Buffer Removal Techniques for Optical Fiber

Fiberguide produces the largest selection of buffer material on silica fiber than any other vendor of fiber optics. Materials include Acrylate, Nylon, Tefzel, Silicone, Hard Clad, Polyimide, Aluminum, and Gold. At times fibers will be dual buffer such as Silicon/Nylon or Aluminum/Nylon, other combination are possible by request.

Each buffer material has its own requirement for removal and doing this safely and effectively without damage to the glass substrate. This is extremely important to the quality of the assembly being made. Nicking or damaging the glass prior to assembly may cause premature failure at the damage point. Some methods of removal can embrittle glass making the glass fragile and prone to breakage during handling. In some instance you may want to remove the doped Fused Silica cladding off the fiber. This is possible but not recommend since this can cause weakening of the glass substrate. Fiberguide has vast experience with removal of the different buffers. This paper is intended to help the user in stripping optical fiber. In some instances buffers may be difficult to remove in these instances contact Fiberguide applications engineering for assistance.

Removal Techniques

Below are removal techniques for removing buffers. Out of these techniques we will be recommending the safest and greenest methods we know for each buffer type. Alternative method may also be discussed or noted.

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<th>Laser</th>
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<th>Hydrofluoric Acid</th>
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P= Preferred, A= Alternate
Removal Details

Many of the removal methods below can be dangerous and require Personal Protection Equipment (PPE). Use appropriate PPE when working with buffer removal tools and chemicals. Consult your safety department for information on the correct PPE.

Buffer Type: Acrylate

Removal Methods: Mechanical, Hot Sulfuric Acid

PREFERED PROCESS
Mechanical

- Use a Micro-Strip® mechanical stripper from Micro Electronic Inc. Sizing of the Micro-Strip guide and stripper blades are critical to a good strip line. The guides should be sized so the fiber moves through the guide with some resistance but does not damage the buffer. The blades should be 0.001”-0.002” (25.4um-50.8um) larger than the fiber cladding. A good strip is indicated by the clean removal of the buffer and a clean straight strip line. Clean with Acetone or IPA (Isopropyl Alcohol) after the strip to assure a clean fiber before termination.
  - Positives: No chemicals used in the process of removal. Therefore no chemical disposal needed.
  - Negatives: If blades and guide are sized incorrectly nicking of the glass is a possibility causing latent failures.

ALTERNATE PROCESS

- Hot Sulfuric Acid can be used to remove the Acrylate buffer. The hot acid is placed in a beaker and heated to 150°C-180°C. The fiber is dipped into the hot sulfuric to where the removal is needed until the buffer dissolves. After stripping dip in clean water with DI wafer and clean
with an organic cleaner, Acetone or IPA after the strip to assure a clean fiber before termination.
  
  - Positives: No nicking of the glass is possible.
  - Negatives: Strip line may be swelled due to acid/heat absorption. Chemical waste stream needed. Fume Hood needed.

Buffer Type: Nylon with Silicone

Removal Methods: Mechanical, Hot Propylene Glycol

Notes: Nylon is normally used as an outer buffer over silicone on the fiber. The silicone can be used as a cladding or just as a buffer. For this reason you may want to keep the silicone buffer on after stripping the Nylon or you may want to remove it. For Nylon with Silicone that is a cladding we would recommend the Hot Propylene Glycol. For Nylon with Non-Cladding Silicone we recommend Mechanical removal.

PREFERED PROCESS
Mechanical (Nylon: Non-Cladding Silicone, Stripped to Fused Silica)

- Use a Micro-Strip® mechanical stripper from Micro Electronic Inc. Sizing of the Micro-Strip guide and stripper blades are critical to a good strip line. The guides should be sized so the fiber moves through the guide with a firm resistance but does not damage the buffer. The blades should be the same size as the Silicone Cladding than the Nylon. This will assure a good strip line. A good strip is indicated by the clean removal of the Nylon buffer and a clean straight strip line. If needed remove the Silicone buffer per the method below. Clean the silica fiber with an organic cleaner, Acetone or IPA after the strip to assure a clean fiber before termination.
  - Positives: No chemicals used in the process of removal. Therefore no chemical disposal needed.
- Negatives: If blades and guide are sized incorrectly nicking of the glass is a possibility causing latent failures.

Chemically (Nylon: Silicone used as a Cladding, Silicone not removed)

- Hot Propylene Glycol can be used to remove the Nylon buffer without damaging the Silicone used as cladding. The Propylene Glycol is placed in a beaker and heated to 160°C-180°C. The fiber is dipped into the Propylene Glycol to where the removal is needed until the buffer dissolves. After stripping rinse in clean water and apply silicone primer such as Momentive SS4120 O1P before termination.
  - Positives: No nicking of the glass is possible.
  - Negatives: Strip line may be swelled due to Propylene Glycol/heat absorption.
    Chemical waste stream needed. Fume Hood needed. Strip line is rough.

Buffer Type: Silicone Removal

Silicone is often removed from the fiber after the buffer of Nylon or Tefzel are removed.

PREFERRED PROCESS
- Hot Sulfuric Acid can be used to remove the Silicone buffer. The hot acid is placed in a beaker and heated to 150°C-180°C. The fiber is dipped into the hot sulfuric to the strip line until the...
buffer dissolves. After stripping, dip in clean water with bicarbonate of soda and clean with an organic cleaner, Acetone or IPA after the strip to assure a clean fiber before termination.

- Positives: No nicking of the glass is possible.
- Negatives: Strip line may be swelled due to acid/heat absorption. Chemical waste stream needed. Fume Hood needed.

**ALTERNATE PROCESS**

- Remove the Silicone mechanically with your fingers or soft cloth. The Silicone will off with rubbing and should remove easily.
  - Positives: No nicking of the glass is possible. No waste stream.
  - Negatives: Cleaning with a soft cloth does not guarantee complete removal of the Silicone which can lead to a poor bond with epoxy.

**Buffer Type: Tefzel or Nylon with Hard Cladding**

**PREFERRED PROCESS**

- Use a Micro-Strip® mechanical stripper from Micro Electronic Inc. Sizing of the Micro-Strip guide and stripper blades are critical to a good strip line. The guides should be sized so the fiber moves through the guide with some resistance but does not damage the buffer. The blades should be 0.001”-0.002” (25.4um-50.8um) larger than the fiber cladding. A good strip is indicated by the clean removal of the buffer and a clean straight strip line. Clean with an organic cleaner IPA after the strip to assure a clean fiber before termination.
  - Positives: No chemicals used in the process of removal. Therefore no chemical disposal needed.
  - Negatives: If blades and guide are sized incorrectly nicking of the glass is a possibility causing latent failures.

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Tefzel Mechanically Stripped with Micro-Strip® mechanical stripper and cleaned with Acetone. Note that some of the hard cladding is still on the fiber.
Buffer Type: Hard Cladding

PREFERED PROCESS
- Dip hard clad into a beaker of Acetone for a few minutes. The hard cladding will soften. After softening remove the hard clad with a soft tissue. Dip the fiber in water and clean with a clean tissue.
  - Positives: No nicking of the glass is possible.
  - Negatives: Hard cladding can be difficult at times to remove with this method. Multiple dipping and wiping may be required.

Buffer Type: Polyimide

PREFERED PROCESS
- Hot Sulfuric Acid can be used to remove the Polyimide buffer. The hot acid is placed in a beaker and heated to 120°C-150°C. The fiber is dipped into the hot sulfuric to the strip line until the buffer dissolves. After stripping dip in clean water with DI Water and clean with an organic cleaner Acetone or IPA after the strip to assure a clean fiber before termination.
  - Positives: No nicking of the glass is possible.
  - Negatives: Strip line may be swelled due to acid/heat absorption. Chemical waste stream needed. Fume Hood needed.

ALTERNATE PROCESS
- Laser stripping of Polyimide is possible with a either a Excimer (308nm) source. The Excimer laser is the laser of choice due to the lack of thermal heating of the glass substrate. The technique is best used for high volume production because the cost of the laser.
  - Positives: No nicking of the glass is possible. Very clean strip lines.
  - Negatives: Initial cost of capital equipment is high.
Buffer Type: Aluminum

PREFERED PROCESS
- Chemical etch

Fill 80 X 40 ml beaker with 1 ounce of sodium hydroxide pellets. Fill up to 30ml with water. Stir until pellets are dissolved. Place on hot plate and heat solution to 80°C. If available use a magnetic spinner. Mask areas not to be etched because the fumes will attack aluminum. Insert fiber for 1-2 minutes. When reaction stops, remove fiber. Aluminum has been removed. Dip into DI water to clean. Note that fresh solution is hot and therefore works fast. Agitation speeds up process. Note that if left in solution longer, Fiber will also be attacked.

- Positives: No nicking of the glass is possible. Very clean strip lines.

Buffer Type: Gold

PREFERED PROCESS
- Fill a 100ml beaker to the height required with 50% tin 50% lead solder without flux. and
- Sprinkle some flakes of wave oil on top of solder.
- Place the beakers on the temperature controlled hot plate and turn on the hot plate and set at 300°C. Wait for the lead solder to come up to temperature.
- When the hot plate is up to temperature the fibers can be dipped into the liquid solder for about 2 minutes to remove the gold jacket.
- After stripping the gold off there will be a layer of Wave Oil on the fiber. Dip the fiber in hot sulfuric acid, rinse in DI water, then ultrasonic in acetone.
- Positives: No nicking of the glass is possible. Very clean strip lines.
Gold Stripped with Hot Tin/Lead Solder and cleaned with Acetone. Note that the Gold is melted at the strip line.

ALTERNATE PROCESS

- 3 parts HCL (hydrochloric acid), Technical grade or Reagent grade ~38% w/w Fisher or equivalent/1 part HNO3(nitric acid) Technical grade or Reagent grade 70% Fisher or equivalent. Mask areas not to be affected. Dip into acid. Agitate to speed up removal of all gold. Rinse in H2O. Dip in acetone and let dry or blow dry.
- Potassium Iodide + Iodine + Water
  8gm Potassium Iodide/3gm Iodine/8ml water. Dissolve KI and I2 in H2O. Dip into solution and agitate until all gold is removed. Rinse in methanol, then acetone. Let dry or blow dry.
  - Positives: No nicking of the glass is possible. Very clean strip lines.

Buffer Type: Fused Silica

- Agitation will help uniform etching. 1-5% solution in water of 49% w/w reagent or technical grade Hydrofluoric acid Fisher or equivalent. Dip bare fiber into acid. Approximate etch rates are 2 to 10x10 5milligram/m2/hour at25°C (77°Fahrenheit). Etch rate constant at 32°C (89.6°Fahrenheit) is K=5x10-8 grams of SiO2 per sec. per cm 2 per Mole of HF. Rinse in DI water, acetone, and methanol. Blow dry with clean air.
  - Positives: No nicking of the glass is possible. Very clean strip lines.