

Di-pak

Dielectric Packaging Systems

 hapco inc.

2.

POTTING & ENCAPSULATING APPLICATIONS:

TRANSFORMERS



BATTERIES



POWER SUPPLIES

COILS

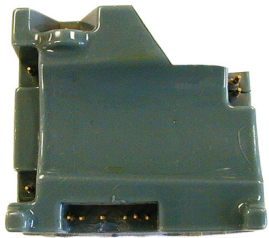
CAPACITORS

MOTORS

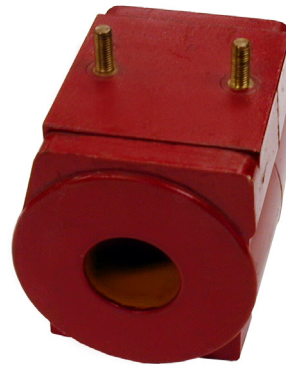


SWITCHES

SOLENOIDS



RELAYS



REGULATORS

EMI FILTERS



BALLASTS

CONTROLLERS



DI-PAK R-Series

- rigid -

WHY choose Hapco's *rigid* **DI-PAK** Products?

ADVANTAGES:

- ↪ **TOUGH**
- ↪ **LOW VISCOSITY**
- ↪ **FAST CURE**
- ↪ **LOW VISCOSITY**
- ↪ **EXCELLENT ELECTRICAL INSULATOR**
- ↪ **HIGH TEMPERATURE**
- ↪ **HIGH PERFORMANCE**
- ↪ **EASY TO USE**

Hapco Dielectric Materials

- rigid -

DI-PAK RIGID PRODUCTS

DI-PAK R-4525 Series

A **general purpose** series of low viscosity, strong, potting and encapsulating compounds. **DI-PAK R-4525** has excellent electrical insulating properties and bonds well to many substrates. By varying the curing agents, the desired cure and working life can be obtained.

DI-PAK R-4528 Series

A black, flame retardant, **thermally conductive**, high performance series that can be used in all types of electrical components. Combined with its ability to dissipate heat, **DI-PAK R-4528** also provides low linear thermal expansion, low shrinkage, and low exothermic heat while curing. Meets UL requirements.

DI-PAK R-4545 Series

A very **low viscosity** potting and encapsulating system with excellent flow and penetration into the most intricate electronic components, without voids or porosity. The **R-4545 Series** cure to a hard, shiny, high gloss, plastic finish that is free from "blushing" under all humidity conditions. The **R-4545 Series** is ideal for electrical applications where surface finish and appearance are critical.

DI-PAK R-4307

A high performance, **long working life** potting compound for potting/encapsulating units requiring high physical strength and excellent electricals. **DI-PAK R-4307** holds its mechanical and electrical properties while under the most severe conditions. This is due to its low water absorption, thermal shock resistance, and retention of strength at elevated temperatures.

DI-PAK R-4200

A **low viscosity, long working life** compound designed for potting/encapsulating units requiring high physical strength, and excellent penetration & adhesion to components. **DI-PAK R-4200** holds its mechanical & electrical properties while under the most severe conditions, due to its low water absorption, and retention of strength at elevated temperatures.

DI-PAK R-4354

A 100% solids, **room temperature cure**, dielectric insulating material used for sealing, coating, bonding and potting. **R-4354** is a medium viscosity, slightly thixotropic system.

DI-PAK R-4806 & R-4807 A/B

Low viscosity, fast cure, high performance, potting and encapsulating compounds with excellent properties and FAST TURNOVER. Both are two part systems with 1:1 mix ratios by volume.

DI-PAK R-4242/4243

Low cost, fast set potting compounds with excellent properties and FAST TURNOVER. **R-4242/4243** are 1:1 by weight or volume, making them ideal for hand pour or automatic metering systems.

DI-PAK R-4912 & R-4260 A/B

Low viscosity, fast cure, high performance, high HDT potting and encapsulating compounds with excellent properties and FAST TURNOVER. Both are two part systems with 1:1 mix ratios by volume.

DI-PAK R-4525 & R-4528

- rigid -

PHYSICAL PROPERTIES	TEST METHOD	DI-PAK R-4525/7	DI-PAK R-4525/17	DI-PAK R-4525/30	DI-PAK R-4525/40	DI-PAK R-4528/7	DI-PAK R-4528/17	DI-PAK R-4528/30	DI-PAK R-4528/40
Mix Ratio by volume A:B by weight A:B	Calculation	100:20	100:40	100:25	100:33	100:10	100:30	100:20	100:25
		100:12.5	100:24	100:15	100:20	100:6	100:16	100:11	100:14
Gel time 100 grams @ 25°C	ASTM D-2971	50 min.	40-60 min.	60-90 min.	35-45 min.	50 min.	40-60 min.	60-90 min.	35-45 min.
Color (cured)	Visual	Black	Black	Black	Glossy Black	Black	Black	Black	Glossy Black
Hardness Shore	ASTM D-2240	95 D	90 D	92 D	88 D	95 D	88 D	90 D	90 D
Viscosity mixed @ 25°C cps	ASTM D-4878	12, 500	1,800	11,500	3,000	24,000	4,050	5,050	4,250
Specific Gravity mixed @ 25°C	ASTM D-4669	1.51	1.43	1.45	1.50	1.69	1.59	1.48	1.59
Shrinkage inch/inch See shrinkage paragraph	ASTM D-2566	0.0005-0.002	0.0005-0.001	0.0005-0.0025	0.0005-0.003	0.0005-0.001	0.0005-0.001	0.0005-0.0025	0.0005-0.0025
Demold time @ 70°F 1/8" thick	HAPCO TEST	16-24 hrs. or 2-4@150°F	24 hrs.	2-4@135°F and 2-4@200°F	24 hrs.	16-24 hrs. or 2-4@150°F	24 hrs.	2-4@135°F and 2-4 200°F	2-4 hrs.
Weight per cubic inch (lbs.)	Calculation	0.0545	0.0516	0.0524	0.0542	0.0610	0.0575	0.0534	0.0575
Tensile Strength (psi)	ASTM D-638	9,050	8,250	7,700	6,200	7,000	6,500	7,250	5,300
Elongation %	ASTM D-638	1.1	3.8	0.8	1.5	0.60	1.70	0.15	0.14
Modulus of Elasticity psi (000)	ASTM D-638	397	360	410	320	350	310	420	430
Izod Impact (ft.lbs/in.) notched unnotched	ASTM D-256	0.45 0.65	0.63 0.76	0.43 0.64	0.50 0.72	0.41 0.62	0.58 0.78	0.52 0.61	0.54 0.70
Flexural Strength (psi)	ASTM D-790	10,100	9,450	8,600	7,300	7,800	7,350	8,000	6,100
Flexural Modulus psi (000)	ASTM D-790	402	387	436	344	386	327	457	444
Available in Flame Retardant (FR)	94V	No	No	No	No	FR only	FR only	FR only	FR only
Service Temperature		155°C	75°C	175°C	110°C	163°C	85°C	195°C	120°C
Thermal Conductivity (BTU)(in)/(hr)(ft ²)(°F)		3.0	2.8	2.9	2.8	2.9	2.7	2.8	2.7
Dielectric Constant 1 KHz 100 KHz	ASTM D-150	4.3 4.2	3.4 3.3	4.4 4.2	4.3 4.2	4.6 4.4	3.6 3.3	4.6 4.4	4.6 4.3
Dielectric Strength (volts/mil.)	ASTM D-149	666	579	630	520	421	633	654	585
Volume Resistivity (ohm-cm)	ASTM D-270	2.6 x 10 ¹³	2.9 x 10 ¹²	1.2 x 10 ¹⁴	1.1 x 10 ¹⁴	7.5 x 10 ¹³	7.3 x 10 ¹³	7.2 x 10 ¹³	7.2 x 10 ¹³
Dissipation Factor 100 KHz @25°C	ASTM D-150	.007	.023	.0038	.0011	.009	.022	.031	.015

NOTE: Before use, reference material handling, processing, and safety notes located at the end of this brochure.

DI-PAK R-4545

- rigid -

	PHYSICAL PROPERTIES	TEST METHOD	DI-PAK R-4545/7	DI-PAK R-4545/17	DI-PAK R-4545/30	DI-PAK R-4545/40	DI-PAK R-4545/44
PHYSICAL PROPERTIES	Mix Ratio by volume A:B by weight A:B	Calculation	100:20 100:20	100:50 100:42	100:33 100:27	100:50 100:43	100:25 100:25
	Gel time 100 grams @ 25°C	ASTM D-2971	45 minutes	60 minutes	40 minutes	30 minutes	12.5 minutes
	Color (cured)	Visual	Black	Black	Black	Glossy Black	Black
	Hardness Shore	ASTM D-2240	90 D	80 D	90 D	85 D	90D
	Viscosity mixed @ 25°C cps	ASTM D-4878	2,000	550	3,600	1,100	3,000
	Specific Gravity mixed @ 25°C	ASTM D-4669	1.09	1.07	1.10	1.09	1.13
	Shrinkage inch/inch See shrinkage paragraph	ASTM D-2566	0.001-0.003	0.0005-0.0025	0.0015-0.003	0.001-0.003	0.002-0.005
	Demold time @ 70°F 1/8" thick	HAPCO TEST	24 hrs.	24 hrs.	2-4 hrs. @ 135°F and 2-4 hrs. @ 200°F	24 hrs.	20-30 min.
	Weight per cubic inch (lbs.)	Calculation	0.0394	0.0386	0.0397	0.0394	0.0408
	PRODUCT PROPERTIES	Tensile Strength (psi)	ASTM D-638	11,000	8,100	10,000	6,250
Elongation %		ASTM D-638	4.5	15.0	3.0	13.0	5 %
Modulus of Elasticity psi (000)		ASTM D-638	420	367	463	361	415
Izod Impact (ft.lbs/in.) notched unnotched		ASTM D-256	0.58 0.88	0.55 0.86	0.53 0.81	0.59 0.91	0.55 0.90
Flexural Strength (psi)		ASTM D-790	12,700	9,700	11,650	7,850	12,500
Flexural Modulus psi (000)		ASTM D-790	451	392	497	421	440
Available in Flame Retardant (FR)		94V	No	No	No	No	No
Service Temperature			137°C	63°C	168°C	80°C	133°C
Thermal Conductivity (BTU)(in)/(hr)(ft ²)(°F)			1.5	1.5	1.5	1.5	1.5
Dielectric Constant 1 KHz 100 KHz		ASTM D-150	4.5 4.2	4.1 3.8	4.5 4.2	4.7 4.4	4.4 4.1
Dielectric Strength (volts/mil.)		ASTM D-149	550	521	565	631	545
Volume Resistivity (ohm-cm)		ASTM D-270	8.0 x 10 ¹³	7.3 x 10 ¹³	8.2 x 10 ¹³	7.3 x 10 ¹³	7.9 x 10 ¹³
Dissipation Factor 100 KHz @25°C		ASTM D-150	.008	.0123	.015	.011	.009

NOTE: Before use, reference material handling, processing, and safety notes located at the end of this brochure.

DI-PAK R-PRODUCTS

- rigid -

PHYSICAL PROPERTIES	TEST METHOD	DI-PAK R-4307	DI-PAK R-4307FR	DI-PAK R-4200	DI-PAK R-4354	DI-PAK R-4806	DI-PAK R-4807	DI-PAK R-4242/4243
Mix Ratio by volume A:B by weight A:B	Calculation	100:100	100:100	100:85	100:66	100:100	100:100	100:100
		100:100	100:100	100:90	100:55	100:96	100:93	100:100
Gel time 100 grams @ 25°C	ASTM D-2971	24 hrs.	24 hrs.	8-24 hrs.	40-60 min.	90-120 seconds	4 min. ± .5	R-4242 9+1 R-4243 17+2
Color (cured)	Visual	Blue	Blue	Clear amber	Light tan	Opaque tan/yellow	Black	Medium gray -brown
Hardness Shore	ASTM D-2240	86 D	86 D	88 D	80 D	79 D	84 D	80 D
Viscosity mixed @ 25°C cps	ASTM D-4878	18,000	18,000	1,200	7,000-12,000	500	240	2,500 ±500
Specific Gravity mixed @ 25°C	ASTM D-4669	1.62	1.62	1.12	1.10	1.10	1.10	1.5-1.7
Shrinkage inch/inch See shrinkage paragraph	ASTM D-2566	0.001 -0.0035	0.001 -0.0035	0.0015-0.0035	0.0005 -0.0015	.002-.004	.0015-.003	0.0015-0.003
Demold time @ 70°F 1/8" thick	HAPCO TEST	2 hrs. @ 250° F	2 hrs. @ 250° F	2 hrs. @ 250° F Or 12 hrs. @ 175° F	12-18 hrs.	15-30 min.	60 min.	1-4 hrs.
Weight per cubic inch (lbs.)	Calculation	0.0585	0.0585	0.0404	0.0397	0.0397	0.0395	0.0542/0.0614
Tensile Strength (psi)	ASTM D-638	14,375	14,375	11,000	7,000	6,370	6,200	5,000
Elongation %	ASTM D-638	3.0	3.0	5.0	5.5	9.5	11.0	3.4
Modulus of Elasticity (psi (000))	ASTM D-638	501	501	478	357	158	340	262
Izod Impact (ft.lbs/in.) notched unnotched	ASTM D-256	0.46 0.72	0.46 0.72	0.61 0.77	0.51 0.80	0.70 1.60	0.23 1.30	0.41 0.55
Flexural Strength (psi)	ASTM D-790	17,100	17,100	13,640	7,700	7,000	8,700	297
Flexural Modulus (psi (000))	ASTM D-790	560	560	501	390	172	361	
Available in Flame Retardant (FR)	94V	No	Yes (94VO @ 3mm)	No	No	No	No	FR only
Service Temperature		170°C	170°C	148°C	80°C	120°C	127°C	100°C
Thermal Conductivity (BTU)(in)/(hr)(ft ²)(°F)	ASTM D-150	2.7	2.7	1.5	1.5	1.5	1.5	2.6
Dielectric Constant 1 KHz 100 KHz	ASTM D-149	3.9 3.7	3.9 3.7	3.5 3.1	3.4 3.1	3.7 3.6	3.77 3.63	4.0 3.3
Dielectric Strength (volts/mil.)	ASTM D-270	432	432	400	450	460	465	510
Volume Resistivity (ohm-cm)	ASTM D-150	5.3 × 10 ¹⁵	5.3 × 10 ¹⁵	3.5 × 10 ¹⁵	3.4 × 10 ¹⁴	1.7 × 10 ¹⁴	1.5 × 10 ¹⁴	2.0 × 10 ¹⁵
Dissipation Factor 100 KHz @25°C		.021	.021	.019	.018	.020	0.22	0.019

NOTE: Before use, reference material handling, processing, and safety notes located at the end of this brochure.

DI-PAK R-PRODUCTS

- rigid -

	PHYSICAL PROPERTIES	TEST METHOD	DI-PAK R-4912	DI-PAK R-4260
PHYSICAL PROPERTIES	Mix Ratio by volume A:B by weight A:B	Calculation	100:100	100:100
			100:90	100:86
	Gel time 100 grams @ 25°C	ASTM D-2971	60 sec.	60 sec.
	Color (cured)	Visual	Transparent	Black
	Hardness Shore	ASTM D-2240	82 D	80 D
	Viscosity mixed @ 25°C cps	ASTM D-4878	500	600
	Specific Gravity mixed @ 25°C	ASTM D-4669	1.2	1.12
	Shrinkage inch/inch See shrinkage paragraph	ASTM D-2566	.002 -.007	.004 - .008
	Demold time @ 70°F 1/8" thick	HAPCO TEST	10 - 15 min.	5 - 12 min.
	PRODUCT PROPERTIES	Weight per cubic inch (lbs.)	Calculation	0.0433
Tensile Strength (psi)		ASTM D-638	6,400	7,700
Elongation %		ASTM D-638	7.1	14.7
Modulus of Elasticity psi (000)		ASTM D-638		95
Izod Impact (ft.lbs/in.) notched unnotched		ASTM D-256	0.73	0.18
			1.70	1.04
Flexural Strength (psi)		ASTM D-790	9,100	10,600
Flexural Modulus psi (000)		ASTM D-790	300	264
Available in Flame Retar- dant (FR)		94V	Yes	No
Service Temperature			140°C	146°C
Thermal Conductivity (BTU)(in)/(hr)(ft ²)(°F)			1.4	1.5
Dielectric Constant			1 KHz	3.6
			100 KHz	3.3
Dielectric Strength (volts/mil.)		ASTM D-150	470	480
Volume Resistivity (ohm-cm)		ASTM D-149	3.1 x 10 ¹²	4.7x 10 ¹³
Dissipation Factor 100 KHz @25°C	ASTM D-270	0.23	0.22	

NOTE: Before use, reference material handling, processing, and safety notes located at the end of this brochure.

DI-COAT R-Series

DI-COAT R-472I / DI-COAT R-472I LV (lower viscosity)

Shore 90 D, room temperature curing, medium to high thixotropic coating for dielectric insulating applications.

DI-COAT R-472I is ideal for use on vertical or sloping surfaces where flow or drain-off cannot be tolerated.

DI-COAT R-472I is easy to use, and should be used on insulating applications where conformal coating is required.

DI-COAT R-472I LV exhibits similar characteristics to **DI-COAT R-472I**, but has a lower viscosity.

	DI-COAT R-472I/7	DI-COAT R-472I/30	DI-COAT R-472ILV/7	DI-COAT R-472ILV/30
Mix Ratio Part A to Part B by Weight	100A:12B	100A:13B	100A:12B	100A:13B
Mixed Viscosity @ 25°C cps	Medium to high thixotropic	thixotropic	Medium thixotropic	thixotropic
Gel Time @ 25°C	65 ±10 minutes	120 ±20 minutes	65 ±10 minutes	120 ±20 minutes
Cure Schedule	Overnight @ room temp.	4-6 hrs @ 120°F Plus 6-12 hours @ 200°F	Overnight @ room temp.	4-6 hrs @ 120°F Plus 6-12 hours @ 200°F
Specific Gravity (mixed)	1.5	1.5	1.5	1.5
Hardness Shore	90 D	90 D	90 D	90 D
Color	White	White	White	White
Tensile Strength psi	7,340	8,700	7,340	8,700
Service Temperature	157°C	175°C **	140°C	167°C **
Dielectric Constant 1 Khz 100 Khz	3.1 3.0	3.1 3.0	3.1 3.0	3.1 3.0
Dielectric Strength (volts/mil.)	625	600	625	600
Volume Resistivity (ohm-cm)	1.85×10^{12}	1.96×10^{12}	1.85×10^{12}	1.96×10^{12}
Dissipation Factor 100khz	.03	.024	.03	.024

**For ultimate HDT post cure an additional 6-12 hrs @ 150°C

DI-PAK SERIES
MATERIAL HANDLING & SAFETY NOTES

POSTCURE:

Postcure Heat: 100-175°F (38-79°C) for a *minimum* of 6-12 hours.

Properties increase with heat acceleration. Izod impact and heat distortion properties increase with postcure heat. The lower the temperature the longer the post-cure (8-24 hrs). **Heat cured products do not require a post cure.**

DEMOLD & CURE TIMES:

Demold and final cure time can be accelerated with the addition of postcure heat 100-175°F (38-79°C) .

To retain working life, heat the mold not the material for best results. Increasing the mold temperature to 80-100°F (26-38°C) will accelerate demold and cure times by up to 50%. For full cure polymers require at least 7-10 days.

Final cure for faster gel materials (3-6 minute gel) is 3-7 days. Please be aware that size and mass effect demold and cure times. The customer and geometry will ultimately determine demold time.

HARDNESS NOTE:

The hardness progresses more slowly in the longer working life systems. The hardness progression can be accelerated by using the faster version or by curing with mild heat. Hardness and cure progress will be retarded, slowed down, when the temperature falls below 70°F.

SILICONE MOLDS:

DI-CLEAR Series

Silicone molds should be post cured overnight, 16-24 hours, in an oven at 120°F (48°C). When using a tin based silicone mold, make sure the mold is open when it is in the oven during postcure. Improperly cured silicone can cause a sticky surface on molded parts. This process extends mold life.

SURFACE PREPARATION TO PREVENT ADHESION:

To prevent adhesion to the mold, use a GREASE-IT release agent. The following are recommended:

GREASE-IT II, GREASE-IT IV, GREASE-IT V, GREASE-IT WAX P, or GREASE-IT WAX LT, use GREASE-IT FDG when a Food & Drug grade release is required. For best results, apply in a few thin coats, drying between coats.

Porous surfaces, i.e. wood, plaster, etc, must be sealed thoroughly before release is applied. Use multiple coats of a good coating, such as: a high grade lacquer or urethane lacquer.

SURFACE PREPARATION FOR ADHESION:

For applications where adhesion is desired, the surface must be cleaned, abraded and dried. Sandblasting and mechanical roughing are the preferred ways of abrading surfaces to be bonded. For added adhesion to metals, use Primer 200 and for added adhesion to plastic, use Primer 810. Make sure all surfaces are clean, dry, and free from moisture.

COLD TEMPERATURES:

CAUTION - Part A may freeze or crystallize in cold temperatures. Part A may appear to be striated or solidify.

This situation can easily be corrected. Place the cover on the Part A loosely (do not seal) and place in an oven set at 125-150°F (51-65°C) for 3-8 hours or 8-12 hours for drums. Reseal, allow to cool, and then mix thoroughly.

CAUTION - Part B may freeze or crystallize in cold temperatures. Part B may turn thicker, appear to be striated, thicken, or solidify. **To prevent this see storage.**

This situation can be easily corrected. To reverse crystallization, loosen the cover on Part B and heat to 170-180°F (77-82°C) for 3-6 hours, drums, 6-12 hours. Allow to cool before using. If contents are pigmented, mix thoroughly.

MIXING:

IMPORTANT!

E-SERIES - Before each use, mix Part B thoroughly before proportioning out the required amount.

R-SERIES - Before each use, mix Part A thoroughly before proportioning out the required amount.

Components may separate and should be mixed before each use. Mix, only when ready to use, by adding the curing agent to the resin portion and blending together thoroughly. Be sure to scrape and stir in all material sticking to the sides and bottom of the mixing container. Do not use paper containers or wooden mixing sticks. They may contain moisture. For best results, use plastic or coated containers, and metal or plastic sticks.

DI-PAK SERIES

MATERIAL HANDLING & SAFETY NOTES

MACHINE MIXING AND DISPENSING:

Use HAPCO'S **RAPIDFIL**, **MINIFIL**, and/or **RAPIDSHOT** Dispensing Equipment for fast, reliable, and efficient dispensing

CASTING:

Pour in a thin unbroken stream into the lowest point in the cavity or mold. This will help break up some of the air entrapped during mixing. Hapco recommends pressure casting, vacuum casting, or **Rapidfil/Minifil** dispensing to eliminate air bubbles.

SHRINKAGE:

Shrinkage or dimensional variation is largely influenced by 5 factors:

1. Mass (total volume and thickness)
2. The temperature of the material
3. Maximum temperature reached during the exotherm (reaction).
The faster the gel time, the higher the exotherm, the greater the shrinkage.
4. The temperature of the mold
5. The stability of the mold

Geometry, part thickness, and total volume vary in each design, therefore, the customer is responsible to test and determine the shrinkage factor to be used. The values in the brochures are for comparative reference only, using ASTM testing procedures.

AIR RELEASE:

Use HAPCO'S ANTI-AIR to aid in air release (see Technical Bulletin). In some products, ANTI-AIR can cause a slight haze to cloudiness. This has no effect on properties.

CLEAN UP:

Cured polymers are difficult to remove. It is best to clean tools and equipment immediately after use. For best results use Hapco's A-TAK.

STORAGE:

Store both components in an area with a temperature range of 68-90°F (20-32°C). Store in a dry place off of cement floors and on shelving if possible. Containers should be kept tightly closed.

SHELF LIFE:

The shelf life on Hapco products begins from the date of invoice for that product shipment. Hapco's shelf life only pertains to containers that are unopened and in their original condition. Once the container is opened Hapco has no control or responsibility for the shelf life.

RESEALING:

Many polymers are moisture sensitive, reseal, using one of the following two (2) methods: blanket with nitrogen or use a hair dryer for 30 seconds to cover with dry air.

PRECAUTIONS:

CAUTION: The MSDS should be read thoroughly before using this product.

Skin or eye contact with polymers should be avoided. Clean housekeeping procedures are urged and the use of gloves and/or protective creams suggested. All polymers, as a general practice, should be used in well ventilated areas. Spot ventilation is most effective. Contaminated clothing should be removed immediately and the skin washed with soap and water or waterless skin cleaner. Should accidental eye contact occur, wash thoroughly with water and consult a physician.

The information presented here is based on carefully conducted laboratory tests and is believed to be accurate. However, results cannot be guaranteed and it is suggested that customers confirm results under their conditions and in their applications before production use.

Important: Hapco Inc. makes no warranty, whether expressed or implied, including warranties of merchantability or of fitness for a particular purpose. Under no circumstances shall Hapco Inc. be liable for incidental, consequential, or other damages from alleged negligence, breach of warranty, strict liability, tort contract, or any other legal theory, arising out of the use of handling of this product. The sole remedy of purchaser and sole liability of Hapco Inc. shall be for the purchase price of the product which is the subject of the claim.