Glazed impervious sheet assembly and method of glazing

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Field of Search 52/309, 397, 398, 400, 52/741, 746; 156/107

References Cited
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3,294,739 12/1966 Weyenberg...... 260/46.5 G
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Glazed, weathertight assemblies particularly adapted for use as closures, e.g., windows, in wall openings comprise an exterior stop, L-shaped in cross-section, framing the opening, a ridge of pressure sensitive resilient tape framing the exterior stop, a toe bead of silicone rubber around the outer periphery of the ridge of tape, an impervious sheet member in weathertight engagement against the tape and the toe bead of silicone rubber and an interior stop having a resilient surface biased against the impervious sheet member, framing the exterior stop and the impervious sheet member and secured to the exterior stop. Also disclosed is a method for the glazing of outside walls from the inside only, in which such a weathertight assembly is produced.

11 Claims, 9 Drawing Figures
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GLAZED IMPERVIOUS SHEET ASSEMBLY AND METHOD OF GLAZING

The present invention relates to glazed, weathertight impervious sheet assemblies, comprising windows, opaque sheets, such as spandrel glass or metal or plastic panels which, depending on the material, function to admit light and/or to provide resistance to the passage therethrough of moisture, air, gases, and selective resistance to some forms of radiant energy, and the like. Also contemplated are methods for the installation of such sheets into outside walls from the inside only.

BACKGROUND OF THE INVENTION

Most conventional methods of glazing openings in outside walls in low, medium and high rise construction contemplate the installation of the impervious sheet members, e.g., glass, plastic, glazing panels, etc., from the outside into the framed opening. This necessitates, especially in high rise construction, expensive staging. Even if the glazing is accomplished by fitting the sheet member from the inside, to insure weathertightness, it has usually been necessary to install a final cap bead from the outside, which, with high rise construction, also requires staging. Such beads are also exposed to the weather and temperature changes which accelerate deterioration.

The present invention provides improved weathertight assemblies in which the sheet members comprise glass, plastic, metal, etc., without the need for an externally applied seal. The present invention also provides a method of glazing in which such assemblies are produced entirely from the interior side of the wall. The method uses a toe bead of sealant which is not exposed to the weather. Moreover, an integral compression gasket on the inner stop eliminates the need to install a full perimeter shim, as in some glazing methods. Non-light admitting sheet members or panels can also be glazed.

As will be seen from the data hereinafter, weathertightness of the assemblies according to this invention is evidenced by compliance with the NAAMM standards for water penetration under load at 30 pounds per square foot. Other advantages will be seen after consideration of the following detailed description.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIGS. 1 and 2 are perspective views, the former exploded, of a weathertight assembly of the present invention, the latter showing its supporting structure in phantom;

FIGS. 3 - 6 are fragmentary perspective end views, illustrating the steps used in glazing an opening in a wall from the inside, according to the present invention;

FIG. 7 is a cross-sectional view of a seal assembly to be described, using a laminated glass (or an insulating glass, glass plastic laminate, etc.), light admitting member and a compression gasket as part of the interior stop;

FIG. 8 is a modification of a seal assembly as shown in FIG. 7 which includes an interior sealant bead; and

FIG. 9 is a cross-sectional view of a seal assembly to be described, using a plastic light admitting means and a spline or compression gasket as part of the interior stop.

DESCRIPTION OF THE INVENTION

In accordance with the present invention, there is provided a glazed weathertight impervious sheet assembly for a wall opening comprising:

i. an exterior stop adapted to engage the marginal edges about an opening in an outside wall, the stop being L-shaped in cross-section, the vertical leg of the stop extending into the opening and the horizontal leg of the exterior stop extending from the wall toward the inside;

ii. a continuous ridge of resilient pressure sensitive tape affixed to the inside face of the vertical leg of the interior stop adjacent to the inner periphery of the exterior stop, the inwardly presented face of the tape being adapted to receive an impervious sheet member;

iii. a toe bead of silicone rubber composition around the outer periphery of the ridge of the resilient tape, the bead bridging the tape edge and the inside face of the vertical leg of the exterior stop;

iv. an impervious sheet member in full weathertight engagement around its outwardly presented edge with the inwardly presented face of the ridge of resilient tape and the toe bead of the silicone composition; and

v. an interior stop framing the exterior stop and the impervious sheet member, the interior stop being affixed to the exterior stop and having a resilient surface biased against the impervious sheet member so as to prevent inward displacement of the member from the opening.

The assemblies of this invention permit the "wet" seal to be placed closer to the weather as a toe bead, providing a greater degree of weathertightness than possible with a heel bead. The toe bead eliminates any possibility of water entering the glazing channel and pooling in front of the impervious sheet. Resilient tapes and silicone rubber beads as used herein are not temperature sensitive, and there is no need to delay construction while waiting for the materials to become fluid and resilient enough for glazing. Moreover, the assembly operation may be carried out with little fear of breakage as may be the case with sealants which harden as the temperature decreases, e.g., acrylic, vinyl acrylic or polysulfide, and the like.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, FIGS. 1 and 2 show and assemble for installation in outside wall 2, having outer surface 4 and inner surface 6. Exterior stop 8 is substantially L-shaped in cross-section, vertical leg 10 of the stop extending into the opening and horizontal leg 12 extending from wall 2 toward the inside. Resilient tape 14 is in the form of a compressed continuous ridge affixed to the inside face of vertical leg 10. Toe bead 16 of silicone rubber is disposed at the outer periphery of resilient tape 14 and bridges the tape and vertical leg 10 of exterior stop 8. Impervious sheet member 18, of glass or plastic (metal or the like can also be used) is in weathertight engagement with tape ridge 14 and toe bead 16. Interior stop 20 is fixed to horizontal leg 12 of exterior stop 8 by being engaged in detents or by being affixed with screws (not shown) and it has an integral formed-to-fit resilient face comprising, for example, compression gasket 22, which bears against impervious sheet member 18 and holds it in position, e.g., during and after cure. Tape 14 and sealant 16 are compressed to about 25-75%, preferably 25-50%, of the tape thickness with spacers or shims, as necessary.
The following description of the glazing method of this invention can be best understood by referring to FIGS. 3 through 5, inclusive, which show the stepwise installation of glass or a similar impervious sheet material into an exterior stop framing an opening. The exterior stop 8 and sheet 18 should be inspected to determine that they meet conventional construction requirements for proper and uniform face and edge clearances. The framed opening should be square and plumb. It is desirable to seal any miter and butt joints with a silicone rubber sealant prior to beginning the installation steps. All weeps, or drain holes, should be located and noted to prevent plugging or inadvertent sealing during glazing.

All glass, metal and plastic surfaces to which the tape and sealants are to be applied should be cleaned, with methyl ethyl ketone solvent on glass and metal surfaces; and isopropyl alcohol or naphtha on plastic surfaces.

Continuous ridge 14 of resilient tape is formed by applying pressure-sensitive tape from a roll against the horizontal head and sill parts of exterior stop 8. The tape should not be pre-cut into strips, and flexible sheet backing 15 should not be stripped before installation as this may cause stretching of the tape. The tape should be aligned evenly at the sight line. Then tape is affixed to the vertical portions of exterior stop 8, butting the tape ends against the head and sill portions of the tape. Release sheet 15 is then removed to expose a clean, impervious sheet member-receiving surface. The corners of the tape should not be lapped as this can create voids. Although the corners can be “turned” by running a continuous strip of tape around the opening, it is preferred not to do so as the tape may be dislodged during the glazing sequence. It is preferred to butt any tape butt joints with a silicone rubber sealant. The width of the tape should be sized to allow a %inch (6.4 mm.) space between the tape and the sheet edge for placement of toe bead 16. In accordance with conventional techniques, place setting blocks on the sill portion of exterior stop 8 at the quarter points from each corner or as desired. Spacers or spacer shims (not shown) should also be installed to allow the tape and sealant to be compressed to 25–75%, preferably 25–50%, of the tape thickness. Then full toe bead 15 of a silicone rubber composition is applied around the perimeter of tape 14, bridging the edge of the tape and the inside surface of exterior stop 8 (FIG. 4).

Impervious sheet member 18 is set on the setting blocks (usually not used if plastic is being glazed), the edges are aligned and the sheet member is firmly driven against tape ridge 14 and toe bead 16. The excess bead of sealant is smoothed and compressed to obtain continuous contact between the members and eliminate sealant voids (FIG. 5).

To complete the installation, interior stop 20 is snapped into the detents on horizontal leg 12 of exterior stop 8. Compression gasket 22 which is keyed into stop 20 bears against impervious sheet member 18 to prevent lateral displacement and to maintain its position (FIG. 6).

The glazing process of this invention is compatible with glass, including laminated glass having a resinous interlayer, such as polyvinyl butyral. FIG. 7 illustrates an assembly adapted for laminated glass sheet 18, the assembly comprising exterior stop 8, tape ridge 14, toe bead 16, interior stop 20 and compression gasket 22. FIG. 8 illustrates another assembly adapted for laminated sheet glass 18, the assembly comprising exterior stop 8, tape ridge 14, toe bead 16, interior stop 20 and compression gasket 22. It also includes optional interior bead 24, which is preferably a silicone sealant composition. Preferred light admitting members are sandwiched of glass with an aromatic polycarbonate resin interlayer, e.g., LEXGUARD, a product of General Electric Company, Pittsfield, Mass.

The glazing process of this invention is compatible with all plastic glazing systems, such as acrylic resin sheets, styrene plastic sheets, aromatic polycarbonate resin sheets, and the like. FIG. 9 shows an assembly adapted for plastic sheet 18, the assembly comprising exterior stop 8, tape ridge 14, which should be at least 1/16 inch thick (after compression), toe bead 16, interior stop 20 and compression gasket 22. Metal sheets as well as other impervious sheets used for glazing purposes can all be used.

The present assemblies are superior to prior art systems because there are no solvents or other volatiles to attack the sealants used to seal insulating sheet members, affect the resinous interlayers in laminated glass, or cause stress crazing in acrylic sheets or polycarbonate sheets. Moreover, even if water should accidentally gain entrance into any glazing channel, because the critical seals are made of silicone rubber, the presence of water will not cause deterioration or failure.

The pressure sensitive tapes used in the present methods and assemblies can be prepared by techniques well known to those skilled in the art.

Typical properties of a useful tape are as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>density, lbs./ft.²</td>
<td>10</td>
<td>ASTM D-1667</td>
</tr>
<tr>
<td>hardness, (Shore 00)</td>
<td>32</td>
<td>ASTM D-2240</td>
</tr>
<tr>
<td>force to compress, 30% psi.</td>
<td>4.9</td>
<td>ASTM D-1667</td>
</tr>
<tr>
<td>compression deflection 30% psi.</td>
<td>2.6</td>
<td>ASTM D-1667</td>
</tr>
<tr>
<td>compression set (% loss from orig. height)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>90° peel adhesion (oz./in. width)</td>
<td>24</td>
<td>PSTC 1-A</td>
</tr>
<tr>
<td>water absorption, % vol.max.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>recommended application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature, °C.</td>
<td>–21 + 71</td>
<td>Excellent</td>
</tr>
<tr>
<td>weathering service temperature, °C.</td>
<td>1-52</td>
<td></td>
</tr>
<tr>
<td>shelf-life</td>
<td>1 year</td>
<td></td>
</tr>
</tbody>
</table>

(2000 hrs. in Atlas XW-WR Carbon Arc) 102 minutes â18 in. from water, 19 inches from arc, 80°F, max storage temperature.
"ASTM" refers to an American Society of Testing Materials Test. "PSTC" is a test method of the Pressure Sensitive Tape Council.

The tapes can be made by casting onto a non-adhesive paper liner a suitable weather- and water-resistant flexible foam of rubber or plastic, such as a plasticized poly (vinyl chloride) foam of 5 to 20 lbs./cubic ft. density, in thickness of about ½ inch or ¾ inch. Then a weather- and water-resistant adhesive comprising a solvent solution of a natural or synthetic rubber or a resin, such as an acrylate resin or a silicone resin, or like is cast onto the foam base. Evaporation of the solvent under conventional conditions deposits a layer about 1–3 mls thick of adhesive on the foam base. Then, the adhesive coated foam-paper composite is rolled and is slit into ribbons, e.g., of ¼ inch or ¾ inch in width, to provide tape in convenient rolls for storage and application. Obviously, other methods can be used to prepare suitable tapes.

A suitable silicone-adhesive tape can be made as follows: a pressure sensitive adhesive is obtained according to the procedure disclosed in U.S. Pat. No. 2,857,356, incorporated herein by reference, by intercondensing at about 140°C. for 1–2 hours a 65% xylene solution of a methylpolysiloxane resin having about 1.12 silicon-bonded methyl groups and chain-terminated with about equal parts of hydroxy and isoproxy groups, and having a viscosity of about 12 centipoises as a 60% solids solution in xylene, with a silanol end-stopped methylpolysiloxane gum having a viscosity of about 1.2 million centipoises and containing a mole ratio of dimethylsiloxys groups to diphenylsiloxys groups of 95:5. The relative amount of resin to gum is about 1:1. The solids content is then adjusted to about 60% solids in xylene, and about 1% by weight, based on solids of benzoyl peroxide catalyst is added. The solution is cast on one of the major faces of a plasticized poly (vinyl chloride) foam ribbon, density 10 lbs./ft.₃, ¾ inch thick × ¾ inch wide and the coated ribbon, backed by a non-adhesive paper liner, is heated at about 140°C. for 10 minutes to evaporate the solvent, and then heated for 2 minutes at 175°C. in a forced draft oven to advance the cure. Such coating is pressure-sensitive and is 1 mil thick. The composite is rolled, then split into tape rolls of suitable widths, e.g., ¼ to ¾ inch.

The silicone rubber sealants used in the present methods and assemblies can be prepared by techniques well known to those skilled in the art.

Typical properties of a useful sealant, after curing for 21 days at 73°F. and 50% relative humidity are as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>hardness, (Shore A)</td>
<td>22</td>
<td>ASTM D-2240</td>
</tr>
<tr>
<td>tensile strength, psi.</td>
<td>175</td>
<td>ASTM D-412</td>
</tr>
<tr>
<td>peel strength, lbs./in.</td>
<td>50</td>
<td>TT-S-001543*</td>
</tr>
</tbody>
</table>

A suitable sealant can be applied from cartridges and is obtained as follows: a base compound is prepared under anhydrous conditions, comprising the following (by weight):

- 25,000 cps. viscosity silanot terminated polymethylsiloxane 100 parts
- dimethylsiloxane treated fumed silica having a surface area of approximately 200 m²/g filter 10 do.
- stearic acid treated calcium carbonate (filter) 125 do.
- 50 cps. methoxy terminated dimethylsiloxane copolymer fluid containing 30 mole % diphenylsiloxane 5 do.
- trimethylsilyl terminated 20 cs. viscosity dimethylsiloxane fluid 20 do.

A catalyst is prepared comprising (by weight):

- methyltrimethoxysilane (cross-linker) 0.5 parts
- 1,3-dioxopropanetitanium-bisethyl acetate (catalyst) 1.8 do.
- 1,3,5-trimethoxysilylpropylisocyanurate (adhesion promoter) 0.75 do.

One hundred parts of the base compound is mixed together with 3.05 parts of the catalyst mixture in the absence of air and atmospheric moisture and then packaged in sealed applicator tubes. Other such compositions are described in Smith and Hamilton, Ser. No. 282,337, filed Aug. 21, 1972, now allowed, and in Weyenberg, U.S. Pat. No. 3,294,739 and 3,334,067, the disclosures of which are incorporated herein by reference.

The water infiltration resistance of a glazed assembly prepared according to this method is measured by testing, as follows:

- A glazing sealant and a ¼ inch × ¼ inch glazing tape are prepared as described above and used to glaze a fixed glass light (¼ inch thick, tempered) in a mill-finish aluminum frame with the glass set from the interior. All surfaces to receive the sealant are cleaned with methyl ethyl ketone. The glazing tape is applied to the fixed stops, flush with the edges, with the corners tightly butted. A full toe bead of silicone glazing sealant is applied to the fixed stop against the glazing tape. The
glass is installed followed by application of the screwed on stops and interior neoprene compression gasket, which compresses the glazing tape about 60%.

The glazed frame is installed in a strong test chamber and subjected to static pressure water tests in accordance with the techniques required by the NAAMM Metal Curtain Wall Manual and by ASTM-E 331-70. The tests utilize a water spray at the rate of 5 gallons per hour per square foot (equal to rain at the rate of 8 inches per hour). The glazed unit is subjected to the static pressures of water indicated, each pressure is maintained for 15 minutes, and the results are as follows:

<table>
<thead>
<tr>
<th>Static Pressure (pounds per sq. ft.)</th>
<th>Equivalent Wind Speed (MPH)*</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>63</td>
<td>no leakage</td>
</tr>
<tr>
<td>20</td>
<td>90</td>
<td>no leakage</td>
</tr>
<tr>
<td>30</td>
<td>110</td>
<td>no leakage</td>
</tr>
</tbody>
</table>

* Per ASTM-E 283-68

The water- and weathertightness of the assembly according to this invention is thus demonstrated. While the preferred embodiments of this invention have been herein illustrated and described, other obvious variations will suggest themselves to those skilled in the art in the light of the above detailed disclosure. The invention in all of its variations is intended to be defined by the appended claims.

1. An assembly as defined in claim 1 wherein the impervious sheet member is a light admitting member.
2. An assembly as defined in claim 3 wherein the light admitting member comprises glass.
3. An assembly as defined in claim 5 wherein the light admitting member comprises laminated glass having a resinous interlayer.
4. An assembly as defined in claim 7 wherein the light admitting member comprises a sandwich of outer layers of glass with an anorganic polycarbonate resin inter-layer.
5. A method for the weathertight installation from the inside of a impervious sheet member into an opening in an outside wall, said method comprising:
   i. providing said opening with a continuous exterior stop, L-shaped in cross-section, the vertical leg of said exterior stop extending into the opening and the horizontal leg of said exterior stop extending from the wall toward the inside;
   ii. framing said exterior stop with a continuous ridge of resilient tape having an inwardly presented impervious sheet member-receiving face by affixing a resilient pressure sensitive tape to the inside face of the vertical leg of said exterior stop adjacent to the inner periphery of said exterior stop, the inwardly presented face of said tape being adapted to receive an impervious sheet member;
   iii. a toe bead of silicone rubber composition around the outer periphery of the ridge of said resilient tape, said bead bridging the tape edge and the inside face of the vertical leg of said exterior stop;
   iv. an impervious sheet member in full weathertight engagement around its outwardly presented edge with the inwardly presented face of the ridge of resilient tape and the toe bead of said silicone composition; and
   v. an interior stop framing the exterior stop and the impervious sheet member, said interior stop being affixed to the exterior stop and having a resilient surface biased against the impervious sheet member so as to prevent inward displacement of said member from said opening and to maintain its position in said opening.
6. A method as defined in claim 8 including the step of applying an interior bead of silicone rubber composition around the inner periphery of the interior stop, said bead bridging the edge of the interior stop and the inside face of the impervious sheet member.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent 3,881,290 Dated May 6, 1975

Inventor(s) George J. Bouchey

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 4, lines 58, 59 (in the table) "in. from" should read -- minutes of --.

Signed and Sealed this thirtyeth Day of September 1975

[SEAL] RUTH C. MASON C. MARSHALL DANN
Attest: Attesting Officer Commissioner of Patents and Trademarks