Ciba Specialty Chemicals

Performance Polymers
Electro & Electronic

Encapsulating

Ciba

®Araldite Casting Resin System

Araldite F
Araldite CY 221
Hardener HY 905
Hardener HY 920
Accelerator DY 062
Fillers

Casting resin systems for processing and curing at elevated temperature
High filler addition possibility, if required

Applications

Encapsulating, potting and/or impregnating of low voltage and electronic components

Processing

Casting / Impregnating

Properties

The flexibility of castings can be adapted to requirements by combining Araldit F and CY 221
Low tendency to cracking
Castings possess high or low flexibility as desired and have little tendency to cracking
Good resistance to thermal ageing

Edition: **July 1998**
Replaces edition: February 1995

Product data

(Guideline values)

Unmodified, medium viscosity solvent free epoxy resin

Araldite F

Viscosity	at 25°C		mPa s	11 000
Specific gravity	at 25°C		g/cm³	1.17
Flash point		DIN 51 758	°C	>200
Epoxy content			Eq/kg	5.25

As supplied form	Pale yellow liquid
Hazardous decomposition products	Carbon monoxide, carbon dioxide and other toxic gases and vapours if burned
Disposal	Regular procedures approved by national and/or local authorities

Modified, low viscosity solvent free epoxy resin

Araldite CY 221

Viscosity	at 25°C		mPa s	ca. 450
Specific gravity	at 25°C		g/cm³	1.15
Flash point		DIN 51 758	°C	190-200
Epoxy content			Eq/kg	4.05

As supplied form	Clear, pale yellow liquid
Hazardous decomposition products	Carbon monoxide, carbon dioxide and other toxic gases and vapours if burned
Disposal	Regular procedures approved by national and/or local authorities

Modified, low viscosity hardener based on carboxylic acid anhydrides

Hardener HY 905

Viscosity	at 25°C		mPa s	ca. 200
Specific gravity	at 25°C		g/cm³	1.2
Flash point		DIN 51 758	°C	150

As supplied form	Yellow or amber liquid
Hazardous decomposition products	Carbon monoxide, carbon dioxide and other toxic gases and vapours if burned
Disposal	Regular procedures approved by national and/or local authorities

Product data

(Guideline values)

Modified hardener based on anhydrides

Hardener HY 920	Viscosity	at 25°C		mPa s	3400
	Specific gravity	at 25°C		g/cm³	1.03
	Flash point		DIN 51 758	°C	155-160
	As supplied form		Yellow liquid		
	Hazardous decomposition products		Carbon monoxide, carbon dioxide and other toxic gases and vapours if burned		
	Disposal		Regular procedures approved by national and/or local authorities		

Amine based accelerator

Accelerator DY 062	Viscosity	at 25°C		mPa s	≤10
	Specific gravity	at 25°C		g/cm³	0.9
	Flash point		DIN 51 758	°C	59
	As supplied form		Clear, yellow to brown liquid		
	Hazardous decomposition products		Carbon monoxide, carbon dioxide and other toxic gases and vapours if burned		
	Disposal		Regular procedures approved by national and/or local authorities		

Araldite Colouring Pastes

Normally, the colouring paste is added to the resin component and mixed with the latter until the colour is evenly distributed. In prefilled, highly viscous resin components homogenization of the colouring paste can be facilitated by heating.
Couloured resin components as well as mixtures of various colouring pastes with resins are stable in storage over long periods (see instruction sheet for these products, Publ. No. 24 849/e).

Storage

Store the components in a dry place at 18-25°C, 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

The resin component should be stirred and homogenized in the original container before use.
The casting mix is best prepared by heating the resin up to 40-50°C before stirring in the hardener. Brief degassing of the mix under 5-10 mbar vacuum improves the mixture homogeneity and enhances the dielectric properties of the castings.

Unfilled systems

The very low viscosity Araldite CY 221 yields flexible castings, the moderately viscous Araldite F harder ones. The viscosity of the casting resin system and the hardness of the casting can be varied by adjusting the mix ratio of the two resin.
Additional flexibility can be obtained by using Hardener HY 920 in place of Hardener HY 905.
Premixes of the two epoxy resins have a shelf life of several months. On the other hand, the shelf life of mixtures of the two hardeners is limited, so that they should be made up in all cases immediately prior to their processing with the resins.
In most applications it is desirable to add the Accelerator DY 062. This allows of curing at lower temperatures with correspondingly reduced shrinkage. The amount of accelerator added depends on the desired pot life as well as on other processing factors such as temperature and duration of curing, demoulding time and so on. As a rule the proportion is 0.2-2.0 parts by weight in 100 parts of resin.
Depending on the proportion of accelerator, the pot life of mixtures at room temperature is 1-4 days.
The resin and accelerator are first thoroughly mixed, after which the hardener and any other components such as fillers, colouring pastes, etc., are added and intensively mixed. This sequence must be strictly adhered to if failures are to be avoided.

Effects obtained with fillers

Filled systems

The addition of powdered inorgainc fillers such as silica flour, microdol, chalk flour, Al_2O_3 etc., has been found to offer considerable advantages in many applications. Specifically, the use of such fillers:

– enhance important mechanical and electrical properties
– reduce shrinkage and exothermic temperature rise during gelling and curing
– impart a lower coefficient of thermal expansion
– improve thermal conductivity
– impart a greater modulus of elasticity while reducing elongation at break

The flame-retardant properties of castings can be enhanced by adding Filler DT 079 ($Al_2O_3 \cdot 3H_2O$), providing that some impairment of mechanical and dielectrical properties is acceptable.

Silica flour is the filler that imparts the best mechanical properties but makes the castings more difficult to machine.

Microdol or chalk flour impart the test dielectric properties. Their quality should be checked to ensure consistant quality and they should be predried when demanding dielectric specifications must be met.

Fillers of suitable quality have no effect on curing times, but gel times are prolonged due to damping of exothermic temperature rise.

Ciba also produces a wide range of pre-filled encapsulating systesm. Due to type, quantity and quality of the mineral fillers the encapsulating systems are manufactured according to customer required properties. The fillers we use are specially pre-dried and placed in a vacuum. Therefore, our filled products are of higher consistent quality and require minimum preparation.

We recommend the use of pre-filled encapsulating systems in all applications that require high reliability and economical processing.

Processing

Unfilled systems

Mix ratio

	1	2	3	4	5	6
	Parts by weight					
Araldite F	100	50	–	100	50	–
Araldite CY 221	–	50	100	–	50	100
Hardener HY 905	100	90	80	–	–	–
Hardener HY 920	–	–	–	160	145	130
Accelerator DY 062	1	1	1	1	1	1

Processing data
(Guideline values)

	1	2	3	4	5	6
Initial viscosity (Hoeppler)						
mPa s at 60°C	80	50	45	–	–	–
at 80°C	55	45	35	125	100	75
Pot life (Hoeppler)						
h at 60°C/1500 mPa s	2 3/4	4 1/2	5	–	–	–
at 80°C/1500 mPa s	1 3/4	1 1/4	1	1 3/4	2	2 1/2
Minimum curing time						
h at 80°C*	≥24	≥24	≥24	≥24	≥24	≥24
h at 100°C	3-4	4	4-5	4-6	5-7	6-8
h at 120°C	2	2	2-3	2-3	3	3-4

*If a long curing time is acceptable (1-2 days), curing is possible at 80°C. The minimum and optimum curing conditions are best determined by practical tests. To avoid internal stresses arising in the castings, fairly large volumes casting mixture, depending on the proportion of accelerator used, should be gelled at temperatures around 100°C and then cured at higher temperature.

Processing

Filled systems

Mix ratio

	7	8	9	10	11	12
	Parts by weight					
Araldite F	100	50	–	100	50	–
Araldite CY 221	–	50	100	–	50	100
Hardener HY 905	100	90	80	–	–	–
Hardener HY 920	–	–	–	160	145	130
Accelerator DY 062	1	1	1	1	1	1
Silica Flour K 13	370	350	330	390	370	350
Filler content %	65	65	65	60	60	60

Processing data
(Guideline values)

	7	8	9	10	11	12
Initial viscosity (Hoeppler)						
mPa s at 60°C	14 000	8000	3500	–	–	–
at 80°C	4000	3000	1350	4000	3000	1500
Pot life (Hoeppler)						
h at 60°C/15 000 mPa s	1/4	1 1/2	2 1/2	–	–	–
at 80°C/15 000 mPa s	1/2	3/4	1 1/4	1 1/2	1 3/4	2 1/2
Minimum curing time						
h at 80°C*	≥24	≥24	≥24	≥24	≥24	≥24
h at 100°C	3-4	4	4-5	4-6	5-7	6-8
h at 120°C	2	2	2-3	2-3	3	3-4

* If a long curing time is acceptable (1-2 days), curing is possible at 80°C. The minimum and optimum curing conditions are best determined by practical tests. To avoid internal stresses arising in the castings, fairly large volumes of casting mixture, depending on the proportion of accelerator used , should be gelled at temperatures around 100°C and then cured at higher temperature.

Properties

Guideline values determined on standard test specimens
Curing of systems 1, 2, 3, 7, 8, 9: 12 h/60°C + 10 h/120°C
Curing of systems 4, 5, 6, 10, 11, 12: 4 h/80°C + 10 h/120°C

Unfilled systems

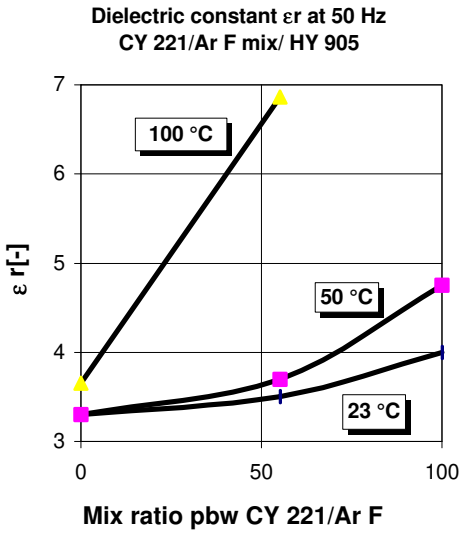
		1	**2**	**3**	**4**	**5**	**6**
Bending test (ISO 178)							
Strength (max.)	MPa	130	115	65	55	too soft	too soft
Strength (breaking)	MPa	110	70	35	25		
Surface strain (F max.)	%	6	5	5	6		
Surface strain (breaking)	%	10	12	14	19		
Impact bending test (ISO 179)							
Impact strength	kJ/m^2	20	25	55	60		
Tensile test (ISO/R 527)							
at 23°C							
Strength (max.)	MPa	70	65	35	35	12	2
Strength (breaking)	MPa	70	60	25	25	12	2
Extension (F max.)	%	2.5	3.5	4.5	3.5	100	50
Extension (breaking)	%	–	6	55	10	100	50
at 0°C							
Strength (max.)	MPa					40	20
Strength (breaking)	MPa					25	20
Extension (F max.)	%					5	80
Extension (breaking)	%					15	80
at -20°C							
Strength (max.)	MPa					60	50
Strength (breaking)	MPa					45	30
Extension (F max.)	%					5.5	4.5
Extension (breaking)	%					7.5	12.5
Martens dimensional stability under heat (DIN 53 458)	°C	90	60	35	40	too soft	too soft
Electric strength (IEC 243)							
2 mm plate (50 Hz)							
Instantaneous value	kV/mm	20	20	19	21	21	20
1-min-value	kV/mm	17	16	15	17	16	14
Arc resistance (ASTM-D 495)	s	85	85	85	70	70	60
Tracking resistance (IEC 112)	VZ	CTI>600	CTI>600	CTI>600	CTI>600	CTI>600	CTI>600
Electrolytic corrosion (DIN 53 489)		Araldite F/HY 221/HY 905/HY 920/DY 062/Fillers **July 1998**					
		A1	AN1.2	AN1.2	AN1.2	**2**grade A1	A1

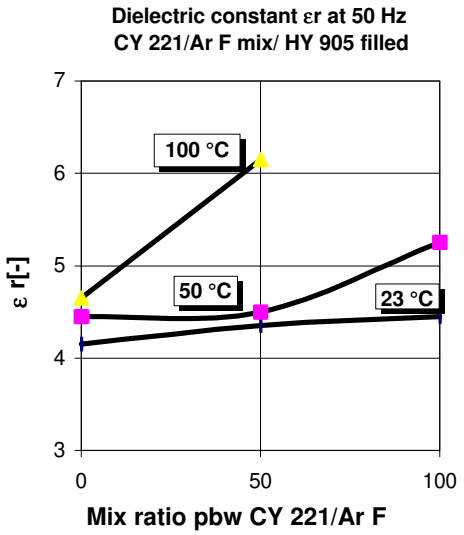
Properties

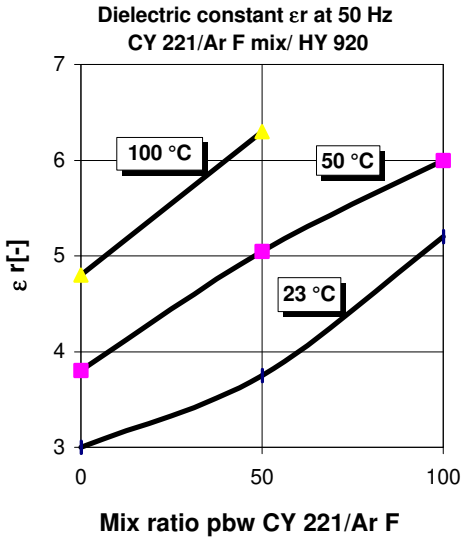
Filled systems

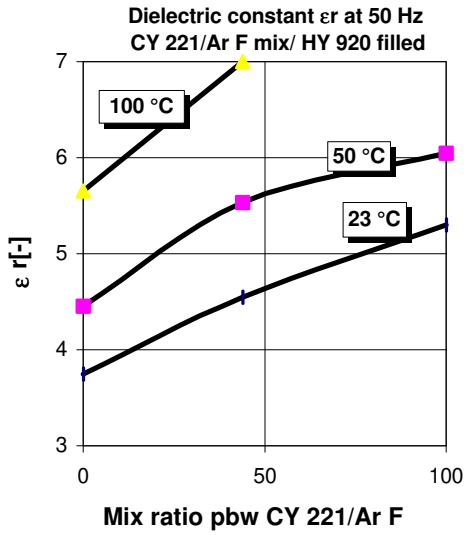
		7	8	9	10	11	12
Bending test (ISO 178)							
Strength (max.)	MPa	100	110	90	75	too soft	too soft
Strength (breaking)	MPa	100	110	90	60		
Surface strain (F max.)	%	1.5	1.5	3.5	3.5		
Surface strain (breaking)	%	1.5	1.5	3.5	7		
Impact bending test (ISO 179)							
Impact strength	kJ/m^2	7	7	7	7		
Tensile test (ISO/R 527)							
at 23°C							
Strength (max.)	MPa	85	80	45	40	13	7
Strength (breaking)	MPa	85	80	45	40	13	7
Extension (F max.)	%	0.8	1.0	1.5	3	25	25
Extension (breaking)	%	0.8	1.0	4.5	4.5	30	25
at 0°C							
Strength (max.)	MPa					50	25
Strength (breaking)	MPa					50	25
Extension (F max.)	%					3.5	15
Extension (breaking)	%					3.5	15
at -20°C							
Strength (max.)	MPa					60	50
Strength (breaking)	MPa					60	50
Extension (F max.)	%					1.5	1.5
Extension (breaking)	%					1.5	1.5
Martens dimensional stability under heat (DIN 53 458)	°C	100	70	45	40	too soft	too soft
Electric strength (IEC 243)							
2 mm plate (50 Hz)							
Instantaneous value	kV/mm	22	22	21	22	20	20
1-min-value	kV/mm	16	15	15	15	14	14
Arc resistance (ASTM-D 495)	s	185	190	190	185	185	165
Tracking resistance (IEC 112)	VZ	CTI>600	CTI>600	CTI>600	CTI>600	CTI>600	CTI>600
Electrolytic corrosion (DIN 53 489)	grade	A1	A1	A1	A1	AN1.4	AN1.4

Dielectric constant ε_r, 50 Hz (DIN 53 483)

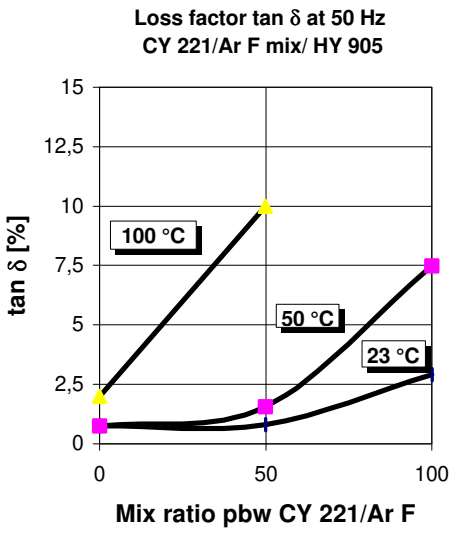


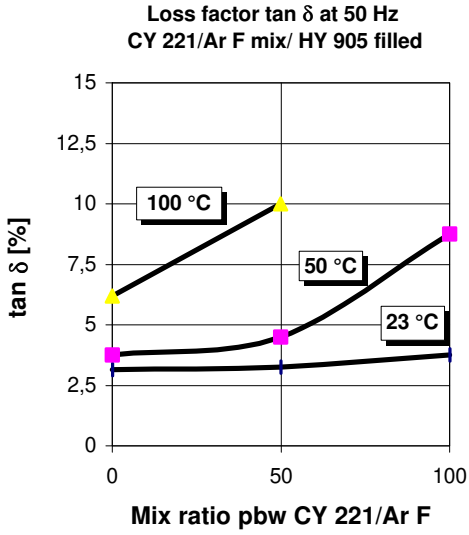


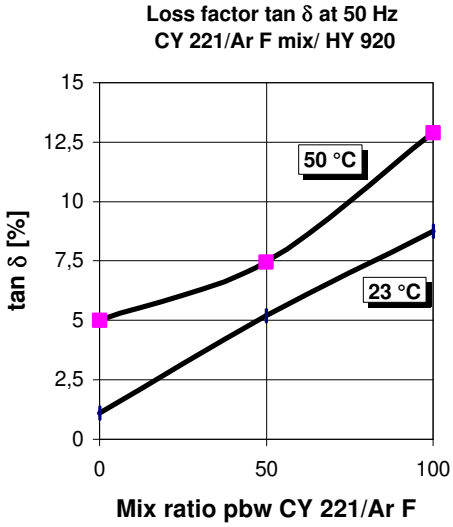


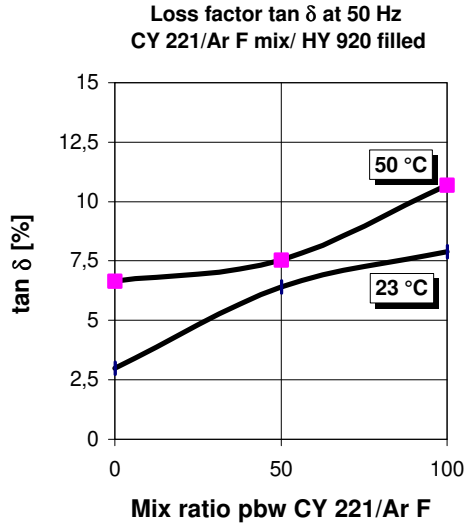


Dielectric loss factor
tan δ, 50 Hz
(DIN 53 483)

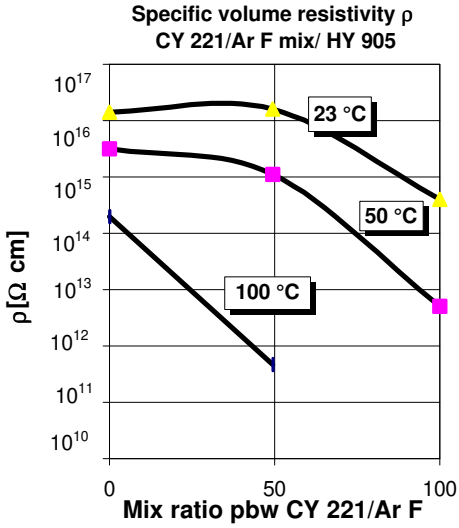


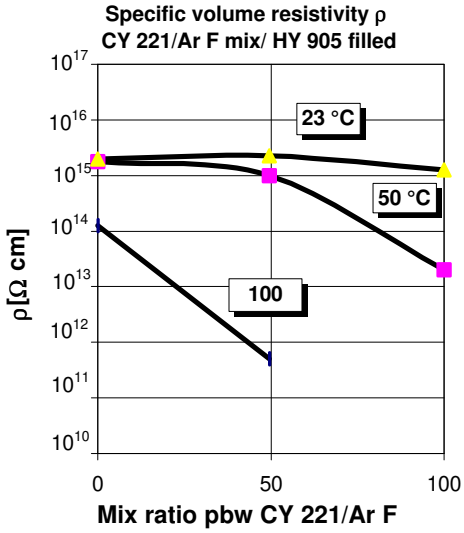


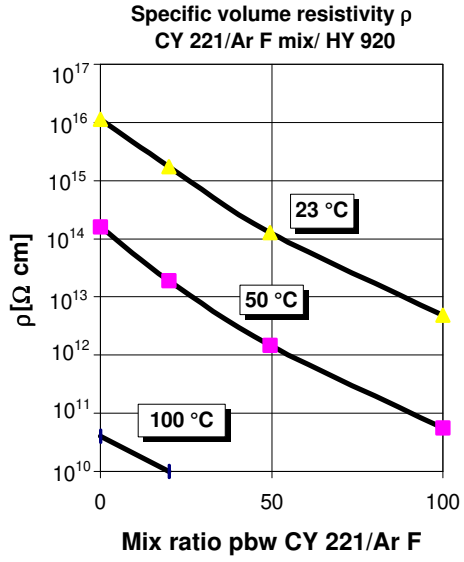


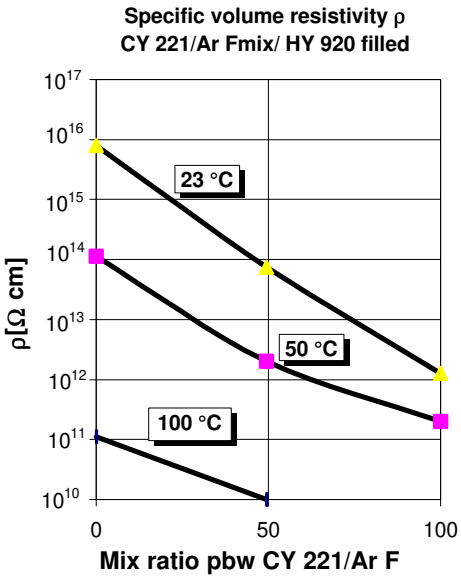


Specific volume resistivity ρ
(DIN 53 482)

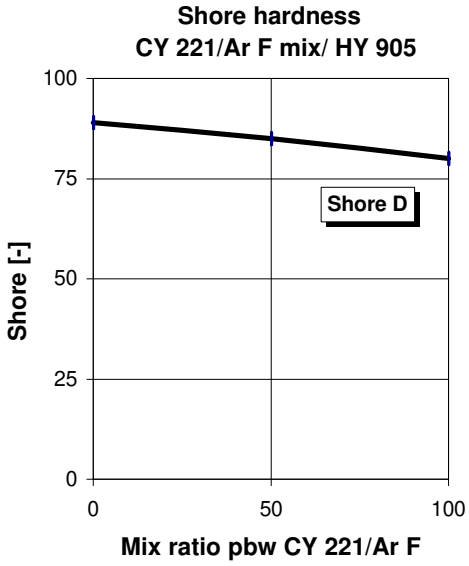


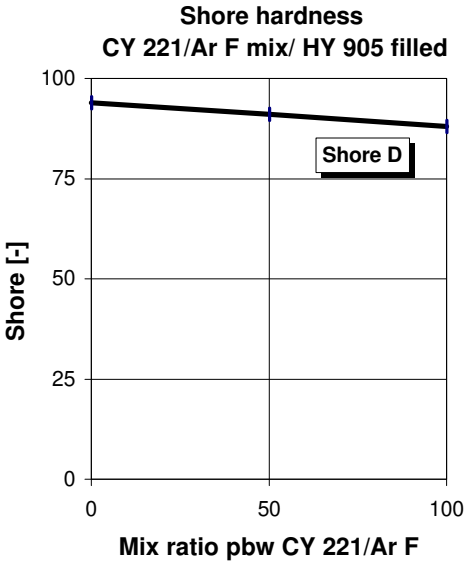


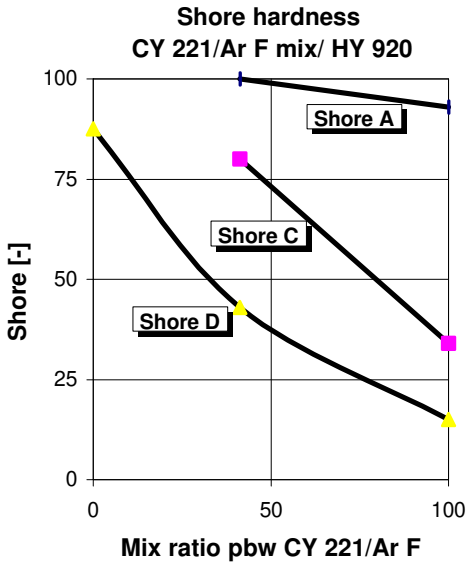


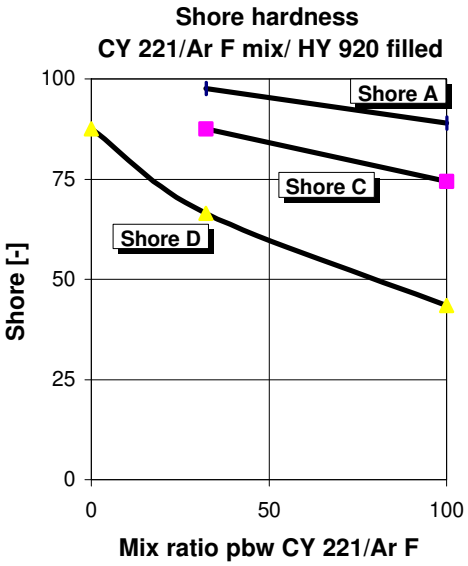


Shore hardness
(DIN 53 505)

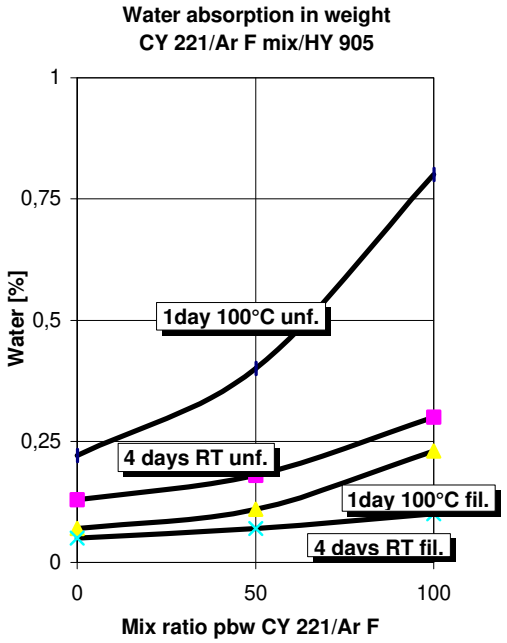


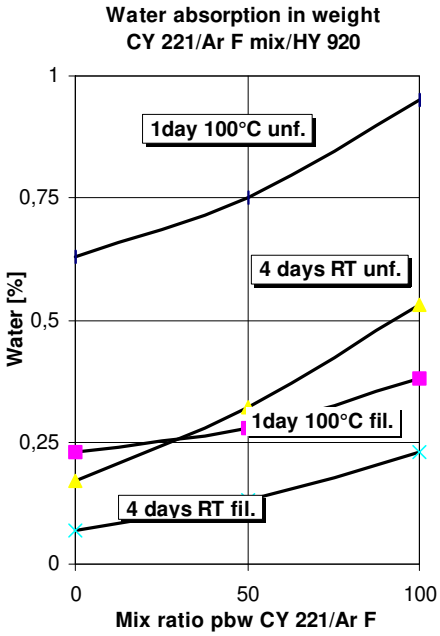






Water absorption





Thermal ageing

The system Araldite F/Hardener HY 920/A ccelerator DY 062 was subjected to a thermal ageing test in accordance with DIN 16 946. Although the system has a Martens heat temperature of only 35-40°C it displays exceptionally good ageing resistance at high temperatures.

The temperature limits for 25'000 h ageing are respectively:
105°C Surface strain (70 % of initial value)
120°C Weight loss (3% of initial value)

Notes

Values determined by testing standard specimens are not directly indicative of the performance to be expected of a casting or laminate. Before initiating a production run, manufacturers, especially those of encapsulated components for electrical applications, should first carry out their own preliminary tests using prototype models.

Industrial hygiene

Mandatory and recommended industrial hygiene procedures should be followed when-ever 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
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 beakers, 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.