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Absorbers are available as : (all types of Alkards)

- 400 x 400mm or 300 x 300 sheets in thicknesses from 1 to 6 (available from stock).
- 5 to 40 mm diameter round bars in 1m lengths.
- All other moulded or machined forms.
- All blocks available on request.

Grades :

- All those described in the sheets are standard.
- Special formulations can be designed.

Hyperfrequency measurements : (Low level and power)

- During manufacture : regular checks on absorbers and fillers.
- During design phase : creation of new fillers or absorbers meeting our customers' measurement requirements.

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2450 MHz FILTER

Cut-off frequency at -50 dB : 850 MHz

Decoupling level : at 2450 MHz < 70 dB

from 2000 to 10000 MHz < -58 dB

Cables used : up to 8,5 mm diameter

Voltage resistance : that of the cable used

Current resistance : up to 1 A, has no effect on properties

Dimensions : diameter of 28 mm for a length of 360 mm

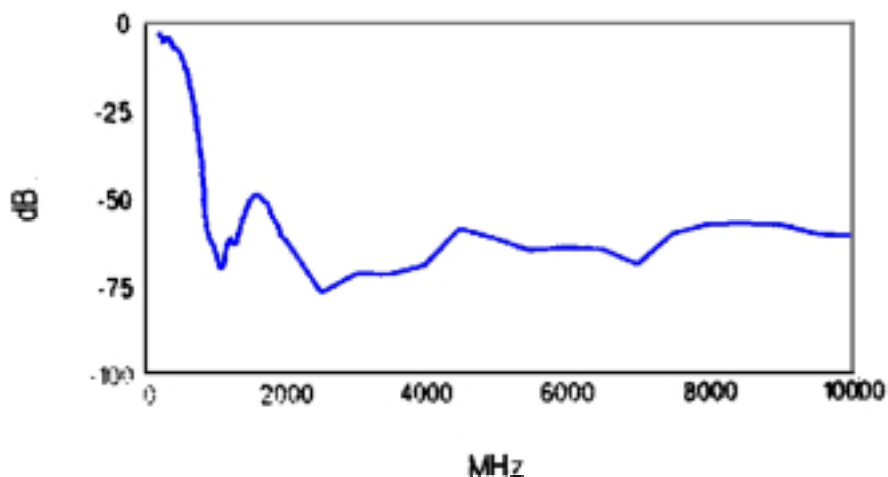
Attachment : to wall by attachment \varnothing 26 mm, gas thread, length 40 mm

External material : copper tube

Internal material : solid ALKARD absorber

Mass : approximately 1Kg

2450 MHz FILTER for hyperfrequency furnaces





896 – 916 MHz FILTER

Cut-off frequency at -50 dB : 750 MHz

Decoupling level : from 896 to 916 MHz < 70 dB

from 900 to 2000 MHz < -55 dB

from 2000 to 10000 MHz < -40 dB

Cables used : up to 8,5 mm diameter

Voltage resistance : that of the cable used

Current resistance : up to 1 A, has no effect on properties

Dimensions : diameter of 28 mm for a length of 360 mm

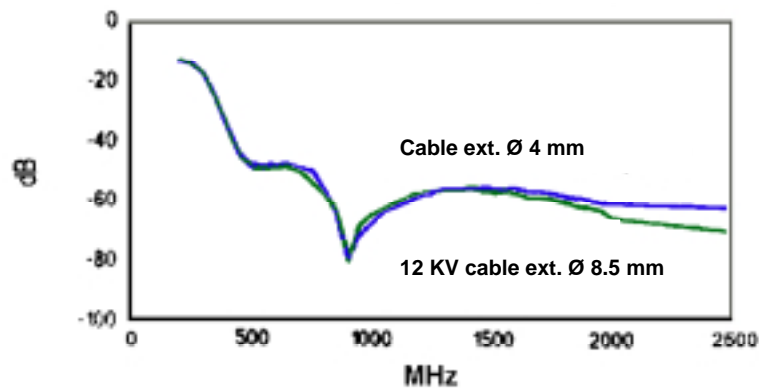
Attachment : to wall by attachment Ø 26 mm, gas thread, length 40 mm.

External material : copper tube

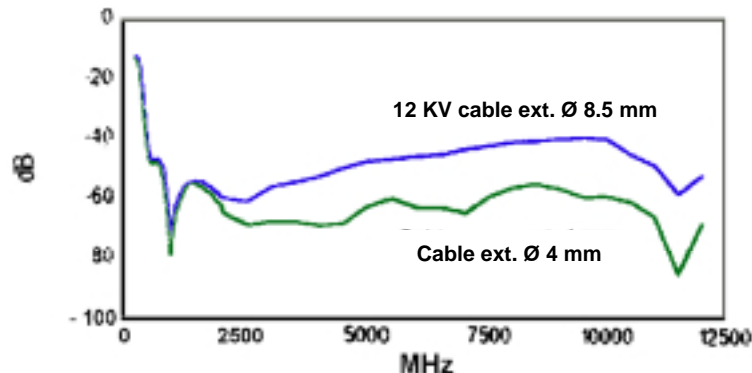
Internal material : solid ALKARD absorber

Mass : approximately 1 Kg

816-916 MHz filter for hyperfrequency furnace



816-916 MHz filter for hyperfrequency furnace





450 MHz /50 dB FILTER

Cut off frequency at -50 dB : 400 MHz

Decoupling level : between 450 MHz and 3 GHz < 55 dB

between 450 MHz and 10 GHz < -35 dB

Cables used : up to 8.5mm diameter

Voltage resistance : that of the cable used

Current resistance : up to 1 A, has no effect on properties

Dimensions : diameter of 28 mm for a length of 360 mm

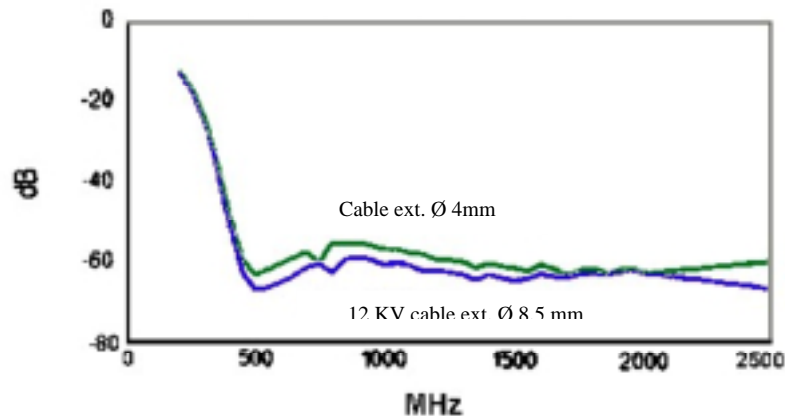
Attachment : to wall by attachment Ø 26mm, gas thread , length 40 mm.

External material : copper tube

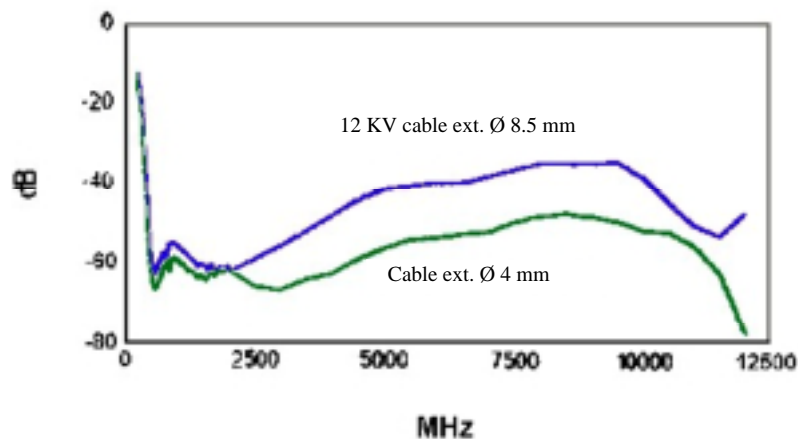
Internal material : solid ALKARD absorber

Mass : approximately 1 Kg

450 MHz 50dB FILTER



450 MHz 50dB FILTER





SPECIALLY ADAPTED HIGH CURRENT FILTERS

These filters are used for pulsed measurement of active hyperfrequency components.

Their role consists of preventing the transistor component from oscillating with the current pulses.

They can be adapted to each specific case (decoupling, SWR, cut-off frequency).

The length varies according to the required SWR and pulse source decoupling.

The filter shown here has the following specifications:

Isolation voltage : 200 V

Average current : 5 A

Pulse peak current : 8 A

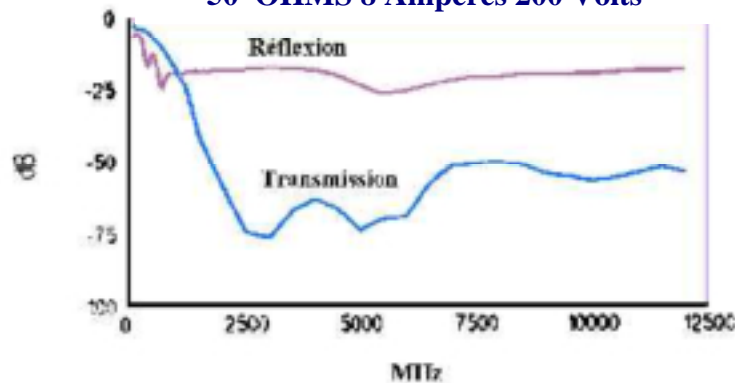
Decoupling at 1,1 GHz : 20dB

SWR at 1,1 GHz : 1,2 (P inc/P refl =20 dB)

Decoupling from 2 to 12 GHz : <50 dB

SWR from 2 to 12 GHz : <1,5

**Specially Adapted filter
50 OHMS 8 Amperes 200 Volts**



**Specially Adapted filter
50 OHMS 8 Amperes 200 Volts**





HIGH VOLTAGE / HIGH CURRENT FILTERS

FILTERS FOR HYPERFREQUENCY FURNACES

Applications

These filters are designed for decoupling continuous high voltage lines and various feeds from enclosures containing the high power magnetrons of industrial hyperfrequency furnaces.

Frequency band

Depending upon the model, attenuation is in excess of 50 dB for frequency bands from 450 MHz to 10GHz.

Voltage resistance

The voltage resistance is that of the cable used. This passes through the solid elements of the filter without being interrupted by any connection, except at the power source and the application (the cable is threaded through the filter).

*Cable diameter can be up to 8.5 mm (e.g.: Filotex 12 KV cable).
Smaller diameter cables can be used without any deterioration in performance.*

Sensitivity to direct current

The direct current passing through the conductor does not affect performance.

Dimensions

The dimensions are very much less than those of a filter having discrete elements such as inductors and condensers.

The three filters illustrated here have a diameter of 28 mm and a length of approximately 400 mm.

Attachment

The enclosure is attached to the wall via a hole 28 mm in diameter. The filter is equipped with a 40 mm gas threaded stud with two nuts for attachment to walls up to 30 mm thick.

Price

The manufacturing cost is very much lower than that of filters with discrete elements and gives appreciably better performance at high frequencies.



HIGH VOLTAGE / HIGH CURRENT FILTERS



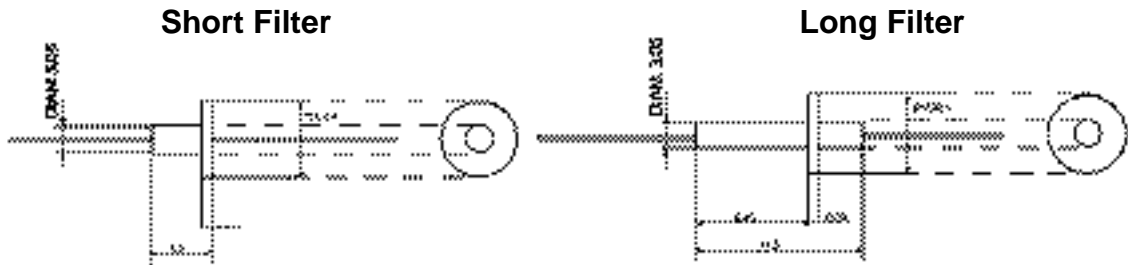


ALKARD COAXIAL FILTERS

These filters, with cylindrical silvered brass bodies and central coaxial conductor passing through a length equal to that of the filter of an ALKARD absorber, are used to decouple the DC outputs of hyperfrequency units. (Connection wire lengths at the time of measurement : 7 mm).

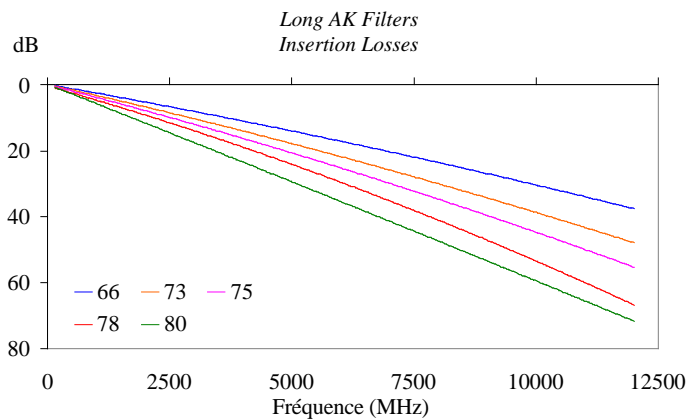
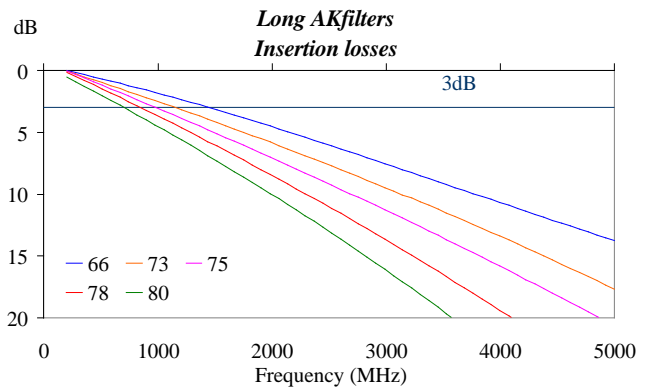
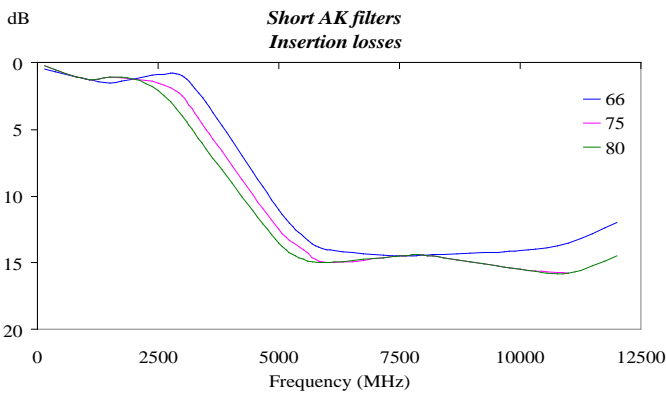
AK FILTER

Silvered brass body



**Wire Diameter : 0.3 mm
Wire Length : 50 mm**

**Wire Diameter : 0.3 mm
Wire Length : 50 mm**





CONICAL LOADS



These loads manufactured from ALKARD 75 are machined with the greatest care. They have an SWR of 1.01 over the bandwidth of each guide shown below. To assist fitting they have a threaded hole at the rear. These absorber cones are designed to provide reference loads or to be fitted to directive couplers.

Please consult us for other sizes or shapes.

Reference	Guide type WR	Frequency range (GHz)	Total length (mm)	Thread/Depth of hole (mm)	Power (W)
284 C 75	284	2,6 - 3,95	280	8/ 30	10
229 C 75	229	3,3 - 4,9	240	8/ 30	8
187 C 75	187	3,95 - 5,85	220	6/ 25	5
159 C 75	159	4,9 - 7,05	190	6/ 25	4
137 C 75	137	5,85 - 8,20	180	4/ 20	4
112 C 75	112	7,05 - 10	130	4/ 20	3
90 C 75	90	8,2 - 12,4	100	3/ 10	2
75 C 75	75	10,0 - 15	80	3/ 10	1
62 C 75	62	12,4 - 18	76	3/ 10	1
42 C 75	42	18 - 26,5	60	2/ 5	0,5
28 C 75	28	26,5 - 40	41	2/ 5	0,5
22 C 75	22	33 - 50	30	1/ 5	0,25
15 C 75	15	50 - 75	20	0,8/ 5	0,1
12 C 75	12	60 - 90	20	0,8/ 5	0,1

SWR measurements can be performed on request, within the limits of our equipment, in test mountings provided by customers.



LIGHTWEIGHT ABSORBERS

ALKARD LMPC

This is a rigid foam hyper frequency absorber in the form of a machinable block.

Available forms : 600 x 300 sheets, thickness 5 to 50mm, can be bonded.

Frequency Range : 2 to 50 GHz

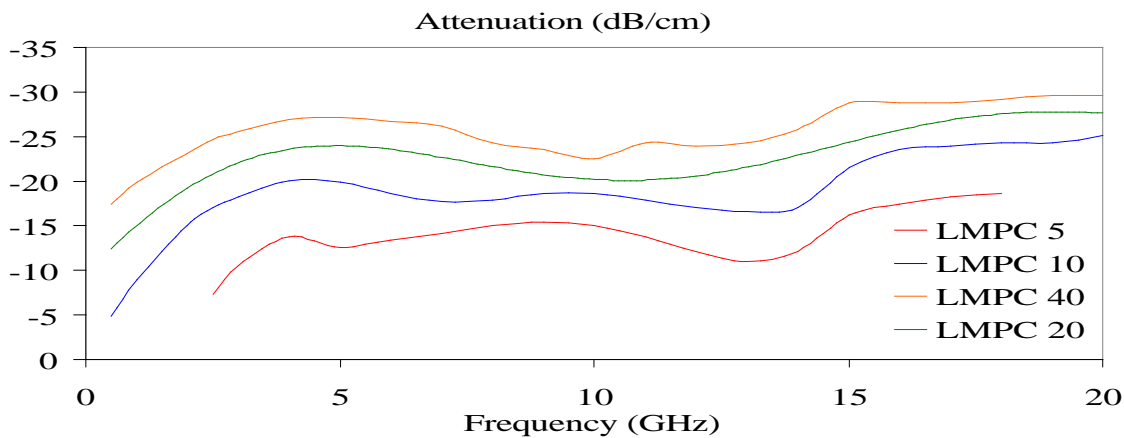
Composition :

- Closed cell PU foam
- Carbon filler

Characteristics :

- Uniform and can be bonded
- Fire classification : M2
- Colour : black

Reflectivity measurements on a metal plate (incidence 0°)



Grades and descriptions :

- Grades : 5, 10, 20, 40
- Description : LMPC5, ...LMPC40

Application :

- As a substitute for solid high density absorbers ($d > 1.2$ up to 4).
- Airborne equipment.
- Machinable for absorbing filling parts.

Attachment :

- Cold bonded using polyurethane adhesive = > permanent attachment
- Epoxy or polyester transfer film



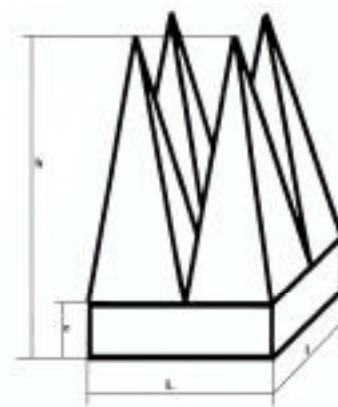
FREE SPACE ABSORBERS

ALKARD PMPC :

This is a pyramid shaped broadband hyperfrequency anechoic absorber.

Available forms : cut pyramid-shaped sections as shown in the following table.

	<i>h</i>	<i>w</i>	<i>l</i>	<i>N° of</i>	<i>weight</i>	<i>thickness</i>
	<i>mm</i>	<i>mm</i>	<i>mm</i>	<i>pyramids</i>	<i>Kg</i>	<i>mm</i>
PMPC 100	100	610	610	289	1	20
PMPC 120	120	610	610	289	1,2	25
PMPC 205	205	610	610	100	2,2	45
PMPC 310	310	610	610	36	3	50
PMPC 470	470	610	610	25	4,6	80
PMPC 600	600	610	610	9	5,5	80
PMPC 700.1	700	203	203	1	0,8	110
PMPC 700.2	700	407	203	2	1,6	110
PMPC 700.3	700	610	203	3	2,4	110
PMPC 700.6	700	610	407	6	4,8	110
PMPC 700.9	700	610	610	9	7,2	110
PMPC 950.1	950	305	305	1	2,3	150
PMPC 950.2	950	610	305	2	4,6	150
PMPC 950.4	950	610	610	4	9,2	150
PMPC 1200.1	1200	305	305	1	2,9	200
PMPC 1200.2	1200	610	305	2	5,8	200
PMPC 1200.4	1200	610	610	4	11,6	200
PMPC 2100	2100	610	610	1	19,7	300
PMPC 3000	3000	610	610	1	27,7	400
PMPC 3900	3900	610	610	1	37,2	600



Composition : *Polyurethane foam*

- *open cells*
- *carbon filler*
- *Standard product : M2 (C.S.T.B.)*
- *M1 on request*
- *Choice of colours in non reflective paint finish.*

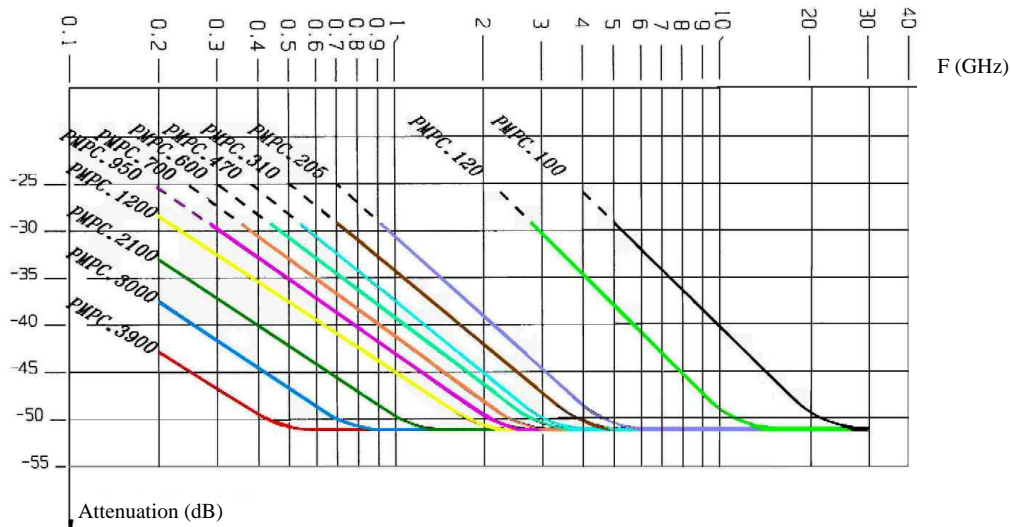
Frequency range : *200 MHz to 95 GHz.*

Applications : *Surfacing of normal interior walls of hyperfrequency chambers and mainly critical zones : receiving walls, vertical and horizontal mirror reflection walls, fixed or mobile modules, etc.*

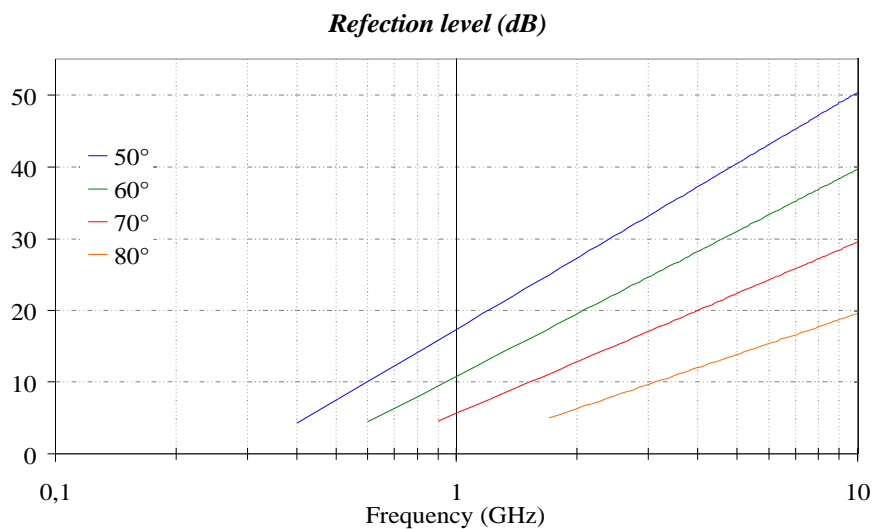
Attachment : - *Neoprene bonding as a permanent method of attachment to most bases.*
 - *Temporary method of attachment : consult us.*

Performances :

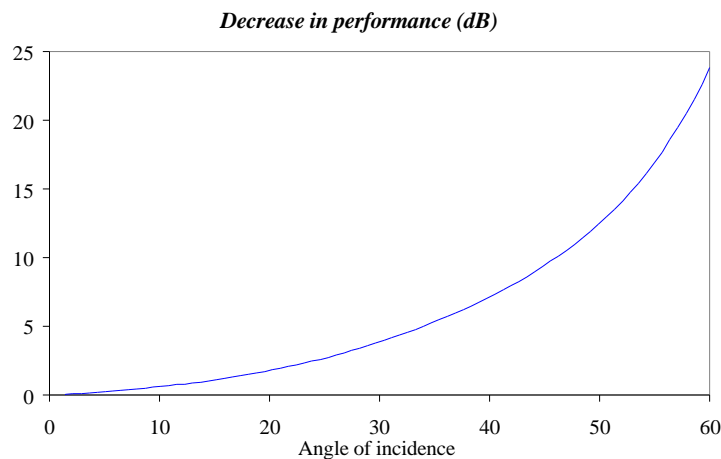
Reflectivity of PMPC absorber as a function of frequency (incidence close to normal).



Reflectivity of PMPC absorber as a function of frequency, at different angles of incidence.



Example of the variation in the performance of a PMPC.950 absorber at a frequency of 10 GHz as a function of the variation in the angle of incidence.





FREE SPACE ABSORBERS

ALKARD FMPC

This is a flat broadband hyperfrequency anechoic absorber.

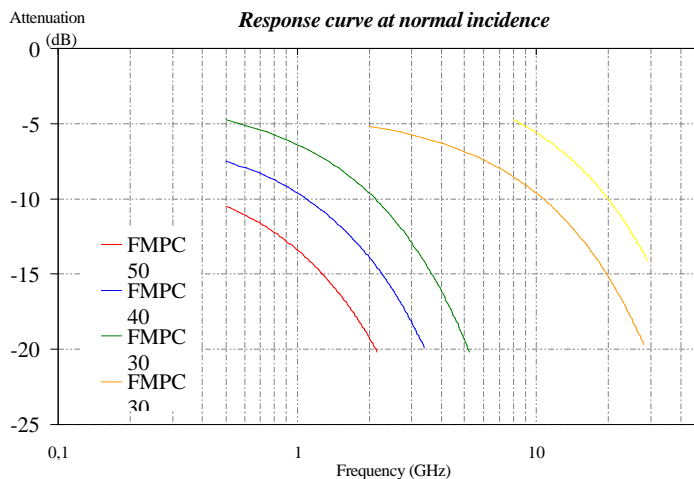
Available forms : 610 x 610 sheets in thicknesses from 10 to 50 mm.

FMPC	10	20	30	40	50
thickness (mm)	10	20	30	40	50
weight (kg)	0,2	0,4	0,6	0,8	1

Composition : Polyurethane foam

- Open cells
- Carbon filler
- Flexible flat sheets
- Uniform
- Standard product: M2 (choice of colours in reflective paint finish)

Frequency range : From 500 MHz to 50 GHz.



Applications : Economical protective coating for materials and equipment which may be affected by undesirable spurious reflections. Used whenever high performance is not essential, particularly at low frequencies. Ideal for short term tests which do not justify large expenditure or for destructive testing. It is very flexible and easily adapts to a variety of surface shapes. Can be easily cut for all made to measure applications.

Attachment : Neoprene bonding as a permanent method of attachment to most bases.



FREE SPACE ABSORBERS

ALKARD MPC :

This is a broadband hyperfrequency anechoic absorber with stud-shaped projections.

Available forms : 610 x 610 panels in thicknesses from 50 to 200mm.

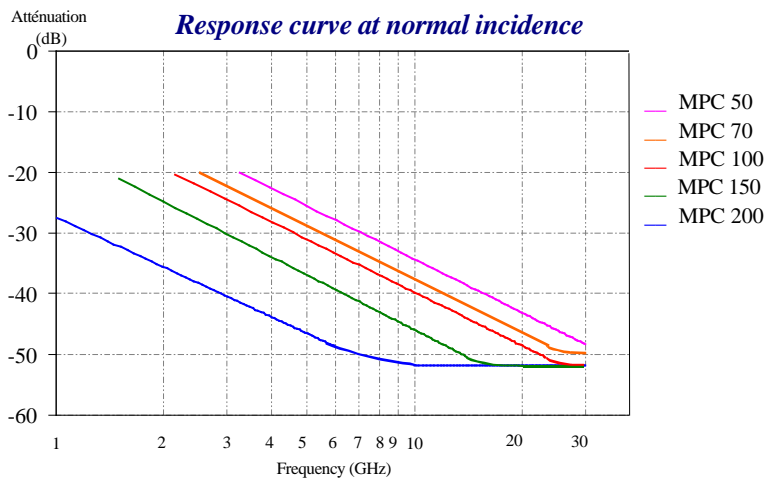
MPC	50	70	100	150	200
Thickness (mm)	50	70	100	150	200
Weight(Kg)	1,2	1,6	2,3	3,5	4,7

Composition : polyurethane foam

- open cells
- carbon filler
- cut to shape, with stud-shaped projections
- with multiplayer base

Standard product: M2 (C.S.T.B)

Frequency range : 1 GHz to 95 GHz and greater particularly from the x band.



Applications : Surfacing of normal internal walls of laboratory premises and specialist chambers for high and very high frequency tests involving high incidences.

An absorber with stud-shaped projections must be used for the above reason and because of its reduced bulk when test enclosures are small.

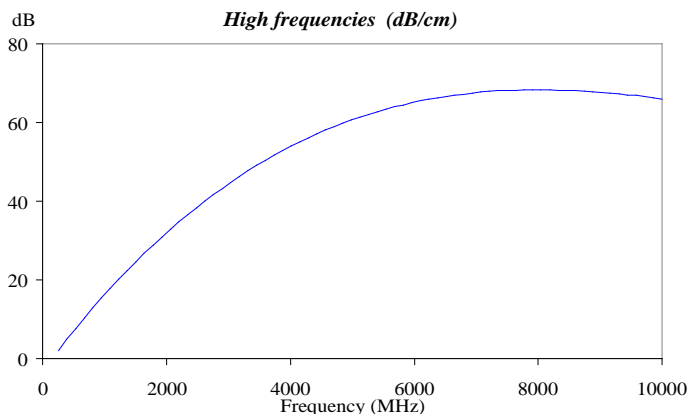
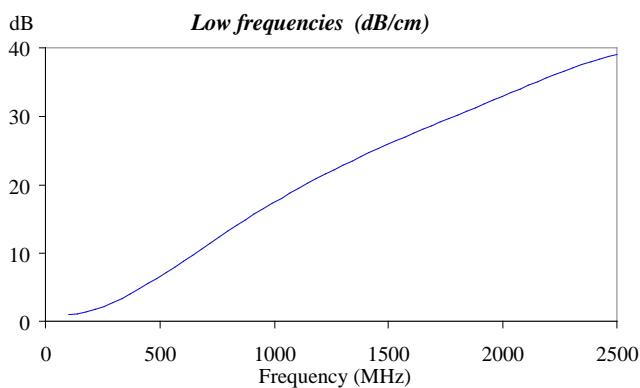
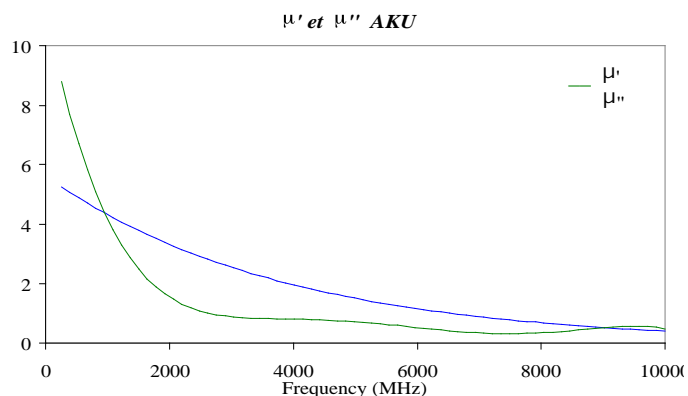
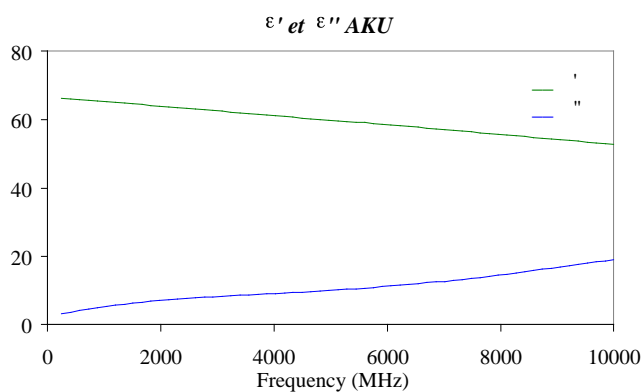


LOW FREQUENCY HIGH ATTENUATION ABSORBER

AKU is a relatively flexible absorber specially designed for applications below 2 GHz, such as screening for cabinets, solid filters, in particular for decoupling high voltage feed from magnetrons.

Available forms : panels or blocks machined as requested.

General Properties





FLEXIBLE AND RIGID LOW FREQUENCY ABSORBERS

The main feature of these absorbers is their attenuation below 2 GHz, while retaining good performance above this level.

Transmission losses (dB/cm) are proportional to material thickness if reflection phenomena at incidence surfaces are eliminated.

Grades

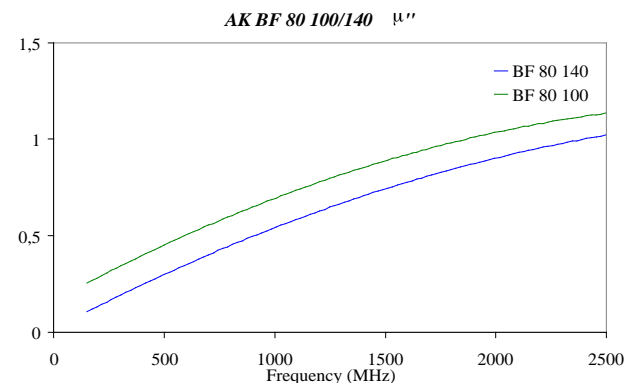
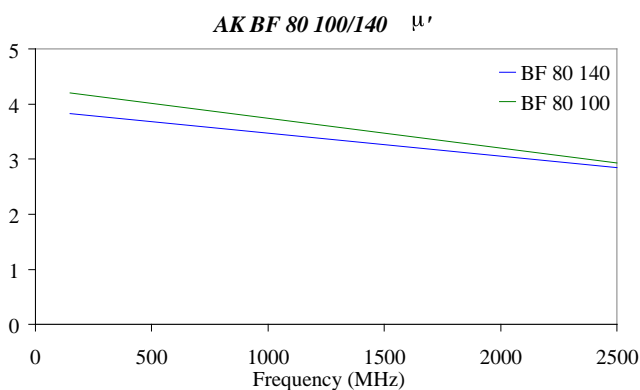
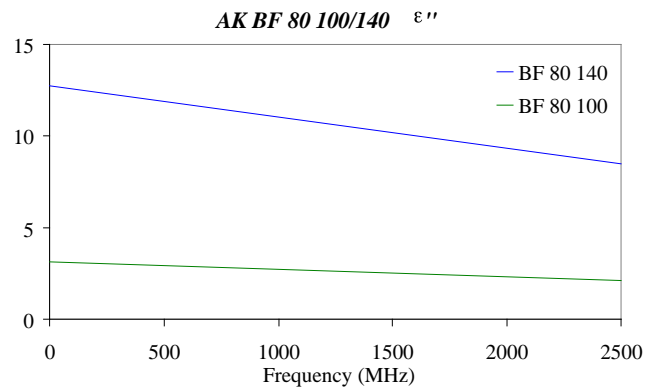
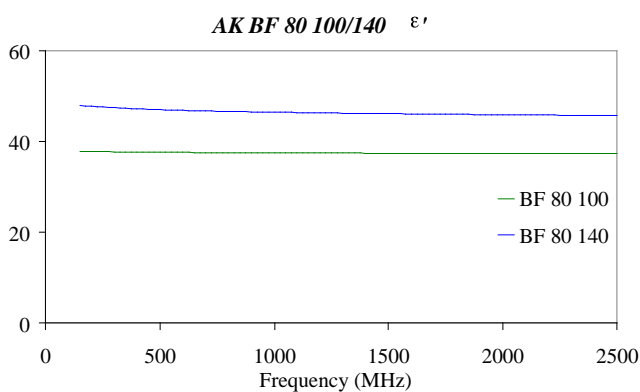
- flexible absorbers : AK BFP 80 100.
- rigid absorbers : AK BF 80 100 – AK BF 80 140.

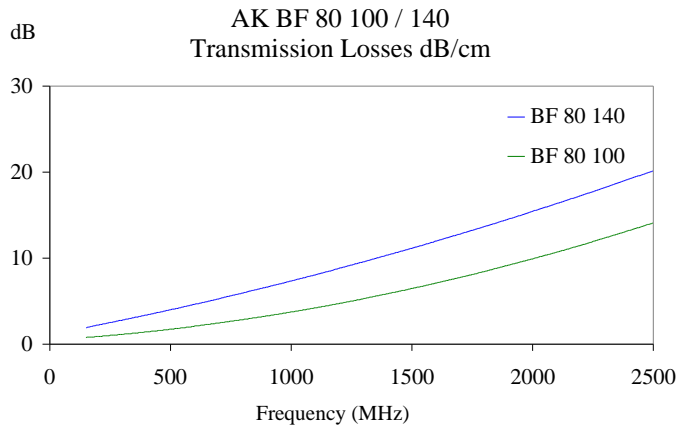
The properties of the flexible absorber are the same as those for the equivalent grade of rigid absorber. Grades other than those shown here can be manufactured on request.

Table of properties

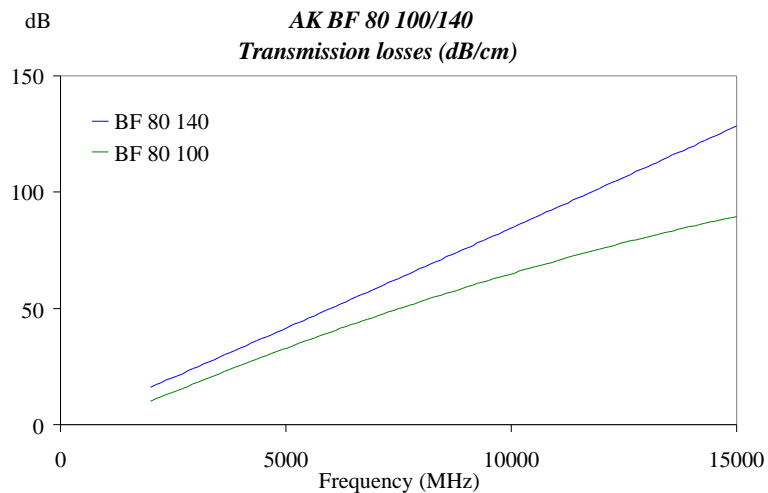
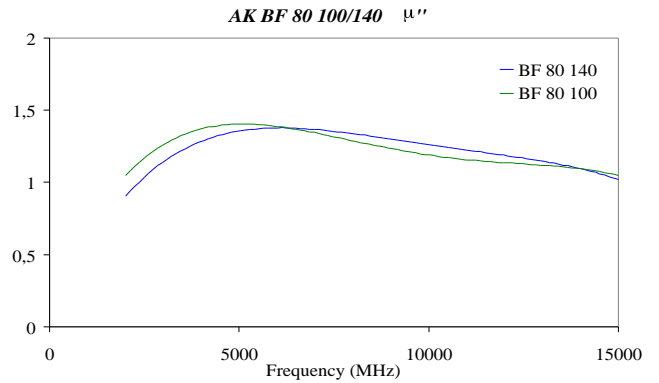
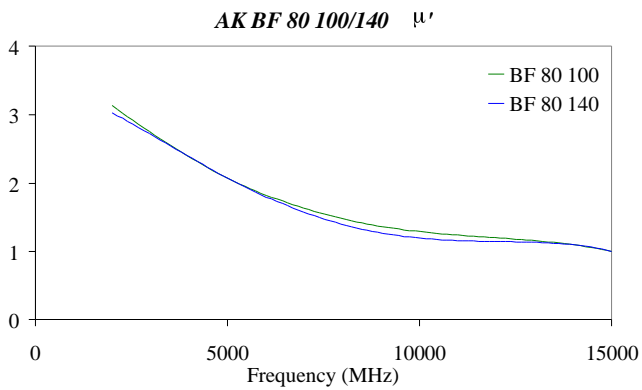
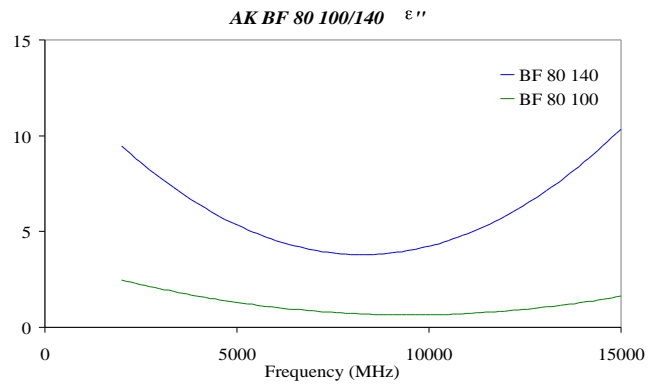
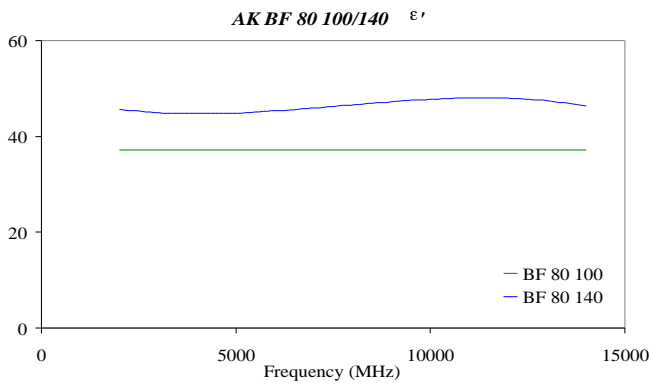
ALKARD	BF 80 100	BF 80 140
Continuous Temperature (°c)	120	120
Density (g/cm ³)	3,57	3,47
Hardness shore D	90	88
Water absorption	Negligible	Negligible

Properties from 50 to 2500 MHz





Properties from 2 to 15 GHz





LOW FREQUENCY ABSORBERS

ALKARD G

This is a non-magnetic absorber which is primarily used below 2 GHz.

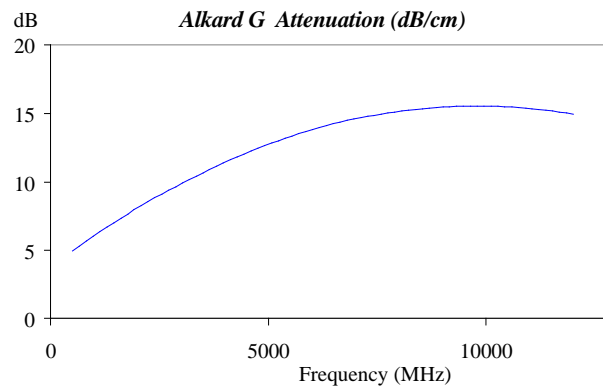
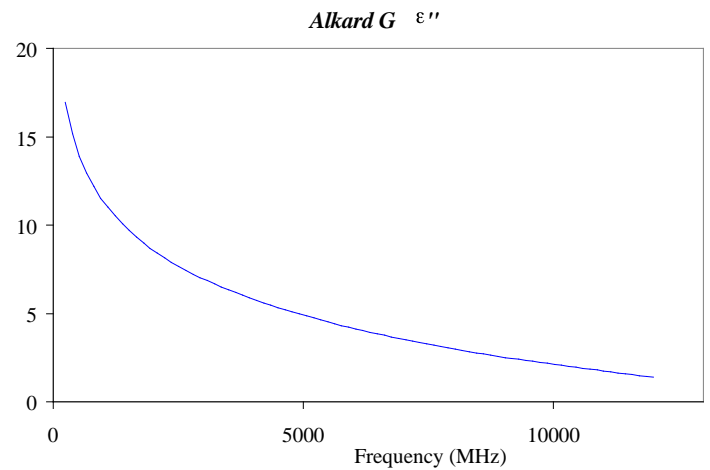
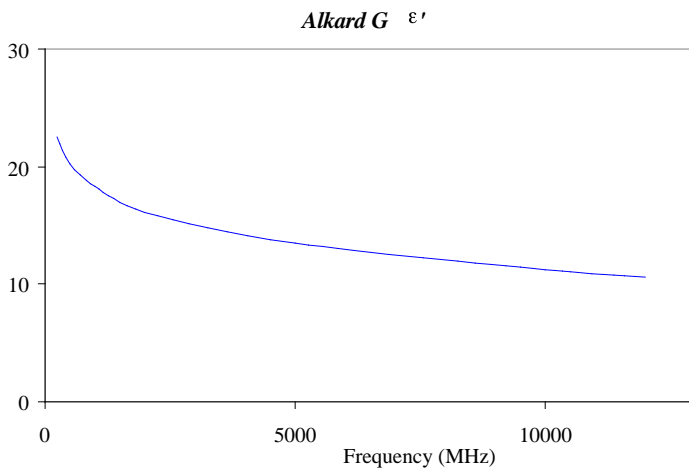
Available forms : bars, round bars, panels etc.

The material is conductive (approximately 90 Ohms.cm.cm₋₁)

Composition : polyester + graphite + etc .

Temperature resistance : +160°C

Utilization : low frequency attenuators.





HIGH POWER ABSORBERS

DEVILIT 450

This absorber is manufactured using a patented process. Its main property is its temperature resistance (+450°C). It has low water absorption and, like ALKARD, it has no porosity.

Available forms : bars, round bars, panels, (may also be moulded)

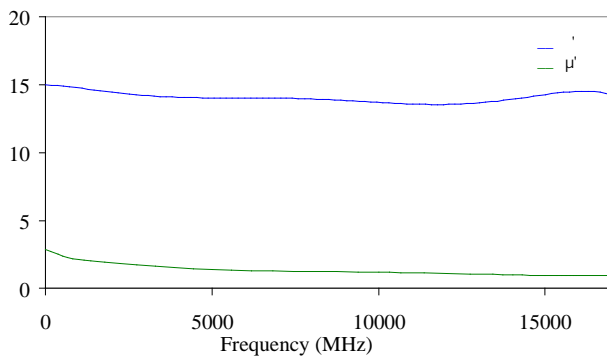
Composition : polyamide resins, iron, additives.

Applications : from 2 GHz.

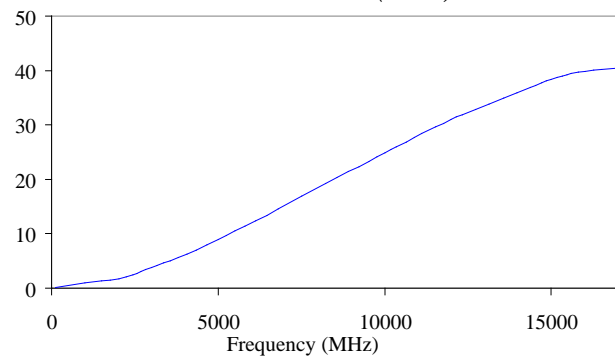
Thermal conductivity of Devilit :

- 20°C : 1,78 W/m °K
- 100°C : 1,58 W/m °K
- 200°C : 1,56 W/m °K

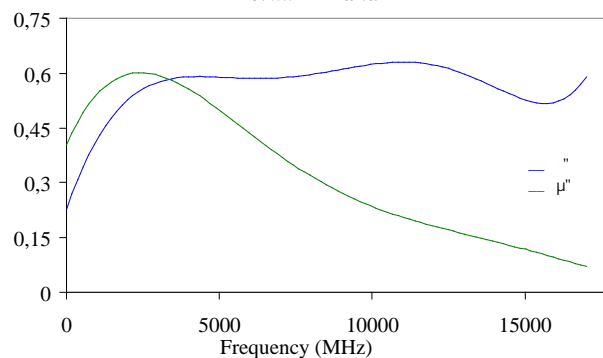
Devilit ϵ' and μ'



Devilit Attenuation (dB/cm)



Devilit ϵ'' and μ''





HIGH POWER ABSORBERS

ALKARD CS

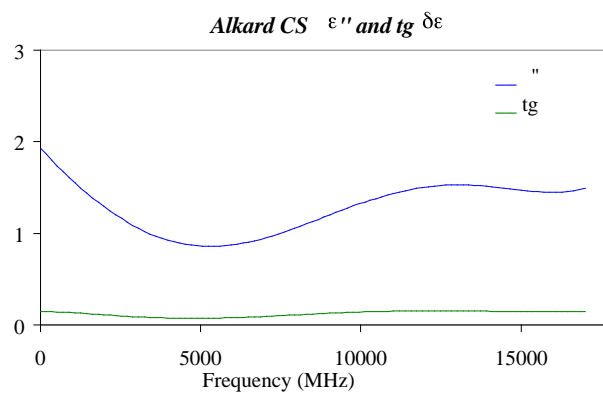
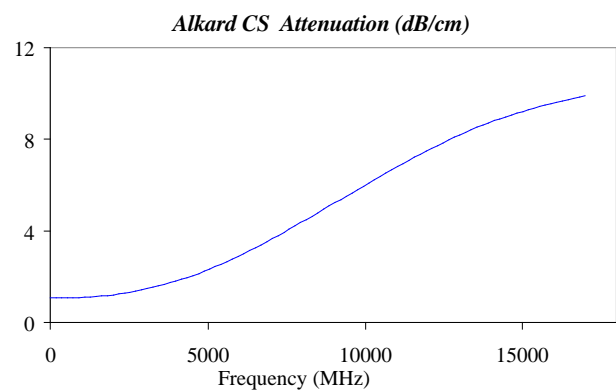
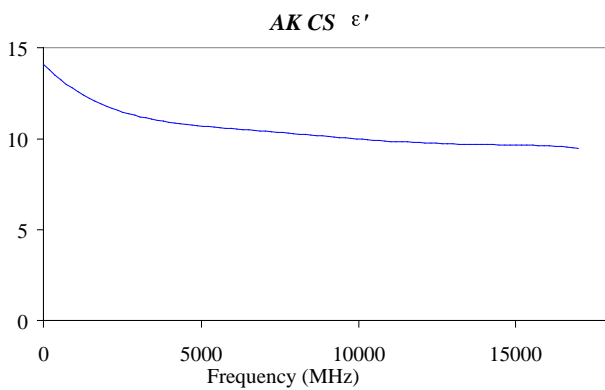
This absorber provides very good results for short loads with small SWR and at very high power. It is slightly porous and can, on request, be coated with a high temperature ceramic which reduces its water absorption.

Maximum operating temperature : 1000°C

Available forms : machined as requested.

Composition : silicon carbide + binders.

Utilization : high power loads / small SWR => Band X, S, L ...





VERY HIGH FREQUENCY ABSORBER

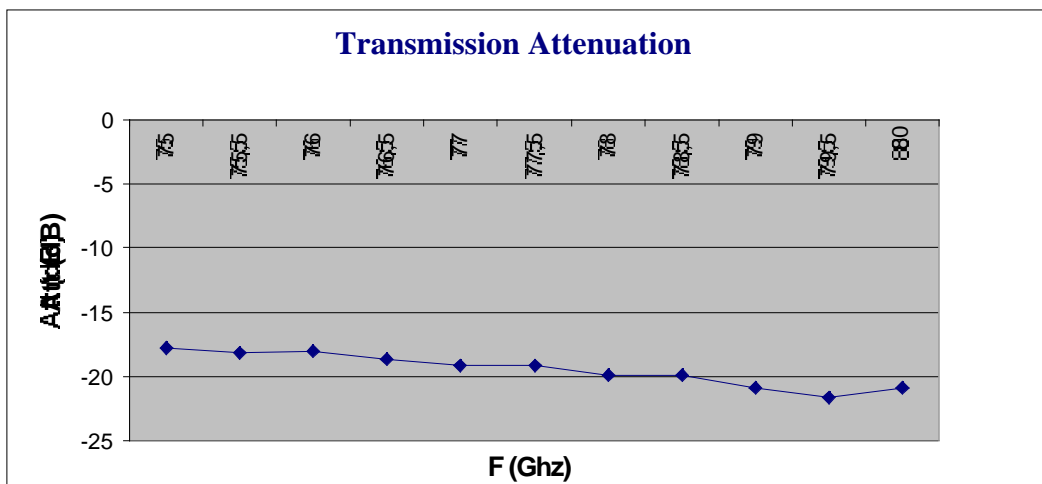
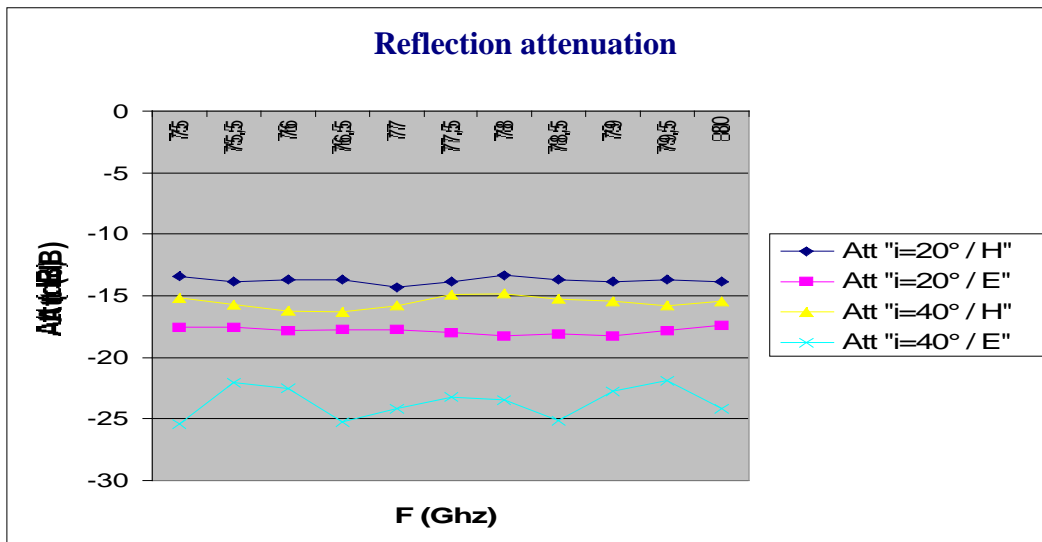
ALKARD PF84

This is a polyurethane-based absorber. Its geometry provides it with a good reflection coefficient for incidences up to 40°, regardless of polarisation, and a good transmission coefficient in the frequency band from 75 to 80 GHz.

Available forms : in the form required by the customer – adhesive or not as required.

Temperature resistance : -40°C to +85°C

Application : anti-collision radar.





FLEXIBLE ABSORBERS

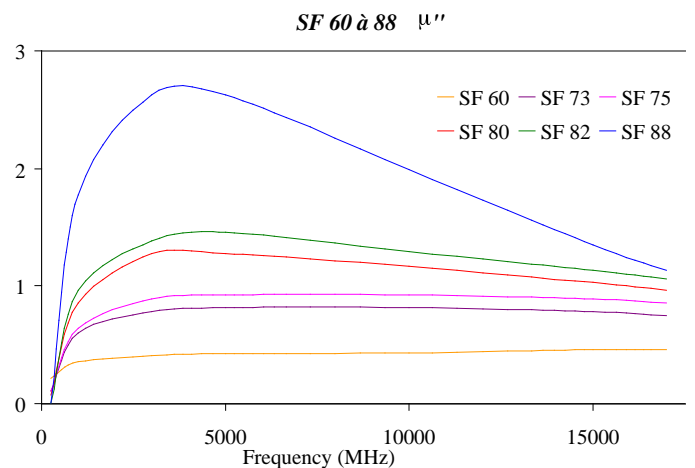
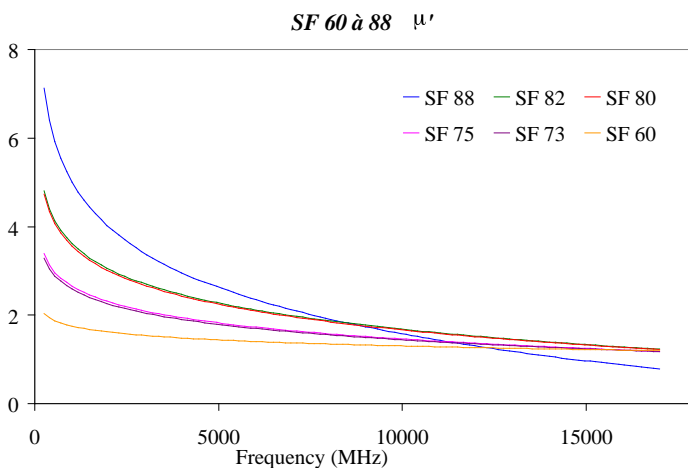
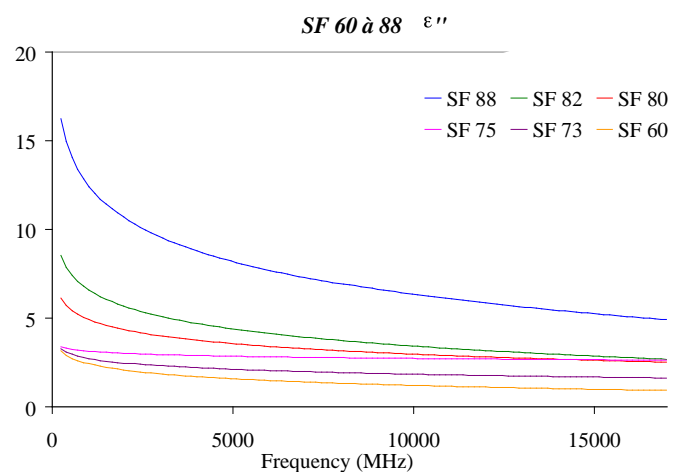
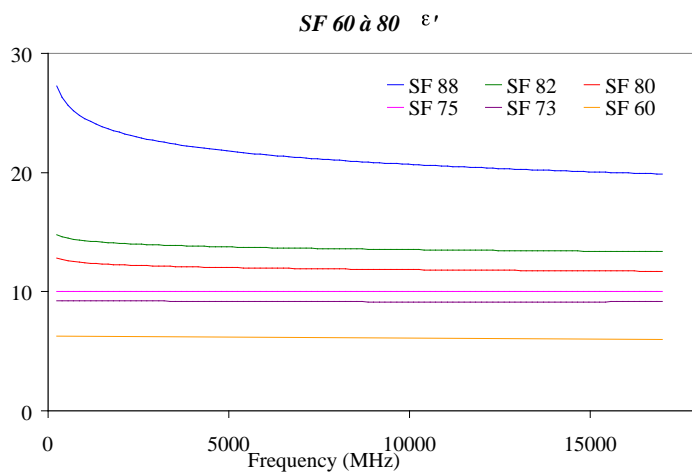
ALKARD SF

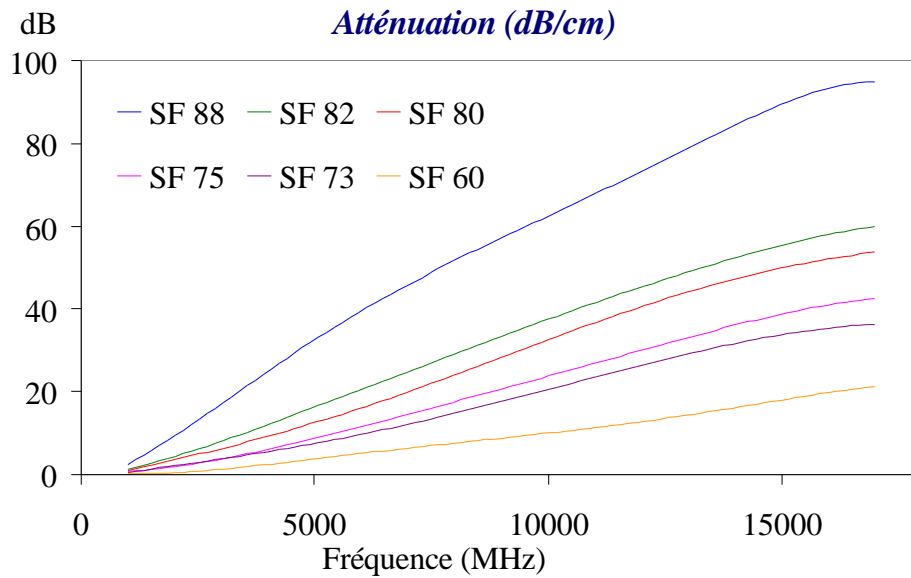
This is a silicone-based absorber containing filler. It generally comes in the form of “rubbery” sheets. Thickness and hardness are manufactured to order. As it can easily be cut with a scalpel it is an ideal absorber for research laboratories.

Available forms : generally in the form of sheets of any thickness between 0.8 and 5 mm. (Can be factory cut on request).

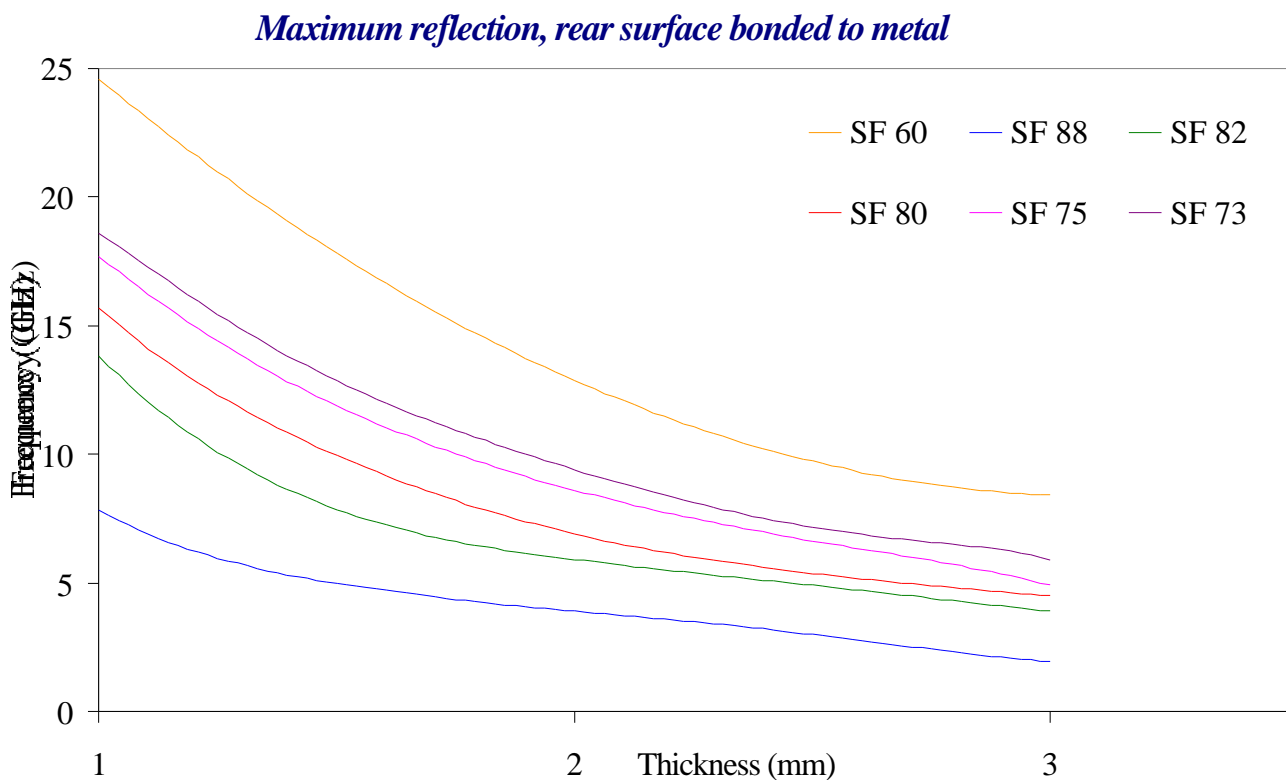
Composition : Silicones + Iron + Additives

Applications : it can be installed at the exterior to alter the reflection conditions of various objects or be bonded to complex shapes. It is often used to eliminate oscillation in hyperfrequency amplifiers, or to avoid leakage between 2 metal surfaces.



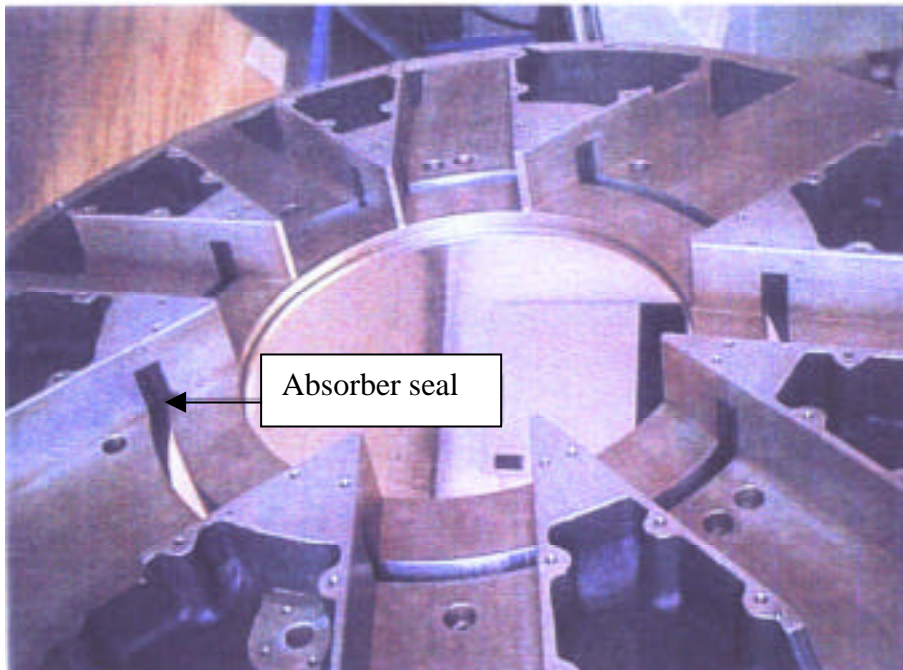
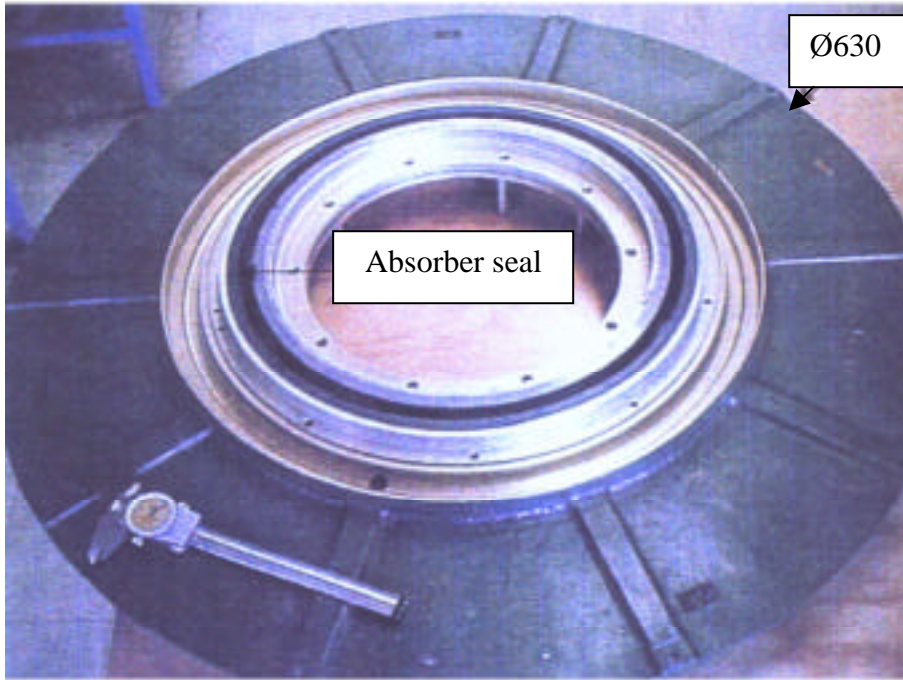


The following table indicates the frequencies at which the incident signal/reflected signal ratio is of the order of 20 dB, in a free field, in a 10% band (rear surface bonded to a metal surface, with normal incidence).





**RADAR ROTARY JOINT EQUIPED WITH ALKARD 80
ABSORBER (DEDIENNE)
MACHINED CAST ALUMINIUM (SAFOM)**





MEDIUM POWER ABSORBERS

The following tables summarise the main properties of Alkard absorbers obtained by varying the proportions of components in the composition.

These proportions are measured using precision electronic scales. Mixing is done in mixers modified for our applications. This enables us to guarantee reproducibility of quality to +/- 1%.

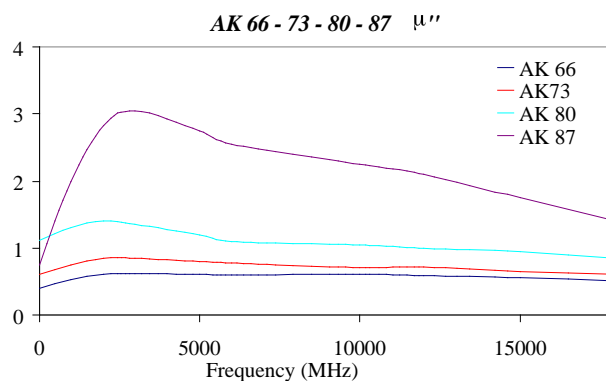
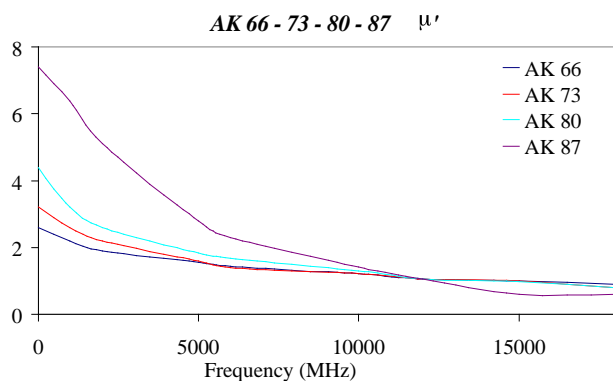
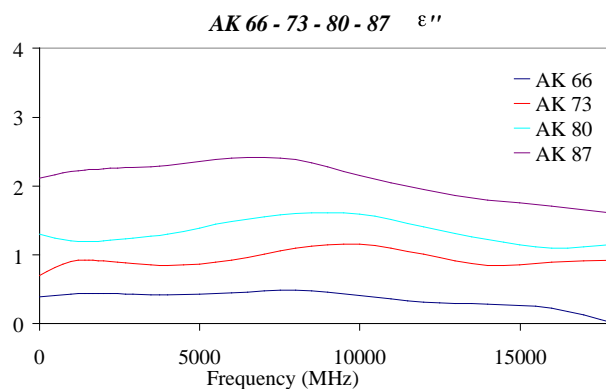
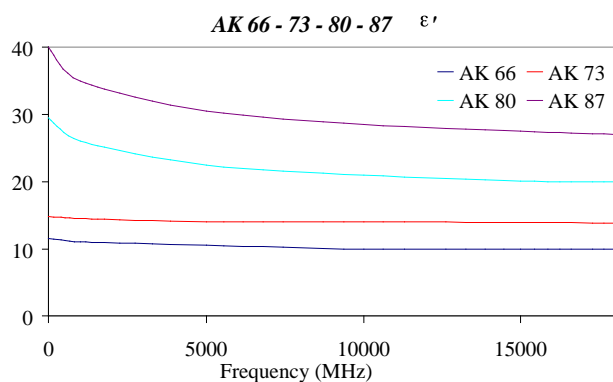
ALKARD	66	73	75	78	80	82	84	87
Continuous T°C	200°C	200°C	200°C	200°C	200°C	200°C	200°C	200°C
Density g/cm ³	2,72	3,03	3,35	3,46	3,79	3,9	4,02	4,65
Hardness shore D	85 to 90	85 to 90	90	90	90	90	90	90
Water Absorption	insignif.	insignif.	insignif.	insignif.	insignif.	insignif.	insignif.	insignif.

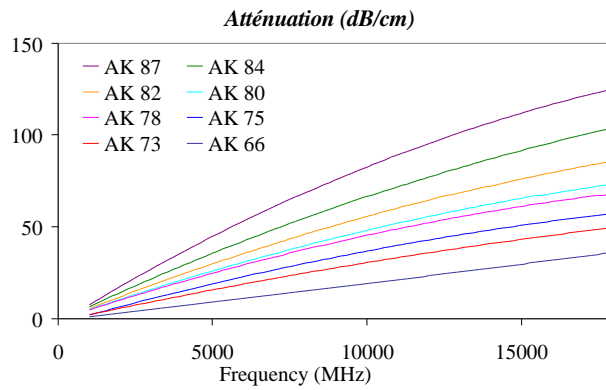
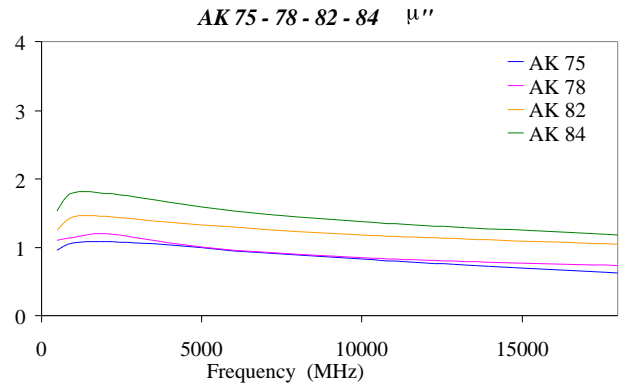
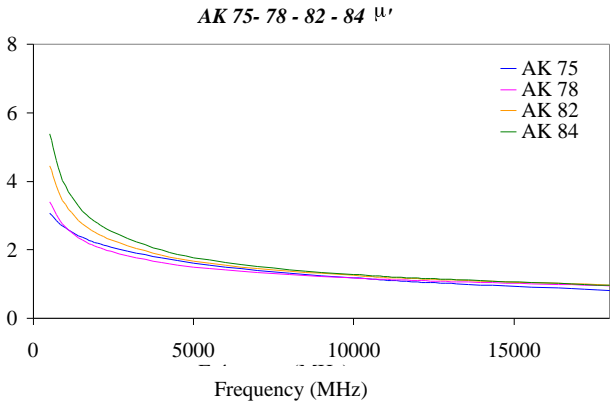
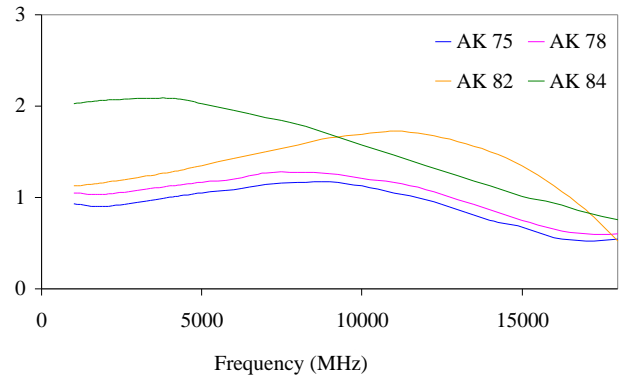
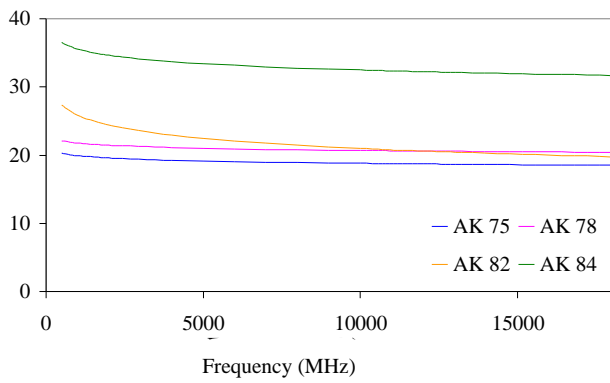
Resistant to ambient environment.

Available forms : bars, round bars, panels (mouldings possible)

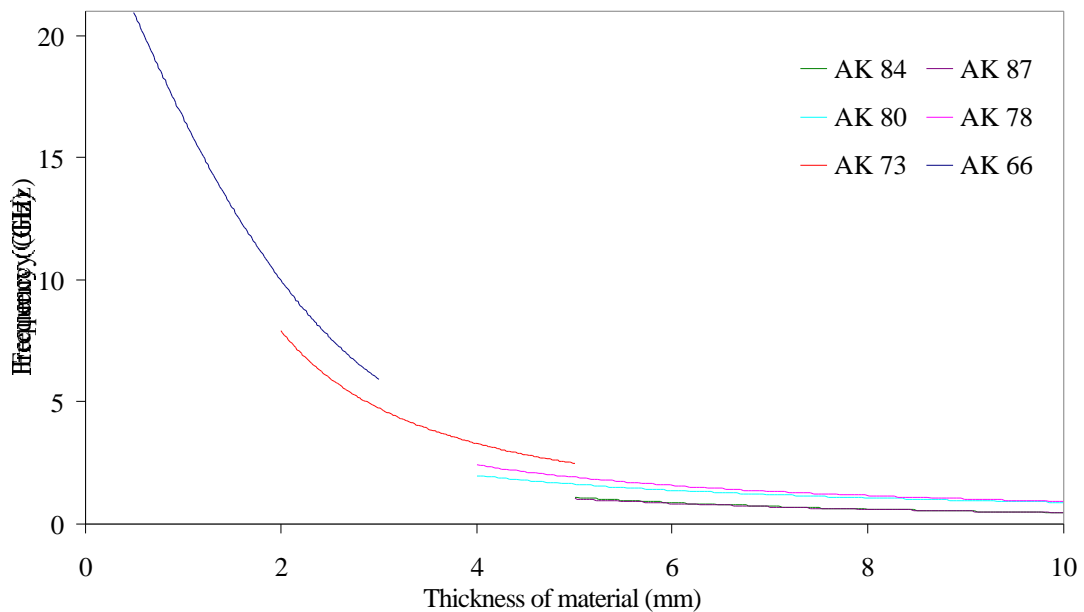
Composition : epoxy resin+ iron + additives

Utilization : - loads (narrow band, coaxial...) for waveguide
- electromagnetic absorbers ...





Maximum reflection (20 dB/cm) rear side bonded metal





BROADBAND ABSORBERS (THIN)

ALKARD DPM

Alkard DPM is a flexible absorber specially designed for the problems of stealth and EMC found on external reflecting surfaces (ships, vehicles, buildings etc.). It has an attenuation of close to -15dB in the 7 to 18 GHz band.

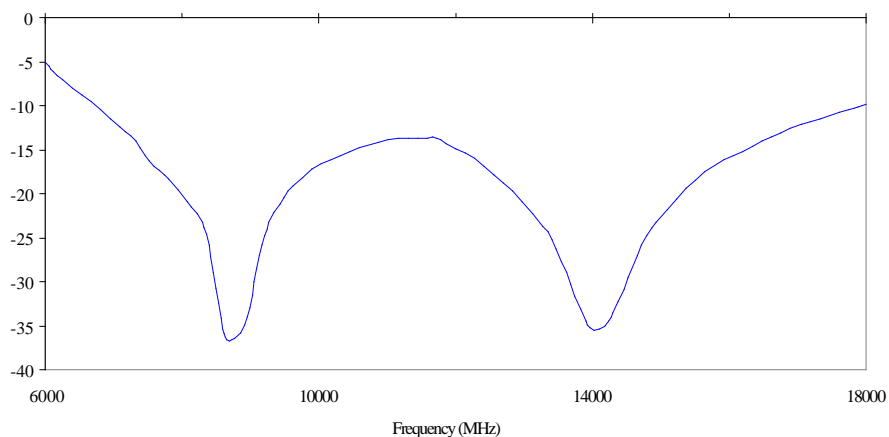
Available forms

- 400 x 400 sheets 4 mm thick, multilayer, also available in 500 x 500 sheets
- Incident surface and rear surface to be bonded (easy to bond).

Resistant to the marine environment.

Density 1.47 – Weight 5.8 kg/m²

Reflection at normal incidence (dB)





Reminder of the formulae for the propagation of energy in the dielectric and magnetic materials

Only formulae which have practical applications are considered. These apply very well to the following cases :

- 1) An absorber panel in free space.
- 2) An absorber block which loads a section of coaxial transmission line.
- 3) A parallelepiped absorber block which loads a rectangular wave guide working in transverse electrical mode TE₁₀.

- **Complex dielectric constant**

$$\epsilon^* = \epsilon - j\epsilon \tan(\delta\epsilon) = \frac{\epsilon'}{\epsilon_0} - j \frac{\epsilon''}{\epsilon_0}$$

$(\delta\epsilon)$ is defined as the dielectrical loss angle

- **Intrinsic impedance of the absorber material**

$$\mu^* = \mu - j\mu \tan(\delta\mu) = \frac{\mu'}{\mu_0} - j \frac{\mu''}{\mu_0}$$

$(\delta\mu)$ is defined as the magnetic loss angle.

- **Intrinsic impedance of the absorber material**

$$\frac{|Z|}{Z_0} = \left| \frac{\frac{\mu' - j\mu''}{\mu_0}}{\frac{\epsilon' - j\epsilon''}{\epsilon_0}} \right| = \left| \frac{\mu' - j\mu''}{\epsilon' - j\epsilon''} \right|$$

- **Attenuation in dB/cm**

$$A = 1,82F \frac{\mu''}{\mu_0} \frac{\epsilon''}{\epsilon_0} \frac{1 - \tan(\delta\epsilon)\tan(\delta\mu)}{2} \frac{1}{1 + \tan^2(\delta\epsilon + \delta\mu)^{1/2}} - 1 \quad \frac{1}{2}$$

in dB/cm where F is expressed in GHz.

This formula does not take into account reflection phenomena at the absorber input and output interfaces. The difference between the calculated and measured attenuation is a maximum of 20% between 2 and 18 GHz.

$$\Gamma^*(0) = \frac{\mu^* - \sqrt{\mu^* \epsilon^*}}{\mu^* + \sqrt{\mu^* \epsilon^*}}$$

$$\Gamma^*(0) = \Gamma^*(0)$$

$$\Gamma^*(0) = \frac{\sqrt{\mu^* \epsilon^*} - \epsilon^*}{\sqrt{\mu^* \epsilon^*} + \epsilon^*}$$

$$\gamma^*(0) = \frac{2\pi d}{\lambda_0} \sqrt{\mu^* \epsilon^*}$$

where d = thickness of the absorber panel.

- **Transmission coefficient under voltage T^***

$$T^* = \frac{\left(\frac{\mu^*}{\epsilon^*} \right)^{-j\gamma^*}}{1 - \frac{\mu^*}{\epsilon^*} e^{-j2\gamma^*}}$$

hence the insertion loss in decibels

$$= 10 \log \frac{1}{|T^*|^2}$$

- **Reflection coefficient under voltage R^***

$$R^* = \frac{\mu^* (1 - e^{-2j\gamma^*})}{1 - \frac{\mu^*}{\epsilon^*} e^{-2j\gamma^*}}$$

hence the reflection loss in decibels

$$= 10 \log \frac{1}{|R^*|^2}$$

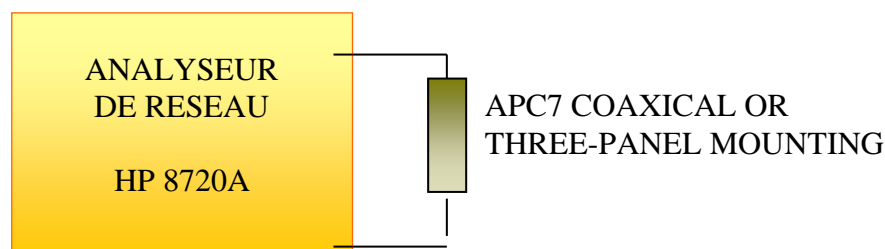
Alkards are absorbers with magnetic or dielectric filler and are used to make:

- Coaxial or wave guide loads,
- Coaxial or wave guide attenuators
- Wave guide effect suppressors in mixers, hyperfrequency amplifiers,
- Free space absorber systems.

The forms and compositions of these absorbers vary enormously depending upon their applications. The main parameters which determine the choice of absorbers are :

- Attenuation as a function of frequency,
- Power dissipated in the absorber
- Possible rigidity level , depending on the shape to be supplied.
- Type of exposure to which it will be subjected.

MEASUREMENT TAST BENCH for the parameters ϵ^* et μ^*



The complex permeability and permittivity of absorbing materials is calculated on the basis of a measurement of S parameters using a vector network analyser.

The method used in the Nicholson-Weir method (HP note 8510-3).

The contact services of the sample are metallised and the sample is placed either in an APC7 structure ($0.5 \text{ GHz} < F < 18 \text{ GHz}$) if the material is machinable, such as epoxy resins, polyamides , etc., or in a three-panel structure ($F < 5 \text{ GHz}$) if the material is difficult to machine (materials which are too soft or too hard).

The thickness of the sample is between 2 and 5 mm (APC7) or 5 and 10 mm (three-panel).

Attenuation in dB/cm is deduced from the Q parameters. This measurement requires thick samples in order to reduce the effect of losses due to reflection.

Comparisons have been made with other methods of measurement (Wiltron, HP sensors, cavities), results can vary from one procedure to another.

Measurements for special samples can be provide on request, within the limits of the equipment available.

The figures published are given for information only and should not be used for preparing possible specifications.