



WHA YU INDUSTRIAL CO., LTD. (HEAD OFFICE)

TAI HWA ELECTRONIC CO., LTD.(CHINA)

SHANGHAI HUA YU ELECTRONIC CO., LTD.(CHINA)

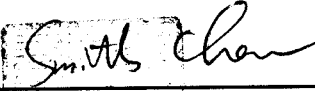
SPECIFICATION FOR APPROVAL

CUSTOMER: 中磊科技股份有限公司

PART NAME: 2.4G RF Antenna Assembly

PART NO: **REVISION:**

W. Y. P / NO.: C147-510026-A **REV.:** X1

	MANUFACTURER SIGNATURE	CUSTOMER SIGNATURE
APPROVED BY :		
DATE :	2003. 8. 26	

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RF Antenna Cable Assembly

Specification

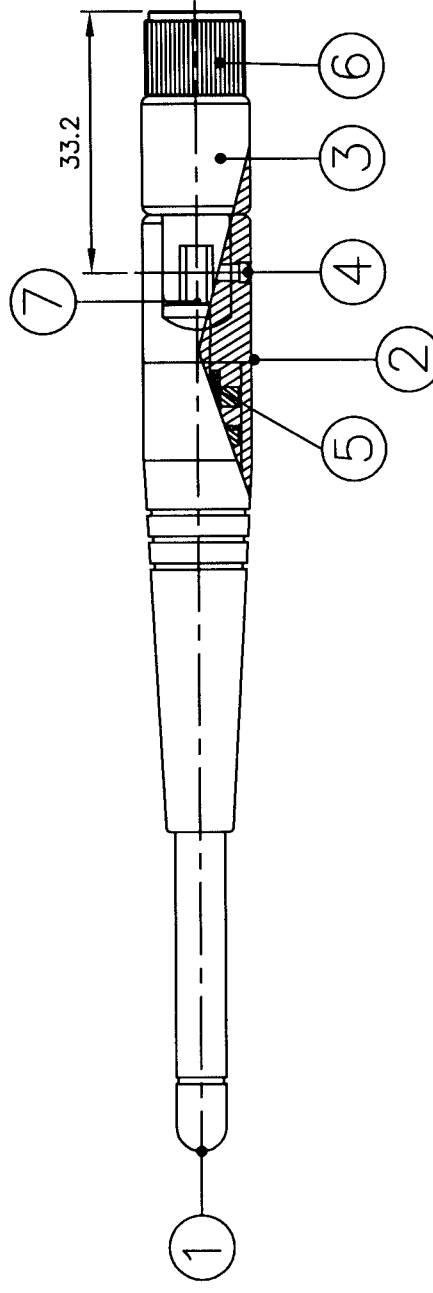
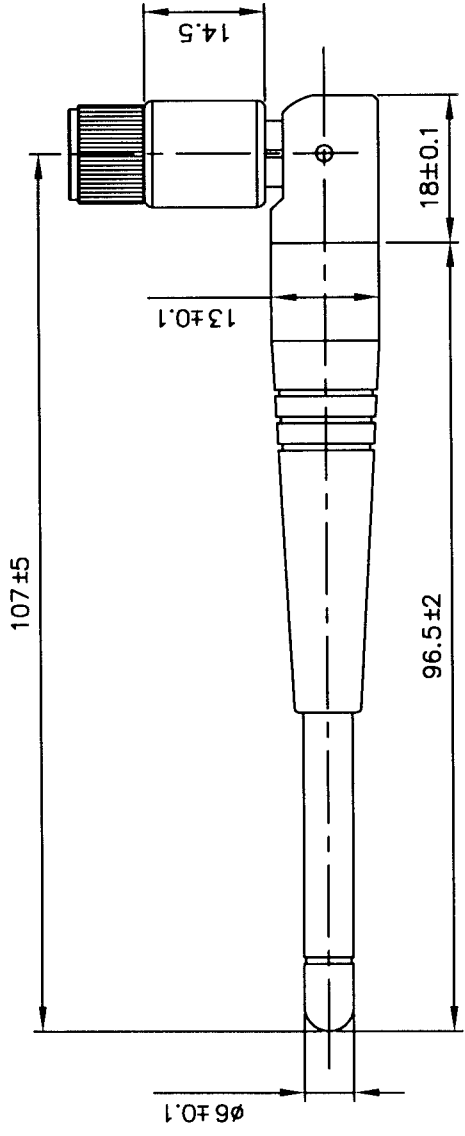
1. Electrical Properties :

- 1.1 Frequency Rang..... 2.4GHz ~ 2.5GHz
- 1.2 Impedance 50Ω Nominal
- 1.3 VSWR2.0 Max.
- 1.4 Return Loss..... -9.5 dB Maximum
- 1.5 Electrical Wave..... 1/2 λ Diople
- 1.6 Gain..... 1.8 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 Operating Temp.-20°C ~ +65°C
- 2.5 Storage Temp.-30°C ~ +75°C
- 2.6 Color Black
- 2.7 Connector..... SMA Plug Reverse


REV	DATE	DESCRIPTION
X1	08/13-2003	New Issue
X2	08/26-2003	Changed Connector



NO	DESCRIPTION	QTY	REMARK
7	Cable	1	
6	Connector	1	
5	Ground Tube	1	
4	Rivet	2	
3	Bottom Fixed Base	1	
2	Upper Fixed Base	1	
1	Antenna Cap	1	

NOTE:
 1. Return Loss : $\leq -9.5\text{dB}$ (2.4GHz ~ 2.5GHz)
 2. VSWR : ≤ 2.0 (2.4GHz ~ 2.5GHz)

APPROVED		CUSTOMER: 中磊實業股份有限公司	
CHECKED		PART NO :	
DRAWING		PARTNAME: SMA RF Antenna 2.4G	
XX ±3.0	XX ±2.0	W.Y PNO :	C147-510026-A
X ±1.0	XX ±0.5	REV	UNIT FILE :
XXX ±0.1		XI	m/m
			SHEET : 1/1

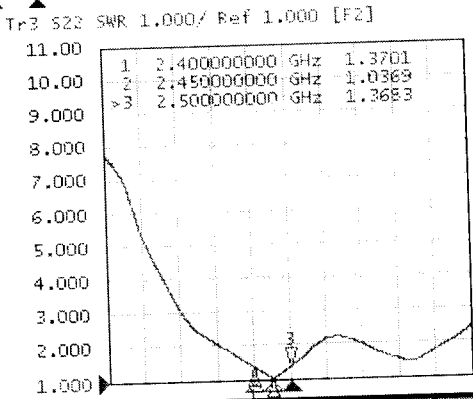
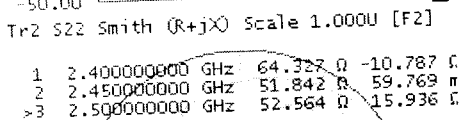
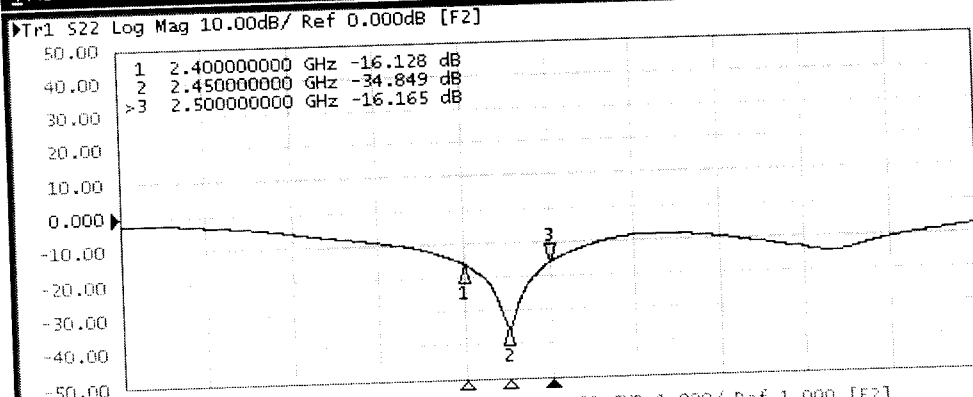


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謙裕實業股份有限公司

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CUSTOMER'S SIGNATURE

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mkr/Analysis 5 Instr State



1 Start 2 GHz IFBW 70 kHz Stop 3 GHz PExt G7

Display

Data -> Mem

Edit Title Label

Title Label OFF

Graticule Label ON

Invert Color OFF

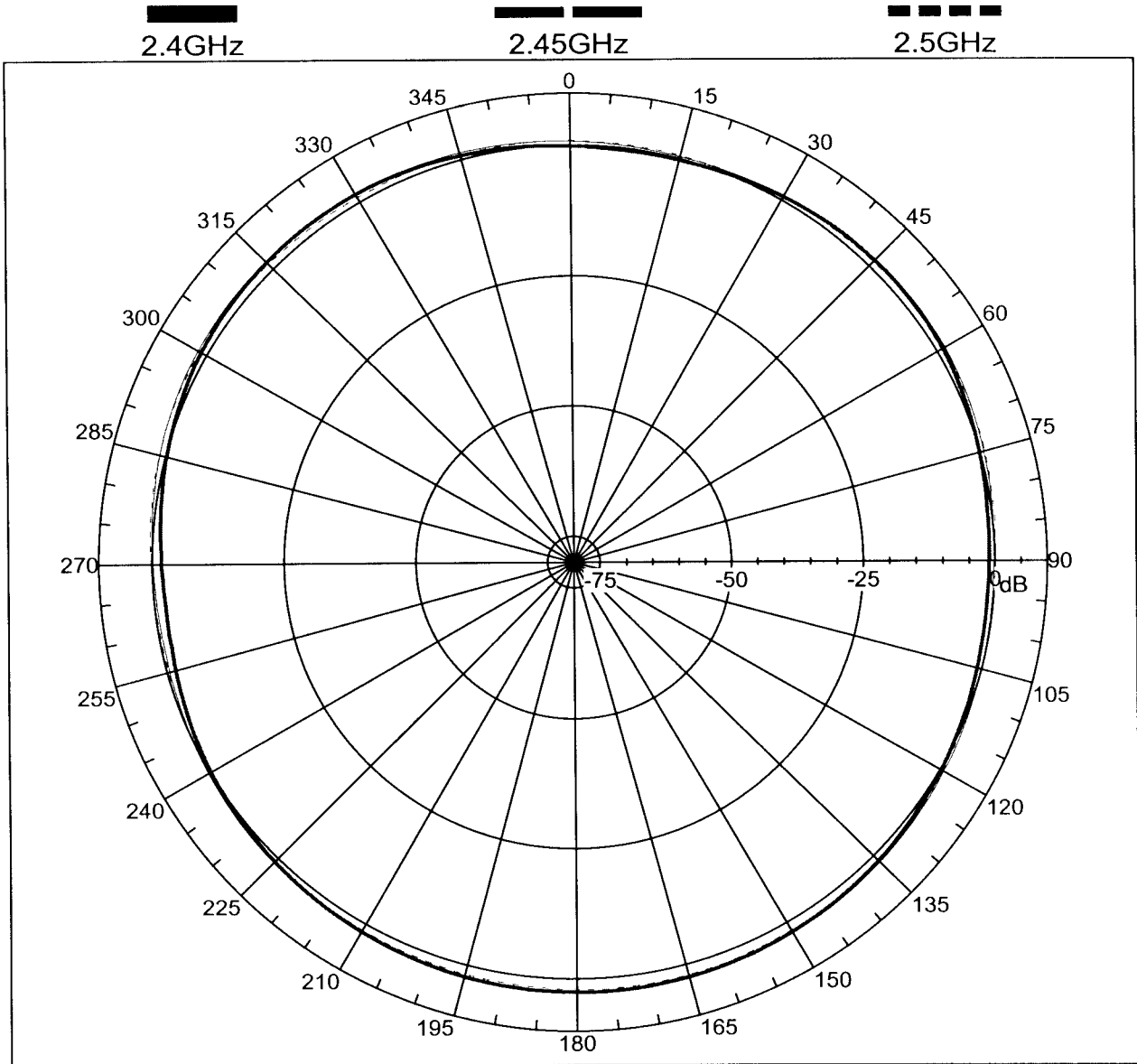
Frequency ON

Update ON

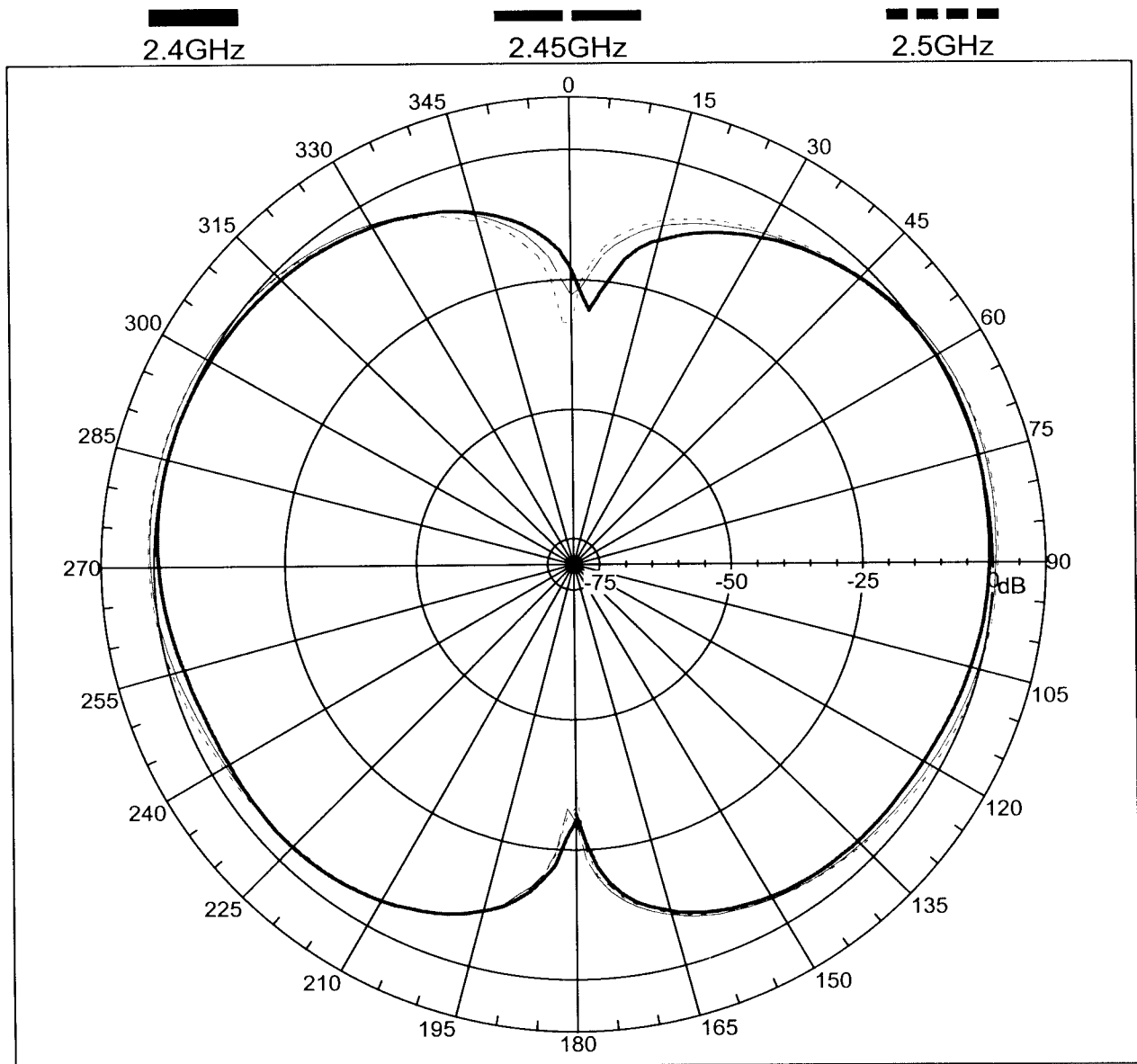
Return

Meas Stop ExtRef Ready Svc 2003-09-04 09:47

Far-field amplitude of 2.4GHz-H.nsi



Far-field amplitude of 2.4GHz-E1.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 :

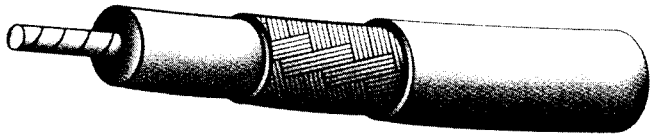
- 1 Weight per 1000ft..... 6.3 lbs Maximum
- 2 Bend Radius.....0.35" Minimum
- 3 Operating Temperature Range -55°C ~ 200°C

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

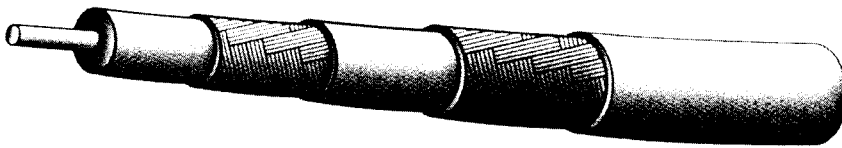
Single braid



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	Operating Temp. (%C)	Weight (lbs./MFT)	Comments
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	Triaxial M17/93-RG
M17/152-00001	.0201"(7/.0067")SCCS	.060"	SPC(2)	FEP	.114"	0.6"	-55 +200	18.5	Double shielded M17/113-RG316
M17/158-00001	.037"SCCS	.116"	SPC(2)	FEP	.195"	1.0"	-55 +200	56.0	Unswep M17/60-RG
M17/169-00001	.0120"(7/.004")SCCS	.033"	SPC	FEP	.071"	0.4"	-55 +200	6.3	Unswep M17/93-RG
M17/170-00001	.037"(SCCS)	.116"	SPC	FEP	.170"	0.9"	-55 +200	39.0	Unswep M17/111-RG
M17/172-00001	.0201"(7/.0067")SCCS	.060"	SPC	FEP	.098"	0.5"	-55 +200	11.5	Unswep M17/113-RG
M17/174-00001	.094"(7/.0312")SCCS	.285"	SPC(2)	FEP	.390"	2.0"	-55 +200	175.0	Unswep M17/127-RG
M17/175-00001	.0384"(19/.008")SC	.116"	SPC(2)	FEP	.390"	1.0"	-55 +200	50.0	Unswep M17/128-RG
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	Flexible, 250° C. rat
RG 188 A/U	.0201"(7/.0067)SCCS	.060	SPC	PTFE	.100"	0.5"	-55 +250	11.0	Flexible, 250° C. rat
RG 195 A/U	.0120"(7/.004)SCCS	.102	SPC	PTFE	.141"	0.7"	-55 +250	18.0	Flexible, 250° C. rat
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/100ft) @					Max Frequency (GHz)	
				100 MHz	400 MHz	1 GHz	3 GHz	5 GHz - 10 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 slant 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
μm/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:

U M 55 1 - V

Thermoplastic elastomer type:

- E = polyether ester; polyether = PTHF
- P = polyether ester; polyether = PEO/PPO
- U = polyester ester; (with extra urethane linkages)

Indication of viscosity range or processing technique

- L, M = injection moulding and extrusion
- B = blow moulding grade

Indication of hardness (Shore D)

Serial number

Indication of additives, performance

- H = heat-stabilized
- L = light/UV stabilized
- V = flame-retardant (not V-0)
- S = flame-retardant (V-0)

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

Amitel® EL630/EM630

2.8.31 General:

Amitel 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. Amitel EL630 and EM630 are excellent materials for injection moulding and extrusion applications respectively. The chemical structure of Amitel EL630/EM630 is shown below.

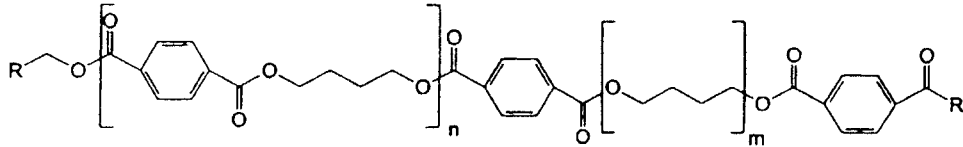


Figure 2.9: Chemical structure of Amitel EL630/EM630.

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



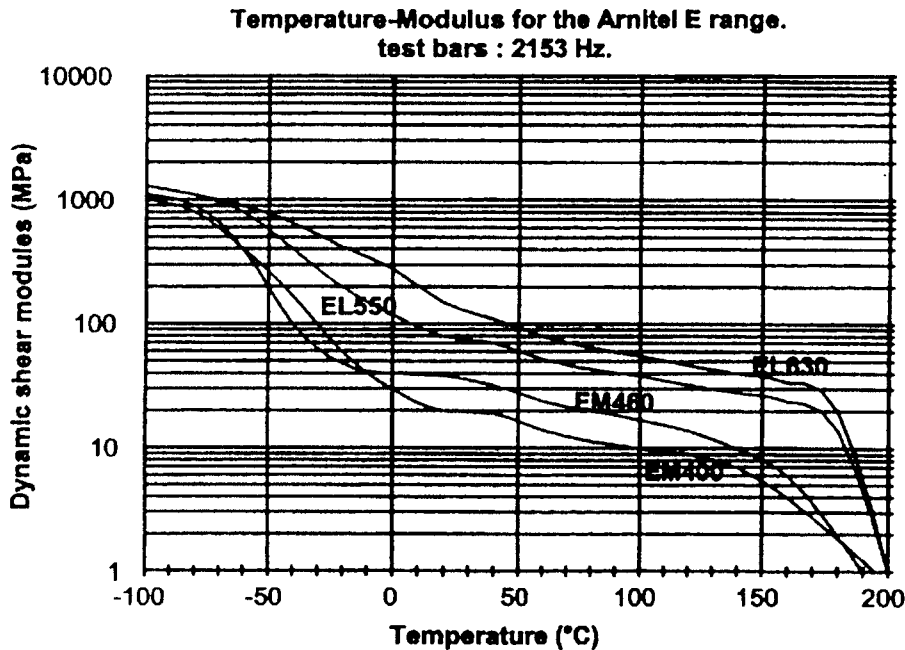
Figure 2.10: Simplified structure of Amitel EL630/EM630 .

Amitel 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 Amitel E types.



Graph 2.76: Modulus-temperature behaviour of Amitel 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

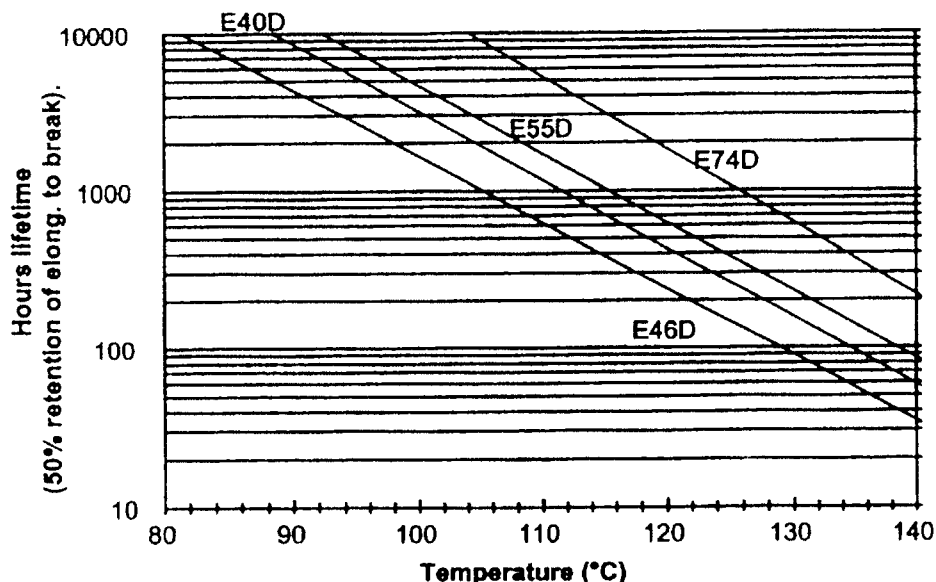
Arnitel EL630 and EM630 have a melting point of 213°C as found in the second heating curve of a DSC. The polymer will crystallize at 155°C using a 20°C/min cooling rate. The thermal expansion coefficient of Arnitel EL630/EM630 and is $140 \cdot 10^{-4} \mu\text{m/m.K}$.

• **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 improve using a stabilisation masterbatch, however for heat stabilisation the P-range is preferred for it's 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 then 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

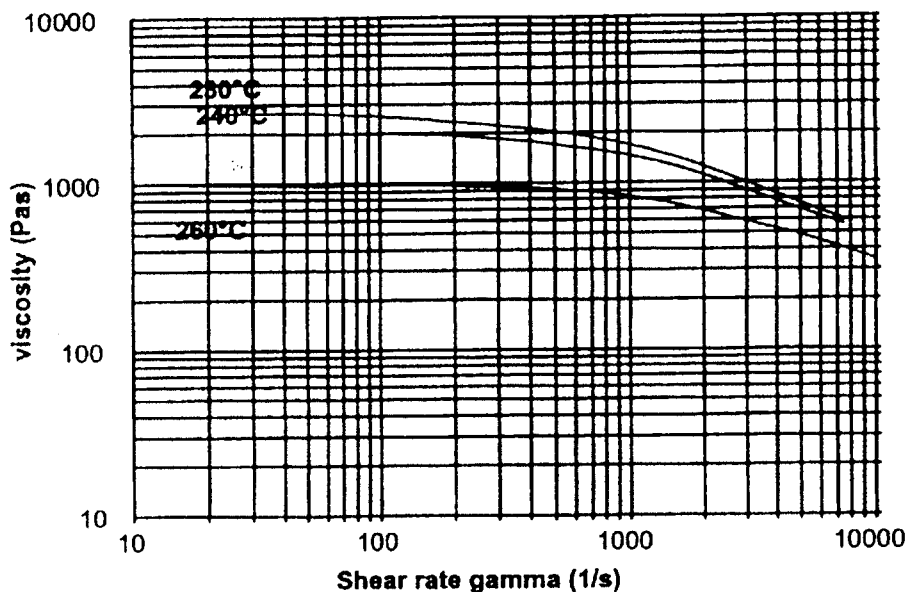
All temperatures are in °C.

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

• **Rheology:**

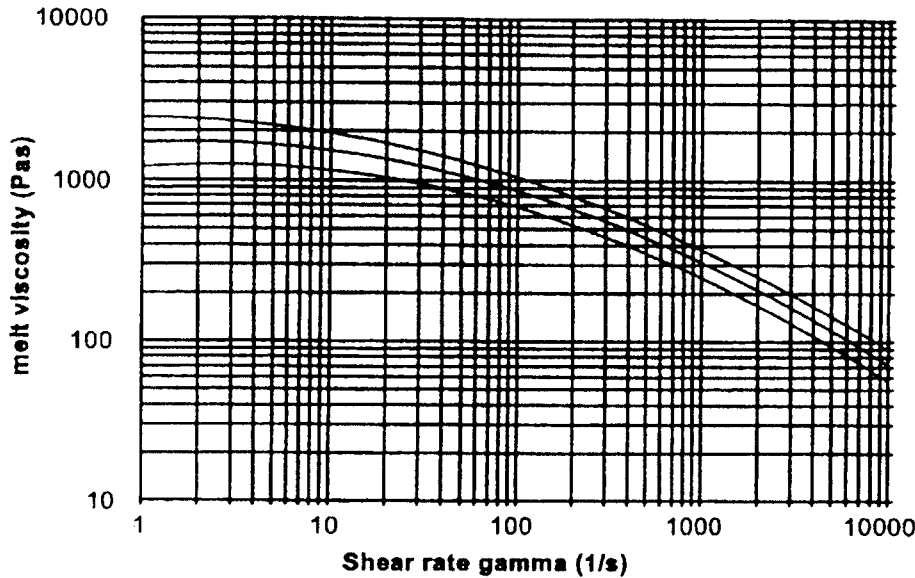
The temperature depending melt viscosity of Arnitel EL630/EM630 and are shown below in graph 2.80 and 2.81 respectively.

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



Amitel[®] EL630/EM630

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



Graph 2.80 and 2.81: Temperature dependency of the melt viscosity for Amitel 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 Amitel EL630/EM630.

• **Use of regrind:**

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

Mechanical property	SI Unit	typical 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

Data for dry natural materials.

*1 NB: No Break

Table 2.32: mechanical properties of Amitel[®] EL630.

Arnitel® EL630/EM630

- **Abrasion:**

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

2.8.35 Flame retardancy:

Arnitel 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:

Arnitel 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 1kHz	-	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 Arnitel® EL630 and EM630.

2.8.37 Chemical resistance:

Arnitel 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 Arnitel EL630 and EM630 request the chemical resistance brochure.

- **Hydrolysis**

Like all polyesters Arnitel are sensitive to moisture, however Arnitels are more stable to water than e.g. PET and PBT. graph 2.84 shows the hydrolytic stability of Arnitel EL630 at 100°C and in steam (120°C). For improved hydrolysis stability, using a polycarbodiimid containing masterbatch like Stabaxol® is 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.



□

LEXAN 123R

Product Portfolio | Product Lines | LEXAN

USA: Commercial

Nonhalogenated. 17.5 MFR, for small, intricate parts. UV stabilized. Internal mold release.

Processing

INJECTION MOULDING-USA

□

Melt Temperature	540-580	deg F
Nozzle Temperature	530-570	deg F
Front Temperature	540-580	deg F
Middle Temperature	520-560	deg F
Rear Temperature	500-540	deg F
Mold Temperature	160-200	deg F
Drying Temperature	250	deg F
Drying Time (minimum)	3-4	h
Drying Time (maximum)	48	h
Back Pressure	50-100	psi
Screw Speed	40-70	rpm
Suggested shot size	40-60	%
Vent Depth	.001-.003	in

Source Eris, last updated: 1997/0

Nonhalogenated. 17.5 MFR, for small, intricate parts. UV stabilized. Internal mold release.

MECHANICAL

Property	Typical Data	Unit	Method
Tensile Strength, yield, Type I, 0.125"	9000	psi	ASTM D 638
Tensile Strength, break, Type I, 0.125"	9500	psi	ASTM D 638
Tensile Elongation, yield, Type I 0.125"	7.0	%	ASTM D 638
Tensile Elongation, break, Type I 0.125"	110.0	%	ASTM D 638
Flexural Strength, yield, 0.125"	13500	psi	ASTM D 790
Flexural Modulus, 0.125"	340000	psi	ASTM D 790
Compressive Strength	12500	psi	ASTM D 695
Compressive Modulus	345000	psi	ASTM D 695
Shear Strength	10000	psi	ASTM D 732
Shear Modulus	114000	psi	ASTM D 4065
Hardness, Rockwell M	70	-	ASTM D 785
Hardness, Rockwell R	118	-	ASTM D 785
Taber Abrasion, CS-17, 1 kg	10	mg/1000cy	ASTM D 1044
Fatigue Limit, 2.5 MM cycles	1000	psi	ASTM D 671

IMPACT

Property	Typical Data	Unit	Method
Izod Impact, unnotched, 73F	60.0	ft-lb/in	ASTM D 4812
Izod Impact, notched, 73F	13.0	ft-lb/in	ASTM D 256
Tensile Impact, Type "S"	260	ft-lb/in ²	ASTM D 1822
Falling Dart Impact (D 3029), 73F	125	ft-lbs	ASTM D 3029

THERMAL

Property	Typical Data	Unit	Method
Vicat Softening Temp, Rate B	310	deg F	ASTM D 1525
HDT, 66 psi, 0.250", unannealed	280	deg F	ASTM D 648
HDT, 264 psi, 0.250", unannealed	270	deg F	ASTM D 648
Thermal Conductivity	0.19	W/m-C	ASTM C 177
CTE, flow, -40F to 200F	3 E-5	in/in-F	ASTM E 831
Specific Heat	0.30	BTU/lb-F	ASTM C 351
Thermal Index, Elec Prop	100	deg C	UL 746B
Thermal Index, Mech Prop with impact	100	deg C	UL 746B
Thermal Index, Mech prop without impact	100	deg C	UL 746B
Brittleness Temperature	-200	deg F	ASTM D 746

PHYSICAL

Property	Typical Data	Unit	Method
Specific Gravity, solid	1.20	-	ASTM D 792
Specific Volume	23.10	in ³ /lb	ASTM D 792
Density	0.043	lb/in ³	ASTM D 792
Water Absorption, 24 hours @ 73F	0.150	%	ASTM D 570
Water Absorption, equilibrium, 73F	0.35	%	ASTM D 570
Water Absorption, equilibrium, 212F	0.58	%	ASTM D 570
Mold Shrinkage, flow, 0.125"	5-7	in/in E-3	ASTM D 955
Melt Flow Rate, nom'l, 300C/1.2 kgf (O)	17.5	g/10 min	ASTM D 1238

OPTICAL

Property	Typical Data	Unit	Method
Light Transmission, 0.100"	88.0	%	ASTM D 1003
Haze, 0.100"	1.0	%	ASTM D 1003
Refractive Index	1.586	-	ASTM D 542

ELECTRICAL

Property	Typical Data	Unit	Method
Volume Resistivity	>1E17	ohm-cm	ASTM D 257
Dielectric Strength, in air, 125 mils	380	V/mil	ASTM D 149
Dielectric Constant, 60 Hz	3.17	-	ASTM D 150
Dielectric Constant, 1 MHz	2.96	-	ASTM D 150
Dissipation Factor, 60 Hz	0.0009	-	ASTM D 150
Dissipation Factor, 1 MHz	0.0100	-	ASTM D 150

FLAME CHARACTERISTICS

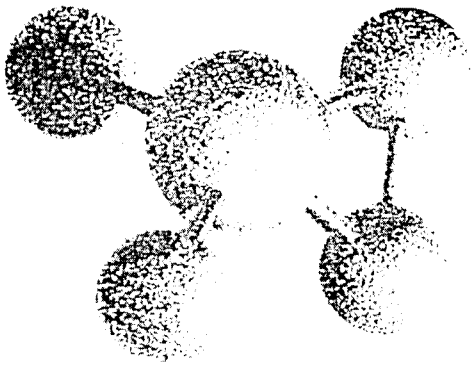
Property	Typical Data	Unit	Method
UL File Number, USA	E121562	-	-
HB Rated (tested thickness)	0.058	inch	UL 94

Source Eris, last updated: 1998/1

Disclaimer

The values shown on the attached pages are typical values that have been obtained using test bars from typical lots and are not intended for specification purposes. These values are for natural colors only. Addition of pigments may alter some values. Inasmuch as the General Electric Company has no control over the use to which others may put the material, it does not guarantee that the same results as those described herein will be obtained. Each user of the material should make his own test to determine the material's suitability for his own particular use. Statements concerning possible or suggested uses of the materials described herein are not to be construed as constituting a license under any General Electric patent covering such use or as recommendations for use of such materials in the infringement of any patent.

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 light 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 ³)	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
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) 樹脂系黏着劑，能在常溫下硬化，應用範圍至為廣泛，可穩定黏着金屬、塑膠以及其他各種物質，而由於此黏着劑，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着劑富有彎曲性的黏着層，縱使黏着不同材質的物品，也能以黏着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着層，可以黏着透明的物質，如玻璃等等。

〔用 途〕

由於能強力黏着各種物質，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。

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

〔實 例〕

汽車、火車、船隻、飛機……，(將金屬把手黏着於玻璃窗) 可以黏着鋁製品，三聚聚胺 (Melamine) 裝飾板等，於內部以增加強度 / 不同金屬間為兼防止電傷且加黏之 / 當作防腐塗料亦可)。

電器製品……，(由於是一種優秀的黏着劑，使用於高級擴音器、音響線圈的黏着 / 電磁器或外殼的黏着 / 線圈座的黏着 / 鐵粉座的黏着 / 馬達線圈的黏着等等)。

建築……，(玻璃、壓克力門或將文字板黏於厚玻璃把手、隔間設備以及其他塑膠裝飾品的加黏以及鋼立 / 不銹鋼製品、鑄製建材、陶器或大理石等需要強力黏劑物品的加黏)。

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，鑄模用，敷層用以及襯裏用。

加 劑	25 份	50 份	100 份	120 份
主 劑	30 份	30 份	100 份	120 份
黏 度	125 分厘	60-80 分厘	40-60 分厘	30-40 分厘

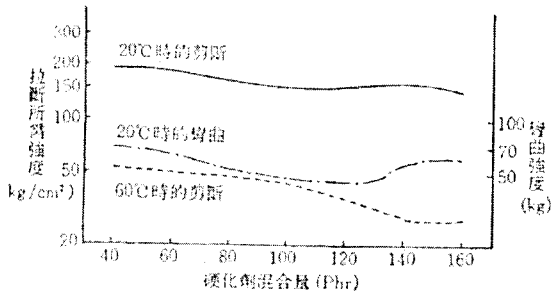


圖 II 2.1
硬化劑混合量與粘結力強度
(在20°C七天的硬化)
試驗片：軟鋼板 (25×100×1.6mm)
(Over-lap)12.5mm

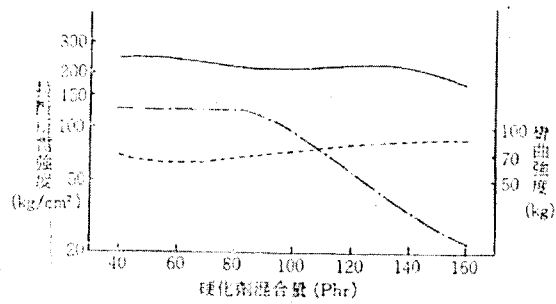


圖 II 2.2
硬化劑混合量和粘結力強度
(在80°C一小時的硬化)
試驗片：以及其他同圖 II 2.1

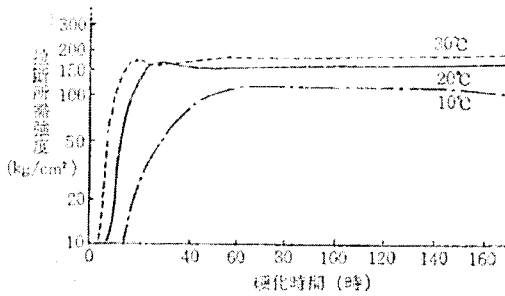


圖 II 2.3
常溫時的硬化特性 硬化劑混合率 100phr

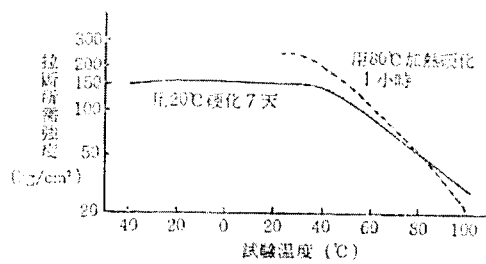


圖 II 2.5
耐熱特性 硬化劑混合率為 100phr

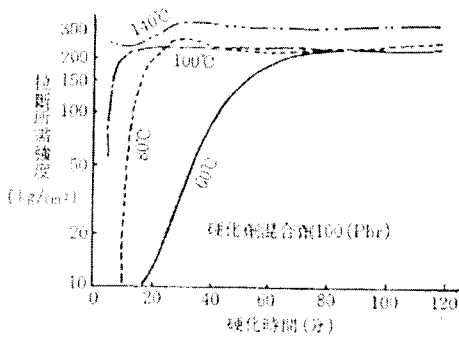


圖 II 2.4
加熱硬化特性 硬化劑混合率為 100phr

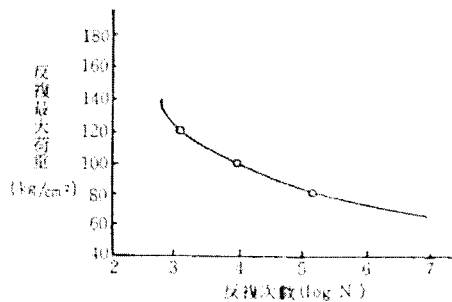


圖 II 2.6
老化特性

表 II 2.1 物理特性

抗張力 (kg/mm ²)	5.04	硬度 {	63
抗剪力 (kg/mm ²)	7.40	{ ロックウール M	67
彎曲彈性率 (kg/mm ²)	214	{ パーコル	82
耐穿強度 (kg/mm ²)	11.6	{ ショア-D	
壓縮強度 (kg/mm ²)	15.10(6.41)(¹)	表面固定電阻 (Ω)	5.6×10 ¹³
熱變形溫度 (°C)	47	體積固有電阻 (Ω-Cm)	10.5×10 ¹³
		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)
樟樹打	83	多元焦炭	22
馬來西亞杉材	106 *	苯乙稀樹脂	19
針葉樹材	99 < *	壓克力樹脂	30
杉材	66	硬質無錫樹脂	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	125
銅	80	R	
銻	71	P	
洋電鍍	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
利用噴射熱水的促進試驗	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

暴露前的粘力強度				拉斷所需強度 (kg/cm ²)
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)

試驗	拉斷所需強度 (kg/cm ²)				
	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)

試驗	拉斷所需強度 (kg/cm ²)				
	時間	0	3個月	6個月	1年
常態試驗		157	150	169	163
耐水試驗			133	108	116

[註] 同表II 2.5

◎ GEMEDINE

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	75.4
0°C油中	--	86.5	71.5	80.5	80.2	--
20°C油中	--	70.5	79.5	78.7	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, 試驗片飛夾片(100×25×3mm)接合部(Over-lap)12.5mm 2. 請為變壓器油。
3. 試驗片全部破裂。

表II 2.8 耐溶劑、耐藥品性

種 類	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	94.1	78.8
	三 氯 乙 烯	85.5	63.8	51.7	66.3
	四 氯 乙 烯	88.8	69.5	93.4	70.8
	二 氯 乙 烷	89.5	71.3	97.4	68.7
	三 氯 化 矽	90.2	64.7	101.3	69.1
油	植 物 油	102.7	90.8	107.3	90.3
	礦 物 油	96.2	87.8	98.1	84.2
藥 品	蒸 餾 水	93.4	72.3	96.3	69.3
	10% 硝 酸 溶 液	93.4	72.8	79.8	69.8
	10% 鹽 酸 溶 液	74.7	67.8	70.8	57.2
	10% 苛 性 蘇 打 溶 液	97.2	74.3	83.8	74.3
	10% 食 鹽 水 溶 液	89.6	71.8	91.0	69.8
10% 醋 酸 溶 液	94.2	77.8	78.4	64.2	

[註] 黏劑混合率=1:1, 試驗片:軟潤片(25×100×1.6mm) 複疊時試驗時使用了SUS-27, 接合部(Over-lap)為12.5mm。

容量規格 = (主) 110g、1kg、15kg (組)



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