



ENERGY STAR®

Residential New
Construction



Technical Bulletin: Achieving Grade-I Insulation in Fire-Rated Roofs

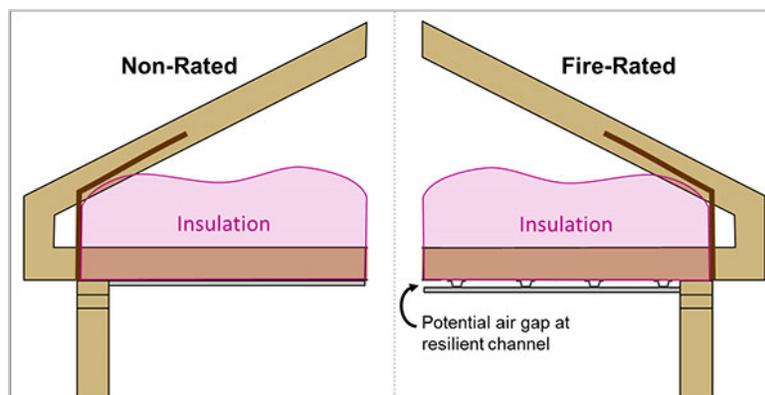
September 9, 2021

ENERGY STAR homes and apartments include quality installed insulation that achieves Grade I (per the ANSI/RESNET/ICC 301-2019 standard) by neatly filling cavities without gaps or voids. In townhouses and multifamily buildings requiring fire-rated construction, the resilient channel present in many rated assemblies makes it more difficult to earn Grade I insulation, especially in flat roofs.

The ENERGY STAR team collaborated with UL, the global safety certification company, to identify three options for fire-rated roofs that can achieve Grade I insulation, as detailed below. Fire-rated designs for each of these strategies can be found in UL's database using the instructions linked at the end of this bulletin.

Challenges with Gaps around Resilient Channels

Many fire-rated assemblies include thin strips of metal furring called resilient channel that hold the gypsum board $\frac{1}{2}$ " to $1\frac{1}{2}$ " off the ceiling framing. If batt insulation is installed at the framing plane, an air gap will be left between the air barrier (the gypsum board) and the insulation, which degrades the insulation's performance and prevents a Grade I designation.



Option 1, for Accessible Attic Spaces: Loose Fill Insulation

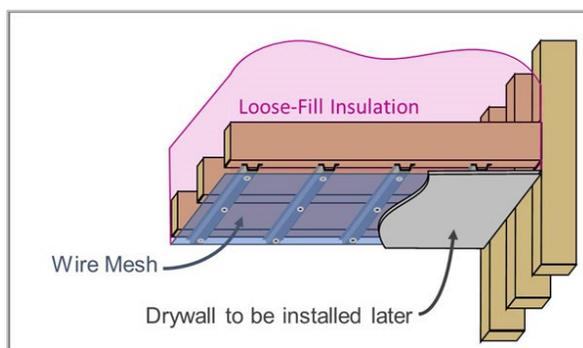
Assemblies with an attic space can use loose-fill insulation to achieve Grade I install. Because it is made up of loose particles, loose-fill insulation tends to settle around the resilient channel without creating gaps and voids, thereby meeting Grade I standards. Installation normally requires access to the attic after the gypsum board is hung, since the insulation rests on the ceiling for support.

Option 2, for Flat Roofs: Continuous Insulation at Roof Sheathing

In buildings without an accessible attic space, like townhouses or multifamily buildings with flat roofs, one option is to insulate at the roof sheathing rather than the ceiling using spray-foam, exterior continuous insulation, or a combination of the two. It is important to optimize such assemblies for the building's climate conditions and include insulation and air-sealing details at the perimeter walls and soffits. Visit the [Building America Solution Center](#) for climate-specific guidance on this approach.

Option 3, for Flat Roofs: Wire Mesh with Loose-Fill Insulation

One other option for flat roofs is a group of roof-ceiling assemblies that include a layer of wire mesh or netting to temporarily support loose-fill insulation prior to gypsum board installation. For project teams accustomed to insulating at the ceiling plane, this is a constructable, fire-resistant design that doesn't sacrifice energy performance.



Additional Resources from UL and EPA

For more details, refer to the two articles below to select the right assembly for your project. Copies of the articles are also attached at the end of this bulletin.

Technical Guidance in UL Newsletter: Find more information on fire performance and energy efficient construction in the latest edition of UL's [The Code Authority](#) newsletter.

Search for Rated Designs: Search for these categories of assemblies by creating a free account in UL's [Product iQ](#) database and following the instruction in UL's [Q&A article](#).

View past [ENERGY STAR Residential New Construction technical bulletins](#).

Best regards,

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Energy Efficient Residential Roofs and Ceilings

The balance of both fire performance and energy efficient construction in buildings can be a challenge, but is achievable.

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There are many performance expectations for a modern residential building, including being safe, functional, durable, energy efficient and healthy. Model building codes tend to focus on these expectations individually, which sometimes puts them in conflict with each other. Tested and certified fire-rated roof-ceiling assemblies achieve a fire rating in a practical way, but they may not always include best practices to also achieve a desired level of energy efficiency. For example, fire-rated roof-ceiling assemblies are very specific as to where attic insulation can be placed due to its effect on the fire rating. This creates a challenge for designers and builders who seek to create high-efficiency buildings, such as ENERGY STAR certified homes and apartments. Fortunately, there is no need to choose between fire performance and energy efficiency because assemblies are available that meet the code requirements and high standards for both.



Energy Efficient Residential Roofs and Ceilings

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Passive Fire Protection

Model building codes combine two approaches to fire protection in the built environment: active and passive. Active fire protection is generally a system or combination of systems that actively controls or extinguishes a fire, such as fire sprinkler systems, or notifies occupants and emergency responders, such as fire alarm systems. Passive fire protection is construction that restricts the spread and passage of fire and smoke through the selection of proper materials and use of products and assemblies to contain a fire. Fire-rated roof-ceiling assemblies are an example of the fire containment approach that are intended to restrict the vertical passage of flames and heat from the top story of a building to the attic space above.

The building codes direct when a fire resistance-rated roof-ceiling assembly is required. This fire resistance rating is determined by demonstrating compliance with the fire test UL 263 (ASTM E119), Standard for Fire Tests of Building Construction and Materials. This large-scale fire test evaluates an assembly's resistance to heat (temperature rise) and flame passage while maintaining the applied structural design load. The ratings are expressed in hours. When a test assembly complies with the acceptance criteria, the assembly details are published as assemblies (designs) in UL Product iQ.

UL online database search tool – Product iQ®

Information about UL designs and systems such as fire resistance-rated horizontal assemblies can be located using our Product iQ online search tool, available at www.ul.com/PiQ. Product iQ is free to use but does require a simple, one-time registration. Once registered, you can easily search for fire-rated roofs, walls, floors, beams and columns using Product iQ.

ENERGY STAR Residential New Construction Program

While fire performance has been a long-standing building code concern, energy efficiency concerns are more recent and advancing quickly. Current model building codes require newly built homes to use only half as much energy as one built in 1975 and many homes are built with even better performance than required by code. In fact, today, over 2 million homes and apartments have earned ENERGY STAR recognition by meeting strict program requirements for energy efficiency developed by the U.S. Environmental Protection Agency. ENERGY STAR certified homes and apartments are at least 10% more efficient than homes built to comply with the adopted residential building codes and achieve a 20% improvement on average. Homes and apartments achieve this level of performance through a complete package of building science measures. Throughout the construction process, an energy rating company works closely with a builder or developer to help utilize energy-saving construction techniques and



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conduct required on-site diagnostic testing and inspections to document eligibility to earn the ENERGY STAR label.

Quality Installation of Attic/Ceiling Insulation

An energy-efficient shell keeps a building warm during cold weather and cool during warm weather. To that end, ENERGY STAR requires quality installed insulation and a continuous air-barrier. These two elements work together like a wool sweater and a windbreaker on a blustery day. When it comes to an attic or exterior ceiling, insulation should be in continuous, direct contact with a horizontal air-barrier. An air barrier is a durable solid material like gypsum board or sheathing that blocks airflow and is sealed at its edges and seams. ENERGY STAR further requires that insulation achieves Grade I installation per the [ANSI/RESNET/ICC 301-2019](#) standard by neatly filling in around framing, wiring, and pipes without gaps or voids.



Figure 1 – Improper Installation versus Grade I Quality
Courtesy of DOE Building America Solutions Center

When a fire-rated attic assembly is not required, as in many low-rise residential buildings, ENERGY STAR requirements are typically achieved using either batt or loose-fill insulation installed directly above and continuous with the ceiling gypsum board that acts as the air barrier.

However, when a fire-rated attic assembly is required, installers need to contend with the resilient channel that is part of most fire-rated assemblies. This metal channel holds gypsum board $\frac{1}{2}$ - $1\frac{1}{2}$ in. off the ceiling framing. If batt insulation is installed at the framing plane, an air gap will be left between the air barrier (ceiling gypsum board) and insulation, degrading the insulation's performance. If there is an accessible attic space, a common solution is to install loose-fill insulation after drywall is hung. Loose-fill insulation, by its nature, packs in tightly around the resilient channel.

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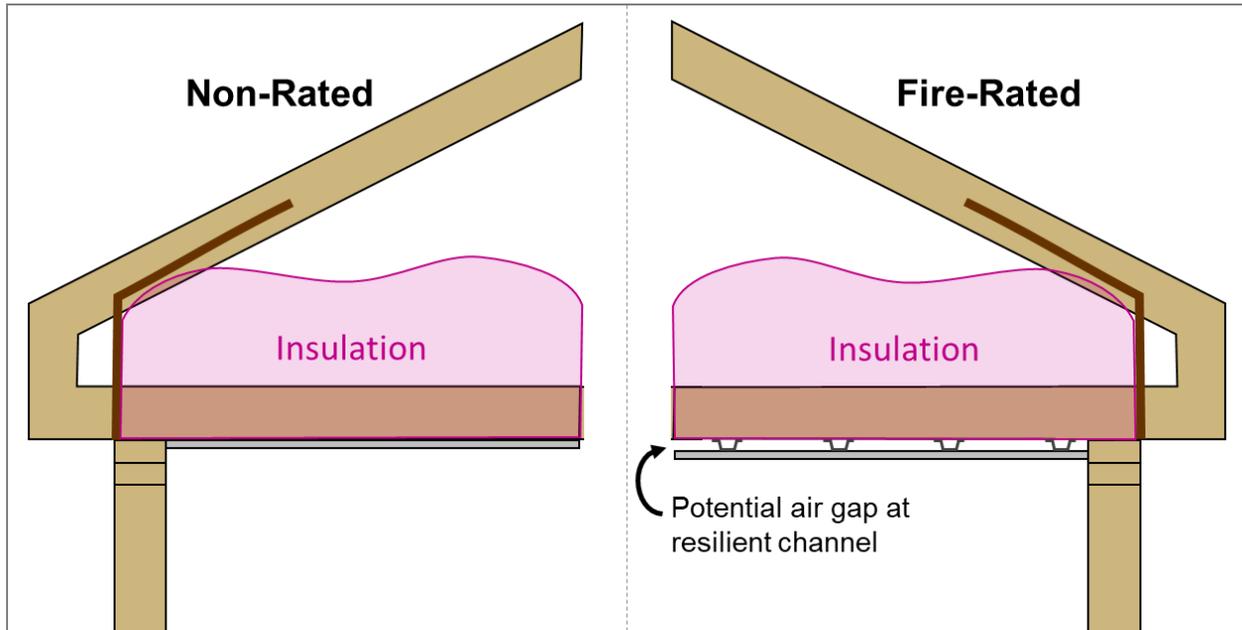


Figure 2 – Potential Air Gap in Fire-Rated Assemblies

However, builders have struggled to identify appropriate assemblies that achieve both a fire rating and Grade I installation quality when there will be no accessible attic space such as in flat-roof townhouse and multifamily buildings. The solution lies in a group of UL roof-ceiling assemblies that include an optional layer of wire mesh or netting to temporarily support loose-fill insulation prior to the gypsum board installation. These previously obscure assemblies provide a good option that is fire-resistant without sacrificing energy efficiency.

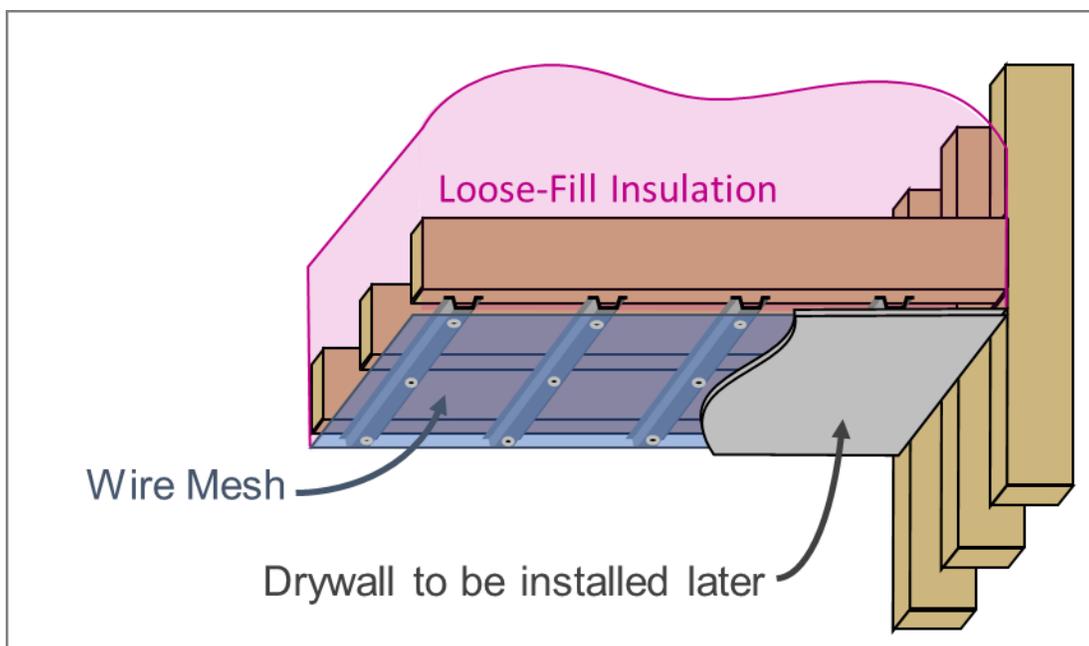


Figure 3 – Fire-Rated Assembly with Wire Mesh



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Insulation in Fire Resistance Rated Roof-Ceiling Assemblies

Insulation needed for energy conservation and energy efficiency rating is known to affect the fire resistance-rating of the complete assembly. In some cases, the addition of insulation in the concealed space between the gypsum board ceiling membrane and the roof structure may reduce the hourly rating of an assembly. Consequently, when insulation is allowed in the individual UL roof-ceiling design, that insulation must be of the type and thickness specified and the method of installation must match the design construction details to ensure the required fire rating is achieved. The design specifications also dictate resilient channel spacing and gypsum board fastener spacing.

The balance of both fire performance and energy efficient construction in buildings can be a challenge, but it is achievable. Insulation is crucial to providing energy efficiency to a building, and its installation details are critical to maintain both Grade I installation quality and the fire rating of the roof-ceiling assembly. Selecting the right assembly is the first step to creating safe, efficient, high-performance buildings.

Discover the benefits of ENERGY STAR new homes and apartments at EPA's [consumer webpage](#) and for more information on the program requirements and helpful guidance for professionals visit the [Partner Resources page](#).

ENERGY STAR New Homes Consumer Page: www.energystar.gov/newhomes
ENERGY STAR New Homes Partner Resources: www.energystar.gov/homes

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Q&A: Fire Resistance-Rated Ceiling Designs Supporting Grade I Insulation Installation

Learn how to identify UL fire resistance rated roof-ceiling designs that include insulation capable of Grade I installation quality with or without netting.

Q: Are there UL fire resistance rated roof-ceiling designs that can meet Grade I insulation quality standards when an attic space is available?

A: Yes, fire-rated roof-ceiling assemblies that include resilient channels and loose-fill insulation are a common option that allow insulation to rest directly against the gypsum board air-barrier without gaps and voids, thereby meeting Grade I standards.

To find these designs, follow this step-by-step process.

On Product iQ, scroll down to the section entitled “IQ PLUS SEARCH TOOLS” and click on “Building Materials, Systems and Installation Codes,” then click on “Fire Rated Roofs, Walls, Floors, Beams and Columns.”

In the menus on the left, select or type in the following:

Keyword – Loose Fill Material

Fire-Rated Design Details Assembly Type – select Roof-Ceiling

Protection Type – select Gypsum Board

Additional Filter – select Steel Structure or Wood Structure appropriately

After entering the above, click “Search” to the right of Keyword. To view a preview of the drawing of each design, click the dropdown “Display” and select “Images.” To view the design, click on the link that begins with “BXUV.” Within each design, look for the items entitled “Loose Fill Material.”

Q: For buildings without an accessible attic space, as in some townhouse or multifamily flat roof assemblies, Are there UL fire resistance rated roof-ceiling designs that can easily meet Grade I insulation quality standards?

A: Yes, rated ceiling assemblies with a suspended wire mesh or netting allow loose fill insulation to be installed before gypsum board is hung. These are a good option for meeting Grade I insulation quality in this scenario.

To find these designs, follow this step-by-step process.

On Product iQ, scroll down to the section entitled “IQ PLUS SEARCH TOOLS” and click on “Building Materials, Systems and Installation Codes,” then click on “Fire Rated Roofs, Walls, Floors, Beams and Columns.”

In the menus on the left, select or type the following:

Keyword – Netting

Fire-Rated Design Details Assembly Type – select Roof-Ceiling

Protection Type – select Gypsum Board

Q&A: Fire Resistance-Rated Ceiling Designs Supporting Grade I Insulation Installation



Additional Filter – select Steel Structure or Wood Structure appropriately

After entering the above, click “Search” to the right of Keyword. To view a preview of the drawing for each design, click the dropdown “Display” and select “Images.” To view the design, click on the link that begins with “BXUV.” Within each design, look for the insulation items that utilize wire mesh or netting.

Q: Are there UL fire resistance rated roof-ceiling designs that utilize spray foam plastic insulation to meet Grade I insulation quality standards?

A: Yes, spray foam is another type of insulation that readily fills areas around obstructions in the cavities, and it has the advantage of providing both air sealing and insulation.

To find these designs, follow this step-by-step process.

On Product iQ, scroll down to the section entitled “IQ PLUS SEARCH TOOLS” and click on “Building Materials, Systems and Installation Codes,” then click on “Fire Rated Roofs, Walls, Floors, Beams and Columns.”

In the menus on the left, select or type the following:

Keyword – Spray Foam Insulation

Fire-Rated Design Details Assembly Type – select Roof-Ceiling

Protection Type – select Gypsum Board

Additional Filter – select Wood Structure

After entering the above, click “Search” to the right of Keyword. To view a preview of the drawing for each design, click the dropdown “Display” and select “Images.” To view the design, click on the link that begins with “BXUV.” Within each design, look for the items entitled “Foamed Plastic.”

Q: Some UL assemblies resulting from the searches above include alternatives with the caveat that “the finished rating when this insulation is used has not been determined.” What does this mean?

A: The finish rating is an optional, supplemental metric that is separate from the hourly rating of the assembly. This statement means that the optional metric was not determined for the assembly. The building code only requires an hourly fire resistance-rating for the assembly. There are no code requirement related to the finish rating.

*This Q&A provided courtesy of UL, LLC
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