FORMEROL® F.10/SUGRU® TECHNICAL DATA SHEET

Sugru® is a product of FORMEROL® *technology*

DESCRIPTION

- Room temperature curing hand mouldable glue
- Soft and flexible when cured
- Adheres to most materials
- Resistant to high and low temperatures
- Waterproof
- Thermal and electrical insulator

APPLICATIONS

- Fixing, adapting and creating. Great for DIY, Arts, Crafts and Prototyping
- Can be smoothed and textured
- Indoor or outdoor projects
- Creates flexible joints
- Vibration and shock protection

PROPERTIES

FORMEROL® F.10 Technology Properties	Description
Material	RTV One-Part Moisture Curing Silicone Elastomer
Service Temperature Range	-50°C (-58°F) to 180°C (356°F)
Colour	Supplied in a range of colours. When uncured the colours can be mixed just like paint to make any colour. The colour is permanent when cured
Appearance	Supplied as uncured non-slumping putty in moisture proof packaging ready to be processed by extrusion, compression moulding or manual shaping at room temperature. Virtually zero shrinkage when cured
Work Time	Up to 30 minutes, at room temperature
Cure Time	Approximately 24 hour cure for the first 3 mm of depth at room temperature. eg. 3 mm cures ~ 24 hours, 5.5 mm cures ~ 48 hours, 8 mm cures ~ 72 hours. (Cure time is influenced by; area which is exposed to atmosphere, temperature and humidity)
Shelf Life	13 month shelf life from the date of manufacture when stored at 21°C (70°F) in original unopened packaging

Cured Material	Resistance	Description
Ozone/ UV-Resistance	Excellent	Slight fading after years in direct sunlight
Oxidation Resistance	Excellent	Resists chemical surface degradation caused by air
Moisture Resistance	Good	Waterproof (not impermeable)
Flame Resistance	Good	Does not readily combust when exposed to direct flame

MECHANICAL & PHYSICAL PROPERTIES

Properties	Industrial Standard	Typical Value for FORMEROL® F.10	Test Unit Metric [Imperial]	Comparative Values Metric
Shore Hardness (cured)	BS EN ISO 868	70	Shore A	Pencil Eraser ~ 40 Shoe Heel ~ 80
Density	-	1380 {86.15]	kg/m^3 [lb/ft^3]	Water ~ 1000 Sand ~ 1602
Williams Plasticity Number (Uncured)	ASTM D926	155-180	mm x 100	Playdough ~ 111 Modelling Clay ~ 351
Ultimate Tensile Strength	ASTM D638	1.6-2.2 [232-319]	MPa [psi]	Expanded Polystyrene (EPS) ~ 0.08 - 0.9 Polypropylene (PP) ~ 28 - 36
Strain at Failure	ASTM D638	100 - 155	%	Acrylic ~ 1.9 - 90 Butyl Rubber ~ 400 - 800
Young's Modulus	ASTM D638	3.6-5.5 [522-798]	MPa [psi]	Polyurethane (PU) Thermal Insulating Foam ~ 1-2 Bath Sealant ~ 1 - 200
Abrasion Resistance	ISO4649 Method A	24	ARI index %	FORMEROL® F.10 was tested against the standard reference compound (durable rubber) which has an ARI index of 100%
Thermal Conductivity	ASTM D5930	0.189 [1.31]	W/ mK BTU in / [hr ft^2 F]	Neoprene Rubber ~ 0.08 Chalk ~ 1.72
Electrical Resistivity - Surface*	BS903	1.40 x 10^{14}	Ohms	Polypropylene (PP) ~ 4.43x10^{13} Acrylonitrile Butadiene Styrene (ABS) ~ 9.09x10^{15}
Electrical Resistivity - Volume*	BS ISO 14 903	2.55 x 10^{14}	Ohms-cm	Copper ~ 1.7x10^{-6} Acrylonitrile Butadiene Styrene (ABS) ~ 1.27x10^{16}
Dielectric Strength	ASTM D149	15.67 [398]	kV/mm [V/mil]	Glass ~ 9.8 – 13.8 Butyl Rubber ~ 24

* Be careful with electricity – limit to consumer electronics rated below 24 Volts.

ADHESION

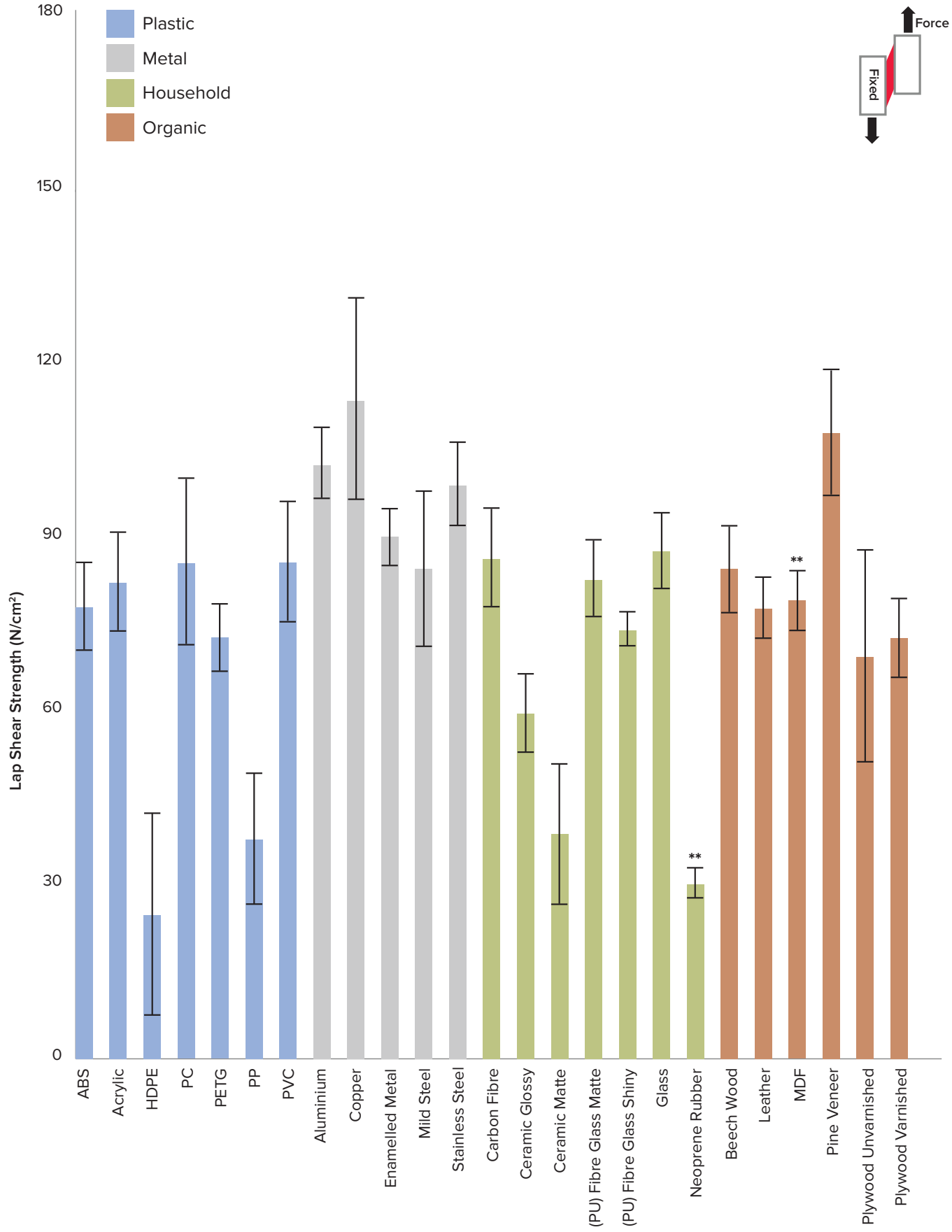
- The adhesion of FORMEROL® F.10 has been tested on a range of materials listed on the following pages
- The following results were collected by testing the adhesive properties: Cleavage strength (ASTM D1062), tensile strength (ASTM D2095) and lap shear strength (ASTM D1200)
- All adhesion test samples were made to a thickness of 2mm
- The surface of the materials were initially abraded (where relevant for the material) with sand paper and then degreased with an appropriate agent, following typical methodology employed for adhesives
- Tests were performed after 7 days of curing under lab conditions
- Please note, ‘real world’ performance may be reduced due to non-lab conditions

Adhesive Strength - Lap Shear (ASTM D1002)

	Material	Examples	Results (N/cm²)	Imperial (psi)
Plastic	Acrylonitrile Butadiene Styrene (ABS)	LEGO®	78	113
	Acrylic	Glass Substitute	82	119
	High-Density Polyethylene (HDPE)	Bottle Caps	25	36
	Polycarbonate (PC)	Goggles	86	124
	Polyethylene Terephthalate-Glycol (PETG)	Signs and Glazing	73	106
	Polypropylene (PP)	Plastic Chairs	38	55
	Polyvinylchloride (PVC)	Cables	86	124
Metal	Aluminium	Window Frames	103	149
	Copper	Wires and Pipes	114	165
	Enamelled Metal	Fridge Doors	90	131
	Mild Steel	Key Rings	85	123
	Stainless Steel	Cutlery	99	144
Household	Carbon Fibre	Bicycle Frames	86	125
	Ceramic Glossy Finish	Tiles and Crockery	60	86
	Ceramic Matte Finish		39	56
	(Polyurethane) Fibre Glass Matte Finish	Bathtubs and Shower Trays	83	120
	(Polyurethane) Fibre Glass Shiny Finish		74	107
	Glass	Windows and Table Tops	88	127
	Neoprene Rubber **	Laptop Sleeves and Mouse Pads	30	44
Organic	Beech Wood	Tables and Chairs	85	123
	Leather	Bags and Shoes	78	113
	Medium-Density Fibreboard (MDF) **	Storage Units	79	115
	Pine Veneer	Furniture Tops	108	157
	Plywood Unvarnished	Floors, Walls and Fences	69	101
	Plywood Varnished		73	105

** Tested material failed before FORMEROL® F.10

Adhesive Strength - Lap Shear (ASTM D1002)



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Adhesive Strength - Tensile (ASTM D2095)

	Material	Examples	Results (N/cm²)	Imperial (psi)
Plastic	Acrylonitrile Butadiene Styrene (ABS)	LEGO®	64	92
	Acrylic	Glass Substitute	50	72
	High-Density Polyethylene (HDPE)	Bottle Caps	10	15
	Polycarbonate (PC)	Goggles	86	124
	Polyethylene Terephthalate-Glycol (PETG)	Signs and Glazing	46	66
	Polypropylene (PP)	Plastic Chairs	16	23
	Polyvinylchloride (PVC)	Cables	90	131
Metal	Aluminium	Window Frames	108	157
	Copper	Wires and Pipes	103	149
	Enamelled Metal	Fridge Doors	108	157
	Mild Steel	Key Rings	107	155
	Stainless Steel	Cutlery	110	159
Household	Carbon Fibre	Bicycle Frames	84	122
	Ceramic Glossy Finish	Tiles and Crockery	99	143
	Ceramic Matte Finish		101	146
	(Polyurethane) Fibre Glass Matte Finish	Bathtubs and Shower Trays	65	95
	(Polyurethane) Fibre Glass Shiny Finish		70	102
	Glass	Windows and Table Tops	108	157
	Neoprene Rubber **	Laptop Sleeves and Mouse Pads	39	56
Organic	Beech Wood	Tables and Chairs	89	129
	Leather	Bags and Shoes	105	152
	Medium-Density Fibreboard (MDF) **	Storage Units	18	25
	Pine Veneer	Furniture Tops	112	163
	Plywood Unvarnished	Floors, Walls and Fences	59	86
	Plywood Varnished		50	73

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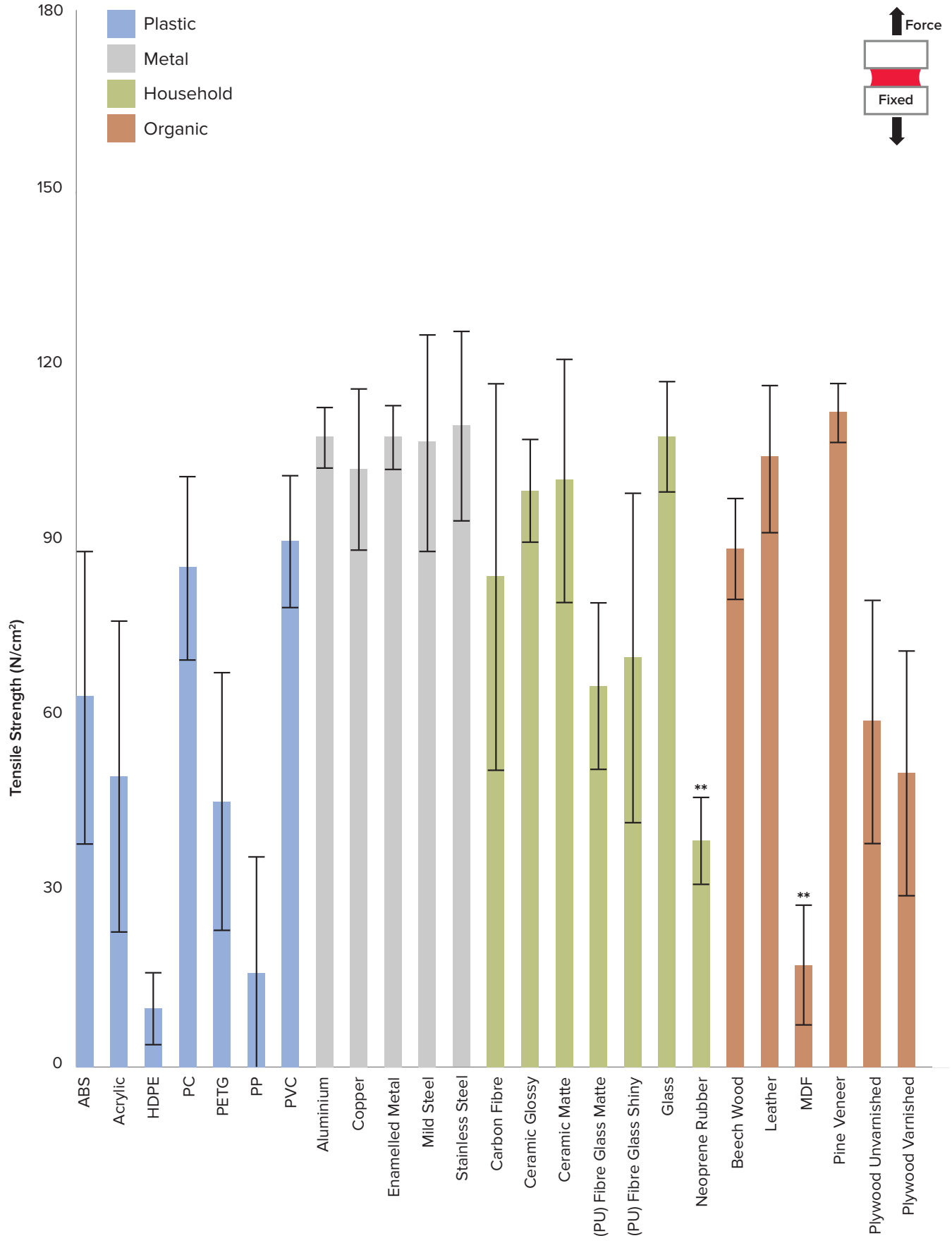

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Adhesive Strength - Cleavage (ASTM D1062)

	Material	Examples	Results (N/cm²)	Imperial (psi)
Plastic	Acrylonitrile Butadiene Styrene (ABS)	LEGO®	33	48
	Acrylic	Glass Substitute	31	44
	High-Density Polyethylene (HDPE)	Bottle Caps	10	14
	Polycarbonate (PC)	Goggles	42	60
	Polyethylene Terephthalate-Glycol (PETG)	Signs and Glazing	38	55
	Polypropylene (PP)	Plastic Chairs	12	17
	Polyvinylchloride (PVC)	Cables	36	52
Metal	Aluminium	Window Frames	48	70
	Copper	Wires and Pipes	47	68
	Enamelled Metal	Fridge Doors	44	63
	Mild Steel	Key Rings	43	62
	Stainless Steel	Cutlery	46	67
Household	Carbon Fibre	Bicycle Frames	46	67
	Ceramic Glossy Finish	Tiles and Crockery	44	63
	Ceramic Matte Finish		44	64
	(Polyurethane) Fibre Glass Matte Finish	Bathtubs and Shower Trays	38	65
	(Polyurethane) Fibre Glass Shiny Finish		43	56
	Glass	Windows and Table Tops	45	63
	Neoprene Rubber **	Laptop Sleeves and Mouse Pads	11	16
Organic	Beech Wood	Tables and Chairs	44	645
	Leather	Bags and Shoes	28	40
	Medium-Density Fibreboard (MDF) **	Storage Units	20	30
	Pine Veneer	Furniture Tops	45	65
	Plywood Unvarnished	Floors, Walls and Fences	42	61
	Plywood Varnished		37	54

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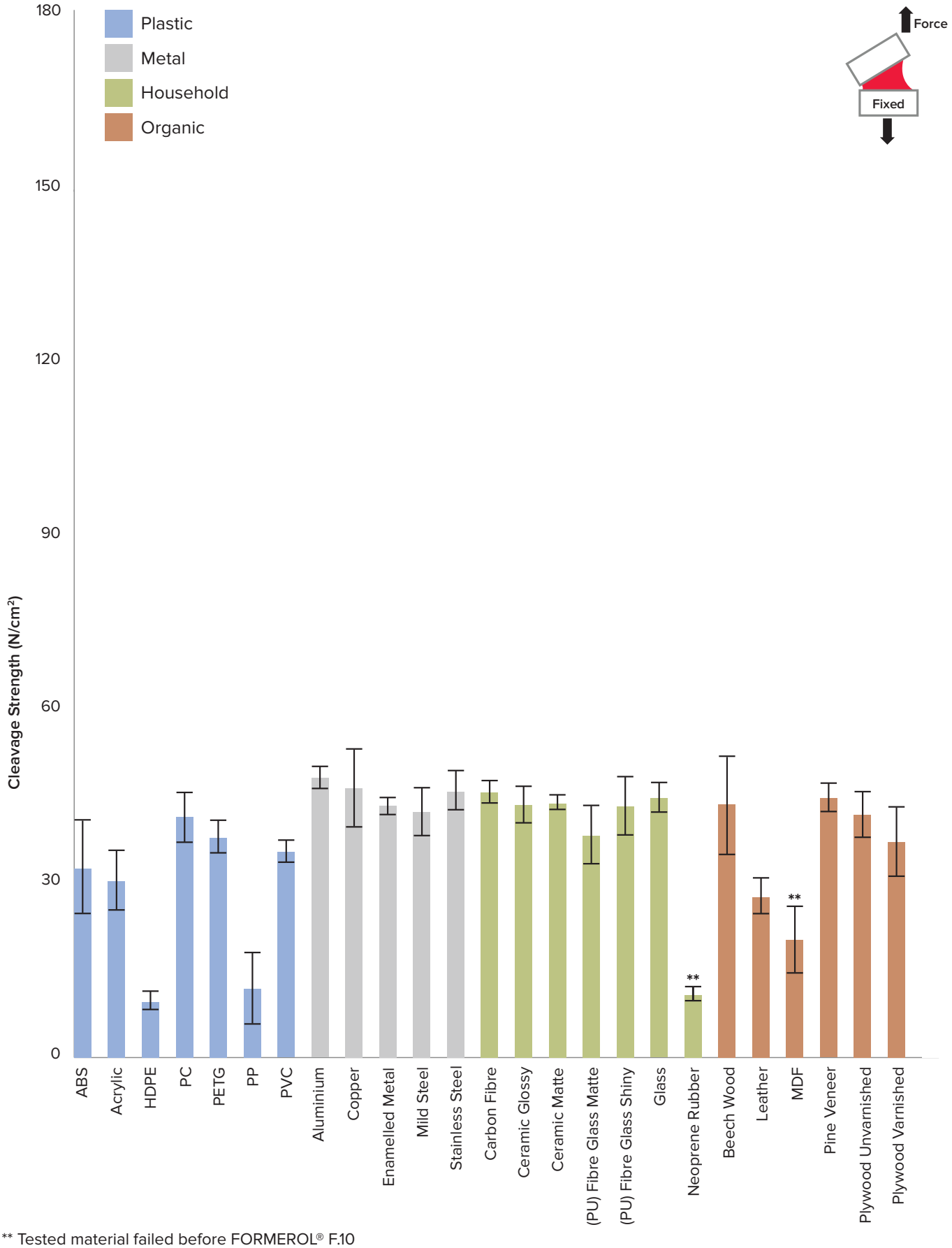
Adhesive Strength - Cleavage (ASTM D1062)



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FAQs

Does FORMEROL® F.10 degrade over time?

FORMEROL® F.10 does not degrade over time under typical ambient conditions.

Can I extend the 30 minutes working time?

FORMEROL® F.10 cures in the presence of moisture and heat. The working time can be extended by working in a colder environment.

Can I speed up the curing process?

If you place FORMEROL® F.10 in a warm place it will begin to cure a little faster. However, some properties e.g. adhesion may be adversely affected.

Is FORMEROL® F.10 mould resistant?

Currently FORMEROL® F.10 does not contain any anti-mould agents, but should not attract mould if kept clean and dry.

Is FORMEROL® F.10 food safe (FDA approved)?

Currently FORMEROL® F.10 is not food safe and should not be applied in areas that will have direct contact with food or drinking water.

Is FORMEROL® F.10 skin safe?

FORMEROL® F.10 contains a small fraction of sensitising ingredients and so can cause an allergic reaction for those with sensitive skin or after constant prolonged contact. Therefore, it is not recommended for uses such as in dental applications, in prosthetics, headphones or spectacles where the FORMEROL® F.10 will be in constant contact with the skin. Find more info on the SDS.

Is FORMEROL® F.10 latex free?

FORMEROL® F.10 does not contain latex. However we cannot guarantee that at some point in the manufacturing process it has not been handled by an operator wearing latex gloves.

Can I use FORMEROL® F.10 past its 'use by' date if it is still soft?

You can still use FORMEROL® F.10 past its use by date but be aware that some properties e.g. strength and cure rate may be affected.

What happens to FORMEROL® F.10 when it is exposed to temperatures higher than 180°C?

It is not recommended to use FORMEROL® F.10 at sustained temperatures higher than 180°C as it will begin to degrade.

Does FORMEROL® F.10 take longer to cure at lower temperatures?

FORMEROL® F.10 cures 3mm deep every 24 hours at 21°C and may take considerably longer to cure at temperatures that are below this point.

Can FORMEROL® F.10 be removed once cured?

FORMEROL® F.10 can be removed from non-porous surfaces by cuttng off the bulk of the material with a sharp blade. Scrape off the residue with a non-abrasive tool.

Will FORMEROL® F.10 stain surfaces once cured?

FORMEROL® F.10 may leave some pigment residue when handling in its uncured state but under normal circumstances once FORMEROL® F.10 is cured it will not stain any surfaces. Cured FORMEROL® F.10 is similar to shoe rubber in so much as the pigment is 'set', but can rub off on a light surface if scuffed.

Does it help to roughen the surface of a material when applying FORMEROL® F.10?

When using any adhesive roughening or 'keying' the surface always helps adhesion and makes a stronger bond. Be aware that this will permanently scratch the surface of your material.

How thin/thick should the layer of FORMEROL® F.10 I apply be?

This will depend on your application. The thinner the layer of FORMEROL® F.10, the faster the cure will be. If you require a strong adhesive bond it is recommended that you do not use a layer that is too thick but rather covers more surface area. The thicker the FORMEROL® F.10, the less flexible it will be and the longer it will take to cure. Anything thicker than 3mm will take longer than 24 hours to fully cure.

Can FORMEROL® F.10 be used on a painted surface?

FORMEROL® F.10 can stick to a painted surface. However the strength will be limited to how strongly the paint is adhered to the surface.

Is FORMEROL® F.10 affected by solvents?

FORMEROL® F.10 is a silicone and may swell in some solvents and oils as well as some strong acids and bases. The swelling may affect FORMEROL® F.10 properties such as strength and adhesion.

What is the best way to dispose of FORMEROL® F.10?

As FORMEROL® F.10 is not biodegradable it is recommended to dispose of it in general waste. Find more info on the SDS.

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GLOSSARY

Adhesive Strength

The maximum force per cross-sectional area of a material required to cause failure of the adhesive joint.

Cleavage mode: when the force is applied to one side of the joint forcing it to be cleaved apart.

Lap shear mode: when the force is applied parallel to the joint causing it to shear apart.

Tensile mode: when the force is applied perpendicular to the joint causing it to be pulled apart.

Dielectric Strength
The voltage at which electricity breaks through a set thickness of a material.

Elastomer
A polymer exhibiting viscoelastic properties.

Extrusion
A processing technique whereby bulk material is pressed through a die to convert into a shaped profile.

Non slumping
A material's ability to hold its shape and not flow when uncured.

RTV
Room Temperature Vulcanising – Curing takes place at room temperature. Vulcanisation occurs when a material forms crosslinks and changes from a liquid or putty to a solid.

Shore Hardness
A measure of a material's resistance to surface indentation.

Strain at failure
The maximum a material extends at the point of failure.

Ultimate tensile strength
The maximum force per cross-sectional area of a material prior to the point of failure.

Williams Plasticity
A measure of how much a material will deform under a set load.

Young's Modulus
A measure of the stiffness of a material.

ADDITIONAL INFORMATION

Processing

FORMEROL® F.10 materials are processed at room temperature, in a dry atmosphere; most commonly by compression moulding, extrusion or manual shaping.

Packaging

Typical sealing materials include any polymer film with good moisture barrier properties e.g. PE/ALU/PET laminates.

Expiry Information

The shelf life is 13 months from the date of manufacture when stored at 21°C (70°F) in original unopened packaging. Keeping unopened single-use packs in the fridge will make them last longer.

Please note that FORMEROL® is a standard material and its properties can be varied for specific applications.

FORMEROL® F.10 is a developmental product. Typical properties are illustrative of the current product formulation but may change. This information is offered in good faith. All data is produced in good faith, but not exhaustive and does not replace the user's good judgment for safe application.

Contact

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For technical inquiries please email: **technical@sugru.com**

Registered Co. no. 5258222

FORMEROL®F.10 technology is protected by the following international patents and applications:

European Patent No. 2089465 B1

Chinese Patent No. ZL200780050641.6

Macau Patent No. J/001226

US Patent No. US 9,284,454 B2

Indian Patent No. 272415