Insulation Module

Chapter 1

Welcome to this Insulation module of the Metal Buildings Institute's Quality and Craftsmanship Series. During this module you'll learn the terminology associated with insulation, and how fiberglass insulation works, and why we use it in metal buildings. You'll be able to tell the difference between standard home grade insulation and the types specifically designed for metal buildings. You'll learn additional materials that are needed to properly insulate a metal building and finally you will learn the safe and proper way to handle insulation for metal buildings. Our objective in this module is to answer the questions related to installing insulation. In later chapters you'll be shown different insulation systems and key differences regarding installation techniques.

Since the introduction into commerce nearly 70 years ago, fiberglass has become one of the world's most useful insulation materials, helping to increase thermal efficiency of buildings. A building that is thermally efficient reduces the amount of energy required to maintain a comfortable working environment. Fiberglass is made from natural ingredients like molten sand and large amounts of recycled glass products such as bottles, glass windows, and industrial plate glass. It is the most widely used metal building insulation product in the world, keeping our industrial buildings warm in the winter, cool in the summer, and quiet all year long.

Let's look at some key terms that are used for insulation specs. First is R-value: this refers to the ability of the insulation to resist thermal transmission. The higher the R-value, the greater the resistance to thermal transmission. Insulation materials such as fiberglass and rigid board are often defined by their R-value.

Next, we'll discuss U-factors or U-values. The U-value represents the overall heat transfer in BTUs per hour that pass through one square foot of an assembly for one degree of temperature difference between the two sides. Building codes specify the maximum allowed U-value of a building envelope component such as a roof or side wall assembly on a metal building. When these assemblies are analyzed, losses in efficiency are considered, such as the compression of fiberglass at girts or purlin locations and small gaps in the insulation. Code authorities will often specify U-values required in the building energy codes; for example: A U-value of 0.055 is specified for a metal building roof in Little Rock, Arkansas. This means that any new metal building built in this municipality must incorporate a roof insulation system that at least meets the prescribed U-value. In order to receive a U-value that can be applied to code compliance, a typical assembly must undergo stringent testing by an independent laboratory, usually in the form of a hot-box test, to verify its ability to resist thermal transmission.

The next component of an insulation system is the vapor retarder or facing. This refers to facing material that may or may not be laminated to the fiberglass. Vapor retarders can be composed of vinyl, polypropylene, polyethylene, foil, or metalized polyester. The purpose of the vapor retarder is to reduce the transmission of water vapor. By limiting the ability of water vapor inside the building to contact the metal skins of the building helps prevent condensation and sweating inside the building roof and wall insulation cavities. Imagine having a cold beverage in the summer heat – the can will sweat if the hot air is allowed to contact the cold surface of the can. If you put the can in a koozie, you are limiting that humid air's ability to contact the cold surface, thus reducing the condensation on the can. Metal buildings are made of thermally conductive materials, so it is very important to have a well-sealed, quality vapor retarder material installed in assemblies in geographic locations where condensation is

likely to occur. The vapor retarders used with metal building insulation systems should be strong enough to withstand handling during installation as well as endure the environmental stresses that will most likely occur during everyday use of the building from the occupants. Vapor retarders are measured and rated by a metric called permeance, generally referred to as a perm rating. This is a measure of water passing through a vapor retarder over time. The lower the permeance rating, the more effective the vapor retarder.

Some other characteristics of fiberglass insulation systems are sound absorption and reflectivity. The Sound Transmission Coefficient, or STC, is the measure of how well a wall or roof assembly absorbs airborne sound. The insulation system can have a significant impact on the STC rating of an assembly. Often, this is not a major consideration when designers specify an insulation system, but it is important to know that it can be the basis for selecting an insulation system on some projects. Sound absorption or acoustic rating of reflected sound is called a Noise Reduction Coefficient or NRC rating and is more important for occupants working inside the building. Vapor retarders also have light reflectivity ratings, which measure how much interior light is reflected off of the surface of the vapor barrier materials. This can affect how much lighting is required inside the building, and designers will often design their lighting to coordinate with a specific facing light reflectivity.

In the following chapters, we will explore the following topics
- Safe handling of fiberglass insulation
- Storage of fiberglass insulation
- Laminated fiberglass systems
- Filled cavity systems
- Liner insulation systems
- (And) Continuous insulation systems

We will examine different systems in the following chapters. It is important to note that any depiction or demonstration of an insulation system should not be considered an endorsement of any specific product or manufacturer.

Chapter 2

Safety is a critical component of any construction project. As you learned in previous modules, OSHA regulations set the standard for construction safety in most states, and some states have more stringent workplace safety requirements. Some insulation systems provide the benefit of acting as a fall protection or fall prevention, while others provide leading edge fall protection hardware that is installed with the system. Often, the insulation system on a project is selected specifically to integrate with the overall fall protection plan. Be sure you understand the insulation system being specified for your project, and if it is rated to be used as fall protection or fall prevention. If the insulation system that is being used for your project is not rated as fall protection, it is very important to have a fall protection system in place to ensure the safety of you and the rest of your crew. Your insulation system supplier can help determine the best system for each application, as well as provide detailed instructions on the safe application and safe use of their products in the specific building.

Let’s look now at personal safety and comfort issues you will need to consider when installing fiberglass insulation. We will cover personal protective equipment and mention some of the tools you will need for installing fiberglass insulation in a metal building. Scientific evidence demonstrates that the fiberglass is safe to manufacture, install, and use when recommended work practices are followed. Following recommended work practices will help to reduce irritation from insulation system materials.

You should always wear a hard hat as required by OSHA on your job sites. A head cover is also recommended when working with fiberglass materials above your head. Loose-fitted, long-legged and long-sleeve clothing is also recommended to prevent skin irritations. Eye protection should be worn whenever synthetic vitreous fiber or SVF products are being handled. If fibers accumulate on the skin, do not rub or scratch the area and never remove the fibers from the skin by blowing with compressed air. If you get fiberglass in your skin, a good practice to alleviate irritation is to scrub lightly in one direction with soap and water. Gloves are not required, but they are recommended to reduce irritation. For a complete guide of recommended work practices for types of insulation materials on your project, contact the insulation system supplier on your project.

The primary tools you will use in the installation of fiberglass insulation are a utility knife with a sharp blade; remember to change the blades often – even though it seems like the material is easy to cut, the glass fibers deteriorate blades quickly. A tape measure will also be needed, and when cutting you will need a straight edge like a Level, a 2x4 or a piece of angle-iron. Be sure you have all the tools you need in sufficient quantities for your crew prior to beginning an installation.

Weather can significantly impact your installation of fiberglass insulation in metal buildings. Before you begin, consider the weather forecast for the day and the current conditions including wind, humidity, and chance of precipitation. Windy conditions can not only be damaging to fiberglass products, but they can also present safety hazards if fiberglass becomes airborne in the wind. Fiberglass also has the ability to hold many times its own weight in water. If a roll of fiberglass becomes waterlogged, it can become very heavy, and even become a safety hazard. You should never install wet fiberglass insulation. If insulation becomes waterlogged, it is usually best to discard the material and procure replacement material.

Chapter 3

It is important that you plan ahead for the delivery of insulation that has been ordered for your particular job. Be sure to give your suppliers sufficient lead time to produce the materials and to ship them for a timely delivery. It is essential to know when the materials will be needed at the jobsite and to prepare a place to store them until they are ready for installation. Depending on weather conditions at your jobsite you should consider storing the insulation in a trailer or a storage unit or at least covering the materials to protect them from the elements or other jobsite activities as well as theft.

Now that you have a plan for where to place the insulation when it arrives, let’s look at the receiving process itself. When the truck arrives with the insulation you have ordered, carefully check the driver's manifest to confirm that this insulation belongs at this job. Confirm quantity of rolls. Rolls received at the jobsite should display a label describing: thickness, R-value, width, and length. Other information that may be identified on the label may include: vapor retarder, job name or number, and the specific wall or roof where the insulation roll is to be installed.

Insulation should be stored in a protected area. A good practice is to separate insulation by installation location, such as placing all the insulation rolls to be used for the roof together, then place all of the rolls for the walls in another group. This will help inventory control.

It is important to keep fiberglass insulation stored in a dry, well-ventilated area. You can get specific storage instructions and consideration from your insulation supplier.

A good rule to remember is whenever possible the insulation should be used as soon as possible after it arrives at the jobsite. The erector should be involved in determining the most efficient scheduling of insulation delivery. The sooner the insulation is installed, the less likely it is to get damaged in storage. You should never install fiberglass insulation if it is wet. If the insulation becomes wet, contact your laminator to help you inspect and determine the effective usefulness of the insulation and any remedies required.

Chapter 4

In this module, we will begin to discuss fiberglass insulation systems.

The most basic system of fiberglass insulation is to install a single layer of laminated fiberglass over the purlins or girts. As the roof or wall system is installed, a roll of laminated fiberglass will be spread across the purlins or girts, with the vapor retarder facing the inside of the building. Ensure that the fiberglass batts are in firm, continuous contact with each other, and that the tabs on the vapor retarder are fully lapped and in good contact with each other. A good practice is to apply double faced tape to the base angle and eave strut and adhere the insulation to that. When attaching the insulation to the base or eave strut, be sure to trim some of the fiberglass away from the edge, so that the tab of facing can be folded back. This prevents moisture from wicking into the insulation system if the weathertight seal at the base or eave is ever compromised. Some projects will require a taped lap, which will help ensure the integrity of the vapor retarder. Once the fiberglass is in place, the roof sheet is installed, securing the system in place. It is also important to use double-sided tape to hold the insulation in place.

Thermal spacer blocks are a common component of insulation systems. The purpose of the thermal block is to help recover insulation value that is lost when the fiberglass thickness is compressed against the purlin. When fiberglass is compressed, it can lose most of its rated R-value. By installing thermal blocks made from closed-cell foam, the thermal loss can be better controlled. If thermal blocks are specified on your project, ensure that they are aligned with the secondary frame member. If the thermal blocks are not properly aligned with the purlin member, it will negatively affect the performance of the system.

The next level of fiberglass insulation system is a double layer system – commonly referred to as “Sag & Bag”. In a double layer system, the first layer consists of a roll of fiberglass that has been laminated to a vapor retarder. This roll is laid across the purlins, but extra “sag” is left in each purlin space. Then, the crew will install a second layer of unfaced insulation between the purlins. A few things to pay attention to when you’re installing a double layer system are: ensure that the seams between the rolls of insulation are tight and consistent. If the facing is “sagged” differently roll to roll, the vapor retarder will be compromised, and the facing will look wrinkled and unsightly – which is not what a new building owner wants to see! Also, ensure that there is enough sag between the purlins to fully loft out the fiberglass. If you are installing two layers of six-inch fiberglass but only sag the facing 8 inches, you are losing a significant amount of insulation value.

There are also a number of “facing first” systems on the market. These systems often dispense the vapor retarder onto the roof surface, with one or two layers of unfaced fiberglass applied on top of the facing.

As with any other insulation system, it is important to regularly check that a good seal is made in the vapor retarder, as well as firm contact between the fiberglass batts.

Something to keep in mind with any roof insulation system, is to make sure that you have extra material to install in the ridge trim space. Ridge trims often sit above the roof panel surface, and this can create an airspace for condensation to appear. By ensuring that the ridge trim is filled with fiberglass, you can prevent call-backs about water dripping from the ridge of the roof!

We talked about installing fiberglass systems in the roof, now let's talk about over-the-girt wall insulation. Similar to the roof, the most basic wall insulation system is a single layer of laminated fiberglass. The insulation will generally be hung from the double-faced tape at the eave strut, ensuring firm contact with the previous batt and a good seal at the vapor retarder seam. Double faced tape is also applied at the base of the wall, to create a seal there. It is important to fold up a section of the vapor retarder at the base of the wall as well as around any framed openings. This prevents water from wicking into the insulation system and prevents fiberglass fibers from working their way out of voids and into sight. Be sure to apply double face tape around framed openings to ensure a tight seal is formed between the facing and the steel. When you reach the corner in the building, neatly wrap the corner with the insulation roll. It is difficult to make a good seal if you terminate two pieces of insulation in a corner, so the best practice is to lay out your wall insulation so you can wrap your insulation around the corner. Some manufacturers recommend scoring the fiberglass at the girt lines if thicker batts are used in the walls. This helps prevent oil canning of the wall panel. Other manufacturers have developed thermal block assemblies for wall panel installation. Refer to your building manufacturer for specific guidance on the installation of these systems.

Chapter 5

The next type of fiberglass insulation system that we will discuss is the filled cavity system.

A filled cavity system is a system where the first layer of faced or unfaced insulation is installed between the purlins. A second layer of unfaced insulation is installed above the first layer, perpendicular to the purlins and compressed when the metal roof panels are attached. A supporting structure retains the bottom of the first layer at the prescribed depth required for the full thickness of insulation. A thermal spacer block between the purlins and the metal roof panels may be necessary to achieve the required assembly U-factor.

Another common name for these systems is "Long-tab banded" systems. These systems are similar to the double-layer systems discussed in the previous section, with a few key differences.

The major difference is the introduction of metal banding or liner panel to support the insulation system. Metal bands are installed perpendicular to the purlins at pre-determined dimensions across the bay length. If liner panels are utilized to support the insulation, follow the building manufacturer's details regarding installation of the liner panel. It is important to note that the insulation system is supported from underneath. This ensures that the fiberglass fills the entire cavity created by the purlin and provides a consistent full thickness of fiberglass insulation across the space.

The next major difference is that the first layer of insulation is installed parallel to the purlins and therefore must be ordered to fit the lengths of each bay as well as the width of each of the purlin

spaces. Rolls of laminated insulation will be spread between purlins, with long tabs that are taped or glued to the tops of the purlins. It is important to ensure a good seal is made at the top of the purlins and the facing lap joints over the rafters. Also, special consideration must be taken at purlin bridging locations to cut the insulation to fit around the purlin bridging to achieve full thickness insulation in order to comply with the ASHRAE 90.1 “Filled Cavity” definition. Once these rolls of insulation are installed, unfaced insulation is then spread perpendicular across the tops of the purlins. Thermal blocks are also required for use with these systems.

The long tab insulation facing must be ordered 4 to 6 inches longer than the bay lengths or otherwise extended to have sufficient facing lengths to effectively seal the two abutting ends together over the tops of the rafters.

Weather can be a significant factor in the installation of filled cavity systems. Wind can severely damage the faced insulation if it is exposed to high winds for extended periods of time. Rain and snow can also damage faced insulation and it may have to be repaired or replaced, so it is important to coordinate the installation of the insulation system and roof sheeting with advantageous weather conditions.

Filled cavity wall systems are also available. With a wall system, a layer of unfaced insulation or thermal break tape should be installed on the outside of the girt between the girt and the wall sheet. The faced layer needs to be ordered to fit the spacing heights between the girts and is run horizontally between the girts with short facing tabs which are adhered to the girts. Banding can then be run from the floor to ceiling and attached at the girts to retain the insulation in place.

It is important to consult your insulation supplier to verify installation instructions for the insulation systems on your project. The installation and attachment details can vary between manufacturers and projects.

Chapter 6

Next, we will explore fiberglass liner systems.

A liner system is where a continuous membrane is installed on the inside flange of girts or purlins. Uncompressed, unfaced insulation then fills the void between the facing membrane and the roof or wall panel.

Liner Systems for Roofs of buildings:
One key difference between liner systems and filled cavity systems is the vapor retarder. Liner systems are characterized by the vapor retarder being installed underneath the purlins or inside the face of the girts. This is achieved by installing large sheets of vapor retarder sheet across the bottom plane of the framing prior to the installation of the roof panel. The vapor retarder sheet is normally supported and secured by metal banding installed perpendicular or in a grid pattern spanning the bay area below the purlins or girts. Each sheet of vapor retarder is fabricated specifically to fit each bay for your job, so take time to review the instructions and dimensions provided by your insulation systems manufacturer and note that each sheet has a specific location for which it is intended to be installed. Each manufacturer has different guidelines for installing banding and liner systems, so be sure to carefully review the installation instructions supplied by your insulation provider.

After the vapor retarder is installed on the banding, fastened and the perimeter sealed, a single layer of unfaced fiberglass is typically dispensed between the purlins from rafter to rafter and depending on the system U-Value, a second layer of blanket fiberglass insulation may be installed perpendicular over the tops of the purlins, similar to the long tab banded system. The rolls of fiberglass are often pre-cut to fit exactly in the purlin spacing. It is important for the fiberglass to be in firm contact with the webs of the purlins. The rolls dispensed perpendicular to the purlins should be adjusted so that they are straight, with no gaps left in between rolls. The second layer of fiberglass blanket is typically dispensed as the roof panel is installed. Thermal spacer blocks are often used with this system as well.

Note, there are two distinct types of liner systems on the market: a fall protection rated liner system and a non-fall protection liner system. Be sure to understand the capabilities of the system on your project.

Another difference with liner systems is that you may have different assembly details regarding flange brace attachment. Be sure to coordinate with your metal building manufacturer if you intend to utilize a liner system, so they can provide you with the correct parts. If there are any penetrations made in the vapor retarder, be sure to seal them carefully in accordance with the manufacturer's guidelines. Other trades should be made aware of the liner system. HVAC and electrical contractors often need to attach hardware to the purlins, so be sure that they have planned for the liner system and they are not damaging the integrity of the vapor barrier.

Liner systems can be installed completely from the inside of buildings for wall and roof retrofit projects. Blanket insulation, blowing wool insulation or other types of insulation may be used to insulate the insulation cavities created by liner systems.

Liner systems for walls are installed from the interior of the building after the walls are installed. With this system insulating foam tape is applied on the girts, eave strut and base channel. Insulation hangers are attached to the girts, which support the insulation batts cut from insulation rolls. One inch of extra insulation length or width is typically recommended to ensure that there are no gaps below or above the wall structural members. Any joints in the insulation should be abutted tightly together. After the wall insulation is installed, the wall vapor retarder sheet is installed in one seamless piece from the ceiling line to the base and from column flange to column flange.

Chapter 7

Next, we'll discuss air barrier or infiltration considerations in metal building insulation systems. Modern building codes often specify air barrier requirements for new construction.

This is tested after the construction of the building by the use of a blower door test, where the building is pressurized with air, and the testing agency will measure the time it takes for the pressure to fall. You can imagine that there are a lot of variables that affect this, but many key areas to pay attention to in your metal building are in the insulation system. Ensure seams and laps in vapor retarder are in firm, continuous contact, free of wrinkles or gaps. When installing wall insulation, pay special attention to create a flat, firm seal of the vapor retarder at the wall base. Caulking under and/or behind the base trim or angle is also critical to ensure the air seal.

Care should be taken at the eave struts and rake angles to ensure a reliable seal against the member. Tape should be applied over all gaps at the ends and corners of eave struts and rake angles to prevent air from escaping through voids in structural members.

Air barrier systems are often integrated with the insulation system. If the governing building code for your project specifies air barrier requirements, it is best to consult with your insulation supplier to determine the best solution for your project. Often the vapor retarder, when properly installed, is enough to meet these requirements.

Chapter 8

The final system that we'll discuss is the continuous insulation system. This most often consists of rigid insulation board installed outside the frame members. This can be installed in conjunction with laminated fiberglass or liner systems. It is important to coordinate with the metal building manufacturer to ensure that the correct trims are fabricated with the building package.

For nearly 40 years, pre-engineered metal building owners and contractors have recognized the value of rigid insulation boards. These are closed-cell polyisocyanurate rigid foam insulation boards. These boards come in a variety of sizes and thicknesses to be able to accommodate the specific needs of a project. Thicknesses of 2" and 3" and lengths of 15' are most common for both sidewall and roof applications. The R-value, or resistance to heat flow is significant. With such high performance in a thinner profile it allows building owners and designers much greater flexibility in their design and overall performance of their structure. What contributes to this performance are millions of closed cell pockets of gas that help resist heat flow. Poly-iso rigid insulation will help prevent the transfer of heating or cooling loads through the steel members of the structure. This thermal bridging or energy transfer can take place on 20% of a typical PEMB structure if traditional insulation methods are selected.

A hybrid system allows you to benefit from the high performance and moisture resistance of rigid insulation board along with the cost-effectiveness and ease of installation of the more traditional fiberglass.

As an alternate, insulated metal panel systems, or IMPs, are also available to satisfy the requirements of continuous insulation.

Chapter 9

Now, we'll look at the application of expanding foam or spray foam as a component of an insulation system. Foam insulation is available in board and liquid-applied form. In this section we'll look at the most common types of liquid-applied foam.

Sealant foams are comprised of one or two components and supplied in various size containers including small cans. These foams are used to supplement fiberglass insulation systems to provide thermal insulation and/or air sealing at voids, crevices and seams that would otherwise be exposed to the environment. Such foams are suitable for installation by insulation and fenestration contractors as well as metal building erectors since no equipment is required. Sealant foams can be more cost effective than caulking.

Spray foams are typically comprised of two components and supplied in 55-gallon drums. Such products are typically used to spray larger surface areas than are economically feasible with sealant foams. These products are available in open-cell and closed-cell types and are sprayed at transitions as well as on interior surfaces of siding and roofs in metal buildings. The products require specialized equipment and are sprayed by professional spray foam contractors who have been trained and certified by the foam manufacturer.

Often, foam is used to supplement a traditional fiberglass insulation system. It can be used to fill voids, crevices, and seams that would be otherwise open to the outside environment. When attaching wall base to rough surfaces, foam can be used to more effectively seal and insulate the void than caulking. When using expanding foam products, be sure to account for the expansion of the product when applying. Be sure to remove any excess material quickly, as the foam will stain surfaces it cures to. It is good practice to finish any foam with trim or caulking, to prevent weathering degradation of the foam product, and to present a clean, finished appearance.

(Note: The use of spray foam should be approved by the building manufacturer to make certain it does not void the roof or wall panel warranties.)

Some buildings utilize a spray-applied foam to meet insulation requirements. There are companies that specialize in the application of foam insulation products, and they are often considered a separate trade from metal building assemblers. In these cases, you will often erect the entire building, including the roof and wall panels, before they begin to insulate the building. The foam insulation is then applied directly to the backsides of the paneling.

Chapter 10

As a final note, we will discuss repair and seal of insulation systems. It is not uncommon to finish a project, only to see a few small tears in the vapor retarder. While these tears and penetrations may not look like anything, they can provide a path for water vapor to contact the metal skin of the building and create condensation problems. To ensure the integrity of the vapor retarder is not compromised, it is important to closely inspect all insulation in your project after it is installed and make any necessary repairs.

Insulation patch tape is made of the same material that vapor retarders are made from, so it matches the facing in your project for a seamless repair. Since it is made from the same material, it also has the same permeance that the vapor retarder has, which ensures that a reliable and consistent seal is present. When applying insulation patch tape, be sure to properly prepare the surface you're going to apply the tape on. Use a damp rag to wipe away any jobsite dust that may have accumulated on the vapor retarder, as well as clean any loose fiberglass off of the surface. It is important to apply the tape to a clean surface, to ensure a long-lasting adhesion. When practical, align the patch tape to match the orientation of the strands in the vapor retarder.

For larger tears or openings it is always best to contact the manufacturer for the recommended method to seal the insulation system through the use of patch tape, caulking and possibly new insulation pieces.

Thank you for watching this Insulation module of the Metal Buildings Institute's Quality and Craftsmanship Series.