

OCULUS
WorldWide

TECHNICAL GUIDE

ACP FABRICATION & INSTALLATION

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FABRICATION & INSTALLATION

GENERAL

Our Aluminum Composite Material (ACM), The OCULUS Panel, can be processed with general woodworking and aluminum-working machines and tools. It can be cut with a circular saw, folded after grooving with a router, and can be bent with a 3-roll bender or a press brake.

We use several methods for junctions between aluminum extrusions and The OCULUS Panel.

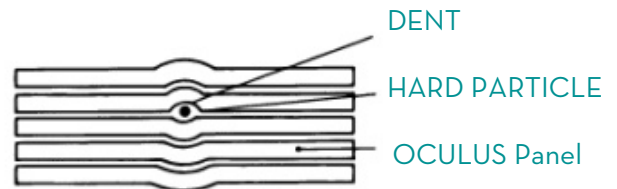
Throughout this document we will introduce our recommended processing and installation methods and examples.

Specific product information, the detail of which is critical for proper fabrication and installation work, is summarized in detailed source material.

In this section, OCULUS Panels is often referred to simply as “panels”, “ACM” or “ACM Panels”.

NOTES ON HANDLING

The panels are made of a rigid material, but it is possible to damage the panel and experience edge denting and deformation by physical impact or contact with hard particles.

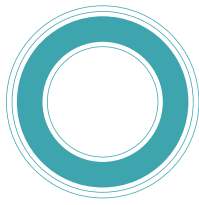


Hard debris and cutting chips between panels will cause a dent as shown in the diagram.

Refer to the following notes through all stages during fabrication and installation.

8. Packing and Unpacking Panels

- (a) Pack and unpack crates in a clean place.
- (b) Remove dusts, chips and debris from panels and packing paper. Hard particles caught between ACM sheets can dent the panels.
- (c) Avoid the handling of panels on a floor. All ACM should be handled on a worktable.
- (d) Panels should be handled by two people. Pickup the panel with the finished surface up or outward. Lift one panel from another, never drag a panel across the surface of another panel.



2. Transport

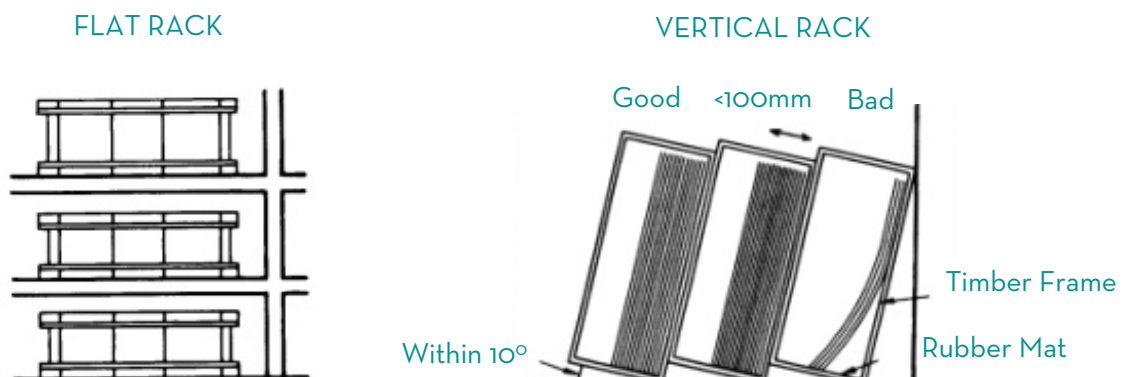
- (a) Lay packed panels horizontally and do not place heavy objects on top.
- (b) Clearly mark “Handle with Care”, “Keep Dry”, “No Hooks” and “This Side Up” on the packing material(s).

3. Fabrication

- (a) Prior to fabrication, make sure the worktable, temporary stand and both sides of the panel are clean and clear of debris.
- (b) Take special notice of the cutting chips generated from saws, routers and drills , as well as those chips and particles caught between the panel and the tool.

4. Storing

- (a) Store the panels indoors in a flat or vertical rack system.
 - i. In a flat racking system, place the same size panels and pallets together. Do not place panels and pallets of differing sizes on top of each other.
 - ii. In a vertical racking system, lean panels closely against an inclined backing material with a pitch of 10° or less. The total thickness of panel stack should not exceed 100 mm thick. Use veneer for backing cover and place a rubber mat on the bottom. Use care to avoid scratches when pulling a panel out from the rack and placing it back.





5. Protective Film

It is possible that the protective film of the panel will degrade with direct sunlight and moisture, which could result in the protective film delaminating from the panel. Storing panels in dry atmosphere will prevent this.

Remove the film immediately after the installation is completed.

In our Reversible Series, a protective film is applied to both sides of the panel - make sure that each film is peeled off from front and back.

Some film is translucent (half-transparent) making it potentially more difficult to notice.

PROCESSING METHODS

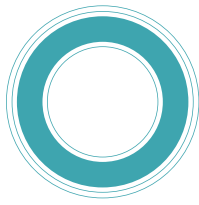
A wide variety of machines and tools can be used to process ACM Panels. We classify these machines as conventional or automated. Generally, conventional machines require greater operator skill to maintain product quality. Typical machines and tools are as shown in the following table.






CONVENTIONAL

Processing	Tools or Machines	No.
Cut	Table Saw	1
	Hand Circular Saw	2
	Hand Router	3
	Hand Jigsaw	4
Groove	Grooving Machine	5
	Hand Router	3
Chamfer	Hand Trimmer	6
	Plane	7
Hole	Hand Drill	8
Punch	Punching Machine	9
Notch	Notching Tool	10
Bend	Press Brake	11
	3-Roll Bender	12

AUTOMATED

Processing	Tools or Machines	No.
Cut	Panel Saw	13
	Square Shear	14
	CNC Router	15
Groove	Panel Saw	13
	CNC Router	15
Perforate	Turret Puncher	16



<p>Table Saw</p> 	<p>Circular Saw</p> 	<p>Hand Router</p> 	<p>Jigsaw</p> 
<p>Grooving Machine</p> 	<p>Hand Trimmer</p> 	<p>Plane</p> 	<p>Hand Drill</p> 
<p>Punching Machine</p> 	<p>Notching Tool</p> 	<p>Press Break</p> 	<p>Roll Bender</p> 
<p>Panel Saw</p> 	<p>Square Shear</p> 	<p>CNC Router</p> 	<p>Turret Puncher</p> 

1. Saw Cutting

Various types of circular saws including, table saws, hand-held circular saws and panel saws, can be used to cut ACM Panels.

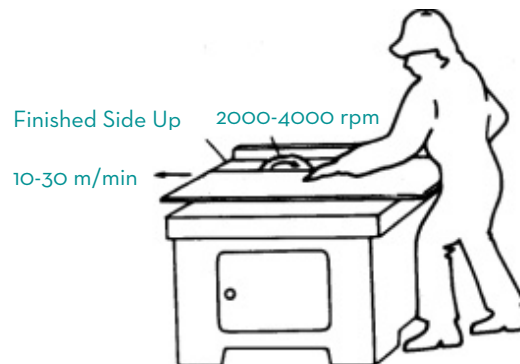
We recommend using a carbide-tipped blade. Carbide-tipped blades are specified for aluminum and/or plastic use.

Typical Saw Blade Example:

Blade Diameter	255 mm
Number of Teeth	80 to 100
Cut Width	2.0 to 2.6 mm
Rake Angle	10°
Tip	Carbide

Operating Conditions

Rotation	2000 - 4000 rpm
Feed Speed	10-30 m/min



Notes on saw cutting:

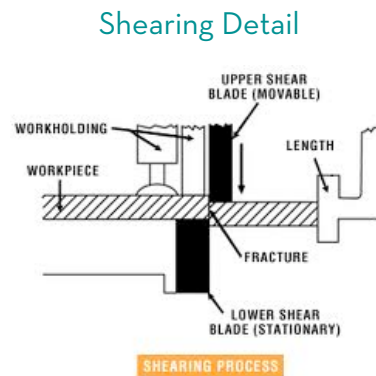
- Do the cutting operation with “finished” side facing upward to prevent the panel from scratching and the protective film from peeling off.
- Remove cutting debris from the panel carefully after processing, to avoid denting during storing or installation.
- Sharpen or replace the saw blade, when it becomes dull. Dull blade will result in large burr or distortion at cut edge.

2. Shear Cutting

Use of a Mechanical Shear allows for greater efficiencies and tighter tolerances when compared to other forms of cutting.

Generally, the most suitable clearance and rake angle are as follows:

Clearance	0.04 - 0.1 mm
Rake Angle	1°

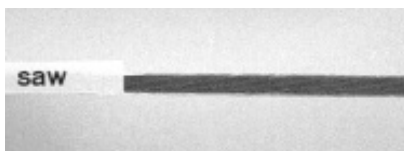


3. Trimming

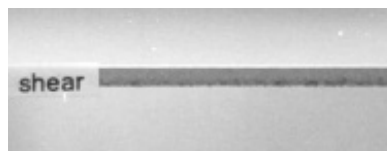
In saw cutting, burrs can appear on either aluminum edge. When shearing, either a droop or burr can appear on each edge.

If installing the panel with the cut edge expose attention should be paid to the condition of the edges.

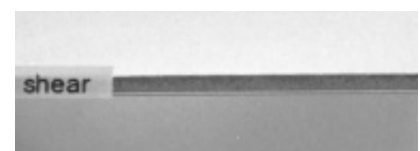
Burr after Saw Cutting



Droop after Shear Cutting



Burr after Shear Cutting



When cutting with a saw, care should be taken to keep the blade sharp and free of material. When shear cutting, the proper adjustment of the die is essential.

Generally, the condition of the edge is more important in interior applications than in exterior installations. When edge trimming is necessary, use a trimmer, plane or sandpaper. In Solid and Metallic Colors, deep trimming like chamfering has a visual effect.

We recommend using a trimmer with a ball bearing chamfering bit or a plane used for woodworking. When using a plane, a guide ruler will help to ensure a uniform edge.

Deep trimming can harm the appearance in Stone and Timber Finishes therefore, dull rough edges with fine sandpaper.

In most conditions, droop edges resulting from shear cutting is mild enough to ensure the safety of the edges.

4. Circular and Curved Cutting

A Hand Router and Trimmer will allow circular cuts in the panel. Using a Guide template will help you to stabilize the work. A jigsaw can be used for cutting complex shapes.

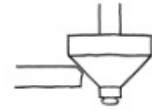
Notes on the use of guide plate :

- a) Put an appropriate guide plate (template) on the effective side of the panel to do the routing work through the guide plate.
- b) Particles caught between the template and the effective surface of The Panel may cause dent or scratch.

Hand Trimmer



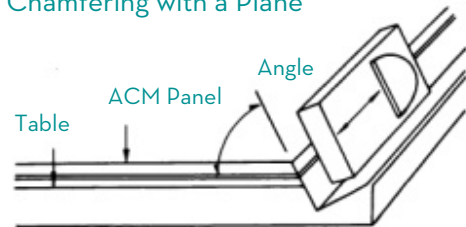
Ball Bearing Chamfering Bit



Plane



Chamfering with a Plane



Hand Router



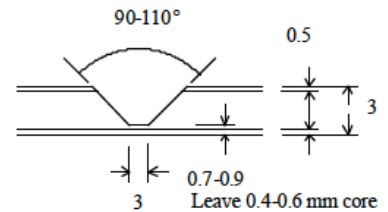
Hand Jigsaw



5. V - Groove

The diagram shows one of the typical V-groove shapes suitable for folding the panels. It is important to leave 0.4-0.6 mm of core. We recommend 110° groove for 90° bending.

V-Groove Cut Pattern in mm

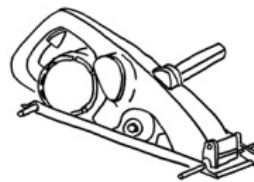


Hand Groove Machine

For straight lines, Hand groove machine can render a proper V-groove in the panel.

An example of the suitable cutter blades and operating conditions are as follows:

Groove Machine



V-Groove Blade



Cutting Blade

Outside Diameter	110 - 120 mm
Number of Teeth	4 - 6
Material	Carbide Tip

Operating Conditions

Rotation	5,000 - 9,000 rpm
Feeding Speed	5 - 20 m/min

Hand Router

A hand router will properly groove ACM Panels in both straight and curved lines. Use a custom router bit (similar to the one indicated in the image above).

An example of the suitable cutter blades and operating conditions are as follows:

Hand Router



Router Bit



Router Bit

Number of Teeth	2-4
Material	Carbide Tip

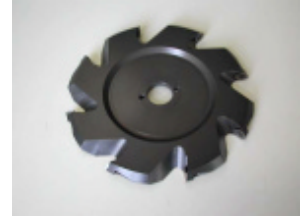
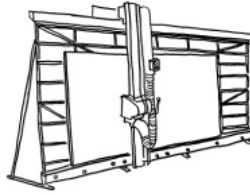
Operating Conditions

Rotation	20,000 - 30,000 rpm
Feeding Speed	3 - 5 m/min



Panel Saw

ACM Panels can be effectively routed with a panel saw using the following conditions:



Cutting Blade

Outside Diameter	220 mm
Number of Teeth	8
Material	Carbide Tip

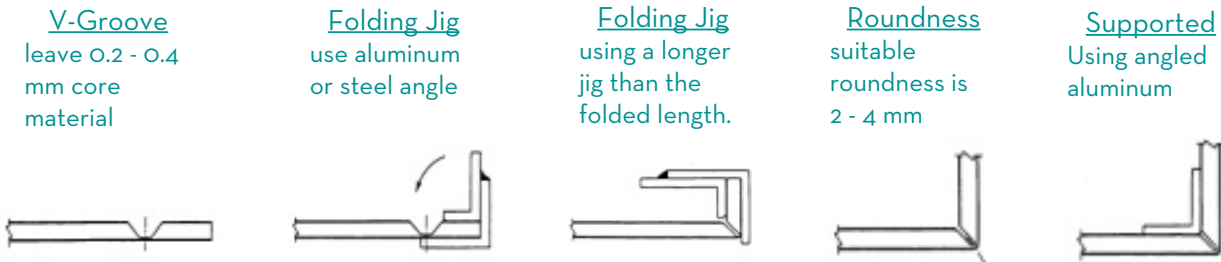
Operating Conditions

Rotation	2,500 - 5,000 rpm
Number of Teeth	30 m/min



6. Folding

After introducing a V-groove, panels can be folded with a jig using the folding procedures are as follows.

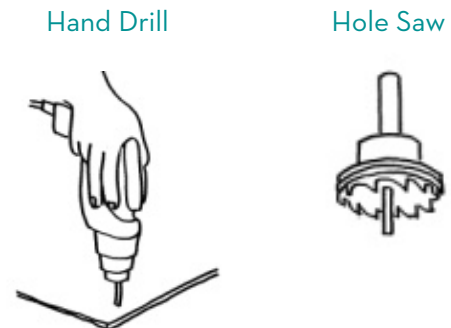


Notes on folding:

- Fold the Panel using a flat steady workstation. If the panel is folded when warped, the folded line will not be straight.
- The folded corner should have a radius roundness of 2-3 mm. If the roundness is too small, the coating may have a crack on the folded corner. This tendency becomes more likely when panels are folded at low temperatures. We recommend that you carry out folding work at 50°F or higher.
- Folding after V-grooving results in slight elongation of the panel edge material. The elongation is 0.5-1.0mm depending on the roundness of the folding corner. Therefore, proper positioning of groove lines must account for this when the fabrication drawings are prepared.

7. Drilling

Drilling holes in our panels is easy with either a hand drill or drill press using a drill bit, hole saw or circular cutter. Always drill thru the panel from the finished panel side to reduce burring.



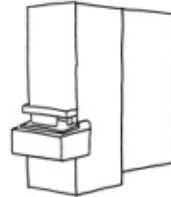
8. Punching and Notching

A punching machine is used for panel notching and cut outs.

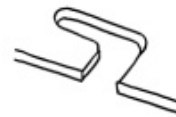
The suitable clearance between punch and die is $\geq 0.1\text{mm}$ (material thickness x approx. 2%).

The panel edge will show a slight droop when punched/ notched.

Punching Machine



Punching



Notching Tool

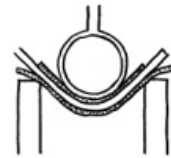


9. Bending with a Press Break

OCULUS Panels can be bent with a Press Break. Maintain the following bend radius:

Bending Direction	Minimum Bend Radius
Traverse	50 mm
Parallel	80mm

Press Break



Notes on Press Brake Bending:

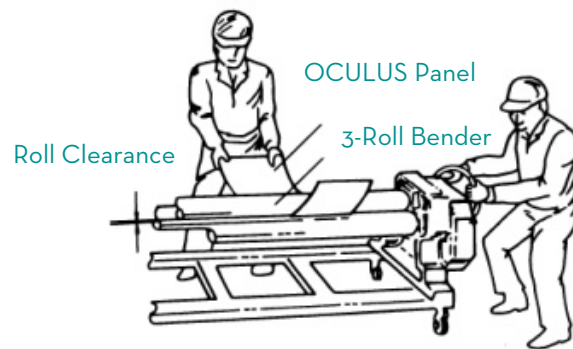
- “Traverse” and “Parallel” show the bending direction toward the rolling (coating) direction, printed on the protective film.
- The minimum bendable radius means the limit with which visible wrinkles appear on the aluminum surface of the panel.
- Use the top die (punch) with the radius equal to the desired bend radius. If the radius of the top die is too small, it is possible that the bending radius becomes partially smaller than the above limit.
- Use a urethane pad for the bottom die, or place a rubber mat between the panel and the bottom die.
- Use a scratch-free top die. Polish and wipe the top die. Do the bending work without peeling off the protective film.

10. Bending with a Three-Roll Bending Machine

You can use a manual or electric-drive 3-roll bending machine to bend the panel. The minimum bendable limit is normally 250 mm in radius, but it depends on the length of the bender and the type of the machine.

The following is an example of relationship between the length of bender and the minimum bendable limit.

Roll Length	Minimum Radius (mm R)
500	120
1000	150
2000	180
2500	200



Notes on 3-roll bending:

- Prior to bending, make sure to wipe the roll surface carefully.
- Remove the burr at the panel edge that may cause denting when rolling.
- Remove any particles from panel cutting/ drilling that may have stuck to the panel and smooth any wrinkles in the protective film. Failure to do so may result in panel dent damage.
- Do not tighten the rollers down on the panel. If the roll clearance is tight in the machine, adjust the clearance to that of the panel thickness plus approx. 0.5 mm.
- If you will be notching a panel that will also be curved, make the notch after bending. Notching before bending distorts the notch.
- When bending to small radius, gradual bending is necessary by adjusting the elevation of bend rollers.
- You can reduce the straight edge portion by means of using additional sheet material, but it remains to some extent. If a consistent curve line is needed near the edge, additional edge bending will be necessary after the regular bending.

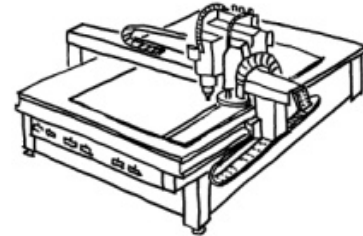
Edge Bending - Before/After



11. CNC Router

A CNC router will effectively cut and groove the panels. Processing is controlled by a computer program. CNC routers are suitable for repetition of the same process. Suitable bit and operating conditions are the same as hand routers.

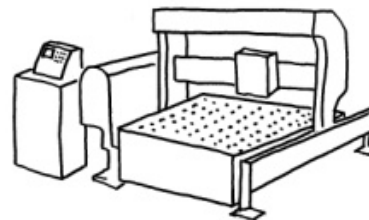
CNC Router



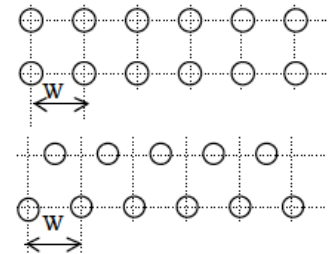
12. Turret Puncher

A Turret Puncher, also computer-controlled, can be used for perforation of the panel. The suitable clearance between punch and die is 0.1mm or smaller (material thickness x approx. 2%). A slight droop will appear at punched edge.

Turret Puncher



Perforated Pattern



13. Other

Water-jet cutting:

Plunge cut (piercing at the starting point) in water-jet cutting may cause a de-lamination between aluminum skin and core material. Therefore, we have to plunge at a disposable area or start at the panel edge. After the penetration point, cutting with a water jet is effective.

Laser Cutting:

Based on our current testing, we have concluded that the panel is not suitable for laser cutting. Fumes generated from the panel might harm the optical instrument of laser system.

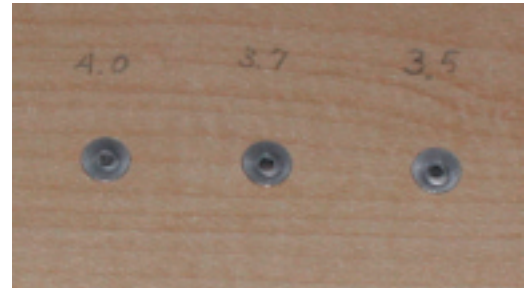
JOINING METHODS

1. Rivets, Nuts & Bolts

We often use rivets, nut & bolt and tapping screws for attaching the panel to aluminum extrusions. We recommend using “blind” aluminum rivets.

Use nut & bolt and tapping screw hardware made of aluminum or stainless steel. A hole of 3mm in diameter withstands approx. 400 N per point - Refer to “Strength of Junction Hole ” in Section 4 for the strength data of hole for your strength design.

Countersunk Rivet

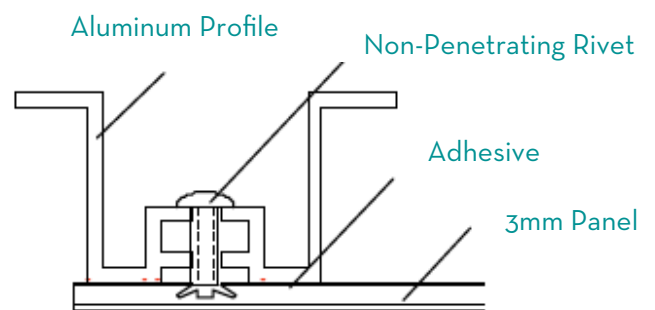


The strength of junction hole depends on the position of the hole. Positioning the junction hole to close to panel edge will not yield sufficient strength. An equation $e > 2D$ indicates a suitable relationship between the hole diameter (D) and the distance from the hole center to panel edge. In the interior installations, countersunk rivets and screws will be used more often than round-head ones. The strength may lessen with countersunk rivets and screws.

2. Modified Non-Penetrating Rivet

In Matte finish products, a non-penetrating rivet is applicable to joining an aluminum profile to the panel.

Note: This method is applicable only to Matte Finish products. If we apply this method to other finishes, the fastener trace is visible from the front side.



3. Adhesives

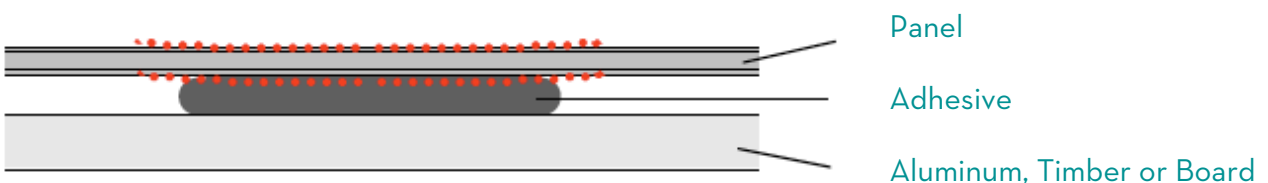
We can use a wide variety of commercial adhesives for joining and assembling our panels. Care should be taken to avoid certain types of adhesives that may corrode aluminum metal. For example, vinyl acetate, widely used for timber and EPS, corrodes aluminum metal.

We recommend the following adhesives when adhering ACM Panels to other materials:

Adhesive Type		Epoxy	Chloroprene	Silicone RTV	Cyno-Acrylate
Commercial Brand Example		Araldite	Contact Cement	All Purpose Silicone	Aron Alpha
Material	Metal	YES	YES	YES	YES
	Timber	YES	YES	YES	YES
	Gypsum Board	YES	YES	No	No
	EPS	YES	No	No	No

Notes on Adhesives:

- Prior to adhesion work, remove all the foreign material such as dust, particles, grease, water, etc. from the area to be bonded.
- Select the most appropriate adhesive that ensures the necessary adhesion strength in the right atmospheric conditions. The adhesion strength depends on the surface conditions of the substrate. Follow the adhesive manufacturer's instructions.
- When the panel is adhered to different material, it is possible that the panel will show a deflection due to the thermal expansion difference or dimension change of the material. Pre-test the adhesive before fabrication and installation.
- Some adhesives may cause a distortion after hardening due to shrinkage of the adhesive, as shown in the diagram. Therefore, pre-testing is necessary for some types of adhesives. Generally, some epoxy adhesives, polyurethane adhesives and silicone adhesives may show this kind of distortion. This distortion is usually very slight and sometimes it is not visible in low gloss and matte finishes.



Apart from the above adhesives, we have successfully used the following adhesives in fabrication and assembly.

Brand Name	Adhesive Type	Remarks
Diabond SG350	Acrylic	2-Part, 5-15 min curing
Super X No. 8008	Silyl - Modified	1-Part, 1-2 hrs curing

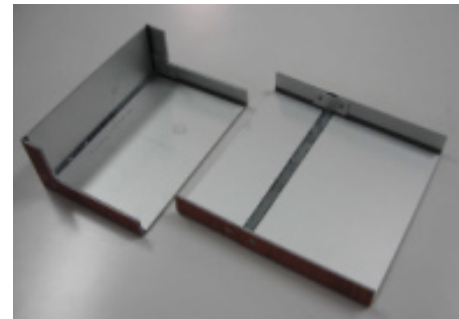
These adhesives, however, are only available overseas. If you are interested in these specific adhesives, please contact our office 646.470.2722.

4. Panel Core Welding

You can connect one end of the panel to another by creating a weld between the core with hot melt adhesive glue.

Prior to heating a glue stick, you have to pre-heat the core surface for good adhesion. We recommend mechanical reinforcement after welding.

Panel Welding - Hot Melt Glue



5. Double -Sided Tape

Double-sided tape, like 3M's VHB tape, is effective in joining the panels to other materials. VHB tape simplifies the joining work and the thicker ones allow for a slight movement between the two materials if desired.

6. Hook & Loop Fastener

Hook/loop fasteners like Velcro tape is useful for signage and displays. This type of fastener is removable and re-usable.

7. Sealants

Use a sealant to ensure proper waterproofing between panel joints. The sealing material must meet the performance and conditional requirements for the installation conditions. Silicone, modified silicone, polysulfide and polyurethane sealant are recommended.

General performance of these sealing materials is as follows. Regarding the joint design such as joint width and thickness, please follow the sealant manufacturer's specifications.

General Performance		Sealing Material			
		Silicone	Modified Silicone	Polysulfide	Polyurethane
Restoring Ability		A	A-B	B	B
Degradation	Due to Aging	VS	S-M	M	M
	Due to Temperature	VS	S-M	M-L	M
Shrinkage After		S	S	S	S
Serviceable Temperature (long-term)		-40/ 120° C -40/ 248° F	-30/ 90° C -22/ 194° F	-20/ 80° C -4/ 176° F	-20/ 70° C -4/ 158° F
Weather-ability		A	A-B	A-B	B
Fatigue Resistance		A	A-B	B	A-B

NOTE 1: A - EXCELLENT S - SMALL
 B - GOOD VS - VERY SMALL
 L - LARGE C - NORMAL
 M - MEDIUM

SURFACE PROCESSING

1. Screen Printing

In screen-printing, a 1-component vinyl type or 2-component polyurethane type ink is suitable for all the finishes of OCULUS Panels. We obtain normal adhesion with these inks after drying at 80°C for 30 min and curing at room temperature for 24 hrs.

The typical printing procedures are as follows:

- a) Remove all dust and dirt with soft cloth (Oily dirt will cause print defects.)
- b) Cure or dry under proper conditions. Follow instructions from ink manufacturer.

Notes on screen-printing:

- a) Keep the curing temperature below 90° C (194° F) for less than 30 min. If the curing temperature is higher, deflection of the panel may occur.
- b) Select the ink suitable for the atmospheric conditions where the panel is located.

2. Cutting film

Various types of cutting films are applicable to the Panels surface. If you are going to fold the area where the film is applied, the film may change color at the crease. Confirm with pre-testing.

3. Digital Printing with Ink Jet Printer

Various types of decorative films and wallpapers printed with ink jet printers can be applied to the panels.

Confirm the fire approval conditions of the film. Direct digital print is also possible with special ink jet printers.

Screen Printing





COATING TOUCH-UP

Commercial or custom acrylic paints are suitable for repair coating of all finishes of OCULUS Panels.

Typical procedures are as follows.

- a) Clean the surface and remove dirt, if any.
- b) Stir the paint well. Apply paint with brush or pencil-type applicator.
- c) Dry and cure at room temperature as instructed from the manufacturer.

Normally acrylic paints show good adhesion after cured, however the touched-up portion may show a slightly different appearance. As appearance of coating depends on coating method, even an exactly matched paint may show a slightly different appearance to some extent. In Stone and Timber Finishes, use an intermediate solid color diluted with clear paint for touch-up.

The suitable dilution rate is, depending on the color, 10-90% of clear content. Munsell Number attached to each color may become a guide to find the intermediate color.



CLEANING

1. General Cleaning

First, rinse with water using a soft sponge with modest pressure to remove the stain. If the stain remains after drying, use a neutral detergent or household cleaner diluted with water.

Typical cleaning procedures are as follows:

- a) Dilute the detergent or cleaner to 1-5% with water.
- b) Apply the solution to the Panel surface with a soft rag or sponge. Wait for 1 minute, then the foam will blacken.
- c) Dry the solution with a squeegee and wipe the remaining solution with a clean wet cloth.

According to our test, dilute Magiclean is suitable for all finishes of OCULUS Panels. Magiclean is a household detergent with pH 8 from Kao Corp. If you use other detergent, pre-test it in a small area prior to using.

2. Stubborn Stains

According to our test, alkali cleaners such as Sharpshooter and Windex are applicable to strong stain, however Metallic Panel colors require thorough rinsing with water afterward. Poor rinsing with the Metallic colors may cause a color change due to remaining alkali. In Solid Colors, Stone and Timber Finishes, rinsing with water is less necessary.

Note:

Sharpshooter is a versatile cleaner from 3M (alkali, pH12), and Windex is a glass cleaner from Johnson (alkali, pH11). As these are alkali solutions, prevent eye and skin contact. Follow manufacturer's safety instructions.

If you use other strong cleaners or stain removers, pre-test in a small area. Generally, strong acid and alkali may cause the gloss coating to change color, or a swelling of the coating film.

Do not use cleaners containing abrasives.

Do not use strong solvents and paint thinners.