Vantico Ltd.

Electronic Polymers

vantico

Heavy Electrical

®Araldite Casting Resin System

Araldite	**F**	**100 pbw**
Hardener	**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.

Applications

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

Properties

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

Edition: **July 2000**
Replaces Edition: October 1998

Araldite F — Liquid, solvent-free, unmodified bisphenol A epoxy resin

Viscosity	at 25°C	ISO 9371	mPa s	9000 - 12000
Epoxy content		ISO 3001	equiv/kg	5.20 - 5.35
Density	at 25°C	ISO 1675	g/cm³	1.15 - 1.20
Refraction	at 25°C	DIN 53491	--	1.5685 -1.5720
Flash point		DIN 51758	°C	> 200
Vapour pressure	at 20°C	(Knudsen)	Pa	< 0.01
	at 60°C	(Knudsen)	Pa	appr. 1

Hardener HY 905 — Liquid, modified, carboxylic anhydride curing agent

Viscosity	at 25°C	ISO 9371	mPa s	150 - 250
Density	at 25°C	ISO 1675	g/cm³	1.18 - 1.22
Refraction	at 25°C	DIN 53491	--	1.4490 -1.5030
Flash point		DIN 51758	°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	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		DIN 51758	°C	82
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 9371	mPa s	1000 - 1800
Density	at 25°C	ISO 1675	g/cm³	1.00 - 1.05
Flash point		DIN 51758	°C	97
Vapour pressure	at 20°C	(Knudsen)	Pa	appr. 1
	at 60°C	(Knudsen)	Pa	appr. 50

Remarks

Hardener 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 at 18-25°C, in tightly sealed and dry original containers. Under these conditions, the shelf life will correspond to the expiry date stated on the label. Product specific advise regarding storage can be found on product 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

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, depending on formulation. Intermittent agitation during storage is advisable to prevent filler sedimentation.

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 properties 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.

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

Processing Viscosities

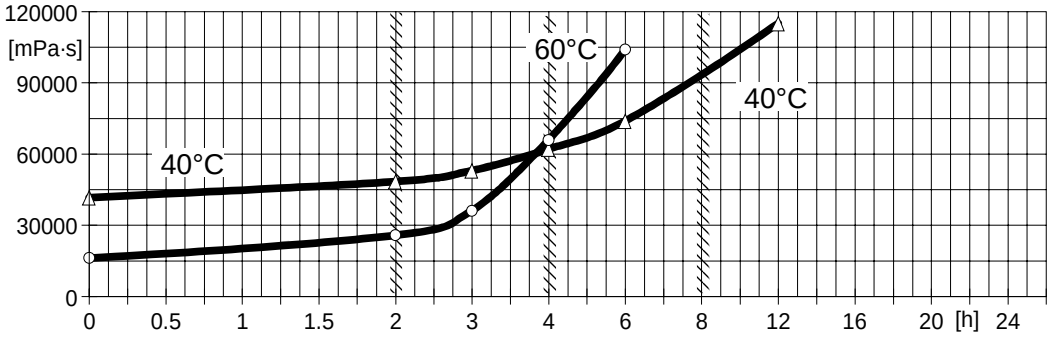

Fig.4.1: **Viscosity increase at 40 and 60°C** (measurements with Rheomat 115)
(Shear rate D = 10 s^{-1})

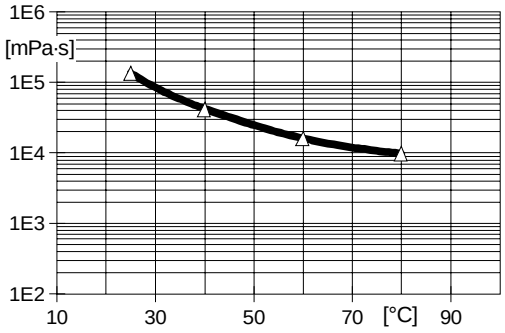

Fig.4.2: **Initial viscosity in function of temperature**
(measurements with Rheomat 115, D =10 s^{-1})

Gelation-/Cure Times

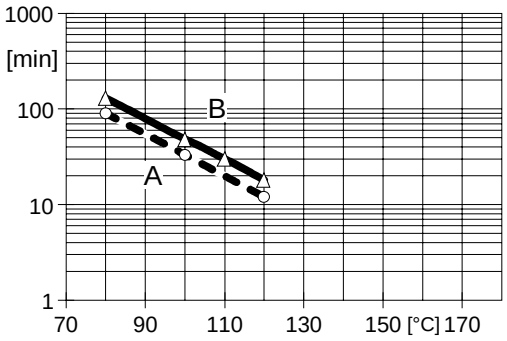

Fig.4.4: **Geltime measured with Gelnorm Instrument in function of temperature**
(DIN 16945/6.3.1)
A = 1 pbw DY 061 / B = 0.5 pbw DY 061.

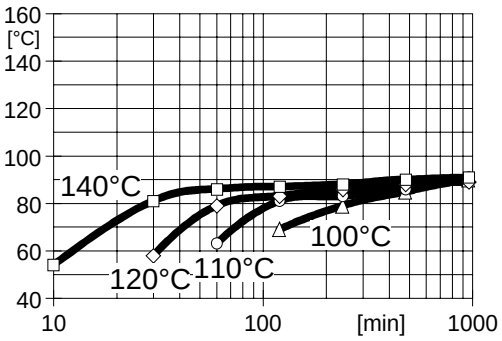

Fig.4.5: **Glass transition temperature in function of the cure time**
(isothermic reaction, IEC 1006)

Mechanical and Physical 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

Tensile strength	ISO R 527	MPa	75 - 85
Elongation at break	ISO R 527	%	0.9 - 1.1
E modulus from tensile test	ISO R 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_{IC})		$MPa \cdot m^{1/2}$	2.7 - 2.9
Specific energy at break (G_{IC})		J/m²	570 - 620
Martens temperature	DIN 53458	°C	80 - 90
Glass transition temperature (DSC)	IEC 1006	°C	90 - 100
Coefficient of linear thermal expansion	DIN 53752		Fig. 5.2
Mean value for temperature range: 20 - 60°C		K^{-1}	$31 - 36 \cdot 10^{-6}$
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 60126		Fig.7.1 - 7.4
Thermal ageing class (20000h)	IEC 60085	class	F
Water absorption (specimen: 50x50x4 mm)	IEC 60062		
10 days at 23°C		% by wt.	0.1 - 0.2
60 min at 100°C		% by wt.	0.1 - 0.2
Decomposition temperature (heating rate: 10K/min)			
	DTA	°C	≥ 350
Density	DIN 55990	g/cm³	1.8 - 1.9
Filler load	by wt.	%	66

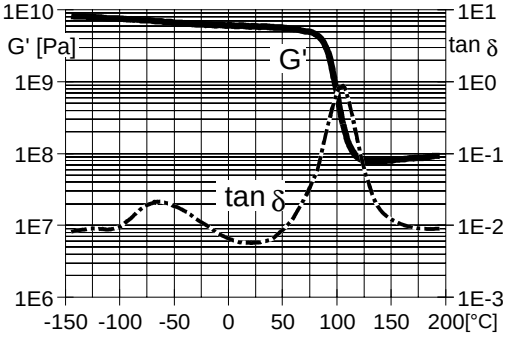

Fig.5.1: **Shear modulus (G') and mechanical loss- factor (tan δ) in function of temperature** (measured at 1 Hz.)
(ISO 537/ DIN 53445, method C)

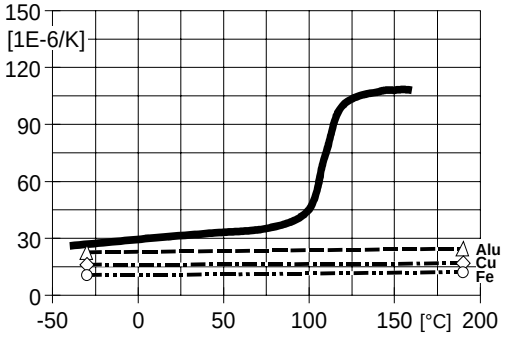

Fig.5.2: **Coefficient of linear thermal expansion (α) in function of temperature**
(reference temperature: 23°C, DIN 53752)

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 600243	kV/mm	18 - 22
Specimen with embedded Rogowski electrodes			
gap: 2 mm	Method Ciba	kV/mm	36 - 41
Diffusion breakdown strength	DIN/ VDE 0441/1	class	HD 2
Temperature of specimen after test		°C	23
HV arc resistance	ASTM D 495	s	185 - 195
Tracking resistance	IEC 60112		
with test solution A			CTI >600-0.0
with test solution B			CTI >600M-0.0
Electrolytic corrosion	DIN 53489	grade	A1

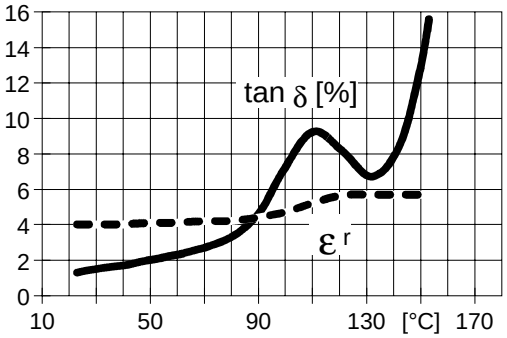

Fig.6.1: **Loss factor (tan δ) and dielectric constant (εr) in function of temperature**
(measurement frequency: 50 Hz, IEC 60250/ DIN 53483)

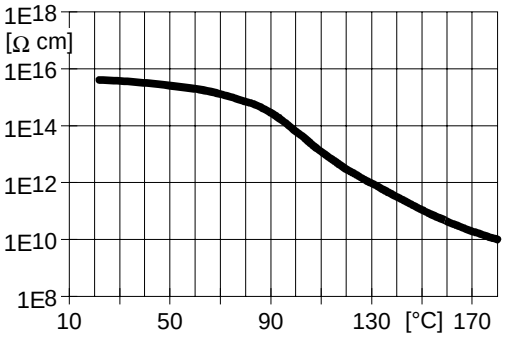

Fig.6.2: **Volume resistivity (ρ) in function of temperature**
(measurement voltage: 1000 V, IEC 60093/ DIN 53482)

Special Properties and Values (guideline values)

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

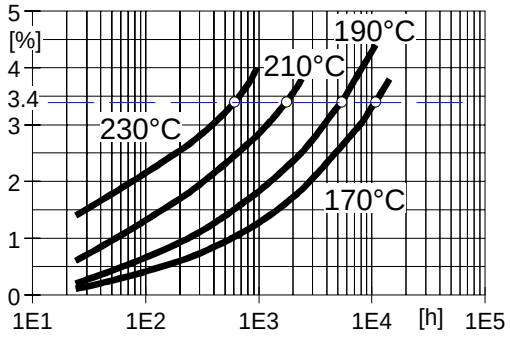

Fig.7.1: **Weight loss** (specimen: 50x50x3 mm)
(limit: 3.4%)

Thermal Endurance Profile acc. IEC 60212

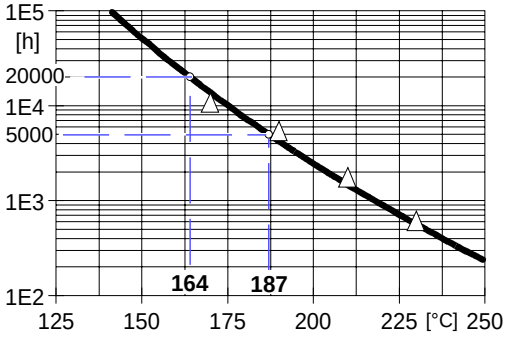

Fig.7.2: **TI 177 / 203** (weight loss 3.4%)
(Araldite F/ HY 905/ DY 040/ DY 061/ SiO_2 100/ 100/ 20/ 1/ 430 pbw)

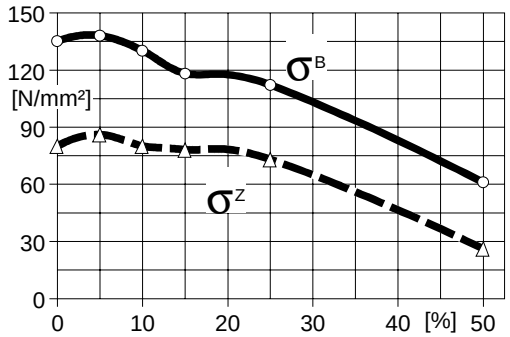

Fig.7.3: **Tensile strength (σ_Z) (ISO R 527) and Flexural strength (σ_B) (ISO 178) at 23°C with different parts (%) of Flexibilizer DY 040.**

Influence of Flexibilizer DY 040

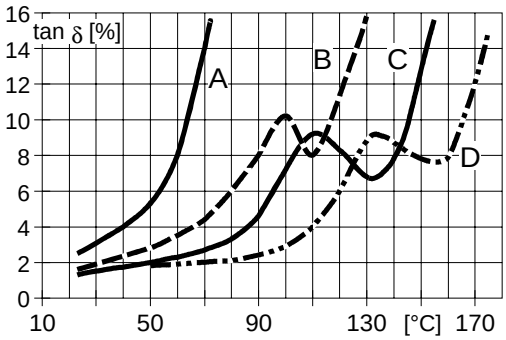

Fig.7.4: **Loss factor (tan δ) in f (T) with: A=25, B=20, C=10, D=0 % of Flex. DY 040**
IEC 60250 (measurement frequency: 50 Hz)

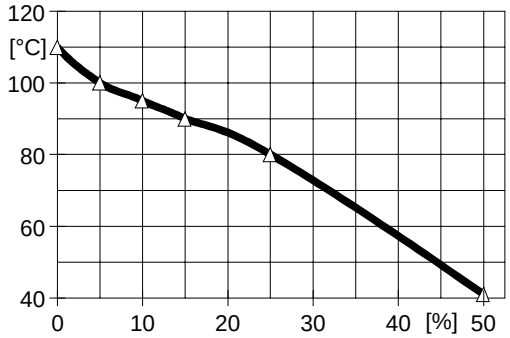

Fig.7.5: **Glass transition temperature**
(IEC 61006) with different parts (%) of Flexibilizer DY 040

Thermal Shock Resistance

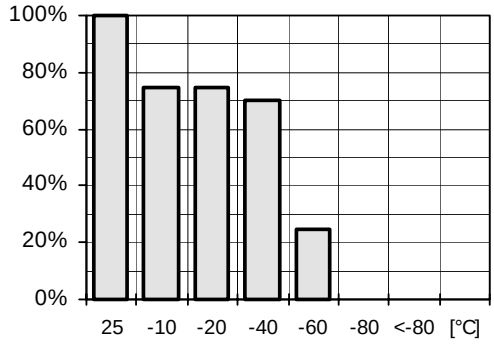

Fig.7.5: **Crack resistance / Temperature shock test**
Passed specimen (%) in function of the temperature steps
Mean failure temperature: - 49°C
Embedded metal parts with 2 mm radius

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 of Ciba Specialty Chemicals (Publ. No. 24264/e).

Handling precautions

Safety precautions at workplace:	
protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
goggels/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
Cleaning 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.

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APPROVED TO ISO 9000 ff

All recommendations for use of our products, whether given by us in writing, verbally, or to be implied from results of tests carried out by us are based on the current state of our knowledge. Notwithstanding any such recommendations the Buyer shall remain responsible for satisfying himself that the products as supplied by us are suitable for his intended process or purpose. Since we cannot control the application, use or processing of the products, we cannot accept responsibility therefore. The Buyer shall ensure that the intended use of the products will not infringe any third party's intellectual property rights. We warrant that our products are free from defects in accordance with and subject to our general conditions of supply.