RAILduct™ Cable Protection

Material & Product Properties

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BRIEF

The purpose of this document is to provide product characteristics and key material properties for the black High Density Polyethylene (HDPE) RAILduct™ product range.

CONTENTS

1. GENERAL

General properties of the material used to manufacture RAILduct™.

- HDPE
- UV Stabilised (2% Carbon Black)
- Classed as Non-Hazardous to the Environment
- Commodity Polymer (Recycling Symbol: 2)
- Parts produced from up to 100% recycled HDPE

2. MECHANICAL PROPERTIES

Key mechanical properties of the material used to manufacture RAILduct™, from both in house tests and generically known values.

Characteristic	Test Method	Value
Tensile Strength	ISO 527	22 - 26 MPa
Flexural Modulus	ISO 178	800 to 1100 N/mm^2
Notched Izod Impact Strength	ISO 180 - 1A	4 to 6 KJ/m^3

3. THERMAL PROPERTIES

Relevant thermal properties of the material used to manufacture RAILduct™, from both independent third party tests and generically known values.

Characteristic	Test Method	Value
Thermal Conductivity (K-Factor)*	ASTM E1530-11 at 23oC	0.34 $W{\cdot}m^{-1}{\cdot}K^{-1}$
Thermal Resistance (R-Value)*	ASTM E1530-11 at 23oC	0.0091 $m^2{\cdot}K{\cdot}W^{-1}$
Thermal Conductivity (K-Factor)*	ASTM E1530-11 at 60oC	0.33 $W{\cdot}m^{-1}{\cdot}K^{-1}$
Thermal Resistance (R-Value)*	ASTM E1530-11 at 60oC	0.0096 $m^2{\cdot}K{\cdot}W^{-1}$
Melt Temperature (DSC)	ASTM D3418	+120 to +131 °C
Glass Transition Temperature (DSC)	ASTM D3418	-120 to -110 °C
Service Temperature		-40 to +80 °C
Vicat Softening Temperature	ASTM D1525	+112 to +121 °C
*Test Performed: Resistance To Thermal Transmission Of Materials By The Guarded Heat Flow Meter Technique		

4. ELECTRICAL PROPERTIES

Relevant electrical properties of the material used to manufacture RAILduct™, conducted by an independent third party. HDPE is a Non-Polar Polymer.

Characteristic	Test Method	Value
Dielectric Strength	ASTM D149-09 (2013) Method A, Short-Time Test	> 462 V/mil
Dielectric Breakdown Voltage	ASTM D149-09 (2013) Method A, Short-Time Test	83.2 kV
Note: ">" indicates no burn through - the electricity arced around the edge of the specimen near the voltage limit of the instrument. Test Performed: Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies		
Dielectric Constant	ASTM D150-11 at 1 MHz	2.27 K
Dielectric Constant	ASTM D150-11 at 1 KHz	2.27 K
Test Performed: A-C Loss Characteristics and Permittivity (Dielectric Constant) using a Guarded Parallel Plate Electrode Type		
Surface Resistivity	ASTM D257-14	> 5.24E+15 ohm/square
Volume Resistivity	ASTM D257-14	> 2.276.39E+15 ohm/cm
Note: ">" Means sample exceeded the measuring capabilities of the Megohmmeter. Test Performed: D-C Resistance Of Insulating Materials using a Guarded Parallel Plate Electrode Type		

5. FIRE BEHAVIOUR

Fire behavioural properties of the standard material used to manufacture RAILduct™, from both in house tests and independent third party test houses.

Characteristic	Test Method	Value
Standard Product Supplied Solid 190x90mm Test Specimens (Unfoamed Samples)	DIN 53438-2	K2
Standard Product Supplied Full Product Test Piece (Part of similar wall thickness tested: Foamed Samples)	UL 94	HB

6. UV STABILITY

Independent UV stability test conducted by third party, on material used to manufacture RAILduct™.

A foamed HDPE product (of the same material composition at the time and a similar wall thickness) was exposed to accelerated UV Exposure as per ASTM D756 Procedure A; the test consisted of a repetitive cycle of 4 hours of UV light (UVB-313 lamp) at 60°C followed by 4 hours condensation (UV light off) at 50°C for a total of 1000 hours. Weight and Shape Changes of the part was determined and the flexural strength was determined before and after exposure as per ASTM D790. This test was performed by Calcoast Analytical Materials Chemistry Lab. Note: the material formulation has since been revised to enhance the UV performance of the RAILduct™ product.

Specimen	Average Weight Change (%)	Average Dimensional Changes (%)		
		Length	Width	Thickness
Specimens exposed to 1000 hours of Accelerated UV Exposure	-0.04	<0.05	No Change	No Change

Specimen	Average Flexural Strength (PSI)	Average Change in Flexural Strength (%)
Unexposed Specimen	1472	
Exposed Specimen	1561	6.1

7. CHEMICAL RESISTANCE

Independent chemical resistance test conducted by third party, on material used to manufacture RAILduct™.

Three samples of foamed HDPE product (of the same material composition and a similar wall thickness) were exposed to each of the listed chemicals for 168 hours. Weight and shape changes were determined before and after exposure to the chemical reagents as per ASTM D756. This test was performed by Calcoast Analytical Materials Chemistry Lab.

Chemical Reagent	Average Weight Change (%)	Average Dimensional Changes (%)		
		Length	Width	Thickness
Acetic Acid (5%)	0.09	< 0.005	-0.61	No Change
Hydrochloric Acid (0.1N)	0.02	0.17	-1.78	No Change
Sulphuric Acid (0.1N)	0.01	-0.09	-0.35	No Change
Sodium Carbonate (0.1N)	0.06	<0.05	-0.35	-0.12
Calcium Carbonate (0.1N)	0.01	<0.05	-0.35	No Change
Sodium Chloride (5%)	0.02	-0.08	0.42	No Change
Sodium Sulphate (0.1N)	0.04	-0.06	-0.74	No Change
Sodium Hydroxide (0.1N)	0.03	< 0.05	-0.49	-0.28
Transformer Oil (Mineral Oil)	0.56	< 0.05	0.6	0.24

Specimen	Average Flexural Strength (PSI)	Average Change in Flexural Strength (%)
Unexposed Specimen	1472	
Acetic Acid (5%)	1411	4.2
Hydrochloric Acid (0.1N)	1457	1
Sulphuric Acid (0.1N)	1408	4.4
Sodium Carbonate (0.1N)	1459	0.8
Calcium Carbonate (0.1N)	1368	7.1
Sodium Chloride (5%)	1375	6.6
Sodium Sulphate (0.1N)	1353	8.1
Sodium Hydroxide (0.1N)	1433	2.4
Transformer Oil (Mineral Oil)	1452	2.3

8. OTHER PROPERTIES

Generic properties well known regarding HDPE.

Characteristic	Test Method	Value
Water Absorption Non-Polar Polymer	N/A	<0.01%