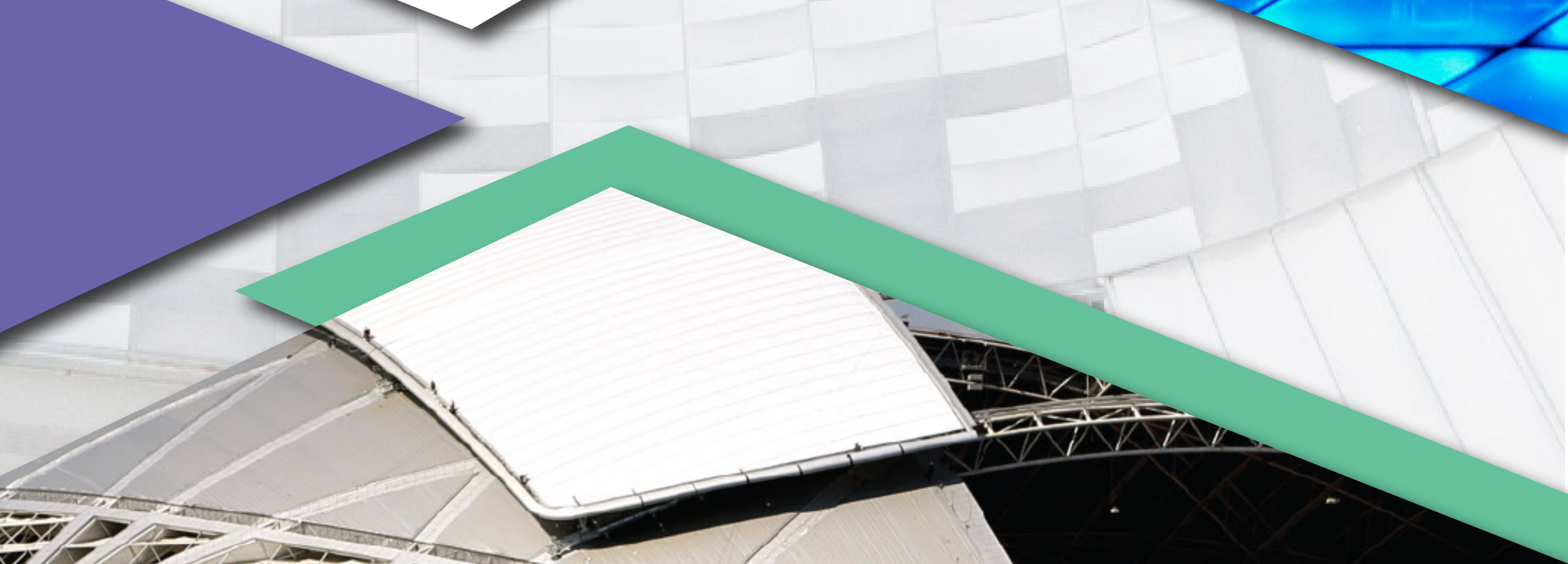
ETFE FILM PERFORMANCE AT WORK

Its Unique Attributes Showcased in Four Innovative Buildings



YEAR-ROUND COMFORT

ETFE film made it possible to construct a building that functions as a year-round, outdoor oasis in a region that has a severe climate

Known as the world's largest tent, the Khan Shatyr Entertainment Center in Astana, Kazakhstan, stands nearly 500 feet tall and encloses an area of more than 24 acres, which includes a park, jogging track, retail shops, restaurants, theaters, exhibition space and a water park with wave pools and slides.

Khan Shatyr was built to provide city residents a place to enjoy social and cultural activities year round. Its structure needed to provide shelter from the region's inhospitable temperatures, which can dip as low as -31 °F in the winter and climb to 95 °F in the summer. ETFE film was selected as the roofing material because it is lightweight and provides exceptional thermal insulation.

Air cushions insulate

The structure is a tubular-steel tripod construction that supports a suspended net of steel cables covered with "cushions" of air made from three layers of ETFE film. The ETFE film cushions provide high insulation.

The translucent material allows daylight to enter the interior, while protecting it from the extreme outdoor temperatures. When it is cold outside, warm air is blown up the inner surface to prevent icing. When the outdoor temperature rises, internal heat is exhausted through the top of the tent.

The ETFE and cable roof is much lighter and more efficient than it would be if made from glass and steel. ETFE film is also ideal for long-term outdoor use. Film subjected to a 16,000-hour accelerated weathering test (comparable to over 30 years' exposure) shows almost no signs of deterioration.

Performance Attributes

- Withstands temperatures between -200 and 200 °C and continuous use over 150 °C
- Resistant to wide light wavelength from infrared to ultraviolet
- Thermal melting point: 260 °C
- Linear thermal expansion coefficient: 9.4

UNIQUE BUILDING DESIGNS

ETFE film made it possible to build a structure with an innovative, futuristic and colorful architectural design

Bayern Munich's Allianz Arena is home to one of the world's most successful and iconic soccer teams. At 700,000 square feet, it is also one of the world's largest stadiums built with a membrane structure and the world's first stadium with a fully color-changeable exterior. Fluon ETFE film was used on all exterior surfaces to keep the structure lightweight and enable its curved lines and changeable color.

Changeable color

Multicolored lights strike the ETFE film from the inside of the stadium to change the entire dome's exterior color to bright red, blue, or white. The color change advertises which team is playing in the stadium, as the city's residents can see it at night from miles away.

Controlling transparency and light diffusion

ETFE film successfully protects spectators from wind and rain while allowing light to shine onto the natural grass. It has a solar transmittance rate of over 90%, and facility operators can control the transparency and diffusion of light. The film is dirt-resistant and self-cleaning with rain, making it easy to maintain.

Performance Attributes

- Solar transmittance rate: 90%
- Total light transmittance rate: 95%
- Adjustable transparency and light diffusion
- Long-term weather durability: 25-30 years

ENERGY SAVINGS

ETFE film made it possible to get enough natural light into the arena to significantly reduce electricity required for light and heat

The 46,000-seat Arena Pernambuco was built in Recife, Brazil to host the 2014 World Cup, but was intended to last long into the future. For that reason the arena's exterior was designed and covered with over 269,000 square feet of Fluon ETFE film.

Improving energy efficiency

The material gives the stadium a futuristic, rounded appearance and transfers natural light inside, reducing its dependence on electricity. ETFE film provides better than 90% light transmission, enabling sunlight to penetrate into the walkways and common areas while preserving a temperate atmosphere.

Maximum strength with minimal maintenance

ETFE film gave the designers flexibility to create a functional building that is also visually appealing from the outside. The material has a maximum tension of 3.5K N/m, so it will not easily rip or scratch over time. It also can withstand extreme environments because of its superior weatherability, chemical resistance and non-stick properties.

Performance Attributes

- Solar transmittance rate: 90%
- Maximum tension: 3.5K N/m
- High tensile elongation: 200 – 510
- Withstands extreme temperatures: -200 to 200 °C

LIGHTWEIGHT AND MOVABLE COVERINGS

ETFE film made it possible to achieve a dome-shaped roof that is lightweight enough to be retracted quickly and safely

Singapore's National Stadium is a state-of-the-art, 55,000 seat, multipurpose facility located within the city's largest sports and entertainment complex. Its dome-shaped, 215,000-square-foot retractable roof is covered with lightweight 0.15 mm to 0.25 mm-thick ETFE film so that it can be closed in just 20 minutes to shelter spectators from snow or rain.

Functional and flexible

ETFE film was used instead of glass or other transparent building materials because it is light enough to be opened to provide spectators with an outdoor experience. Even when closed, the film allows a considerable amount of natural light to pass through. Its reflective properties and resistance to heat, chemicals and extreme weather enable it to stand the test of time with minimal maintenance.

Innovative visual effects

A sophisticated LED system is installed beneath the retractable roof so that the ETFE film can be used as a giant screen. Nighttime illumination effects amplify the stadium's visual experience for spectators inside the stadium and those viewing the stadium from the outside.

Performance Attributes

- Tensile elongation: Over 400% from room temperature and over 600% at 100° C.
- Thicknesses and finishes ranging: from 12 µm to 250 µm
- Total light transmittance options: Over 90%
- Ideal for curved surfaces and flex module applications

Fluon® ETFE FILM

Fluon® ethylene tetrafluoroethylene (ETFE) is a revolutionary architectural material that is used around the world because it is safer and lighter than glass. Light weight means that ETFE film requires less structural support, which in turn reduces building time and costs. The material is heat resistant, chemical resistant and fire resistant with excellent thermal insulation properties, high light transmittance and long-term weatherability. Its high level of heat retention, combined with its ability to allow in more natural light than glass, can reduce energy costs by up to 30% compared to glass.

Despite being lighter than glass, Fluon ETFE Film will not easily rip or scratch over time, even in the harshest environments. The film has a high tensile elongation (200 – 510) and tear strength, as well as a thermal melting point of 260° C and a linear thermal expansion coefficient of 9.4. Fluon ETFE Film is available in various thicknesses and finishes ranging from 12 µm to 250 µm and with light transmittance options of over 90%.

AGC Chemicals Americas, Inc.
55 E. Uwchlan Avenue, Suite 201
Exton, PA 19341
United States of America

Tel: +1 610-423-4300
Toll Free (US only): 800-424-7833
Fax: +1 610-423-4305

www.agcchem.com
Visit our website for compliance information and industry certifications.

AGC Fluon ETFE Film Performance At Work.01-5/18.