

WHA YU INDUSTRIAL CO., LTD. (HEAD OFFICE)
TAI HWA ELECTRONIC CO., LTD.(CHINA)
SHANGHAI HUA YU ELECTRONIC CO., LTD.(CHINA)
AEON TECH CO., LTD. (CHINA)

SPECIFICATION FOR APPROVAL

CUSTOMER: 環隆電氣股份有限公司

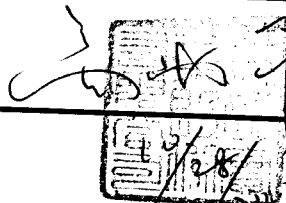
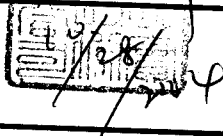
PART NAME: 2.4GHz 5dBi Antenna

PART NO.:

REVISION:

W. Y. P/NO.: C492-510053-A

REV.: X1

	MANUFACTURER SIGNATURE	CUSTOMER SIGNATURE
APPROVED BY :		
DATE :		

WHA YU GROUP

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Fax: + 86-512-63627981

High Gain Antenna

Specification

1. Electrical Properties :

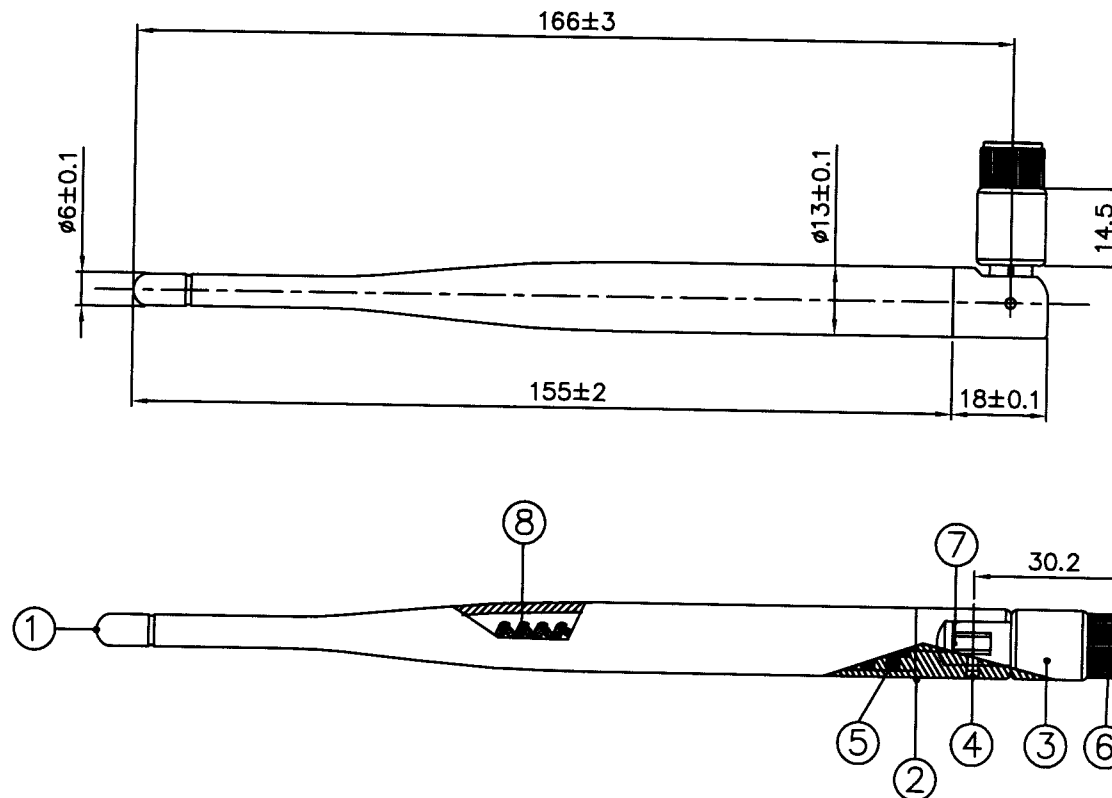
- 1.1 Frequency Rang..... 2.4GHz ~ 2.5GHz
- 1.2 Impedance 50Ω Nominal
- 1.3 VSWR 1.92 Max.
- 1.4 Return Loss..... -10 dB Maximum
- 1.5 Electrical Wave..... $1/2 \lambda$ Diople
- 1.6 Gain..... 5 dBi
- 1.7 Admitted Power..... 1W

2. Physical Properties :

- 2.1 Cable..... RG-178 50Ω
- 2.2 Antenna Cover..... TPE
- 2.3 Antenna Base..... PC
- 2.4 Antenna Base..... PBT
- 2.5 Operating Temp. -20°C ~ +65°C
- 2.6 Storage Temp. -30°C ~ +75°C
- 2.7 Color Black

CG-

REV	DATE	DESCRIPTION
X1	10/28-2003	New Issue



8	Helix	Phosphor Bronze	1	
7	Cable	RG-178 ; 50 Ω	1	
6	Connector	Big SMA Straight Plug Reverse	1	
5	Ground Tube	Brass ; Ni Plated	1	
4	Rivet	Brass ; Cr Plated (Black)	2	
3	Antenna Base	PBT Color : Black	1	
2	Antenna Base	PC Color : Black	1	
1	Antenna Body	TPE Color : Black	1	
NO	DESCRIPTION		QTY	REMARK

CUSTOMER'S SINGATURE

XX.	±5	APPROVED
X.	±1.0	CHECKED
.X	±0.1	DRAWING
.XX	±0.01	
.XXX	±0.005	

CUSTOMER: 環隆電氣股份有限公司

PART NO :

PARTNAME: 2.4GHz High- Gain Antenna

W.Y P/NO : C492-510053-A

REV UNIT FILE :

X1 m/m SHEET : 1/1

Wha Yu
INDUSTRIAL CO.,LTD.

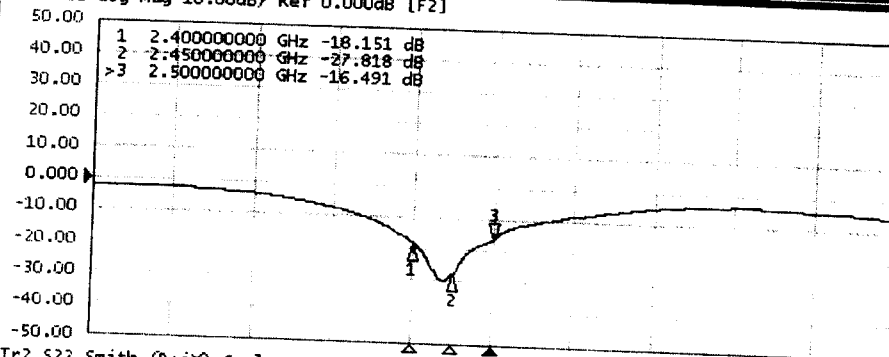
譚裕實業股份有限公司

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ARE THE PROPERTY OF WHA YU AND AS SUCH MAY NOT
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WITHOUT THE WRITTEN CONSENT OF WHA YU.

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mkr/Analyzer 5 Inch State

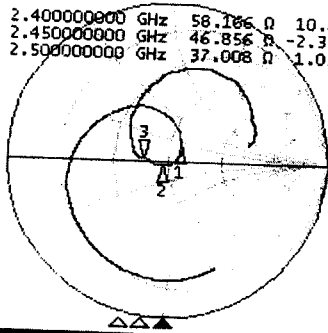
Tr1 S22 Log Mag 10.00dB/ Ref 0.000dB [F2]

1	2.400000000	GHz	-18.151	dB
2	2.450000000	GHz	-27.818	dB
>3	2.500000000	GHz	-16.491	dB



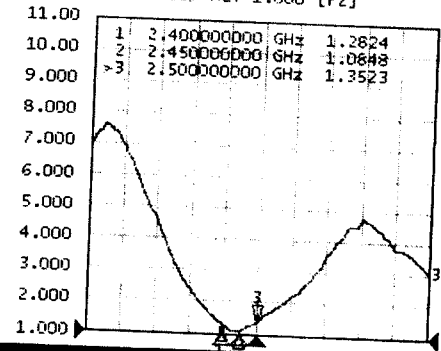
Tr2 S22 Smith (R+jX) Scale 1.000U [F2]

1	2.400000000	GHz	58.186	Ω	10.685	Ω
2	2.450000000	GHz	46.856	Ω	-2.3717	Ω
>3	2.500000000	GHz	37.008	Ω	1.0386	Ω



Tr3 S22 SWR 1.000/ Ref 1.000 [F2]

1	2.400000000	GHz	1.2824
2	2.450000000	GHz	1.0648
>3	2.500000000	GHz	1.3523



1 Start 2.4GHz

IFBW 70 kHz

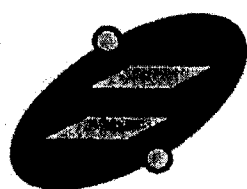
End 2.5GHz

Extensions
cm

Extension Port 1
3.000 ps

Return

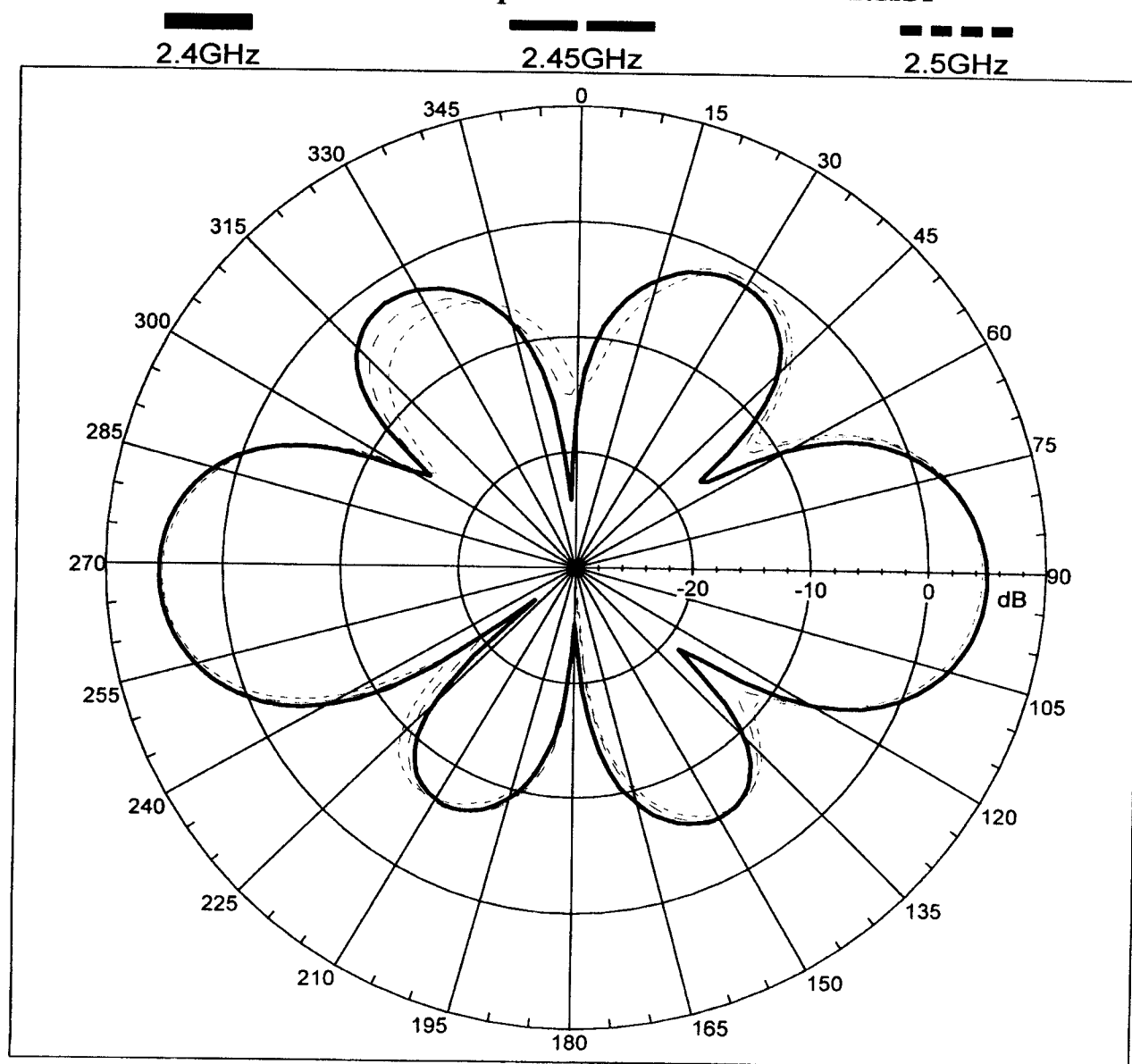
2008-02-11 10:07

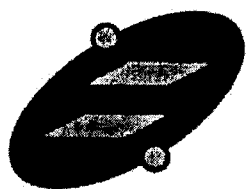


譚裕實業股份有限公司

WHA YU INDUSTRIAL CO., LTD

Far-field amplitude of 2.4GHz.nsi

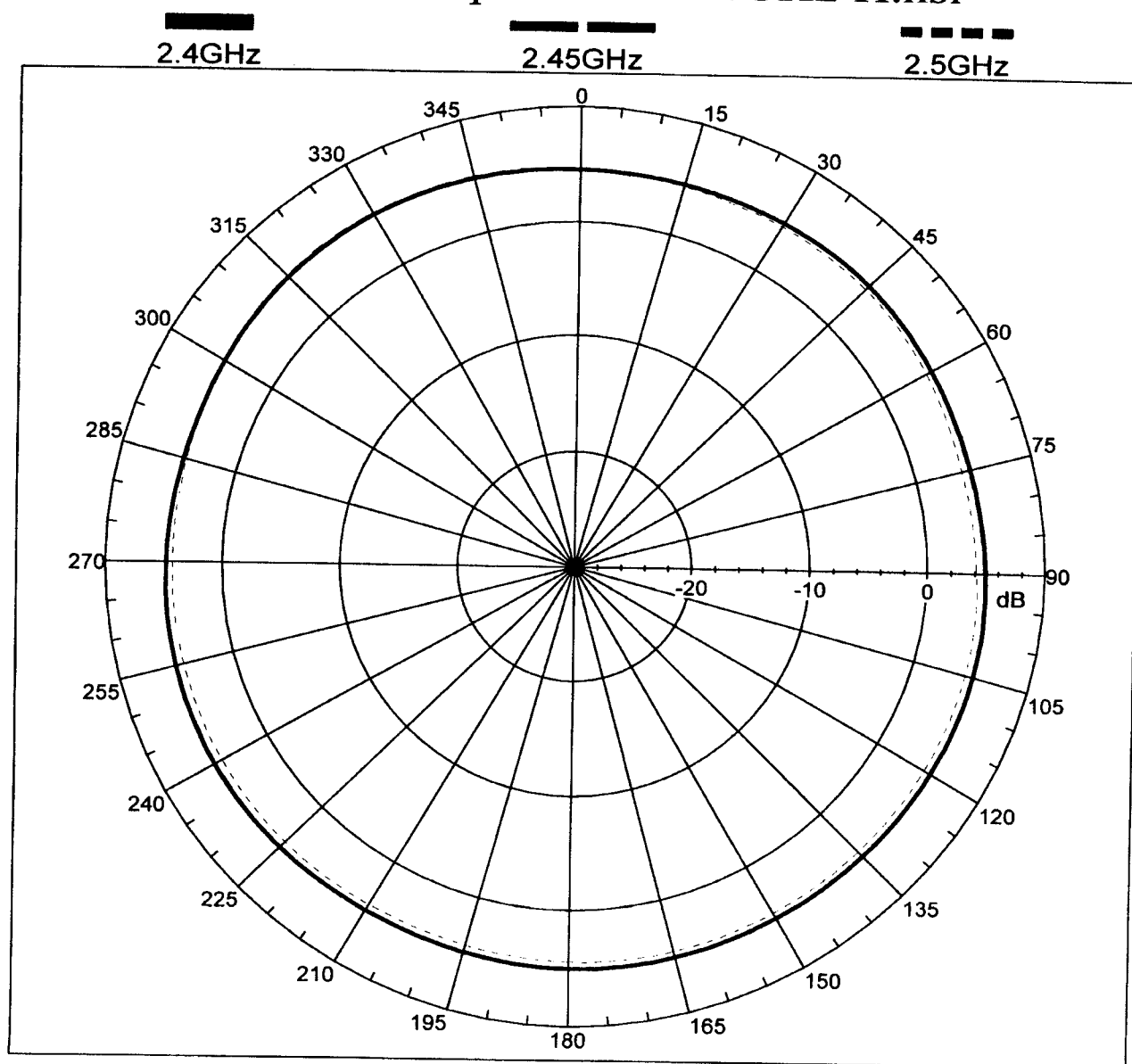




華裕實業股份有限公司

WHA YU INDUSTRIAL CO., LTD

Far-field amplitude of 2.4GHz-H.nsi



Cable Specification

Cable : Mil-C-17 Coaxial Cable RG-178

1. Construction :

- 1 Conductor..... 30AWG 7/38 SCCS
- 2 Dielectric..... PTFE OD : 0.033"±0.002"
- 3 Shielded.....38AWG SPC OD : 0.051" Nominal
- 4 Jacket.....FEP OD : 0.071"±0.004"

2. Physical Properties :

- 1 Weight per 1000ft..... 6.3 lbs Maximum
- 2 Bend Radius.....0.35" Minimum
- 3 Operating Temperature Range -55°C ~ 200°C

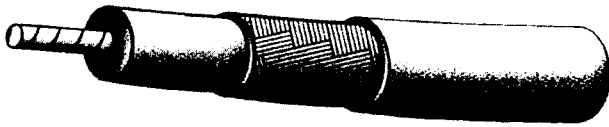
3. Electrical Properties:

- 1 Impedance..... 50±2 ohms
- 2 Capacitance..... 32 pF/ft Maximum
- 3 Cut off Frequency..... 116 GHz
- 4 Attenuation.....45.0 dB/100ft @ 1GHz
64.4 dB/100ft @ 2GHz
79.7 dB/100ft @ 3GHz
92.7 dB/100ft @ 4GHz
104.3 dB/100ft @ 5GHz
115.0 dB/100ft @ 6GHz

Mil-C-17 Coaxial Cable

QPL Approved

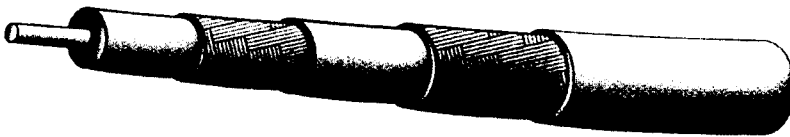
Single braid



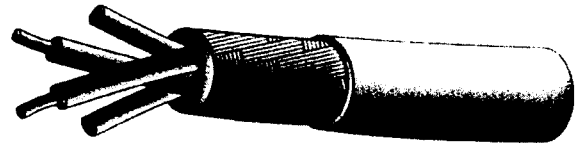
Double braid



Triax



Twinax



Harbour supplies a complete line of high temperature, high performance QPL approved MIL-C-17 coax cables for the military, commercial and industrial applications. The specific M17 constructions referenced are manufactured in accordance with the most recent revision of the MIL-C-17 specification. The MIL-C-17 specification defines complete physical and electrical characteristics for each M17 part number, including dimensional parameters, dielectric materials, shield construction, maximum attenuation, and VSWR levels.

VSWR Sweep Testing

When selecting a 50 ohm coaxial cable, constructions with VSWR requirements are recommended. Manufacturing and sweep testing cables with concern for VSWR ensures a quality cable free of spikes over the referenced frequency range. (Note the test frequencies specified in the electrical characteristics section.)

Precision PTFE Dielectrics

All of the high temperature, high performance coax cables listed have PTFE dielectrics with high dielectric strength and low capacitance in proportion to the dielectric constant. All PTFE dielectrics are manufactured with tolerances tighter than the MIL-C-17 specification to ensure uniformity of electrical characteristics, especially impedance, attenuation and VSWR.

Tape wrapped PTFE Constructions

Harbour also manufactures PTFE tape wrapped cables to a previous revision of the MIL-C-17 specification. These constructions can withstand operating temperatures up to 250° C. versus 200° C. for FEP jacketed cables. Also, PTFE tape wrapped cables are generally more flexible than their FEP jacketed counterparts.

UL Approvals

All of Harbour's M17 part numbers manufactured to the MIL-C-17 specification may be ordered with UL and FT4 approvals.

Mil-C-17 Coaxial Cables

Physical Characteristics:

M17 Number	Center Conductor	PTFE Dielectric Diameter	Shield	Jacket	Overall Diameter	Minimum Recommended Bend Radius		
M17/60-RG142	.037" SCCS	.116"	SPC(2)	FEP	.195"	1.0"	-55 +200	43.0
M17/93-RG178	.0120"(7/.004")SCCS	.033"	SPC	FEP	.071"	0.4"	-55 +200	6.3
M17/93-00001	.0120"(7/.004")SCCS	.033"	SPC	PFA	.071"	0.4"	-55 +230	6.3
								M17/93-RG178 w/extended temp. ra
M17/94-RG179	.0120"(7/.004")SCCS	.063"	SPC	FEP	.100"	0.4"	-55 +200	10.8
M17/95-RG180	.0120"(7/.004")SCCS	.102"	SPC	FEP	.141"	0.7"	-55 +200	19.8
M17/110-RG302	.0253"SCCS	.146"	SPC	FEP	.202"	1.0"	-55 +200	40.0
M17/111-RG303	.037"SCCS	.116"	SPC	FEP	.170"	0.9"	-55 +200	31.0
M17/112-RG304	.059" SCCS	.185"	SPC(2)	FEP	.280"	1.4"	-55 +200	94.0
M17/113-RG316	.0201"(7/.0067")SCCS	.060"	SPC	FEP	.098"	0.5"	-55 +200	12.2
M17/127-RG393	.094"(7/.0312")SC	.285"	SPC(2)	FEP	.390"	2.0"	-55 +200	165.0
M17/128-RG400	.0384"(19/.008")SC	.116"	SPC(2)	FEP	.195"	1.0"	-55 +200	50.0
M17/131-RG403	.0120"(7/.004")SCCS	.033"	SPC(2)	FEP(2)	.116"	0.6"	-55 +200	15.0
M17/152-00001	.0201"(7/.0067")SCCS	.060"	SPC(2)	FEP	.114"	0.6"	-55 +200	18.5
								Triaxial M17/93-RG Double shielded M17/113-RG316
M17/158-00001	.037"SCCS	.116"	SPC(2)	FEP	.195"	1.0"	-55 +200	56.0
M17/169-00001	.0120"(7/.004")SCCS	.033"	SPC	FEP	.071"	0.4"	-55 +200	6.3
M17/170-00001	.037"(SCCS	.116"	SPC	FEP	.170"	0.9"	-55 +200	39.0
M17/172-00001	.0201"(7/.0067")SCCS	.060"	SPC	FEP	.098"	0.5"	-55 +200	11.5
M17/174-00001	.094"(7/.0312")SCCS	.285"	SPC(2)	FEP	.390"	2.0"	-55 +200	175.0
M17/175-00001	.0384"(19/.008")SC	.116"	SPC(2)	FEP	.390"	1.0"	-55 +200	50.0
M17/176-00002	.0235"(19/.005")SPA(2)	.042"	SPA	PFA	.129"	0.6"	-55 +230	18.0
								Controlled impedar twinax
PTFE Tape Wrap Jacketed RG Cables								
RG 187 A/U	.0120"(7/.004)SCCS	.063	SPC	PTFE	.100"	0.5"	-55 +250	10.0
RG 188 A/U	.0201"(7/.0067)SCCS	.060	SPC	PTFE	.100"	0.5"	-55 +250	11.0
RG 195 A/U	.0120"(7/.004)SCCS	.102	SPC	PTFE	.141"	0.7"	-55 +250	18.0
RG 196 A/U	.0120"(7/.004)SCCS	.034	SPC	PTFE	.067"	0.4"	-55 +250	6.0
								Flexible, 250° C. rat

Electrical Characteristics:

M17 Number	Impedance (ohms)	Capacitance (pF/ft)	Max. Operating Voltage (RMS)	Maximum Attenuation (dB/100 ft)						
				100 MHz	400 MHz	1 GHz	2 GHz	3 GHz	4 GHz	5 GHz
M17/60-RG142	50 +/- 2	29.4	1900	5.5	11.7	19.0	35.0	48.0	-	17.4
M17/93-RG178	50 +/- 2	29.4	1000	16.0	33.0	52.0	94.0	-	-	3.0
M17/93-00001	50 +/- 2	29.4	1000	16.0	33.0	52.0	94.0	-	-	3.0
M17/94-RG179	75 +/- 3	19.4	1200	-	21.0	-	-	-	-	-
M17/95-RG180	95 +/- 5	16.4	1500	-	17.0	-	-	-	-	-
M17/110-RG302	75 +/- 3	19.4	2300	-	8.0	-	26.0	-	-	-
M17/111-RG303	50 +/- 2	29.4	1900	3.9	8.0	15.0	28.0	-	-	-
M17/112-RG304	50 +/- 3	29.4	3000	2.7	6.4	11.1	22.0	30.0	-	8.0
M17/113-RG316	50 +/- 2	29.4	1200	11.0	21.0	38.0	58.0	-	-	3.0
M17/127-RG393	50 +/- 2	29.4	2500	2.4	5.0	8.8	18.0	24.6	37.0	11.0
M17/128-RG400	50 +/- 2	29.4	1900	4.5	10.5	17.0	38.0	50.0	78.0	12.4
M17/131-RG403	50 +/- 2	29.4	1000	-	37.0	-	-	-	-	10.0
M17/152-00001	50 +/- 2	29.4	1200	11.5	24.0	40.0	75.0	110.0	170.0	12.4
M17/158-00001	50 +/- 2	29.4	1900	-	9.5	-	-	-	-	-
M17/169-00001	50 +/- 2	29.4	1000	-	29.0	-	-	-	-	-
M17/170-00001	50 +/- 2	29.4	1900	-	8.6	-	-	-	-	-
M17/172-00001	50 +/- 2	29.4	1200	-	21.0	-	-	-	-	-
M17/174-00001	50 +/- 2	29.4	2500	-	5.0	-	-	-	-	-
M17/175-00001	50 +/- 2	29.4	1900	-	10.5	-	-	-	-	-
M17/176-00001	77 +/- 7	19.0	1000	-	-	-	-	-	-	-
PTFE Tape Wrap Jacketed RG Cables										
RG 187 A/U	75 +/- 3	19.4	1200	-	21.0	-	-	-	-	3
RG 188 A/U	50 +/- 2	29.4	1200	11.0	21.0	38.0	58.0	-	-	3
RG 195 A/U	95 +/- 5	15.4	1500	-	17.0	-	-	-	-	3
RG 196 A/U	50 +/- 2	29.4	1000	-	29.0	-	-	-	-	-

"Maximum frequencies" are those as referenced on individual sheet sheets of the Mil-C-17 specification. No values are given for unswept constructions as the specification recommends these cables should not be used above 400 MHz. (All figures referenced above are nominal unless otherwise specified.)

Arnitel

polyether esters
polyetherester
esters de polyether

天線桿套材質特性表



Units Einheiten Unites	EM400	EM460	EL550	EL630	EL740	PL380
	1.12	1.16	1.20	1.23	1.27	1.18
°C	195	185	202	212	221	197
μ m/m.k	220	160	180	140	110	150
°C	\	\	110	115	120	\
°C	130	150	180	200	200	145
°C	\	50	85	115	150	\
%	0.30	0.30	0.20	0.20	0.15	0.40
%	0.75	0.70	0.55	0.60	0.90	7.0
*	HB	HB	HB	HB	HB	HB
Mpa	55	110	220	375	900	60
Mpa	4.0	7.1	13.2	20.2	26.9	3.5
Mpa	5.4	9.0	15.7	23	22.6	5.2
Mpa	8.4	11.4	16.6	22.0	26.3	8.5
Mpa	17	21	32	40	45	16
%	700	800	600	600	360	450
kj/m ²	NB	NB	NB	NB	NB	NB
kj/m ²	NB	NB	NB	NB	200	NB
kj/m ²	NB	NB	NB	NB	9	NB
kj/m ²	NB	NB	20	4	4	NB
	38	45	55	63	74	38
MV/m	\	\	\	\	\	\
Ω .cm	$5*10^{14}$	10^{14}	10^{14}	10^{14}	10^{12}	10^{12}
Ω	$>10^{13}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{10}$	$>10^{13}$
\	4.1	\	\	3.8	\	4.7
\	4.0	4.4	4.0	3.4	3.3	4.4
$x10^{14}$	10	\	\	3.8	\	310
$x10^{14}$	170	350	400	350	300	350
\	800	800	600	600	600	800
\	600	600	600	800	800	600

Arnitel

2.2 Product coding

The structure of the Arnitel productcodes is illustrated with the following example:

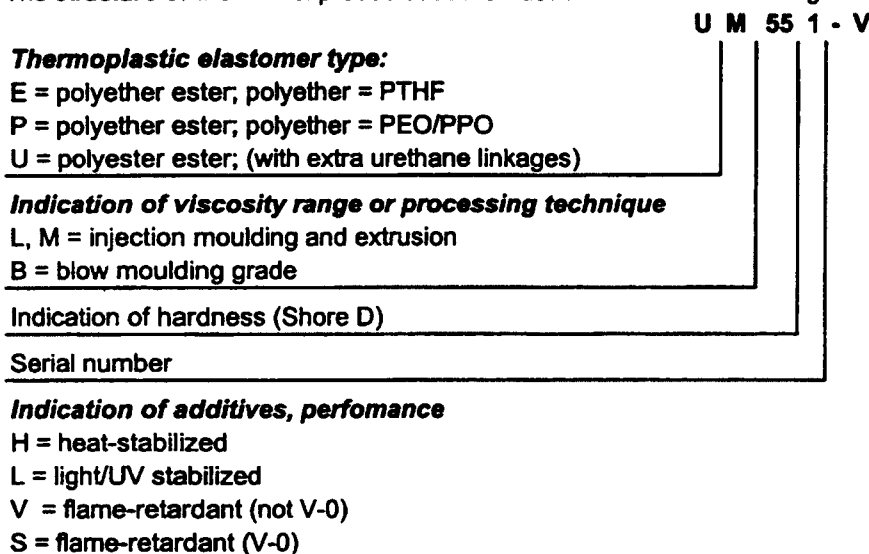


Figure 2.2: Arnitel product coding

2.3 Product portfolio

The Arnitel productrange is available with a hardness from 38 to 74 Shore D. The general Arnitel grades are shown in table 2.2. In order to enhance the flexibility of the portfolio a set of masterbatches (a.o. for heat, UV, etc) are on offer (refer to § 2.4).

Because of the development of these masterbatches heat stabilised Arnitel P is suggested for application areas where thermo-oxidative stability is an issue. For applications where colour and UV stability is required, the Arnitel E range is advised.

	Shore D					
	38	40	46	55	63	74
Arnitel E		EM400	EM460	EL550 EM550	EL630 EM630	EL740 EM740
Arnitel P	PL380		PL460	PL580 PM581		
Arnitel U				UM551 UM551-V UM552 UM552-V	UM622	

Table 2.2: Arnitel productrange for general purpose

Besides these multi-purpose grades, specialty grades can be offered for specific purposes and/or application areas. These grades are not intended for regular sales and are therefore restricted. Permission from marketing is needed before sampling is initiated.

	Arnitel E	Arnitel P	Arnitel U
Automotive			
• CVJ boots	EB460 EB463 EB464		
• Boyplugs		PL380-M0	
Extrusion			
• Roofing foil	EM402-L		

Table 2.3: Examples of specialty grades

Arnitel® EL630/EM630

2.8.31 General:

Arnitel is the brand name of a series polyester based thermoplastic elastomers. These polymers combine excellent processability with good elastomeric properties between -40 and 200°C. Arnitel EL630 and EM630 are excellent materials for injection moulding and extrusion applications respectively.

The chemical structure of Arnitel EL630/EM630 is shown below.

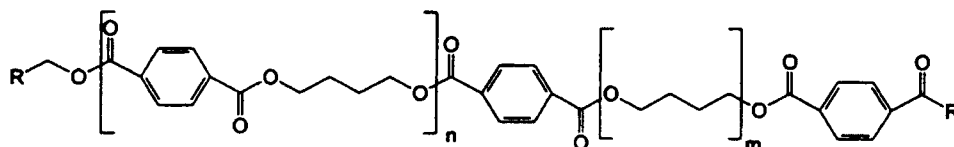


Figure 2.9: Chemical structure of Arnitel EL630/EM630.

Another way of writing the structure of Arnitels is shown below in Figure 2.



Figure 2.10: Simplified structure of Arnitel EL630/EM630.

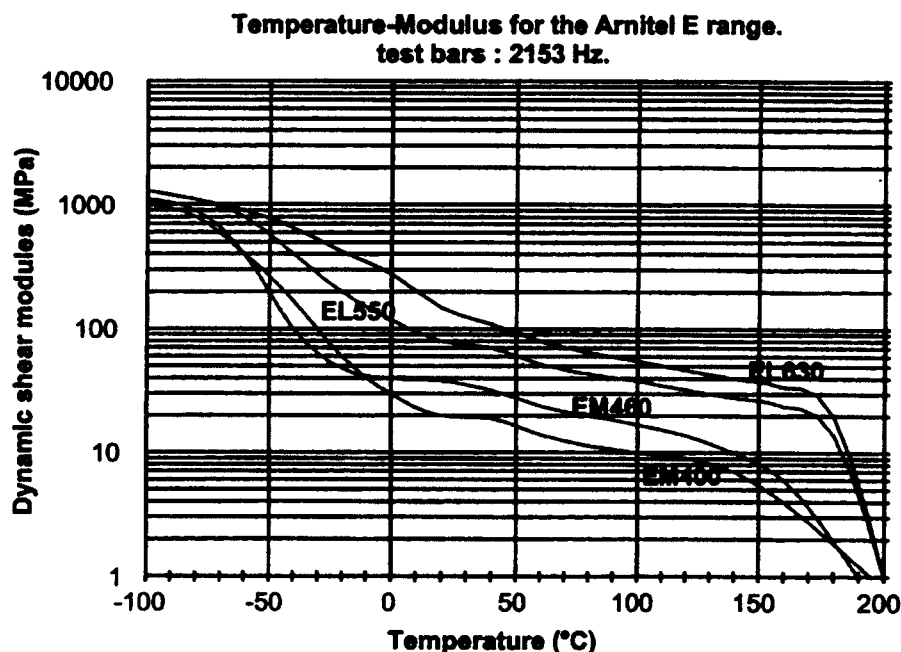
Arnitel EL630/EM630 is TOSCA registered (including DSL-Canada) under CAS 37282-12-5

2.8.32 Thermal properties:

- **Modulus-temperature behaviour:**

The materials have a glass transition at circa -40°C and a typical melting point at 213°C.

The modulus-temperature behaviour is shown in graph 2.76, for comparison, accompanied by other Arnitel E types.



Graph 2.76: Modulus-temperature behaviour of Arnitel EL630/EM630.

Arnitel[®] EL630/EM630

Although information on performance at higher temperatures may be extracted from the above shown graph, a Vicat or HDT are shown in table 2.29.

analysis	SI unit	typical data	test method
Vicat A	(°C)	200	ISO 306/A
Vicat B	(°C)	125	ISO 306/B
HDT-B	(°C)	115	ISO 75-1

Table 2.29: Vicat and HDT data on Arnitel[®] EL630 and EM630

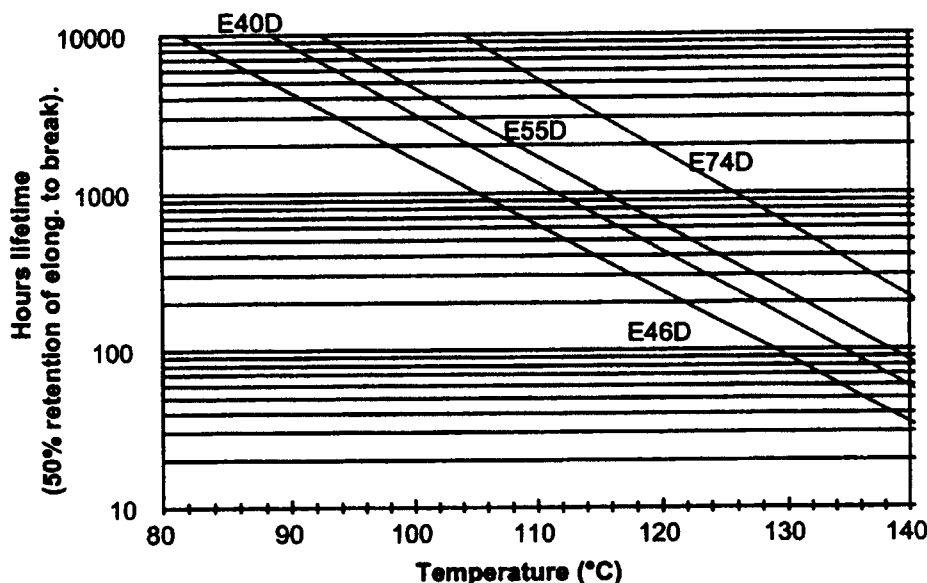
Arnitel EL630 and EM630 have a melting point of 213°C as found in the second heating curve of a DSC. The polymer will crystallize at 155°C using a 20°C/min cooling rate. The thermal expansion coefficient of Arnitel EL630/EM630 and is $140 \cdot 10^{-4} \mu\text{m/m.K}$.

- **Heat aging:**

Arnitel EL630/EM630 shows an optimum between heat resistance and colour stability. Heat aging for EL630/EM630 is under test at this moment, however the data will be between EL550 and EL740. Arrhenius curves of thermo-oxidative heat aging are shown in graph 2.77. Criterium chosen is retention of 50% original elongation at break.

Heat aging of Arnitel E40D, 46D, 55D and 74D.

Natural products, Arrhenius plot.



Graph 2.77: Heat stability for Arnitel E-range.

Heat ageing can be improved using a stabilisation masterbatch, however for heat stabilisation the P-range is preferred for its excellence in performance. These data can be found in the Arnitel properties summary or an Arnitel P datasheet.

2.8.33 Processing and Handling:

Arnitel EL630/EM630 is a polyester with a density of 1.12 g/cm^3 according ISO 1183.

Due to the polyester nature of these materials it is of major importance to store the material dry prior to processing. Materials packaged in sealed packaging should have a moisture content lower than 500 ppm. The polymer will contain 0.12% moisture in 50% RH and 0.58% water after saturation in water. Both numbers are in equilibrium.

If samples have become wet during storage a drying step of 24 hours 120°C (or 6 hours 140°C) prior to use will prevent degradation of the material during processing combined with an eventual loss of properties. The air or nitrogen will have to have a dew point of at least -30°C.

Arnitel® EL630/EM630

• **Processing:**

Arnitel EL630/EM630 shows a single melting point at 195°C in DSC. Processing conditions are shown in the table below.

polymer	zone 1	zone 2	zone 3	additional	melt	mold
EL630	225	230	235	235	225-235	20-50
EM630	225	230	235	235	235	50

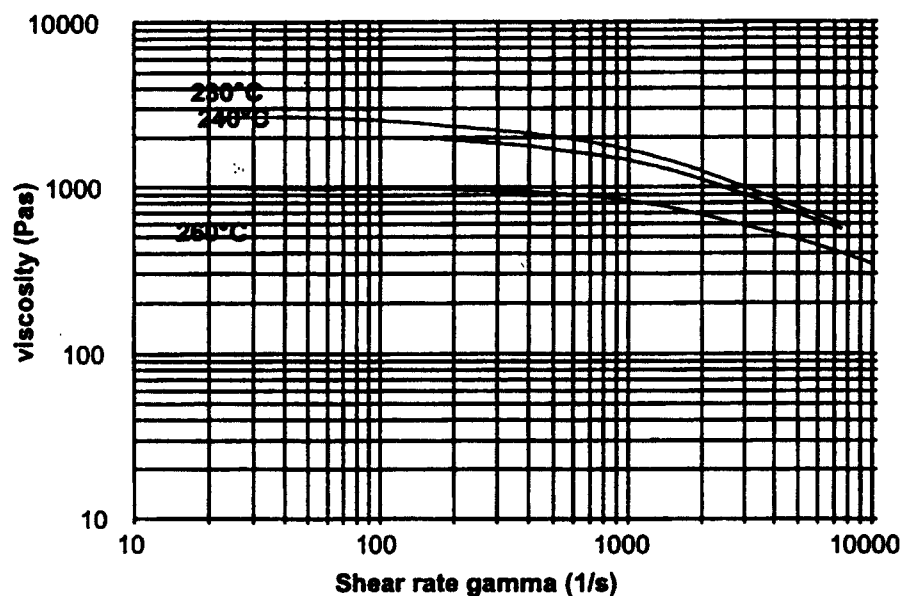
All temperatures are in °C.

Table 2.30: Processing conditions for Arnitel EL630 and Arnitel EM630.

• **Rheology:**

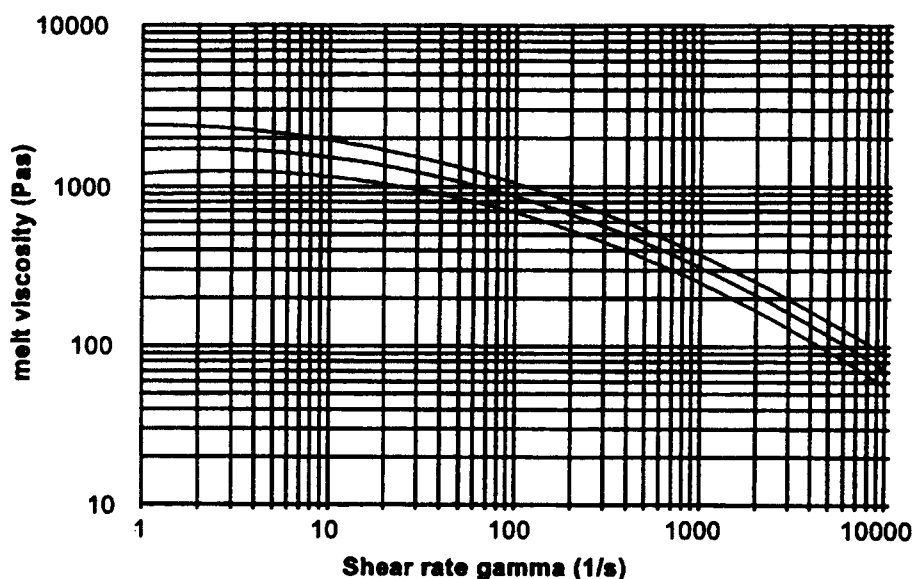
The temperature depending melt viscosity of Arnitel EL630/EM630 and are shown below in graph 2.80 and 2.81 respectively.

**Shear rate dependent of the melt viscosity of Arnitel EL630.
Effect of melt temperature.**



Arnitel® EL630/EM630

Capillar melt viscosity of Arnitel EM630.
240, 250 and 260°C.



Graph 2.80 and 2.81: Temperature dependancy of the melt viscosity for Arnitel EL630 and EM630 .

The MFI values are shown in table 2.31.

		EL630	EM630	
MFI 230°C	g/10 min		7	ISO 1133
MFI 240°C	g/10 min	30		ISO 1133

Table 2.31: MFI for Arnitel EL630/EM630.

• Use of regrind:

Arnitel can readily be recycled. If the MFI of the regrind is up or down to four points higher, 20% can be recycled. A difference of 2 MFI points allows up to 50% of regrind. Obviously the regrind should be dried properly before use.

2.8.34 Mechanical properties:

If Arnitel EL630 or Arnitel EM630 are processed properly the materials will have mechanical properties as shown in table 2.32.

Mechanical property	SI Unit	typica data*		test method
		EL630	EM630	
Hardness	Shore D	63	63	ISO 868
Tensile modulus (1 mm/min)	MPa	330	330	ISO 527
Tensile strength (50 mm/min)	MPa	30	30	ISO 527
Strain at break	%	350	350	ISO 527
Tensile stress at 5% strain	Mpa	11.5	11.5	
Tensile stress at 10% strain	Mpa	15.9	15.9	
Tensile stress at 50% strain	Mpa	17.3	17.3	
Tear strength Graves	KN/m	145	145	DIN53515
Izod notched 23°C (73°F)	KJ/m ²	NB	NB	ISO 180/1A
Izod notched -30°C (-22°F)	KJ/m ²	4	4	ISO 180/1A
Charpy notched 23°C (73°F)	KJ/m ²	NB	NB	ISO 179/1eA
Charpy notched -30°C (-22°F)	KJ/m ²	12	12	ISO 179/1eA

*1 Data for dry natural materials.

NB: No Break

Table 2.32: mechanical properties of Arnitel® EL630.

Aritel® EL630/EM630

- **Abrasion:**

Aritels show good abrasion resistance in both Taber and DIN 53516 abrasion tests. Data are shown in the Aritel general property overview (also included in the EPIC)

2.8.35 Flame retardancy:

Aritel EL630 and EM630 show in an ISO1210/A flammability test a burning rate leading to a classification FH-1. Flame retardancy can be improved using a halogenated or halogen free FR masterbatch.

2.8.36 Electrical properties:

Aritel EL630/EM630 can be used for cable jacketing applications. If the material is in permanent contact with copper a copper stabilisation package should be added. If the copper wires are coated with a tin layer, no stabilisation is necessary. The electrical properties are shown in table 33.

Electrical property	SI Unit	typical data*		test method
		EL630	EM630	
Dielectric strength	KV/mm	22	22	IEC 243-1
Relative permittivity (ϵ_r) at 1 kHz	-	4.4	4.4	IEC 250
Dissipation factor ($\tan \delta$) at 1 kHz	-	0.019	0.019	IEC 250
Comparative tracking index	-	600	600	IEC 112
Volume resistivity	$10^{14} \Omega \cdot \text{cm}$	1	1	IEC 93
Surface resistivity	$10^{14} \Omega$	1	1	IEC 93

Table 2.33: Typical electrical properties of Aritel® EL630 and EM630.

2.8.37 Chemical resistance:

Aritel EL630 and EM630 are sensitive to strong bases and strong acids, especially at elevated temperatures. In some halogenated hydrocarbons (like tetrachloroethane), the materials (partially) dissolve. For a full review on chemical resistance of Aritel EL630 and EM630 request the chemical resistance brochure.

- **Hydrolysis**

Like all polyesters Aritel are sensitive to moisture, however Aritels are more stable to water than e.g. PET and PBT. graph 2.84 shows the hydrolytic stability of Aritel EL630 at 100°C and in steam (120°C). For improved hydrolysis stability, using a polycarbodiimid containing masterbatch like Stabaxol® in an option. To maintain all other properties use a masterbatch based on polyester. Data on the Stabaxol stabilised grade are shown in graph 2.85.



VALOX® 310SE0

Americas: COMMERCIAL

Unreinforced. UL94V-0/5VA rated. For electrical industry; bobbins, keyboard switches and switch components, and appliance housings.

Property

TYPICAL PROPERTIES ⁽¹⁾			
MECHANICAL	Value	Unit	Method
Tensile Stress, yld, Type I, 50 mm/min	59	MPa	ASTM D 638
Tensile Stress, brk, Type I, 50 mm/min	59	MPa	ASTM D 638
Tensile Strain, brk, Type I, 50 mm/min	80	%	ASTM D 638
Flexural Stress, yld, 1.3 mm/min, 50 mm span	101	MPa	ASTM D 790
Flexural Stress, brk, 1.3 mm/min, 50 mm span	101	MPa	ASTM D 790
Flexural Modulus, 1.3 mm/min, 50 mm span	2620	MPa	ASTM D 790
Hardness, Rockwell R	120	-	ASTM D 785
IMPACT	Value	Unit	Method
Izod Impact, unnotched, 23°C	1602	J/m	ASTM D 4812
Izod Impact, notched, 23°C	37	J/m	ASTM D 256
Gardner, 23°C	34	J	ASTM D 3029
Modified Gardner, 23°C	34	J	ASTM D 3029
THERMAL	Value	Unit	Method
HDT, 0.45 MPa, 6.4 mm, unannealed	163	°C	ASTM D 648
HDT, 1.82 MPa, 6.4 mm, unannealed	71	°C	ASTM D 648
CTE, -40°C to 40°C, flow	7.92E-05	1/°C	ASTM E 831
CTE, 60°C to 138°C, flow	1.31E-04	1/°C	ASTM E 831
Relative Temp Index, Elec	120	°C	UL 746B
Relative Temp Index, Mech w/impact	120	°C	UL 746B
Relative Temp Index, Mech w/o impact	140	°C	UL 746B
PHYSICAL	Value	Unit	Method
Specific Gravity	1.39	-	ASTM D 792
Specific Volume	0.72	cm ³ /g	ASTM D 792
Water Absorption, 24 hours	0.08	%	ASTM D 570
Mold Shrinkage, flow, 0.75-2.3 mm	0.9 - 1.6	%	GE Method
Mold Shrinkage, flow, 2.3-4.6 mm	1.5 - 2.3	%	GE Method
Mold Shrinkage, xflow, 0.75-2.3 mm	1 - 1.7	%	GE Method
Mold Shrinkage, xflow, 2.3-4.6 mm	1.6 - 2.4	%	GE Method
ELECTRICAL	Value	Unit	Method
Volume Resistivity	>1.6E+16	Ohm-cm	ASTM D 257
Dielectric Strength, in air, 3.2 mm	18.4	kV/mm	ASTM D 149

Dielectric Strength, in oil, 1.6 mm	22	kV/mm	ASTM D 149
Relative Permittivity, 100 Hz	3.1	-	ASTM D 150
Relative Permittivity, 1 MHz	3.1	-	ASTM D 150
Dissipation Factor, 100 Hz	0.002	-	ASTM D 150
Dissipation Factor, 1 MHz	0.02	-	ASTM D 150
Arc Resistance, Tungsten {PLC}	6	PLC Code	ASTM D 495
Hot Wire Ignition {PLC}	2	PLC Code	UL 746A
High Voltage Arc Track Rate {PLC}	4	PLC Code	UL 746A
High Ampere Arc Ign, surface {PLC}	0	PLC Code	UL 746A
Comparative Tracking Index (UL) {PLC}	3	PLC Code	UL 746A
FLAME CHARACTERISTICS		Value	Unit
UL Recognized, 94V-0 Flame Class Rating (3)		0.7	mm
UL Recognized, 94-5VA Rating (3)		3	mm
CSA (See File for complete listing)		LS88480	File No. CSA LISTED

Source GMD, last updated:04/14/2003

Processing

Parameter		
Injection Molding	Value	Unit
Drying Temperature	120	°C
Drying Time	3 - 4	hrs
Drying Time (Cumulative)	12	hrs
Maximum Moisture Content	0.02	%
Melt Temperature	245 - 260	°C
Nozzle Temperature	240 - 255	°C
Front - Zone 3 Temperature	245 - 260	°C
Middle - Zone 2 Temperature	240 - 255	°C
Rear - Zone 1 Temperature	230 - 250	°C
Mold Temperature	50 - 75	°C
Back Pressure	0.3 - 0.7	MPa
Screw Speed	50 - 100	rpm
Shot to Cylinder Size	40 - 80	%
Vent Depth	0.013 - 0.025	mm

Source GMD, last updated:04/14/2003

THESE PROPERTY VALUES ARE NOT INTENDED FOR SPECIFICATION PURPOSES.

PLEASE CHECK WITH YOUR (LOCAL SALES OFFICE) FOR AVAILABILITY IN YOUR REGION

(1) Typical values only. Variations within normal tolerances are possible for various colors. All values are measured after at least 48 hours storage at 23°C/50% relative humidity. All properties, except the melt volume and melt flow rates, are measured on injection molded samples. All samples tested under ISO test standards are prepared according to ISO 294.

(2) Only typical data for selection purposes. Not to be used for part or tool design.

(3) This rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.

(4) Internal measurements according to UL standards.

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CALIBRE 700 series

Ignition Resistant Resins

These CALIBRE® resins are formulated and produced to supply both clarity and enhanced ignition resistance. They do so while maintaining excellent physical properties and processability. Grades are available with additives for improved mould release and/or UV stabilisation.

CALIBRE 700: No mould release, no UV stabilisation. CALIBRE 701: Only mould release. CALIBRE 702: Only UV stabilisation. CALIBRE 703: Mould release and UV stabilisation.

Applications

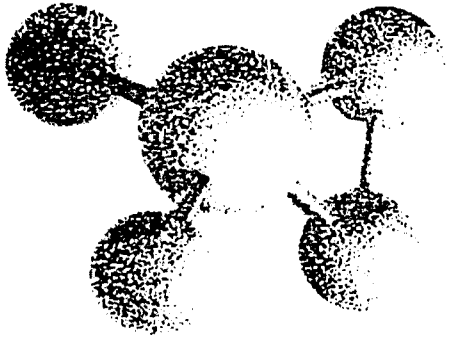
- Industrial switches
- Circuit breakers
- Plugs, sockets and switches
- Street lights
- Safety lights
- Reflectors

Properties	Test method	Value	Value
Products, Units		700-10	700-15
Physical			
Melt Flow Rate (300°C, 1.2 kg), g/10 min.	ISO 1133	10	15
Density, kg/m ³	ISO 1183	1200	1200
Mould Shrinkage, %	ASTM D-955	0.5-0.7	0.5-0.7
Optical			
Light Transmittance, %	ASTM D1003	84-88	84-88
Thermal			
HDT 0.45 MPa, annealed, °C	ISO 75	144	142
HDT 1.82 MPa, annealed, °C	ISO 75	140	139
HDT 1.82 MPa, unannealed, °C	ISO 75	123	122
Vicat Softening Point (B/50), °C	ISO 306B	149	147
Mechanical			
Tensile Strength at Yield, MPa	ISO 527	60	60
Tensile Strength at Rupture, MPa	ISO 527	66	66
Elongation at Yield, %	ISO 527	6	6
Elongation at Rupture, %	ISO 527	120	120
Tensile Modulus, MPa	ISO 527	2300	2300
Flexural Strength, MPa	ISO 178	100	100
Flexural Modulus, MPa	ISO 178	2400	2400
Izod Notched (23°C), J/m	ISO 180	900	850
Izod Unnotched (23°C), J/m	ISO 180	no break	no break
Charpy Notched (23°C), kJ/m ²	ISO 179	30	20
Flammability Rating ⁽¹⁾			
1.6 mm	UL-94	V2	V2
3.2 mm	UL-94	V0	V0
Electrical			
GWT 2.0 mm, 5 sec., °C	IEC 695-2-1	960	960
Ball Indentation Temperature, °C	IEC 598-1 ⁽²⁾	> 125	> 125
Comp. Tracking Index (2.0 mm), V	IEC 112	250	250

(1) These numerical flame spread ratings are small scale test values and are not intended to reflect hazards presented by these or any other materials under actual fire conditions.

(2) Ball Indentation Temperature is described in IEC 598-1.

Two-part adhesive		1590	High Super 5	EP-330 (HighSuper30)	EP-331	1500	Super
Feature		curing for 5 min type		curing for 30 min type	curing for 30min type Low- viscosity	Standard type	
Appearance	Base	Clear, blue	Translucent, blue	Translucent, pink	Clear, light yellow	Clear, light yellow	Translucent
	Hardener	Clear ight yellow	Translucent, light yellow	Translucent, milk white	Clear, light yellow	Clear, light brown	Light yellow
Viscosity (Pa · S/20°C)	Base	8	120	80	7	25	100
	Hardener	12	70	170	7	60	50
Specific gravity (g/cm ²)	Base	1.17	1.17	1.17	1.16	1.16	1.14
	Hardener	1.11	1.15	1.14	1.16	0.97	0.99
Mixing ratio(Base : Hardener)		1 : 1	1 : 1	1 : 1	1 : 1	1 : 1	1 : 1
Pot life		Within 5 min	Within 5 min	Within 30 min	Within 30 min	Within 1 hr	Within 1 hr
Tensile shear strength(N/mm ²)		19.0	18.0	17.5	17.6	15.7	15.1
T-Formed peeling adhesion (N/mm)		2.71	0.31	0.47		0.40	
Hardness(shore D)		77	77	82	71	82	
Coefficient of linear expansion (× 10 ⁻⁵)		8.6	10.7	6.7	4.1	7.1	
Tg(°C)			47	43		53.7	
Volume resistivity(Ω · cm)			4.9 × 10 ¹⁵	3.8 × 10 ¹¹	3.6 × 10 ¹¹	1.1 × 10 ¹⁶	
Coefficient of water absorption(%)			2.5	2.3		0.8	
Capacity standards		Base 1 kg Hardener 1 kg	6 g set 15 g set 25 g set 80 g set	320 ml set Base 3 kg Hardener 3 kg 6 g set, 15 g set, 80 g set	Base 1 kg Hardener 1 kg	Base 500 g, 1 kg, 3 kg, 15 kg Hardener 500 g, 1 kg, 3 kg, 15 kg	15 g set 40 g set 110 g set



施敏打硬 CEMEDINE 1500

〔一般性質〕

	主 劑	硬 化 劑
主 要 成 分	環氧 (Epoxy) 樹脂	聚醯胺 (Poly-Amido) 樹脂
顏 色 常 態	中間體淺黃色透明液體	色透明液體
不揮發率 (%)	99.6	99.4
黏度 (9/20°C)	350	600
比重 (20/20°C)	1.16	0.97
溶 劑	無	
硬化劑混合比例 phr	60~110	
保持粘度時間	參照混合硬化劑後的粘度變化表	
膠 化 時 間	3 小時	
硬化所需時間	6 小時 10 分鐘	
可保存時間 (20°C)	2 年	

〔特性〕

由兩種液體混合而成的環氧 (Epoxy) 樹脂系黏著劑，能在常溫下硬化，應用範圍至為廣泛，可穩定黏著金屬、塑膠以及其他各種物質。而由於此黏著劑，通常以聚醯胺 (Poly-Amido) 樹脂為其硬化劑，具有下列各優點：

1. 能在常溫下硬化。
2. 縱使所使用的硬化劑份量不同，也不影響其特性。
3. 由於能產生比一般黏著劑富有彈曲性的黏著層，縱使黏著不同材質的物品，也能以黏著層緩和熱膨脹的差別所引起的兩物品彎曲，對機械學的衝擊也能顯示較為良好的性能。
4. 由於能形成透明的黏著層，可以黏著透明的物質，如玻璃等等。

〔用 途〕

由於能強力黏著各種物質，諸如金屬、熱硬化塑膠、玻璃、飛機裝配以及一般家庭器具等等，應用範圍至為廣泛。

縱然是複聚乙烯 (Polyethylene)，聚酯 (Polyester)，天然以及人造橡膠等，以一般的黏著根本無法黏著的物質，如果加以適當的表面處理，即可強力黏著。

〔實 例〕

汽車、火車、船隻、飛機……。(將金屬把手黏著於玻璃罩／可以黏著鋁製品，三聚氰胺 (Melamine) 裝飾板等，於內部以增加強度／不同金屬間為兼防止電偶且加黏之／當作防腐塗料亦可)。

電器製品……。(由於是一種優秀的黏著劑，使用於高級擴音器、音響線圈的黏著／電磁鐵或外殼的黏著／線圈框的黏著／鐵粉芯的黏著／馬達線圈的黏著等等)。

建築……。(玻璃、壓克力門或將文字板黏於屏風黏住把手／照明設備以及其他塑膠裝飾品的加黏以及組立／不銹鋼製品、鋁製建材、陶器或大理石等需要強力黏劑物品之加黏)。

高級裝飾品，玻璃以及塑膠製工藝品，精密機械……

(照像機，調整距離儀／分光儀等等的固定)。

其他諸如罐頭，運動器材，公路標誌等等的加黏。

除上述各種加黏外，也可以使用作填充劑，諸如鑄，敷醫用以及磚裏用。

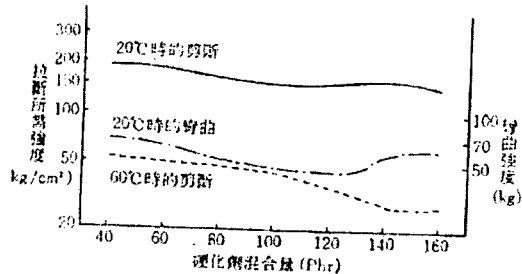


圖 II 2.1

硬化劑混合量と粘着力強度

(在20°C七天的硬化)

試驗片：軟鋼板 (25×100×1.6mm)

(Over-lap)12.5mm

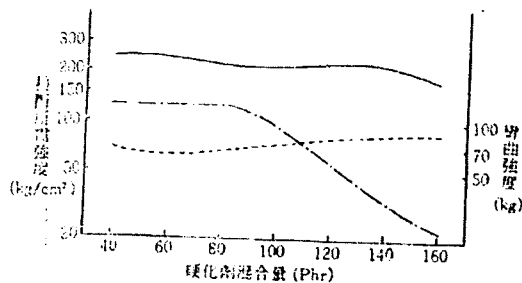


圖 II 2.2

硬化劑混合量と粘着力強度

(在80°C一小時的硬化)

試驗片：以及其他同圖 II 2.1

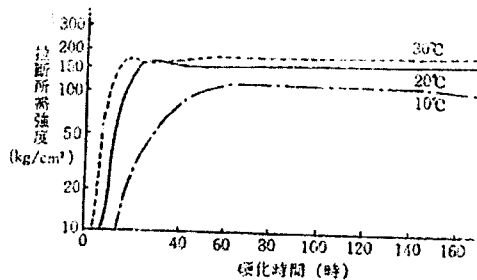


圖 II 2.3

常溫時的硬化特性 硬化劑混合率 100phr

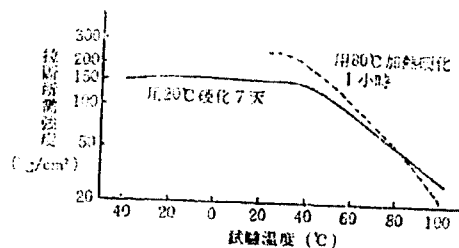


圖 II 2.5

耐熱特性 硬化劑混合率為 100phr

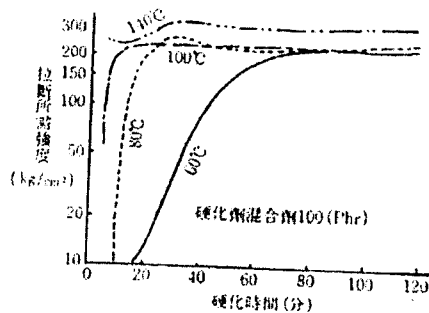


圖 II 2.4

加熱硬化特性 硬化劑混合率為 100phr

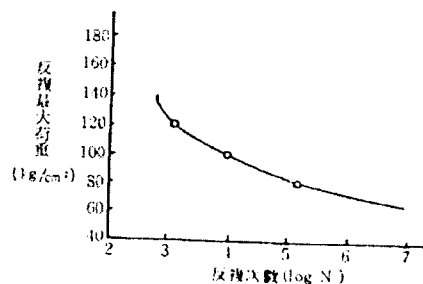


圖 II 2.6

老化特性

表 II 2.1 物理特性

抗張力 (kg/mm²)	5.04	硬度 { ロックウェルM	68
抗拉力 (kg/mm²)	7.40	{ バーナル	67
彎曲彈性率 (kg/mm²)	214	{ ショアーD	82
拉伸強度 (kg/mm²)	11.6	表面固定電阻 (Ω)	5.6×10^{13}
壓縮強度 (kg/mm²)	15.10(6.41)(¹)	體積固有電阻 (Ω-Cm)	10.5×10^{13}
熱變形溫度 (°C)	47	誘電率 (10 ⁶ cycle)	2.94
		電壓破壞 (kv/mm)	19

表II 2.2 拉斷所需強度

被粘體	拉斷所需強度	被粘體	拉斷所需強度 (20°C)
樟樹材	83	多元素焦炭	22
馬來西亞杉材	106 ※	苯乙基樹脂	19
針葉樹材	99 < ※	聚克力樹脂	30
杉材	66	優質鑄錫樹脂	36
鐵	158	三聚氰胺裝飾板 (表面)	55
鋁	61	三聚氰胺裝飾板 (背面)	45
黃銅	60	F R P	125
銅	80		
鍍電鍍	71		
鍍電鍍	50		

〔註〕 1. 粘着條件：20°C，硬化7天，硬化劑混合比 100phr(接合部over-lap)12.5mm。

2. ※記號者表示材料拉斷。

表II 2.3 促進劣化特性

試驗	未試驗前的粘力強度 (kg/cm ²)	比較調整試驗片的粘力強度(1) (1個月) (kg/cm ²)	經過各試驗1個月後的粘力強度 (kg/cm ²)	經過各試驗1,000小時後的粘力強度 (kg/cm ²)
利用測候儀所做的耐候試驗	143	150	—	166
利用噴射鹽水的促進試驗	143	150	100	—
利用高溫高濕的促進試驗(2)	143	150	143	—
利用反復冷卻的促進試驗(3)	143	150	183	—

〔註〕 (1) 20±1°C, 65±5%RH 各保持1個月的試驗片；(2) 50°C100%RH；(3) -5°C8小時~50°C16小時。

表II 2.4 耐 候 性

拉斷所需強度 (kg/cm²)

曝露前的粘力強度				147
比較調整試驗片的粘力強度 (6個月)	※	156	在戶外暴露6個月的粘力強度	147
" (1年)	※	138	" 1年 "	152
" (2年)	※	130	" 2年 "	138
" (3年)	※	123	" 3年 "	137
" (10年)	※	111	" 10年 "	130

〔註〕 ※20±1°C, 65±5%RH 保持各期間的試驗片。

表II 2.5 耐水性 (20°C, 7天硬化)

拉斷所需強度 (kg/cm²)

時間	0	3個月	6個月	1年
常態試驗	120	106	123	120
耐水試驗		109	117	109

〔註〕 硬化劑混合比為 100phr
試驗片：不銹鋼 (100×25×1.5mm)
(接合部Over-lap)12.5mm。

表II 2.6 耐水性 (60°C, 2小時硬化)

拉斷所需強度 (kg/cm²)

時間	0	3個月	6個月	1年
常態試驗	157	150	169	161
耐水試驗		133	108	116

〔註〕 同表II 2.5

表II 2.7 耐油性

拉斷所需強度 (kg/cm²)

放置日數	1天	3天	5天	10天	20天	1個月
放置於20°C室溫	—	—	—	80.0	—	79.0
0°C油中	—	—	77.5	87.5	—	80.0
20°C油中	—	—	82.5	77.6	—	89.5
70°C油中	77.6	75.3	80.0	74.3	—	71.0
循環油中 cycle	—	—	79.0	78.0	89.0	76.0

放置日數	40天	2個月	3個月	6個月	1年	10年
放置於 20°C室溫	—	—	73.0	65.9	76.3	75.1
0°C油中	—	86.5	71.5	80.5	80.2	—
20°C油中	—	70.5	79.5	73.7	79.7	—
70°C油中	—	75.5	—	75.4	68.3	—
循環油中 (cycle)	71.5	—	—	—	—	—

[註] 1. 硬化劑混合比為80phr，試驗片龍宋片 (100×25×3mm) 接合部(Over-lap)12.5mm 2. 油為變壓器油。
3. 試驗片全部破裂。

表II 2.8 耐溶劑、耐藥品性

種類	名稱	浸漬7天後的黏力保持率 (%)		浸漬1個月後的黏力保持率 (%)	
		以20°C硬化7天 的試驗片	以80°C硬化1小 時的試驗片	以20°C硬化7天 的試驗片	以80°C硬化1小 時的試驗片
溶劑	已 烷	107.0	80.6	91.1	78.8
	—	85.5	63.8	51.7	66.8
	—	88.8	69.5	93.4	70.8
	—	89.5	71.3	97.4	63.7
	—	90.2	64.7	101.3	69.1
油	三 氯 化 矽	91.5	72.7	65.0	69.5
	—	—	—	—	—
油	植 物 油	102.7	90.8	107.3	90.3
	礦 油	96.2	87.8	98.1	84.2
藥	—	—	—	—	—
	10% 硝 酸 溶 液	93.4	72.3	96.3	69.3
	10% 硫 酸 溶 液	93.4	72.8	79.8	69.8
	10% 苛 性 蘇 打 溶 液	71.7	67.8	70.8	57.2
	10% 苛 性 蘇 打 溶 液	97.2	74.3	83.8	74.3
品	10% 食 鹽 水 溶 液	89.6	71.8	91.0	69.8
	10% 醋 酸 溶 液	91.2	77.8	78.4	61.2

[註] 黏劑混合率=1:1，試驗片：軟質片 (25×100×1.6mm) 但是耐藥試驗時使用了SUS-27，接合部 (Over-lap) 為 12.5mm。

容量規格 = (主)、(硬) 110g、1kg、15kg (組)



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