

## **Module 9 – Roof Penetrations and Curbs**

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### **Chapter 1**

Improper roof penetrations are the number one reason for callbacks in the metal building industry. They will most often also cause damage to the owner's facility and interrupt their business as well. Leaks from penetrations are very costly to repair for any installer. In this module we will show you the right way to handle most every roof penetration that will be specified for a metal building. This will help to reduce the chance of callbacks due to leaking penetrations. Those penetrations include curbs and flexible pipe flashing systems.

During this module you'll also learn about the importance of developing and following a fall protection plan, as well as some vital rules for safety when working on a roof, regardless of the type of roof penetration that needs to be made. It is vital that you begin by carefully reviewing the building drawings and specs to determine location, size of penetrations, and type of penetration. It is costly to correct an improperly installed roof penetration system but very costly to have to relocate a penetration due to the installer locating the penetration in the wrong place. And when it comes to curbs, remember that there are many different types of curb systems. So always follow the manufacturer's guidelines carefully for proper installation. Oftentimes an architectural drawing indicates a location for penetration that conflicts with another building component or that does not fall on modulation. While there are ways of adapting to that, it is often a better decision to move the particular penetration a little to accommodate the field reality. Whenever you feel you should deviate from the drawings be sure and get an okay from your supervisor prior to doing so.

Now that we know where a penetration needs to be made and what type of penetration is called for we can locate the required penetration hardware from our storage area or as many in the industry call it, a boneyard. Next we determine the tools and sealants that will be needed. In most cases these will include screw gun, reciprocal saw, measuring tape, drill and bits, an extension cord, utility knife, power shears, nibblers, snips, an approved marker, mastics, the specified caulking and gun, fasteners, double face tape, patch tape for insulation, acetone and wipes, chemical resistant rubber gloves, a sledgehammer, a cold chisel, a Shop-Vac, scissors, and finally the manufacturer's installation instructions for the particular roof penetration system that you are about to install.

### **Chapter 2**

Safety on the job site is never more important than when you are working on a roof. Simply put, there is virtually no margin of error when your life and health and those of your co-

workers is on the line. You and your crew members should be in a constant state of training and retraining when it comes to safety. The first step toward safety begins before you ever arrive at the job site. Your supervisor has the responsibility to develop and provide to you a comprehensive safety plan that can be thoroughly reviewed by the entire crew. You see, if just one of your crew members is not aware of the plan or is not committed to following it he will not only be a danger to himself but also to the entire crew. In addition to good training it is vital that you have the proper safety equipment. This includes personal protective equipment required by OSHA as well as fall protection equipment that may be attached to the structure. It is also necessary that you have the right tools and lift equipment both for personnel and materials available on the job site. These will vary with each job.

Some rules that must be followed when installing roof penetrations include: Stay alert constantly. The roof is no place for daydreaming on the job. Hard hats must be worn to prevent injury from falling objects or from equipment and materials being moved around personnel. Never step on light transmitting panels or translucent panels. They are not designed to support the weight of an installer or heavy tools or materials. Referred to throughout this module required currently by OSHA as well as other statutory or customary practices must be followed carefully in order to maximize safety.

This particular frame was erected specifically for the production of this DVD module on roof penetrations. It is unusual in that it stands three to four feet off the ground and is located inside a warehouse. We have installed a Skyweb II fall protection system in this frame as well. Keep in mind this entire facility is used only for training purposes. The typical roof you will be working on will be much higher off the ground and you will need to conform to all safety requirements that apply to the height you are working from. So please note for this demonstration module these erectors are OSHA complaint because they are not up at normal roof heights.

### **Chapter 3**

When roof penetrations are to be used for installing mechanical units, roof access hatches, duct penetrations, skylights, and other large or heavy openings you will need to use a roof curb system. For this training module we'll demonstrate these procedures on a standing seam roof. Penetrations made in R-panel roofs are similar and generally less complicated to do. Curbs are critical in providing needed support and adequate drainage. They also allow for movement of the roof system due to environmental conditions causing expansion and contraction.

Remember that a metal roof will move  $\frac{3}{4}$  of an inch in 100 ft for every 100 degrees Fahrenheit change in temperature. It is critical that the installation of a curb be performed by an experienced crew member and not delegated to a rookie. Make sure the curbs that are ordered are designed for your particular metal roof. Otherwise you will never get them sealed properly for a weather tight installation.

### **Chapter 4**

In this chapter we will cover the process for cutting the hole in the roof for a curb. In many cases you will install a curb support frame prior to installing the roof as we did at another location shown here. But for this demonstration module we will begin with a standing seam roof already installed. The first step in this process is to carefully confirm the placement location. Here the installers are using a jig like a template that conforms to the footprint of the curb. Check to be sure that the curb will align properly with the roof panels in order to prevent water from damming up. Water should flow freely around the curb.

Before you cut verify the location of the purlins to see how they will affect the installation of the curb. Verify that the penetration made for the curb will align properly with the purlins, rafters, bridging, and other framing components. Then mark the corners on the outside of the

curb and mark the high of the rib as well. If you do not have a jig you can use a straightedge or chalk line to mark the opening to be cut. Using the outside curb marks, now measure and mark for the inside dimension to determine the cut line. Next use a straightedge to draw the cut line parallel to the standing seam using your inside marks. Here the installers use the curb to mark the cut line across the rib. The installers write on the roof to indicate the cut line. This is done in case a different installer makes the rough cut.

Now a reciprocal saw is used to cut through the standing seam rib at both the front and back of the curb on your marks. Hot saws should never be used on a roof as this will cause galvanized panels to be damaged by hot flying debris. Next with a cold chisel make starter holes in the panel. Now use power shears to cut through the lows of the roof sheet. You should use snips to make precision cuts. Then remove the panel section. Next using a utility knife cut the fiberglass insulation, being careful not to cut the vinyl vapor retarder at this point. Then remove the fiberglass.

## **Chapter 5**

In this chapter we will cover the steps for installing the curb support frame. The first step is to install the two channels parallel to the roof sheet from purlin to purlin. Next install the bottom support frame. Tek screws are specified here. Now we will prepare the top support frame for installation. To do that, lay out the support frame component on the roof. Mark it for alignment and mastic placement. Use acetone to clean the surface of the support frame that will come in contact with mastics. This will assure that oil and debris do not interfere with proper seals.

Now we will apply mastic around the entire closure as shown. Next apply 2" mastic as specified by the support frame. Then remove the mastic protective tab. Now the closure is centered on your marks over the 2-inch mastic and attached with a fastener. Next lift the roof panel and carefully slide the upper support frame underneath the roof sheets. Be sure not to damage the mastic seals. The closure should be flush as shown. Now with acetone clean the bottom of the curb that the mastic will contact. Then the roof panels are cleaned where the curb will be placed. Now 2-inch mastic is placed along the bottom of the curb as shown. Next with a utility knife cut the vapor retarder as shown to allow for the proper fold back to seal at the support frame.

You can see that the installer is careful not to cut through the sky web system. If he did it would compromise his required fall protection. Remember to be aware of where you are stepping at all times. Insulation or vapor retarder has no ability to support the weight of a person or equipment. Double stick tape is used on the rest of the edges of the frame to hold the vapor retarder in place. Be sure and tuck the vapor retarder under the roof panel. Now matching patch tape is used to seal the four corners as shown.

## **Chapter 6**

Now that our frame has been installed we are ready to install the curb. Mastic is first applied on the front frame support as shown. Mastic is also applied to the standing seam at the back of the curb as shown. Next carefully lift the curb and set it in position for installation. Then gently push the curb down to ensure proper nesting between the standing seam ribs. It should fit tightly against the center front standing seam. Now remove the rigid insulation from the inside of the curb being careful not to damage it.

At the rib, locate and install the exterior fasteners. These are used to lock in the rubber closure and properly compress the mastics. We can then install the exposed fasteners at the high side of the curb. Be sure and use the proper spacing and alignment called for in the specs. This is both to ensure that the correct number of fasteners are used to provide an adequate seal and to maintain a uniform professional appearance. Next we can install all of the interior screws.

Now carefully replace the rigid insulation in the interior of the curb. Then remove the excess mastic using a utility knife and acetone. The skinning caulk and mastic are not chemically compatible. Next we will apply a bead of skinning caulk around the edge of the curb and also along the seal at the high end of the curb.

Now clean up the area of all excess building materials and packaging. It is a good idea to use a Shop-Vac to remove the fine metal particles. If the curb is designed to be used for a skylight or smoke dome you would now clean the top of the curb with acetone. Then apply a bead of sealant or foam tape and then install the dome using the specified fasteners.

## **Chapter 7**

The most common roof penetration you are likely to install on most metal buildings will be for an electrical conduit or pipe made of steel or plastic. In most cases the electrician or plumber will have already drilled a hole in the roof panel and installed a pipe through that hole prior to you installing the pipe flashing. A flexible pipe flashing system will provide an adequate seal around the pipe to prevent leaking. If you are the person assigned to make the hole through the roof first measure and mark the roof panel for the penetration. Be sure to confirm the particular size and location of the opening needed. Be careful to check for locations of purlins, rafters, and other structural components that might be in the way of the designated path. Also, be certain that the flexible pipe flashing system will not interfere with the standing seam rib and cause water to dam up.

Now, with a small sledgehammer and cold chisel, you can strike the roof panel to make a starter hole. Be sure you always wear safety glasses on the job. Insert your snips and cut out the marked hole on the roof sheet. As you determine the size of the hole needed, be sure to allow for expansion and contraction of the roof system due to normal climatic changes. Next apply the mastic on the bottom of the flexible pipe flashing system being certain to cover the entire perimeter. If the bottom face of the flashing is dirty or oily be sure and clean it first with acetone. Here the protective tab is removed from the mastic.

Now we measure the diameter of the pipe. This measurement will determine the ring to cut on the flexible pipe flashing system. Each ring indicates a different diameter. Here the flexible pipe flashing system is cut. You can use snips or scissors for this. Now clean the surface of the roof panel that will be under the mastics with acetone. Also clean the surface of the pipe as shown. This assures a proper and lasting seal from the mastics. T

hen install the flexible pipe flashing system over the pipe. Be careful not to split the rubber or allow the mastic to come in contact with the pipe. Check to be sure that the flexible pipe flashing system is pressed down firmly around the entire perimeter. Now install the required fasteners. Be sure you use the designated spacing pattern as shown. Now clean up the area of all metal shavings, excess building materials, and packaging.

## **Chapter 8**

It is common for the architect to call for HVAC, electrical equipment, and lightning protection to be mounted on a standing seam roof. There are some special utility clamps like this one which can be mounted to the standing seam without piercing the roof panel. These provide support or an anchor for many HVAC and electrical building components. Snow guards can also be installed using the same utility clamps or other manufacturers' systems. Using care to properly install all of these roof components will dramatically reduce the amount of callbacks.

Remember that improper roof penetrations are the number one reason for callbacks in our industry. Do your part to ensure that quality and craftsmanship are always first and foremost in your mind while on the job.

This concludes the module on roof penetrations. This presentation was created by the Metal Buildings Institute and is one of several training modules available to metal building

erectors. We hope that has helped you gain an understanding of the basics of installing roof penetration systems.