



## PVC & KEE Roof Membranes: In-Depth Analysis of Material Composition, Standards, Performance, Applications, and Environmental Considerations

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Roofing membranes play a crucial role in protecting buildings from weather elements and maintaining structural integrity. Among various roofing materials, PVC (Polyvinyl Chloride) and KEE (Ketone Ethylene Ester) membranes stand out for their durability and versatility. This paper presents a discussion of PVC and KEE roof membranes, focusing on their material composition, standards performance characteristics, applications, and environmental considerations in roofing systems.

### **Introduction**

Roofing membranes are essential components of modern construction, providing protection against weather elements, UV radiation, and water ingress. PVC and KEE membranes have gained popularity in the roofing industry due to their performance and longevity. Understanding the similarities and differences between these two materials can be helpful for informed decision-making in roofing projects.

### **Industry Standards**

**PVC Roof Membranes:** ASTM D4434, titled “Standard Specification for Poly(vinyl Chloride) Sheet Roofing,” is the standard specification for poly(vinyl chloride) (PVC) roofing membranes used in single-ply roofing systems. PVC roofing membranes are required by building code to meet ASTM standard D4434.

**KEE Roof Membranes:** ASTM D6754, titled, “Standard Specification for Ketone Ethylene Ester Based Sheet Roofing,” is the standard specification for Ketone Ethylene Ester (KEE) roofing membranes used in single-ply roofing systems. KEE roofing membranes are required by building code to meet ASTM standard D6754.

The standards—D4434 and D6754—largely include the same physical requirements and test methods for PVC and KEE, respectively. They each cover requirements such as thickness, tensile strength, elongation, tear resistance, dimensional stability, and weathering resistance, among others.

It is important to understand that both roofing membrane types are thermoplastic, white in color, and include a significant amount of PVC polymer. Roofing membranes that meet ASTM standard D4434 have a PVC polymer content “in amounts greater than 50% of the total polymer content,” and roofing membranes that meet ASTM standard D6754 have a KEE polymer content of “a minimum of 50% by weight of the polymer content of the sheet.” The specific language within each standard that defines, and ultimately differentiates the two product types can be confusing to owners and specifiers because both membrane types are, at their core, “PVC-based” roofing membranes.

## **Material Composition**

**PVC Roof Membranes:** PVC membranes are typically composed of polyvinyl chloride, liquid plasticizers, (sometimes) solid plasticizers, additives, stabilizers, and reinforcement. These membranes are known for their flexibility, protection against chemical exposure and ease of installation.

**KEE Roof Membranes:** KEE membranes are typically composed of ketone ethylene ester, polyvinyl chloride, liquid plasticizers, additives, and reinforcement. These membranes are known for their flexibility, enhanced protection against chemical exposure, ease of installation, and puncture resistance.

One of the key differences between PVC and KEE lies in their chemical composition. Both membranes require plasticizers to make them flexible for use as roofing membranes. PVC-based membranes use liquid plasticizers while KEE-based membranes contain ketone ethylene ester, which is a solid plasticizer. Liquid plasticizers may migrate out of the sheet over the life of the roof, which can make the PVC material less flexible. Solid plasticizers do not migrate out of the sheet because they are solid.

Importantly, KEE membranes typically contain less liquid plasticizers than their PVC counterparts. While KEE membranes do contain PVC, utilization of the KEE polymer as a solid plasticizer can lead to a more stable and durable chemical composition of the single ply membrane.

A much more comprehensive discussion of polymer content in regards to ASTM standard classification and polymer content relative to overall sheet content is provided in [D6754 Standard and Polymer Content Analysis in Single Ply Roof Membranes](#).

## **Performance Characteristics**

**Durability:** Both PVC and KEE membranes have excellent resistance to UV radiation and heat. The requirements for accelerated weathering and heat aging in both ASTM standards are equal for PVC and KEE membranes. Retention of physical properties after heat aging is 90%. Again, this is the same in both ASTM standards.

Thickness and thickness over scrim are often discussed as components of durability. PVC is required to have a total thickness of 45 mils or 36 mils (there are 3 PVC types available), and KEE is required to have a total thickness of 32 mils. [One mil is 1/1000th of an inch.] For thickness over scrim (i.e., material above the reinforcement), all 3 types of PVC are required to have 16 mils of material above the scrim, while the KEE sheet is required to have 7 mils of material above the scrim.

Reinforcement type varies between PVC and KEE roof membranes. Breaking strength and tearing strength are directly related to the reinforcement type. The following chart provides the minimum requirements for breaking and tearing strength from D4434 and D6754, respectively.

Minimum Breaking and Tearing Strengths of PVC and KEE Roof Membranes				
	PVC			KEE
	Type II	Type III	Type IV	
Breaking Strength, min, lbf/in	55	200	275	337
Tearing Strength, min, lbf	-	45	90	76

**Flexibility:** Both PVC and KEE membranes are flexible, allowing for ease of installation and some accommodation for normal rooftop movement. However, KEE membranes tend to maintain their flexibility over a longer period, even in more challenging weather conditions. As stated earlier, a much more comprehensive discussion of polymer content in regards to ASTM standard classification and polymer content relative to overall sheet content is provided in the link above.

**Chemical Resistance:** Membranes that include the KEE polymer demonstrate excellent resistance to chemicals, oils, and pollutants, making them suitable for installations in industrial settings or areas with high chemical or pollutant exposure. However, both PVC and KEE membranes have a level of chemical resistance, as shown in the chart below.

Relative Chemical Resistance of PVC and KEE Membranes		
Chemical	PVC	KEE
Calcium Chloride	A	A
Sodium Chloride	A	A
Gasoline	C	C
Diesel Fuel	C	C
Lubricating Oils	B	B
Hydrochloric Acid	B	B
Fats/Oils - Animal and Vegetable	C	C
Oxalic Acid	A	A
Hydrofluoric Acid	C	C
Potassium Hydroxide	A	A

Notably, most PVC membrane manufacturers do not provide warranty or guarantee coverage for exposure to chemicals.

**Fire Resistance:** PVC and KEE membranes have inherent fire-resistance properties, because of the PVC component within each. It is important to recognize that there are no fire-resistance ratings for membranes alone. Fire resistance is a characteristic of a roofing system, which includes the membrane, insulation (with or without a cover board), and the roof deck. There are many low-slope roof systems that have a Class A fire-resistance rating.

## Applications

**PVC and KEE Roof Membranes:** PVC and KEE membranes are widely used in commercial and industrial roofing applications. Attachments methods may vary by manufacturer but generally encompass all of the common methods used today. Installation methods include: mechanical attachment, adhered, and induction welded (most commonly called by its trade name - RhinoBond). PVC and KEE membranes are used over many different insulation systems and deck types.



## Environmental Conditions

**PVC-based Roof Membranes:** PVC-based roof membranes (both PVC and KEE are included) continue to face criticism for their environmental impact during manufacturing and disposal. Advancements in material formulation have significantly reduced the quantities of harmful chemicals used. Additionally, advancements in recycling technologies are helping to enable the use of existing PVC in new PVC materials.

## Conclusions

Both PVC and KEE roof membranes offer unique advantages in terms of performance, durability, and application versus other single-ply membrane types. While PVC membranes are widely used for their affordability and versatility, KEE membranes stand out for their increased durability. The choice between PVC and KEE membranes oftentimes comes down to project requirements and budget constraints.