OVERHEAD AIR DISTRIBUTION

The Price Prodigy® and Varitherm® personal VAV diffuser allows personal control of a zone by use of thermostat or infrared remote control (Prodigy only). These diffusers are an ideal solution to providing personal control in an office environment.

THERMAL COMFORT: DESIGN (1 point)

UFAD

Underfloor air distribution swirl diffusers are designed to have high induction rates with short penetration into the room. They also tend to cause little disturbance of the surrounding air, allowing them to be located in the work area. The mixing that occurs in the occupied zone causes consistent temperature throughout the occupied zone.

DISPLACEMENT VENTILATION

Due to the fact that air is introduced at the floor level and there is minimal entrainment of room air, displacement diffusers are designed to introduce air that has a higher temperature than typical supply air at low velocities. This is in consideration of ASHRAE 55 which limits the combination of temperatures and velocities which can occur in the occupied zone according to Figures 1 and 2.

The intent of introducing the supply air at low velocities and levels in the space is to stratify the zone. Another stipulation in ASHRAE 55 is that the maximum temperature gradient allowed from ankle to head level is 5 °F; the ideal temperature gradient in the occupied zone is ~4 °F. Care must be taken when designing these types of systems not to over stratify the zone by under estimating the cooling load or to sub cool the space by over estimating the load. Displacement diffusers are designed with this standard in mind, therefore use of this technology, if applied correctly, can qualify for this credit.

RADIANT SYSTEMS

Radiant systems have an advantage when it comes to thermal comfort due to the fact that they transfer heat using mainly radiation. The human body transfers most of its heat in this fashion and therefore, using radiation to heat and cool is a much more natural and comfortable method. As radiant systems generally reduce the air flow to the minimum quantities, there is also a much lower chance of draft in the space.

OVERHEAD AIR DISTRIBUTION

When designing an overhead air distribution system, the location of air outlets must be carefully considered. The high exit velocities which are characteristic of many overhead diffusers can lead to drafts if they are located such that their air patterns collide with each other or obstacles in the room (walls, bulkheads etc.), causing them to detach from the ceiling. A properly designed overhead air distribution system will qualify for this credit.

INNOVATION AND DESIGN PROCESS

Displacement Ventilation is a relatively new technology in North America. It is also a very versatile technology where inlets and returns can be integrated into almost any surface. Price offers several options that allow diffusers to be hidden in stair risers, wall treatments, table or bench supports. Innovative ventilation solutions from Price can help in achieving up to 4 credits in the Innovation in Design category.

Displacement ventilation also provides a very quiet environment. As LEED-NC version 2.2 does not make an accommodation for acoustics, it may be possible to apply for an innovation in design credit if the project is designed to meet certain acoustical criteria.

RADIANT SYSTEMS

Radiant systems generally will have a iterative design process which can lead to some novel and unique designs. It may be possible to get an innovation in design credit based on some of these innovations.

The category "Innovation in Design" provides one point for exceptional performance above the requirements of LEED™ or innovative performance in categories not addressed by the LEED™ program. One example may be the extremely low noise level of displacement diffusers that could be applied towards a credit for exceptional acoustic performance. Credit will not be given for system characteristics that have already received credit in the Energy and Atmosphere section.

MORE INFORMATION

USGBC

Additional information about the USGBC and the LEED™ program can be found at the USGBC website: www.usgbc.org

ASHRAE Standards 55-2004, 62-2004 and 90.1-2004

ASHRAE standards are available in print and PDF formats on the ASHRAE website at www.ashrae.org

ENERGYSTAR

www.energystar.gov

UFAD

ASHRAE has published the "Underfloor Air Distribution Design Guide" which is available at www.ashrae.org

Information about designing underfloor air distribution systems can be found in the Price UFAD Design Guide and Section I.

DISPLACEMENT VENTILATION

ASHRAE's publication "System Performance Evaluation and Design Guidelines for Displacement Ventilation" provides insight into design considerations, load calculations and overall system design of displacement ventilation systems. This publication is available in the ASHRAE online bookstore at www.ashrae.org

Information about designing displacement ventilation systems can be found in the Price Displacement Design Guide and Section J.



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The founding principles of our company have never changed - business integrity, first class service and a commitment to people. Price manufacturing endeavors arose from our belief that we could supply superior products and services at a reasonable price. Our mission is to become the worldwide supplier of preference for air distribution products and services. You can rely on Price – our products and services – with confidence.

Product Improvement is a continuing endeavor at Price. Therefore, specifications are subject to change without notice. Consult your Price sales representative for current specifications or more detailed information.

Warranty: The Company warrants and guarantees that all goods within this catalog that have been manufactured by the Company have been manufactured in accordance with the specifications published herein and will be free from defects in material and workmanship for a period of twelve (12) months from the date of Bill of Lading issued by the Company. The Company will replace defective product at its option, but will not be responsible for labor or material charges in replacing product or consequential damages. Any installation not conforming with the Company's specifications, manuals, bulletins or instructions or any misuse or any modification not authorized by the Company voids this warranty. This warranty is in lieu of all Provincial, State, and Federal statutory warranties and the conditions herein are in substitution and replacement of such warranties, statutory or otherwise.

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