

Electrical Insulation Materials

ARALDITE Casting Resin System

ARALDITE® F CI	100	100	100	pbw
ARADUR® HY 905 CI	100	100	100	pbw
Flexibilizer DY 040 CI	10	20	7	pbw
Accelerator DY 062	1	--	0.2	pbw
Accelerator DY 073-1	--	0.4	--	pbw
Filler Silica flour	410	430	--	pbw

Liquid, hot-curing casting resin system for producing castings with good electrical and mechanical end properties.

Indoor electrical insulators for medium and high voltage, such as post insulators, bushings, switch and apparatus components as well as instrument transformers and power distribution transformers

Applications

Conventional gravity casting process under vacuum
Adjustable to existing handling parameters

Processing methods

Good mechanical and electrical end properties
Very high thermal endurance properties
Considerable insensitivity to atmospheric and chemicals influences

Properties

Edition: October 2005
Replaces Edition: March 2004

Liquid, solvent-free, bisphenol A epoxy resin

ARALDITE F CI	Viscosity	at 25°C	DIN 53015	mPa s	9000 - 14000
	Epoxy content		ISO 3001	equiv/kg	5.24 - 5.49
	Density	at 25°C	ISO 1675	g/cm ³	1.15 - 1.20
	Refraction	at 25°C	DIN 53491	--	1.568 - 1.572
	Flash point		DIN 51758	°C	>200
	Vapour pressure	at 20°C at 60°C	(Knudsen) (Knudsen)	Pa Pa	< 0.01 appr. 1

Liquid modified anhydride curing agent

ARADUR HY 905 CI	Viscosity	at 25°C	DIN 53015	mPa s	150 - 250
	Density	at 25°C	ISO 1675	g/cm ³	1.18 - 1.22
	Refraction	at 25°C	DIN 53491	--	1.449 - 1.503
	Flash point		DIN 51758	°C	150
	Vapour pressure	at 20°C at 60°C	(Knudsen) (Knudsen)	Pa Pa	ca. 0.3 ca. 50

Low viscous, solvent-free flexibilizer

Flexibilizer DY 040 CI	Viscosity	at 25°C	DIN 53015	mPa s	50 - 110
	Density	at 25°C	ISO 1675	g/cm ³	0.95 - 1.05
	Flash point		DIN 51758	°C	>100
	Vapour pressure	at 20°C at 60°C	(Knudsen) (Knudsen)	Pa Pa	appr. 0.03 appr. 1

Solvent-free accelerators

DY 062CI

DY 073-1CI

Accelerators	Viscosity	at 25°C	DIN 53015	mPa s	≤10	200 - 300
	Density	at 25°C	ISO 1675	g/cm ³	0.88 - 0.92	0.93 - 0.97
	Flash point		DIN 51758	°C	59	82
	Vapour pressure	at 20°C at 60°C	(Knudsen) (Knudsen)	Pa Pa	ca. 300 ca. 1600	< 6 --

Remarks ARADUR HY 905 CI is sensitive to humidity and tends to crystallize at low storage temperature. It can be reliquified by stirring and heating it to 40 - 80°C

Storage Store the components at 18-25°C, in tightly sealed and dry original containers. Under these conditions, the shelf life will correspond to the expiration date stated on the label. After this date, the product may be processed only following reanalysis. Partly emptied containers should be closed tightly immediately after use.
For information on waste disposal and hazardous products of decomposition in the event of fire, refer to the Material Safety Data Sheets (MSDS) for these particular products.

General instructions for preparing liquid ARALDITE casting resin systems

System Preparation

Long pot life is desirable in the processing of any ARALDITE casting resin system. Mix all of the components together very thoroughly at room temperature or slightly above and under vacuum. Intensive wetting of the filler is extremely important. Proper mixing will result in:

- better flow properties and reduced tendency to shrinkage
- lower internal stresses and therefore improved mechanical properties on object
- improved partial discharge behaviour in high voltage applications.

For the mixing of medium- to high viscous ARALDITE casting resin systems and for mixing at lower temperatures, we recommend special thin film degassing mixers that may produce additional self-heating of 10-15 K as a result of friction. For low viscous ARALDITE casting resin systems, conventional anchor mixers are usually sufficient.

In larger plants, two premixers are used to mix the individual components (ARALDITE resin and ARADUR hardener) with the respective quantities of fillers and additives under vacuum. Metering pumps then feed these premixes to the final mixer or a continuous mixer. The individual premixes can be stored at elevated temperature (about 60°C) for up to about 1 week, depending on formulation. Intermittent agitation during storage is advisable to prevent filler sedimentation.

Note: A premix of accelerator with ARALDITE resin is not stable; a premix of accelerator with ARADUR hardener is stable under certain conditions. Pls contact our staff for details.

Mixing time can vary from 0.5 to 3 hours, depending on mixing temperature, quantity, mixing equipment and the particular application. The required vacuum is 0.5 to 8 mbar. The vapour pressure of the individual components should be taken into account.

In the case of dielectrically highly stressed parts, we recommend checking the quality consistency and predrying of the filler. Their moisture content should be $\leq 0.2\%$.

The effective pot life is about 1 day at temperatures below 25°C. Conventional batch mixers should be cleaned once a week or at the end of work. For longer interruptions of work, the pipes of the mixing and metering installations have to be cooled and cleaned with the ARALDITE resin component to prevent sedimentation and/or undesired viscosity increase. Interruptions over a week-end (approx. 48h) without cleaning are possible if the pipes are cooled at temperature below 18°C.

Specific Instructions

In case to use mixtures with high reactivity, we recommend to clean daily with flexibiliser DY 040 CI.

Viscosity increase and gel time at various temperatures, refer to Fig: 4.

Mould temperature

Conventional vacuum casting 80 - 100°C

Demoulding times (depending on mould temperature and casting volume)

Conventional vacuum casting 6 - 12h

Cure conditions

APG process (minimal postcure) 6h at 80°C + 10h at 130°C or
6h at 80°C + 6h at 140°C

Castings with big volume (exothermic reaction, internal mechanical stresses) or encapsulations of heat sensitive active parts could be cured at appr. 80°C.

To determine whether crosslinking has been carried to completion and the final properties are optimal, it is necessary to carry out relevant measurements on the actual object or to measure the glass transition temperature (T_g). Different gelling and curecycles in the manufacturing process could lead to a different crosslinking and glass transition temperature respectively.

System 1:
ARALDITE F CI / ARADUR HY 905 CI / DY 040 CI / DY 062 CI / Silica
Mix ratio: 100 / 100 / 10 / 1 / 410

Processing Viscosity

System 1

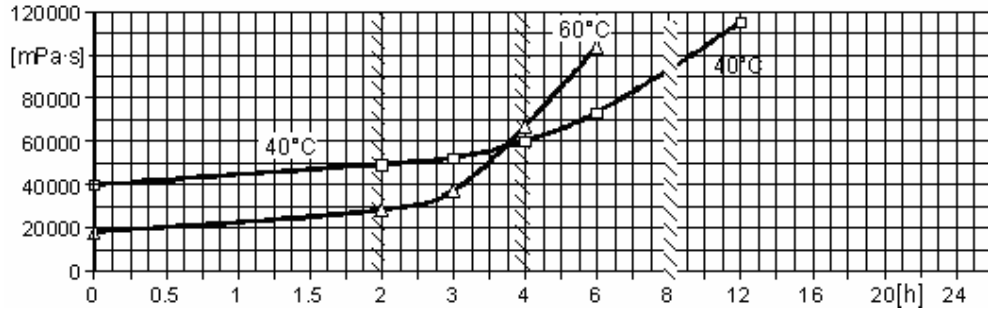


Fig.4.1.1: **Viscosity increase at 40 and 60°C** (measurements with Rheomat 115)
 (Shear rate: $D = 10 \text{ s}^{-1}$)

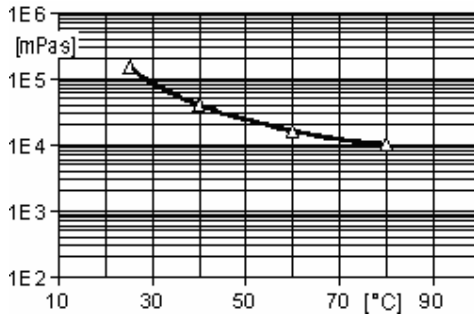


Fig.4.2.1: **Initial viscosity in function of temperature**
 (measurements with Rheomat 115, $D = 10 \text{ s}^{-1}$)

Gelation-/Cure Times

System 1

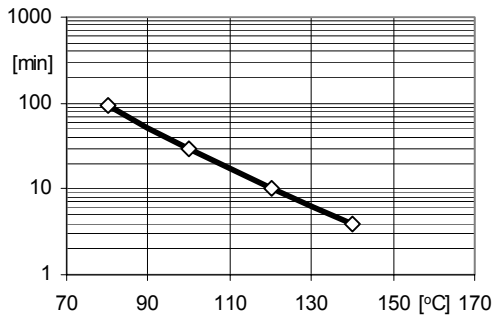


Fig.4.4.1: **Geltime measured in function of temperature**
 (measurements with Gelnorm Instrument / DIN 16945/6.3.1)

Processing (guideline values)

System 2:

ARALDITE F CI / ARADUR HY 905 CI / DY 040 CI / DY 073-1 CI / Silica

Mix ratio: 100 / 100 / 20 / 0.4 / 430

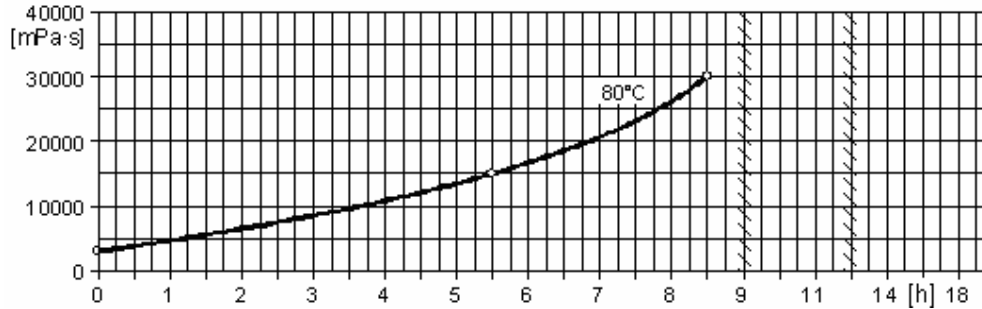


Fig.4.1.2: Viscosity increase at 80°C (measurements with Rheomat 115)
(Shear rate: $D = 10 \text{ s}^{-1}$)

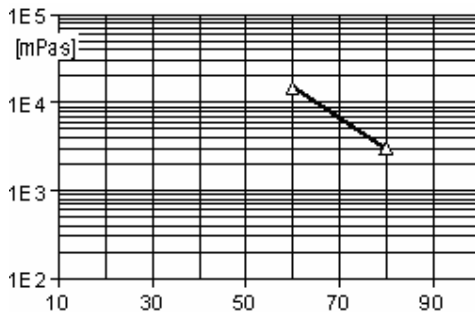


Fig.4.2.2: Initial viscosity in function of temperature
(measurements with Rheomat 115, $D = 10 \text{ s}^{-1}$)

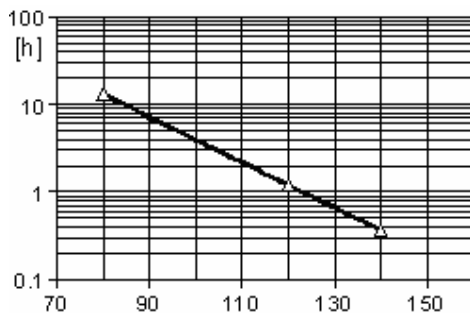


Fig.4.4.2: Geltime measured in function of temperature
(measurements with Gelnorm Instrument / DIN 16945/6.3.1)

Processing
Viscosity

System 2

Gelation-/Cure Times

System 2

System 3:
ARALDITE F CI / ARADUR HY 905 CI / DY 040 CI / DY 062 CI
Mix ratio: 100 / 100 / 7 / 0.2

Processing
Viscosity
System 3

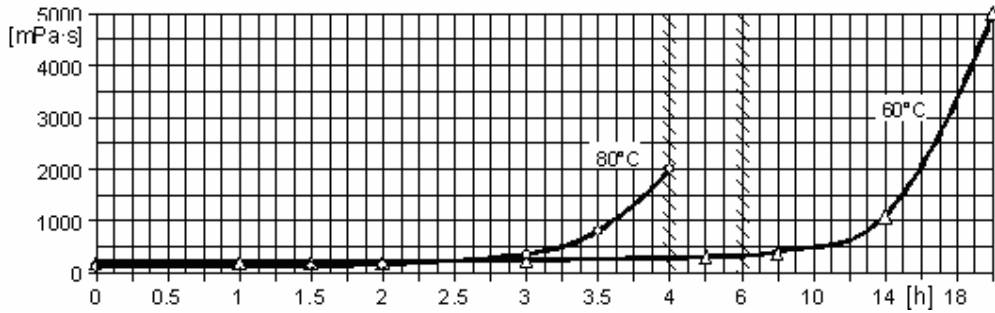


Fig.4.1.3: **Viscosity increase at 60 and 80°C** (measurements with Rheomat 115)
 (Shear rate: $D = 10 \text{ s}^{-1}$)

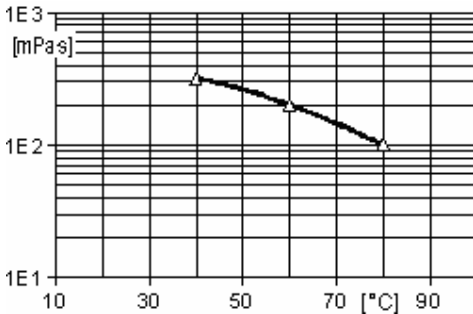


Fig.4.2.3: **Initial viscosity in function of temperature**
 (measurements with Rheomat 115,
 $D = 10 \text{ s}^{-1}$)

Gelation-/Cure Times
System 3

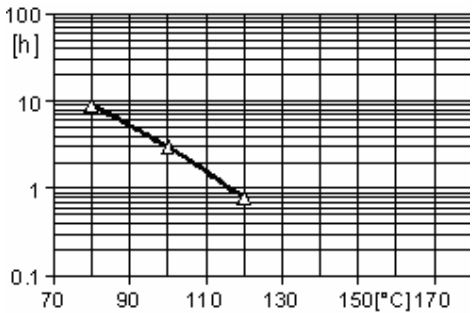


Fig.4.4.3: **Geltime measured in function of temperature**
 (measurements with Gelnorm Instrument /
 DIN 16945/6.3.1)

Mechanical and Physical Properties

Determined on standard test specimen at 23°C
 System 1 : Cured for 4h at 80°C + 10h at 130°C
 System 2 : Cured for 14h at 80°C + 14h at 110°C
 System 3 : Cured for 10h at 80°C + 10h at 130°C

System			1	2	3
Tensile strength	ISO R 527	N/mm ²	75 - 85	75 - 85	80 - 90
Elongation at break	ISO R 527	%	0.9 - 1.1	0.9 - 1.1	--
E modulus from tensile test	ISO R 527	N/mm ²	12000 - 12400	12000 - 12400	3300 - 3900
Flexural strength at 23°C	ISO 178	N/mm ²	125 - 135	120 - 125	130 - 150
Surface strain at 23°C	ISO 178	%	1.1 - 1.5	1.0 - 1.5	5-7
E modulus from flexural test	ISO 178	N/mm ²	11600 - 12000	12300 - 14000	--
Compressive strength	ISO 604	N/mm ²	140 - 150	--	130 - 150
Compression set	ISO 604	%	6 - 7	--	-
Impact strength	ISO 179	kJ/m ²	10 - 12	10 - 12	10 - 12
Double Torsion Test	CG 216-0/89				
Critical stress intensity factor (K _{IC})		MPa·m ^{1/2}	2.7 - 2.9	2 - 2.5	--
Specific energy at break (G _{IC})		J/m ²	570 - 620	350 - 450	--
Martens temperature	DIN 53458	°C	80 - 90	--	--
Heat distortion temperature	ISO 75	°C	--	--	--
Glass transition temperature (DSC)	IEC 1006	°C	90 - 100	70 - 80	90 - 100
Coefficient of linear thermal expansion	DIN 53752		Fig.5.2	Fig. 5.2	--
Mean value for temperature range: 20-60°C :		10 ⁻⁶ K ⁻¹	31 - 36	31 - 36	60 - 70
Thermal conductivity similar to	ISO 8894-1	W/mK	0.8 - 0.9	0.8 - 0.9	0.2 - 0.3
Glow resistance	DIN 53459	class-	2b	2b	--
Flammability		UL 94			--
Thickness of specimen: 4 mm		class	HB	HB	--
Thickness of specimen: 12 mm		class	V1	V1	--
Thermal endurance profile (TEP)	DIN/ IEC 216		Fig.7.1 - 7.2	--	--
Temperature index (TI): weight loss (20000h/ 5000h)		°C	164 / 187	--	--
Thermal ageing class (20000h)	IEC 85	class	F	--	--
Water absorption (specimen: 50x50x4 mm)	ISO 62				
10 days at 23°C		% by wt.	0.1 - 0.2	0.1 - 0.2	0.25 - 0.3
60 min at 100°C		% by wt.	0.1 - 0.2	0.1 - 0.2	0.25 - 0.3
Decomposition temperature (heating rate: 10K/min)					
Density (Filler load: 66% by wt.)	DTA DIN 55990	°C g/cm ³	≥ 350 1.8 - 1.9	≥ 350 1.8 - 1.9	≥ 350 --

System 1

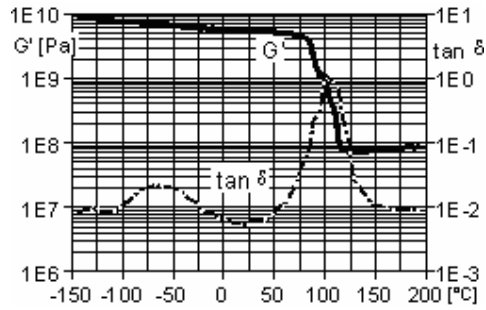


Fig.5.1.1: **Shear modulus (G') and mechanical loss factor ($\tan \delta$) of system 1 in function of temperature**
(ISO 537/ DIN 53445 method C, measured at 1Hz)

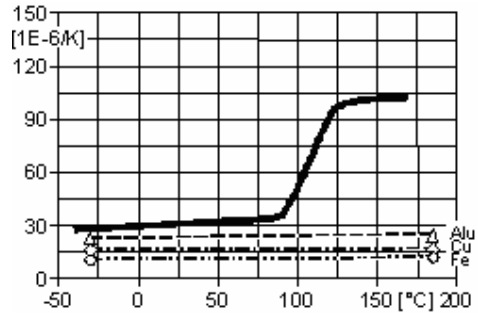


Fig.5.2.1: **Coefficient of linear thermal expansion (α) in function of temperature (system 1)**
(DIN 53752 / reference temperature: 23°C)

System 2

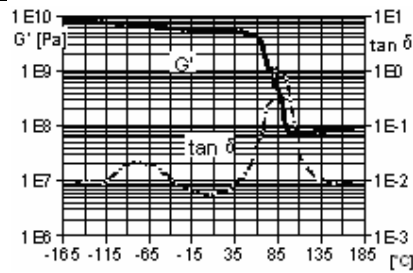


Fig.5.1.2: **Shear modulus (G') and mechanical loss factor ($\tan \delta$) of system 2 in function of temperature**
(ISO 537/ DIN 53445 method C, measured at 1Hz)

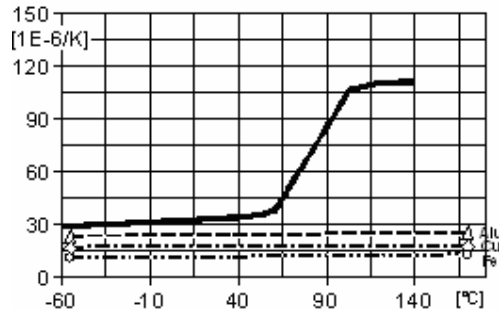


Fig.5.2.2: **Coefficient of linear thermal expansion (α) in function of temperature (system 2)**
(DIN 53752 / reference temperature: 23°C)

Electrical Properties

Determined on standard test specimen at 23°C
 System 1 : Cured for 6h at 80°C + 10h at 130°C
 System 2 : Cured for 14h at 80°C + 14h at 110°C
 System 3 : Cured for 10h at 80°C + 10h at 130°C

System			1	2	3
Breakdown strength	IEC 243-1	kV/mm	18 - 22	18 - 22	18 - 22
Specimen with embedded Rogowski electrodes					
Gap: 2mm	Huntsman Method	kV/mm	36 - 41	36 - 41	--
Diffusion breakdown strength	DIN/ VDE 0441/1	class	HD 2	HD2	--
Temperature of specimen after test		°C	23	23	--
HV arc resistance	ASTM D 495	s	185 - 195	185 - 195	60 - 110
Tracking resistance	IEC 112				
with test solution A			CTI>600-0.0	CTI>600-0.0	CTI>600-0.0
with test solution B			CTI>600M-0.0	CTI>600M-0.0	--
Electrolytical corrosion	DIN 53489	grade	A1	A1	A1

System 1

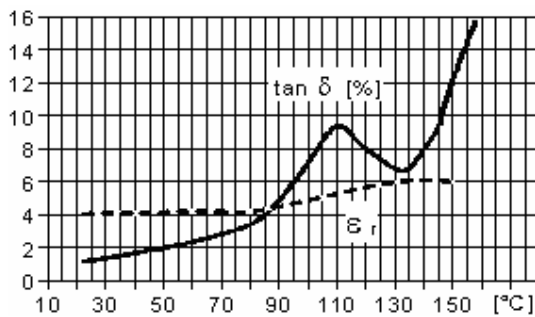


Fig.6.1.1: Loss factor ($\tan \delta$) and dielectric constant (ϵ_r) in function of temperature (system 1)
 (measurement frequency: 50 Hz / IEC 250 / DIN 53483)

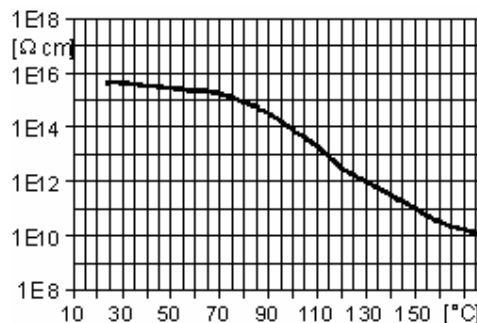


Fig.6.2.1: Volume resistivity (ρ) in function of temperature (system 1)
 (measurement voltage: 1000 V / IEC 93 / DIN 53482)

System 2

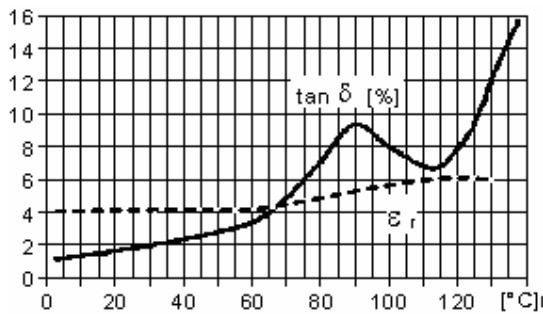


Fig.6.1.2 Loss factor ($\tan \delta$) and dielectric constant (ϵ_r) in function of temperature (system 2)
 (measurement frequency: 50 Hz / IEC 250 / DIN 53483)

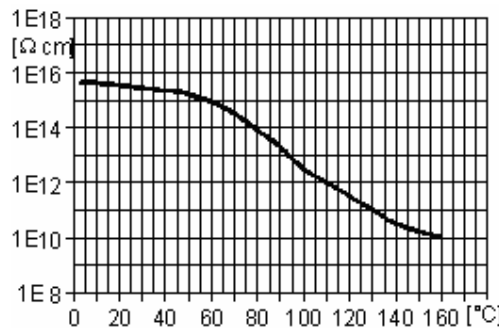


Fig.6.2.2: Volume resistivity (ρ) in function of temperature (system 2)
 (measurement voltage: 1000 V / IEC 93 / DIN 53482)

System 3

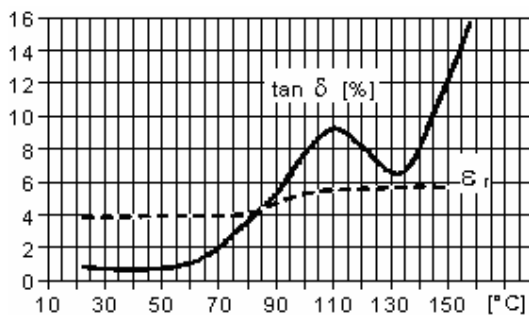


Fig.6.1.3: Loss factor ($\tan \delta$) and dielectric constant (ϵ_r) in function of temperature (system 3)
 (measurement frequency: 50 Hz / IEC 250 / DIN 53483)



Fig.6.2.3: Volume resistivity (ρ) in function of temperature (system 3)
 (measurement voltage: 1000 V / IEC 93 / DIN 53482)

Special Properties and Values (guideline values)

System tested:
ARALDITE F CI / ARADUR HY 905 CI / DY 040 CI / DY 062 CI / Silica
Mix ratio: 100 / 100 / 10 / 1 / 410

Thermal Endurance profile acc. IEC 216

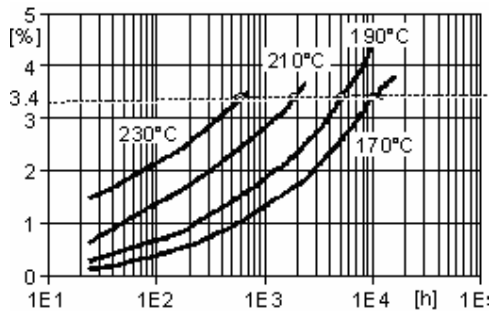


Fig.7.1: **Weight loss (system 1)**
 (specimen: 50x50x3 mm, limit: 3.4%)

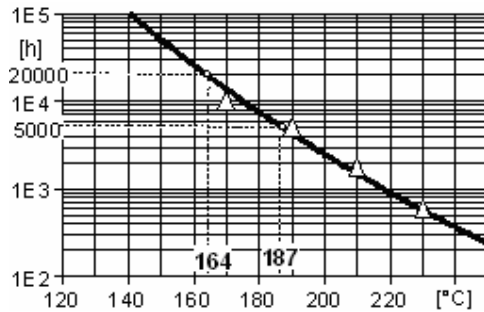


Fig.7.2: **Temperature Index 164 / 187 (system 1)**
 (weight loss 3.4%)

Influences of Flexibiliser DY 040 CI to the end properties

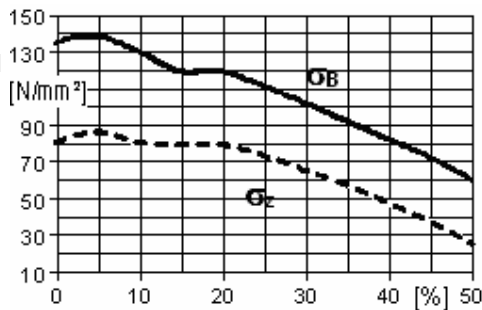


Fig.7.5: **Tensile strength (σ_t) (ISO R 527) and Flexural strength (σ_b) (ISO 178) of system 1 at 23°C with different parts (%) of Flex. DY 040 CI.**

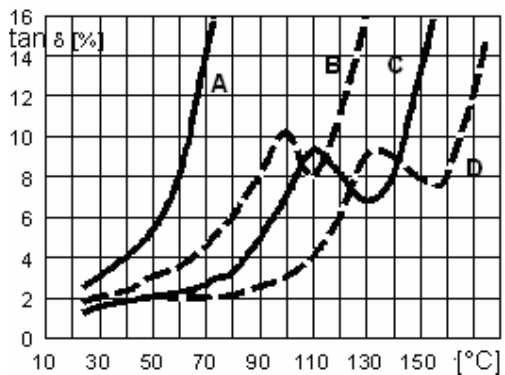


Fig.7.6: **Loss factor (tan δ) in f (T) with: A=25, B=20, C=10, D=0% of Flex. DY 040 CI. IEC 250 (measurement frequency: 50 Hz)**

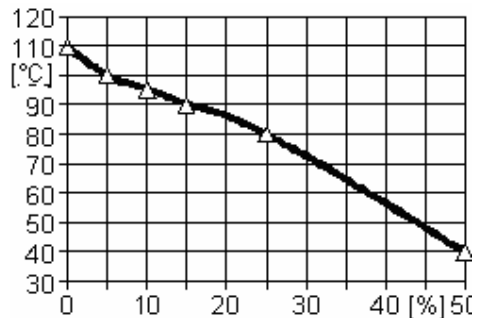


Fig.7.7: **Glass transition temperature (IEC 10060 with different parts (%) of Flex. DY 040 CI.**

Industrial hygiene

Mandatory and recommended industrial hygiene procedures should be followed whenever our products are being handled and processed. For additional information please consult the corresponding Safety Data Sheets and the brochure "Hygienic precautions for handling plastics products".

Handling precautions

Safety precautions at workplace:

protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
goggles/safety glasses	yes
respirator/dust mask	recommended
Skin protection	
before starting work	Apply barrier cream to exposed skin
after washing	Apply barrier or nourishing cream
Cleansing of contaminated skin	Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents
Clean shop requirements	Cover workbenches, etc. with light coloured paper. Use disposable breakers, etc.
Disposal of spillage	Soak up with sawdust or cotton waste and deposit in plastic-lined bin
Ventilation:	
of workshop	Renew air 3 to 5 times an hour
of workplace	Exhaust fans. Operatives should avoid inhaling vapours.

First Aid

Contamination of the **eyes** by resin, hardener or casting mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.

Material smeared or splashed on the **skin** should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.

Anyone taken ill after **inhaling** vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.

Note

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Huntsman LLC

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