

129. Claim 28 is anticipated by Dunning or would have been obvious in view of Dunning alone or in combination with Ohta. Claim 28 recites “. . . the adhesive layer is tinted.” Dunning discloses this limitation because it states that:

To maximize the desired continuous bright reflective effect of the metallized layer 18, a variety of means can be used to reinforce the opacity of the metallized layer. For example, the adhesive layer 20 may include a black pigment, white pigment, or aluminum flakes to provide the necessary opaque undersurface for the reflective metal layer 18.

Col. 5:13-19. One of ordinary skill in the art would have understood that black pigments, white pigments, or aluminum flakes tint Dunning’s adhesive layer to the extent the opacity of metallized layer is adjusted.

130. Claim 29 would have been obvious in view of Dunning alone or in combination with Wade or further in view of Ohta. Claim 29 recites “. . . at least one of said thermoplastic layers is tinted with a dye.” Tinting a thermoplastic layer using a dye was well known in this art. For example, Wade states that “[i]t is an object of the present invention to provide a part for a vehicle, be it exterior or interior, having a weather sealed mirror finish decorative portion integral therewith.” Col. 2:16-18. Wade discloses a laminate structure including a first polymer layer 20, a metal layer 26, an adhesive layer 30, and a second polymer layer 40. Col. 4:23-29; 5:53-6:39; FIGS. 1-2. The first polymer layer may be

polyester. Col. 4:8-15. The metal is aluminum or other metals. Col. 4:56-59. “These polymers can be clear or *tinted*.” 4:12-13 (emphasis added). Wade further discloses: “Different pigments, such as metallic or pearlescent pigments, can be included in adhesive 30 in addition to micronized titanium oxide, fluorescent pigments or graphite. Additionally, other *dye*, coloring or pigment materials can be included to provide the desired color and appearance to vehicle part 10.” Col. 5:67-6:6 (emphasis added). It would have been obvious to use Wade’s dye to tint Dunning’s thermoplastic layer because both Dunning and Wade are directed to decorative automobile trim and Dunning discloses tinting of its decorative trim and Wade discloses one way of doing so, i.e., tinting the thermoplastic layers with dye.

131. Claim 30 would have been obvious in view of Dunning alone or in combination with Wade or further in view of Ohta. Claim 30 recites “. . . either of said first or second thermoplastic layers includes carbon black.” Tinting a thermoplastic layer using carbon black was well known in this art.

132. For example, Wade disclosed tinting a thermoplastic layer with carbon black.

Advantageously, adhesive 30 is colored or pigmented, to match or complement either the interior or exterior colors of the car.

Different pigments, such as metallic or pearlescent pigments, can be included in adhesive 30 in addition to micronized titanium oxide, fluorescent pigments or *graphite*. Additionally, other dye, coloring or



pigment materials can be included to provide the desired color and appearance to vehicle part 10.

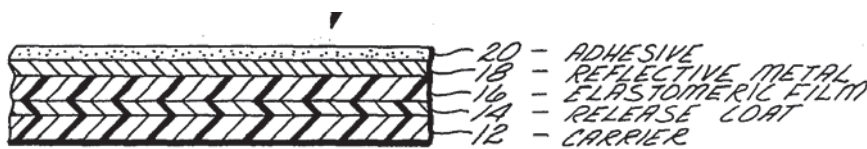
Col. 5:6-6:6 (emphasis added). A person of ordinary skill in the art would understand that the “graphite” in this context means carbon black, as explained in the Kuwahara section. It would have been obvious to use graphite to tint the thermoplastic layer given that the adhesive in Wade is tinted with graphite.

133. Claim 31 would have been obvious in view of Dunning alone or in combination with Ohta. Claim 31 recites “. . . the first and second thermoplastic layers predominantly include different thermoplastic polymer components.” As explained with respect to claim 1, Dunning teaches attaching its laminate to a bumper. Ohta discloses a bumper formed from thermoplastic layers. Specifically, Ohta discloses a bumper in which the outer layer of the bumper is made of the thermoplastics PET or ABS. Ohta, Table 1 and 2. Accordingly, one of ordinary skill in the art would have understood that Dunning in combination with Ohta discloses this limitation because Dunning’s first thermoplastic layer is made of polyurethane and when attached to Ohta’s bumper, which is made of PET or ABS, Dunning in combination with Ohta disclose “. . . the first and second thermoplastic layers predominantly include different thermoplastic polymer components.”

134. Claim 32 would have been obvious in view of Dunning alone or in combination with Ohta. Claim 32 recites “. . . said metal islands preferentially

adhere to one of the two thermoplastic layers.” As explained with respect to claim 31, Dunning and Ohta disclose first and second thermoplastic layers made of different materials. I have already explained that all materials have a different affinity to each other in part due to their different surface tensions, in the Kuwahara section. Accordingly, one of ordinary skill in the art would have understood that Dunning in combination with Ohta discloses this limitation.

135. Claim 33 is anticipated by Dunning or would have been obvious in view of Dunning alone or in combination with Ohta. Claim 33 recites “. . . said composite is supported by a substrate.” Dunning discloses this limitation because Dunning discloses a type of substrate, a carrier: “Referring to FIG. 1, an elastomeric laminate 10 according to this invention includes a *carrier sheet* 12 having a release coat 14 overlying the carrier sheet.” See FIG. 1, col. 4:12-14 (emphasis added).



136. Further, it was known in the art that thermoplastic laminates can be supported by a substrate.

137. Claim 34 would have been obvious in view of Dunning alone or in combination with Ohta. Claim 34 recites “. . . said composite is folded.” Dunning states that:

Referring to FIG. 1, an elastomeric laminate 10 according to this invention includes a carrier sheet 12 having a release coat 14 overlying the carrier sheet. A layer 16 of synthetic resinous elastomeric material, such as polyurethane, is coated over the release coating 14 to form a relatively thin, continuous, planar flexible and *foldable* elastomeric film or skin coat after the coating sets. . . .

Col. 4:12-19 (emphasis added). Accordingly, Dunning discloses folding its composite film.

138. Claim 35 would have been obvious in view of Dunning alone or in combination with Moran or further in combination with Ohta. Claim 35 recites “. . . said composite is embossed.” Embossing was well known. Moran is directed to decorative trim for automobiles similar to those in Dunning. Col. 1:11-14. Moran discloses embossing at col. 1:21-31, as explained above. It would have been an obvious design choice to use Moran’s embossing in Dunning.

139. Claim 36 is anticipated by Dunning or would have been obvious in view of Dunning or in combination with Ohta. Claim 36 recites “. . . said composite is molded.” Dunning discloses this limitation because it states that “FIGS. 6 and 7 show a preferred means for integrally bonding the laminate 36 to an injection-molded article. . . . The result is a *molded* urethane rubber article 48 having an elastomeric reflective metal surface.” Col. 6:36-54. (emphasis added). It also states that:

The article shown in FIG. 4 also can be injection-molded in much the same way as shown in FIGS. 6 and 7. In this instance, the adhesive layer 20 can be replaced with a primer layer which is compatible with the material from which the laminate and the molded article are made to control the bond between the injection-molded plastic and the metal or opaque layer of the laminate. Typical primer layers include thermoplastic polyurethane, ABS, or acrylic coatings, or Union Carbide's VMCH vinyl resin.

Col. 7:7-16. In addition, this limitation would have been obvious in view of Dunning and Ohta since Ohta's bumper, which can correspond to the second thermoplastic layer, is molded. Abstract.

### **Parker**

140. Claims 1-3, 8, 10, 16-19, 21 and 25-36 are obvious in view of Parker and Applicant's Admitted Prior Art (AAPA) or Eisfeller in combination with additional references.

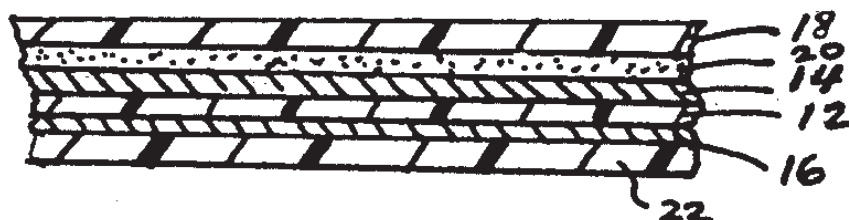
141. Claim 1 recites:

1. A metallized composite, comprising: a) a first thermoplastic layer; b) a discontinuous layer on said first layer, said discontinuous layer including discrete islands of metal in an adhesive; and c) a second thermoplastic layer, said discontinuous layer being between said first and second thermoplastic layers.

142. As explained below, Parker discloses a composite film that includes a) a first thermoplastic layer; b) a metal layer on said first layer; and c) a second

thermoplastic layer, said metal layer being between said first and second thermoplastic layers. Although Parker does not state that its metal layer is discontinuous, Parker does not teach away from using a discontinuous metal layer, and AAPA and Eisfeller both disclose using a discontinuous metal layer including discrete islands of metal. Using this layer in Parker would create “a discontinuous layer on said first layer, said discontinuous layer including discrete islands of metal in an adhesive.” As detailed below, it would have been obvious to one of ordinary skill in the art to use AAPA’s or Eisfeller’s discontinuous metal layer in the composite film of Parker. Following is also a detailed explanation of how Parker and AAPA or Eisfeller and additional prior art render obvious claims 1-3, 8, 10, 16-19, 21 and 25-36.

143. Parker discloses “a metallized composite” because Parker is directed to “. . . reflective decorative laminates.” Col. 1:6-9. These laminates can be used as vehicle parts, such as bumpers, side trims and grills. Col. 1:14-22. Parker’s laminate includes a base layer 12, metal coatings 14 and 16 deposited on both sides of base layer 12, a capping layer 18 and a backing layer 22. Col. 4:58-63, 5:26-30, and 6:54-57. *See also* FIG. 1 below.



144. Parker discloses “a first thermoplastic layer” because the base layer 12 may include polyethylene terephthalate (PET) or acrylonitrile-butadiene-styrene (ABS) resins. Col. 4:30-42. A PET layer and an ABS layer are both thermoplastic layers.

145. Parker discloses a metal layer 14 on the first thermoplastic layer 12. With respect to “a discontinuous layer on said first layer,” it would have been obvious to one of ordinary skill in the art to use the discontinuous metal layer of AAPA or Eisfeller as a known substitute for Parker’s metal layer, as explained below.

146. Parker is directed to reflective decorative laminates for automobiles, as explained above. Parker’s preferred metal for metallization is aluminum. “The metal layers may be applied by conventional techniques, such as vapor deposition, and may include chromium, nickel, iron, aluminum, and others, with aluminum preferred.” Col. 2:67-3:2. Applicant’s Admitted Prior Art (AAPA) of the ’138 patent discloses that using a discontinuous metal layer as the metal layer in a metallized film can help overcome corrosion problems. “One attempt to reduce the likelihood of delamination and loss of appearance resulting from corrosion of the metal layer has been to form a discontinuous metal layer on a polymer basecoat, such as a resinous urethane.” The ’138 patent, col. 1:24-27. Like Parker, the ’138 patent is directed to “decorative chrome parts, especially in the automotive

industry.” The ’138 patent, col. 1:9-11. It would have been obvious to one of ordinary skill in the art to use a discontinuous metal layer in accordance with the AAPA in Parker’s metallized composite in order to improve corrosion resistance of the decorative films of automobiles.

147. In addition, claim 1 is obvious in view of Parker and Eisfeller. Eisfeller discloses a discontinuous metal layer on a first thermoplastic layer. The discontinuous metal layer is used to improve corrosion resistance of the metallized composite. “This product is particularly useful in the automotive applications as an automobile exterior trim component to replace heavier and more expensive conventional chrome-plated metal parts.” Col. 4:60-63.

The present invention is based on the finding that with a thin vacuum metallized layer if the metal layer as it is being deposited or coalesced into electrically discrete islands and maintained electrically non-conductive, the metal layer is corrosion resistant if adequately topcoated even though the metal is one that is corrosion prone such as indium. The metal film is non-conductive as deposited because the metal nuclei initially deposited from the vapor phase are allowed to grow in molten phase only to a discrete island stage with the particles being electrically isolated from one another. The coating is kept quite thin and there is insufficient metal deposited to bring about a bridging or coalescence of the metal particles and formation of an electrically conductive film. . . .

Col. 4:64-col. 5:10. The metals for the metal film include aluminum and indium.  
Col. 6:23-28.

148. Eisfeller further states:

In general, the coalesced islands forming the indium films of the present invention are smaller and there is a much greater spacing between them that can be filled with the resin of the top coating, in effect encapsulating the islands and binding them to the substrate surface. The rounded islands are better protected by the resin and the film over all is far more corrosion resistant, surprisingly so. The metal film is much more securely adhered to the substrate--a very significant advantage. The appearance of the globular island product is better--it is more specular, more reflective.

Col. 2:52-62.

149. Both Parker and Eisfeller are directed to decorative metalized laminate trim for automobiles to replace chrome-plated metal parts. Parker acknowledged that corrosion and delamination were problems with metallized films. Col. 1:63-2:2, 2:31-34. Eisfeller discloses that the use of a discontinuous structure for the metal layer improves corrosion resistance and adhesion between the metal layer and the base thermoplastic layer. Accordingly, a person of ordinary skill in the art would have used Eisfeller's discontinuous metal layer as the metal layer in Parker to improve corrosion resistance and increase adhesion of the metal layer. This would be applying a known technique (Eisfeller's discontinuous



metallized layer) to a known device (Parker's laminate) ready for improvement to yield predictable results.

150. Accordingly, Parker in combination with AAPA or Eisfeller render obvious "said discontinuous layer including discrete islands of metal in an adhesive" in claim 1. Parker's discontinuous metal layer is attached to the capping layer using an adhesive. "Capping layer 18 is adhesively bonded to metal coating 14 by a pressure and heat sensitive elastomeric adhesive coating 20." Col. 5:58-60. Using Eisfeller's or AAPA discontinuous metal layer as the metal layer in Parker would produce discrete islands of metal in Parker's adhesive coating 20.

151. Parker discloses "a second thermoplastic layer" because it states that "[l]ayer 18 may thus be prepared from a material selected from the group consisting of fluorinated vinyl-polymers, fluorinated polyolefins, and polyesters treated for resistance to ultra-violet radiation. In particular, capping layer 18 may comprise a polyvinylfluoride, generally available and manufactured by DuPont under the name 'Tedlar.'" *Id.* at col. 5:48-54. These layers are thermoplastic layers. Parker also discloses "said discontinuous layer being between said first and second thermoplastic layers" because in Parker's laminate, a metal coating 14 is between a base layer 12 and a capping layer 18, as explained above.

152. Claim 2 would have been obvious in view of Parker in combination with AAPA or Eisfeller. Claim 2 recites, ". . . said first and second thermoplastic

layers are laminated together.” Parker discloses this limitation because Parker’s first thermoplastic layer 12 and second thermoplastic layer 18 are laminated through adhesive layer 20. *See* 1.1-1.5, and FIG. 1.

153. Claim 3 would have been obvious in view of Parker in combination with AAPA or Eisfeller. Claim 3 recites “. . . at least one of the thermoplastic layers includes polyethylene terephthalate.” Parker discloses this limitation because it states that:

The base layer 12 is preferably prepared from a non-oriented film selected from the group consisting of amorphous polyester resins, polycarbonate resins, substituted and unsubstituted vinyl polymers, and their copolymers. More particularly, the amorphous polyesters may include *polyethylene terephthalate*, the polycarbonates may include acrylonitrile-butadiene-styrene resins, the vinyl polymers may include polyvinylchloride homo- or copolymers as well as other commercially available vacuum formable or thermo-formable materials.

Col. 4:33-42 (emphasis added).

154. Claim 8 would have been obvious in view of Parker in combination with AAPA or Eisfeller. Claim 8 recites “. . . the first thermoplastic layer includes acrylonitrile butadiene styrene.” Parker discloses this limitation because Parker’s base layer 12 can be made of acrylonitrile butadiene styrene. *See* the passage of Parker reproduced above with respect to claim 3.

155. Claim 10 would have been obvious in view of Parker in combination with AAPA or Eisfeller. Claim 10 recites “. . . the first thermoplastic layer includes thermoplastic olefin.” Olefin is one of the most common materials used to make thermoplastic films. Eisfeller discloses using a thermoplastic olefin layer as a layer for the metallization. Col. 6: 64-68. Eisfeller, like Parker, uses aluminum for the metallization. Both Parker and Eisfeller are directed to decorative metalized laminate trim for automobiles to replace chrome-plated metal parts. Both use the same metal for metallization. Accordingly, it would have been obvious for a person of ordinary skill in the art to use Eisfeller’s thermoplastic olefin as the first thermoplastic layer in Parker as a known alternate with an expected result.

156. Claim 16 would have been obvious in view of Parker in combination with AAPA or Eisfeller. Claim 16 recites “. . . said adhesive includes at least one component selected from the group consisting of styrene-butadiene copolymers, ethylvinyl acetates, polyesters, polyamides, acrylic pressure-sensitive adhesives, silicone pressure-sensitive adhesives, polyurethanes and isocyanate-crosslinked polymers.” Parker discloses this limitation because Parker states that “[c]apping layer 18 is adhesively bonded to metal coating 14 by a pressure and heat sensitive elastomeric adhesive coating 20.” Col. 5:58-60. “The adhesive coating 20 may be a composition such as a silicone resin or an appropriate acrylic polymer, and is

preferably the former.” *Id.* at 6:1-4. In other words, Parker’s silicone adhesive and acrylic adhesive are pressure sensitive. Further, I have explained with respect to Kuwahara, the adhesives recited in claim 16 were well-known adhesives for thermoplastic laminates in the art.

157. Claim 17 would have been obvious in view of Parker in combination with AAPA or Eisfeller. Claim 17 recites “. . . the adhesive is a thermally activated adhesive.” Parker discloses this limitation because it states that “[c]apping layer 18 is adhesively bonded to metal coating 14 by a pressure and heat sensitive elastomeric adhesive coating 20.” Col. 5:58-60. Parker’s adhesive is a thermally activated adhesive because it is heat sensitive.

158. Claim 18 would have been obvious in view of Parker in combination with AAPA or Eisfeller or further in view of Igarashi. Claim 18 recites “. . . the adhesive includes two components.” Adhesives including multiple components were well-known in this art, as I already explained in the Kuwahara section.

159. Igarashi discloses an adhesive for metalized films and plastic films. In one embodiment, a PET film is metallized. Col. 7:46-53. The metallized film composites made by Igarashi’s adhesive are for “application in decorative materials , electrical industry. . . .” Col. 1:17-19. The metals for metallization are aluminum, nickel, chrome and their alloys. Col. 1:8-16. Igarashi’s adhesive includes “(A) a *polyester* polyol, polyester *polyurethane* polyol or their mixture,

(B) a silane coupling agent, (C) a vinyl-chloride copolymerization resin, (D) a diene synthetic rubber and (E) an organic polyisocyanate.” Col. 2:3-8 (emphasis added); *see also* Table 1. Replacing Parker’s adhesive with Igarashi’s adhesive would have been an obvious design modification to one of ordinary skill in the art, because both adhesives are used for metallized PET films and the applications for both Parker and Igarashi include decorative trim. Having Eisfeller’s discontinuous metal layer would allow bonding of the PET layer directly to the adhesive, instead of only to the metal layer. This would further reduce the potential of delamination.

160. Claims 19 and 21 would have been obvious in view of Parker in combination with AAPA or Eisfeller or further in view of Dani. Claim 19 recites “. . . the adhesive includes polyester and isocyanate,” and claim 21 recites “. . . the adhesive includes polyurethane and isocyanate.” The multi-component adhesives recited in claims 19 and 21 were well-known in the art. Igarashi discloses the limitations of claim 19 and the limitations of claim 21. *See* Igarashi’s five-component adhesive above with respect to claim 18.

161. Dani also discloses a multi-component adhesive. Dani discloses a laminate film including a polyester film layer 10, a metallized layer 11, an adhesive layer 13, and a vinyl film layer 20. Col. 2:51-3:7, and FIG. 1. The polyester film may be PET. Col. 8:39-44. The adhesive includes polyester and isocyanate. Col. 4:63-68, and 5:45-47. “In accordance with the present invention,

a novel metalized resin film--containing laminate of improved weathering properties and enhanced resistance to delamination is obtained by employing as an adhesive bond between said film and the film layer next adjacent the metalized surface, a specially developed in-situ formed *polyester-isocyanate polyurethane*.” Col. 2:5-11 (emphasis added).

162. Parker’s first thermoplastic layer can be PET. Parker’s second thermoplastic layer can be polyvinyl chloride film (PVC). Replacing Parker’s adhesive with Dani’s adhesive would have been an obvious design modification to one of ordinary skill in the art based on a known alternate, because Dani is used to join the same polymer materials (PET and a PVC) to form the same structure of PET layer/metal layer/ adhesive layer/ PVC layer.

163. Claim 25 would have been obvious in view of Parker in combination with Eisfeller. Claim 25 recites “. . . said metal is indium.” Eisfeller explains that indium is a preferred metal for a reflective discontinuous metal layer. “With some metals, such as aluminum and silver it is impossible at a practical temperature, to vacuum deposit sufficient metal to give the desired opacity and reflectivity and not to deposit so much as secure film electrical conductivity, i.e. bridging between the metal islands.” Col. 5:21-25. “The appearance of an indium layer deposited according to this invention and top coated approximates that of electroplated chrome.” Col. 5:35-37.

. . . It is to be noted that all of the metal films except that of indium became conductive at a light transmission far too high to be useful for the decorative usage purposes of this invention, i.e. for automobile bright trim. Also note that the indium film remained nonconductive and relatively opaque over a range of organic substrate types.

Example 4, col. 12:49-55. It would have been an obvious design choice to one of ordinary skill in the art to use Eisfeller's indium layer in Parker's laminate in order to achieve better decorative appearance than the aluminum layer of Parker.

164. Claim 26 would have been obvious in view of Parker, in combination with AAPA or Eisfeller. Claim 26 recites “. . . said metal is selected from the group consisting of zinc, tin, gallium, aluminum, cadmium, copper, nickel, cobalt, iron, stainless steel, gold, platinum, chromium, nichrome, palladium, and rhodium.” Parker discloses this limitation because it states that “[t]he metal layers may be applied by conventional techniques, such as vapor deposition, and may include chromium, nickel, iron, aluminum, and others, with aluminum preferred.” Col. 2:67-3:2.

165. Claim 27 would have been obvious in view of Parker, in combination with AAPA or Eisfeller, and Wade. Claim 27 recites “. . . at least one of said thermoplastic layers is tinted.” Tinting of a thermoplastic layer was well known in this art. For example, Wade discloses tinting of thermoplastic layers. Similar to Parker, Wade discloses a laminate structure including a first polymer layer 20, a

metal layer 26, an adhesive layer 30, and a second polymer layer 40. Col. 4:23-29, 5:53-6:39, and FIGS. 1 and 2. Wade is also directed to automotive decorative parts. Col. 1:10-13.

166. Wade states that “[t]hese polymers can be clear or *tinted*. Moreover, multilayer coatings such as polyvinylchloride with acrylic overlayer, can be employed as polymeric material 20.” Col. 4:10-13 (emphasis added). Parker states that “[w]hile wide-spread employment of resinous materials exists, their use has been primarily in the instance where pigmented non-reflective hardware such as bumpers, and the like, is acceptable in the design of the vehicle.” Col. 1:22-25. It would have been an obvious design choice to one of ordinary skill in the art to apply Wade’s tinting in Parker’s laminate in view of application of Parker’s teaching that its laminate can be applied to colored bumpers.

167. Claim 28 would have been obvious in view of Parker, in combination with AAPA or Eisfeller, and Wade. Claim 28 recites “. . . the adhesive layer is tinted.” Wade states that:

Advantageously, adhesive 30 is colored or pigmented, to match or complement either the interior or exterior colors of the car. Different pigments, such as metallic or pearlescent pigments, can be included in adhesive 30 in addition to micronized titanium oxide, fluorescent pigments or graphite. Additionally, other dye, coloring or pigment materials can be included to provide the desired color and appearance to vehicle part 10.



Col. 5:66-6:6. Adding pigments, graphite, dye, coloring materials or oxides to an adhesive would result in tinting of the adhesive. It would have been an obvious design choice to one of ordinary skill in the art to apply Wade's tinting in Parker's laminate in view of application of Parker's teaching that its laminate can be applied to colored bumpers.

168. Claim 29 would have been obvious in view of Parker, in combination with AAPA or Eisfeller, and Wade. Claim 29 recites “. . . at least one of said thermoplastic layers is tinted with a dye.” Tinting a thermoplastic layer using a dye was well known in this art. For example, Wade states that “[d]ifferent pigments, such as metallic or pearlescent pigments, can be included in adhesive 30 in addition to micronized titanium oxide, fluorescent pigments or graphite. Additionally, other *dye*, coloring or pigment materials can be included to provide the desired color and appearance to vehicle part 10.” 5:67-6:6 (emphasis added). Wades' thermoplastic layers are tinted. 4:12-15. It would have been obvious to use Wade's dye to tint Parker's thermoplastic layer because both Parker and Wade are directed to decorative automobile trim and Parker discloses tinting of its decorative trim and Wade discloses one way of doing so, i.e., tinting the thermoplastic layers by a dye.

169. Claim 30 would have been obvious in view of Parker, in combination with AAPA or Eisfeller, and Wade. Claim 30 recites “. . . either of said first or

second thermoplastic layers includes carbon black.” Tinting a thermoplastic layer using carbon black was well known in this art. For example, Wade states:

Advantageously, adhesive 30 is colored or pigmented, to match or complement either the interior or exterior colors of the car. Different pigments, such as metallic or pearlescent pigments, can be included in adhesive 30 in addition to micronized titanium oxide, fluorescent pigments or *graphite*. Additionally, other dye, coloring or pigment materials can be included to provide the desired color and appearance to vehicle part 10.

Col. 5:66-6:6 (emphasis added). Wade discloses tinting a thermoplastic layer with graphite, which means carbon black in this context, as explained in the Kuwahara section. Parker discloses tinted decorative laminates. Col.1:22-25. It would have been obvious to use graphite to tint Parker’s thermoplastic layer given that the adhesive in Wade is tinted with graphite.

170. Claim 31 would have been obvious in view of Parker, in combination with AAPA or Eisfeller, and Wade. Claim 31 recites “. . . the first and second thermoplastic layers predominantly include different thermoplastic polymer components.” Parker discloses this limitation because Parker’s first and second thermoplastic layers (base layer 12 and capping layer 18) are made of different materials:

. . . The base layer 12 is preferably prepared from a non-oriented film selected from the group consisting of amorphous polyester resins,

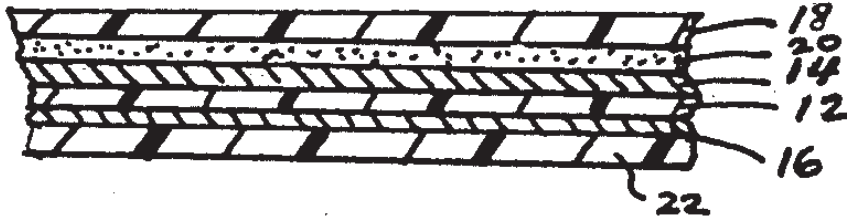
polycarbonate resins, substituted and unsubstituted vinyl polymers, and their copolymers. More particularly, the amorphous polyesters may include polyethylene terephthalate, the polycarbonates may include acrylonitrile-butadiene-styrene resins, the vinyl polymers may include polyvinylchloride homo- or copolymers as well as other commercially available vacuum formable or thermo-formable materials.

Col. 4:33-42. “Layer 18 may thus be prepared from a material selected from the group consisting of fluorinated vinyl-polymers, fluorinated polyolefins, and polyesters treated for resistance to ultra-violet radiation. In particular, capping layer 18 may comprise a polyvinylfluoride, generally available and manufactured by DuPont under the name ‘Tedlar.’” Col. 5:48-54.

171. Claim 32 would have been obvious in view of Parker, in combination with AAPA or Eisfeller. Claim 32 recites “. . . said metal islands preferentially adhere to one of the two thermoplastic layers.” As explained with respect to claim 31, Parker’s first and second thermoplastic layers are made of different material. I have already explained that all materials have a different affinity to each other in part due to their different surface tensions, in the Kuwahara section. Accordingly, Parker discloses this limitation.

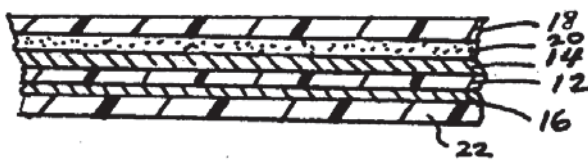
172. Claim 33 would have been obvious in view of Parker, in combination with AAPA or Eisfeller or further in view of ’139 Dunning. Claim 33 recites “. . . said composite is supported by a substrate.” Parker discloses the substrate of claim

33. Parker's laminate includes base layer 12, metal coatings 14 and 16 deposited on both sides of base layer 12, capping layer 18 and backing layer 22. Col. 4:58-63, 5:26-30, and 6:54-57. See also FIG. 1 below.



Backing layer 22 supports the composite of base layer 12, metal coating 14, adhesive coating 20 and capping layer 18. Parker's backing layer 22 is a substrate supporting Parker's thermoplastic

173. Further, claim 33 would have been obvious in view of Parker, in combination with AAPA or Eisfeller. Parker's laminate includes base layer 12, metal coatings 14 and 16 deposited on both sides of base layer 12, capping layer 18 and backing layer 22. Col. 4:58-63; 5:26-30; 6:54-57; see also FIG. 1 below.



Backing layer 22 supports the composite of base layer 12, metal coating 14, adhesive coating 20 and capping layer 18.

174. Claim 35 would have been obvious in view of Parker, in combination with AAPA or Eisfeller, and Moran. Claim 35 recites "... said composite is

embossed.” Embossing was well known in the art. Moran is directed to decorative trim for automobile similar to those in Parker. Col. 1:11-14. Moran discloses embossing at 1:21-31, as I explained in the Kuwahara section. It would have been an obvious design choice to use Moran’s embossing in Parker.

175. Claim 36 would have been obvious in view of Parker, in combination with AAPA or Eisfeller. Claim 36 recites “. . . said composite is molded.” Parker discloses this limitation because Parker’s thermoplastic laminate is molded, as explained above.

### **Wade**

176. Claims 1-3, 8, 10, 16-19, 21 and 25-36 are obvious in view of Wade in combination with AAPA or Eisfeller and additional references.

177. Claim 1 recites:

1. A metallized composite, comprising: a) a first thermoplastic layer; b) a discontinuous layer on said first layer, said discontinuous layer including discrete islands of metal in an adhesive; and c) a second thermoplastic layer, said discontinuous layer being between said first and second thermoplastic layers.

178. As explained below, Wade discloses a composite film that includes a) a first thermoplastic layer; b) a metal layer on said first layer; and c) a second thermoplastic layer, said metal layer being between said first and second thermoplastic layers. Wade does not explicitly state that its metal layer is

discontinuous. However, Wade does not teach away from using a discontinuous metal layer, and AAPA and Eisfeller both disclose using a discontinuous metal layer including discrete islands of metal. Using this layer in Wade would create “a discontinuous layer on said first layer, said discontinuous layer including discrete islands of metal in an adhesive.” As detailed below, it would have been obvious to one of ordinary skill in the art to use AAPA’s or Eisfeller’s discontinuous metal layer in the composite film of Wade. Following is also a detailed explanation of how Wade and AAPA or Eisfeller and additional prior art render obvious claims 1-3, 8, 10, 16-19, 21 and 25-36.

179. Wade discloses “a metallized composite” because it states that “[i]t is an object of the present invention to provide a part for a vehicle, be it exterior or interior, having a weather sealed mirror finish decorative portion integral therewith.” Col. 2:16-18. Wade discloses a laminate structure including a first polymer layer 20, a metal layer 26, an adhesive layer 30, and a second polymer layer 40. Col. 4:23-29, 5:53-6:39, and FIGS. 1 and 2.

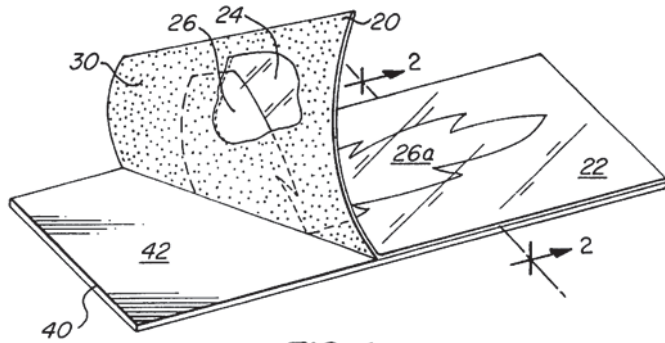


FIG. 1

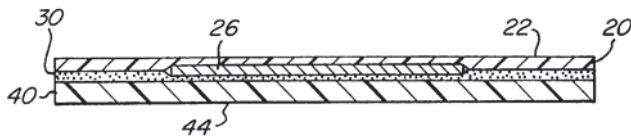


FIG. 2

The first polymer layer may be a polyester. Col. 4:8-15. The metal layer may be aluminum or other metal. Col. 4:56-59. The second polymer layer may be a polyolefin, a polyvinyl chloride or an acrylonitrile-butadiene-styrene copolymer. Col. 6:22-27.

180. Wade discloses “a first thermoplastic layer” because it states:

Referring now to FIG. 1, the inventive process begins with the provision of a sheet of relatively clear weather resistant polymeric material 20, which has two surfaces, denoted an external surface 22 (the top surface in the orientation illustrated in FIG. 1) and an internal surface 24 (the bottom surface in the orientation illustrated in FIG. 1).

Col. 3:36-41. Wade further states:

Two typical polymeric material useful herein are a polyvinylidene fluoride (PVDF) film and an unoriented polyvinyl fluoride (PVF) film commercially available under the trade name SP Tedlar from DuPont

DeNemours Company of Wilmington, Del. In addition, polymeric material 20 can comprise other polymeric materials such as polyethyltetrafluoroethylene, acrylic, polyurethane, polycarbonate, polyester, melamine, urea formaldehyde, polyvinylchloride, silicone, silica or mixtures of any of the above.

Col. 4:3-13. The disclosed polymeric material layer is a thermoplastic layer because they are made of well-known thermoplastic materials.

181. Wade discloses a metal layer 26 on the first polymer layer 20. With respect to “a discontinuous layer on said first layer,” it would have been obvious to one of ordinary skill in the art to use the discontinuous metal layer of AAPA or Eisfeller as a known substitute for Wade’s metal layer, as explained below.

182. Wade’s laminate includes a metal layer: “The polymeric material 20 is then metallized as shown in FIG. 1, that is a layer of metal 26 is applied to internal surface 24 of polymeric material 20.” Col. 4:24-25. Wade also discloses that thin metal layers are prone to corrosion. “Since the aluminum layer is typically extremely thin, it is subject to attack by moisture, salt and other materials to which it can be exposed, especially on the exterior of a vehicle.” *Id.* at 1:24-27. “It is an object of the present invention to provide a part for a vehicle, be it exterior or interior, having a weather sealed mirror finish decorative portion integral therewith.” *Id.* at 2:16-18.



183. Applicant's Admitted Prior Art (AAPA) of the '138 patent discloses that using a discontinuous metal layer as the metal layer in a metallized film can help overcome corrosion problems. "One attempt to reduce the likelihood of delamination and loss of appearance resulting from corrosion of the metal layer has been to form a discontinuous metal layer on a polymer basecoat, such as a resinous urethane." The '138 patent, col. 1:24-27. Like Wade, the '138 patent is directed to ". . . decorative chrome parts, especially in the automotive industry." The '138 patent, col. 1:9-11. It would have been obvious to one of ordinary skill in the art to use a discontinuous metal layer in accordance with AAPA in Wade's metallized composite in order to improve corrosion resistance.

184. In addition, claim 1 is obvious in view of Wade and Eisfeller.

185. Eisfeller discloses a discontinuous metal layer on thermoplastic first layer. The discontinuous metal layer is used to improve adhesion of the metallized layer. "This product is particularly useful in the automotive applications as an automobile exterior trim component to replace heavier and more expensive conventional chrome-plated metal parts." Col. 4:60-63.

The present invention is based on the finding that with a thin vacuum metallized layer if the metal layer as it is being deposited or coalesced into electrically discrete islands and maintained electrically non-conductive, the metal layer is corrosion resistant if adequately topcoated even though the metal is one that is corrosion prone such as

indium. The metal film is non-conductive as deposited because the metal nuclei initially deposited from the vapor phase are allowed to grow in molten phase only to a discrete island stage with the particles being electrically isolated from one another. The coating is kept quite thin and there is insufficient metal deposited to bring about a bridging or coalescence of the metal particles and formation of an electrically conductive film. . . .

*Id.* at 4:64-col. 5:10.

186. The metals for the metal film include aluminum and indium. *Id.* at Col. 6:23-28.

In general, the coalesced islands forming the indium films of the present invention are smaller and there is a much greater spacing between them that can be filled with the resin of the top coating, in effect encapsulating the islands and binding them to the substrate surface. The rounded islands are better protected by the resin and the film over all is far more corrosion resistant, surprisingly so. The metal film is much more securely adhered to the substrate--a very significant advantage. The appearance of the globular island product is better--it is more specular, more reflective.

*Id.* at Col. 2:52-62.

187. Both Wade and Eisfeller are directed to decorative metalized laminate trim for automobiles to replace chrome-plated metal parts. Eisfeller discloses that the use of a discontinuous structure for the metal layer improves corrosion

resistance and adhesion between the metal layer and the base thermoplastic layer. Accordingly, persons of ordinary skill in the art would have used Eisfeller's discontinuous metal layer as the metal layer in Wade to improve corrosion resistance and increase adhesion of the metal layer. This would be applying a known technique (Eisfeller's discontinuous metallized layer) to a known device (Wade's laminate) ready for improvement to yield predictable results.

188. Accordingly, Wade in combination with AAPA or Eisfeller render obvious "said discontinuous layer including discrete islands of metal in an adhesive" in claim 1. Wade's laminate includes an adhesive:

Once polymeric material 20 is metallized in a desired pattern, an adhesive 30 is printed or coated across metallized polymeric material 20 in a preferred embodiment of the present invention illustrated in FIGS. 1-4. ... Generally, adhesive 30 can be a thermoplastic or cross-linked (with or without aid of an active or latent crosslinking agent) polyester, acrylic, polyamid or urethane adhesive capable of preventing delamination of vehicle part 10 as well as polyvinylchloride or epoxy, or mixtures of any of the above.

Col. 5:53-63; *see also* 1.1 and 1.3. Using Eisfeller's or AAPA discontinuous metal layer as the metal layer in Wade would produce discrete islands of metal in Wade's adhesive layer 30.

189. Wade discloses "a second thermoplastic layer" because it states that "[t]ypically substrate material 40 comprises a polyolefin, a polyvinyl chloride or an

acrylonitrile-butadiene-styrene copolymer. Other suitable materials include polypropylene, thermoplastic elastomers such as thermoplastic olefins or urethanes, polystyrene, polyurethane, polycarbonate or mixtures of any of the above in single or multiple layers.” Col. 6:22-28. A layer made of these materials is a thermoplastic layer. Substrate material 40 corresponds to the second thermoplastic layer. *See* FIG. 2.

190. Wade also discloses “said discontinuous layer being between said first and second thermoplastic layers” because Wade’s metal layer is between two thermoplastic layers. For example, in FIG. 2, metal layer 26 is between first thermoplastic layer 20 and second thermoplastic layer 40.

191. Claim 2 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 2 recites, “. . . said first and second thermoplastic layers are laminated together.” Wade discloses this limitation because Wade’s first thermoplastic layer 20 and second thermoplastic layer 40 are laminated through adhesive layer 30. *See* 1.1, FIG. 2.

192. Claim 3 would have been obvious in view of Wade in combination with AAPA or Eisfeller or further in view of Dani. Claim 3 recites “. . . at least one of the thermoplastic layers includes polyethylene terephthalate.” Polyethylene terephthalate (PET) is one of the most common materials used to make thermoplastic films.

193. One example of Wade's thermoplastic layer is polyester: "In addition, polymeric material 20 can comprise other polymeric materials such as polyethyltetrafluoroethylene, acrylic, polyurethane, polycarbonate, *polyester*, melamine, urea formaldehyde, polyvinylchloride, silicone, silica or mixtures of any of the above." Col. 4:8-12 (emphasis added).

194. Dani discloses a thermoplastic layer made of polyethylene terephthalate (PET). Dani also relates to decorative metallized composites for automobiles: "It is particularly concerned with such laminates employed in protective and decorative trim molding strips applied to doors and side panels of automobile bodies and to edges of automobile doors." Col. 1:9-12. Dani discloses a three-layer laminate similar to Wade's laminate: "The preferred laminate of the present invention comprises a clear transparent *polyester* resin film having on one side thereof a thin coating of vacuum deposited aluminum metal and on its opposite side, a clear weather resistance coating of a polyester resin preferably containing ultraviolet inhibitor." *Id.* at Col. 2:11-17 (emphasis added). In addition, Dani discloses that the adhesives are used to bond a metallized film to a second thermoplastic layer. *Id.* at 2:5-11. Dani also discloses that "[t]he preferred laminate of the present invention comprises a clear transparent *polyester* resin film having on one side thereof a thin coating of vacuum deposited aluminum metal and on its opposite side, a clear weather resistance coating of a polyester resin

preferably containing ultraviolet inhibitor.” Col. 2:11-17 (emphasis added). Dani discloses using polyethylene terephthalate (PET) as the first thermoplastic layer to be metalized. “A running length of clear transparent biaxially oriented *polyethylene terephthalate* film (Melinex 442; I.C.I. Americas) of 23 micron thickness is passed through a vacuum metalizing chamber at a rate to deposit aluminum metal on one surface of the film at a thickness of about 150 angstroms.” (emphasis added). Example, col. 8:39-44. It would have been obvious to one of ordinary skill in the art to use PET as taught by Dani as the polyester material of Wade’s layer 20. This would have been an obvious selection of a known material.

195. Claim 8 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 8 recites “. . . the first thermoplastic layer includes acrylonitrile butadiene styrene.” Acrylonitrile butadiene styrene (ABS) is one of the most common materials used to make thermoplastic films.

196. For example, Eisfeller discloses that an acrylonitrile butadiene styrene (ABS) layer can be used as the thermoplastic layer for the metal deposition. Col. 6:57-59. It would have been an obvious design choice to one of ordinary skill in the art to use in Wade Eisfeller’s ABS as the first thermoplastic layer on which to form the metal layer.

197. Claim 10 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 10 recites “. . . the first thermoplastic layer

includes thermoplastic olefin.” Olefin is one of the most common materials used to make thermoplastic films. For example, Eisfeller discloses using a thermoplastic olefin layer as a layer for the metallization. Col. 6: 64-68. Eisfeller, like Wade, use aluminum for the metallization. Both Wade and Eisfeller are directed to decorative metalized laminate trim for automobiles to replace chrome-plated metal parts. Both use the same metal for metallization. Accordingly, it would have been obvious for a person of ordinary skill in the art to use Eisfeller’s thermoplastic olefin as the first thermoplastic layer in Wade as a known alternate with an expected result.

198. Claim 16 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 16 recites “. . . said adhesive includes at least one component selected from the group consisting of styrene-butadiene copolymers, ethylvinyl acetates, polyesters, polyamides, acrylic pressure-sensitive adhesives, silicone pressure-sensitive adhesives, polyurethanes and isocyanate-crosslinked polymers.” Wade discloses this limitation because Wade states that “[g]enerally, adhesive 30 can be a thermoplastic or cross-linked (with or without aid of an active or latent crosslinking agent) *polyester*, acrylic, *polyamid* or urethane adhesive capable of preventing delamination of vehicle part 10 as well as polyvinylchloride or epoxy, or mixtures of any of the above.” (emphasis added). Col. 5:59-63.

Further, I have as explained with respect to Kuwahara, the adhesives recited in claim 16 were well-known adhesives for thermoplastic laminates in the art.

199. Claim 17 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 17 recites “. . . the adhesive is a thermally activated adhesive.” Thermally activated adhesives were well known in this art. For example, Wade states “adhesive 30 can be cured merely by the application of pressure, by the *application of heat and pressure.*” Col. 6:34-36 (emphasis added).

200. Claim 18 would have been obvious in view of Wade in combination with AAPA or Eisfeller or further in view of Dani or Igarashi. Claim 18 recites “. . . the adhesive includes two components.” Adhesives including multiple components were well known in this art.

201. Dani’s first thermoplastic layer can be PET. Col. 8:39-44. Dani states that “[t]he metal coated surface of the film is bonded to a vinyl resin film by the in-situ formed thermosetting adhesive bond comprising the polyurethane formed by the reaction of the isocyanate with hydroxy groups of the polyester polyol.” *Id.* at 2:18-22. “To react with the hydroxyl polyester in the adhesive coating there is added thereto a mixture of certain organic polyisocyanates and suitable tertiary amine catalyst.” *Id.* at 4:65-68. In both Dani and Wade, the adhesive attaches a metallized thermoplastic layer to a vinyl polymer layer. *See* Wade, col. 6:22-24. Further, both Dani and Wade use polyester as the first



thermoplastic layer. It would have been an obvious design modification to use Dani's adhesive in Wade because both Wade and Dani are directed to similar decorative trim for automobiles and their adhesives are used to attach metallized polyester layers to vinyl polymer layers.

202. In addition, Igarashi's adhesive includes ". . . (A) a polyester polyol, polyester polyurethane polyol or their mixture, (B) a silane coupling agent, (C) a vinyl-chloride copolymerization resin, (D) a diene synthetic rubber and (E) an organic polyisocyanate." Col. 2:3-8; *see also* Table 1. It would have been obvious to one of ordinary skill in the art to use in Wade Dani's multi-component adhesive or Igarashi's multi-component adhesive as a well-known substitute for Wade's adhesive.

203. Claim 19 and 21 would have been obvious in view of Wade in combination with AAPA or Eisfeller or further in view of Dani or Igarashi. Claim 19 recites ". . . the adhesive includes polyester and isocyanate," and claim 21 recites ". . . the adhesive includes polyurethane and isocyanate." Dani and Igarashi disclose these limitations. *See* the passages of Dani and Igarashi reproduced above for claim 18. Further, the multi-component adhesives recited in claims 19 and 21 were well-known in the art.

204. Claim 25 would have been obvious in view of Wade in combination with Eisfeller. Claim 25 recites “. . . said metal is indium.” Claim 25 is obvious over Wade and Eisfeller.

205. Wade’s laminate includes an aluminum layer, as explained above. Eisfeller discloses that indium produces laminate with better reflectivity: “With some metals, such as aluminum and silver it is impossible at a practical temperature, to vacuum deposit sufficient metal to give the desired opacity and reflectivity and not to deposit so much as secure film electrical conductivity, i.e. bridging between the metal islands.” *Id.* at 5:21-25. “The appearance of an indium layer deposited according to this invention and top coated approximates that of electroplated chrome.” *Id.* at 5:35-37.

. . . It is to be noted that all of the metal films except that of indium became conductive at a light transmission far too high to be useful for the decorative usage purposes of this invention, i.e. for automobile bright trim. Also note that the indium film remained nonconductive and relatively opaque over a range of organic substrate types.

*Id.* at Example 4, col. 12:49-55. It would have been an obvious design choice to one of ordinary skill in the art to use Eisfeller’s indium layer in Wade’s laminate in order to achieve better decorative appearance than the aluminum layer of Wade.

206. Claim 26 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 26 recites “. . . said metal is selected from the

group consisting of zinc, tin, gallium, aluminum, cadmium, copper, nickel, cobalt, iron, stainless steel, gold, platinum, chromium, nichrome, palladium, and rhodium.” Wade discloses this limitation because Wade’s metal is aluminum, as explained above. Further, Eisfeller states that “[t]his invention is most usefully applied to metals and alloys which are not inherently strongly corrosion resistant: zinc, tin, gallium, aluminum, cadmium, copper, nickel, cobalt or iron as opposed to stainless steel, gold, platinum, chromium, nichrome, palladium and rhodium.” Col. 6:23-28.

207. Claim 27 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 27 recites “. . . at least one of said thermoplastic layers is tinted.” Wade discloses this limitation because it states that “[t]hese polymers can be clear or *tinted*. Moreover, multilayer coatings such as polyvinylchloride with acrylic overlayer, can be employed as polymeric material 20.” Col. 4:12-15 (emphasis added). Further, tinting of a thermoplastic layer was well known in this art.

208. Claim 28 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 28 recites “. . . the adhesive layer is tinted.” Claim 18 discloses this limitation because it states that

Advantageously, *adhesive 30* is colored or pigmented, to match or complement either the interior or exterior colors of the car.

Different pigments, such as metallic or pearlescent pigments, can be

included in *adhesive 30* in addition to micronized titanium oxide, fluorescent pigments or graphite. Additionally, other dye, coloring or pigment materials can be included to provide the desired color and appearance to vehicle part 10.” Col. 5:66-6:6 (emphasis added).

Wade’s adhesive layer is tinted by being “. . . colored or pigmented, to match or complement either the interior or exterior colors of the car.” *Id.*

209. Claim 29 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 29 recites “. . . at least one of said thermoplastic layers is tinted with a dye.” Tinting a thermoplastic layer using a dye was well known in this art. For example, Wade states that “[t]hese polymers can be clear or *tinted*.” Col. 4:12-13 (emphasis added). “Additionally, other *dye*, coloring or pigment materials can be included to provide the desired color and appearance to vehicle part 10.” Col.6:4-6 (emphasis added).

210. Claim 30 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 30 recites “. . . either of said first or second thermoplastic layers includes carbon black.” Wade discloses this limitation because it states:

Advantageously, adhesive 30 is colored or pigmented, to match or complement either the interior or exterior colors of the car. Different pigments, such as metallic or pearlescent pigments, can be included in adhesive 30 in addition to micronized titanium oxide, fluorescent pigments or *graphite*. Additionally, other dye, coloring or

pigment materials can be included to provide the desired color and appearance to vehicle part 10.

Col. 5:66-6:6 (emphasis added). Wade discloses tinting a thermoplastic layer with graphite, which means carbon black in this context, as explained in the Kuwahara section. Wade's thermoplastic layers are tinted. It would have been obvious to use graphite to tint Wade's thermoplastic layer given that the adhesive in Wade is tinted with graphite.

211. Claim 31 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 31 recites “. . . the first and second thermoplastic layers predominantly include different thermoplastic polymer components.” Wade discloses this limitation because Wade's first and second thermoplastic layers are made of different materials: “[P]olymeric material 20 can comprise other polymeric materials such as polyethyltetrafluoroethylene, acrylic, polyurethane, polycarbonate, polyester, melamine, urea formaldehyde, polyvinylchloride, silicone, silica or mixtures of any of the above.” Col. 4:8-12. “Typically substrate material 40 comprises a polyolefin, a polyvinyl chloride or an acrylonitrile-butadiene-styrene copolymer. Other suitable materials include polypropylene, thermoplastic elastomers such as thermoplastic olefins or urethanes, polystyrene, polyurethane, polycarbonate or mixtures of any of the above in single or multiple

layers.” Col. 6:22-28. *See* also FIGS. 1 and 2. Thus, Wade’s first and second thermoplastic layers are made of different materials.

212. Claim 32 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 32 recites “. . . said metal islands preferentially adhere to one of the two thermoplastic layers.” As explained with respect to claim 31, Wade’s first and second thermoplastic layers are made of different material. I have already explained that all materials have a different affinity to each other in part due to their different surface tensions, in the Kuwahara section. Accordingly, Wade discloses this limitation.

213. Claim 33 would have been obvious in view of Wade in combination with AAPA or Eisfeller. Claim 33 recites “. . . said composite is supported by a substrate.” Wade discloses this limitation because it states:

. . . Once formed into the final shape of part 10, part 10 can be used as is or a backing material 50 such as a polyvinyl chloride, a polyolefin, an acrylonitrile-butadiene-styrene copolymer or a urethane can be molded into the rear of part 10 to provide *support*, as shown in FIGS. 5 and 6. This molding can be through injection or other types of molding, casting, or the use of a foaming material as would be familiar to the artisan.

Col. 6:56-63 (emphasis added). Wade’s backing material that supports vehicle trim part 10 corresponds to the substrate of claim 33.

214. Claim 35 would have been obvious in view of Parker in combination with Eisfeller or AAPA or further in view of Moran. Claim 35 recites “. . . said composite is embossed.” The passage of the ’138 patent, reproduced above, states that embossing is a conventional choice for thermoplastic laminates. Embossing was well known in the art. Moran is directed to decorative trim for automobiles similar to those in Wade. Col. 1:11-14. Moran discloses embossing at 1:21-31, as I explained in the Kuwahara section. It would have been an obvious design choice to use Moran’s embossing in Wade.

215. Claim 36 would have been obvious in view of Parker in combination with Eisfeller or AAPA. Claim 36 recites “. . . said composite is molded.” Wade discloses this limitation because Wade’s thermoplastic laminate is molded, as explained above. *See* claim 33.

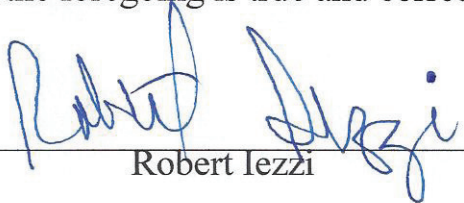
## **X. CLAIM CHARTS**

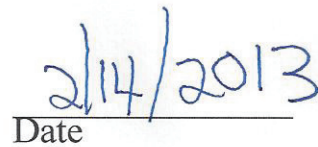
216. I have reviewed the claim charts in the petition to be filed with my declaration and agree with all the statements about the factual findings and arguments based on the findings. It is my opinion that the claims of the ’138 patent are anticipated or rendered obvious as set forth in these charts and as additionally addressed above in this declaration.

**XI. CONCLUSION**

217. This declaration is based on my present assessment of materials and information currently available to me. My investigation and assessment may continue, which may include reviewing documents and other information that may yet to be made available to me. Accordingly, I expressly reserve the right to continue my study in connection with this case and to expand or modify my opinions and conclusions as my study continues.

218. I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

  
\_\_\_\_\_  
Robert Iezzi

  
\_\_\_\_\_  
Date



**Appendix List for Declaration of Robert Iezzi, Ph.D. (Exhibit 1017)**

**In Inter Partes Review of U.S. Patent No. 6,455,138**

Appendix Description	
Curriculum Vitae of Robert Iezzi, Ph.D.	A
Du Pont Tedlar polyvinyl fluoride film, <i>Adhesive and Lamination Guide for Tedlar PVF Film</i> (1995)	B
Rubin, I.I., <i>Handbook of Plastic Materials and Technology, Chapter 117 - Adhesion and Solvent Bonding</i> (John Wiley & Sons 1990)	C
Perfetti, B., <i>Federation Series On Coatings Technology, Metal Surface Characteristics Affecting Organic Coatings 8 and 15</i> (Federation of Societies for Coatings Technology 1994)	D
Fontana, M.G., <i>Corrosion Engineering 236 and 239</i> (McGraw-Hill, Inc. 3d ed. 1986)	E
Timm, J. A., <i>General Chemistry 407</i> (McGraw-Hill, Inc. 3d ed.1956)	F
<i>The American Heritage Dictionary 96</i> (2d ed. 1985)	G
Wicks, Z.W. <i>et al.</i> , <i>Organic Coatings Science &amp; Technology 427 and 490</i> (Wiley Interscience 3d ed. 2007)	H
Kroschwitz, J., <i>Concise Encyclopedia of Polymer Science and Engineering 104</i> (Wiley Interscience 1998)	I

<p>Baghdachi, J.A., <i>Federation Series On Coating Technology, Adhesion Aspects of Polymeric Coatings 13</i> (Federation of Societies for Coating Technology 1996)</p>	<p>J</p>
<p>Van Iseghem, L.C., <i>Coating Plastics – Some Important Concepts from a Formulators Perspective, Trends in Plastics Coatings</i>,  <a href="http://www.vtcoatings.com/plastics.htm">http://www.vtcoatings.com/plastics.htm</a>  Downloaded January 17, 2013</p>	<p>K</p>
<p>NatureWorks LLC Product Literature NWF S017-020111, Ingeo Film Surface Treatment, <a href="http://www.natureworkslc.com">http://www.natureworkslc.com</a>  Downloaded January 17, 2013</p>	<p>L</p>
<p>Scheirs, J., <i>Modern Fluoropolymers</i> 165 (John Wiley &amp; Sons 1997)</p>	<p>M</p>
<p><i>Determining Critical Surface Tension of Solid Substrates</i>,  SpecialChem, January 24, 2007,  <a href="http://www.specialchem4adhesives.com/home/editorial.aspx?id=1785">http://www.specialchem4adhesives.com/home/editorial.aspx?id=1785</a>  Downloaded January 30, 2013</p>	<p>N</p>

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**Qualifications Summary**

Accomplished technologist with an outstanding record of achievement in chemical Research and Development. Strength areas include new product development. Drive profitability through utilization of well-honed creativity, innovation, and project management skills. Possess in-depth knowledge of the sciences, along with excellent business acumen. Particular expertise in:

- fluoropolymers
- organic/inorganic coatings
- corrosion
- polymers & nanocomposites
- expert witness
- materials/polymer science
- general chemistry
- electrochemistry
- plastics
- pretreatments

Demonstrated ability to build a cohesive team of highly motivated technical personnel to achieve organizational, technical, and business unit goals. Technically adaptable, self-starting, innovative professional with excellent communication, interpersonal, and organizational abilities.

**Professional Experience**

**NEI CORPORATION**, Somerset, NJ (part-time) 2009 - Present

**Vice President, Coating Technologies**

Responsible for new product development of novel polymers and coatings based on nano-materials.

**RAI TECHNICAL SOLUTIONS®, INC.**, West Chester, PA 2006 – Present

Founder and CEO of my own consulting business specializing in corrosion, coatings, polymers, and nanocomposites.

**PENN STATE UNIVERSITY – GREAT VALLEY CAMPUS**, Malvern, PA 2006 – 2010

Teach graduate level engineering courses in innovation, creativity, and project management, along with an MBA course in New Business Ventures and Entrepreneurship.

**ARKEMA CHEMICALS RESEARCH CENTER**, King of Prussia, PA 1994-2006

**Manager, Plastic Additives Research** (2002-2006)

Responsible for the management of the new product development of novel additives for plastics products (i.e., impact modifiers, process aids, etc. for use in various polymers such as polycarbonate, polyesters, and PVC).

- Managed a group of 8 individuals, including 3 Chemistry or Chemical Engineering PhD's.
- Conceived and led the development of a compatibilizer for wood-PVC composites. Co-inventor on a Patent Application filed in 2005.
- Led the development of Clearstrength® E-950, a new MBS impact modifier commercialized in 2005. Patent Application filed in 2005.
- Led the development of Durastrength® 440, a novel acrylic impact modifier commercialized in 2005. Patent Application filed in 2005.
- Led the effort to improve MBS blocking. This work saved \$8 million per year of business.
- Led the development of Clearstrength® E-922, which was commercialized in 2005.

**Manager, Coatings Research, Technical Polymers (1994 – 2002)**

Responsible for the new product development and technical service of polyamide and fluoropolymer coatings.

- Managed a group of 12 individuals, including seven Chemistry or Chemical Engineering PhD's.
- Led the development of Aquatec® (Acrylic Modified Fluoropolymer), which is currently commercial.
- Led the development of Primgreen®2, a non-toxic primer for polyamide powder coatings.
- Led the technical activity to qualify the use of polyamide powder coatings for dishwasher baskets.
- Authored a chapter in the book *Modern Fluoropolymers*, published several technical papers in respected journals, and presented numerous papers at various technical conferences (see attached list of publications).

**BETZ LABORATORIES RESEARCH CENTER, Trevese, PA** 1989 – 1994  
**Section Head**

Directed the new product & process development, and technical service of cleaner and pretreatment chemicals for metals and plastics. Managed 15 individuals.

**CAMPBELL SOUP COMPANY, Camden, NJ** 1985 – 1989  
**Director, Packaging Technology**

Managed a staff of 18. Responsible for the development of new metal & plastic food packages, organic coatings for metal containers, technical service, and container specifications. Additional "dotted line" responsibility for seven manufacturing plants, which produced 5 billion cans per year.

**BETHLEHEM STEEL CORPORATION, Bethlehem, PA** 1974 - 1985  
**Supervisor, Coatings Research**

Managed scientists in new product & process development, and customer applications of inorganic and organic coatings on steel.

**REPUBLIC STEEL CORPORATION, Cleveland, OH** 1965 - 1974  
**Research Engineer, Coatings**

New product development of metal coatings on steel.

**Education**

- **Ph. D., Materials Science** - Lehigh University, Bethlehem, PA
- **M. S., Physics** - Kent State University, Kent, OH
- **Seven M.B.A. courses** - Kent State University, Kent, OH
- **B.S., Chemical Engineering** - Widener University, Chester, PA

### Awards

- *Packaging Institute International* Annual Educational Award – best paper.
- *National Association of Corrosion Engineers* Romanoff Award – best paper published in *Corrosion Journal*.
- Chosen to participate in the *Industrial Research Institute* Visiting Scientist Program.
- *National Coil Coating Association* Technical Section Certificate of Appreciation.

### Associations

- American Chemical Society
- American Coatings Association
- Federated Societies of Coatings Technology
- National Coil Coating Association – Board of Directors (past)
- American Society for Materials (past)
- Delaware Valley Volunteers of America – Board of Directors (past)

### Patents

Patent Application #11/827,710 “Self Healing Polymer Nanocomposite Coatings for use on Surfaces Made of Wood” – filed August 16, 2011

WO/2007/050324 - Patent pending - Compatibilizers for PVC-Wood Composites

U.S. Pat. #3,559,662 - Method and Valve Apparatus for Metering Flow of Liquid Metal

U.S. Pat. #4,470,897 - Electroplated Product and Method

U.S. Pat. #5,562,833 - Dual Feed Paint Detackification Program

U.S. Pat. #5,614,103 -Methods for Detackifying Paint Spray Booth Water

U.S. Pat. #5,354,494 - Reactive Silane Composition and Process for Enhanced Drainage of Residual Aqueous Rinse on the External Surfaces of Plastic Parts

U.S.Pat. #5,719,224 – Compositions and Methods for Detackifying Paint Spray Booth Water

Several foreign patents also granted on these U.S. patents.

### Publications and Presentations

Corrosion Mechanisms of Painted Metal, presented at the PSCT Symposium, September 20, 2012.

Corrosion-Resistant Nanocomposite Coating for Metal Structures, *Paint & Coatings Industries*, September 2012, pp. 40 – 43.

Enhancing the Energy Efficiency of Condensers, presented at the 2012 Navy Opportunity Forum, June 6, 2012.

High Performance Fluoroelastomers, presented at the 2012 Navy Opportunity Forum, June 5, 2012.

Novel Nanocomposite Self-Healing Coatings, presented at the 2012 Navy Opportunity Forum, June 4, 2012.

Novel Nanocomposite Self-Healing Coatings – A Systems Approach, presented at the Metropolitan New York City Coating Society Symposium, March 22, 2012.

Corrosion Resistant Nanocomposite Coating for Marine Structures, presented at the Society of Naval & Marine Engineers Annual Conference, November 18, 2011.

For Protection and Repair, *Furniture Design & Manufacturing Asia*, Nov/Dec 2011, pp. 16-19.

Corrosion Mechanisms of Painted Metal, presented at the DoD Corrosion 2011 Conference, August 1, 2011, and published in the Conference Proceedings.

Novel Self-Healing Nanocomposite Coatings, presented at the DoD Corrosion 2011 Conference, August 2, 2011, and published in the Conference Proceedings.

Novel Self-Healing Nanocomposite Coatings, presented at Smart Coatings 2011 Conference, February 25, 2011.

Novel Self-Healing Nanocomposite Coatings for Wood Substrates, presented at the Wood Coatings and Substrates Conference, September 10, 2010.

Corrosion Resistant Nanocomposite Coatings, presented at the Navy Opportunity Forum, June 8, 2010.

Crystallinity of Coatings Based on Polyvinylidene Fluoride, *Paint and Coatings Industries*, Oct. 2008, pp. 62-68.

Recent Advances in Wood – Polymer Composites, *Additives 2006*, January 2006.

Fundamentals of Corrosion and Their Application to Coil-Coated Metal, *National Coil Coatings Association Technical Manual*, 2002.

Acrylic-Fluoropolymer Mixtures and Their Use in Coatings, *Progress in Organic Coatings*, December 2000, pp 55-61; presented at the 6th Biennial North American Research Conference on the Science and Technology of Organic Coatings, Hilton Head, SC, November 8, 2000; presented at Fluoropolymer 2000, Savannah, GA, October 16, 2000; presented at the 25<sup>th</sup> Annual International Conference on Organic Coatings, Athens, Greece, July 6, 1999.

Corrosion of Painted Aluminum, presented at the Aluminum Extruders Council Management Meeting, September 1998

Creating Coatings for Better Buildings, *Paint and Coatings Industries*, July 1998, pp. 48-60.

Update on Fluoropolymer Coating Technology, panel discussion at the National Coil Coaters Association Annual Meeting, April 1998. Published in NCCA Meeting Proceedings, pp. 49-58; and in *Coil World*, November/December 1998, pp. 22-28.

Novel VF<sub>2</sub>/HFP Copolymers for Exterior Coatings, presented at the European Coil Coaters Association Technical Meeting, November 1997, and published in Conference Proceedings.

Fluoropolymer Coatings for Architectural Applications, chapter published in book *Modern Fluoropolymers*, John Wiley, 1997, pp. 271-299.

PVDF Coatings for Aluminum, presented at Alumitech 97, May 1997.

Corrosion of Painted Metal Buildings, presented at Metalcon, October 1996.

Corrosion of Coil Coated Metal, presented at the National Coil Coaters Association Fall Meeting, and published in NCCA Conference Proceedings, October 1996.

No Rinse Chromium Pretreatment for Aerospace Applications, presented at the 7<sup>th</sup> Annual Aerospace Hazardous Material Conference, October 1992, and Aeromet Conference, June 1993.

No Rinse Chromium Pretreatment for Aluminum Extrusions, presented at SME Finishing '91 Conference, September 1991.

Packaging Strategy - Two Piece Can Making, presented at the National Metal Decorators Association Annual Meeting, October 1988.

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How Campbell Tests CPET Trays, *Packaging*, April 1987, pp. 102-103.

Innovative Plastic Technologies and Their Application to Food Packaging, presented at the ACS Annual Meeting, April 1987.

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Plastic Packaging Thrusts at Campbell Soup, presented at the Packaging Institute International Annual Meeting, September 1986 (paper won PII Annual Education Award), and the 5<sup>th</sup> International Conference on Packaging, Bristol, England, October 1986.

Critical Process Parameters Affecting Zincrometal Performance, SAE Paper 840209, presented at the 1984 SAE International Congress, and the 1984 ACS Annual Meeting.

The New Prepainted Galvalume Sheet, Proceedings of NCCA Fall Meeting, pp. 2-9, presented September 1983; also published in *Metal Building Review*, May 1984.

Prepainted Galvalume - U.S. Perspective, *Steel Times International*, September 1981, pp. 130-137, presented at the European Coil Coaters Association Annual Meeting, Stockholm, Sweden, April 1981.

Surface Characteristics of Cold-Rolled Steel as they Affect Paint Performance, *Corrosion*, January 1981, pp. 28-38 (paper won Romanoff Award).

Theoretical and Practical Considerations of Sheet Steel Surface Cleanliness, SAE Paper 800149, February 1980.

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ASM Annual Meeting, November 1978  
Society Manufacturing Engineers, October 1978  
Gordon Research Conference on Corrosion, July 1978

How Ford's Work Relates to the Coil Coating Industry, Proceedings of the NCCA Annual Meeting, pp. 18-25, presented May 1978.

Lower Antimony Contents Improve Terne Coatings, *Materials Protection and Performance*, 1978, Vol. 12, pp. 43-46.





# Tedlar®

polyvinyl fluoride film

## Adhesive and Lamination Guide for Tedlar® PVF Film

### General

This guide is intended to assist the manufacturer in the selection of adhesives for laminating *Tedlar®* polyvinyl fluoride (PVF) film to a variety of substrates. Lamination and quality control guidelines are also included for laminating *Tedlar®* PVF film to:

Aluminum	Vinyl fabric
Cellulosic substrates	Thermoplastic sheet
Galvanized steel	Vinyl wall covering

Guidelines are also given for thermoforming *Tedlar®* PVF film and installation in solar collectors.

This information is believed to be the best currently available and is offered for what help it might be in your own experimentation and evaluations. This information will be revised as additional experience and information are developed.

### Film and Adhesive Storage

*Tedlar®* must be used within one year of receipt by the laminator. Protect these materials from temperature and humidity extremes. The film should be kept in cool, dry storage in a kraft wrapper. If adhesives are exposed to temperatures below 4°C (40°F), they must be brought to room temperature, 22°C (70°F), and thoroughly mixed as separate units. Additional mixing is required when blending the compounds.

Adhesives, thinned to a desired viscosity with toluene, can be applied to the film using a variety of coating methods. The coated film is normally passed through an oven where the solvent is evaporated to obtain a nonblocking adhesive coating. Thorough drying is essential as residual solvent may cause blocking in the roll. Drying temperatures of 77–104°C (170–220°F) coordinated with proper film web speed and tension are presently being used with success. Excessive machine direction (MD) film stretching and transverse direction (TD) film shrinkage can result from

improperly controlled oven temperature and film web tension. Adhesive coated film should be used within six months of the coating date.

### Flexible Product Adhesives

Over the last 25 years DuPont has developed a family of adhesives used for laminating *Tedlar®* PVF film to a wide range of substrates. These adhesives are characterized by excellent resistance to moisture and UV radiation.

DuPont flexible product adhesives are versatile acrylic adhesives developed specifically for laminating *Tedlar®* PVF film to a variety of substrates. With these adhesives, high-quality, long-lasting bonds can be achieved to meet demanding quality control specifications of manufacturers.

Acrylic adhesive 68040 is thermoplastic, but can be cured with epoxy resin to give thermoset properties. It has been used to bond *Tedlar®* PVF film to vinyl, aluminum foil, Nomex® aramid fiber, nylon, paper, and wood products. As an extrusion primer, 68040 has been applied to polypropylenes, aluminum foil, and PVDC-coated films—followed by extrusion of polyolefins, such as Surlyn® ionomer resin, EVA polyethylene, and polyethylene.

Resin solution 68065 and acrylic adhesive 68070 have been used to bond *Tedlar®* PVF film to aluminum and galvanized steel in various gauges. 68065 is a dispersion of corrosion-inhibiting pigment and epoxide polymer in toluene. It is formulated to be used in conjunction with 68070 at a ratio of one gallon of 68065 to fifteen gallons of 68070. 68065 is soft settling and the dispersion must be shaken just prior to use.

Acrylic adhesive 68080 is a liquid that can be preapplied to *Tedlar®* PVF film to facilitate lamination of products for interiors, such as vinyl wall coverings, and for exteriors, such as architectural siding, awnings, flexible sign faces, and fabric structures.

## Adhesive Characteristics

DuPont flexible product adhesives have varying degrees of activation temperature, amine reactivity, and hardness. Key characteristics of these adhesives are shown below:

	68080	68040	68070
Composition	Polymethyl methacrylate	Methacrylate copolymer	Methacrylate copolymer
Increasing hardness	<-----<<<<		
Increasing amine reactivity	>>>>----->		
Increasing activation temperature	<-----<<<<		
Lamination temperature	177-204°C (350-400°F)	149-204°C (300-400°F)	135-204°C (275-400°F)

## Solvent Composition

	68080	68040	68070
Toluene, %	45	11	70
Isopropanol, %	55	67	30
Xylene, %	—	22	—

## Product Advantages

These flexible product adhesives have superior durability that resists light and moisture degradation and discoloration. DuPont has accumulated extensive data in accelerated weatherometer testing and outdoor Florida exposure. In some applications the bond is warranted for 25 years. These adhesives are used in a wide variety of substrates and broad range of conditions.

## Product Limitations

These flexible solvent based adhesives have a one year shelf life.

68070 has been observed to interact with some components in a flame-retardant vinyl causing yellowing.

68070/68065 mixtures only have an 8-hour pot life.

68080 is incompatible with 68040 and 68070. Very small amounts of 68040 in 68070 drastically impair adhesion.

Ketone solvents should be avoided in diluting the adhesives as yellow discoloration will result.

**Caution:** In most cases DuPont does not warrant the "lamination." DuPont warrants the film and adhesive separately as advertised in our technical bulletins. The performance of the "system" is the

sole responsibility of the applicator. DuPont will provide consultation and our best information in assisting the customer to achieve satisfactory lamination.

## Other Additives

68065—Corrosion inhibiting, cure-promoting epoxide additive in toluene.

68011—Cure-promoting epoxide additive in carbon black. Dispersion of Shell Epon 828 and carbon black in toluene. This product is custom manufactured and available directly from CDI Dispersions, Inc.

Phenolic accelerator (Dimethyl aminoethyl phenol, formerly DuPont 68060). Available as CMP-10 from Rohm & Haas.

## Safety Precautions

These products are FLAMMABLE AND CONTAIN HARMFUL VAPORS. Keep away from heat, sparks, and open flame. Use only with adequate ventilation. Avoid breathing vapor or spray mist. Avoid contact with eyes and skin. Keep container closed when not in use.

In case of skin contact, flush with plenty of water; for eyes, immediately flush with plenty of water for 15 minutes and get medical attention.

In case of fire, use water spray, foam, dry chemical, or CO<sub>2</sub>. In case of spill, absorb and dispose of in accordance with local regulations.

## Laminate Adhesive Selection Guide

Cellulosic Substrate	68070/CMP-10/Epoxy
Metals	68070/68065
Thermoplastics	
Polycarbonate	68040, 68080
Polystyrene	68040
PMMA	68040
ABS	68080
PVC Film	68070/Epoxy, 68080
Vinyl Siding	68080
Vinyl Wall Covering	68080

## Flexible Adhesive Application

Heat the adhesive to room temperature and mix according to instructions. Dilute with toluene to desired viscosity. Apply adhesive using spray gun, brush, dipping, extrusion, rollers, doctor blade/wire

### Adhesives Useful with *Tedlar*® PVF Film

Type	Manufacturer	Application	Advantage	Limitation
Modified acrylic	68080, 68070, 68040 (DuPont)	General use	Durability experience	Solvent based
Polyester/isocyanate	46960/RC-803 (Whitaker) 56065/RC-803 (Whitaker)	Polyester films		
Epoxy	Most 1- and 2-part epoxies	General use	Room temperature	
Urethane	Most 1- and 2-part urethane	General use	Room temperature	
Silicone RTV	Most 1- and 2-part silicones	Solar, laminate seams	Room temperature UV stable	Expensive
Phenolic	Most phenolic adhesives and embossing resins	Aircraft		
Rubber	Many rubber adhesives Nitrile—1099 (3M) Neoprene—1300, 1357 (3M)	Gasketing		
Acrylic pressure sensitive	Solvent: Gelva 1159, 1753 (Monsanto) Latex: Hycar 2600x-205, 146 (Goodrich)	Solar	Room temperature	
Silicone pressure sensitive	Silgrip SR-6573, 6574 (GE) 280A (Dow Corning)	Solar		

**Note:** Adhesives, especially non-DuPont, must be tested for the specific application. Some epoxies may not bond well to the *Tedlar*® PVF film. Trial laminations should be made to test adhesive suitability. The harder polyester adhesives do not bond well to *Tedlar*® PVF film. Isocyanate curing agents generally enhance adhesion. Some phenolic materials or curing agents may cause staining of the *Tedlar*® PVF film. Silgrip SR-6573 gives a credible bond with untreated *Tedlar*® PVF film.

wound rod, reverse roller coater, roller coater or gravure coating. Lamination can proceed as soon as the adhesive is dry.

Toluene and/or methyl ethyl ketone (for cleanup only) may be used to clean up equipment.

### Laminating *Tedlar*® PVF Film to Aluminum

Lamination is accomplished by cleaning the metal, depositing a controlled conversion coating on the metal, coating the metal with a solvent-based adhesive, evaporating the solvent, heating the metal to 195–205°C (383–401°F) to activate the adhesive, combining with *Tedlar*® PVF film in nip rolls and quenching the laminate.

#### Materials

Film—*Tedlar*® PVF film type TWH15BL3 and colors

Adhesive—DuPont adhesives 68070, 68065

Metal—Aluminum

### Adhesive Mixing and Application

The adhesive is prepared by the following formula:

Adhesive 68070	15 gal
Adhesive 68065	1 gal

Shake the 68065 on a paint shaker for 3 to 5 minutes to disperse the pigment. While stirring the 68070, slowly add the well mixed 68065. Blend the mixture for approximately 5 minutes with a suitable mechanical mixer. Adjust adhesive coater to lay down 37–50 µm (1.5 to 2.0 mil) wet adhesive equivalent to 6–7.5 µm (0.23 to 0.30 mil) of dry adhesive. Adjust viscosity by diluting with toluene.

During normal operation, the rate of solvent evaporation is slight enough to have no effect on the percent solids. If prolonged halts in coating occur, the viscosity must be checked and adjusted with toluene to the original value. Pot life of the mixed adhesive is 24 hours.

The solvent is removed and adhesive activated in an oven of such length that the metal is in the oven from 30 to 90 seconds. The metal temperature must be 195–205°C (383–401°F) at the end of the oven followed by immediate lamination.



## Lamination

The laminating equipment consists of a pair of combining or "nip" rolls that are unaffected by the operating temperature of 175°C (347°F). A nip pressure of 87–175 N/cm (50–100 lb/in) of width must be used. A film wrap of at least 90° on the upper nip roll must be used to prevent wrinkling.

## Quality Control—On Line

### Formability Test

Test the formability of the laminate by pressing a 25 mm (1") diameter steel ball into the metal forming a dimple 6 mm (1/4") high. Make two parallel cuts in the film 2 mm (1/16") apart across the apex of the dimple and attempt to peel the film from the metal. Any peeling of the film greater than one-half the distance from the apex to the bottom of the dimple requires that the coil be placed on "hold."

### Boiling Test

Immerse flat laminates in boiling water for 5 minutes, cool them, and make two parallel cuts 3 mm (1/8") apart in the laminate. Try to peel the wet film from between the two parallel cuts. If more than 3 mm (1/8") film peels from the laminate, place the coil from which the sample is taken on "hold."

If the sample passes the 5-minute boiling water test, make another test after one hour boiling. As before, if more than 3 mm (1/8") film peels from the laminate, place the coil from which the laminate is taken on "hold."

Any coils placed on "hold" should be retested after 24 hours. If the samples pass, the coils may be released. If not, the coils should be rejected.

## Laminating Tedlar® PVF Film to Cellulosic Substrates

Laminating Tedlar® PVF film to boards requires removing all dust, dirt, and loose material from the board, applying adhesive, evaporating the solvent from the adhesive, heating the adhesive to the required temperature, and laminating the board and Tedlar® PVF film with nip rolls.

### Board Preparation

Remove loose material on the board surface prior to lamination. A revolving brush with vacuum, or an air knife, is suitable. Board edges to be wrapped with film must be smooth and free from nicks and loose particles.

## Adhesive Mixing and Application

The components of the adhesives are to be mixed thoroughly in the following proportions:

DuPont No.	Parts by Volume	Parts by Weight
68070	7 (7 gal)	20
68011	1 (1 gal)	3.1
CMP-10	0.016 (2 fl oz)	0.05

Shake component 68011 for at least 5 minutes on a paint shaker before mixing it with the other components.

On the average, this mix weighs 7.7 lb/gal and contains 36% solids by weight and 30% by volume. The mixed adhesive should have a pot life of at least 12 hours. Dilute and maintain an optimum application viscosity with nitration grade toluene (1°F cut).

Care must be taken that mixing, measuring, and coating equipment are cleaned of all possible contaminants to avoid "poisoning" of the adhesive.

The adhesive may be applied by roll coating or spraying. Exact adhesive thickness will depend on porosity of the board being used. (See Approximate Adhesive Requirements on page 5.)

Method A: Simultaneous application of adhesive to both board and film.

Method B: Application of adhesive to board only.

When the board is to be edge wrapped, either Method A or B may be used to apply adhesive to the edges of the board. If B is used, adhesive must also be applied to the back of the board.

After application of the adhesive, the solvent must be evaporated in an air oven or ovens.

### Heating the Adhesive

After applying the adhesive and evaporating the solvent, heat the board so that it reaches 68–85°C (155–185°F) at the moment of lamination. Take precautions so that the adhesive on the board is not overheated. Heating may be accomplished by the same oven used for solvent removal or additional heaters may be used between the oven and nip roll station.

Infrared heaters will heat the adhesive on the board more rapidly than forced hot air and not add as much heat to the hardboard.

Heating elements should be positioned so the last element is as close to the nip station as possible. Overheating followed by subsequent cooling before the adhesive coated board enters the nip rolls should be avoided.

### Lamination

Combine the adhesive coated board and the film (or coated film) in the nip rolls. Depending upon the laminating speed, it is essential that the temperature of the top nip roll be between 93–149°C (200–300°F).

The top nip roll should be made of rubber unaffected by temperatures of 149°C (300°F). Sufficient contact for a bonding is produced by a nip force of 30 to 60 lb/in.

To determine whether there is sufficient and uniform contact, place a 51 mm (2") cellophane tape lightly on a stationary board and lower the nip rolls. A 19–25 mm (3/4–1") uniform flat impression should be left on the tape across the width of the roll.

Flatten the film as it is unwound from the roll by uniformly applying heat across the film while using a small amount of tension. Reduce brake pressure as the film roll diameter decreases to maintain uniform tension. Film temperature should not exceed 121°C (250°F). The film entering the nip rolls should be under as low a tension as possible (the tension needed for flattening should be isolated). A film wrap of 90° around the nip is required.

If the laminate is edge wrapped, it is essential that the temperature of the adhesive on the edges and back of the board be maintained at 68–85°C (155–185°F). The rolls that nip the film to the edges and back of the board should be heated to 91–110°C (195–230°F).

Upon leaving the laminator and edge-wrapper, the laminate will have sufficient bond to allow normal handling in end-sealing and packaging operations.

### Quality Control

#### Initial Peel Test

On-line quality control is based on appearance and initial peel on laminate. Test initial peels as soon as the laminate is made. A sample should be checked every 2 hours.

Determine initial peel by cutting a 13 mm (1/2") strip, 203–254 mm (8–10") long, across the surface of laminate and attempt to peel the strip by pulling it perpendicular to the board.

If the film peels, the plane of failure should occur in the hardboard or adhesive. Reject laminates if the plane of failure occurs between the film and adhesive.

### Water Soak Test

Prior to shipment, samples should be tested before and after immersion in room temperature water for 24 hours. These tests may be started after the laminates have cured 2 days at 24°C (75°F) or 4 hours at 60°C (140°F).

Prepare 51 mm × 102 mm (2" × 4") samples for testing by making several parallel slits 3 mm (1/8") apart in the 51 mm (2") direction of each sample. Check the bond by attempting to peel a 13 mm (1/2") strip of film by first prying it up and then pulling it perpendicular to the board.

The laminates should peel film less than 3 mm (1/8"). Laminates may peel greater than 3 mm (1/8") if the plane of failure is in the substrate.

### Approximate Adhesive Requirements

	Thickness of Adhesive
Sealed Hardboards	30.5–40.6 dry μm (1.2–1.6 dry mil)
Unsealed Hardboards	40.6–55.9 dry μm (1.6–2.2 dry mil)

### Laminating Tedlar® PVF Film to Galvanized Steel

Lamination is accomplished by cleaning the metal, depositing a controlled conversion coating on the metal, coating the metal with a solvent-based adhesive, evaporating the solvent, heating the metal to activate the adhesive, combining with Tedlar® PVF film in nip rolls and quenching the laminate.

### Materials

Film—Tedlar® PVF film type TWH15BL3 and colors.

Adhesive—DuPont adhesives 68070, 68065.

Metal—Hot dipped galvanized steel, generally G-90, is used. The steel must have good forming quality and preferably minimum spangle, temper rolled, lock forming quality or extra smooth spangle.

The metal being used must have a light oil (Tectyle 447—Ashland Oil Company or equivalent) applied at the mill after galvanizing and must not be chemically treated or stabilized. The metal must be free of white rust to enable proper surface treatment and adhesion. Prior to lamination the metal being used must have all mill oils removed; note that anything but light mill oils such as T447 may require aggressive removal techniques.

The optimum thickness metal to be laminated is 18 gauge (0.0516").

Laminates on metal, 22 gauge (0.0366") or lighter, may be made on any standard type of galvanized, including commercial quality, regular spangle. Better forming quality is preferred.

Metals heavier than 22 (0.0366") gauge must be minimum spangle or spangle-free surface. Commercial quality, regular spangle steel is not acceptable in gauges heavier than 22 gauge (0.0366"). Care should be taken when laminating metal heavier than 22 gauge (0.0366") and formed to a radius of less than 3 mm (1/8") to prevent splitting.

### **Adhesive Mixing and Application**

The adhesive is prepared by the following formula:

Adhesive 68070	15 gal
Adhesive 68065	1 gal

Shake the 68065 on a paint shaker for 3 to 5 minutes to disperse the pigment. While stirring the 68070, slowly add the well-mixed 68065. Blend the mixture for approximately 5 minutes with a suitable mechanical mixer. Adjust the coater to lay down 37–50  $\mu\text{m}$  (1.5–2.0 mil) wet adhesive equivalent to 6–7.5  $\mu\text{m}$  (0.23–0.30 mil) of dry adhesive.

During normal operation, the rate of solvent evaporation is slight enough to have no effect on the percent solids. If prolonged halts in coating occur, the viscosity must be checked and adjusted with toluene to the original value. The pot life of the mixed adhesive is 24 hours.

The solvent is removed and adhesive melted in an oven of such length that the metal is in the oven from 30 to 90 seconds. The metal temperature must be 195–205°C (383–401°F) at the end of the oven followed by immediate lamination.

### **Lamination**

The lamination equipment consists of a pair of combining or "nip" rolls that are unaffected by the operating temperature of 175°C (347°F). A nip pressure of 10–20 kg/cm (50–100 lb/in) of width must be used. A film wrap of at least 90° on the upper nip roll must be used to prevent wrinkling.

### **Quality Control—On Line Formability**

To test the formability of the laminate, a 25 mm (1") diameter steel ball is pressed into the metal forming a dimple 6 mm (1/4") high. Two parallel cuts are made in the film 2 mm (1/16") apart across the apex of the dimple and an attempt made to peel the film from the metal. Any peeling of the film greater than one-half the distance from the apex to the bottom of the dimple shall require that the coil be placed on "hold."

### **Boiling Test**

The boiling test consists of bending laminates 90° around a 3.18 mm (0.125") mandrel. Bends are made with the *Tedlar*<sup>®</sup> PVF film both inside and outside. Test after 5 minutes boiling by cutting the *Tedlar*<sup>®</sup> PVF film and adhesive in the center of the bend parallel to the crest or valley and peeling parallel to the cut. Measure the width of the perpendicular peel.

If more than 3 mm (1/8") film peels from the laminate, the coil from which the sample is taken must be placed on "hold." If the sample passes the 5-minute boiling water test, test again after one hour boiling. As before, if more than 3 mm (1/8") film peels from the laminate, the coil from which the laminate is taken must be placed on "hold."

Any coils placed on "hold" shall be retested after 24 hours. If the samples pass, the coils may be released. If not, the coils should be rejected.

### **Slitting of Laminate**

High speed slitting of the galvanized laminate must be done with the knives positioned so that the ones in contact with *Tedlar*<sup>®</sup> PVF film are on the section of laminate that is to be retained.

### **Laminating *Tedlar*<sup>®</sup> PVF Film to PVC for Outdoor Applications**

Since there are many formulations of PVC, optimum laminating conditions may vary with the PVC formulation. The following is given as a suggested starting point for lamination studies and has given good results with a number of PVC films.

### **Materials**

For transparent *Tedlar*<sup>®</sup> PVF film/PVC laminates for outdoor use, the *Tedlar*<sup>®</sup> PVF film overlay should be UV screening, usually TUT10BG3, with adhesive 68070/Epon 828 in a ratio of about 30/1 by volume (24/1 by weight). This is somewhat lighter in epoxy than normal usage of this adhesive combination, but it appears to be the best place to start in balancing the possible light discoloration



tendency of epoxy against the added resistance to moisture, which it gives the bond.

For opaque laminates, pigmented *Tedlar*<sup>®</sup> PVF film, such as TWH15BL3 white film, can be used. Under the pigmented films, a higher proportion of epoxy can be used, and a 68070/Epon 828 ratio of 18/1 by volume (14/1 by weight) can be used.

### Adhesive Application

Apply 7.5–12.7  $\mu\text{m}$  (0.3 to 0.5 mil) (measured on dry resin) of adhesive to the *Tedlar*<sup>®</sup> PVF film or PVC. Dry the adhesive at 66–71°C (150–160°F), film temperature. After drying, the adhesive will appear practically dry to touch and only slightly tacky. If the PVC is coated, note that the adhesive solvent contains toluene, which attacks vinyl, but under the above conditions it will probably be flashed off so fast that this will not cause trouble. Note also that ketones should not be used for dilution as they can cause yellowing of the 68070 adhesive.

### Lamination

Combine the *Tedlar*<sup>®</sup> PVF film and PVC in a nip roll, with a glue line temperature of at least 79°C (175°F) but preferably not over 121°C (250°F). Some people have accomplished such laminations with roll temperatures of about 121°C (250°F).

Satisfactory laminations will give strong initial bonds, but these should be tested slightly warm. When cold they may be “zippy” initially but should cure within 4 to 24 hours to eliminate this defect.

## Laminating *Tedlar*<sup>®</sup> PVF Film to Thermoplastic Sheet

### Materials

Film	Any <i>Tedlar</i> <sup>®</sup> PVF Film
Adhesive	DuPont 68040, 68070, or 68080
Plastic	Polystyrene, Polymethacrylate, Polycarbonate, Acrylonitrile-butadiene-styrene (ABS)

### Adhesive Application

Adhesive	% Solids	ft <sup>2</sup> /mil/gal	Recommended Thickness
68040	25	300	6–7.5 dry $\mu\text{m}$ (0.2–0.3 dry mil)
68070	34	460	6–7.5 dry $\mu\text{m}$ (0.2–0.3 dry mil)
68080	30	370	6–7.5 dry $\mu\text{m}$ (0.2–0.3 dry mil)

Apply the adhesive, thinned with toluene to a desired viscosity, to the film using adhesive coating equipment. Pass the coated film through an oven evaporating the solvent obtaining a nonblocking adhesive coating. Thorough drying is essential as residual solvent may cause blocking in the roll. Drying temperatures of 77–104°C (170–220°F) coordinated with proper film web speed and tension are presently being used with success. Excessive MD film stretching and TD film shrinkage can result from improperly controlled oven temperature and film web tension.

### Lamination

Laminating adhesive-coated *Tedlar*<sup>®</sup> PVF film to thermoplastic sheet is easily accomplished at the extruder. The operation consists of combining the film with the hot sheet at the first nip of the take-off stack. Stock temperatures of 149°C (300°F) or higher are necessary to heat activate the adhesive and adequately bond the film. The unwind roll of *Tedlar*<sup>®</sup> PVF film should be positioned so that the film wraps the top roll 30° or more and tension across the sheet is uniform. Press Operations: 1-1/2 minutes, 135–149°C (275–300°F), 100–150 psi; cool to 38°C (100°F) before removing from press.

### Quality Control

#### Peel Test

Test samples for adhesion by making two parallel cuts in the film 3 mm (1/8”) apart. Using a razor knife, attempts to pry or peel the film from the substrate between these parallel cuts. A satisfactory bond will exhibit no peel when tested in this manner. The usual cause of poor adhesion is a lack of heat and/or pressure during lamination.

## Laminating *Tedlar*<sup>®</sup> PVF Film to Vinyl Wall Covering

Wall covering having excellent stain resistance and cleanability is possible with *Tedlar*<sup>®</sup> SP PVF film. Lamination is accomplished by combining adhesive-coated *Tedlar*<sup>®</sup> SP PVF film with preheated vinyl in heated nip rolls. The finished product is recommended for interior applications only.

### Film Types

*Tedlar*<sup>®</sup> type TTRWCAM9, TTR5JAM9, or TTR10AM9 coated with 6–7.5  $\mu\text{m}$  (0.2–0.3 mil) dry 68080 acrylic adhesive from DuPont.

### **Vinyl Wall Covering**

As described in Federal Specification CCC-W-408D and CFFA-W-101A furnished in various weights, textures, and designs. Plasticizer content should not exceed 50 parts per 100 parts of resin.

### **Laminating**

Laminating adhesive-coated *Tedlar*<sup>®</sup> PVF film to vinyl has been successfully demonstrated on various types of equipment familiar to the wall covering industry. The operation consists of combining the film with the vinyl in hot nip rolls, heating the composite to 149–177°C (300–350°F) and embossing. The unwind roll of *Tedlar* PVF film should be positioned so that the film wraps the top nip roll at least 90° and tension across the sheet is uniform.

### **Quality Control**

Vinyl-based wall coverings clad with *Tedlar*<sup>®</sup> SP PVF film should be evaluated using the following tests.

#### **Water Soak Test**

Soak samples from the beginning and end of each laminating run in 50°C (122°F) water for 24 hours. Test laminates by making two parallel cuts in the film 3 mm (1/8") apart. Using a razor knife, attempt to pry or peel the film from the vinyl between these parallel cuts. A satisfactory bond will exhibit no peel when tested in this manner. The usual cause of poor adhesion is a lack of heat during lamination.

#### **Shrinkage Test**

Laminate shrinkage should conform with CFFA Specification W-101-A. Soak three 254 mm × 254 mm (10" × 10") specimens in distilled water at room temperature 30 minutes and dry in a circulating air oven at 93°C (200°F) for 30 minutes. Condition the specimens as described in ASTM D-751 for 8 hours prior to remeasuring. Calculate percent shrinkage using the original and final dimensions. Maximum shrinkage in machine direction is 2% and 1% in the transverse direction.

#### **Film Integrity Test**

Soak samples in a solvent such as acetone until the *Tedlar*<sup>®</sup> SP PVF film can be separated from the vinyl. Check the free film under a microscope for damage that can result from severe embossing. Good quality laminates will exhibit no film splitting or "pinholing" when examined in this manner.

### **Thermoforming *Tedlar*<sup>®</sup> PVF Film**

*Tedlar*<sup>®</sup> PVF film is readily thermoformed if conditions are adjusted to suit its characteristics. Some of the important points are summarized below.

#### **Type of Forming Machine**

The narrow forming temperature range and the low heat capacity of thin films make it necessary for the heat source to be brought over the work; that is, a skin packaging setup.

#### **Clamping**

At the forming temperature, *Tedlar*<sup>®</sup> PVF film becomes taut and exerts considerable pull on the clamping device. It is necessary to have a clamp that can restrain the relatively thin film without slippage.

#### **Heat Input**

Best results are achieved with rapid rate of heating with the film reaching forming temperatures in less than 15 seconds. In the case of printed laminates, minimum heat-up time is important to reduce the possibility of ink discoloration.

#### **Forming Temperature**

The best indication of readiness for forming is the appearance of the film. During the heat-up period, the film first sags due to thermal expansion, then pulls up into loose wrinkles due to unbalanced shrinkage. As the temperature increases further, the wrinkles suddenly smooth out. At this instant, the film has entered the forming range. Paper thermometer measurements indicate around 193°C (380°F) on the lower surface. Drape should take place within 1–2 seconds of "smooth out."

#### **Sequence**

Timing of vacuum application after drape is critical for the production of well-detailed pieces. Vacuum must be applied at the earliest instant before the thin film can cool below the forming range.

#### **Handling**

Care should be taken that the surface of the film is not scratched or abraded in handling as this could lead to splitting during forming.



## Solar Collector Assembly with Tedlar® PVF Film

Several methods of assembly have been used for solar collector covers glazed with *Tedlar*® PVF film. Presently we prefer attaching the film to a frame with adhesives and subsequently heating the assembly slightly to shrink the film, pulling it taut.

### Adhesives and Mounting

#### Epoxy

Two-component epoxy adhesives give strong durable bonds and are readily available. In paste form, these should be satisfactory for initial experimental work, but might present difficulties in handling for production. Liquid epoxies are available but have not been studied extensively because of low initial tack.

A liquid, modified epoxy formulation having reasonable green tack has been used in our laboratory with satisfactory results. The formulation is:

Parts by Weight	
DuPont Adhesive 68070	10
Shell Epon 828	2

Apply the adhesive to one side of the frame in a uniform thickness of about 76.2–127  $\mu\text{m}$  (3–5 mil) wet and air dry for 15–30 minutes to remove solvent. Gentle heat can shorten drying time. Turn the frame adhesive side down and press on a slightly oversized sheet of film that has been spread on a table, adhering the film to the frame. Turn the frame film side up and roll the bond to ensure good contact. Insufficient adhesive tack suggests that the adhesive layer is too thin or has been dried too long. After standing overnight at room temperature, the adhesive cures sufficiently to permit shrinking the film at temperatures up to 163°C (325°F). The appearance of bubbles under the film after shrinking suggests insufficient drying of the adhesive.

#### Acrylic

Some liquid acrylic adhesives, such as Monsanto's Gelva RA-1753, are also easy to use. It gives a pressure-sensitive mass, which has sufficient creep resistance to permit the film to be shrunk at temperatures as high as 163°C (325°F). The taut film will support considerable weight with no apparent

creep of the adhesive. However, there have been indications of creep on exposure in several of a group of collector covers; this may have been due to insufficient removal of solvent. It is suggested that anyone evaluating liquid acrylic adhesives watch for this possible problem.

#### Silicone

Silicone adhesives generally give good bonds with *Tedlar*® PVF film, are durable, and have been used with *Tedlar*® PVF film for other uses. They are being used in solar collectors, but our experience with them in this application is limited.

#### Film and Shrinkage

*Tedlar*® PVF film types TSE30BG2 and TUT20BG3 can be used directly with a variety of adhesives for glazing applications. All adhesive should be shielded from direct exposure to the sun when the collector is in use.

After the film is attached to the glazing frame, shrink it slightly, pulling it taut for appearance and preventing wind flutter, noise, and film fatigue. Exact shrinkage conditions should be checked as they will depend to some extent on how the film has been mounted.

When *Tedlar*® PVF film is heated, two opposite effects take place: the film shrinks and simultaneously undergoes thermal expansion. (The coefficient of thermal expansion of *Tedlar*® PVF film is roughly twice that of aluminum.) Because of the thermal expansion, the shrinkage may not be apparent until the collector cover is cooled. However, as the film cools and contracts thermally, the shrinkage that has occurred will be obvious. Excessive shrinkage can warp light frames during cooling because of the film's strength. On repeated heating cycles, no further shrinkage will occur unless the film temperature exceeds that reached in a previous heating cycle.

Film on frames can be shrunk by heating in an oven at 135–163°C (275–325°F). Shrink tunnels have also been used, and heating by hot air may be preferred to radiation because of the film's transparency. Reasonably taut spans of a single glazing have been shrunk satisfactorily on the collector by exposing it under stagnant conditions for a few hours.

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Declaration of Robert A. Iezzi, Ph.D.  
APPENDIX B-10

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