HUNTSMAN

Enriching lives through innovation

Advanced Materials

Araldite®	**F**	**100**	**pbw**
Aradur®	**HY 905**	**100**	**pbw**
Flexibilizer	**DY 040**	**0 - 20**	**pbw**
Accelerator	**DY 061**	**0.2 - 1**	**pbw**
Filler	**Silica Flour**	**310 - 430**	**pbw**

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

Application

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

Processing Methods

Conventional gravity casting process under vacuum.

Adjustable to existing handling parameters.

Key Properties

Good mechanical and electrical end properties

Very high thermal endurance properties

Considerable insensitivity to atmospheric and chemical influences.

Product Data (Guideline Values)

Araldite F

Liquid, solvent-free, unmodified bisphenol A epoxy resin.

Viscosity	at 25°C	ISO 12058-1	mPa s	9000 – 12000*
Epoxy content		ISO 3001	equiv/kg	5.10 - 5.30*
Density	at 25°C	ISO 1675	g/cm³	1.15 - 1.20
Refraction	at 25°C	DIN 53491	--	1.5685 -1.5720
Flash point		ISO 1523	°C	> 200
Vapour pressure	at 20°C	(Knudsen)	Pa	< 0.01
	at 60°C	(Knudsen)	Pa	appr. 1

Aradur HY 905

Liquid, modified, carboxylic anhydride curing agent.

Viscosity	at 25°C	ISO 12058-1	mPa s	150 – 200*
Density	at 25°C	ISO 1675	g/cm³	1.18 - 1.22
Refraction	at 25°C	DIN 53491	--	1.4490 -1.5030
Flash point		ISO 1523	°C	150
Vapour pressure	at 20°C	(Knudsen)	Pa	appr. 0.3
	at 60°C	(Knudsen)	Pa	appr. 50

Flexibilizer DY 040

Low viscous, solvent-free Polyglycol.

Viscosity	at 25°C	ISO 12058-1	mPa s	60 – 90*
Density	at 25°C	ISO 1675	g/cm³	1.02 - 1.04
Refraction	at 25°C	DIN 53491	--	1.4450 -1.4464
Flash point		ISO 1523	°C	> 100
Vapour pressure	at 20°C	(Knudsen)	Pa	appr. 0.03
	at 60°C	(Knudsen)	Pa	appr. 1

Accelerator DY 061

Solvent-free tertiary amine

Viscosity	at 25°C	ISO 12058-1	mPa s	1000 – 1800*
Density	at 25°C	ISO 1675	g/cm³	0.97 – 1.02
Flash point		ISO 1523	°C	> 100
Vapour pressure	at 20°C	(Knudsen)	Pa	appr. 1
	at 60°C	(Knudsen)	Pa	appr. 50

*Specified range

Remarks

Hardener Aradur HY 905 is sensitive to humidity and tends at low storage temperature to crystallize. It can be reliquefied by stirring and heating it to 40 - 80°C.

Storage

Store the components in a dry place according to the storage conditions stated on the label in tightly sealed original containers. Under these conditions, the shelf life will correspond to the expiry date stated on the label. After this date, the product may be processed only after reanalysis. Partly emptied containers should be tightly closed immediately after use.

For information on waste disposal and hazardous products of decomposition in the event of a fire, refer to the Material Safety Data Sheets (MSDS) for these particular products.

Processing (Guideline Values)

System Preparation

General instructions for preparing liquid resin systems

Long pot life is desirable in the processing of any 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 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 casting resin systems, conventional anchor mixers are usually sufficient.
In larger plants, two premixers are used to mix the individual components (resin, 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, de-pending on formulation.
Note: A premix of accelerator with resin is not stable; a premix of accelerator with hardener is stable under certain conditions. Please 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 5 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%.

Specific instructions

The effective pot-life of the mix 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 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 temperatures below 18°C.
In case to use mixtures with high reactivity, we recommend to clean daily with the flexibilizer DY 040.
Viscosity increase and gel time at various temperatures, refer to Figs: 4.1 and 4.4.

Mould temperature

Conventional vacuum casting	80 - 100°C

Demoulding times (depending on mould temperature and casting volume)

Conventional vacuum casting	6 - 12h

Cure conditions (minimal postcure)

Conventional Vacuum Casting	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 proper-ties are optimal, it is necessary to carry out relevant measurements on the actual object or to measure the glass transition temperature (Tg). Different gelling and cure cycles in the manufacturing process could lead to a different crosslinking and glass transition temperature respectively.

Processing Data (Guideline Values)

System tested:
Araldite F / HY 905 / DY 040 / DY 061 / Silica.
Mix ratio: 100 / 100 / 10 / 1 / 410.

Processing Viscosities

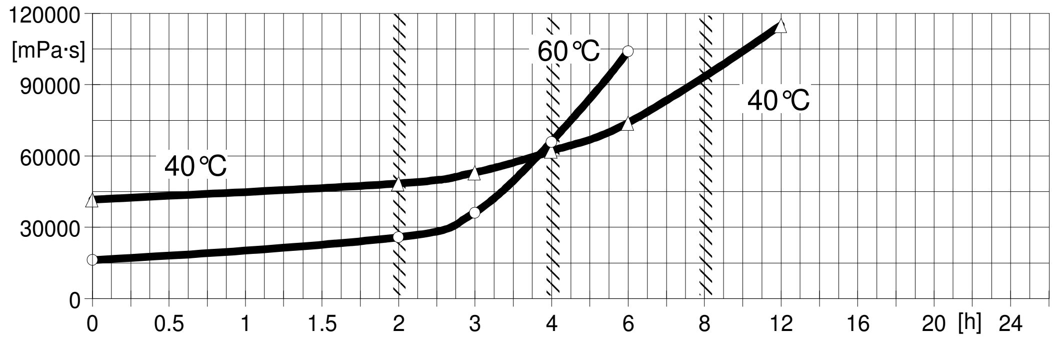

Fig.4.1: **Viscosity increase at 40 and 60 °C** (measurements with Rheomat 115)
(Shear rate D = 10 s^{-1})

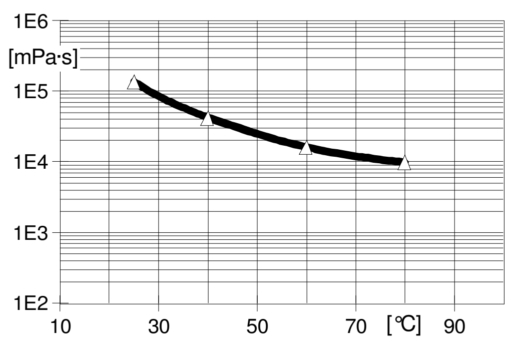

Fig.4.2: **Initial viscosity as a function of temperature**
(measurements with Rheomat 115, D =10 s^{-1})

Gelation-/Cure Times

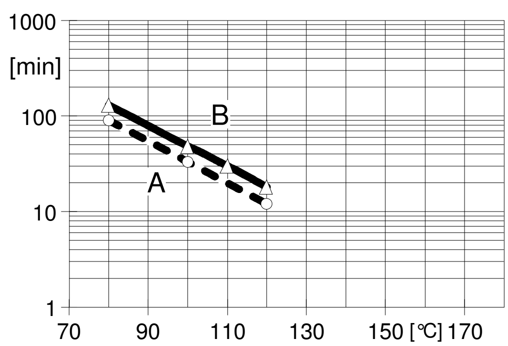

Fig.4.4: **Geltime measured with Gelnorm Instrument as a function of temperature**
(ISO 9396)
A = 1 pbw DY 061 / B = 0.5 pbw DY 061.

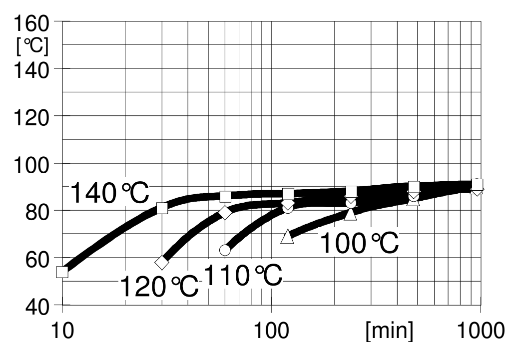

Fig.4.5: **Glass transition temperature as a function of the cure time**
(isothermic reaction, ISO 11357-2)

Mechanical and Physical Properties (Guideline Values)

Araldite F / HY 905 / DY 040 / DY 061 / Silica.
Mix ratio: 100 / 100 / 10 / 1 / 410, cured for 6h at 80°C + 10h at 130°C.
Determined on standard test specimen at 23°C.

Tensile strength	ISO 527	MPa	75 - 85
Elongation at break	ISO 527	%	0.9 - 1.1
E modulus from tensile test	ISO 527	MPa	12000 - 13000
Flexural strength	ISO 178	MPa	125 - 135
Surface strain	ISO 178	%	1.1 - 1.5
E modulus from flexural test	ISO 178	MPa	11600 - 12000
Compressive strength	ISO 604	MPa	140 - 150
Compression set	ISO 604	%	6 - 7
Impact strength	ISO 179	kJ/m²	10 - 12
Double Torsion Test	CG 216-0/89		
Critical stress intensity factor (K_{1C})		MPa·m$^{1/2}$	2.7 - 2.9
Specific energy at break (G_{1C})		J/m²	570 –– 620
Martens temperature	DIN 53458	°C	80 - 90
Glass transition temperature (DSC)	ISO 11357-2	°C	90 - 100
Coefficient of linear thermal expansion	ISO 11359-2		Fig. 5.2
Mean value for temperature range: 20 - 60°C		K^{-1}	31 - 36·10^{-6}
Thermal conductivity similar to	ISO 8894-1	W/mK	0.8 - 0.9
Glow resistance	DIN 53459	class-	2b
Flammability		UL 94	
Thickness of specimen: 4 mm		class	HB
Thickness of specimen: 12 mm		class	V1
Thermal endurance profile (TEP)	IEC 60216		Fig.7.1 - 7.2
Temperature index (TI): weight loss	(20000h/5000h)	°C	164 / 187
Thermal ageing class (20000h)	IEC 60085	class	F
Water absorption (specimen: 50x50x4 mm)	IEC 60062		
10 days at 23°C		% by wt.	0.10 - 0.20
60 min at 100°C		% by wt.	0.10 - 0.20
Decomposition temperature (heating rate: 10K/min)	DTA	°C	> 350
Density (Filler load: 66 % by wt.)	ISO 1183	g/cm³	1.80 - 1.90

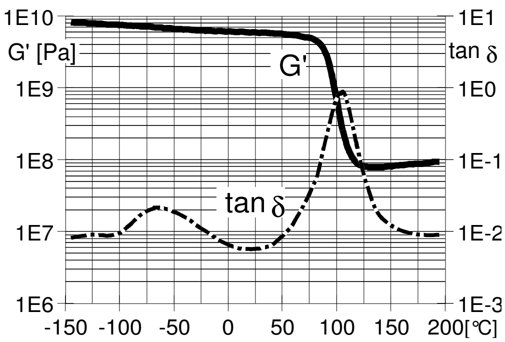

Fig.5.1: **Shear modulus (G') and mechanical loss-factor (tan δ) as a function of temperature** (measured at 1 Hz.)
(ISO 6721-7, method C)

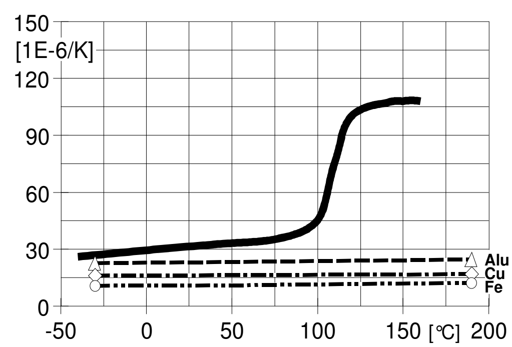

Fig.5.2: **Coefficient of linear thermal expansion (α) as a function of temperature**
(ISO 11359-2, reference temperature: 23°C)

Electrical Properties (Guideline Values)

System tested:
Araldite F / HY 905 / DY 040 / DY 061 / Silica.
Mix ratio: 100 / 100 / 10 / 1 / 410.

Determined on standard test specimen at 23°C.
Cured for 6h at 80°C + 10h at 130°C.

Breakdown strength	IEC 60243-1	kV/mm	18 - 22
Breakdown strength embedded Rogowski electrodes (∅ = 25 mm, 2 mm gap)	Huntsman method	kV/mm	36 - 41
Diffusion breakdown strength Temperature of specimen after test	DIN/ VDE 0441/1	class °C	HD 2 23
HV arc resistance	IEC 61621	s	185 - 195
Tracking resistance with test solution A with test solution B			 CTI >600-0.0 CTI >600M-0.0
Electrolytic corrosion	IEC 60426	grade	A-1

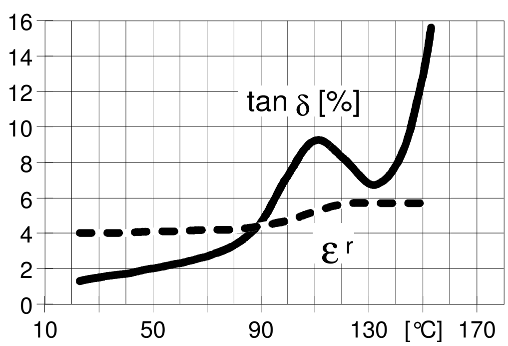

Fig.6.1: **Loss factor (tan δ) and dielectric constant (εr) as a function of temperature**
measurement frequency: 50 Hz,
IEC 60250/ DIN 53483)

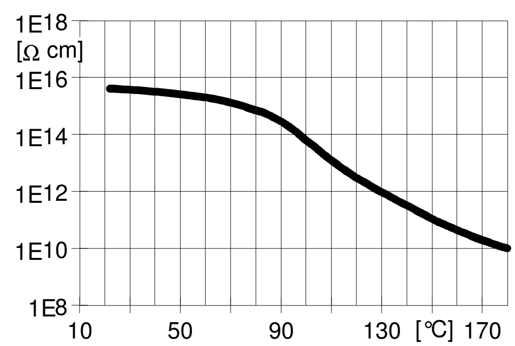

Fig.6.2: **Volume resistivity (ρ) versus function of temperature**
(measurement voltage: 1000 V,
IEC 60093/ DIN 53482)

Special Properties (Guideline Values)

System tested:
Araldite F / Aradur HY 905 / DY 040 / DY 061 / Silica
Mix ratio: 100 / 100 / 10 / 1 / 410

Thermal Endurance Profile IEC 60216

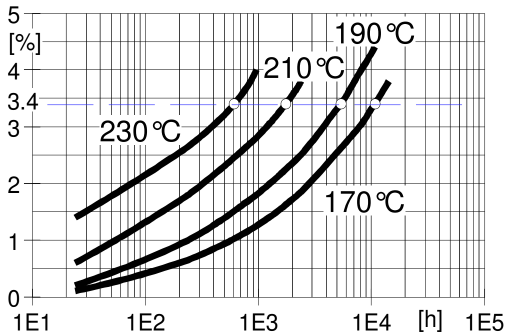

Fig.7.1: **Weight loss** (specimen: 50x50x3 mm)
(limit: 3.4%)

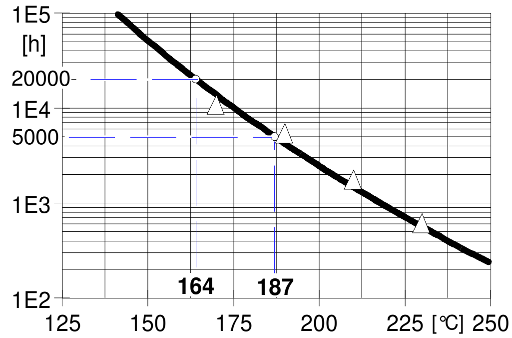

Fig.7.2: **TI 164 / 187** (weight loss 3.4%)
(Araldite F/Aradur HY 905/ DY 040/ DY 061/ SiO2
100/ 100/ 20/ 1/ 430 pbw)

Influence of Flexibilizer DY 040

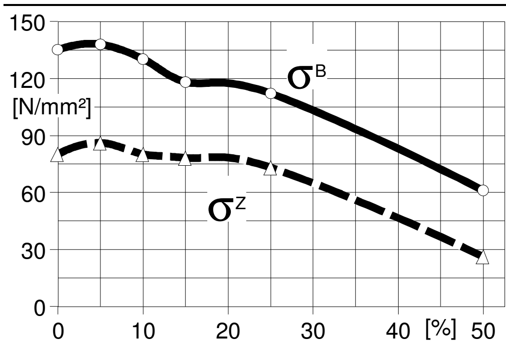

Fig.7.3: **Tensile strength (σ_Z) (ISO R 527) and**
Flexural strength (σ_B) (ISO 178) at
23℃ with different parts (%) of Flexibilizer DY 040.

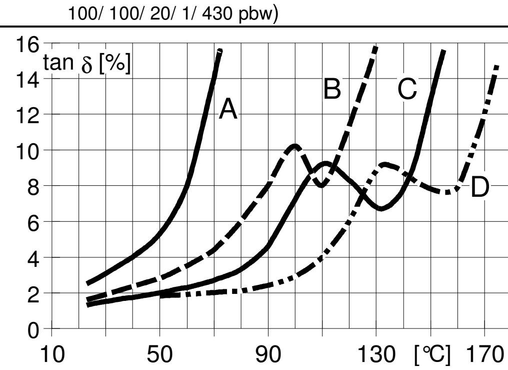

Fig.7.4: **Loss factor (tan δ) in f (T) with:**
A=25, B=20, C=10, D=0 % of Flex.
DY 040
IEC 60250 (measurement frequency: 50 Hz)

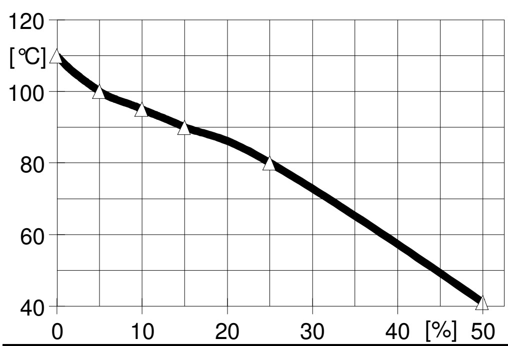

Fig.7.5: **Glass transition temperature**
(ISO 11357-2) with different parts (%) of
Flexibilizer DY 040

Thermal Shock Resistance

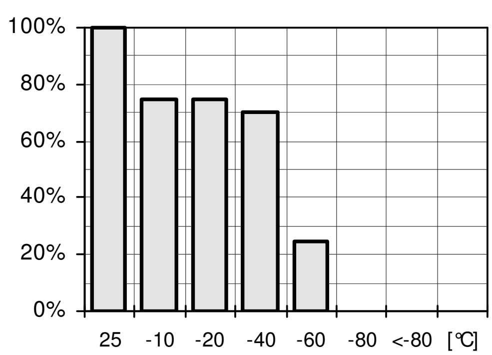

Fig.7.5: **Crack resistance / Temperature shock test**
Passed specimen (%) as a function of the temperature steps
Mean failure temperature: - 49℃
Embedded metal parts with 2 mm radius

Legal Notice

Huntsman Advanced Materials
(Switzerland) GmbH
Klybeckstrasse 200
4057 Basel
Switzerland

Tel: +41 (0)61 299 11 11
Fax: +41 (0)61 299 11 12

www.huntsman.com/advanced_materials
Email:
advanced_materials@huntsman.com

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