

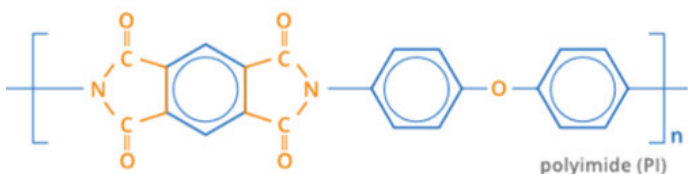
# DuPont™ Kapton®

Polyimide Film

Safety in Handling and Use

## Safety in Handling and Use

DuPont™ Kapton® polyimide film is a strong, tough, transparent amber-colored plastic film exhibiting excellent physical, chemical and electrical properties over an extremely wide temperature range. It has this structure:



Kapton® is produced in three forms, Type HN, Type HPP-ST and Type FN. Type HN is the basic uncoated polyimide film. Type HPP-ST is similar to Type HN but has superior dimensional stability. Type FN is coated on one or both sides with FEP fluorocarbon resin which imparts heat sealability, provides a moisture barrier and enhances chemical resistance. Kapton® is used as insulation for wire and cable formed coils, magnet wire and transformers and motor slot lines among other uses. It is also used as a substrate for flexible printed circuits.

This bulletin provides guidelines for the safe handling of Kapton® during processing, use and disposal.

## General Properties

Kapton® Type HN and Type HPP-ST exhibit no melting point or softening point. A 25µm thick film has a zero-strength temperature of 815°C. Zero-strength is measured as the maximum temperature at which the film will sustain a load of 0,14 N/mm<sup>2</sup> for 5 seconds.

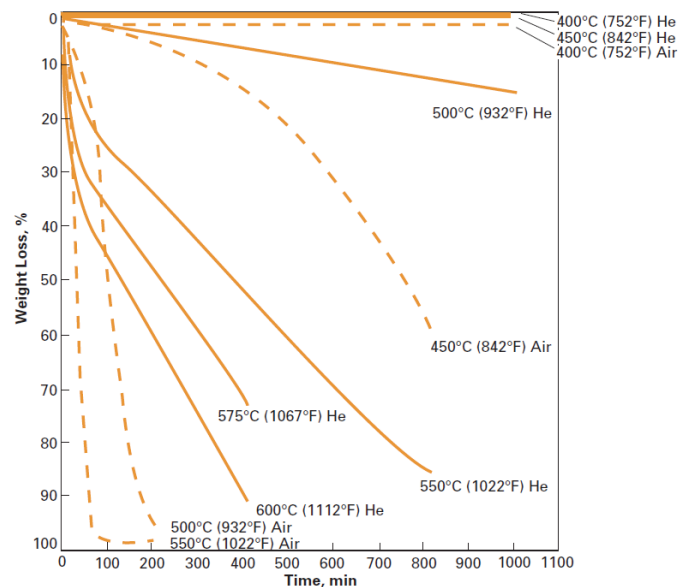
Kapton® is insoluble in most common organic solvents after immersion for up to a year (Ref. 1). The hydrolytic stability of Kapton® Type HN has been measured after 166 days exposure to boiling water. The film retained 65% of its tensile properties and 20% of its elongation. Kapton® is dissolved by strong acids (Ref. 2, 3) such a fuming nitric and concentrated sulfuric acid, particularly on heating and is hydrolyzed by alkali and super-heated steam.

Kapton® Type FN exhibits better chemical, hydrolytic and oxidative resistance than Types HN and HPP-ST.

Specific grades of Kapton® polyimide film may contain trace amounts of residual solvent from the manufacturing process. It is recommended to have adequate ventilation while processing Kapton® polyimide films. Normal air movement may be sufficient for handling at room temperature. Exhaust ventilation is recommended when processing at elevated temperatures. Refer to the respective article information sheet or safety data sheet for additional guidance.

## Isothermal Weight Loss, Type HN Film, 25 µm (1 mil)

Figure 10. Isothermal Weight Loss, Type HN Film, 25 µm (1 mil)



## Pyrolysis studies

Studies (Ref. 4, 5) have shown the outstanding thermal stability of polyimide film. Its rate of degradation is dependent upon the availability of oxygen. In air at about 500°C, Kapton® decomposes and completely disappears after twelve hours. At 450°C in air, carbon monoxide may be formed in significant amounts. In a vacuum or inert atmosphere, 60 to 65% of the film remains after prolonged aging at 1000°C. The residue retains its original shape but has lost its mechanical strength. The major off gases are carbon dioxide and carbon monoxide.

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## Flammability

Lewis and Stabler (Ref. 6) report the flammability characteristics of polyimide film as "self-extinguishing". Kapton® has a 94 VO rating, the highest given the U.L. 94 vertical burning test for thin films. The oxygen index is 38% for 100 HN film (ASTM 2863).

## Handling Practices

Safe handling of Kapton® Type HN and HPP-ST polyimide films at high temperatures requires adequate ventilation. If small quantities of Kapton® are involved, as is often the case, normal air circulation will be all that is needed in case of overheating. Whether or not existing ventilation is adequate at higher temperature will depend on the combined factors of film quantity, temperature and exposure time.

### A. Soldering and Hot Wire Stripping

Major uses for all types of Kapton® include electrical insulation for wire and cable and other electronic equipment. In virtually all of these applications, soldering is a routine fabricating procedure as is the use of a heated element to remove insulation. Soldering operations rarely produce sufficient off-gases to be of toxicological significance.

Ventilation practices should follow the same common-sense rules applicable to any soldering procedure. Normal ventilation provided for worker comfort usually provides adequate safety. During hot-wire stripping, it is recommended that exhaust ducts be used at the workbench. There have been no reports of ill effects during soldering or hot-wire stripping of wire and cable insulated with Kapton®.

### B. Welding and Flame Cutting

Direct application of welding arcs and torches can quickly destroy most plastics, including all types of Kapton® film. For practical reasons, it is best to remove all such parts from equipment to be welded. Where removal is not possible, such as in welding or cutting coated parts, mechanical ventilation should be provided.

Because Kapton® is rated for use at very high temperature, parts made from it may survive at locations close to the point of direct flame contact. Thus some-in-place welding operations can be done. Since the quantity of film heated is usually relatively small (less than 0,5 kg), ventilation requirements seldom exceed those of normal welding work. Because of the possibility of inadvertent overheating, however, the use of a small fan or elephant-trunk exhaust is advisable.

### C. Scrap Disposal

Disposal of scrap Kapton® polyimide films present no special problems to the user. Small amounts of scrap may be incinerated along with general plant refuse. The incinerator should have sufficient draft to exhaust all combustion products to the stack.

Care should be taken to avoid breathing smoke and fumes from any fire. Because Kapton® is so difficult to burn, it is often best to dispose of scrap film in a landfill. Kapton® can be expected to be stable in landfills.

**Note:** Disposal method must comply with local and national regulations.

### D. Fire Hazards

Whether in storage or use, Kapton® is unlikely to add appreciably to the hazards of fire. Bulk quantities of Kapton® (over 50 kg) should be stored away from flammable materials.

In the event of fire, personnel entering the area should use a fresh air supply or respirator. This type of equipment is standard in fighting many types of fire. All types of chemical extinguishers may be used to fight fires involving Kapton®. Large quantities of water also may be used to cool and extinguish a fire.

### E. Static Electricity

The processing of Kapton® polyimide film can cause the generation of a strong static charge. Unless this charge is bled off as it forms through the use of ionizing radiation or metal tinsel, it can build to many thousands of volts and discharge to people or to metal equipment. In dust or solvent-laden air, a flash fire or explosion could result. Precautions for static charges should also be taken when removing plastic films used as protective packaging for Kapton®.

## References

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