

TECHNICAL UPDATE - TU-5018

SUBJECT: FRPVC and TPU Jacket Properties

Dekoron/Unitherm provides preinsulated and traced products with a number of different outer jacket materials based on the application and the customer's needs. The two most common jacket materials used are Polyvinyl Chloride (PVC) and Thermoplastic polyurethane (TPU). The purpose of this Update is to detail some specific properties of these two materials to help the customer decide which would be the better selection for his application.

Overview

PVC has been the mainstay of the wire and cable industry for over 60 years. This flexible, weather-resistant compound provides a combination of mechanical properties and chemical resistance that works well in a wide variety of industrial applications. TPU jacketing compounds were originally limited to automotive applications, but have seen increased use in industrial applications. TPU's exhibit excellent flexibility and low temperature properties.

Mechanical Properties

The table below lists some common properties used to specify jacketing compounds used in preinsulated and traced products along with typical values. Note that the values of these properties vary based on the actual compound used.

Property	PVC	Polyether Urethane
Room Temperature Tensile	1500 – 2500 PSI	3000 – 4500 PSI
Ultimate Elongation	250%	550%
Hardness	87 – 93 Shore A	75 – 85 Shore A
Low Temperature Brittleness	-20 to -40 °C	-40 to -50°C
High Temperature Rating	105°C per ICEA/UL	80°C per manufacture ¹
Air Aging – 168 hrs @ 138°C	70-85% retained tensile	unable to perform this testing on TPU ¹
Oil Aging – 4 hrs at 70°C, ASTM #2 Oil	70-80% retained tensile	unable to perform this testing on TPU ¹
Effect of Moisture	none	some loss of properties ²

¹ The test used to rate wire and cable jacket materials simulates a 40 year life span by aging the materials at a higher temperature for a shorter time span. TPU materials cannot be tested in this manner because the aging temperature is above their vicat softening point. This would be like attempting to age the PVC jacketing material at a temperature above its melting point. A common industry practice is to use the vicat softening temperature of urethanes as their maximum use temperature.

² Testing has shown that 6 month exposure to 80°C water can cause polyether urethane to lose 50% of its

original tensile strength. Actual loss of tensile strength will depend upon the specific urethane compound, temperature of the water, and duration of contact.

Weather Resistance

Material manufacturers report that both PVC and Polyether Urethanes are weather and ozone resistant. Our experience confirms this.

The major effect of exposure on FRPVC jackets is embrittlement. Excessive exposure could cause the jackets to become so brittle that they crack during normal use.

Dekoron/Unitherm has bundles in service in refineries and chemical plants worldwide with FRPVC jackets that have been exposed to the elements for more than 20 years. There have been no reported jacket failures on these bundles.

For TPU, exposure to weather and UV results in two changes that effect our products, discoloration and loss of tensile strength. Discoloration is generally not a problem for industrial users, and since most TPU jacketed bundles are black, it is not normally apparent. The initial tensile strength of TPU is high enough that even moderate loss is not detrimental to our application. We have dockside hoses with Polyether Urethane jackets that have been in service for over 10 years, still withstanding the rigors of use.

Chemical Compatability

The chemical compatability list below is compiled from material vendors and other sources.

This is general information and does not constitute a warranty.

Dekoron/Unitherm strongly recommends that the customer test jacket compounds against specific agents if there is a concern.

Material	PVC	Polyether Urethane
Acetone	5	5
Acids	1-2	1-3
Calcium Hydroxide	1	2
Caustic Soda	1	3
Chlorine/Water 2%	2	3
Diesel Fuel	3	1
Engine Oil	1	1
Ethyl Alcohol	1	3
Ethylene Glycol	1	2
Gasoline	2	4
Hydrogen Sulfide (wet)	2	5
Methanol	1	3
Methyl Ethyl Ketone	5	3
Sodium Hydroxide/Water 35%	1	4
Sour Crude Oil	3	1

Key: 1 = Excellent 2 = Good 3 = Fair 4 = Poor 5 = Not Recommended

Flame Retardancy

All PVC compounds are flame-retardant to a degree. Various compounds can be formulated for increased flame retardance, low smoke, and low flame spread to meet the needs of different applications.

The PVC compounds used by Dekoron/Unitherm are rated V-0 per the UL 94 Vertical Flame Test rating system, and have passed the IEEE 383 Cable Tray Burn Test developed for wire and cable used in nuclear power plants.

Polyether Urethanes can be compounded for moderate to good flame retardance. Unlike PVC, these compounds can be flame retardant and halogen-free.

The halogen-free polyether urethane used by Dekoron/Unitherm is rated V-2 per the UL 94 Vertical Flame Test rating system.

Installation

TPU jacketing compounds are tough and rubbery. Bundles jacketed with this material are easy to bend into tight areas, even in cold climates.

The rubbery nature of this material makes bundles more difficult to pull into position than those jacketed with PVC. The TPU jacket will tend to snag, while the PVC jacket will slide.

The TPU jacket will also tend to wrinkle at the inside of a bend, while the PVC jacket does not. This wrinkling is an appearance factor only and not detrimental to the operation of the bundle.

Each material has properties that make it a better choice for certain applications. The customer should review the data and see which properties are more important in his installation. Further information on these and other jacketing materials can be found on the Dekoron/Unitherm Web Site, or contact your Dekoron/Unitherm representative.