DESIGN PROCEDURE
APEX RAIL - HIGH CAPACITY

TABLE OF CONTENTS

INTRODUCTION

The following pages explain how to select vehicle exhaust equipment and size an exhaust fan for a High Capacity Apex Rail application with Vacuum Holster™ hosedrops. The Vacuum Holster™ hosedrop simplifies vehicle exhaust removal by using the static pressure of the exhaust fan to assist in storage of the exhaust hose, eliminating the expense and maintenance of additional equipment such as hosereels or retracting balancers.

This design manual is for applications in which the Vacuum Holsters™ are not fixed-mounted in the facility, but are incorporated into an Apex Rail system with sliding trolleys.

For fleet service applications, the Vacuum Holster™ uses 6" diameter hose to move 600 CFM; for military applications, 8" diameter hose is furnished to move 1,400 CFM per drop. The High Capacity Apex Rail is recommended for total airflow rates of 1,400 CFM or more - meaning 3 fleet service 6" drops or 1 or more 8" drops. **(Please see page 4, section B.3 for more information on which Apex Rail to select).** The Vacuum Holster™ and Apex Rail are suitable for applications with intermittent airstream temperatures up to 700 degrees F.

Before beginning design, it is important to note that the Apex Rail with Vacuum Holster™ is **not** intended for the following applications:

A. **Fire station/emergency vehicle applications**, in which the vehicle exhaust system follows the vehicle to the garage door and automatically disconnects.
B. **Diesel dynamometer applications.** These applications require extreme temperature hose that is not suitable for Vacuum Holsters™. Ascent Systems offers systems to accommodate these situations, but not in a Vacuum Holster™-Apex Rail configuration.

PREVIEW

Page 2 is intended to assist the system designer in selecting the Apex Rail, Vacuum Holsters™, and system options for the particular application. This page should be used in conjunction with page 3, which will enable the specifier to generate accurate part numbers for the desired equipment selections. With the equipment selected, Page 4 describes how to size the exhaust fan, calculating the CFM and determining the pressure drops from the Vacuum Holster™, system options, Apex Rail, and ductwork; and including the effects of temperature and elevation on exhaust fan performance.

I-HC8-01

As mentioned above, the Vacuum Holster™ relies on the static pressure from the exhaust fan to retract the exhaust hose, and pages 4-5 explain how to select a fan that will accomplish this function. Page 6 is a system design worksheet that is intended to give a step-by-step procedure for the items explained on pages 4-5.

Page 7 depicts typical layouts and gives suggestions for the location of the equipment. Page 8 provides dimensions and weights.

OTHER RESOURCES

This manual provides assistance in designing an Apex Rail system, but it is not comprehensive. There are other resources, all available at www.ascentsystemsinc.com, that are helpful in completing a design, including:

A. **Ascent Systems Exhaust Fan Manual**. This manual will enable the designer to determine the CFM-static pressure point of operation, but the Exhaust Fan Manual has performance curves, specifications, and dimensions as well.
B. **Product specifications**. These specifications are available in Word format from the website and can be inserted into project plans and specifications.
C. **CAD files**. Available upon request, these installation diagrams and equipment schedules can be inserted into plans.

PRODUCT SELECTION - APEX RAIL - HIGH CAPACITY

NOTE: This page should be used in conjunction with page 3, High Capacity Apex Rail™ Nomenclature.

The purpose of these two pages is twofold:

1) To assist the system designer in making the correct selection of the Apex Rail Assembly and the Vacuum Holsters™.
2) To enable the system designer or specifying engineer to generate correct part numbers for the desired equipment.

Please see the exhaust fan catalog to determine the proper exhaust fan selection and to generate the correct ordering information.

STEP #1: SPECIFY THE APEX RAIL ASSEMBLY

A. Selection of the High Capacity Apex Rail.
The High Capacity Apex Rail is recommended for 1,400 CFM or more - equivalent to 3 fleet service drops or 1 High Capacity drop. **(Please see page 4, section B.3 for more information on which Apex Rail to select).**

B. Length of the Apex Rail.
The Apex Rail is offered in 12' sections, with an option available for 6' sections. In specifying the length of the Apex Rail, the quantities of rubber seals, couplings, end caps, etc. are implicit in the part number.

C. Quantity of Duct-to-Rail Transitions.
On High Capacity Apex Rails, it is not possible to use the end cap to connect to the spiral duct. To minimize pressure drop and improve system performance, it is recommended that a duct-to-rail transition piece be located in the center of the Apex Rail. In some circumstances, more than one piece may be desirable to improve performance.

D. Diameter of Duct-to-Rail Transitions.
A 8" diameter duct transition piece is sufficient if the flow is no more than 1,400 CFM; above that, a 12" diameter piece is recommended.

STEP #2: SELECT THE VACUUM HOLSTER™

A. Diameter of Exhaust Hose.
6" exhaust hose is recommended for commercial truck and heavy equipment applications.
8" exhaust hose is recommended for military and other high capacity applications.

B. Length of Exhaust Hose.
6 and 8" diameter exhaust hoses are offered in lengths of 17', 20', and 25'. For 16' wide bays, a hose length of 20' is typically sufficient; for 20' wide bays, select a hose length of 25'. 17' lengths should be specified only when the vehicle is in close proximity to the hose drop.

C. Height of Hose Holster Storage Cylinder.
Extended Hose Holster is the standard Hose Holster size, and is 72" high in both the 6" and 8" models. The Extended Hose Holster is the default Hose Holster selection, and should be selected in almost all cases.

Compact Hose Holster is available for both the 6" and 8" Holster models, under special circumstances. The Compact model can be selected only if the exhaust hose is 20' or less. The Compact model provides for easier installation when the Apex Rail height is low - (bottom of Apex Rail is less than 14'6" AFF for 6" and 8" Holsters. If the bottom of the Apex Rail is higher than the above guidelines, the extended model is recommended.

D. Composition of Exhaust Hose.
High Temp Silicon-Kevlar Hose can withstand temperatures up to 600 degrees F continuous, 700 F intermittent. It is available for 6 and 8" diameters.

STEP #3: SELECT SYSTEM OPTIONS

Please refer to product details for more detailed descriptions of system options. In High Capacity applications, the most common options are as follows:


I-A6W-04

Wye Assemblies for connection to dual exhaust ports. # A4WYE, for 6" systems; # A6WYE, for 8" systems.


I-H8S-11

Extension Hoses for additional reach, which include a tailpipe adapter without a damper assembly. Part # H?S??-EX, where "?" is the diameter, and "??" indicates the length.


I-A8E-05

Exhaust Canes for connection to vertical stacks. 7' is the standard height; short 5' canes and long 10' canes are available. Part # A?EXC-??, where "?" is the diameter, and "??" indicates the height of the cane.


I-A3C-01

Remote Start Fan Controls for fan on/off control from the Vacuum Holster. Part # A3CP, for control panel (one per fan is required); Part # A3TK, for wireless transmitter (one per Holster is recommended).

STEP #4: SELECT THE EXHAUST FAN

Please refer to other pages in this design procedure manual for and the Ascent Systems Exhaust Fan Manual to select and specify an effective exhaust fan.

DESIGN PROCEDURE - APEX RAIL - HIGH CAPACITY PART NUMBERS AND NOMENCLATURE

(ARHC) = **A**pex **R**ail **H**igh **C**apacity, for CFM of 1,400 or more

(??) = Length of the Apex Rail

(?) = Quantity of Duct-to-Rail Transition Pieces
On the High Capacity Apex Rail, the end cap cannot be used for duct connection. Typically there is one in the middle of the Apex Rail (2 may be needed).

(??)= Diameter of Duct-to-Rail Transition Piece
"8" if flow is 1,400 CFM or less;
"12" if flow is more than 1,400 CFM.

ARHC- 60 - 1 - 12 = **Apex Rail, High Capacity, 60' long, with 1 duct transition piece, 12" round.**
ARHC-144- 2 - 8 = **Apex Rail, High Capacity, 144' in length, with 2 duct transition pieces, 8" round.**

STEP #1: APEX RAIL ASSEMBLY

This step includes selections concerning the:
A) Suitability of the High Capacity Apex Rail:
A) Length of the High Capacity Apex Rail;
B) Number of duct transition pieces;
C) Diameter of the duct transition pieces.

NOTE: The appropriate quantities of rubber seals, couplings, end caps, etc. are implicit in the above part number.

(VHT) = **V**acuum **H**olster with **T**rolley

(6/8) = Diameter of the Exhaust Hose

(??) = Length of the Exhaust Hose
Standard Length, 6-8" Hose: 17, 20, or 25'

(E/C)= Height of Hose Holster
"E" for Extended (standard height)
"C" for Compact (only if bottom of Apex Rail is less than 14'6" AFF for 6" or 8" Holsters)

(S) = Composition of Exhaust Hose
"S" for Silicon-Kevlar

VHT 6 25 E S = **Vacuum Holster - 6" Trolley and 6" x 25' High Temp Hose and Extended Holster.**
VHT 8 20 C S = **Vacuum Holster - 8" Trolley and 8" x 20' High Temp Hose and Compact Holster.**

STEP #2: VACUUM HOLSTER ASSEMBLY

This step includes selections concerning the:
A) Diameter of the exhaust hose;
B) Length of the exhaust hose;
C) Height of the Hose Holster;
D) Composition of exhaust hose.

The appropriate tailpipe adapter, rotational damper, and trolley are automatically included in the assembly.

STEP #3: SYSTEM OPTIONS

Common system options include wye assemblies for connection to dual exhausts; exhaust canes for connection to vertical stacks; extension hoses for additional coverage; and remote start fan control. Please refer to the page 2 and to product details for more information.

STEP #4: EXHAUST FAN

Please refer to the other pages in this design procedure manual and the Ascent Systems Exhaust Fan Manual to select and specify the correct exhaust fan.

FAN DESIGN PROCEDURE - APEX RAIL - HIGH CAPACITY

A. CALCULATING THE CFM REQUIREMENT

The recommended CFM per hose drop is given in Table 1. In general, 6" exhaust hose is recommended for commercial truck and heavy equipment applications. 8" exhaust hose is recommended for military and specialized applications. The High Capacity Apex Rail is suitable for 3 or more 6" drops, as well as all 8" diameter systems.

To obtain the CFM requirement, multiply the total number of Vacuum Holsters™ by the recommended CFM per hosedrop as given in Table 1 (Confirm CFM rates with local codes).

Table 1 - CFM Rates

Diameter	6"	8"
CFM	600	1,400

B. DETERMINING STATIC PRESSURE

The static pressure arises primarily from five sources:

1) The exhaust hose and tailpipe adapter of the Vacuum Holster™ assembly;
2) System options such as canes or wye assemblies;
3) The High Capacity Apex Rail;
4) Runs of straight duct;
5) Elbows in the exhaust duct.

1. Pressure Drop from Exhaust Hose and Tailpipe Adapter

Table 2 shows the pressure drop though Ascent Systems exhaust hose and tailpipe adapters. The figures below assume the CFM rates as shown in Table 1.

Table 2 - Pressure Drop, Vacuum Holster™, at Standard Conditions

Hose Length	6" diameter	8" diameter
17'	1.45" wg	2.50" wg
20'	1.70" wg	2.90" wg
25'	2.15" wg	3.65" wg
Note: Assumes CFM rates in Table 1.		

2. Pressure Drop from System Options

Table 3 - Pressure Drop from System Options at Standard Conditions

6" Options	Pressure Drop	8" Options	Pressure Drop
6-4-4" Wye Assembly	.40" wg	8-6-6" Wye Assembly	.30" wg
Extension Hose/ft	.08" wg	Extension Hose/ft	.08" wg
Exhaust Cane	.90" wg	Exhaust Cane	.70" wg

Table 3 above the pressure drop though system options.

3. Pressure Drop through High Capacity Apex Rail

In determining the pressure drop through the standard capacity Apex Rail, the system designer must consider the location of the duct transition piece and the number of Vacuum Holsters™.

In the simplest scenario, only one Vacuum Holster™ trolley (in this example, an 8" Vacuum Holster) is on an Apex Rail. There will be only 1,400 CFM in the system when in operation. If the Apex Rail is (for example) 60' long and the duct transition piece is located at the end of the rail, then the loss through 60' of Apex Rail must be designed for. However, if the duct transition piece is located in the middle of the rail, only 30' of Apex Rail must be accounted for.

If there are two Vacuum Holsters™ on the Apex Rail, more assumptions about system usage must be made. The designer should consider:

1) Are the Vacuum Holsters™ assumed to be in simultaneous usage?
2) (If the duct transition piece is in the middle of the rail) will there always be one trolley on each side of the take-off, resulting in 1,400 CFM; or could both trolleys be on the same side of the duct transition piece, resulting in 2,800 CFM?
3) What is the maximum distance from the duct transition piece, and what is the maximum CFM that may be required?

Table 4 provides the pressure drop per foot for various CFM rates.

Table 4 - Pressure Drop per Foot, High Capacity Apex Rail

Hose Dia.	# Drop in Use	CFM	Pressure drop/ ft, in. wg
6"	1	600	.004
6"	2	1,200	.015
8"	1	1,400	.021
6"	3	1,800	.035
6"	4	2,400	.062
8"	2	2,800	.084

4. Pressure Drop through Runs of Straight Spiral Pipe

Ascent Systems recommends that the ductwork be sized for an airstream velocity of 2,500 FPM. The static pressure from straight duct can be referenced from a standard pressure drop chart. For estimation, allow .006" wg for each foot of straight duct.

4. Pressure Drop from Elbows

The static pressure from elbows may likewise be found in standard pressure drop charts. For estimation, add .06" wg per elbow.

DESIGN PROCEDURE - APEX RAIL - HIGH CAPACITY

C. DENSITY CORRECTIONS

Most fan performance curves are predicated on an air density that exists when the temperature is 70 degrees F and the elevation is zero, resulting in a density of .075 pounds per cubic foot. When elevations and temperatures vary from the above assumptions, multiply the required static pressure by the correction factors in Tables 5 and 6 below.

While determining the elevation is straightforward, the designer must make an assumption about the inlet temperatures of a vehicle exhaust system. Due to the dilutionary air from the tailpipe adapter and the cooling of the air en route to the fan inlet, Ascent Systems recommends an inlet temperature assumption of 150 degrees F for 6" systems and 200 degrees F for 8" systems.

Table 5 - Elevation Correction Factors

Elevation	Factor	Elevation	Factor
1,000	1.04	4,000	1.16
2,000	1.08	5,000	1.20
3,000	1.12	6,000	1.24

Table 6 - Temperature (F) Correction Factors

Temperature	Factor	Temperature	Factor
100	1.06	250	1.34
150	1.15	300	1.43
200	1.25	350	1.53

D. EXHAUST HOSE RETRACTION

Introduction

Similar to any emission extraction system, the system designer must first determine the CFM-static pressure requirement of the system, as described above. The exhaust fan is selected to meet this requirement.

However, when designing a Vacuum Holster™ system, one more design consideration is necessary to consider - the static pressure to the "left" of the CFM-static pressure requirement on the fan performance curve (the lower CFM range).

The static pressure of the exhaust fan is the force that assists in the retraction of the exhaust hose. The designer must ensure that sufficient static pressure is present to cause the exhaust hose to compress, aiding the operator in exhaust hose retraction.

The requirement of static pressure is dependent upon the diameter and length of the exhaust hose. Table 7 shows the amount of static pressure necessary to compress a given exhaust hose. If the static pressure does not equal or exceed this number, then the retraction of the exhaust hose will be unwieldy. The simplest design scenario occurs when there is only one Hose Holster on an exhaust fan.

Table 7 - Static Pressure for Hose Retraction

Length, ft.	6" dia.	8" dia.
17'	5.2" wg	5.6" wg
20'	5.6" wg	6.2" wg
25'	6.1" wg	6.9" wg

One Vacuum Holster™ per Exhaust Fan

When the damper of the Vacuum Holster is closed, the CFM in the system equals 0. When there is no air flow throughout the system, the entire ductwork and hosedrop attain equilibrium, where the static pressure is equal to where CFM = 0 on the performance curve. To determine the static pressure, simply look at the vertical axis of the performance curve, where CFM = 0. This yields the amount of static pressure generated by the exhaust fan that is available for retraction.

Sometimes, even if there is more than one Vacuum Holster™ per fan, only one hosedrop will be in use at the same time. For example, in a shop with two vehicle bays but only one technician, it can be assumed for purposes of design that only one Vacuum Holster™ would be in use at the same time.

Multiple Vacuum Holsters per Exhaust Fan

On larger systems with multiple service bays and service technicians, more than one Vacuum Holster™ may be in operation at the same time. When this situation arises, one exhaust hose will have to retract while another hosedrop is open. If a hosedrop is opened, the CFM in the system is not equal to zero, and therefore the corresponding shut off pressure (when CFM = 0) will not be present throughout the entire system.

The exhaust fan must operate along its performance curve. By computing the amount of CFM running through the system, the corresponding static pressure available for retraction in the other closed hosedrops (where CFM = 0 from the damper to the duct manifold) can be determined by ascertaining the pressure at the fan inlet and deducting the pressure drop (usually negligible) through the intermediate duct.

NOTE: In larger systems, the BD or BB Series is recommended. These fans have backwardly inclined airfoil wheels, which (unlike flat-bladed backwardly inclined wheels) provide smooth operation over the entire operating range.

DESIGN WORKSHEET - APEX RAIL - HIGH CAPACITY

SELECTION CRITERIA #1: CFM-STATIC PRESSURE REQUIREMENT

CFM CALCULATION

Number of hosedrops ..... 1 _____
CFM per hosedrop (see Table 1 on page 4, confirm with local codes) ..... 2 _____
Total CFM requirement (Multiply Line 1 x Line 2) ..... 3 _____

STATIC PRESSURE CALCULATION

Loss through Vacuum Holster™ (see Table 2 on page 4) ..... 4 _____
Loss through system options (see Table 3 on page 4) ..... 5 _____
Loss through High Capacity Apex Rail (see Table 4 on page 4) ..... 6 _____
Loss through straight duct (Use standard chart, or estimate .006" wg per foot) ..... 7 _____
Loss through elbows (Use standard chart, or estimate .06" wg per elbow) ..... 8 _____
Total Static Pressure (Add lines 4-8) ..... 9 _____

DENSITY CORRECTIONS

Altitude correction factor (see Table 5 on page 5) ..... 10 _____
Temperature correction factor (see Table 6 on page 5) ..... 11 _____
Altitude-adjusted static pressure (Multiply Line 9 by Line 10 and Line 11) ..... 12 _____

SELECT THE FAN TO MEET THE CFM-SP REQUIREMENT (LINE 3 AND 12)

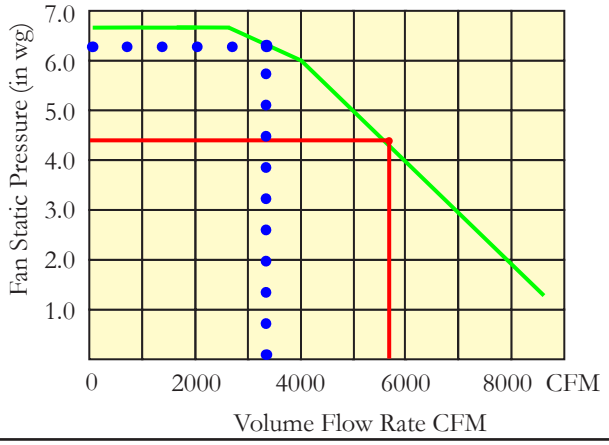
SELECTION CRITERIA #2: EXHAUST HOSE RETRACTION REQUIREMENT

Total system CFM (See line 3 above) ..... 13 _____
Assumed peak usage factor ..... 14 _____
Maximum CFM at assumed peak usage (Multiply Line 13 x Line 14) ..... 15 _____
Static pressure needed for retracting exhaust hose (See Table 7 on page 5) ..... 16 _____
Static pressure available for retracting exhaust hose (See Fan Performance Curve) ..... 17 _____
(Observe static pressure at the CFM value on line 15)

Take the CFM value from line 15 and locate it on the fan performance curve that was selected according to criteria #1. Note the corresponding static pressure, and enter that value on line 17. Compare lines 16 and 17. For adequate retraction, line 17 should equal or exceed line 16. If not, consider a fan with higher static pressures in the lower CFM range.

EXAMPLE

The fan curve below presents an example of a system with 4 Vacuum Holsters with 8" x 20' exhaust hose on one exhaust fan, for a total CFM requirement of (1,400 CFM x 4) 5,600 CFM. The static pressure at the point of maximum operation is 4.3". The static pressure needed to retract 20' of hose is 6.2" (Table 7). As seen from the dotted line, this pressure is present when CFM is 3,300 or less; thus a Holster would retract readily even when two others are open and in operation. If a 100% usage factor is desired, it would be necessary to select a fan with higher static pressure in the 3,300-5,600 CFM range.



LOCATION OF HIGH CAPACITY APEX RAIL - 6-8" HOLSTERS

GUIDELINES FOR LOCATION OF STANDARD CAPACITY APEX RAIL, SIDE VIEW

In High Capacity applications, the location of the Apex Rail can vary, depending upon 1) the layout of the bays and 2) the type of vehicles being serviced. Three common scenarios are illustrated below.

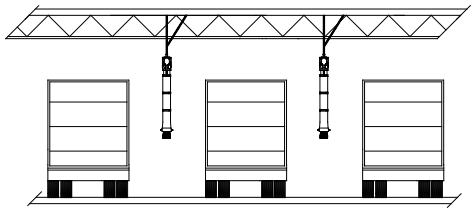

F-I801

DIAGRAM #1:
DRIVE THROUGH BAYS

The bays are drive through, and the vehicles can be parked at any location along the length of the service bay. The Apex Rail should simply be located between the drive through bays.

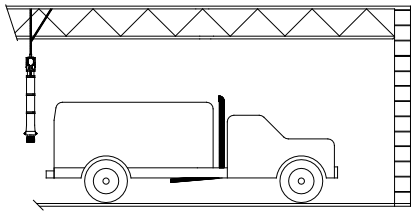

F-I802

DIAGRAM #2
PULL-IN, BACK-OUT BAYS WITH STANDARD LENGTHS

The service bays are defined, pull-in back-out bays. If the fleet has a standardized size, and if the length from the back of the cab to the bumper does not exceed 15', place the Apex Rail 1-2' behind the bumper when the vehicle is in the parked position.

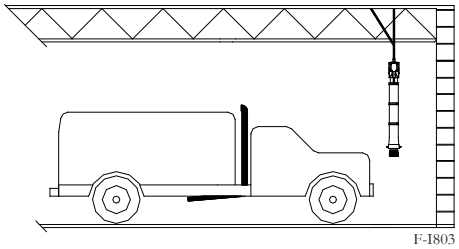

F-I803

DIAGRAM #3
PULL-IN, BACK-OUT BAYS WITH VARIABLE LENGTHS

Here, the service bays are defined, pull-in back-out bays, and the length of the vehicle varies widely. In this circumstance, it is recommended to place the Apex Rail 1-2' in front of the bumper of the parked vehicle.

GUIDELINES FOR SUSPENSION HEIGHT OF HIGH CAPACITY APEX RAIL

For 6" or 8" Vacuum Holsters™, the bottom of the aluminum profile should ideally be 14'6" AFF, and the bottom rim of the tailpipe adapter should be 6'3" AFF, +/- 3".

The Vacuum Holster™ is attached to the trolley by two flexible straps. These are shipped in 3' lengths, with holes pre-punched every 6". The diagrams below show scenarios for three different mounting heights.

DIAGRAM #1
APEX RAIL IS 14'6" - 17'6" AFF.

If the bottom of Apex Rail is 14'6"-17'6" AFF, select the pair of pre-punched holes that results in bottom rim of tailpipe adapter being 6'3" AFF. Trim excess from the strap.

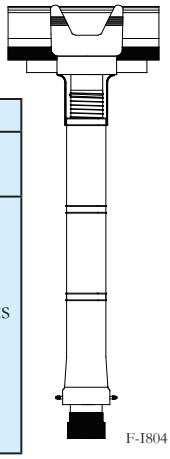

F-I804

DIAGRAM #2
RAIL IS < 14'6" AFF.

If bottom of the Apex Rail is less than 14'6" AFF, use the shortest possible strap and field-cut the Hose Holster, but no more than 18".

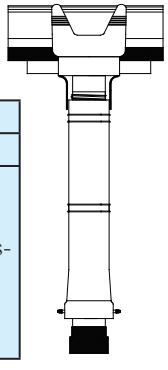
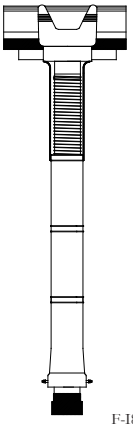

F-I805

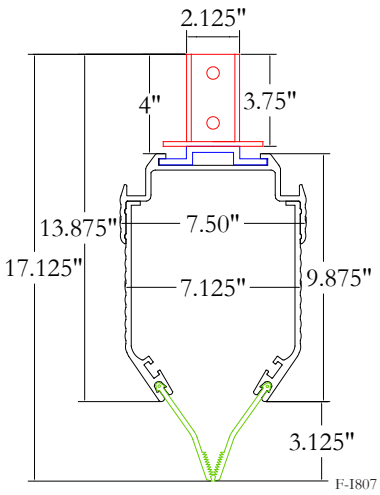
DIAGRAM #3
RAIL IS > 17'6" AFF.

If the bottom of the Apex Rail is more than 17'6" AFF, contact your representative to arrange straps of a custom length.

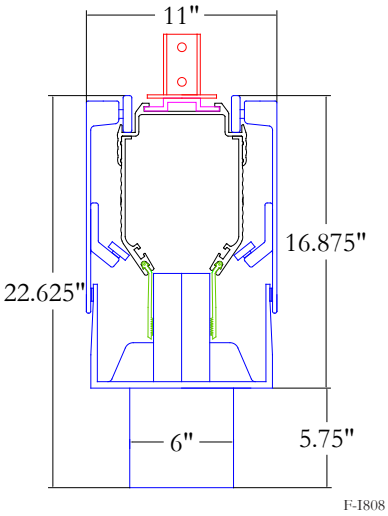

F-I806

DIMENSIONS - APEX RAIL, TROLLEYS, AND VACUUM HOLSTERS™

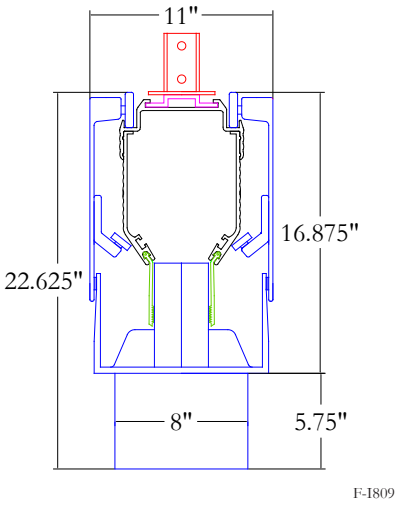
APEX RAIL PROFILE



TROLLEY - 6"



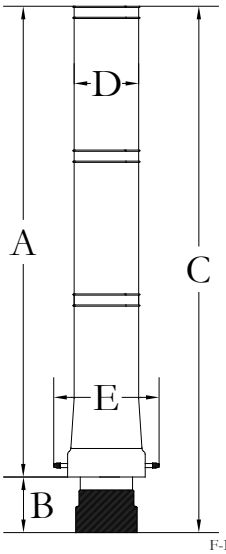
TROLLEY - 8"



Dimensions are given for the rubber seals, exterior coupling, and suspension bracket adapter. All dimensions are in inches, rounded to the nearest 1/8".

Weight - Standard Capacity Apex Rail	
Rail Profile, lineal foot	10.8 lbs
Trolley Assembly - 6"	38 lbs
Trolley Assembly - 8"	45 lbs.
1: The weight of the rail profile includes accessories such as rubber seals, couplings, and bracket adapters.	
2: Please see below for the weight of the Vacuum Holster™ Assembly.	

DIMENSIONS & WEIGHT: VACUUM HOLSTER™



Dimensions and Weights - Vacuum Holster™ Assembly				
Hose Holster Model	6" Compact*	6" Extended	8" Compact*	8" Extended
A - Holster Height	50"	72"	50"	72"
B - Tailpipe Adapter below Holster	7 1/2"	7 1/2"	8 1/2"	8 1/2"
C - Height, Bottom Rim to Tailpipe Adapter to Underside of Trolley	63 1/2"	85 1/2"	64 1/2"	86 1/2"
D - Width, Holster Body	7 7/8"	7 7/8"	9 7/8"	9 7/8"
E - Width, Damper Axle	14"	14"	16 3/4"	16 3/4"
*Note: For compact Holsters, Dimensions A, B, and C are minimum dimensions. The installer may field-cut the Holster to any length between the Compact and Extended dimensions.				
Weight - Vacuum Holster w/ 17' Hose	38 lbs.	41 lbs.	53 lbs.	57 lbs.
Weight - Vacuum Holster w/ 20' Hose	41 lbs.	44 lbs.	56 lbs.	60 lbs.
Weight - Vacuum Holster w/ 25' Hose	n/a	49 lbs.	n/a	66 lbs.