EPDM

A Roof System for Every Climate

Light, dark or ballasted, there's an EPDM membrane that's right for your facility.

Today's construction climate places a heavy emphasis on green, sustainable building practices. For example, a building's roof was once thought of as just a means to keep the building dry, but not anymore. The impact a roof can have on energy consumption is understood now more than ever, but determining which roofing surface is most energy efficient continues to generate spirited debate. Many experts agree that light-colored, reflective surfaces are most appropriate in warm southern climates while dark, heat-absorbing surfaces are best in the north. EPDM (ethylene propylene diene terpolymer) single-ply roofing membrane is the only roofing material that offers solutions for all climates without the need for additional coatings or modifications.

More than 45 years of empirical experience in field applications has shown EPDM to have the roofing industry's longest average service life. As environmentalists and code regulators place more emphasis on the sustainable performance of building materials, EPDM single-ply rubber roofing membrane continues to be the roofing material that stands the test of time.

If you're considering a new or retrofit roof for your facility, now is actually a great time to be searching for a sustainable solution. In terms of dependability, performance and sustainability, the choices in the low-slope roofing market have never been better.

According to a variety of surveys conducted by roofing industry publications and associations, EPDM has been the number one roofing choice of architects, roof consultants, contractors and building owners for both new construction and replacement roofing projects for nearly half a century.

Just as important, the greatest test of any construction material is how it performs under actual field conditions.

Today, there are more than 500,000 warranted EPDM roof installations in the U.S. This figure represents an astounding 20 billion-plus square feet of exist-

The primary function of a roofing membrane like EPDM is waterproofing. As important as sustainability is, proven application techniques and long-term weathering performance can overshadow reflectivity by increasing membrane service life.

ing low-slope roofing on facilities across the country. In fact, EPDM is the only roof membrane that delivers solutions to meet all of today's sustainability and energy efficiency needs.

Recent research shows that EPDM has other desirable performance characteristics that dovetail nicely with the nation's need for more environmentally friendly and durable low-slope roofing systems.

Here's a short list of EPDM's overall system performance benefits:

- Cyclical membrane fatigue resistance
- Proven hail resistance
- High resistance to ozone, weathering and abrasion
- Flexibility in low temperatures
- Thermal shock durability
- Ultraviolet radiation resistance
- The ability to meet FM Global's most stringent Class 1 roofing requirements.

Weatherability is the key reason why more EPDM roofs continue to perform in the existing inventory than any other single-ply membrane.

REFLECTIVE ROOFING IN THE SOUTH

It's no surprise that reflective roofing products remain the fastest growing product in warmer low-slope roofing markets. White roofs can lower energy consumption (in climates where the number of cooling-degree days exceeds the number of heating-degree days)—a key goal of state and federal regulators—as well as meet more stringent cool-roof performance requirements in many building codes.

So there's no question that in ASHRAE Zones 1 to 3, most architects and roof designers today will specify a reflective roof membrane like white EPDM—and rightly so.

However, lowering energy use is not the only result from the use of a reflective roof membrane.

Depending on the geographical location and building configuration, white roof membranes can reduce energy consumption and improve building occupant comfort.

No roof membrane is perfect, of course. Dirt pick-up and mildew growth can be issues with some white roofing membranes. However, a well-designed roof system, regardless of color, should be resistant to dirt pick-up and be reasonably receptive to cleaning. This is best accomplished by initiating a semi-annual maintenance program that includes thorough cleaning, inspection and repairs.

COLOR-NEUTRAL IN ASHRAE ZONES 3 AND 4

There's little question that a white roof is the best choice in Florida. But across the geographic "middle" of North America, there is a neutral or gray area. This region makes up ASHRAE Climate Zones 3 and 4. In these areas, one can make a case that energy efficiency is not impacted by roof membrane color. Using the DOE Cool Roof Calculator, calculations would show little to no difference when comparing white versus black membranes in these zones in overall energy consumption (see figure 1).

In fact, it may surprise you to know that ballasted roofs can save as much energy as white roofs in ASHRAE zones 3 and 4—and in more southerly climates as well.

The development of complementary technologies has allowed EPDM to be beneficial in a wide number of applications, including plaza decks and larger projects using white EPDM membrane. Pictured (above) is a plaza deck paver system installed over a 145-mil EPDM system and (below) a white EPDM roof system.

In May of 2008, SPRI released a final report on a joint study with the Department of Energy (DOE) and the EPDM Roofing Association (ERA) entitled, "Evaluating the Energy Performance of Ballasted Roof Systems." The study shows that ballast and paver systems can save as much energy as a reflective or "cool" roof—even in southern climates.

"The magnitude of the savings was somewhat of a surprise to us," says André Desjarlais, who led the research effort at Oak Ridge National Laboratory (ORNL) for SPRI and DOE.

"To think that these very low-tech ballasted roofs that have been out there for so long were achieving energy savings equal to the newer white roof membranes. The 'adobe' method of construction used 600-700 years ago all makes sense."

In fact, the California Energy Commission now includes certain ballasted systems as a prescriptive equivalent to a cool roof in its Title 24 standard. In addition, ASHRAE may insert the energy saving data on ballasted roofs in its revisions for the next version of Standard 90.1. The EPA is also reviewing SPRI's request that the ballasted system be included in the ENERGY STAR roofing category.

Besides energy efficiency, part of the reason for the continued use of ballasted systems is positive real-world experience: Many older ballasted systems continue to perform well long beyond the warranty period.

Data from the Roofing Industry Committee on Weather Issues (RICOWI) Wind Investigation Program sheds further positive light on the performance of ballasted roofs.

EQUALIZING ENERGY PERFORMANCE UTILIZING ASHRAE 90.1 STANDARDS

With the emphasis on optimizing energy performance, the table below is based on insulation R-values (shown in second column) published in ASHRAE 90.1 Addendum F, which was approved in June 2010. For white and black membranes, the table outlines the necessary adjustments in R-values to maintain a roof assembly's energy performance. For example, with ASHRAE's intent to utilize reflective membranes in Zone 3, to achieve the same energy performance using a black membrane, the assembly must utilize insulation with an R-value of 29. Quite the contrary in colder regions (ASHRAE Zones 4 through 8). For example, while optimum performance can be achieved with a black membrane combined with R-35 in Zones 7, an assembly with a white membrane will require an increase in the insulation levels to R-38 in order for the assembly to deliver the same energy performance.

Traditional ballasted EPDM roof assemblies can deliver superior energy performance to cool roofs in Zones 4 and above. With an increase in coverage, ballasted roofs equal the performance of cool roofs in Zones 3 and below.

INSULATION LEVELS WITH EQUIVALENT LOAD VALUES

		Fully Adhered & Mechanically Fastened		
ASHRA Zone	**R-Value**	**White EPDM**	**Black EPDM**	**Ballasted EPDM**
1	R-20	R-20	R-33	R-20 *
2	R-25	R-25	R-31	R-25 *
3	R-25	R-25	R-29	R-25 *
4	R-30	R-31	R-30	R-30 **
5	R-30	R-32	R-30	R-30 **
6	R-30	R-32	R-30	R-30 **
7	R-35	R-38	R-35	R-35 **
8	R-35	R-38	R-35	R-35 **

Figure 1. * = 17 #/SF Ballast ** = 10 #/SF Ballast

RICOWI inspected 93 low-slope and 91 steep-slope roofs in Florida in the immediate aftermath of Hurricane Charley in August 2004 and Hurricane Ivan in September 2004. More than 50 experts examined roof shape, materials, edge conditions, installation details and degree of deterioration, if any.

"From the ballasted roofs observed in the Charlie and Ivan investigations, I would conclude that stone ballasted roofs did not contribute to the debris stream from these hurricanes," said Dave Roodvoets, RICOWI's wind event coordinator. "Worst case, after Katrina, we saw a few stones lying around near a building with a ballasted roof. In Ivan and Charlie, there was some movement of stone on the roof, but the stone did not blow off the roof, even when the building height and wind zone requirements did not comply with local codes."

Poor workmanship and improper materials and specifications were the primary causes of roof failures in Florida and on the Gulf Coast, according to the RICOWI report.

SPECIFYING FOR ZONE 4 AND ABOVE

Legislators, architects and property owners are embracing the idea that building design has a large impact on energy consumption and sustainability. They are also recognizing that white roofing has a few drawbacks, depending on where it is specified.

Energy Secretary Dr. Steven Chu's now-famous suggestion for painting all the roofs of all buildings white to reduce carbon dioxide emissions and save energy has increased interest in reflective roofing. It has also evoked widespread debate within the scientific community.

Especially in ASHRAE Zone 4 and above, a dark-colored roof membrane is almost always the best choice.

"You need to step away from Dr. Chu's comment and think about what it will do for you and your home or building," says Dr. Brian Eberly on Legal Planet, The Environmental Law and Policy Blog. "Where I live in California, the winter sun warms my house. If I am required to have a reflective roof, my winter heating bill will be much higher than it is now. Maybe this should be legislated by climate zone in my state. Let's not use a one-building-fits-all approach."

A property owner responding to Dr. Eberly agrees: "Our greatest energy usage (in Wisconsin) is in the winter when the heater runs to keep our pipes (metal and biological) from freezing. I chose a black roof last year to lower my energy costs."

White membranes, throughout the northern part of the U.S., may be a strategy for addressing heat island concerns, but they do not always deliver energy savings, nor do they contribute to lower carbon emissions. The key factor should always be the amount of insulation utilized in the assembly, which has been demonstrated as the most influential component by which sustainability can be achieved.

For the developers, owners and operators of large-scale multifamily properties, sustainable design has become a fiscal necessity.

Pacific Retirement Service's (PRS's) projects are a case-in-point. Developer PRS and local design partner Ankrom Moisan Architects always aim for Leadership in Energy and Environmental Design (LEED) certification on the facilities they develop.

"We don't care what color the roof is, as long as it saves us energy down the road," says Rick

Mazza, vice president of business development and planning for PRS, one of the largest multifamily developers in the U.S. "Admittedly, the U.S. Green Building Council (that administers LEED), and other organizations, tend to push the reflective roofing products, but we're much more concerned about the energy efficiency of the entire building envelope. And, on the roof, that means more insulation, particularly in high heating-degree-day climate zones."

SAVING ENERGY ISN'T A BLACK-AND-WHITE ISSUE

Well-meaning legislators are pushing for "cool" roof requirements in the building codes. In their zeal to address heat islands, many are focusing too closely on roofing color instead of energy performance in northern climates.

Tom Hutchinson of The Hutchinson Design Group in Chicago, Ill., is a well-respected roof consultant who has worked with two international committees tasked with defining roof sustainability.

"It's gotten to the point out there where people think, 'if a roof membrane is white, then it's great,'" Hutchinson says. "In the real world of roof design, that is definitely not the case."

According to Hutchinson, specifying bright-white roofing has become a knee-jerk reaction for some designers who do not take climate zones and building use into consideration.

That's why it's so important that roof designers, contractors and facilities managers consider the right roofs for the right markets.

For example, ASHRAE's current 90.1 recommendations are calling for R-values that are 33 percent higher than in the past. This means that a properly insulated roof often negates the intended reflective benefits of a white roofing membrane in ASHRAE Zones 4 and above.

"We push no particular (roof) system but look at each building, geographic location and owner situation as unique," says Andy Hoover, principal of The Best Consultant Inc. in Suwanee, Ga., and secretary of the Roof Consultants Institute's (RCI's) Georgia chapter.

The fact is that "cool" roofing can be light, dark or anything in between depending on the climate zone where it is specified.

> "Maybe this should be legislated by climate zone in my state. Let's not use a **ONE-BUILDING-FITS-ALL** approach."
>
> – Dr. Brian Eberly, Legal Planet

The primary function of a roofing membrane is waterproofing. As important as sustainability is, a major roof leak will help facilities managers forget about reflectivity in a hurry. That's why it's so important to keep the "big picture" in mind when choosing a roof membrane. It's a point that few experts in the roofing industry would dispute.

Unfortunately, there are currently no standards governing sustainability beyond singular characteristics, such as roof reflectivity. This can lead to the deselection of some high-performance roofing solutions and the specification of roofing systems that may actually be less sustainable over the long term. In addition, this is creating confusion in the design and research community.

For example, the efforts to modify specifications and replace black membranes with white material in Northern Climate Zones (ASHRAE zones 4 and above) could prove to have a less than favorable outcome. In fact, there are good reasons why black EPDM roofs account for more than 52 percent of roofing installations in the northern part of the U.S.

Primary among these sustainable strategies is longevity. Black roofs have been successfully performing in all ASHRAE Zones over the past four decades.

Measuring the environmental impact and carbon emissions potential of low-slope roofs should also play a part in sustainable design. For the past 30 years, Certified Energy Manager Randy Koller, P.E., has been hard at work doing just that.

In 2008, he conducted an energy analysis for the West Virginia School Building Authority using the Department of Energy (DOE) Cool Roof Calculator. He found that black roofs installed on the state's public schools showed favorable results for potential energy costs and carbon emissions when compared to white roofs.

His analyses compared assemblies using dark-colored and white reflective membranes with R-values ranging from R-15 to R-32. Energy cost and carbon emission comparisons were conducted, and black roofs were found to be the most economical and environmentally friendly option.

When considering the higher energy costs of white membranes plus periodic cleaning costs to keep them light and reflective, the use of black membranes can deliver the best return on investment and should have less of an environmental impact due to recycling potential and lower carbon emissions.

A BRIGHT FUTURE FOR EPDM

Since the early 1960s, EPDM has gained wide industry acceptance and respect by providing long-term, economically efficient, dependable roofing solutions for facilities managers and others in the construction industry.

EPDM attributes include long-term warranties, low life-cycle costs, reduced labor costs, minimal maintenance and user-friendly code approvals.

The sustained growth of EPDM roofing systems is attributed to the development of complementary technologies that have made it possible for EPDM roofing systems to be beneficial in a wide number of applications. Architects, property owners and facilities managers have come to depend on this proven track record of performance.

As environmentalists and code regulators place more emphasis on energy efficiency and the long-term performance of building materials, EPDM has become an increasingly versatile and preferred choice.