



## **Installation Guide Application**

Application Note – AN10007

General Guidelines for Installation of Segmented Lightning Diverter Strips

### **GENERAL**

Segmented diverter strips consist of a series of critically spaced metal segments mounted on a thin dielectric substrate. The strips are designed to withstand multiple lightning strikes and to have a negligible effect on RF pattern characteristics.

The diverter strips are bonded to the exterior surfaces of radomes, dielectric enclosures, and composite parts and once properly grounded they provide an electrostatic lightning shield for antennas and other equipment contained in the radome, and will protect wind turbine blades in the event of a lightning event.

### **PLACEMENT**

Diverter strips should be positioned and installed so that any antennas, pitot tubes, heater wires, air data lines, tuning wires, and other equipment installed under the radome are protected from lightning strikes from all possible directions.

There are no hard and fast rules on spacing, but generally, the spacing between strips should range from 12 to 24 inches. Where applicable, spacing is dependent on the size and dielectric strength of the radome and the shape and proximity of metal objects beneath the radome.

### **BONDING**

The bonding process for diverter strips is established by the manufacturer of the radome/mounting structure or by the maintenance installation facility.

The following information describes some successful processes for positioning and bonding diverter strips.

Bonding methods fall into two general categories: 1. Bonding using a pre-applied, pressure sensitive adhesive and 2. Bonding using conventional epoxy adhesives.

### **Bonding using Pre-applied, Pressure Sensitive Adhesive (PSA)**

The latest generation diverter strips are supplied with a pre-applied pressure sensitive adhesive (3MA10 Acrylic Adhesive No. 9473 tape).

Ideally, these strips should be applied at temperatures between 70 F to 100 F. Application at temperatures below 50 F is not recommended. Bond strength is dependent upon the amount of adhesive-to-surface contact and depends on having a clean, dry and well-unified substrate.

Suggested installation steps are as follows:

- Clean the substrate with a suitable solvent. Some typical surface cleaning solvents are isopropyl alcohol or heptane. (Note: be sure to follow the manufacturer's precautions and directions for use of solvents.)
- Allow the substrate to dry completely.
- Mark the location of the strip with a pencil or marker.
- Apply masking tape the full length of the strip on both sides of the strip location using your marks as guidelines.
- Lightly scuff the area between the masking tape with 320-400 sandpaper or 3M Scotch Brite scrub pad.
- Re-wipe the mounting area with solvent and allow to dry
- Apply a thin coat of 3M Promoter 86A to mounting area in accordance with manufacturer's instructions.
- Remove the protective paper from the back side of the diverter strip.
- Carefully place the diverter strip in its proper location on the substrate, being careful not to let the strip touch the substrate until the diverter strip is in the proper position.
- Apply firm, even pressure to the strip using a firm (not hard) roller to assure complete adhesive-to-surface contact.

***Workmanship: There shall be a continuous bond of the diverter strip to the substrate surface with no voids or separation along the diverter edge.***

### **Bonding Using Conventional Adhesive (PSA)**

Diverter strips supplied without pre-applied adhesive are installed using a conventional adhesive selected by the user. Choice of bonding adhesive should be based on

compatibility with the diverter strip, the substrate and the operating environment. Some adhesives that have been successfully used are:

- Hysol EA 956 Epoxy Paste Adhesive
- Hysol EA 960F Epoxy Paste Adhesive
- Hysol EA 9330 Epoxy Paste Adhesive
- 3M 847 Rubber & Gasket Adhesive
- 3M 2216 Epoxy Adhesive

To ensure a complete and secure bond, installation is generally done using vacuum bagging.

Suggested installation steps are as follows:

- Prepare the bond surface of the substrate
  - Clean the substrate with a suitable solvent. Some typical surface cleaning solvents are isopropyl alcohol or heptane. (Note: be sure to follow the manufacturer's precautions and directions for use of solvents.)
  - Allow the substrate to dry completely.
  - Mark the location of the strip with a pencil or marker.
  - Apply masking tape the full length of the strip on both sides of the strip location using your marks as guidelines.
  - Lightly scuff the area between the masking tape with 320-400 sandpaper or 3M Scotch Brite scrub pad.
  - Remove the masking tape.
  - Re-wipe the mounting area with solvent and allow to dry.
- Prepare the bond surface of the diverter strip
  - Clean with suitable solvent
  - Lightly scuff the back side using a fine 3M Scotch Brite scrub pad. (Note: for strips with a black resistive strip on the back, take particular care not to damage the black strip.)
  - Re-clean the surface with suitable solvent.
  - Allow the strip to dry completely.
  - Avoid handling the bond surface of the strip.
- Apply masking tape to the mounting surface on both edges of the diverter strip location the full length of the diverter strip. The tape will limit the spread of the adhesive and help with positioning the diverter strip. (See illustration below).

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- Mix the adhesive in accordance with the manufacturer's instructions and apply it to the back side of the diverter strip.
- Position the diverter strip and tape it in place.
- Vacuum bag the diverter strip and allow adhesive to cure in accordance with manufacturer's instructions.
- After cure, remove bagging material and masking tape and clean off excess adhesive using Teflon or phenolic tools to preclude damaging the nickel segments.

***Workmanship: There shall be a continuous bond of the diverter strip to the substrate with no voids at the edges. The bonded strip shall be free of excessive adhesive and other surface defects.***

## PAINTING

The metal segments on the surface of the diverter strips must be kept free of paint and coatings.

### **For Installations to be Painted After Strip Application**

Select a masking/stripping tape the same width as the nickel segments and apply it over the segments the length of the strip.

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Paint the radome or mounting surface as normal. The paint will serve as additional fairing material for the strip.

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Remove the masking tape from the segments and clean off any tape residue.

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Paint on the outside edges of segments is permissible. Remove any paint on the surface of the segments or in between the segments. Use of Teflon or phenolic tools is suggested to prevent damage to the segments.

### **For Installations with No Subsequent Painting**

Apply an adhesive fillet along the diverter strip to fair the strip to the radome surface. The adhesive fillet is to be approximately  $0.12 \pm 0.06$ " wide along the strip. The adhesive fillet should not extend up onto the strip such that it covers the nickel segments.

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## **ELECTRICAL BONDING (GROUNDING)**

The diverter strip must be electrically connected (grounded) to the metal mounting structure of the radome.

Some typical methods of grounding the diverter strips are shown below.

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**Figure 1** – Grounding of the diverter strip through a bleeder resistor – no special connector required at the end of the strip.

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**Figure 2** – Grounding of diverter strip using a #10 bolt through the termination. (Note: many termination styles, both flat and countersunk, are available.) Lightning attaches directly to the grounding bolt.

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**Figure 3** – Grounding of diverter strip using Grounding Clip (LDS P/N LDS10-10 & LDS10-07). Diverter strip is installed under the indentation in the grounding clip. Lightning attaches to the clip.

## **RESISTANCE MEASUREMENTS**

### **Ground Connection Resistance**

Resistance between the lightning strip termination pad and the attachment flange should be 0.01 Ohm or less.

Where a resistor is used to ground the diverter strip as in Method A, the resistance to ground shall be as specified in the radome detail specification or the diverter installation drawing.

### **Lightning Strip Resistance**

Normally, lightning strip resistance is not measured in the field. However, when measurement is required by the radome specification, resistance values should be in accordance with the radome spec.

As a point of interest, electrical resistance of the strip is measured as part of the normal production process. Values vary by lightning strip type and are specified in Lightning Diversion Systems Material Specifications LDS10-01 and LDS10-02.

Diverters with a resistance strip on the back have a specified resistance value of between 0.5 and 100.0 megohms per inch when measured with 500 volts applied.

Measurement requires the use of a “Megger” insulation tester. Normal practice is to measure resistance from end to end of the diverter and divide the value by length to get an average per inch value.