TRI-LITE HVLS SERIES
CEILING FANS

CANARM® HVAC

DESIGN & ENGINEERING GUIDE

PLEASE READ AND SAVE THIS GUIDE

ABOUT THESE FANS

Tri-Lite HVLS fans blanket a very large area by constantly moving air to create an expansive comfort zone. As a result, the big ceiling fan can create an evaporative cooling effect of three to four degrees Celsius throughout the facility.

During the heating season, the Tri-Lite HVLS fan technology can de-stratify uneven temperatures that can be in excess of fifteen degrees Celsius from ceiling to floor. This results in significant energy savings since heating system cycles less frequently.

THE TUBERCLE ADVANTAGE

Tubercle Technology™ blades outperform all conventional airfoils.
They accomplish this by:

- Offering stall angles as high as 22°. Airfoil blades without whale technology stall at 8 degrees so whale power allows for much more air movement with fewer blades.
- Eliminating span-wise pumping; the primary cause of efficiency loss in all rotating systems.
- Eliminating tip stalling; the primary cause of blade noise and damaging vibration.
- Lowering noise by offering Tubercle Technology's™ hyper-stability which also lowers vibrations which cause wear and tear on the blades and drive train.

THE BENEFITS OF TRI-LITE HVLS FANS

- Quiet speed and efficient operation, no annoying high speed circulating and exhaust fans.
- Virtually maintenance free (recommended inspection every 20,000 hours).
- Inexpensive to operate.
- Greatly reduces "recovery" time when overhead doors are open with a constant air flow throughout the space.
- Provides a constant, even temperature from floor to ceiling and wall to wall.
- Will minimize the need for expensive duct work in new construction for both heating and air conditioning systems.
- A comfortable workplace environment increases productivity and decreases absenteeism.

HVLS fans provide many benefits for many applications, such as:

- For hot months where air conditioning is not available, or not affordable, a HVLS fan moves the air above the minimum speeds that break up the moisture saturated layer surrounding the human body. The evaporation happens faster, which provides a cooling effect often referred to as "windchill". This creates a comfortable workplace and increases productivity.
- For large sparsely populated warehouses, or open and un-insulated buildings where air conditioning would be wasteful and pointless
- For instances where fumes and smoke are produced from welding, forging, painting, etc. and the continuous ventilation of the HVLS dilutes the air.
- For renovations where moving duct work is not feasible, or in new installs where ductwork would be expensive and time-consuming, a HVLS can be installed to compensate.
- The HVLS is quiet and operates efficiently, no annoying high speed circulating or exhaust fans that sometimes direct too much air in a small area.
- The HVLS is virtually maintenance free! (recommended inspection every 20,000 hours).
- The HVLS is inexpensive to operate(0.75 kW Gear Motor).
- The HVLS greatly reduces "recovery" time when overhead doors are open, working like an air curtain, the inside air is kept inside, and the outside air is blocked with a constant airflow throughout the space.
- For heated buildings where a large amount of heat is trapped at the ceiling. HVLS fans destratify the air by continually circulating the warm air from the ceiling back to the floor along the outside wall without creating a windchill by operating in reverse and reducing heating costs by up to 30%. **See Figure 1 and 2**.

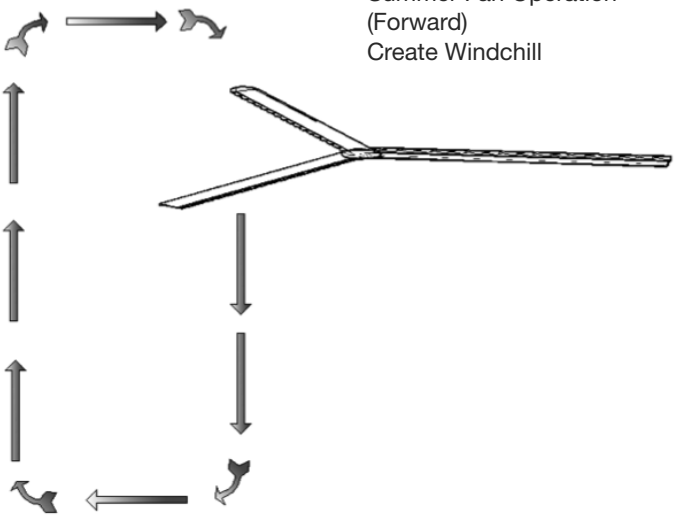


Figure 1
Summer Fan Operation
(Forward)
Create Windchill

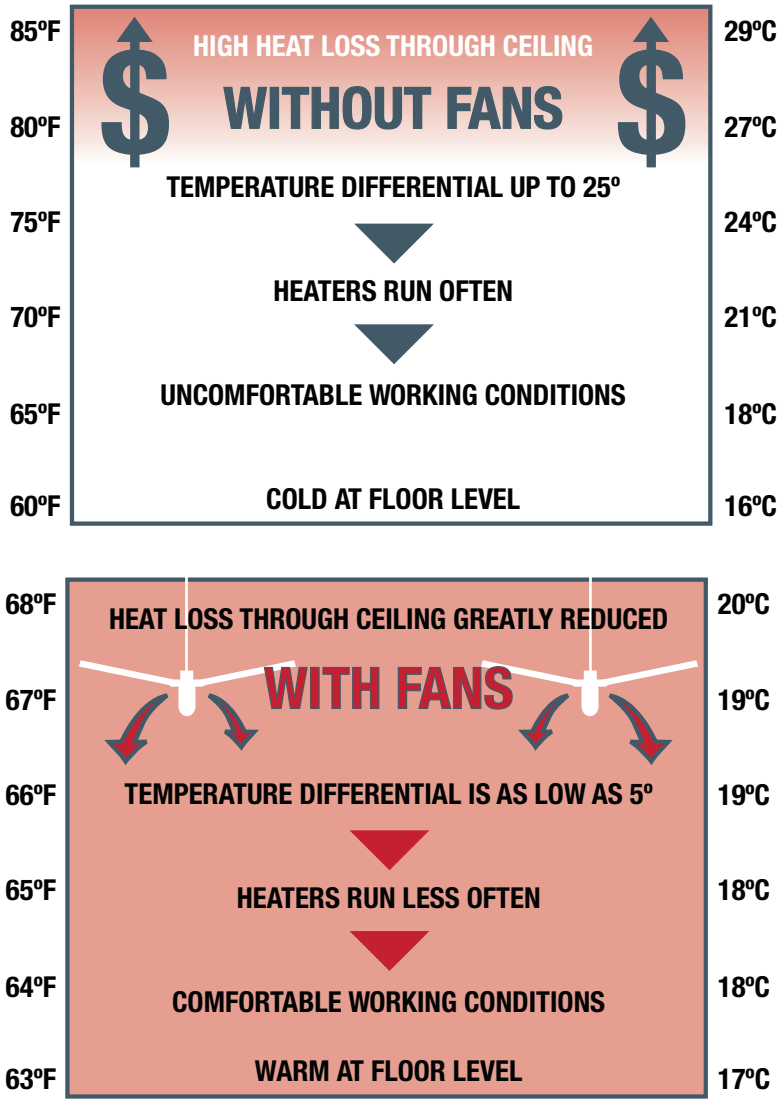


Figure 2
Winter Fan Operation
(Reverse)
Destratify

CALCULATING AIRFLOW OF HVLS INSTALLED AT CANARM FACILITY

At Canarm's Corporate Office(and manufacturing facility), an HVLS-24 was installed above our assembly lines. A series of tests were conducted to calculate the total airflow(CFM) and to determine fan layout. Below are the results.

Installation Details are as follows:
Ceiling Height is 20 feet
HVLS is 2 feet below ceiling
A VFD is used to control the RPM of the HVLS, during testing it was set to full speed

VERTICAL AIRFLOW MEASURED

A calibrated anemometer was used to calculate the various airspeeds at locations concentric to the center of the HVLS fan. The anemometer was held 4 feet above the ground(14 feet below the HVLS) and an average airspeed(through 30 seconds) was recorded at the predetermined distances from center. The measurements were taken every 3 feet from center(6 foot diameter), as shown below in **Figure 3**.

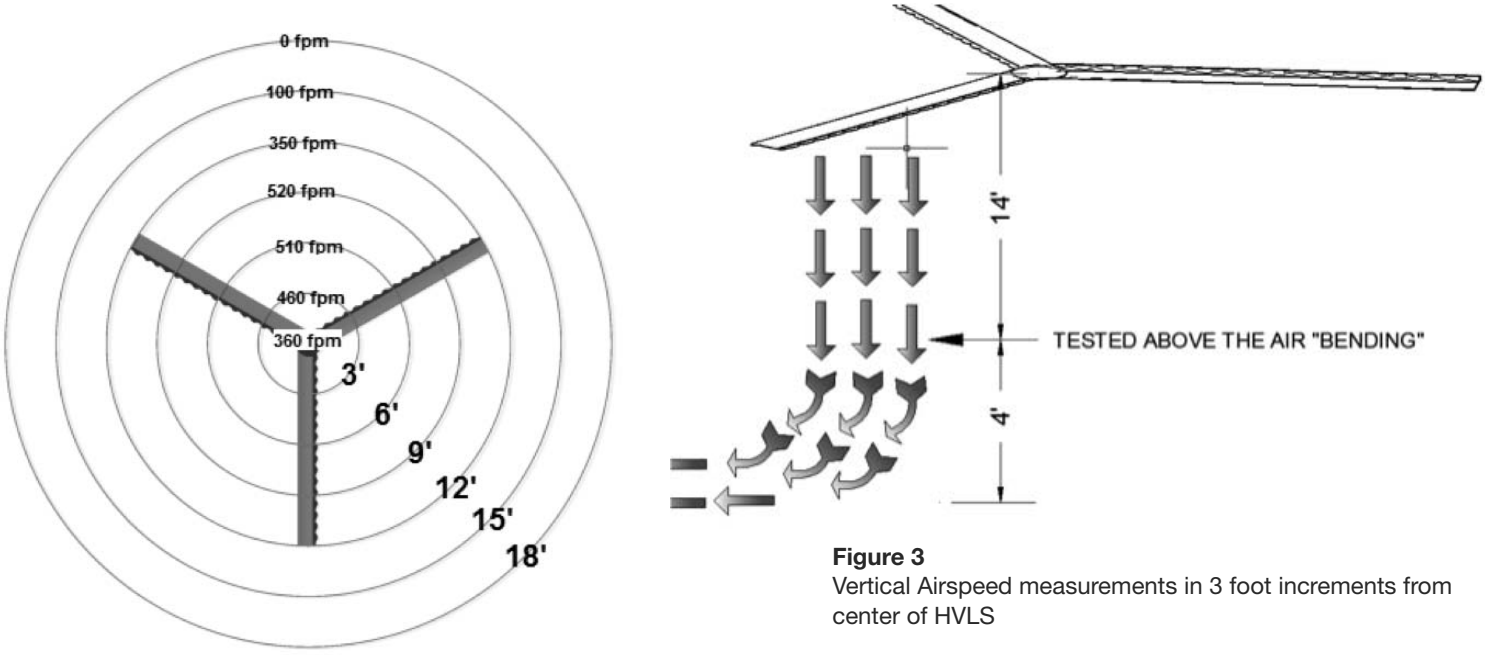


Figure 3
Vertical Airspeed measurements in 3 foot increments from center of HVLS

These results were then plotted in a line graph(Figure 4), a 4th order polynomial trendline was used to represent the data. The formula from this trendline will be used to calculate the estimated airflow of the HVLS at 14 feet from the fan.

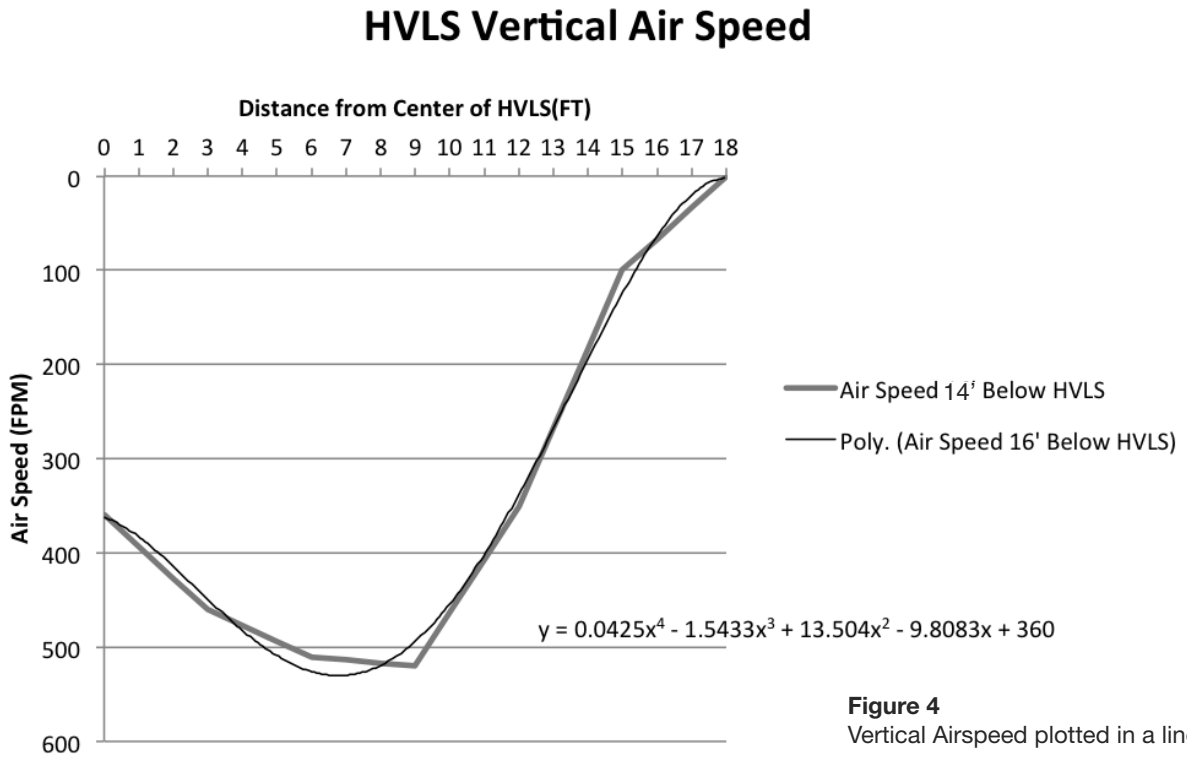


Figure 4
Vertical Airspeed plotted in a line graph

Using the recorded values of Air Speed at the specified distances, the average was taken and applied to the square footage of coverage to find the total CFM. Calculated average air movement 14 feet from the HVLS fan is **334,445 CFM**.

To get a more accurate CFM value(and to verify the estimate above), calculus was used with the polynomial trendline to calculate the volume under the curve when revolved about the y-axis(FPM). Using the shell method, the volume was found by integrating the function from 0 to 18 foot radius from center of the HVLS.

The calculations and results are shown in **Figure 5**.

Figure 5
Shell Method to calculate CFM(Volume under the curve revolved about y-axis)

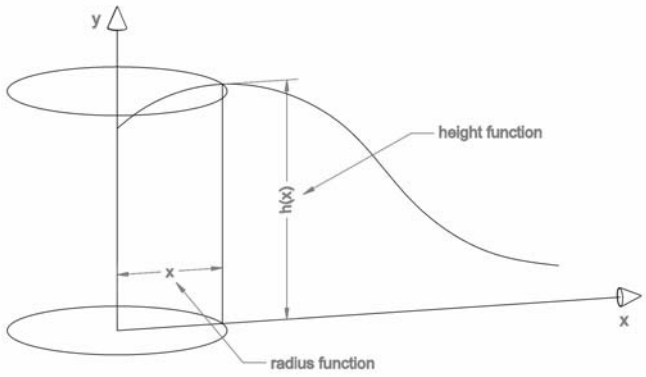
FUNCTION OF A TRENDLINE

$$y = 0.0425x^4 - 1.543x^3 + 13.504x^2 - 9.808x + 360$$

VOLUME FORMULA, from center "0" to radius 18 ft

$$V = \int_a^b 2\pi * r(x) * h(x)dx$$

Radius function — Height function



$$= 2\pi \int_0^{18} (x) * (0.0425x^4 - 1.543x^3 + 13.504x^2 - 9.808x + 360)$$

$$= 2\pi \int_0^{18} (0.0425x^5 - 1.543x^4 + 13.504x^3 - 9.808x^2 + 360x)$$

$$= 2\pi * [0.0071x^6 - 0.3086x^5 + 3.376x^4 - 3.269x^3 + 180x^2]_0^{18}$$

$$= 2\pi(241{,}486 - 583{,}120 + 354{,}398 - 19{,}064 + 58{,}320)$$

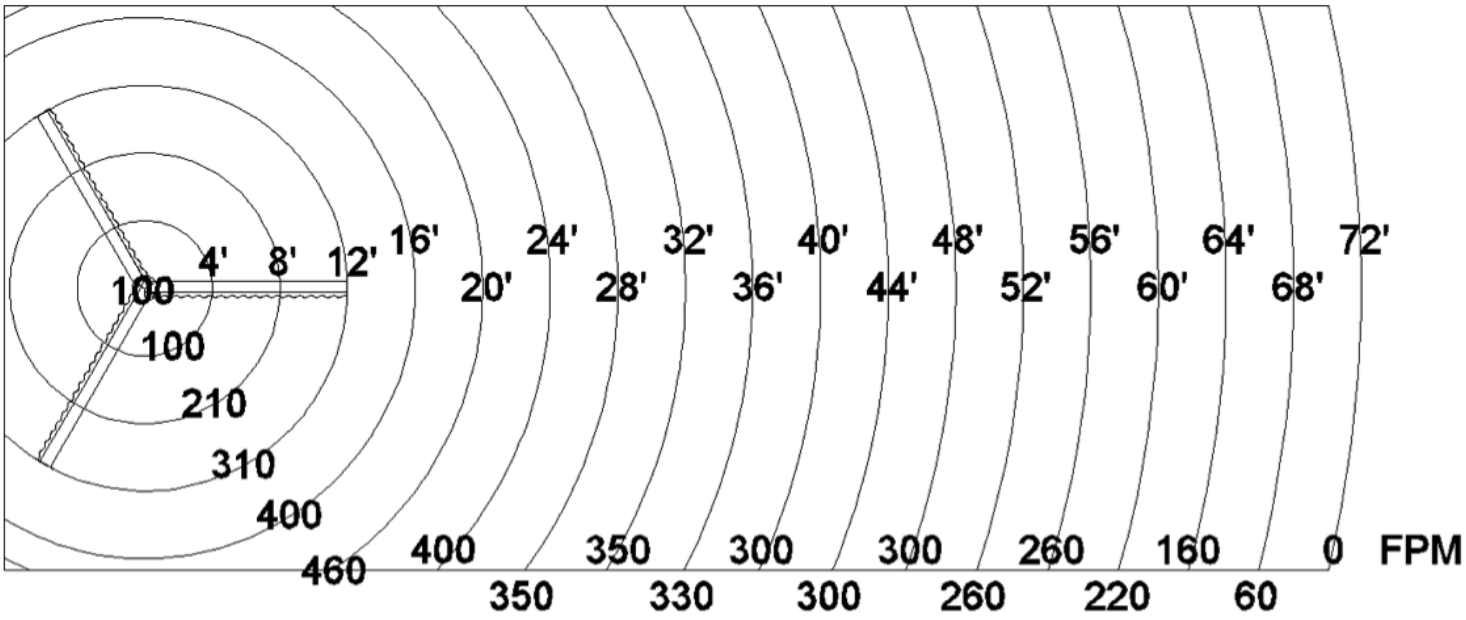
$$= 326{,}851\ CFM$$

From the data collected you can see the total CFM can be verified as at least 325,000 CFM. This value can change depending on the location and height of the HVLS. Later in this document fan layout will be explained in more depth to assist in locating the HVLS in your installation.

HORIZONTAL AIRFLOW MEASURED

A calibrated anemometer was used to calculate the various airspeeds at locations concentric to the center of the HVLS fan. The anemometer was held 2 feet above the ground(16 feet below the HVLS) and an average airspeed(through 30 seconds) was recorded at the predetermined distances from center. The measurements were taken every 4 feet from center, as shown below in **Figure 6**.

Figure 6
Horizontal Airspeed measurements in
4 foot increments from center of HVLS



These results were then plotted in a line graph (**Figure 7**), typical air speed to create a “cooling effect” for employees is 100-200 FPM(depending on ambient temperature). As you can see in **Figures 6 and 7**, the HVLS provides more than enough air speed past the 128 foot diameter range. This allows the installation to have fewer fans required, which saves initial cost, and energy consumption over time.

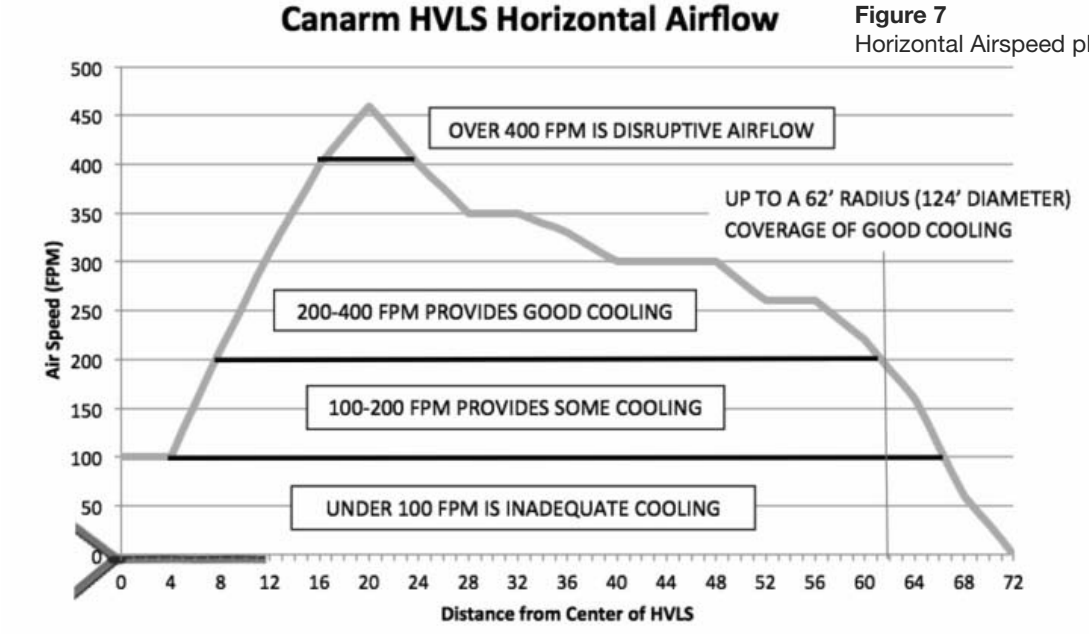


Figure 7
Horizontal Airspeed plotted in a line graph

As seen in **Figure 7**, the horizontal airflow is low near the center of the HVLS. This is because the air is moving more in a downward direction. If the horizontal and vertical airflow is compared, the horizontal flow increases as the vertical airflow decreases. This shows that the air is moving down, and then is pushed outwards along the floor, this concludes that the HVLS can cover a large amount of floor area while maintaining an acceptable air speed for cooling. **Figure 8** shows the overlap of the vertical and horizontal airflows.

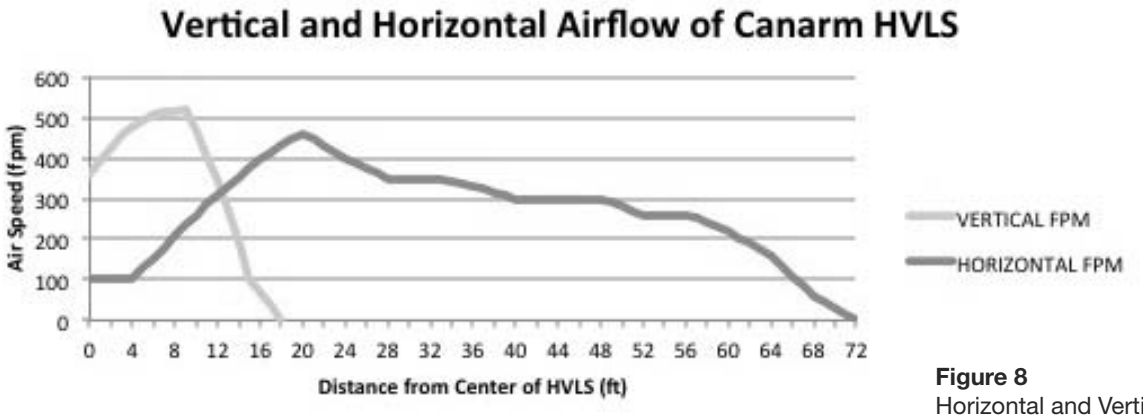


Figure 8
Horizontal and Vertical Airspeed plotted in a line graph

FAN LAYOUT

An HVLS fan is only as good as the location it is installed. It can be very easy to assume that the fan will move the air no matter where it is installed. The fan layout in a building needs to be analyzed and calculated so that there is consistent air movement (in the desired areas), and that there is also no “dead zones” where the air is stagnant.

Canarm provides customer support in this area. Provide a floor plan to our sales representative and they will work with the engineering team to determine the perfect fan layout for your application. (See Figure 12 for an example of a layout)

The airflow of the HVLS is unique such that most air movement is along the floor. The fan pushes the air down in a tunnel based on the diameter of the fan, then the air is forced outwards covering a large floor area. So locating the fans must consider obstructions that may interfere with this lateral airflow.

When placing one of the HVLS fans, consider the vertical area directly below the fan(Diameter plus 2-4 feet), and consider the horizontal area up to 140 feet in diameter from the fan. Any obstructions may cause turbulent or diminished air, and ultimately reduce the effectiveness of the fan. The primary concern would be the effectiveness of the fan on cooling your employees. There is no point of using the energy to cool racks of parts, so keep this in mind when locating your HVLS!

The following diagrams illustrate locations of the HVLS fans and how the air moves in relation to the fans location. It is recommended to contact Canarm for assistance in layout to ensure the fans are utilized properly. In some cases circulating fans may be required to assist the air movement to specific locations in your installation, the specialists at Canarm can help!

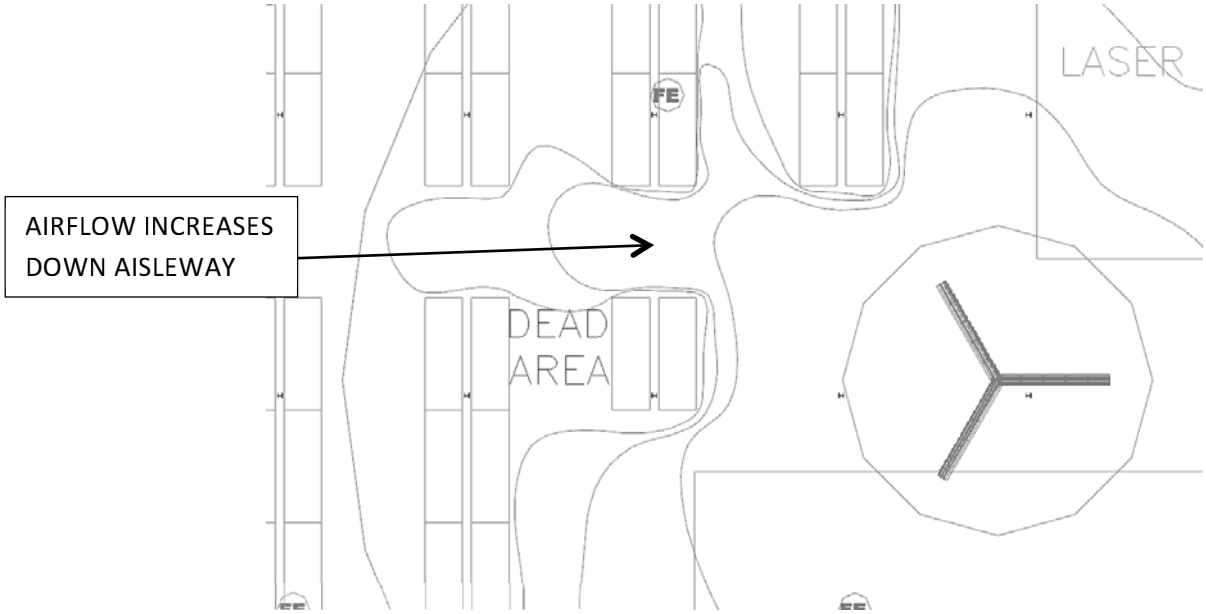


Figure 9
Air blocked by racking

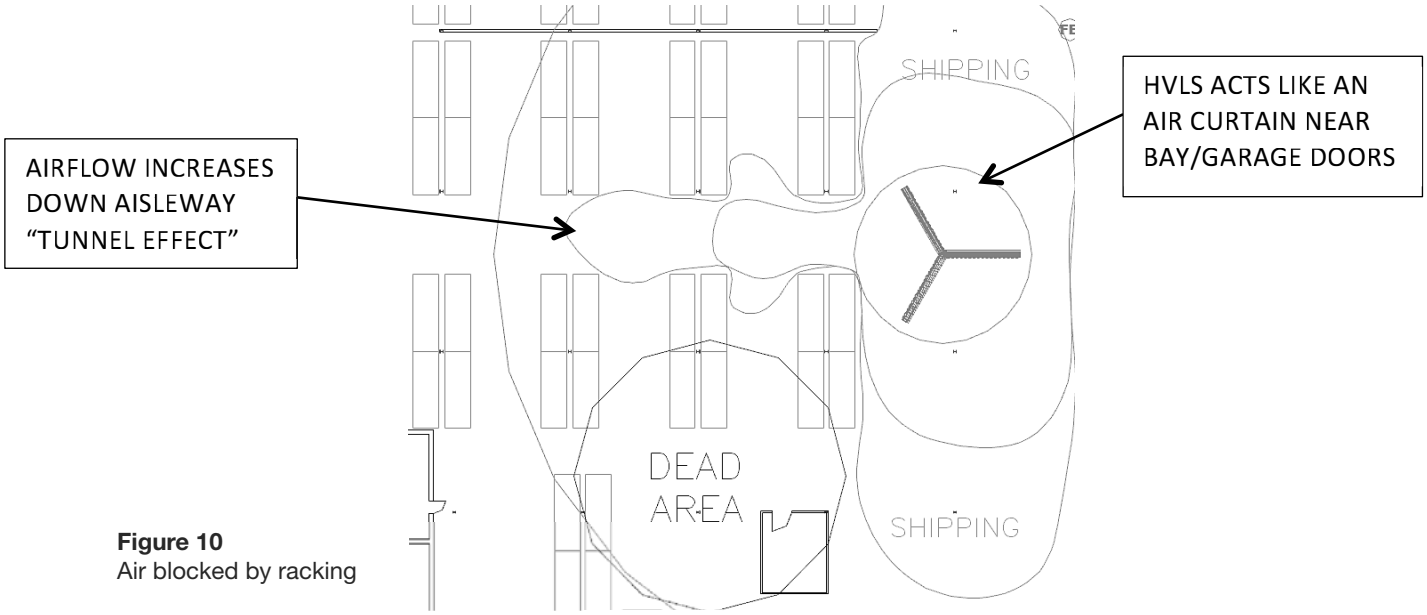


Figure 10
Air blocked by racking

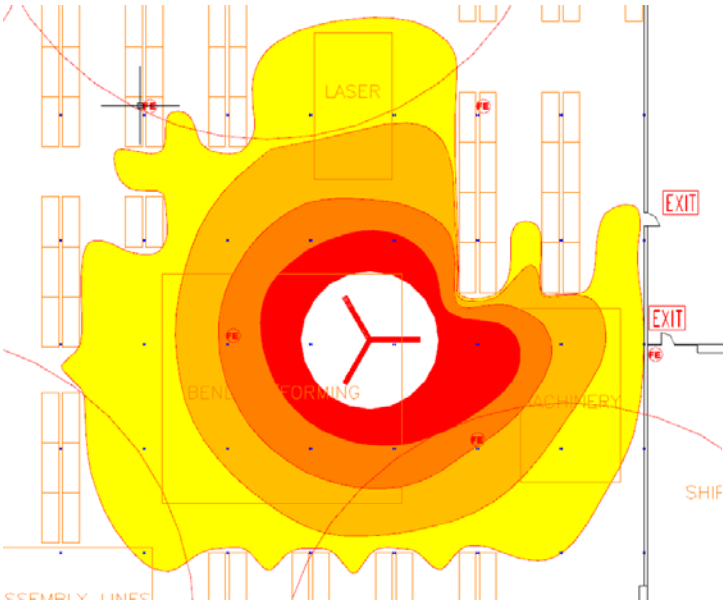


Figure 11
Obstructions will affect airflow
Providing as much detail as possible will assist in the most efficient layout for your application

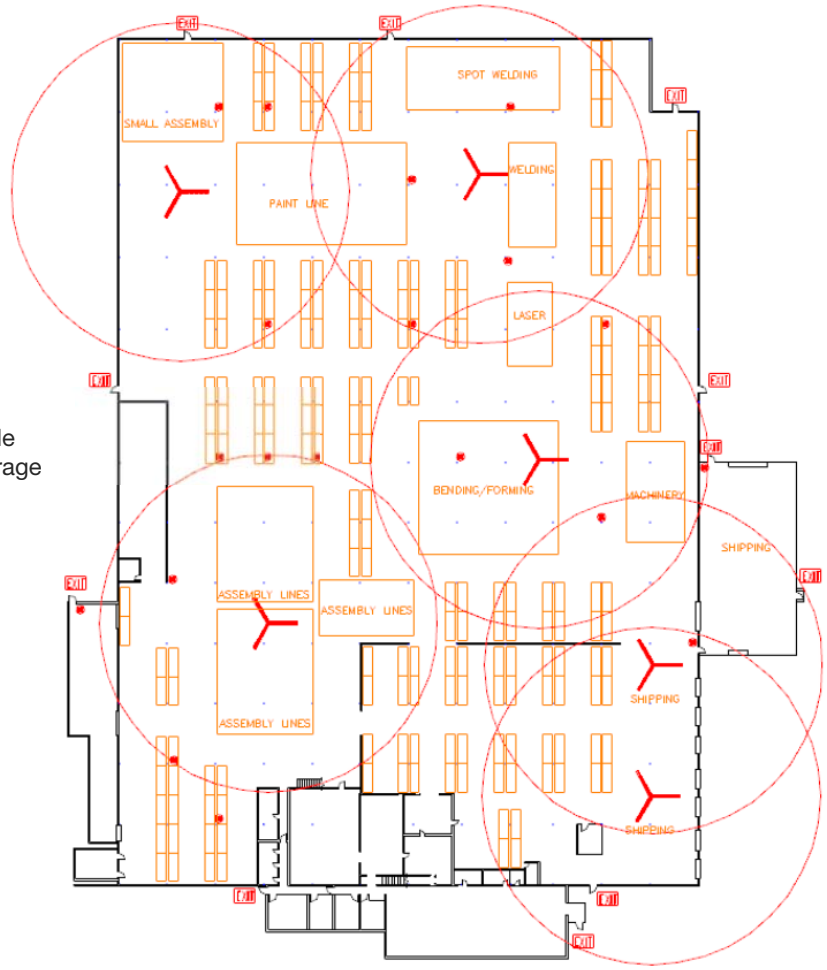


Figure 12
Floor Layout Example
140' Diameter Coverage Rings

INSTALLATION

Tri-Lite HVLS fans come as a complete system including power unit, mounting hardware, wiring kit (optional) and low voltage controller (optional). Having everything included in this complete package streamlines installation and eliminates the costly search for components and hardware.

SAFETY SYSTEMS

All Tri-Lite HVLS fans are supplied with superior safety equipment and harnessing systems to maintain an integral safety status and give the customer peace of mind. All fan installations include safety cables, guy wires, safety rings, thermal protection on motor to prevent overheating. If fans are installed between racks in a storage facility, signs should be posted identifying locations. The variable frequency drive also comes equipped with a current limit, motor overload sensor, minimum and maximum speed control.

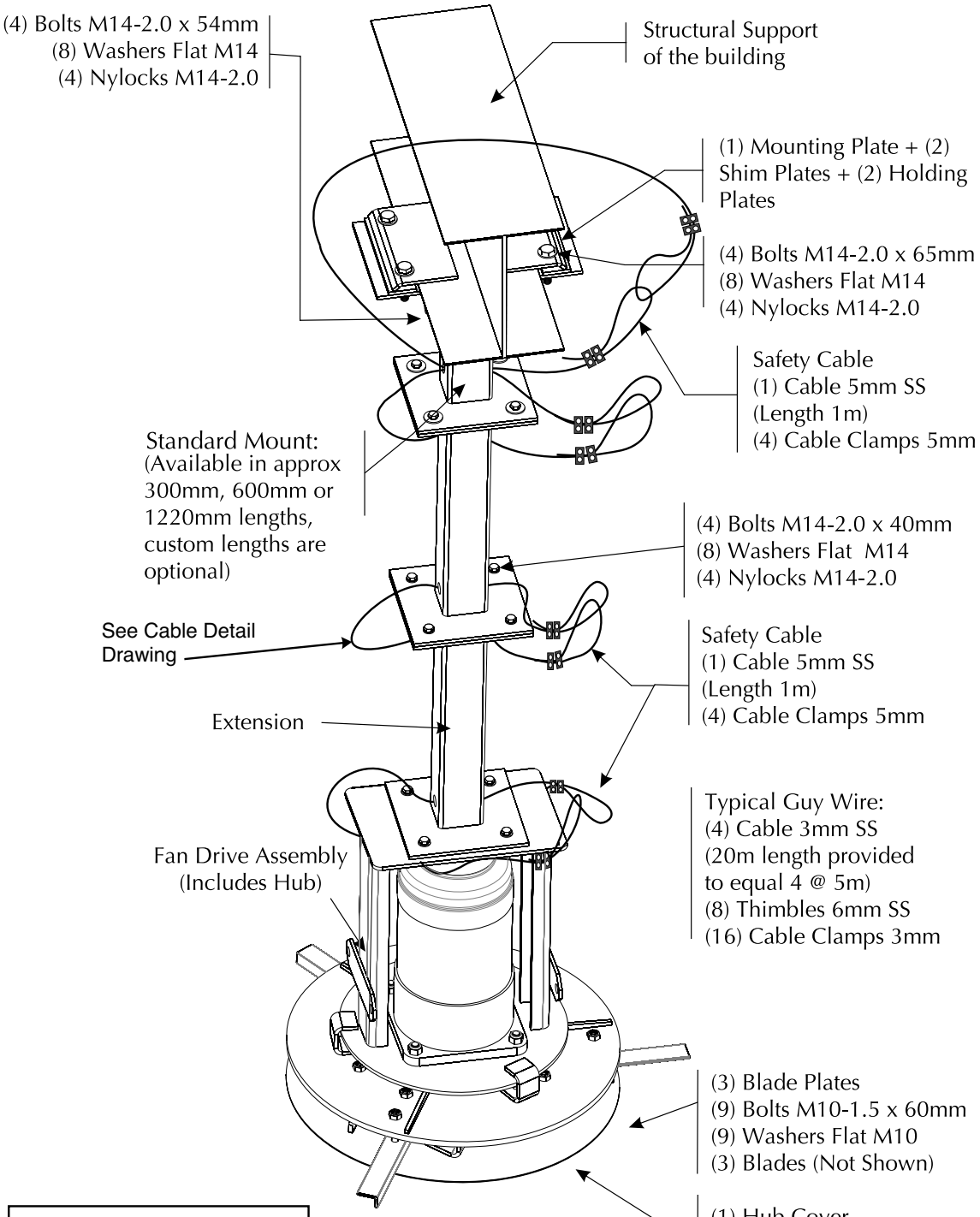
WARRANTY

The Tri-Lite HVLS fans are of industrial grade construction and should provide many years of virtually maintenance free use. Warranty duration is as follows:

a)	Air Foil Shaped Blade	1 year limited warranty
b)	Steel Hub	1 year limited warranty
c)	Gear Motor	1 year limited warranty
d)	VFD Control Panel	1 year limited warranty

Please see the Tri-Lite HVLS fan installation manual for complete warranty information, including specifics and warranty exclusions. Use the above warranty information as a general guideline only.

FAN COMPONENTS



Note: All bolts are "Class 8.8"
FT= Fully Threaded
(#) = Quantity Supplied

SPECIFICATIONS HVLS-16230460-1HP (16')

General
Model Number HVLS-16230460-1HP
Diameter ..... 16'
Blade ..... Whale Power Tubercle Technology™
Number of Blades 3
Motor Power ..... 0.75 kW (1 Hp)
Noise level ..... 62 dBA
Weight (no mount) . ..... 168 lbs*
Packaged Fan- 60 em x 60 em x 73 em ..... 157 lbs
Packaged Blades- 28 em x 13 em x 253 em .....56 lbs

Performance (at max speed)
Airflow ..... 144,400 CFM
Maximum Speed ..... 68 rpm
Power Usage ..... 368 W
Maximum Effective Diameter ..... 60'

Construction
Frame ..... 914 mm Gage Steel/ Galvanized
Hub ..... 9.7mm Zinc Plated Steel
Blades ..... 6063 Extruded Anodized Aluminum
Blade Leading Edge .....Plastic Extrusion
Blade End Caps ..... Plastic Extrusion
Blade Leading Edge Colour . ..... Pantone Blue

Safety Components
Safety Cables .....5 mm Stainless Steel
Guy Wires..... 3 mm Stainless Steel
Safety Clips ..... 6 mm Galvanized Steel

Mounting Hardware
Standard Mount .....Universal-Beam Clamp w/ Swivel
Drop Extensions (Optional) ..... 2' / 4'

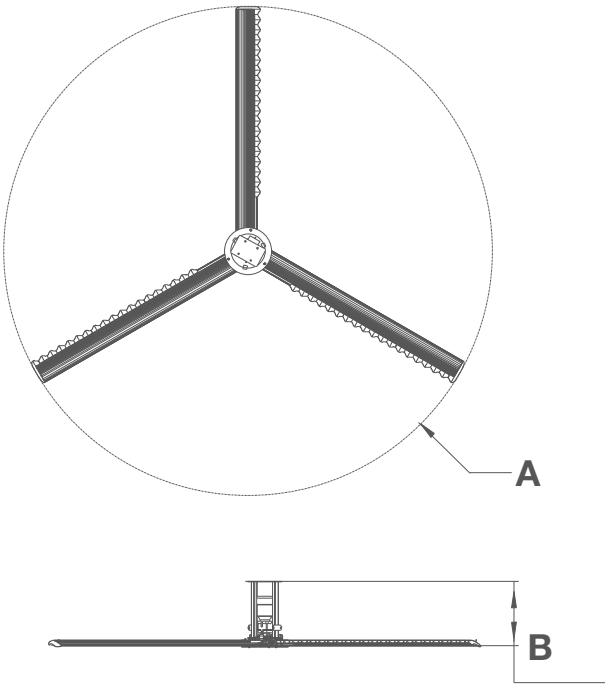
Mounting*
Open Web Steel Joist (Optional) .....Steel Beam With Brackets
Wood Beam Mount (Optional)..... Steel Machined Mount Plates
Concrete Beam Mount (Optional) ..... Steel Beam with Matching Mount Plates
Purlin "Z" Mount (Optional) .....Steel Beam Brackets
Steel Thickness Varies Depending on Beam Span ..... Consult Factory for Specifics
*Please see Tri-Lite HVLS Fans Installation Manual for more information regarding mounting hardware.

Gear Motor
Type ..... Helical Inline Reducer
HP ... . 0.75 kW (1 Hp) - 50 Hz /60 Hz
Ratio 25.85
Volts..... 230 V /460 V
Amps Consumed .....1.6 A ® 230 V
Insulation Class ..... F
Torque..... 112 Nm (988lb.in.)

Fan Control
Enclosures .....NEMA4 (IP65) or NEMA1
Operation ..... Key Pad
Control Options (Not Included) .....Low Voltage / Temperature Control
Standard Power ..... 208 V /230 V /400 V /460 V
Special Wiring (Thermostats, Fire Alarm Interface, Networking Etc.)(Optional) ....Consult Factory
50 / 60 Hz Operation

Warranty*
Motor & Gearbox ..... 1 Year
Blades, Hub & Mounting System .....1 Year
*Please see Tri-Lite HVLS Fans Installation Manual for warranty specifications and exclusions.

DIMENSIONS



MODEL NUMBER	A	B
HVLS-16230460-1HP	185"	24"

SPECIFICATIONS HVLS-24230460-1HP (24')

General
Model Number HVLS-24230460
Diameter ..... 24'
Blade ..... Whale Power Tubercle Technology™
Number of Blades 3
Motor Power ..... 0.75 kW (1 Hp)
Noise Level ..... 57 dBA
Weight (no mount) ..... 199 lbs*
Packaged Fan - 60 em x 60 em x 73 em . ..... 157 lbs
Packaged Blades - 28 em x 13 em x 375 em ..... 82 lbs
*Mounts, extensions & controls packages separately. Weights may vary.

Performance (at max speed)
Airflow ..... 325,000 CFM
Maximum Speed .....57 rpm
Power Usage ..... 621 W
Maximum Effective Diameter ..... 140'

Construction
Frame ..... 914 mm Gage Steel I Galvanized
Hub . .....9.7mm Zinc Plated Steel
Blades .....6063 Extruded Anodized Aluminum
Blade Leading Edge . ..... Plastic Extrusion
Blade End Caps .....Plastic Extrusion
Blade Leading Edge Colour . ..... Pantone Blue

Safety Components
Safety Cables ..... 5 mm Stainless Steel
Guy Wires ..... 3 mm Stainless Steel
Safety Clips .....6 mm Galvanized Steel

Mounting Hardware
Standard Mount .....Universaii-Beam Clamp w/ Swivel
Drop Extensions (Optional) ..... 2' /4'

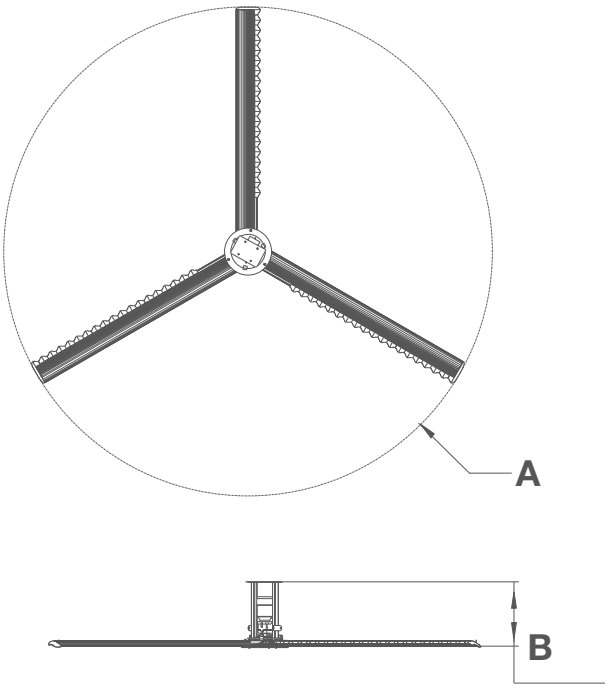
Mounting*
Open Web Steel joist (Optional) ..... Steel Beam With Brackets
Wood Beam Mount (Optional) ..... Steel Machined Mount Plates
Concrete Beam Mount (Optional) .....Steel Beam with Matching Mount Plates
Purlin "Z" Mount (Optional) ..... Steel Beam Brackets
Steel Thickness Varies Depending on Beam Span ..... Consult Factory for Specifics
*Please see Tri-Lite HVLS Fans Installation Manual for more information regarding mounting hardware.

Gear Motor
Type ..... Helical Inline Reducer
HP ..... 0.75 kW (1 Hp) -50 Hz /60 Hz
Ratio 25.85
Volts..... 230 V /460 V
Amps Consumed ..... 2 .7A ® 230 V
Insulation Class ..... F
Torque .....112 Nm (988 lb.in.)

Fan Control
Enclosures ..... NEMA4 (IP65) or NEMA1
Operation ..... Key Pad
Control Options (Not Included) .....Low Voltage I Temperature Control
Standard Power .....208 V /230 V /400 V /460 V
Special Wiring (Thermostats, Fire Alarm Interface, Networking Etc.)(Optional) Consult Factory
50 /60 Hz Operation

Warranty*
Motor & Gearbox .....1 Year
Blades, Hub & Mounting System ..... 1 Year

DIMENSIONS

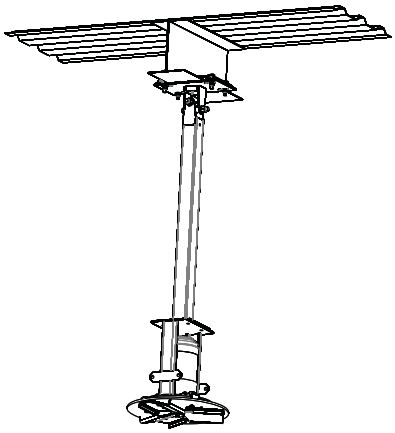


MODEL NUMBER	A	B
HVLS-24230460-1HP	279.5"	24"

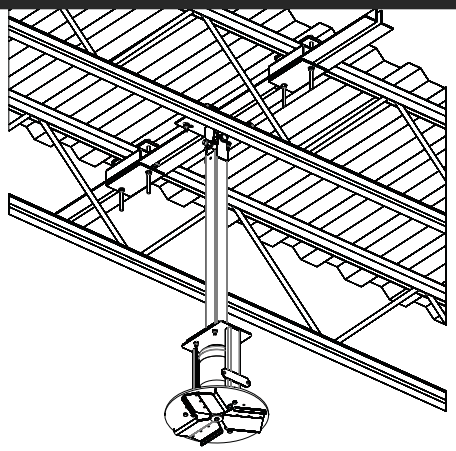
DIFFERENT MOUNTING APPLICATIONS

NOTE: The following mounting applications are representations only and are subject to change without notice. Contact your Canarm sales representative for complete mounting instructions.

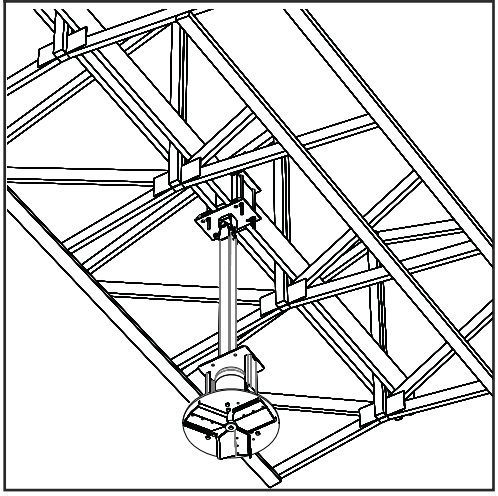
I BEAM MOUNTING



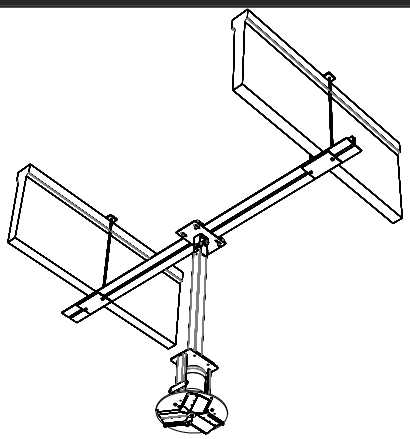
OWSJ MOUNTING



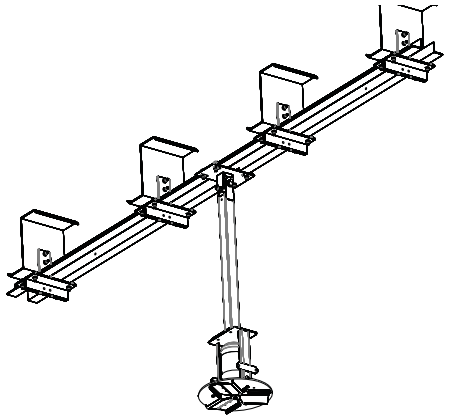
WOOD BEAM MOUNTING



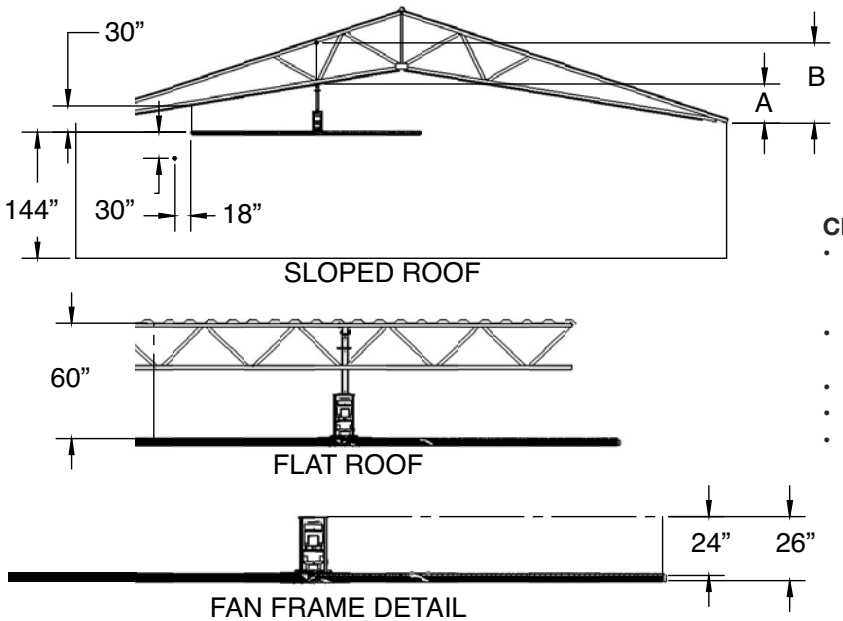
CONCRETE BEAM MOUNTING



PURLIN "Z" MOUNTING



FAN BLADE CLEARANCE (Minimum Dimensions for Clearance)



OPEN CEILING - USE
DIMENSION A, MINIMUM 60”

FINISHED TRUSS CEILING -USE
DIMENSION B, MINIMUM 48”

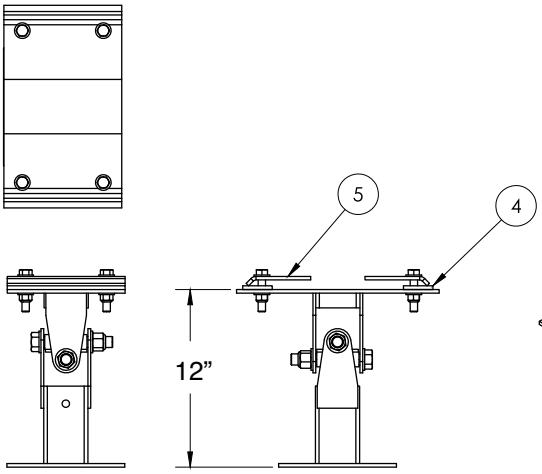
CLEARANCES:

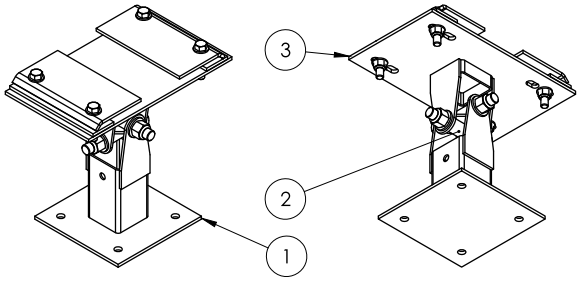
- Min 60" center of fan to roof deck: or to finished ceiling for ideal operating performance without comprising overall fan performance.
- Min 30" from fan blade's leading edge to obstruction above or below fan.
- Min 18” from side of fan to any obstruction
- Min floor to fan leading edge height 144”
- To determine correct length for drop
  - establish method to mount the fan
  - determine necessary clearances
  - add clearance to distance required to mount location
  - select from standard UMH mounts’ lengths available

NOTE: All dimensions are minimum requirements

MOUNTS

1 FT UMH MOUNT

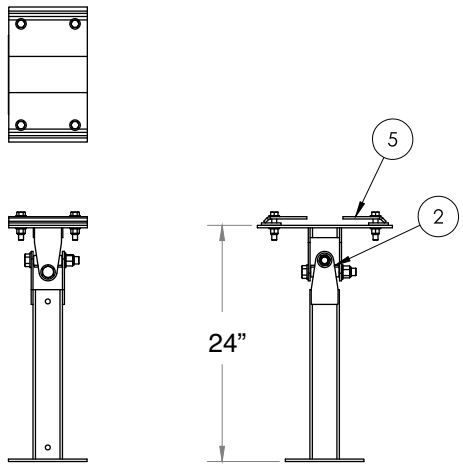


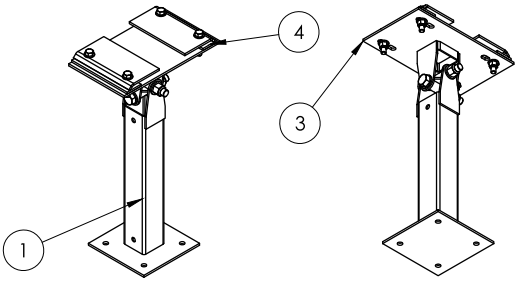


ITEM #	MODEL #	DESCRIPTION	QTY.
1	EN823X8425	DROP H TYPE 1 FT	1
2	EN823x8418	UMH COUPLER PC	1
3	EN823x8417	UMH UPPER PIVOT PLATE	1
4	EN823X8401	MANUFACTURED I-BEAM SPACER	2
5	EN823x8402	MANUFACTURED I-BEAM CLAMP	2

Subject to change without notice.

2 FT UMH MOUNT

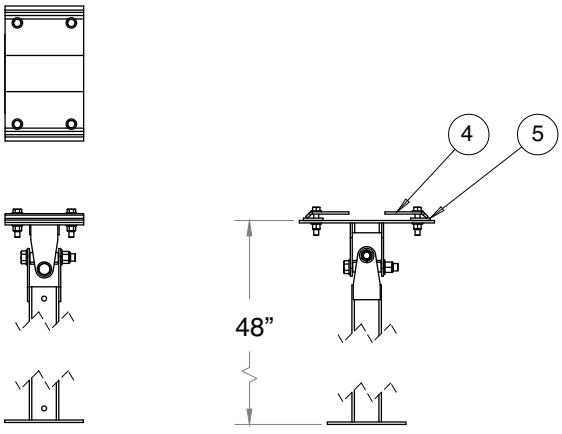


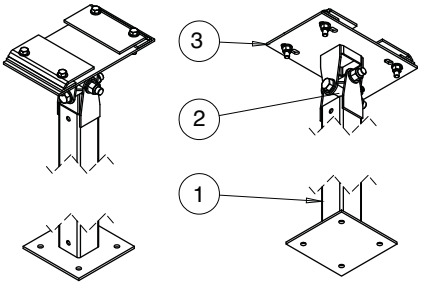


ITEM #	MODEL #	DESCRIPTION	QTY.
1	EN823X8426	DROP H TYPE 2 FT	1
2	EN823x8418	UMH COUPLER PC	1
3	EN823x8417	UMH UPPER PIVOT PLATE	1
4	EN823X8401	MANUFACTURED I-BEAM SPACER	2
5	EN823x8402	MANUFACTURED I-BEAM CLAMP	2

Subject to change without notice.

4 FT UMH MOUNT



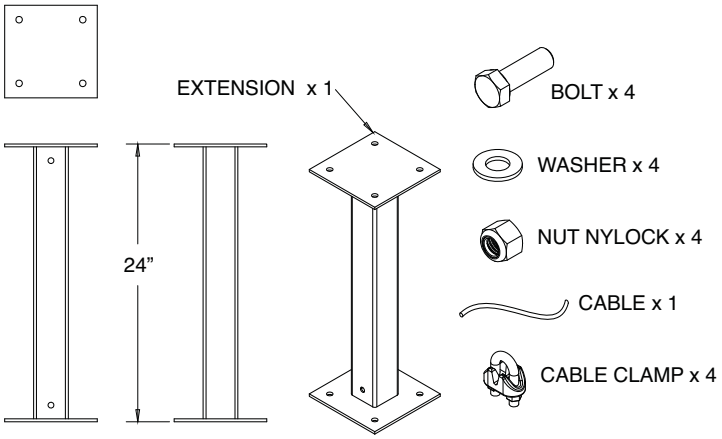


ITEM #	MODEL #	DESCRIPTION	QTY.
1	EN823X8428	DROP H TYPE 4 FT	1
2	EN823x8418	UMH COUPLER PC	1
3	EN823x8417	UMH UPPER PIVOT PLATE	1
4	EN823x8402	MANUFACTURED I-BEAM SPACER	2
5	EN823X8401	MANUFACTURED I-BEAM CLAMP	2

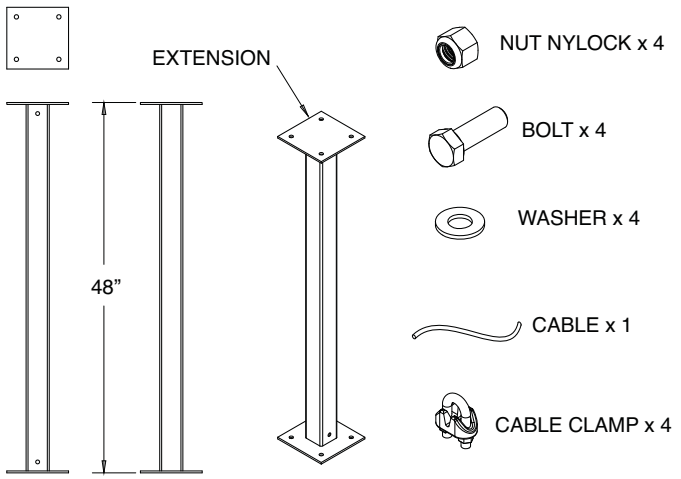
Subject to change without notice.

EXTENSION MOUNTS

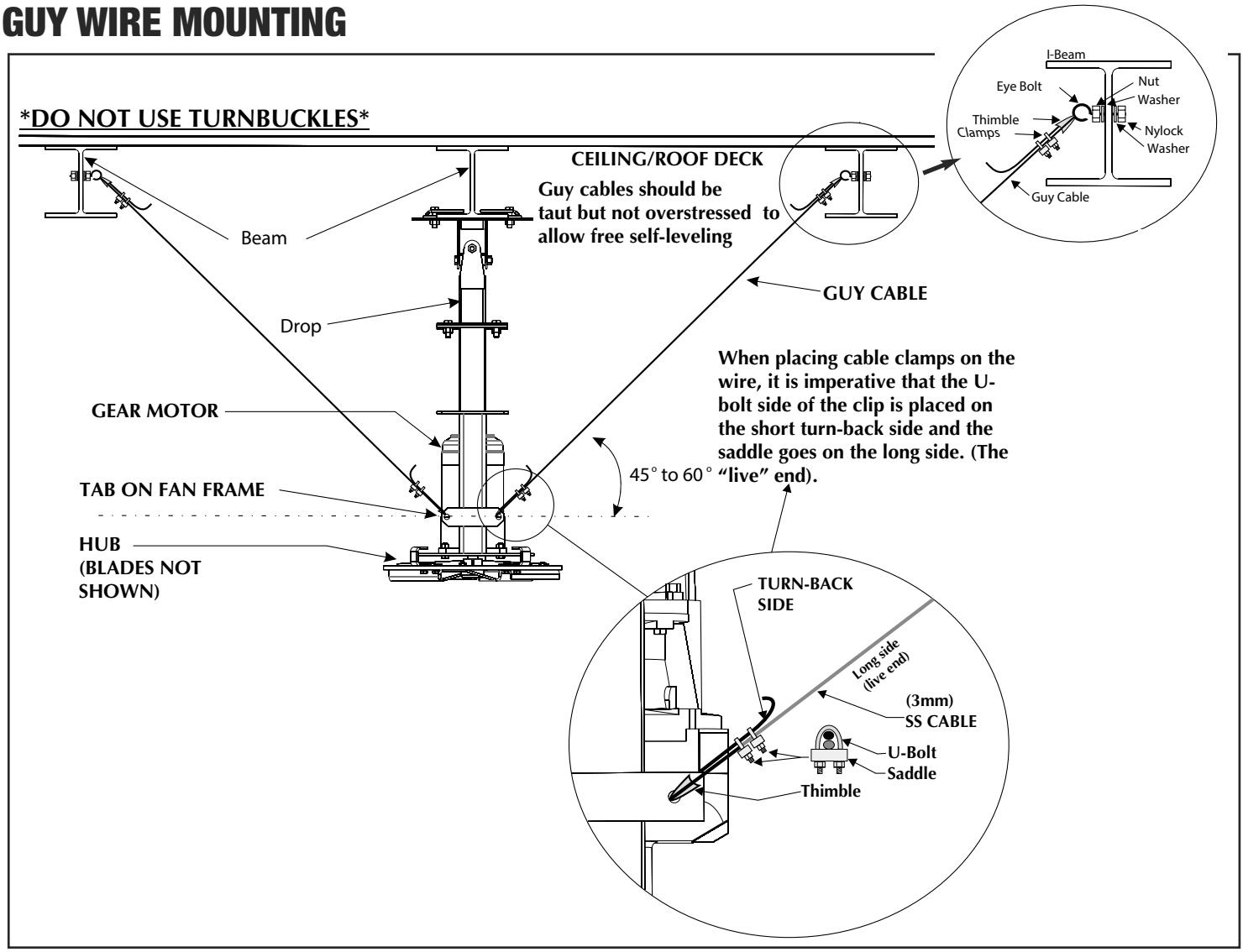
2 FT PKG EXTENSION MOUNT



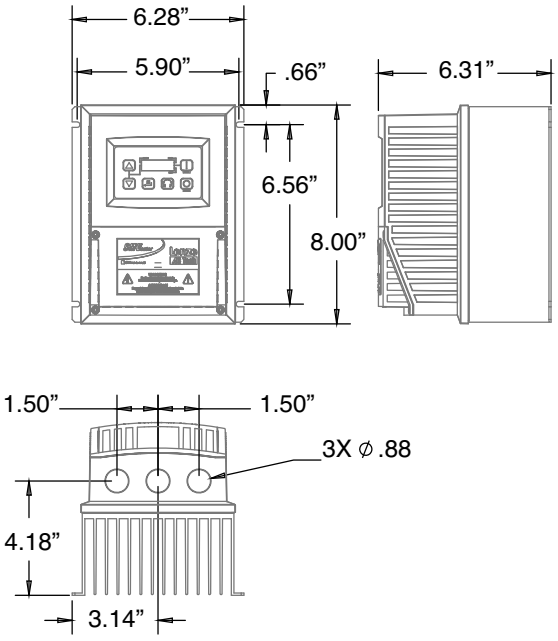
4 FT PKG EXTENSION MOUNT



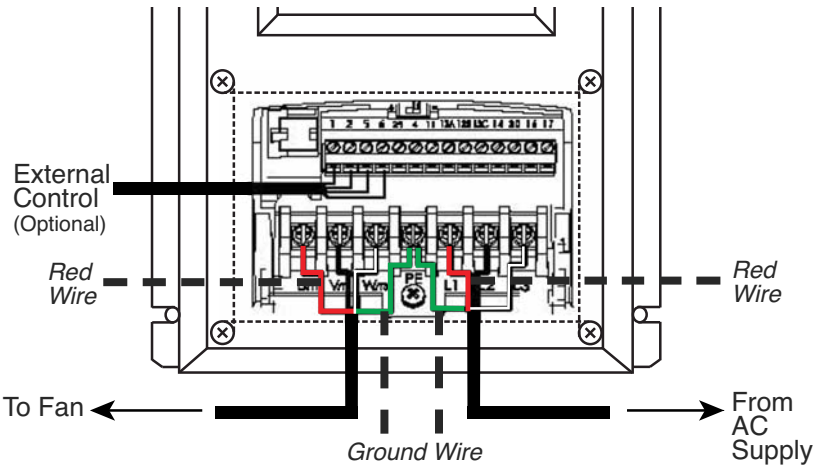
GUY WIRE MOUNTING

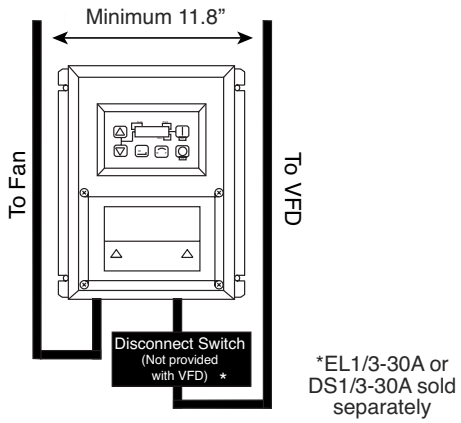


FAN CONTROL
2HP 230V NEMA 4 VFD



WIRE CONNECTIONS TO VFD
(Variable Frequency Drives)





SAFETY & INSTALLATION

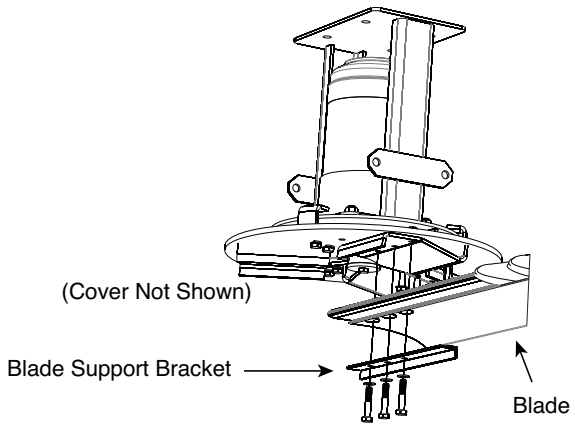
Tri-Lite HVLS Fans have the following measures in place to ensure the safety of our fans:

Safety Cable
This cable ties together the vertical drop and the gear motor frame to the physical structure of your building.

Blade Support Brackets
These clips help support the blade from underneath.

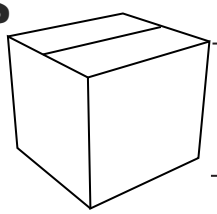
Guy Wires
The wires have two functions; first, to avoid unnecessary sway of the fan in case of unbalanced blade(s) and second, to avoid large movements due to wind or draft.

Mount
The mounting hardware has been designed and engineered to support the weight of the fan and provide a secure connection to the structure.

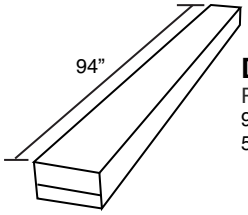


PACKAGING DETAILS

16' TRI-LITE HVLS

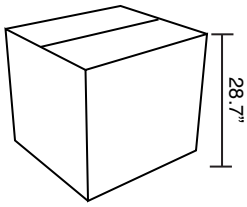


Dimensions
HVLS-16230460-1HP
23.6" x 23.6" x 28.75"
157 lbs

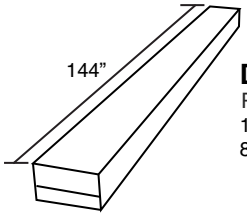


Dimensions
Packaged Blades
94" x 11.0" x 10.5"
56 lbs

24' TRI-LITE HVLS



Dimensions
HVLS-24230460-1HP
23.6" x 23.6" x 28.75"
157 lbs



Dimensions
Packaged Blades
144" x 11.0" x 10.5"
82 lbs

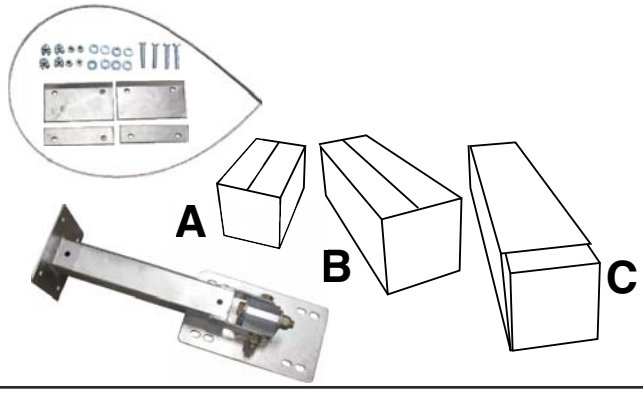
STANDARD FAN MOUNTING

A
1' Packaged UMH Mount
15" x 9" x 9"
22 lbs

B
2' Packaged UMH Mount
28" x 9" x 9"
33 lbs

C
4' Packaged UMH Mount
51" x 9" x 9"
46 lbs

Note: Custom lengths available upon request.

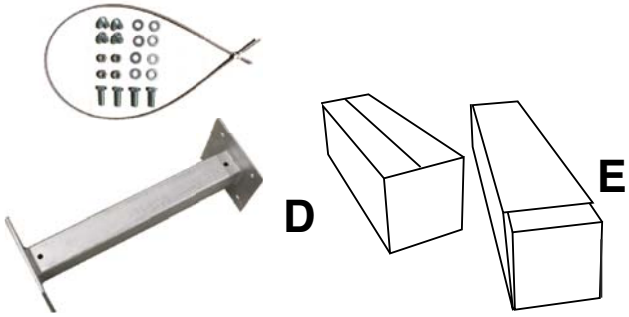


FAN EXTENSIONS

D **HVLS-MBX2**
2' UMH Extension
28" x 9" x 9"
21 lbs

E **HVLS-MBX4**
4' UMH Extension
49" x 9" x 9"
31 lbs

Note: Custom lengths available upon request.



VFD FAN CONTROLS

HVLS-ESV751N02YXB
Variable Frequency Drive - 230V, 1Ø/30 Input (0 - 230V 3Ø Output)(NEMA1)

HVLS-ESV751N02YXC
Variable Frequency Drive - 230V 1Ø/30 Input (0 - 230V 3Ø Output)(NEMA4)

HVLS-ESV751N04TXB
Variable Frequency Drive - 480V, 3Ø Input (NEMA1)

HVLS-ESV751N04TXC
Variable Frequency Drive - 480V, 3Ø Input (NEMA4)

DISCONNECT SWITCH

EL1/3-30A
Disconnect Switch 30A, IP65

DS1/3-30A
Disconnect Switch 30A, NEMA3R

INSTALLATION OR PRODUCT PROBLEMS?

Do not return to store of purchase. Contact **Canarm at 1-800-265-1833 (CANADA), 1-800-267-4427 (U.S.A.), 1-800-567-2513 (EN FRANCAIS)** Monday to Friday 8:00 - 5:00pm e.s.t. or visit www.canarm.com

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Tel: (613) 342-5424; Fax: (613) 342-8437 **hvacsales@canarm.ca** **www.canarm.com**