**ZeroClearance**

**Product Attributes**
- Light weight
- Very effective in limited space
- Easily formed into place
- No additional attachments required
- Low cost tooling
- Late design changes are not difficult
- Reliable processes

**Composite Information**
- High temperature, laminated composites
- Designed with an aggressive, high temperature Pressure Sensitive Adhesive (PSA) for attachment
- Embossed aluminum foil typically faces heat or noise source
- Available in both a glass on non-glass forms
- Available in various thickness’ and weights

**Performance Attributes**
- Thermal Insulation Features
  - Reflectance from Low Emissivity Embossed Foil
  - Low Conductivity through the Core Material
  - Increased Effectiveness vs. Typical Stamping as Product Ages
- Acoustic Insulation Features
  - Transmission Loss via Aluminum Foil and Effective Decoupler
  - Absorption via Combination of Micro-Pierced Aluminum and Small Diameter Fibers in Core Material
  - Sheet Metal Damping via Viscoelastic PSA Film
- Attachment Features
  - PSA allows Permanent Attachment without Mechanical Fasteners
  - Composite and PSA Designed for Exterior Automotive Environment
  - Product Withstands High Heat, Moisture, and Common Automotive Fluids
**ZeroClearance**

### Glass Version (ZC 112-XX)
- High-temp, non-woven fiberglass & PET blend into a composite matrix
- Qualified through long-term durability at numerous OEM’s
- Standard PSA designed for painted metals and high surface energy substrates.
- Long-term temperature resistance to 450°F (232°C) in ambient air
- Current production styles
  - No Foil – 5.0 mm Black Fiber Blend (ZC112BLK-PSA)
  - Foil thickness’ at 0.002” (0.05 mm) and 0.010” (0.25 mm)
  - Core Material thickness at 4mm

### Non-Glass Version (ZC 312, 325-XX)
- 100% high-temp, non-woven PET fiber matrix
- Qualified through long-term durability at several OEM’s
- Standard PSA designed for painted metals and high surface energy substrates.
- Long-term temperature resistance to 400°F (204°C) in ambient air
- Current production styles
  - No Foil – 6.8 mm 100% Black Fiber w/ Water Repellant Finish (ZC350BLK-PSA)
  - Foil thickness’ at 0.002” (0.05 mm) and 0.010” (0.25 mm)
  - Core Material thickness at 3.2 mm and 6.4 mm

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**Applications**
- Undercarpet Systems
- Interior Dash
- Rear Kick-up
- Trunk Insulator
- Intake Tubes
- Evaporator
- Dog House
- Outer Dash
- Outer Wheel Well
- Wiper Motor
- Tunnel Insulator
- Chassis / Frame Insulation
- Floorpan
- Fuel Tank / System
ZeroClearance

Applications

- Undercarpet Systems
- Interior Dash
- Rear Kick-up
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PolyTack Version (ZC 612, 712, 725-XX)
- Same Glass, Non-Glass constructions available as Standard PSA
- PSA system designed for use on Plastics and low surface energy substrates (HDPE, PP, PA, etc.)
- Qualified on Fuel Tanks and numerous Molded Plastic Components
- Foil thickness’ at 0.002” (0.05 mm) and 0.010” (0.25 mm)

Solvent Resistant Version (ZC 812-XX)
- Same Glass, Non-Glass constructions available as Standard PSA
- PSA system designed to resistant chemical solvents (e.g., diesel fuel, transmission fluid, etc.) on painted metals and other high surface energy substrates
- Qualified on Aluminum and E-Coated Steels
- Foil thickness’ at 0.002” (0.05 mm) and 0.010” (0.25 mm)

Low Cost Version (ZC 212-03)
- 3.2 mm 100% PET Core Material
- PSA system designed for painted metals and other high surface energy substrates
- Long-term temperature resistance to 400° F (204° C) in ambient air
- 0.003” (0.076 mm) Foil
<table>
<thead>
<tr>
<th>Lydall Material Designation</th>
<th>Core Material</th>
<th>Adhesive System</th>
<th>Composite Thickness</th>
<th>Composite Thickness Tolerance</th>
<th>Composite Surface Mass</th>
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<tr>
<td>ZC-112-02</td>
<td>Fiberglass/PET</td>
<td>Standard</td>
<td>3.8 mm</td>
<td>+/- 1.5</td>
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ZeroClearance Thermal Performance - Glass & Non-Glass vs. No Shield

Representative Data for comparative purposes. Actual results depend on specific thermal environment.

25mm Source to Component
(X, Y) = (Source, Component)

Baseline/No Shield
ZC 112-10
ZC 312-10
ZC 325-10
ZC 212-03
ZeroClearance Thermal Performance - ZC PolyTack (ZC 612-10) vs. No Shield

- 50mm Source to Component (HDPE Fuel Tank)
- Above 427°C Source Temperature, Unprotected Component began to melt.
- (X, Y) = (Source, Component)

Representative Data for comparative purposes. Actual results depend on specific thermal environment.
Normal Absorption Testing per ASTM E1050
ZeroClearance - ZC 725PERF & ZC 325-02

- ZC 725PERF Large Tube
- ZC 725PERF Small Tube
- ZC 325-02 Large Tube
- ZC 325-02 Small Tube
ZeroClearance

Alpha Cabin Reverberant Room Acoustic Test
Random Incidence Absorption

- ZC 725PERF
- ZC 325-02
ZeroClearance

Installation and Use

- ZeroClearance is a thin profile thermal / acoustic insulator capable of attachment via a pressure sensitive adhesive.
- When applied correctly, ZeroClearance may be attached to almost any interior or exterior vehicle surface as thermal or acoustic insulation.
- An aggressive, high-temperature pressure sensitive adhesive (PSA) is used which is capable of withstanding long term temperatures in excess of 450°F (232°C).

_In order to ensure proper bonding and long term adhesion, the ZeroClearance product must be applied correctly._

_The following information is intended to recommend the use and application procedures to users of ZeroClearance products that will ensure long term performance. This information will also make users of ZeroClearance aware of possible factors that may reduce the bond strength of the product._
Surface Adhesion Fundamentals

- Adhesion is molecular attraction between unlike materials
- Strength of the attraction is determined by the surface energy of the material
  - Higher surface energy → greater attraction
  - Lower surface energy → weaker attraction
- On high surface energy materials, the adhesive can flow or ‘wet out’ to assure a stronger bond
- On low surface energy materials, the adhesive flows less and ‘beads up’, decreasing bond strength
- Unit of measure - dynes/cm
- Polytack ZeroClearance is designed for use on low surface energies
Approximate Surface Energy Values

**Metals**
- Copper: 1103 dynes/cm
- Aluminum: 840 dynes/cm
- Zinc: 753 dynes/cm
- Tin: 526 dynes/cm
- Lead: 458 dynes/cm
- Stainless Steel: 700 - 1000 dynes/cm
- Glass: 250 - 500 dynes/cm

**High surface energy plastics**
- Kapton: 50 dynes/cm
- Phenolic: 47 dynes/cm
- Nylon: 46 dynes/cm
- Polyester: 43 dynes/cm
- ABS: 42 dynes/cm
- Polycarbonate: 42 dynes/cm
- PVC: 39 dynes/cm
- Acrylic: 38 dynes/cm

**Low surface energy plastics**
- PVA: 37 dynes/cm
- Polystyrene: 36 dynes/cm
- EVA: 33 dynes/cm
- Polyethylene: 31 dynes/cm
- Polypropylene: 29 dynes/cm
- Teflon: 18 dynes/cm

*Reference Only - Contact Lydall Product Development for more information*
Substrate Material

- The substrate that the product will be applied to should be approved by Lydall Product Development
- Approval is based on material surface energy and adhesive bond strength.
- Materials should be re-approved by Lydall after any significant material and/or process changes affecting surface characteristics

Application Surface Cleanliness

- The surface should be clean and dry prior to application of the product
- The surface should be free from any dust, dirt, or any other foreign matter that will inhibit adhesion. This includes release agents used in the molding process, oils, plasticizer migrations, or other similar surface contaminates
- Surface contamination may be removed by cleaning the area with a clean drying solvent such as VM&P naphtha or isopropyl alcohol
Application Surface Contact

- Higher surface contact between the Zero Clearance product and the bonding substrate will lead to increased adhesive bond strength
- A minimum contact area of 50% is recommended between the adhesive system and substrate for all applications. Full exterior perimeter edges of all parts should have contact with substrate.

Installation Pressure

- Firm even pressure should be applied across the entire surface of the product during application
- To achieve optimal performance of Zero Clearance through manual application the product should be applied with adequate surface contact, consistent application pressure, and even distribution of pressure across the entire surface
- A pressure of 6 to 10 PSI (41.4 – 68.9 kPa) is recommended - wet-out of the adhesive is instantaneous
Installation Temperature

- Decreased application temperatures can inhibit the adhesion of the product
- It is recommended to apply ZeroClearance in an ambient temperature at or above 60°F (15.5°C)
- All application substrates and ZeroClearance products should be stored at or above 60°F (15.5°C) prior to final application. Materials should be stored at this temperature long enough to ensure that the surfaces meet the above requirements during application

Installation Time

- ZeroClearance products should be applied within 5 minutes of the removal of the release liner. In extremely dirty environments, this time may need to be reduced to eliminate contamination
Minimum edge to edge distance for holes, slots or other penetrating shapes is 10mm.

All interior and exterior corners must contain a minimum radius of 6.35mm.

All ZeroClearance Parts contain a “Pull-Tab” to aid in the removal of the release liner. The placement of this tab is established to facilitate manufacturing with input from our customer regarding the installation process.

The minimum slot width is 8.0mm with a 4.0mm radius at the end.

Specific Design Criteria:
- Minimum Part Size: 50.8mm X 50.8mm
- Maximum Rectangular Blank Size: 1219.2mm X 1473.2mm
- Maximum Part Size: 1143mm X 1447.8mm
- Standard Trim Tolerance: ± 3.0mm
- Standard Hole Size Tolerance - Holes or Slots: ± 3.0mm
- ZeroClearance can be edge coated to minimize dust out if required.
- ZeroClearance must be applied to a clean, dry and oil-free surface.
ZeroClearance should not be designed with a single slit.

ZeroClearance should not be designed with sliced crosshairs.

ZeroClearance should not be designed with sharp interior or exterior corners.

The tab should be located to avoid tearing of the release liner upon removal as well as for ease of assembly during the manufacturing process.

Elimination of sharp corners and slits within part design aids in part manufacturing and reduces liner tearing during installation.
Full Size Pickup Application
Results of full thermal & structural durability cycle - Pass
150K Customer Equivalent Miles
Sedan Fuel Tank Application
Results of full structural durability cycle - Pass
150K Customer Equivalent Miles
Full Size Van Application
Results of full thermal & structural durability cycle - Pass
150K Customer Equivalent Miles
ZeroClearance

Applications

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ZeroClearance

Qualified Material Specifications

- Qualified and approved to General Motors GMN10046, GMW16653
- Qualified and approved to Ford WSS M99P32-D6
- Qualified and approved to FCA (Chrysler) MS10943
- Qualified and approved to Honda specifications.
- Qualified for FMVSS302 Flammability Requirements
  - Self Extinguishing Rating [FMVSS302 & SAE J369]
  - UL-94 Vertical Burn Rating – V0 for Fiberglass Styles

Product Validation Testing

- Adhesion Performance and Durability Measured and Qualified Through:
  - Heat Aging (Ambient up to 204°C)
  - Environmental Cycling (Heat, Humidity, Cold Cycling)
  - Salt Spray (500 Hours)
  - Fluid Immersions (Water, Salt Water, Oils, Acids, & Other Automotive Fluids)
  - Impact Cycles (From -7C to 204°C)
- Durability Qualified through Gravelometer Testing per SAE J400
- Qualified to many Interior Requirements (Odor, Fogging, Mildew, etc.)
- High Physical Strength Maintained (Tensile, Tear, Laminate Strength, etc.)
- Many other Application and OEM specific Requirements