

Government of India
Ministry of Railways
R.D.S.O.
Manaknagar, Lucknow-11

No. EL/2.2.3.4

Dated 17-2-1993

SPECIAL MAINTENANCE INSTRUCTIONS NO.

EL/RS-SMI/154

1. Title : Characteristic properties of insulating varnishes.
2. Application : Auxiliary meters, Traction Meters and coils of EM Contactors of Electric Locomotives/EMUs
3. Object

3.1 Railways have reported a large number of failure of auxiliary meters, traction meters and coils of electromagnetic contactor due to interturn shorts or earth faults. These failures can be attributed to use of inappropriate impregnating varnishes obtained from trade. To arrest these failures in service special instructions are being issued to follow correct and compatible varnishes for a particular application.

4.0 Drawing/Catalogue No.

4.1 Following catalogue on various types of varnishes are enclosed for necessary guidance and adoption.

S.No.	Catalogue No.	Name of varnishes	Class of insulation and temperature Index.
1.	TSD:DOC-410B-92	Debecken FT-1052	F/155°C
2.	2-16-9204	Elmethern-E71 H+80-	H/180°C
3.	2-51-9204	Siliconil C84	C/213°C
4.	2-28-8912	Siliconil E233(Red)	H/175-180
5.	2-14-9204	Elmethern F-40	F/155
6.	2-15-9204	Elmethern F-50	F/155
7.	TSD:DOC-410C-92	Debecken FT/2005/500EX	
8.	5-36-8806	Epoxy Gel coat (Red & White)	
9.	2-31-8912	Becktel(Red Or grey)	B/130

Note: Application as per RDSO's existing SMIs and as well as meter manufacturer recommendations.

5.0 Maintenance Instructions

5.1 Type of varnish to be used for a particular application shall be as per para 4.0 above. However for a particular

application SMI issued earlier by RDSO or manufacturers instructions may also be followed.

- 5.2 Before use of the varnish, railways shall conduct test to watch the characteristics as per catalogue indicated in para 4.0 above for a particular application. This procedure shall be mandatory.
- 5.3 Railways shall use only those varnishes declared compatible with the present system of insulation already adopted.
- 5.4 After application of this varnish, EDV test on auxiliary motors/stators, armature of Traction Motors and EM coils and meter fields shall be conducted by railways.
- 5.5 All components shall be vacuum pressure impregnated with a particular varnish for a particular application, as per method specified in a particular catalogue.
- 5.6 Procurement of the varnishes shall be made from RDSO's approved suppliers only.
- 6.0 Agency of Insulation.
All electric loco sheds and shops of electrified railways.
- 7.0 Periodicity of Implementation
 - i) When any aux. motors/coils/traction motor is rewound in shed and shop.
 - ii) When any aux. motors/coil/traction motor field coils, armature are procured from the manufacturers.
- 8.0 Distribution

As per enclosed test.

Pradeep Jain
(Pradeep Jain)
for Director General/Elec.



Siliconit Insulating Varnishes

Siliconit C 84

A silicone varnish with excellent flexibility and high heat resistance

Structure, Salient Properties and Application

Siliconit C 84 is a silicone resin based baking varnish. Siliconit C 84 is highly heat resistant and water repellent. Cured film of Siliconit C 84 is highly flexible and flexibility of the cured varnish film is retained even on prolonged ageing at 250°C.

Siliconit C 84 is specially formulated for use as a binder varnish for glass-mica and nomex-mica composites. It can also be used for coating of glass-fibre fabric.

In combination with fillers such as mica, talc etc. Siliconit C 84 can be used as coating varnish for wire wound resistors.

For detailed information on formulation and application, please refer to our Technical information 2-81 Silicone Varnishes for resistor coatings.

Properties of Siliconit C 84

Colour and appearance			Pale yellow, clear liquid
Solids content	1.5g/150°C/2h	%	47-49
Viscosity at 23°C	DIN 53211/ cup no. 4	s	18-28
at 27°C	IS 3944/ cup no. 4	s	28 (typical)
Density at 20°C	DIN 51757	g/ml	1.01 (typical)
Flash point	DIN 53213	°C	32 (typical)
Recommended thinner			Thinner 231
Storage life	In original sealed container at temperature 25°C or below	months	6

Curing Schedule

- General application: 2 h at 250°C (for each coat)

The exact curing schedule in a conveyerised plant or continuous cloth impregnation tower could differ and has to be arrived at after initial trials and properties evaluation.

For example:

- (a) For glass-fibre fabric impregnation in an impregnation tower, curing can be done:

10-15 min at 120°-150°C + 25-30 min. at 250°-300°C
(solvent evaporation zone) (Polymerisation zone)

- (b) Glass-mica composites

1 h at 250°C

- For multicoat resistors coating

Initial coats 2 h at 120°C

Final coat 6-8 h at 200°-220°C

SMI/154/1

Technical data sheet



Typical Properties of the Cured Varnish Film

Specimen curing 2 h at 250°C each coat
Tests according to DIN 46456 unless otherwise specified

Dielectric strength	at 25°C	kV/mm	65
	at 200°C		35
	24 h water immersion at RT		35
Volume resistivity	(1000 VDC)	ohm.cm	
	at 25°C		10 ¹⁶
	at 200°C		10 ¹²
	at 250°C		10 ¹¹
Dielectric loss factor	240 h water immersion at R.T.		10 ¹⁵
	(at 30 V & 1 kHz)		
	at 25°C		0.004
	at 200°C		0.030
Dielectric constant	at 250°C		0.160
	(at 30 V & 1 kHz)		
	at 25°C		4.6
Water absorption	at 200°C	mg	3.4
	at 250°C		3.2
	at 25°C		4
Resistance to chemicals	(7 days, RT immersion)	% retention in dielectric strength	
	25% H ₂ SO ₄		90
Temperature Index	5% NH ₄ OH		80
	IEC 216 (weight loss)		
	°C		213

Packing

Notice

Siliconit C 84 : 1, 4 & 25 kg in polyethylene containers.
Thinner 231 : 0.9, 4 & 20 kg in metal containers.

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TSD

Varnishes & Resins For Railway Traction And Auxiliary Machines -
Manufacturing & Repairs

Application : Anti-Tracking Finishing Resin for Auxiliary
Machines, Smoothing Reactor, etc.

1. Epoxy Gel Coat (Red) + Hardener EH 411 + Thinner 221 : Class 130
Type : Epoxy pigmented finishing Resin.

2. APPLICATIONS

HOW TO USE

- 2.1 Finishing varnish
for Auxiliary
Machine

Apply by spray gun or by brush.

- 2.2 Finishing varnish
for Smoothing
Reactor

Apply by spray gun or by brush.

Curing schedule : Drying - 4 h at room temperature
Curing - 24 h at room temperature

- 3.0 APPLICABLE STANDARDS : IS 10026-3-3 and
IEC 464-3-1

4.0 SPECIAL CHARACTERISTICS OF EPOXY GEL COAT (RED)

- 4.1 Excellent resistance to humidity and chemicals.
4.2 Excellent adhesive properties because of epoxy based
epoxy resin.
4.3 Suitable for overhangs of Class 155 machine.

5. DETAILED PROPERTIES

As per enclosed data sheet 5-36

SME/154/2

TSD:DOC-4101-92



Beck Epoxy Compounds

Epoxy Gel Coat (Red/White)

A room temperature curing thixotropic pigmented epoxy compound

Structure and Salient Properties

Epoxy Gel Coat (Red/White) is a specially formulated compound having thixotropic consistency. It is used in combination with room temperature curing hardeners such as Hardener 758 (Polyamine) or Hardener EH 411 (Polyamide)

Epoxy Gel Coat (Red/White)+Hardener 758 is a fast curing system with hard cured mass.

Epoxy Gel Coat (Red/White)+Hardener EH 411 is a slow curing system with elastic cured mass.

Epoxy Gel Coat (Red/White) with Hardener 758 or EH 411 has the following characteristics

- Good adhesion to most organic and inorganic materials
- Good mechanical and electrical properties
- Excellent chemical and humidity resistance

Application Methods

Epoxy Gel Coat (Red/White) with Hardener 758 or EH 411 can be applied by brush or spray. Thinner 221 addition is necessary to adjust the viscosity for a particular application.

Suggested Coating Formulations

For brush coating application

	Formulation I	Formulation II
Mixing proportion	(Parts by weight)	
Epoxy Gel Coat (White/Red)	100	100
Hardener 758	10	—
Hardener EH 411	—	35
Thinner 221	15 to 20	10 to 15
Viscosity of mixture at RT IS 3944/Cup 4	100 to 120 seconds	
Covering capacity for two coats, approx. 0.3 mm coating thickness	0.5 kg/m ² Actual consumption of Gel Coat mixture will vary depending upon unevenness of substrate	
Formulation characteristics	Low pot life of mixture Fast cure at RT Hard & Brittle cured film Good adhesion Excellent chemical and water resistance	Long pot life of mixture Slower cure at RT Hard & flexible cured film Excellent adhesion Moderate chemical and good water resistance

SMI/54/3



For spray application (*)

	Formulation III	Formulation IV
Mixing proportions	(Parts by weight)	
Epoxy Gel Coat (Red/White)	100	100
Hardener 758	10	—
Hardener EH 411	—	35
Thinner 221	35 to 45	30 to 40
Viscosity of mixture at RT IS 3944/cup 4	60-80 seconds	
Covering capacity for two coats, coating thickness approx. 0.15 to 0.2 mm	0.25 kg/m ² Actual consumption may vary depending upon unevenness of substrate.	
Formulation characteristic	Low pot life of mixture Fast cure at RT Hard and brittle film Good adhesion Excellent chemical and water resistance	Long pot life Slower cure at RT Hard & flexible cured film Excellent adhesion Moderate chemical and water resistance

(*) Use dry compressed air with pressure 3-4 kg./cm² and normal paint spray gun.

Curing

Epoxy Gel Coat (Red/White)/ Hardener EH 411

at 20°C — 48 hours
or at 30°C — 20-24 hours
or at 40°C — 10-20 hours

Postcuring 4h/80-100°C suggested in all cases

Epoxy Gel Coat (Red/White)/ Hardener 758

at 20°C — 24 hours
or at 30°C — 16 to 20 hours
or at 40°C — 10 to 12 hours

Postcuring 4h/80-100°C suggested in all cases

Physiological Characteristics

Epoxy Gel Coat (Red/White) has hardly any effect on the skin and mucous membrane. Hardeners do affect the skin. Direct contact with hardeners and resin + hardener mixture should be avoided by using rubber gloves and goggles. Affected area of the skin should be scrubbed with 5% acetic acid and washed with plenty of water and soap. For detailed instructions, ask for our technical information 5-03 'Safe Processing with Dobeckot Epoxy Resins and Hardeners'.



Packing

Epoxy Gel Coat (Red/White) : 1, 5 and 25 kg in metal containers
Hardener 758 : 50 g, 250 g, 1 kg, 5 kg and 25 kg in polyethylene containers
Hardener EH 411 : 250 g, 1 kg and 5 kg in polyethylene containers and 25 kg in metal containers
Thinner 221 : 0.9, 4 & 20 kg in metal containers.

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I-154/4/2



**Properties
of Cured
Compound**

Specimen curing : 24 hours at RT+4 hours at 80°C with Hardener 758 : 48 hours at RT+4 hours at 80°C with Hardener EH 411.				
			Epoxy Gel Coat (Red/ white)+ Hardener 758	Epoxy Gel Coat (Red/ white)+ Hardener EH 411
Electrical Properties				
Track resistance	DIN 53480	KA KB	3C >600	3C >600
Dielectric strength at RT	DIN 53481 (3mm thick specimen)	kV/mm	17	17
Volume resistivity at RT	DIN 53482	ohm. cm	10 ¹⁵	10 ¹⁴
Chemical Properties				
Water absorption	DIN 53473	mg	17	26
Effect of Chemicals 25% H ₂ SO ₄	DIN 53476	% change in weight	+0.50 (Not affected)	-0.17 (Not affected)
25% HCl			+0.40 (Not affected)	+0.35 (Not affected)
25% NaOH			+0.15 (Not affected)	+0.35 (Not affected)

**Field of
Application**

Epoxy Gel Coat (Red/White) with Hardener 758 or EH 411 is suitable as

- Finishing coat on varnish impregnated coils, transformers, stators, armatures, bus bars and other components of electrical machines for improved resistance to track, moisture and chemicals.
- Coating of metallic and concrete structural parts for preventing corrosion in fertilizer, sugar and other chemical manufacturing plants
- Coating of concrete slabs and water storage tanks for preventing water leakages (water-proofing)
- Coating of electronic components such as capacitors, thermistors for moisture resistance and retention of electrical characteristics in service

SME/154/4

Varnishes & Resins For Railway Traction And Auxiliary Machines
Manufacturing & Repairs

Application : Impregnation of Stator, Rotor & Coils

1. Elmotherm F 50 Class : 155

Type : Isophthalic Alkyd Varnish

2. APPLICATIONS HOW-TO USE

2.1 Impregnation of Auxiliary Machines Impregnation by VPI or by dip.

2.2 Impregnation of Smoothing Reactor Impregnation by VPI or by dip.
Curing schedule : 12 h/120 degree C

3.0 APPLICABLE STANDARDS : IS 10026-3-6 and
: IEC 464-3-2

4.0 SPECIAL CHARACTERISTICS OF ELMOTHERM F 50

4.1 Low temperature curing Class 155 impregnating varnish.

4.2 Retention of electrical properties at high temperature and under humid conditions.

4.3 Suggested for large machine requiring increased inbuilt flexibility.

5. DETAILED PROPERTIES

As per enclosed data sheet 2-15

TSD:DOC-410D-92

SMI/154/5



Elmotherm Impregnating Varnishes

Elmotherm F 50

An isophthalic alkyd resin based baking impregnating varnish with high heat resistance

Structure, Salient Properties and Applications

Elmotherm F 50 is an isophthalic alkyd resin based, baking, impregnating varnish of Temperature Index 155 (Type TL 155 H-LM-AM) according to DIN 46456.

It is characterised by high heat stability, coupled with very good elastic properties at operating temperatures. In addition, the cured varnish film possesses favourable dielectric properties even at elevated temperature, excellent resistance to humidity, mild acids and alkalis; remarkable bond strength and adhesion.

Elmotherm F 50 is suitable for use as an impregnating varnish for all types of electrical equipment, e.g. large machines requiring increased flexibility. The varnish can be applied by the customary methods of impregnation such as dipping, vacuum, etc.

Properties of Elmotherm F 50

Colour & appearance	Ruby red clear liquid		
Solids content	1.5 g/170°C/2h	%	47-49
Viscosity at 23°C	DIN 53211/ cup no. 4	s	50-70
27°C	IS 3944/ cup no. 4	s	70 (typical)
Density at 25°C	DIN 51757	g/ml	0.969 (typical)
Flash point	DIN 53213	°C	29 (typical)
Recommended Thinner	Thinner 205		
Storage life	When stored in original sealed container at RT	months	12

Suggested Curing Schedule

For stationary windings
12h at 120°C
or 2h at 120°C + 4h at 160°C

For rotating windings
2h at 120°C + 8h at 140°C
or 2h at 120°C + 6h at 160°C

Properties of Varnish (DIN 46456)

Drying in thin layer	2h at 120°C	Inside Underneath Top	Satisfactory Hard, tough Non-tacky Smooth No change
Curing in thick layer	12h at 120°C		
Resoftening	at 165°C	min	100
Gelling time	at 120°C		

SM1/154/6



Typical Properties of Cured Varnish Film

Specimen curing—12 h at 120°C Tests as per DIN 46456			
Dielectric strength	at 25°C	kV/mm	65
	at 155°C	kV/mm	55
	24 h water immersion at RT	kV/mm	30
Volume resistivity (1000 VDC)	at 25°C	ohm.cm	10 ¹⁶
	at 155°C	ohm.cm	10 ¹⁰
	240 h water immersion at RT	ohm.cm	10 ¹⁴
Dielectric constant 30V/1kHz	at 25°C		3.5
	at 155°C		3.3
Dielectric loss factor 30V/1kHz	at 25°C		0.015
	at 155°C		0.030
Bond strength co-efficient	at 25°C		2.5
	at 155°C		3
Water absorption		mg	5
Temperature Index	IEC 216 (weight loss)	°C	55-153

Packing

Elmotherm F 50: 1 & 4 kg in tin containers.
21 & 185 kg in m.s. containers
Thinner 205: 0.9, 4, 20 & 160 kg in m.s. containers.

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Application : Impregnation of Stator, Coils & Armatures

- SMI/154/T



Elmotherm® Impregnating Varnishes

Elmotherm F 40

A baking impregnating varnish with high heat resistance

Structure & Salient Properties

Elmotherm F 40 is an impregnating varnish suitable for continuous operation at 155°C and has been specially developed for use with wire enamels Terebec F, FH, or glass fibre covered wires.

Elmotherm F 40 is characterised by outstanding mechanical behaviour, good dielectric properties under conditions of humidity and excellent bonding properties.

The system Terebec/Elmotherm F 40 represents such a well balanced system that by far it surpasses the conditions specified by Class 155 requirement.

Elmotherm F 40 is suggested for impregnation of railway auxiliary machines, low and high voltage motors, transformers, etc.

Elmotherm F 40 can be used by all customary methods of impregnation such as dip, vacuum pressure impregnation, etc.

Properties of Elmotherm F 40

Colour and appearance			Pale yellow, clear to slight hazy liquid
Solids content	1.5g/170°C/2h	%	40-42
Viscosity at 23°C	DIN 53211/ Cup No. 4	s	110-140
Viscosity at 27°C	IS 3944/ Cup No. 4	s	140 (Typical)
Density at 25°C	DIN 51757	g/ml	1.012 (Typical)
Flash point	DIN 53213 (Closed cup)	°C	30 (Typical)
Recommended Thinner			Thinner 224
Storage stability	When stored in original sealed container at R.T.	months	6

Suggested Curing Schedule

Stationary Windings	Rotating Windings
4-6 h/100°C	4-6 h/100°C
+	+
12-16 h/160°C	15 h/160°C

Drying Properties of Elmotherm F 40

Tests according to DIN 46456			
Drying in thin layer	4 h at 150°C		Tackfree film with uniform flow
Curing in thick layer	4 h at 100°C + 12 h at 160°C	Inside Top Bottom	Hard Smooth Tackfree
Resoftening	165°C/1 h		No change in shape

SMI/154/8

Technical data sheet



**Properties of
Cured Varnish
Film**

Tests according to DIN 46456
Specimen curing 4 h at 100°C + 16 h at 160°C

Dielectric strength	at 25°C	kV/mm	85
	at 155°C	kV/mm	44
	After 24 h immersion in water	kV/mm	40
Volume resistivity	1000 V DC at 25°C	ohm.cm	10 ¹⁶
	After 24 h immersion in water	ohm.cm	10 ¹⁴
	30 V/1 kHz at 25°C		0.0026
Dielectric loss factor	at 130°C		0.0340
	at 155°C		0.082
Bond strength co-efficient	at 25°C		12
	at 155°C		3.2
Water absorption	96 h immersion mg at R.T.		14
Temperature Index	30% weight loss criteria °C		155-160

Packings

Elmothrm F 40 : 1, 4, 21 and 185 kg in metal containers
Thinner 224 : 0.9, 4, 20 and 160 kg in metal containers

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Ver

App

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TSD:1

Varnishes & Resins For Railway Traction And Auxiliary Machines -
Manufacturing & Repairs

Application : Impregnation of Traction Motor Field & Armature

1. Dobeckan FT 2005/500 EK : Class 220

Type : Solventless, polyesterimide
resin based single
component.
UL approved Class 200/220.

2. APPLICATIONS HOW TO USE

- 2.1 Impregnation of Traction Armature Impregnation by VPI technique.

- 2.2 Impregnation of Traction Field Coils Impregnation by VPI technique

Curing schedule : Traction Machine - 10-12 h/160 degree C

- 3.0 APPLICABLE STANDARDS : IEC 455-3-5

- 4.0 SPECIAL CHARACTERISTICS OF DOBECKAN FT 2005/500 EK

- 4.1 Under Writer's Laboratory (UL), USA approved product for
Class 200 (Dielectric strength), Class 200 (Bond strength
criteria).

- 4.2 Single component and no addition of hardener required.

- 4.3 Only one Impregnation is enough.

- 4.4 Better void filling and retention of the resin in the machine
provides excellent vibration resistance and humidity
resistance.

- 4.5 Lower temperature rise in machine during running because of
better heat transfer through the winding.

- 4.6 Retention of mechanical and electrical properties upto 220 C.

- 4.7 Long pot life : 1 year at 23 degree C.

5. DETAILED PROPERTIES

As per enclosed data sheet 3-15

SMI/154/9

TSD:DOC-410G-92



Dobeckan Impregnating Resins

Dobeckan FT 2005/500 EK

One component Solventless UP Impregnating Resin of Temperature Index 180

Structure Salient Properties & Applications

Dobeckan FT 2005/500 EK is a one component solventless unsaturated polyesterimide (UP) impregnating resin. Dobeckan FT 2005/500 EK is classified as TH-180-LM-HS according to DIN 46448 Sheet 2.

Dobeckan FT 2005/500 EK cures into an elastic and tough mass.

Dobeckan FT 2005/500 EK is characterised by—

- Good dielectric and mechanical properties upto 220°C
- Good penetration
- Tough elastic bonding
- Higher flash point
- Long storage life
- Good resistance to chemicals

Dobeckan FT 2005/500 EK is suitable for all customary methods of impregnation such as dip, vacuum + pressure, roll, etc. Dobeckan FT 2005/500 EK is suitable for impregnation of standard and special motors upto Frame size IEC 355. HT motors, DC machines, traction motors and dry type transformers. For HT motors and generators whose windings are insulated with glass mica paper epoxy novalac tapes. Dobeckan FT 2005/500 EK provides excellent consolidation of overhangs.

Properties of Dobeckan FT 2005/500 EK

Chemical base			Unsaturated polyesterimide resin
Colour and appearance			Brown, clear liquid
Viscosity at 23°C at 23°C	DIN 53015 DIN 53211/ Cup No. 4	mPa.s s	475-525 100 (Typical)
Density at 23°C	DIN 51757	g/cm ³	1.05
Gelling time at 120°C at 60°C at 40°C	DIN 46448	min days days	20-30 10-12 200
Flash point	DIN 53213 (closed cup)	°C	51 (Typical)
Storage stability	In original sealed container at 23°C or below.	months	12

Suggested Curing

2-4 hours at 160°C

The suggested curing time is after the unit attained the specified temperature. Depending upon the size and weight of the unit, the heating time is required to be added.

SMI/15/10

Technical data sheet



**Properties
of the
Cured Resin**

Tests as per IEC 455/464: Specimen curing 4 h at 160° C		
Dielectric strength		
at 23° C	kV/mm	72
at 23° C after immersion	kV/mm	56
in water for 24 h		
at 220° C	kV/mm	39
Bond strength (twisted coil)		
at 25° C	N	260
at 220° C	N	29
Flexibility on mandrel (3 mm) at 23° C (Thickness)	mm	No crack upto angle 60° 0.035
Volume resistivity		
at 23° C	Ohm.cm	10 ¹⁵
at 23° C after immersion	Ohm.cm	10 ¹⁵
in water for 7 days	Ohm.cm	10 ¹⁵
at 220° C	Ohm.cm	10 ¹⁵
Resistance to solvent vapours after 7 days exposure to acetone, benzene, hexane, methanol, carbondisulphide.		Good
Resistance to liquids at 23° C		
—Alkali solution		No change in weight
—30% Sulphuric Acid		Resistant
—Transformer oil		Resistant
Thermal Endurance		
—Decrease of BDV on impregnated twisted specimen*	° C	198

* Enamelled wire made of wire enamel polyesterimide (Theic) plus polyamide-imide.

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Methods of Application

Dobeckan FT 2005/500 EK is suitable for all customary methods of impregnation such as dip, vacuum-pressure, roll, etc.

Cleaning

Uncured resin can be easily cleaned by washing with hot detergent solution such as acetone or styrene or vinyl toluene. It is difficult to remove the cured resin and for this reason, tools and containers contaminated with activated resin mixture should be cleaned after use.

Safe Handling

Inhalation and direct contact with skin of resin should be avoided. In case of contact, the affected area should be washed with soap and water. Protective barrier and cleansing creams are suggested for hands. For detailed instructions, ask for our technical information 3-51 "safe handling with Dobeckan Resins".

Recommended Storage

The resin should be stored at below 23°C in original sealed containers. At this temperature, the resin will remain good for 12 months. At higher storage temperature, the storage life would decrease. The resin container should not be exposed to sun light to avoid premature gelation.

Packing

Dobeckan FT 2005/500 EK ... 30 kg in polyethylene containers.

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SMI/154/11



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TSE

Varnishes & Resins For Railway Traction And Auxiliary Machines -
Manufacturing & Repairs

Application : Solventless Impregnation of Traction Motor Field
Coils and Armatures

1. Dobeckan FT-1052 : Class : 180 (UL approved)
Type : Solventless polyesterimide
two component resin system.

2. APPLICATIONS HOW TO USE

2.1 Impregnation of Traction Armature Impregnation by VPI.

2.2 Impregnation of Traction Field Impregnation by VPI.

2.3 Impregnation of Auxiliary Machines Impregnation by VPI.

Curing schedule : Traction Machines - 12 h/140 degree C
Auxiliary Machines - 8 h/140 degree C

3.0 APPLICABLE STANDARDS : IEC 455-3-5

4.0 SPECIAL CHARACTERISTICS OF DOBECKAN FT 1052

4.1 Under Writer's Laboratory (UL), USA approved product for
Class 180 machines.

4.2 One impregnation is sufficient due to solventless.

4.3 Low viscosity hence better void filling in the machines
provides excellent vibration resistance and humidity
resistance.

4.4 Low temperature rise in machine during running because of
better heat transfer through the winding.

4.5 Long pot life of mixed resin - 6 months at 20-23 degree C.

5. DETAILED PROPERTIES

As per enclosed data sheet 3-14

SMI/154/12

TSD:DOC-410E 92



Dobeckan® Impregnating Resins

Dobeckan FT 1052

Solventless UP impregnating resin with tough elastic bonding and Temperature Index 155

Structure Salient Properties and Applications

Dobeckan FT 1052 is a solventless unsaturated polyesterimide (UP) impregnating resin

Dobeckan FT 1052 with Hardener P is classified as TH-155-LM-HS according to DIN 46448 sheet 2.

Dobeckan FT 1052 in combination with Hardener P cures into an elastic and tough mass.

Dobeckan FT 1052/Hardener P system is characterised by

- Good penetration
- Short curing time
- Long activated resin (useful) life
- Tough elastic bonding
- Excellent dielectric properties
- Good resistance to chemicals

Dobeckan FT 1052 is suitable for all customary methods of impregnation such as dip, vacuum + pressure, roll, etc. Dobeckan FT 1052, Hardener P is suitable for impregnation of standard and special motors upto frame size IEC 355. H.T. motors, D.C. machines, traction motors and alternators of class E, B & F. For HT motors and generators whose windings are insulated with glass-mica paper-epoxy novalac tapes, Dobeckan FT 1052 + Hardener P provide excellent consolidation of overhangs. Such machines are conveniently impregnated by roll or dip impregnation methods. Dobeckan FT 1052/Hardener P system is also suitable for impregnation of windings with fine size wires as also for rectangular wires of heavy sizes.

Properties of Components

Dobeckan FT 1052

Chemical base			Unsaturated polyesterimide resin
Colour and appearance			Brown, clear liquid
Viscosity at 23°C at 27°C	DIN 53015 I S 3944/ Cup No. 4	mPa.s s	450-550 128 (typical)
Density at 23°C	DIN 51757	g/ml	1.05 (typical)
Flash point	DIN 53213 (closed cup)	°C	32 (typical)
Compatibility			
New Product Designation Diluent M	resin : styrene	Pbv	1 : > 1
Storage stability	In original sealed container at 20°C or below	months	6

SMI/154/13



Hardener P

Chemical base			Tertiary butyl cumyl peroxide
Colour and appearance			Yellow, clear liquid
Density at 23°C	DIN 51757	g/ml	0.96 (typical)
Storage stability	When stored in original sealed container at 20°C or below	months	6

Mixing Proportions

Dobeckan FT 1052 100 parts by weight
 Hardener P 1 part by weight

Properties of Resin + Hardener Mixture

Viscosity at 23°C	DIN 53015	mPa.s	450-550
Density at 23°C	DIN 51757	g/ml	1.05 (typical)
Flash point	DIN 53213 (closed cup)	°C	32 (typical)
Drying in thin layer	DIN 46448 2 h at 140°C		Tackfree film with uniform flow
Drying in thick layer	DIN 46448 10g/140°C/2h		Tough-non tacky, free from blisters Top: non tacky smooth Bottom: non tacky
Gelling time of mixture at 100°C	DIN 46448	min	40-60
Activated resin life	At storage temperature upto 23°C	months	6



Methods of Application

Dobeckan FT-1052/Hardener P is suitable for all customary methods of impregnation such as dip, vacuum-pressure, roll, etc. For better bond strength, resin should be used for impregnation in as supplied viscosity. Viscosity reduction of the resin is possible by addition of monostyrene. Figure 1 gives viscosity temperature characteristic of Dobeckan FT 1052. Figure No. 2 gives viscosity reduction characteristic of Dobeckan FT 1052 on addition of monostyrene.

Cleaning

Uncured resin can be easily cleaned by washing with hot detergent solution, acetone or styrene. It is difficult to remove cured resin and for this reason, tools and containers, contaminated with activated resin mixture should be cleaned after use.

Safe Handling

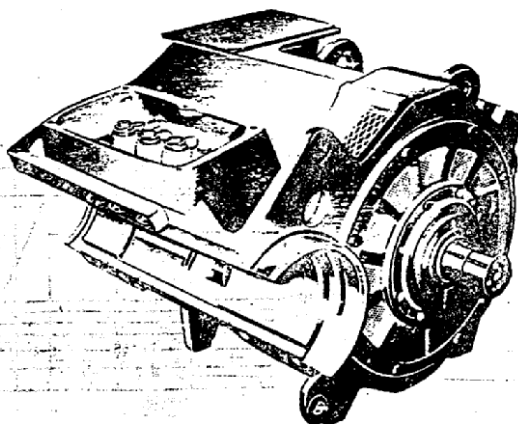
Inhalation and direct contact with skin of resin, hardener or their mixture should be avoided. In case of contact, the affected area should be washed with soap and water. Protective barrier and cleansing creams are suggested for hand. For detailed instructions ask for our Technical Information 3-51 "Safe Processing with Dobeckan Resin".

Recommended Storage

The resin and hardener should be stored at a temperature not exceeding 23°C in original sealed containers. At this temperature, the activated resin will remain good for 3 to 6 months. At higher storage temperature the storage life would decrease sharply. The resin and hardener containers should not be exposed to sunlight to avoid premature gelation.

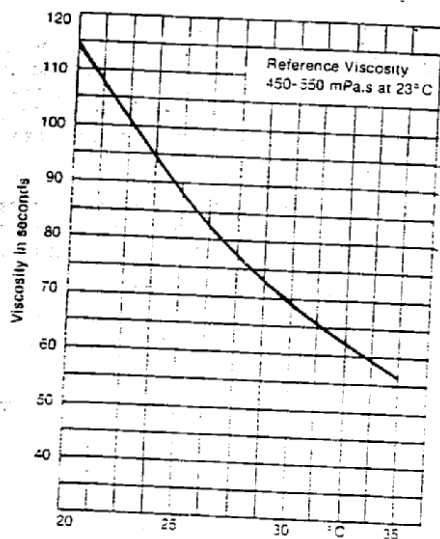
Packing

Dobeckan FT 1052 : 30 kg in polyethylene containers
Hardener P : 1 kg and 5 kg in polyethylene containers.

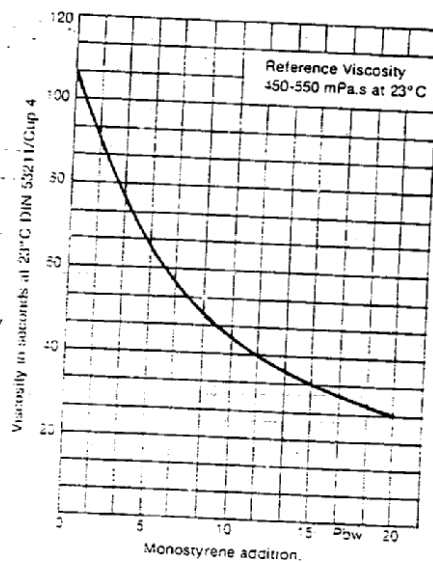


SMI/154/14

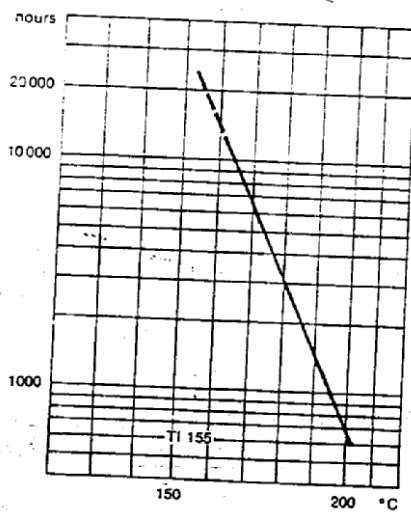
Vacuum Impregnation of traction motor armature



Viscosity of Dobeckan FT 1052 at different temperatures by DIN 53211/Cup 4



Viscosity reduction of Dobeckan FT 1052 on monostyrene addition



Dobeckan FT 1052 Thermal Endurance

Suggests Curing

Properties of the Cure



Suggested Curing

2 hours at 140°C

The suggested curing time is after the unit attains the specified temperature. Depending upon the size and weight of the unit, heating time is required to be added.

Properties of the Cured Resin

Test methods according to DIN 46448
Specimen curing 2 h at 140°C

Dielectric strength	at 25°C at 155°C	kV/mm kV/mm	90 80
Volume resistivity	1000 VDC at R.T. at 155°C after 240 h water immersion at R.T.	ohm.cm ohm.cm ohm.cm	10 ¹⁵ 10 ¹² 10 ¹⁵
Dielectric dissipation factor	30 V & 1 kHz at 25°C at 155°C		0.007 0.125
Dielectric constant	30 V & 1 kHz at 25°C at 155°C		3.3 3.6
Track resistance	DIN 53480	Grade	KB > 600 KA 3 C
Adhesive strength	at 25°C at 155°C	N/mm ² N/mm ²	12 1.2
Bond strength coefficient	at 25°C at 155°C		14 2
Water absorption	at 25°C	mg	11
Resistance to chemicals	Reduction in dielectric strength after 7 days immersion in —Transformer oil —Chlorinated diphenyl —Washing detergents		No decrease No decrease No decrease
Temperature Index	30% weight loss criteria	°C	155-160

SMI/154/15



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TSD:1

Varnishes & Resins For Railway Traction And Auxiliary Machines -
Manufacturing & Repairs

Application : Impregnation of Traction Motor Field & Armature

1. Elmotherm H 71 Class : 180
Type : Polyesterimide varnish
with low temperature curing.

2. APPLICATIONS HOW TO USE

2.1 Impregnation of traction armature Impregnation by VPI.

2.2 Impregnation of field coil Impregnation by VPI or by dip.

Curing schedule : 4 h/120 degree C

8 h/150 degree C

3.0 APPLICABLE STANDARDS : IS 10026-3-7 and
IEC 464-3-2

4.0 SPECIAL CHARACTERISTICS OF ELMOTHERM H 71

4.1 Under Writer's Laboratory (UL), USA approved product Class 180.

4.2 Low temperature curing impregnating varnish.

4.3 Very good bond retention at Class temperature.

4.4 Storage life of one year at ambient temperature.

4.5 Excellent vibration and humidity resistance.

5. DETAILED PROPERTIES

As per enclosed data sheet 2-16

SMI/154/16

TSD:DOC-410C-92



Elmotherm Impregnating Varnishes

Elmotherm H 71

A polyesterimide baking impregnating varnish of temperature index 180

Structure, Salient Properties and Applications

Elmotherm H 71 is a modified polyesterimide baking impregnating varnish of Temperature Index 180 (Type TL 180 WA-AM-LM according to DIN 46456). Elmotherm H 71 offers

- Better adhesion and bonding strength compared to silicone impregnating varnishes.
- Short and lower temperature curing
- Long storage and tank life.

Elmotherm H 71 is suitable for impregnation of windings of polyester, polyesterimide and dual coated (amide-imide top coat) wires. Elmotherm H 71 is suggested for the impregnation of electrical windings of:—

- Traction machines: field and armature windings
- Class H electrical rotating machines, generators and DC machines
- Special duty motors
- Solenoid coils
- Dry type transformers.

Elmotherm H 71 can be applied by the customary methods of impregnation such as dipping, vacuum-pressure etc. Elmotherm H 71 varnish can be used for electrical equipment of increased safety Ex (e) category.

Properties of Elmotherm H 71

Colour and appearance			Clear liquid
Solids content	1.5 g/130°C/2h	%	45-48
Viscosity at 23°C at 27°C	DIN 53211/Cup 4 IS 3944/Cup 4	s s	65-80 80 (typical)
Density	DIN 51757	g/ml	1.07 (typical)
Flash point (closed cup)	DIN 53213	°C	38 (typical)
Recommended Thinner			Thinner 218
Storage life	When stored in original sealed container at RT	months	12

Suggested Curing Schedule

For general machine winding & transformers
4 hours at 120°C

+

8 hours at 150°C

According to PTB Test Certificate for Ex(e) category machines

4 hours at 120°C

+

8 hours at 150°C

(After every impregnation)

SMJ/154/17

Technical data sheet
2-16-9204



Typical Properties of Cured Varnish Film

Tests according to DIN 46456
Specimen curing—4h at 120°C + 8h at 150°C

Bond strength coefficient	at 25°C at 180°C		14 2.8
Dielectric strength	at 25°C at 180°C	kV/mm kV/mm	70 70
Volume resistivity	1000 VDC at 25°C at 180°C 240h water immersion at RT	ohm.cm ohm.cm ohm.cm	10 ¹³ 10 ¹¹ 10 ¹⁵
Dielectric constant	30V/1 kHz at 25°C at 180°C		3 4.8
Dielectric loss factor	30V/1 kHz at 25°C at 180°C		0.006 0.18
Water absorption		mg	5
Resistance to chemicals	% retention of breakdown voltage after immersion for 7 days in: transformer oil at 105°C 25% sulphuric acid at 25°C	% %	95 90
Temperature Index	IEC: 216 (weight loss)	°C	180

Packing

Elmoitherm H 71 : 1 & 4 kg in tinned metal containers,
21 & 185 kg in m.s. containers.
Thinner 218 : 0.9 & 4 kg in tinned metal containers,
20 & 160 kg in m.s. containers.

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TS

Varnishes & Resins For Railway Traction And Auxiliary Machines -
Manufacturing & Repairs

Application : Anti-Tracking Finishing of Armature and Field
Coils of Traction Motors

1. Siliconit E 233 (Red) Class : 180

Type : Silicone resin based pigmented
finishing varnish with high
heat resistance.

2. APPLICATIONS

HOW TO USE

2.1 Finishing varnish
for Traction
Armatures

Apply by spray gun or by brush.

2.2 Finishing varnish
for Traction
Field coils.

Apply by spray gun or by brush.

Curing schedule : 2 h/120 degree C

16 h/160 degree C

3.0 APPLICABLE STANDARDS : IS 10026-3-6 and
: IEC 464-3-2

4.0 SPECIAL CHARACTERISTICS OF SILICONIT E 233 (RED)

4.1 High heat resistance, finishing varnish.

4.2 Excellent moisture and chemical resistance.

4.3 Excellent bonding to moist of cured films of Becks
impregnating varnishes and solventless resins.

4.4 Smooth glossy cured film provides excellent track
resistance.

5. DETAILED PROPERTIES

As per enclosed data sheet 2-28

SMI/154/18

TSD:DOC-410H-92



Beck Silicone Varnishes

Siliconit E 233 (Red)

A Silicone resin based, baking, pigmented finishing Varnish with high heat resistance

Structure, Salient Properties and Applications

Siliconit E 233 (Red) is a modified Silicone resin based, baking finishing Varnish of temperature Index 175-180. Siliconit E 233 (Red) contains selected heat resistant pigments to impart bright red colour to cured varnish film.

The finishing coat of Siliconit E 233 (Red) offers the winding moisture resistance, track resistance and resistance to chemicals.

Siliconit E 233 (Red) is suggested as a finishing Varnish for large electric machines, Turbo Generators, Traction Motors, Marine motors and other industrial machines, particularly where the insulation system is based on Silicones.

Siliconit E 233 (Red) can be applied by spray, brush or dip coating applications.

Properties of Varnish Siliconit E 233 (Red)

Colour and appearance	Red. Coaque liquid
Non Volatile Content 1g/180°C/4h	47-49
Viscosity at 20°C DIN 53211/ Cup no 4	s 40-60
IS 3944, Cup no 4	s 45 (typical)
Asn content	% by Wt: 14-16
Flash Point (closed cup) DIN 52313	°C 29
Recommended thinner	Thinner 231
Shelf life	In original Sealed containers at 25°C or below months : 6

Suggested Curing Schedule

2h at 120°C + 16h at 160°C.

SMI/154/19.



Properties of the Cured Varnish Film

Tests according to DIN 48456,
Specimen Curing—2h/120°C+16h/160°C

Dielectric Strength	at 25°C	kV/mm	65
	at 180°C	kV/mm	40
	24h water immersion at RT	kV/mm	40
Volume resistivity	(1000V DC)		
	at 25°C	ohm.cm	10 ¹⁴
	at 180°C	ohm.cm	10 ¹²
	24h water immersion at RT	ohm.cm	10 ¹⁴
Dielectric Constant	(30V/1 kHz)		
	at 25°C		3.0
	at 180°C		2.5
Dielectric loss factor	30V/1 kHz		
	at 25°C		0.005
	at 180°C		0.060
Tracking Index		Volts	220
Temperature index	IEC 216		
	Wt. loss		75-180

Storage and Remixing

Siliconit E 233 (Red) should be stored at 25°C or below. Since Siliconit E 233 (Red) contains fillers and pigments, which has tendency to settle down during storage, Varnish should be stirred well before use to homogenous mass.

Packings

Siliconit E 233 (Red): 1 & 4 kg round tins.
Thinner 231: 0.9, 4, 20, 160 kg M.S. containers.

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Properties of the Cured Varnish Film

Tests according to DIN 46456,
Specimen Curing—2h/120°C-16h/160°C

Dielectric Strength	at 25°C	kV/mm	65
	at 180°C	kV/mm	40
	24h water immersion		
	at RT	kV/mm	40
Volume resistivity	(1000V DC)		
	at 25°C	ohm.cm	10 ¹⁴
	at 180°C	ohm.cm	10 ¹²
	24h water immersion		
Dielectric Constant	(30V/1 kHz)		
	at 25°C		3.0
	at 180°C		2.5
	30V/1 kHz		
Dielectric loss factor	at 25°C		0.005
	at 180°C		0.060
Tracking Index		Volts	220
Temperature index	IEC 216		
	(Wt. loss)		175-180

Storage and Remixing

Siliconit E 233 (Red) should be stored at 25°C or below. Since Siliconit E 233 (Red) contains fillers and pigments, which has tendency to settle down during storage, Varnish should be stirred well before use to homogenous mass.

Packings

Siliconit E 233 (Red) : 1 & 4 kg round tins.
Thinner 231 : 0.9, 4, 20, 160 kg M.S. containers.

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Varnishes & Resins For Railway Traction And Auxiliary Machines -
Manufacturing & Repairs

Application : Anti-Tracking Finishing Varnish For Auxiliary
Machines, Coils, Shunt Reactor, etc.

-
1. Becktol (Red/Grey) Class : 130
Type : Alkyd Pigmented, Finishing
Varnish.

2. APPLICATIONS HOW TO USE

2.1 Finishing varnish for auxiliary
machines Apply by spray gun or by brush.

2.2 Finishing varnish for Smoothing
Reactor Apply by spray gun or by brush.

Curing schedule : Drying - 4 h at Room Temperature
Curing - 24 h at Room Temperature

3.0 APPLICABLE STANDARDS : IS 10026-3-3 and
: IEC-464-3-1

4.0 SPECIAL CHARACTERISTICS OF BECKTOL (RED/GREY)

4.1 Excellent resistance to humidity and mild chemicals.

4.2 Smooth, glossy cured film provides excellent track resistance.

5. DETAILED PROPERTIES

As per enclosed data sheet 2-31

SMI/154/20

TSD:DOC-410F-92



Beck Insulating Varnishes

Becktol (Red or Grey)

An alkyd based air drying finishing varnish.

Structure Salient Properties and Applications

Becktol (Red/Grey) is an air drying finishing varnish based on alkyd resin.

The cured varnish film exhibits excellent resistance to tracking, mild acids and alkalis and prevents ingress of moisture into the windings.

Becktol (Red/Grey) is suitable for application as a finishing varnish for field coils, overhangs of stators, armatures, transformers and other electrical windings to provide additional protection against moisture and chemical attack to the impregnated windings.

Becktol (Red/Grey) can be applied by all customary methods of application such as dipping, brushing and spraying.

The varnish contains fillers and pigments which have tendency to settle down on storage and hence it is necessary to stir the contents to a homogenous mass before use.

Becktol is available in two shades, red and grey.

Properties of Becktol (Red/Grey)

			Becktol (red)	Becktol (grey)
Colour and appearance			Red opaque liquid	Grey opaque liquid
Non volatile content	1g/150°C/2h	%	50-55	50-55
Viscosity at 20°C at 27°C	DIN 53211/Cup No. 4 IS: 3944/Cup No. 4	s s	150-180 175 (typical)	150-180 175 (typical)
Density at 27°C	DIN 51757	g/ml	0.990	1.006
Flash point	DIN 53213 (closed cup)	°C	35	35
Recommended thinner			Thinner 234	Thinner 234
Storage life	In original sealed containers under covered storage at 25°C	months	12	12

Curing Schedule

24h at room temperature
or
16h at room temperature
+4-6h at 60-80°C

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Technical data sheet



**Properties of the
Cured Varnish Film
of Becktol (Red)***

Specimen curing—24h at room temperature

Tests according to DIN 46449 unless otherwise specified

Dielectric strength	at 25°C	kV/mm	51
	at 130°C	kV/mm	43
	24 h water immersion	kV/mm	20
Volume resistivity (1000 VDC)	at 25°C	ohm×cm	10 ¹⁴
	at 130°C	ohm×cm	10 ¹⁰
	240h water immersion	ohm×cm	10 ¹⁰
Tracking index	IS 8264	Volts	300-330
Water absorption	at 25°C	mg	3
		%	1.6

(*) Becktol (Grey) has performance properties comparable to those of Becktol (Red)

Storage and Remixing

Becktol (Red/Grey) should be stored at room temperature (25°C-35°C) under covered storage. Since Becktol (Red/Grey) contains fillers and pigments, which have settling tendency during storage, varnish must be stirred well before use to homogenous mass.

Packing

Becktol (Red/Grey) : 1, 4 and 21 kg in mild steel containers
Thinner 234 : 0.9, 4 and 20 kg in mild steel containers

Notice

This information is intended only for general guidance in the application of our product. It has been obtained by careful investigation and represents the present state of our knowledge and experience. Because of the large number of possible methods of application and processing, we are not able to assume responsibility in any one particular case for either the technical results or the patent rights situation applicable to the country under consideration.

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