Penetrating the Sprung Structure
Penetrating the Sprung Structure

Framed Openings for HVAC & Penetration Kits for Plumbing and Vent Stacks,

Openings for HVAC duct work along with penetration kits for plumbing and vent stacks are easily dealt with on the Sprung structure. There are two types of penetration options. The first is the framed opening which is designed to accommodate the sheet metal duct work from the HVAC equipment. The second is the penetration kit which is designed to accommodate a pipe or duct size of 20” or less. A framed opening is typically used when the duct or pipe is in excess of 20” in diameter.

Framed Openings

Framed openings can accommodate large ducts from HVAC equipment. The frame is manufactured from extruded aluminum material and held in place with structural spreaders. Please note that framed openings are not designed to support the duct work. The HVAC ducting must be supported independently either by a support frame from the ground and if also required, supported with a flexible connection from the structure arch.

Each framed opening inside dimension is oversized by 1” around the entire perimeter from the final outside dimensions of the duct. This clearance allows for easier installation of the duct work. The 1” gap is filled with insulation if required and closed off using a flashing material by a local flashing contractor.
A framed opening order form is provided by the Sprung Sales representative to the owner or contractor. This order form, when filled out properly will provide width, height, elevation and quantity of ducts. A marked up Structural Plan also provides Sprung design with early detection of conflicts with the structure’s design features. The framed opening order forms must be completed ASAP and given to the Sprung Sales Representative no later than 2 weeks prior to the structure ship date. Please ensure that the mechanical contractor and other representatives complete the order form in a timely manner. For insulated structures, the framed openings are required very early in the erection sequence. Although framed openings can be installed later within insulated structures, this is not advisable as it will add significant time and labor to the erection time of the structure and will create unsightly patches inside the structure in order to access inside the insulated wall assembly.

Depending on the duct(s) size and elevation, snow conditions may require that duct sizes be adjusted or relocated within the module or to an adjacent module so as not to impact the snow shedding characteristics of the structure. Please note, that in snow load areas the width of ducts and quantity may be limited to one duct per “Zone” and maximum top of duct elevation limited to 9ft (see framed opening order form). For structures in snow load areas, a snow deflector or “dog house” is recommended, so that snow shedding off the structure is deflected away to reduce the risk of duct and/or structural damage. These deflectors can be ordered directly from Sprung or can be manufactured locally by a sheet metal contractor. If you require assistance please contact our Parts and Service Department at: parts@sprung.com or 801 280 1555.
INSULATED STRUCTURES

NOTES:

1. DUCT WORK BY OTHERS MUST REMAIN INDEPENDENT OF SPRUNG FRAME. A 1" PERIMETRIC STRIP IS PROVIDED.

2. THE CRITICAL REQUIREMENT FOR DUCT LOCATION IS TO PREVENT THE POTENTIAL BUILD UP OF SNOW AROUND THE DUCTWORK AND FRAME WHICH PREVENTS THE SPRUNG FRAME INITIALLY FROM SHEDDING SNOW.

3. IN LOCATIONS WHERE HIGH SNOW LOADS PREVENT DUCTS FROM LIFTING INTO THE STRUCTURE IN ZONE 2, THE DUCTS ARE BUILT INTO THE STRUCTURE TO THE DESIRED ELEVATION.

4. STRUCTURAL PURLIN LOCATIONS ARE FIXED AND ARE NOT SUBJECT TO CHANGE.

5. VERTICAL DIMENSIONS ARE MEASURED FROM (U/S) UNDERSIDE OF SPRUNG FRAME BASE PLATE.

6. SHAPED "ZONES" REPRESENTS THE VERTICAL BOUNDARIES THAT DUCTWORK CAN PASS THROUGH.

7. FRAMED OPENINGS ARE NOT PERMITTED IN CABLE BRACED PANELS. REFER TO SPRUNG ARCHITECTURAL DRAWINGS FOR CABLE BRACED LOCATIONS.

8. FINAL DUCT ELEVATIONS HAVE ±2" VERTICAL TOLERANCE.

9. DUCTS CAN NOT BE CLOSER THAN 16" FROM THE CENTER LINE OF THE SPRUNG FRAMING ARCH.

10. SPACE BETWEEN SPRUNG FRAME AND DUCTING TO BE FILLED WITH FLASHING BY OTHERS.

11. NOT MORE THAN 50% OF A SPRUNG PANEL WIDTH IN ZONE 2 CAN BE OCCUPIED BY FRAMED OPENING WHERE GROUND SNOW IS GREATER THAN 30psf.

12. SPRUNG TO BE PROVIDED WITH A MARKED-UP SPRUNG ARCHITECTURAL DRAWING SHOWING PROPOSED DUCT LOCATIONS, A MECH. OVERLAY IS ALSO ACCEPTABLE.

13. DUCTS HIGHER ON THE STRUCTURE ARE PERMITTED IN "NO SNOW" AREAS ONLY. SNOW DOES NOT EFFECT STANDARD SPRUNG PEAK FRAMES.

FOR DETAILED INFORMATION REGARDING FRAMED OPENINGS INSTALLATION GUIDELINES, PLEASE REFER TO THE SECTION TITLED: "PENETRATING THE SPRUNG FRAME" IN SPRUNG'S CONTRACTORS GUIDE BOOK. THIS IS AVAILABLE FROM YOUR LOCAL SPRUNG REPRESENTATIVE.
"INSULATED" FRAMED OPENING - ORDER FORM

SECTION

NOTE RULE: U/S OF DUCT ELEVATION + DUCT HEIGHT CANNOT END ABOVE OR BELOW DUCT ZONE (HATCHED ZONES).

CLIENT TO PROVIDE STRUCTURAL INFORMATION DUCT (#) LOCATIONS

ELEVATION

CLIENT FRAME APPROVAL

SIGNATURE: ___________________________ DATE: ____________

PRINT NAME: _________________________

TO BE FILLED OUT BY SPRUNG REPRESENTATIVE

PROJECT NAME: _______________________

WORK ORDER #: ___________ SNOW LOAD: ___________

STRUCTURE SIZE (WxL): ___________ INSULATED Y/N: ___________

REFER TO ARCHITECTURAL PLAN FOR DUCT LAYOUT & COORDINATION

INSULATED STRUCTURES FRAMED OPENINGS ORDER FORM

30–90 STRUCTURES

DATE: ___________ SCALE: ___________ NTS: ___________

SPRUNG

Penetrating the structure – 24

Proprietary & Confidential
Penetrating the structure – 25

Sampling INSTANT STRUCTURES, INC.

Version 2.4

Proprietary & Confidential

SAMPLE

INSULATED FRAME SECTION

FLASHING, SEAL & INSULATION BETWEEN FRAMED OPENING AND DUCT BY HVAC COMPANY

EXHAUST OR SUPPLY DUCT BY HVAC COMPANY

FRAMED OPENING ALUM. FRAME

ALUM. STRUCTURAL I BEAM

INSULATED FRAME SHOWN

Support Bracket

INSULATED WALL SECTION

FRAME ELEVATION

FRAME O.D.

DUCT O.D.

1" ERECTION CLEARANCE

2 1/2" SPRUNG FRAME

FRAME ASSEMBLY LAYOUT

ORDER FORM

30-90 STRUCTURES

DATE

09/07/2012

SCALE

NTS

DRAWING #

PENETRATION FRAME ASSEMBLY
UNINSULATED STRUCTURES

TYPICAL 5" X 1" BEAM SECTION FOR 30' - 90' SPRUNG STRUCTURES

ZONE 3 CANNOT CONTAIN FRAMED OPENINGS IF THE SPRUNG STRUCTURE SITE AS A GROUND SNOW LOAD GREATER THAN 20psf

INSTRUCTIONS:

- CHOOSE ZONE, (U/S DUCT ELEV.)
- ADDULATE DUCT HEIGHT BASED ON ZONE HEIGHT ALLOWANCE.
- SELECT DUCT WIDTH AS REQUIRED.
- PROVIDE MARKED UP STRUCTURAL PLAN INDICATING DUCT LOCATIONS.
- SUBMIT DOCUMENTATION TO SPRUNG SALES REPRESENTATIVE.

HORIZONTAL DUCT LOCATION IS AT CLIENT'S REQUEST BUT LIMITATIONS & CUSTOM PARTS MAY APPLY.

NOTES:

1. DUCTS MUST REMAIN INDEPENDENT OF SPRUNG FRAME. A 1" PERIMETER GAP IS PROVIDED.

2. THE CRITICAL REQUIREMENT FOR DUCT LOCATION IS FROM THE POTENTIAL BUILD UP OF SNOW AROUND THE DUCTWORK AND FRAME WHICH PREVENTS THE SPRUNG STRUCTURE ITSELF FROM SHEDDING SNOW.

3. IN LOCATIONS WHERE HIGH SNOW學生 PREVENTS DUCTS IN ZONE 2 THE DUCTWORK MUST ENTER THE STRUCTURE IN ZONE 2 THEN BE DUCTED TO THE DESIRED ELEVATION.

4. STRUCTURAL PURLIN LOCATIONS ARE FIXED AND ARE NOT SUBJECT TO CHANGE ADDITIONAL PURLINS MAY BE REQUIRED FOR FRAME SUPPORT OR WITH ANCHORAGE REQUIREMENTS.

5. VERTICAL DIMENSIONS ARE MEASURED FROM (U/S) UNDERSIDE OF SPRUNG BASE PLATE.

6. SHADED "ZONES" REPRESENT THE VERTICAL BOUNDARIES THAT DUCTWORK CAN PASS THROUGH.

7. FRAMED OPENINGS ARE NOT PERMITTED IN CABLE BRACED PANELS, REFER TO SPRUNG ARCHITECTURAL DRAWING CABLE BRACED LOCATIONS.

8. FINAL DUCT ELEVATIONS HAVE A ±2" VERTICAL TOLERANCE.

9. DUCTS CAN NOT BE CLOSER THAN 18" FROM THE CENTER LINE OF THE SPRUNG STRUCTURAL ARCH.

10. SPACE BETWEEN SPRUNG FRAME AND DUCTING TO BE FILLED WITH FLASHING BY OTHERS.

11. NOT MORE THAN 50% OF A SPRUNG PANEL WIDTH IN ZONE 2 CAN BE OCCUPIED BY FRAMED OPENINGS WHERE GROUND SNOW IS GREATER THAN 30psf.

12. SPRUNG TO BE PROVIDED WITH A MARKED-UP SPRUNG ARCHITECTURAL DRAWING SHOWING PROPOSED DUCT LOCATIONS, A MECH. OVERLAY IS ALSO ACCEPTABLE.

13. DUCTS HIGHER ON THE STRUCTURE ARE PERMITTED IN "NO SNOW" AREAS ONLY. SNOW DOES NOT EFFECT STANDARD SPRUNG PEAK FRAMES.

FOR DETAILED INFORMATION REGARDING FRAMED OPENING INSTALLATION GUIDELINES, PLEASE REFER TO THE SECTION TITLED: "PENETRATING THE SPRUNG STRUCTURE" IN SPRUNG'S CONTRACTORS GUIDE BOOK. THIS IS AVAILABLE FROM YOUR LOCAL SPRUNG REPRESENTATIVE.
Sample Architectural Plan

1 - Intake Vent
2 - Utilities Opening
3-4 - HVAC (S & R)
5 - Exhaust Vent
6-7 - Roof Peak Vent

- Initial duct sizes dependent on air volume requirements.
- Using page 2/3, determine U/S duct elevation then calculate duct height (or max. duct height allowable) then increase duct width if necessary to achieve flow capacity area required.
- Standard peak vents and penetration kits ordered directly through the sales rep.

Exterior Duct Support
Interior Duct Support

Framed Opening
Structural Spreader

MIN. 10'-0" NTS FOR SNOW REMOVAL

Interior Duct Elevation Change

NTS

Sample

Framed Opening
Duct Layout
Information Sketch
All Structures

Date: 09/07/2012
Scale: NTS

Drawing: SUPPLEMENT TO ORDER FORM

Proprietary & Confidential
HVAC unit adjacent to Sprung structure.
In snow areas unit to be placed 10' from structure to allow for snow shed and clearing

In snow load areas, it is recommended that HVAC equipment be placed approximately 10’ from the structure to allow for snow shedding and snow clearing. Sprung structures will not allow a framed opening or a series of framed openings and penetration kits, to be installed on any position on the structure that might hinder the natural snow shedding action of the structure. A general rule is never on the roof: the lower on the wall the better.

Framed Openings c/w Installed duct work.
Penetration Kits

Penetration Kits are used for any penetrations under 20” in diameter. These consist mainly of plumbing stacks, vent stacks and conduit. These kits are installed at the very end of the project. They can be ordered at anytime. A penetration kit consists of a rubber boot with a small aluminum backing which is bolted through the membrane. High temperature kits are available for the vent stacks. These can handle temperatures of up to 437 degrees F.

Care must be taken in placing Penetration Kits on the roof of the Sprung structure in snow load areas. Penetration kits should not be installed side by side across the panel for they would interfere with the snow shedding action of the structure. Penetration kits should be placed adjacent to a beam with no more than two per panel, one at each beam location allowing the area in the middle of the panel to remain open. Alternatively, several penetration kits can be placed vertically along the I beam.

If there are any questions regarding the placement of the penetration kits, please contact our Parts and Service Department at: parts@sprung.com or 801 280 1555.
This document applies to the installation of a Sprung penetration kit for a single membrane structure.

**Required Materials**

- Sprung Penetration Kit
  - Roof flashing
  - Outside pressure plate
  - Pipe clamps
- Tape measure
- Utility knife (box cutters)
- 7/16” wrenches
- Slot screwdriver (for pipe clamps)
- Polyurethane sealant

Safety equipment to comply with by local and/or federal OSHA regulations

**NOTE:** One individual will be required to work from the interior while another individual will be required to work from the exterior of the structure.

**Step one:**

**Determine where the penetration is to be located.**

**Step two:**

Clean the surface of the membrane with isopropyl alcohol and apply polyurethane sealant where the roof flashing will lay. Apply another bead of polyurethane sealant to the roof flashing itself.

**Step three:**

Place the roof flashing on the membrane in the desired location. Using a sharp tool, such as a nail, poke holes through the flashing and through the membrane. Install the 1/4” bolts through the inside pressure plate, penetration kit, and outside pressure plate. Install nuts and washers. Tighten.

**NOTE:** In most cases the interior roof flashing will need to be installed by a contractor while penetrating the structure with whatever diameter piping is required. Using the pipe clamp, press flashing firmly against the interior membrane and tighten pipe clamp.
Penetration Kit for an Insulated Structure
Installation Instructions for Penetration Kit for an Insulated Structure

This document applies to the installation of a Sprung penetration kit for an insulated structure.

**Required Materials**

Sprung Penetration Kit
- Roof flashing
- Outside/Inside pressure plate
- Pipe clamps

Tape measure
Utility knife (box cutters)
7/16” wrenches
Slot screwdriver (for pipe clamps)
Polyurethane sealant

Safety equipment to comply with by local and/or federal OSHA regulations

**NOTE:** One individual will be required to work from the interior while another individual will be required to work from the exterior of the structure.

**Step one:**  **Determine where the penetration is to be located.**

**Step two:**  Clean the surface of the membrane with isopropyl alcohol and apply polyurethane sealant where the roof flashing will lay. Apply another bead of polyurethane sealant to the roof flashing itself.

**Step three:**  Place the roof flashing on the membrane in the desired location. Using a sharp tool, such as a nail, poke holes through the flashing and through the membrane. Install the 1/4” bolts through the inside pressure plate, penetration kit, and outside pressure plate. Install nuts and washers. Tighten. Note: To tighten the nuts you must cut a small hole through the interior membrane (just large enough for a hand).

**NOTE:**  In most cases the interior roof flashing will need to be installed by a contractor while penetrating the structure with whatever diameter piping is required. Using the pipe clamp, press flashing firmly against the interior membrane and tighten pipe clamp.
WITH SNOW LOADING

NO OBSTRUCTIONS IN CENTER OF ANY PANEL ABOVE 10'-0" WITH SNOW LOADING

UNINSULATED

INSULATED

10'-0"

UNINSULATED

INSULATED

26'

STANDARD PENETRATION KITS

<table>
<thead>
<tr>
<th>SIZE</th>
<th>DUCT Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMALL</td>
<td>1/4&quot; to 4&quot;</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>3&quot; to 6&quot;</td>
</tr>
<tr>
<td>LARGE</td>
<td>5&quot; to 9&quot;</td>
</tr>
<tr>
<td>X-LARGE</td>
<td>7&quot; to 13&quot;</td>
</tr>
</tbody>
</table>

ALL PENETRATION KIT SIZES COME IN INSULATED OR UNINSULATED AS WELL AS HIGH TEMP. & STANDARD TEMP. SEE SALES REP. FOR PRICING.

STRUCTURE SECTION

END PANEL

PEAK

CENTER PANELS

ACCEPTABLE PLACEMENT

ACCEPTABLE PLACEMENT

ACCEPTABLE PLACEMENT

NOT PERMITTED

PARTIAL ELEVATION

NOTE: IN "NO SNOW" LOAD AREAS, PENETRATION KITS CAN BE PLACED AS REQUIRED. CONSULT WITH SPRUNG SALES REP. FOR OTHER POSSIBLE RESTRICTIONS.

SMALL PENETRATION OPENINGS SIZES & LOCATIONS INSULATED & UNINSULATED

DATE: 03/20/2012
SCALE: AS NOTED
DRAWING #: SMALL PENETRATION DETAILS

innovation | versatility | reliability
Proprietary & Confidential

Penetrating the structure – 35
Interior High Temp Penetration kit c/w vent stack.

Please note: Vent stack is to be braced to the structure and not supported by the penetration kit.

Penetration Kit showing gas line.

In snow areas, any external utilities need to be installed inside the structure or protected, to prevent damage to the gas line during the snow clearing process.
Positive Pressure - HVAC Balancing

Building Pressure Diagnostics
By Fob Falke
May 15, 2005

The accepted ideal for most buildings, whether a residential or light commercial structure, is to place them under a positive pressure of +0.02-in. to +0.03-in. water column. These are very slight pressures that can make a huge difference in building comfort and efficiency. We create positive pressures in a building by installing a fresh air duct to the HVAC system or by properly installing a Heat Recovery Ventilator (HRV). Positive pressure controls ventilation into a building, and keeps air from being pulled in from undesirable locations.

Fresh air pressurizes a building as it’s introduced into the return side of the system before the fan. The amount of return air is reduced by the amount of the fresh air. So if 10% fresh air is brought into the system, the fan can only pull 90% of the return air through the return ducting. The supply side still delivers 100% of its airflow. So, supply airflow exceeds return airflow in the building, leaving a positively pressurized building.

The amount of air required to pressurize a building will increase depending on how leaky the building envelope is. For adequate positive building pressure, some building pressurize with as little as 50 cfm of outside air per every 1000 square feet. Some buildings need as much as 300 CFM or more per 1,000 sq.ft.

Exhaust fans create a negative pressure in a building. Those rooms, such as rest rooms, containing cleaning or other chemicals should be placed under a negative pressure with an exhaust fan to prevent fumes and smells from migrating around the building.

Mechanical Rooms

Positive pressure is critical in mechanical rooms where combustion appliances are located to prevent flue gasses from being pulled into the building. In mechanical rooms, always verify a positive or at least a neutral pressure. A negative pressure in a mechanical room or combustion area as low as .015 in. can cause a gas furnace, water heater, or other gas appliance to back draft and carry deadly carbon monoxide into the building. This poses a serious health exposure to the occupants.

Consider installing a small supply register on the supply plenum with a manual damper that can be adjusted to assure the combustion area is kept under a positive pressure when the system fan is energized. An outside air fan may be necessary in mechanical rooms with boilers.

Other pressures act upon a building, as well. Wind is one and it changes from moment to moment. Wind exerts a positive pressure on the windward side and a negative pressure on the downwind side. Stack effect, the upward flow of warmer air, also creates slight pressures. Doors opening and closing do too. Don’t forget clothes dryers and kitchen exhaust fans.

The bottom line: There are conditions where you cannot effectively measure building pressures. Also, whenever you test, be mindful that there may be other pressure events in a building that may be outside of your experience and consideration.

Instruments and Tools

To measure building pressures, you’ll need a digital manometer with typical test range from 0-in. to 5-in. w.c. with a readable scale of at least .005-in. w.c. Manometers with larger scales are unable to read lower pressure with the required accuracy. Analog gauges should be a 0 to 1/4-in. w.c. scale to read building pressures accurately.

You’ll need tubing or pressure hoses to connect to the manometer through which the pressure travels to the pressure ports. Building pressure testing may require up to 100 ft. of tubing. The best pressure tubing measures 5/16 OD by 3/16 ID, but any tubing that will make a tight seal on the port of the manometer will do.

How to Measure

Set the fans and building conditions in the mode that reflects the state you wish to measure. Normally, bring on the fan for the HVAC system, with other fans off to start with. To measure the building pressure with reference to outdoors, select an outdoor location and place the
open end of the pressure tubing outdoors, away from the wind.

Run the tubing indoors through a door or window. Be sure not to pinch off the tubing. You may need to use masking tape to block off the open area of the door or window to be sure the pressure areas remain separate.

At the indoor location, connect the pressure tubing to the negative port on the manometer. The difference between the two pressures will appear on your manometer. If a negative pressure appears positive on the meter, simply switch the hoses on the ports. You may verify a positive or negative pressure in the building visually by using artificial smoke testing at the door or window.

Pressure can be measured between rooms or pressure zones in the same manner. Simply place the open end of the hose in one zone, and then stand in the other pressure zone with the manometer. The port with the tube connected measures one pressure, the open port on the manometer measures the other pressure. The difference between the two pressures appears on the face of the manometer.

**Overcome the Wind**

When measuring building pressures with reference to outdoor pressure, the wind can cause enough fluctuations in your readings that testing becomes futile. To stabilize the outdoor pressure, place the outdoor end of your pressure tubing into a sheltered area unaffected by the wind. Many contractors I know place the outdoor end of their tubing in a Tupperware bowl with holes punched in the top, then fill it loosely with paper towels to diminish the effects of the wind on outdoor pressures.

**Smoke Makes Pressures Visible**

High pressure travels to low pressure and smoke makes the movement apparent. Titanium Tetrachloride is a chemical that reacts with the moisture in the air to produce a cool smoke. So, a puff of smoke makes the traveling air visible. This can be a real help before, during, or after pressure measurement.

One method to check if a room has a positive or negative pressure with reference to the neighboring room is to open the door an inch or so, then blow smoke gently near the opening. In theory, if the room has a positive pressure, the smoke will blow out of the room. If the room has a negative pressure, the smoke will be pulled back into the room.

Good pressure diagnosticians understand that they don’t make a decision on how the building is operating based on a single test or on a 1/100th of an inch pressure differential. Pressures change throughout a building from minute to minute. So advanced pressure testing may require building pressure traverses, a sense of patience and some creativity.
HVAC Balancing

Similar to conventional construction, a properly balanced system is very important in a Sprung structure. The air permeability of the structure is extremely low (almost zero leakage). While this desirable feature allows for precise control of the interior environment, consideration must be given to ensure a positive pressure is always maintained. On rare occasions, some clients have experienced some water migration into the structure. This is caused by having a negative pressure inside the Sprung structure.

Example: Note the graph (below) from a 24 hr pressure monitoring cycle. These test results are from an actual project. Any red inside the darkened circular line represents negative pressure. The balancing contractor was able to determine that kitchen exhaust fans were putting the system into negative pressure and they had not taken this into account when designing the system.