
® Araldite Casting Resin System

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.

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

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 chemical influences

Properties

Araldite F	Liquid, solvent-free, unmodified bisphenol A epoxy resin				
Viscosity	at 25°C	ISO 12058	mPa s	9000 - 12000	
Epoxy content		ISO 3001	equiv/kg	5.20 - 5.35	
Density	at 25°C	ISO 1675	g/cm ³	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	mPa s	150 - 250	
Density	at 25°C	ISO 1675	g/cm ³	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	mPa s	60 - 90	
Density	at 25°C	ISO 1675	g/cm ³	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	mPa s	1000 - 1800	
Density	at 25°C	ISO 1675	g/cm ³	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	

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 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

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.

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 $\leq 0.2\%$.

System Preparation

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.

Specific Instructions

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 (T_g). 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

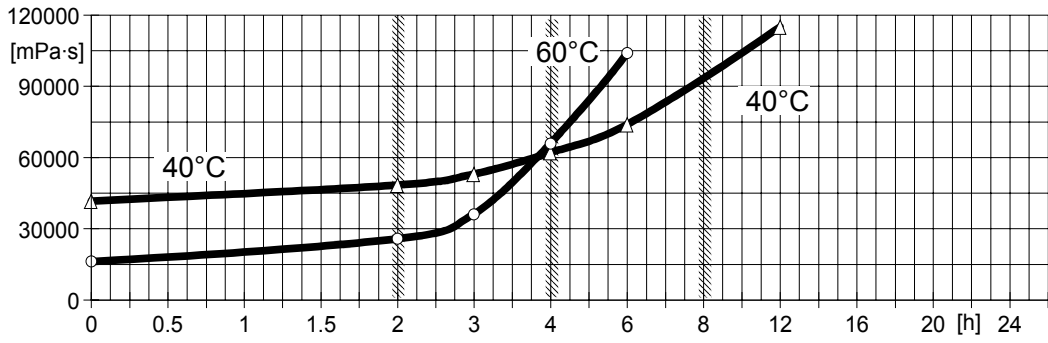


Fig.4.1: **Viscosity increase at 40 and 60°C** (measurements with Rheomat 115)
 (Shear rate $D = 10 \text{ s}^{-1}$)

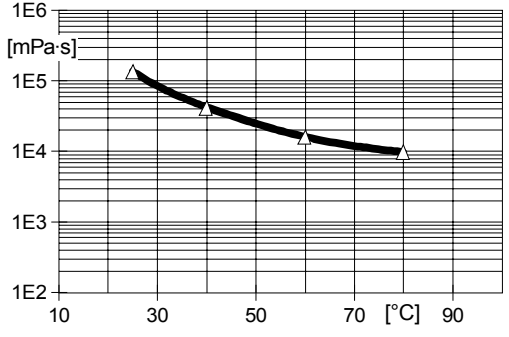


Fig.4.2: **Initial viscosity as a function of temperature**
 (measurements with Rheomat 115, $D = 10 \text{ s}^{-1}$)

Gelation-/Cure Times

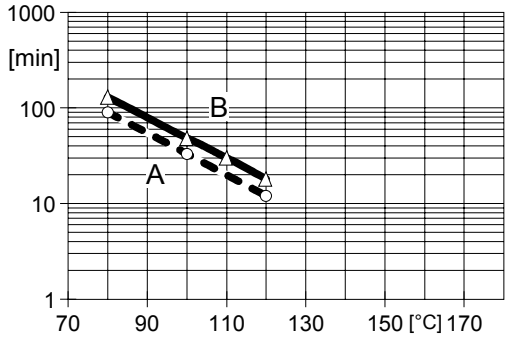


Fig.4.4: **Geltime measured with Gelnorm Instrument as a function of temperature**
 (ISO 9396)
 A = 1 pbw DY 061 / B = 0.5 pbw DY 061.

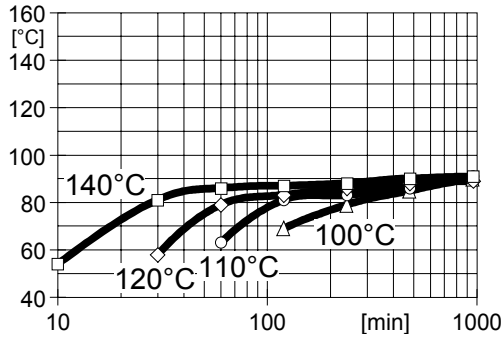


Fig.4.5: **Glass transition temperature as a function of the cure time**
 (isothermic reaction, ISO 11357-2)

Mechanical and Physical Properties (guideline values)

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 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/m ²	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/m ²	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/cm ³	1.80 - 1.90

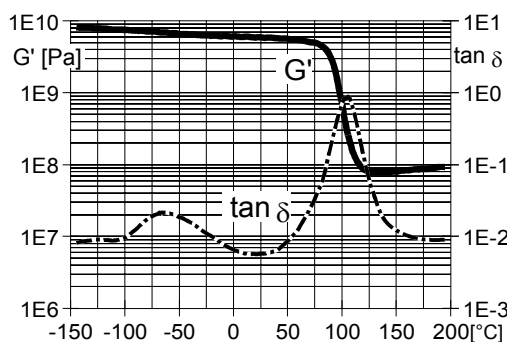


Fig.5.1: **Shear modulus (G') and mechanical loss-factor ($\tan \delta$) as a function of temperature** (measured at 1 Hz.) (ISO 6721-7, method C)

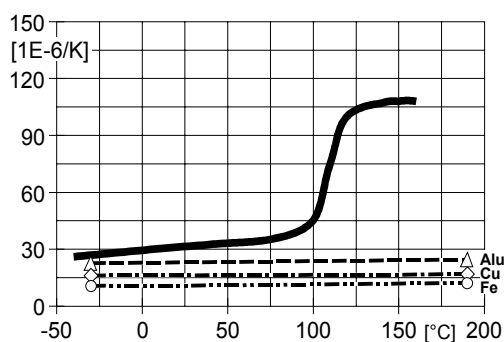


Fig.5.2: **Coefficient of linear thermal expansion (α) as a function of temperature** (ISO 11359-2, reference temperature: 23°C)

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 ($\varnothing = 25$ 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

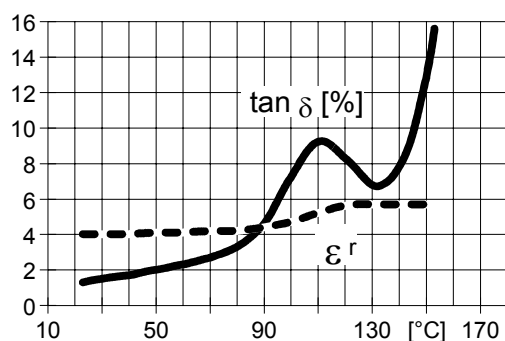


Fig.6.1: **Loss factor ($\tan \delta$) and dielectric constant (ϵ_r) as a function of temperature**
measurement frequency: 50 Hz,
IEC 60250/ DIN 53483)

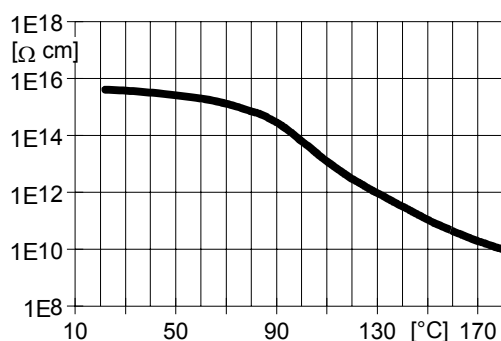


Fig.6.2: **Volume resistivity (ρ) versus function of temperature**
(measurement voltage: 1000 V,
IEC 60093/ DIN 53482)

Special Properties and Values (guideline values)

System tested:

Araldite F / Aradur HY 905 / DY 040 / DY 061 / Silica

Mix ratio: 100 / 100 / 10 / 1 / 410

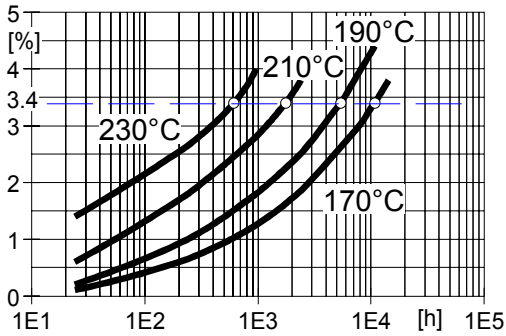


Fig. 7.1: **Weight loss** (specimen: 50x50x3 mm) (limit: 3.4%)

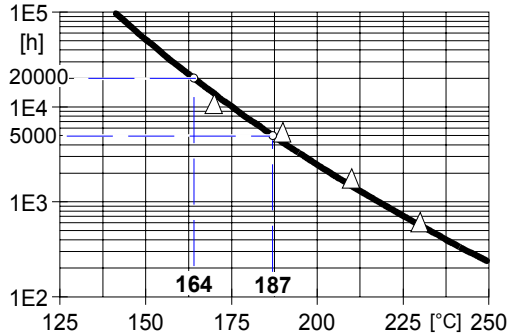


Fig. 7.2: **TI 164 / 187** (weight loss 3.4%) (Araldite F/Aradur HY 905/ DY 040/ DY 061/ SiO2 100/ 100/ 20/ 1/ 430 pbw)

Thermal Endurance Profile IEC 60216

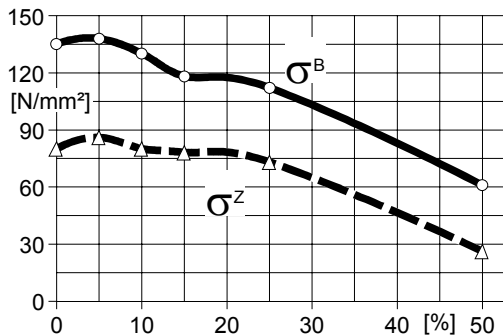


Fig. 7.3: **Tensile strength (σ_z) (ISO R 527) and Flexural strength (σ_B) (ISO 178)** at 23°C with different parts (%) of Flexibilizer DY 040.

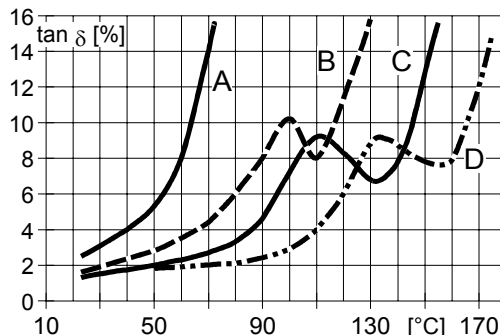


Fig. 7.4: **Loss factor (tan δ) in f(T) with:** A=25, B=20, C=10, D=0 % of Flex. DY 040 IEC 60250 (measurement frequency: 50 Hz)

Influence of Flexibilizer DY 040

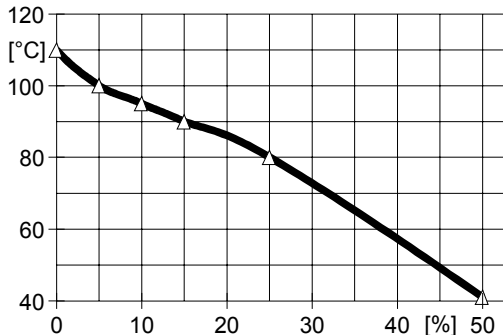


Fig. 7.5: **Glass transition temperature** (ISO 11357-2) with different parts (%) of Flexibilizer DY 040

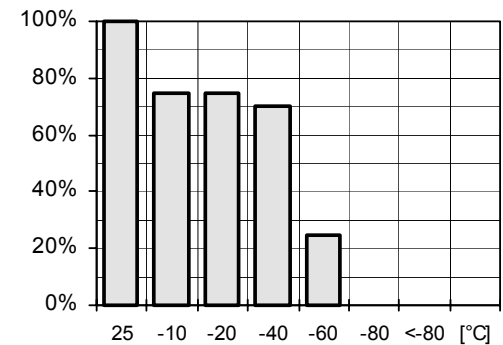


Fig. 7.5: **Crack resistance / Temperature shock test**
Passed specimen (%) as a function of the temperature steps
Mean failure temperature: - 49°C
Embedded metal parts with 2 mm radius

Thermal Shock Resistance

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
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.

Note

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