

# Acrylic Roof Coatings 101

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## INTRODUCTION

Most people are familiar with at least one acrylic plastic, Plexiglas®. Plexiglas is an all-acrylic material, usually associated with a polymeric, plastic material that is extremely durable, and has excellent weathering properties, and is very resistant to ultraviolet radiation from sunlight and the adverse effects of weathering. Plexiglas is an all-acrylic material, meaning that it is composed entirely of highly durable building blocks called monomers. While this is a clear sheet of the acrylic plastic, most acrylics are blended with other materials to create other easily recognized products such as paint, adhesive or caulk.

Acrylic polymers can be formulated to be tough and hard, and also very flexible. Plexiglas impact resistance is one example where it is used in banks to provide bulletproof shields. But acrylic polymers can also be manufactured to be flexible, to be tolerant of movement at low temperature, very elastic in their behavior.

## THE RIGHT ACRYLIC FOR THE RIGHT JOB

In the mid-1950's, acrylic technology developed to the point where these polymers could be incorporated into waterborne emulsion. This created the advent of the acrylic latex waterborne house paints. In the mid-1950's, an excellent highly durable house paint was based on solvent-based alkyd chemistry. In the 90's the most widely used, highly durable house paint material is a waterborne acrylic material.

The key feature of acrylic materials is that they can be used for a wide range of applications, but you need to use the right acrylic for the job. Polymers that you would use to make adhesives would not necessarily make good floor polishes. The polymer chemistry that's used to make elastomeric roof coatings would not necessarily do well as a leather tanning material. The acrylic used for house paint would not necessarily make an excellent caulk or sealant. But they're all acrylics. So the key thing here is the right acrylic for the right job.

## ACRYLIC ROOF COATINGS-FEATURES AND BENEFITS [Need Help?](#)

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Acrylic polymers have been engineered that are specifically designed for roof applications, and specifically for [roof coatings](#). Coatings manufacturers have tried to use house paints on roofs but these were too brittle. Formulators also tried to use caulk and sealant technology to make elastomeric roof coatings, but they have not been totally successfully - resulting in failures. Today the technical requirements for a successful roof coating are fully understood.

[Acrylic elastomeric roof coatings](#) refer to a liquid-applied monolithic (seamless), fully adhered, elastomeric membrane that's formed in situ on the roof. These coatings are applied 5 to 10 times thicker than a house paint. Typically, the thickness of an exterior house paint is 3 mils, .003 inches. For elastomeric roofing applications, these would be 15 to 30 mils. So we're talking about membrane-like materials. EPDM is often 45 mils; Hypalon<sup>R</sup> and PVC are 60 mils. However, with these coatings the membrane comes out of a can. That's why the term formed in-situ on the roof is used. It's applied as a liquid. As it dries, it forms a tough membrane, like EPDM and like Hypalon<sup>R</sup>. But, unlike those materials, it has no seams. No field or factory seaming is necessary. Moreover it is also fully adhered. These coatings are not mechanically attached like other types of single-ply membranes.

## NOT A PAINT

The [roof coating](#) looks like a paint in a can. It has the same viscosity as paint, which makes it brushable or sprayable, or, it can be applied with a roller, just like a house paint. But, it's a very different material based on a different class of acrylic chemistry. Also, it's a material that has a unique set of performance criteria. An [acrylic elastomeric roof coating is not a paint](#). Typically a paint does not require resistance to ponding water, reflectivity properties, flexibility at low temperature, ability to expand and contract or resistance to foot traffic. But an elastomeric roof coating does require these properties. The roof is going to sit on a relatively horizontal surface, tolerating many external stresses and water contact for extended time.

These [acrylic roof coatings](#) are usually white in color. This white color provides two unique features. First it reduces the temperature of the roof membrane to which it is applied. This reduced temperature coupled with the UV blocking properties of the coating reduces the degradation and deterioration of the roofing membrane enabling it to last longer. This white color also reflects as much as 85% of the heat portion of the sunlight, reducing the heat transfer into the building and reduces air conditioning costs.

## EXPANSION AND CONTRACTION

Roofs are dynamic environments, meaning they expand and contract. We look at a building, and we don't think it moves. In a microscopic examination, roofs are dynamic. There's thermal expansion, seismic expansion, the weight of snow and rain loads, wind uplift and "flutter" and vibrational effects that subject roofs to movement. The coating must be able to tolerate that kind of movement at roof temperature, and high temperature, in the summer, low temperature in the winter. Roofs must also tolerate foot traffic resistance. People are going to be walking on these roofs. They will be servicing HVAC units, cooling towers, satellite dish antennas; all kinds of equipment that's placed on a roof. The roof must be able to withstand foot traffic and the abuse from maintenance and repair crews.

However, these Elastomerics are not caulks or sealants. While they must tolerate expansion and contraction, and the dynamics associated with the roof, just like a caulk or sealant. But, caulks and sealants don't require resistance to standing water, impact resistance, or reflectivity properties.

## DURABILITY

The key property required of any roof coating material is durability. Acrylic technology is widely used in exterior applications for sealants, Plexiglas<sup>R</sup>, industrial coatings, house paints, because of its durability. Durability implies resistance to the [effects of UV degradation from the sun](#). The sunlight strikes a polymer, such as asphalt, the asphalt absorbs some of the radiation, and the polymer begins to vibrate, and break up into smaller pieces. This is the degradation that is associated with the harmful effects of sunlight. This can be seen readily in aged asphalt roofing. When new, it looks OK. However, six months later, there's a brown chalky residue. This is the result of ultraviolet degradation from the sun. Acrylic polymers are transparent to ultraviolet radiation which means they do not absorb the sun's destructive radiation. The polymer is not absorbing any of the radiation; it's reflecting the radiation back into the atmosphere. When that same acrylic polymer is formulated into a roof coating and the UV transmission is measured, there is no transmission. The coating contains UV blocking pigments that reflect this degrading UV radiation and so the roof substrate is protected.

## EASE OF APPLICATION

Another advantage of acrylic roof coatings is that they are easy to apply. They are waterborne materials, they're single component and don't require two component mixing. Simply stated, they are very easy to work with. They can be

applied just like a house paint, by spray, by roller, by brush, by squeegee. They can be cleaned up with water, airless spray units can be rinsed with the same ease that a painter would rinse out after painting with typical latex house paint. They don't carry any [volatile organic compound](#) constraints, they're not red label, and because they are waterborne there is little concern about shipping and handling. These coating have minimal toxicity, usually no more than a conventional house paint.

## COST PERFORMANCE

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[Benefits Brochure](#) From a cost performance standpoint, these [acrylic roof coatings](#) are extremely attractive. When compared to other types of coatings used to maintain roofs, acrylics, in terms of the initial cost, are sometimes higher an asphalt emulsion or an asphalt cutback. But when the expected service life of the coatings is considered and life cycle costs are computed, the acrylics come out with the most attractive (lower) life cycle costs.

## IMPORTANT CONSIDERATIONS

The following are some things to keep in mind when considering roof coatings:

1. **Exterior durability.** How well does it weather? Acrylic roof coatings offer excellent durability, UV resistance, and substrate protection from degradation from sunlight.
2. **Low temperature flexibility.** How flexible is the coating at cold temperatures? If the roof is in Chicago, and it's roughly zero in the winter, the roof and any coating must be able to tolerate movement and not be brittle and crack. If the roof coating product data sheet claims this coating will stretch 300% before it breaks, that's OK at room temperature. However, what happens at 0°F? Or at 120°F in the summer time? These are key criteria for successful acrylic roof coatings.
3. **Dirt pickup resistance** is another important issue. If the coating is to reflect the sun's heat, it must be and remain white in color. As it darkens as a result of dirt pickup, the air conditioning energy savings realized will be lessened or lost. This will be discussed later in this paper.
4. **Adhesion.** How well does the coating adhere to the roof substrate. These may include aged metal, aged BUR, aged cap sheet, aged EPDM, PVC, Hypalon<sup>R</sup>? These are important considerations when making a selection among acrylic roof coatings.
5. **Ponded water resistance.** How well does the coating adhere after long term submersion in puddles on the roof?

## ELONGATION TESTING

The elongation or stretching properties of the roof coating are a key criterion for successful performance. Here's a slide of an Instron Tester. It grips the sample, which is the white section in the center, between the two jaws, and we turn the machine on, it pulls the sample and it stretches between the jaws. The amount of stretching is measured. This is the percent elongation test. This test can be conducted at room temperature, low temperature simulating Chicago in the winter, or high temperature (simulating a summer day).

## ACCELERATED WEATHERING

These coatings can be exposed to the harmful effects of sunlight in the laboratory by placing them in accelerated

weather devices like a Weather-Ometer, and age them for several thousand hours, take them out and remeasure the elongation stretching properties as a function of weathering. Ideally the coating should retain most of its original (before weathering) elongation after a thousand hours in the Weather-Ometer.

## REFLECTIVITY AND REDUCED ENERGY COSTS

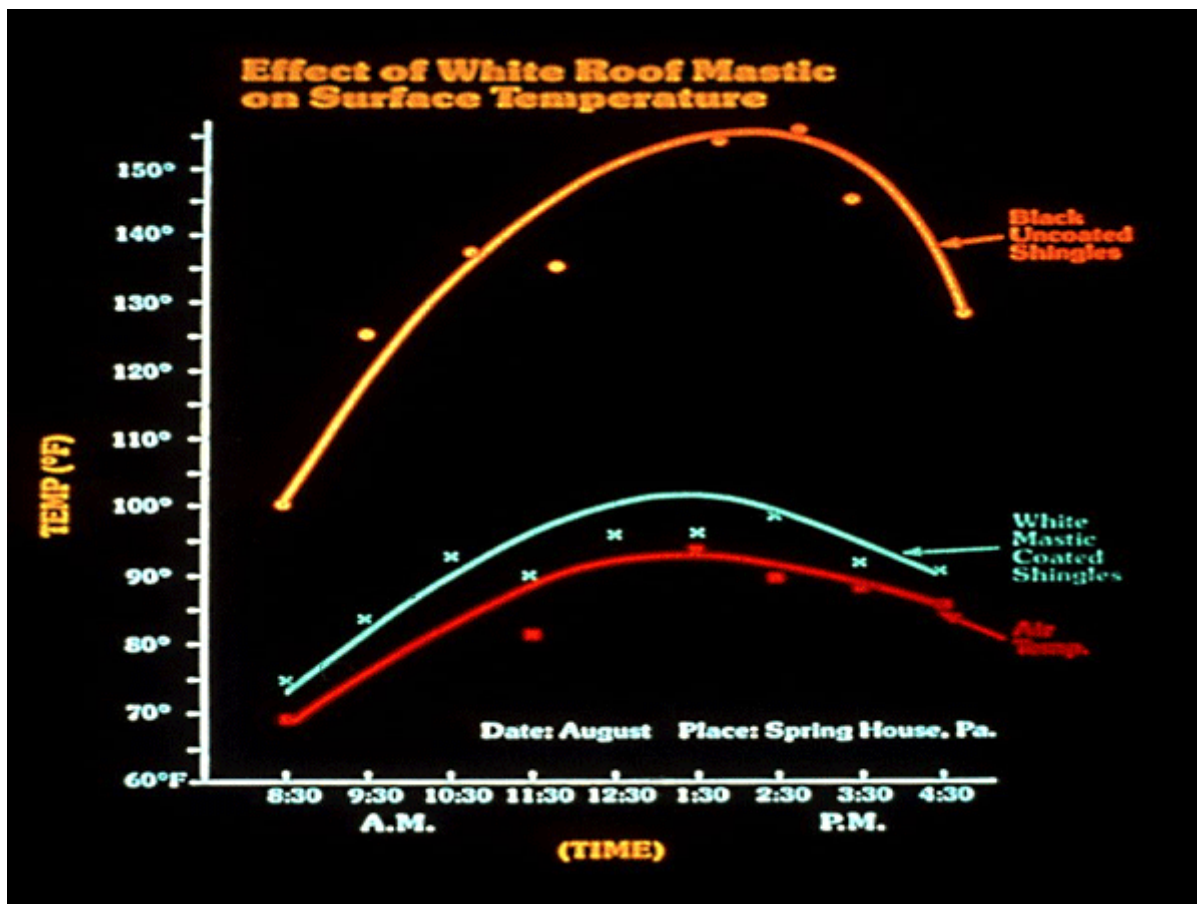
**Reflectivity** and dirt pickup resistance were mentioned earlier. This is a key property for an elastomeric coating that is growing in importance. Simply put, the whiter it is the cooler it is. Typically an infra red thermometer is used to measure the surface temperature. The photo below shows a scientist with an infrared thermometer measuring the surface temperature of a number of different elastomeric coatings on exposure. On the exposure rack is other roofing materials including sprayed in place polyurethane materials, foam, shingles, metal.



In the slide below the surface temperature of a number of different roofing materials were measured as a function of the time of day. The green line is the air temperature. The vertical axis is temperature, the horizontal axis is the time of day. And we saw that at about 2:30 or 3:00 PM, the air temperature was about 90°F (August, PA). The surface temperature was measured using the infrared thermometer of the black asphalt shingle exposed to sunlight. The yellow line at the top of the time-temp grid for a black asphalt shingle. 8:30 in the morning it started out at 85°F, by 3:00 p.m. it was up to 160°F. And by the end of the day, by 4:30, it tailed off to about 120°F.

This contrasts with the red line. This same black asphalt shingle coating with 100% acrylic elastomeric coating. The surface temperature of the shingle was much lower initially, 80°F. By mid afternoon the peak surface temperature was only about 90°F, then it tailed off into the 80's. This shows the benefits of reflectivity as the white elastomeric acrylic coating protects the asphalt roofing material and keeps it cooler.





There is a second benefit here also. Consider a warm August afternoon where there are afternoon thunder showers. It's 3:30 in the afternoon and that black asphalt shingle has a surface temperature of 160°F, then a

thunder shower occurs. The temperature of the shingle drops from 160° to 80°F in 15 minutes. The white coatings drops from 90°F to 80°F in 15 minutes. The black shingle experiences considerably more thermal shock. 80°F difference versus 10°F difference. The black shingle is undergoing a lot more stress, a lot more strain, more expansion and contraction, as a result of these temperature fluctuations. The thermal stress will shorten the life of a black roof.

Similarly consider a housing development, where there are two houses built at the same time, facing the same direction, one with black shingles, one with white shingles. The black shingled roof will have to be replaced before the white.

## REAL WORLD ENERGY SAVINGS

Actual studies have been conducted to quantify how much [economic benefit](#) there would be in terms of reduced air conditioning costs as a result of a reflective roof surface. Restated, if we had a black asphalt built-up roof and we coated it white with an [elastomeric coating](#), would we save any money, how much would we save, how long would it take to amortize the investment of [elastomeric coating](#)? To this end, an actual side by side study was conducted where three homes, semi-scale houses were built, each with different design parameters, each heated and cooled with a heat pump, and each monitored with some extensive telemetry on a 15 minute basis over the course of one year.

The slide below compares the three buildings. The building on the far right was called the Mississippi Power & Light Good Sense House. This was designed to exemplify energy savings measures that Mississippi Power Co. wanted building owners and contractors to follow. A lot of insulation in the ceilings and walls, a lot of heavy use of weather stripping and double insulated windows. The building No. 2 house was the control. Minimally insulated in the ceilings, no insulation in the walls, loose fitting windows, loose fitting doors, no foundation insulation, and a conventional built-up

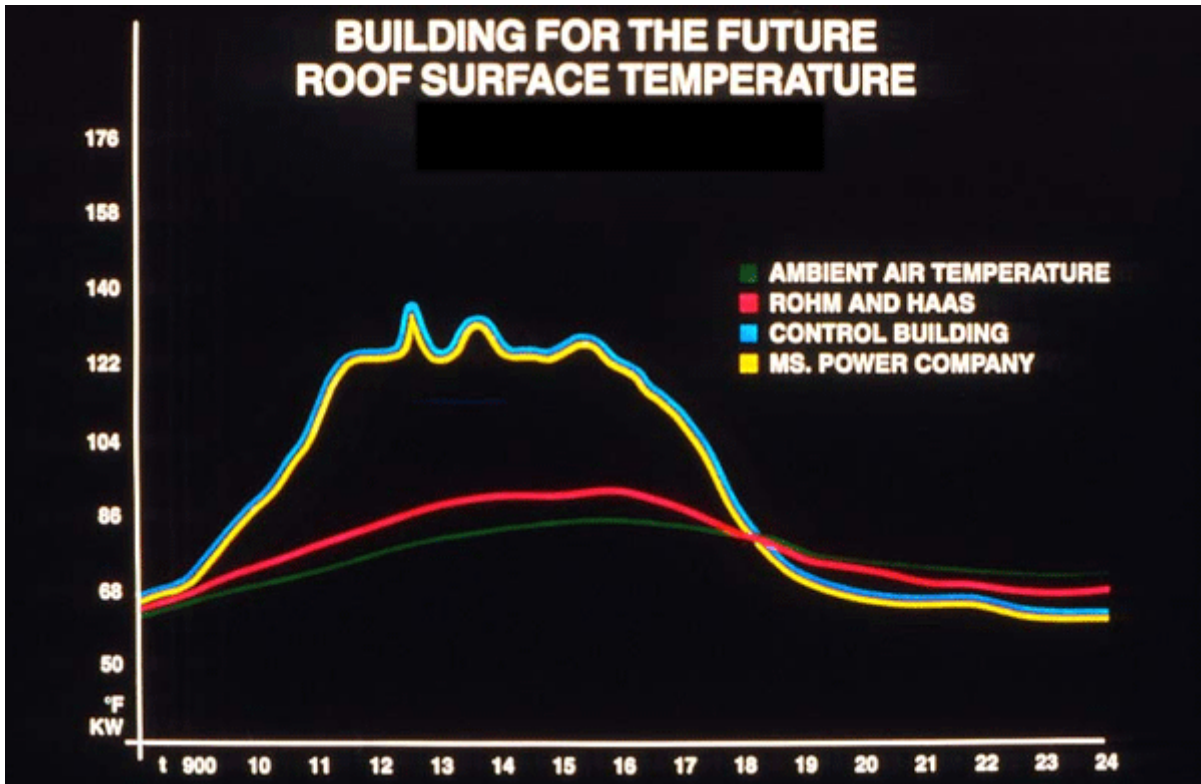
roof like the Mississippi house.

| <b>Construction Material</b> | <b>#1 R&amp;H/NCC</b>    | <b>#2 Control</b> | <b>#3 Miss Power</b> |
|------------------------------|--------------------------|-------------------|----------------------|
| Ceiling                      | R11                      | R11               | R30                  |
| Walls                        | No Insulation            | No Insulation     | Perlite              |
| Windows                      | Single Pane              | Single Pane       | Double Pane          |
| Doors                        | Wood                     | Wood              | Metal Insul.         |
| Foundation                   | No Insulation            | No Insulation     | Perlite              |
| Roof                         | White Acrylic Coated BUR | BUR               | BUR                  |
| Cost Increase                | \$135                    | -----             | \$548                |

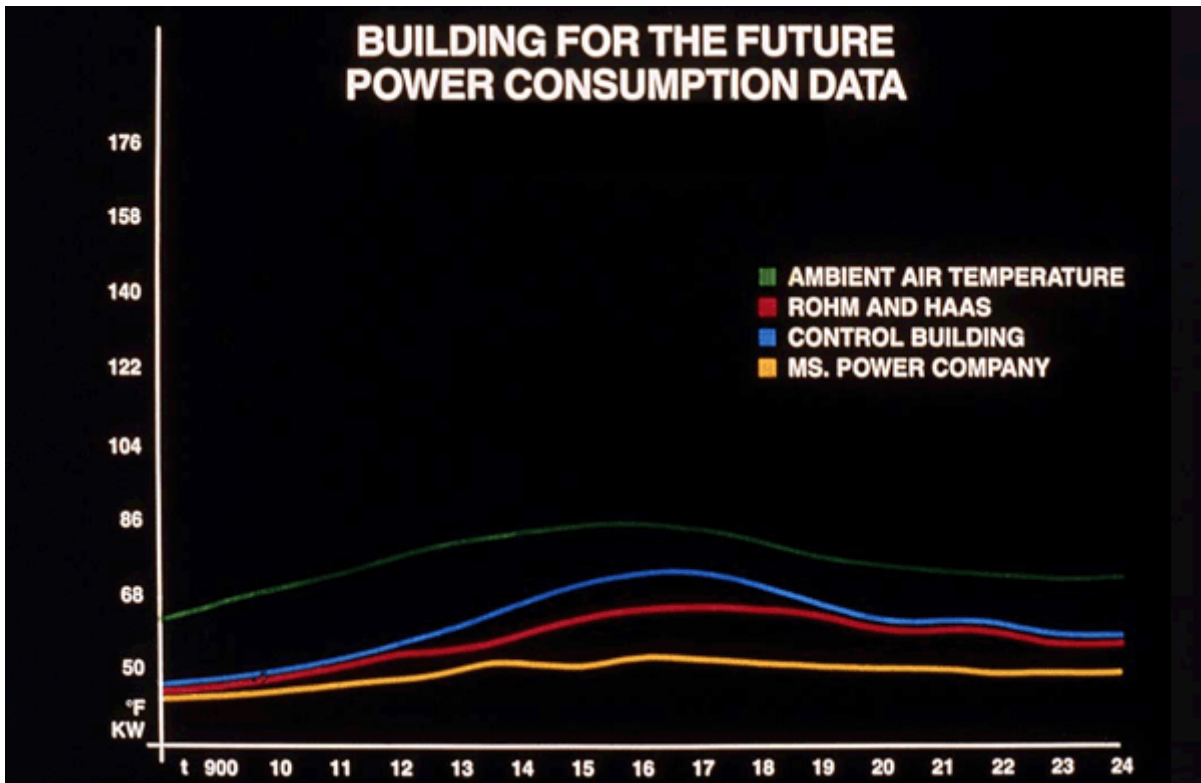
The building No. 1 and the one of greatest interest is the R&H/ National Coatings Corporation house. Minimal insulation in the ceiling, like the control. No insulation in side walls, like the control, loose fitting windows and doors, like the control. The only difference was that over the built-up roof was an elastomeric acrylic roof coating applied on top. The study was designed to compare the energy costs, or savings, between a black roof building No. 2, and the elastomeric roof coating based on R&H National Coatings Corporation technology, No. 1.

There was a cost premium in each case. The Mississippi House with the extra insulation cost about \$550 more - a cost more practical in new construction than retrofits. The house with the roof coating costs for coating and labor were \$135. Interestingly the coating could be applied anytime during the roof life to begin receiving this benefit.

The study generated energy use and weather data for one full year. Below is one particular day where we looked at ambient air temperature, at surface temperature, at watt-hour usage to maintain the same constant temperature inside each house. The ambient temperature is the blue line at the bottom. Horizontal axis is time of day. Vertical axis is temperature. By 2 or 3 o'clock in the afternoon the temperature had peaked in the mid-80's (October, 1985). The two black roofs were the blue and yellow lines. Here we're measuring just the surface temperature of the roof, using the same kind of infrared thermometer you saw before. The spikes and peaks in the curve are clouds that went overhead, partially obscuring the sun, causing the surface temperature to drop a little bit. Noteworthy here is the red line, the roof coated with the white elastomeric reflective coating. This is the surface temperature, which tends to be 5 to 30°F lower than the black roof temperature. This translates into energy savings.



The slide below compares time of day on the horizontal axis and watt-hours on the vertical axis. Compare the blue line, which was energy costs for the control house with the red line, the roof coated house, where both are similarly insulated. The area between the blue curve and the red curve is the savings, the amount of money that was saved by virtue of applying that white [elastomeric coating](#) over the roof. The cost for the roof coating and application was \$135. The time for amortization is two years. The cost of the investment is recouped in two years. Beyond that time money is being made with the elastomeric roof coating.



## FIRE RETARDANCY

Another benefit of acrylic roof coatings is in the area of fire retardancy. Many roofing systems require an Underwriter's Laboratory class A rating. A fire test, according to a standard specification UL790. This elastomeric coating can be formulated with fire retardant pigments to reduce the burning effects on the roofing system. The slide below shows a test called spread of flame conducted at Underwriters Laboratory in Chicago. It's a mockup of a roofing system four feet wide, 12 feet long; there's a slight incline to the mockup. The mockup consists of a wooden deck with isocyanurate board stock insulation and a built-up roof applied over top. This is topped with a white acrylic elastomeric coating containing fire retardant pigments.

A gas flame is turned on at the low end, and the flame propagation is measured after 10 minutes burning. If it goes less than six feet, the roof system (the deck, insulation, membrane and coating) get a Class A rating. It is important to remember that it is the system and not merely the coating that gets the fire rating.

## LIMITATIONS OF ACRYLIC ROOF COATINGS

There are limitations to these waterborne elastomeric coatings. These roof coatings can provide some restoration to an aged roof. However, if the roof is too badly deteriorated or the deck is rotted or badly corroded, coating will not return the roof to a useful service life.

There are some unique application limitations for these roof coatings also. These are waterborne coatings and can't be applied in the rain or when precipitation is imminent. They are applied at rates 10 times thicker than house paint and it will take longer to dry. If the relative humidity is extremely high, over 90%, it will take an extremely long time to dry. By contrast, if the humidity is very low such as Phoenix AZ in the summer the coating will dry in 1-2 hours.

These coatings should not be applied when it is extremely cold. Water freezes - so there are limitations as to the time of year when you can apply the coating, the contractor needs to be conscientious about what the overnight temperature is. It might be 66°F expected high for the day. But if he's going to be applying the coating until later in the afternoon, and the temperature is going to drop to the mid-20's, there may be a serious problem with freezing.

Another important consideration for the successful application of these elastomeric roof coatings is that the adhesion of the coating is only as good as how mechanically sound the substrate is. An aged roof membrane surface may be dirty or may have a powdery degraded roofing material on it or a new roof membrane may have mica or talc dusting on the surface. These powdery materials prevent the roof coating from achieving acceptable adhesion to the roof membrane substrate. Simply stated, the roof must be properly cleaned, usually with detergent and a pressure washer, to achieve a clean substrate suitable for coating. Just as a house paint would not be applied to chipped or peeling surfaces or mold spores, an elastomeric roof coating would not be applied to a substrate that wasn't mechanically sound free of debris, dirt, and powdery degraded roof substrate.

## CONCLUSIONS

- [Acrylic coatings](#) provide extended durability. They can be applied over most any type of a roofing system and they will dramatically enhance the life of that roof. They can be applied initially, to a new roof, and they can be applied somewhere later during the life of the existing roof.
- They reduce the energy costs. A white [acrylic roof coating](#) applied over a smooth surface built-up roof reduces the energy costs, saves money, and also extends the life of that roof.
- They can lower the roof [life cycle costs](#) by making the roof last longer, and can extend the date that the roof will be replaced.
- From an aesthetic standpoint, these acrylic coatings can be supplied as white for reflectivity, and [earth tone](#)



colors to compliment the building architecture. Reds, greens, browns - also in bright colors to enhance the overall architecture of malls, or landmark buildings.

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