etalbond®

Aluminium composite material

Technical manual

ETEM
Shaping materials to fit human needs

FOR LEAVING BEHIND AN IMPORTANT HERITAGE...

ETEM
Shaping materials to fit human needs

etalbond®

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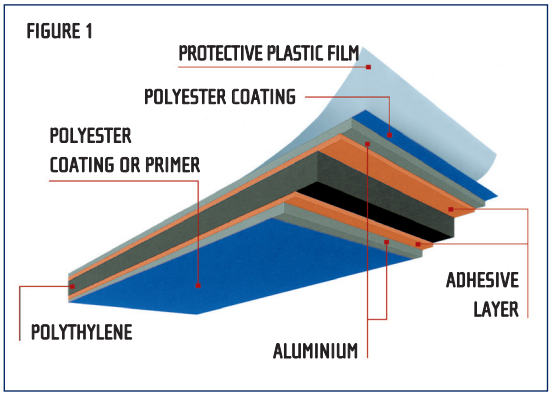
C O N T E N T S

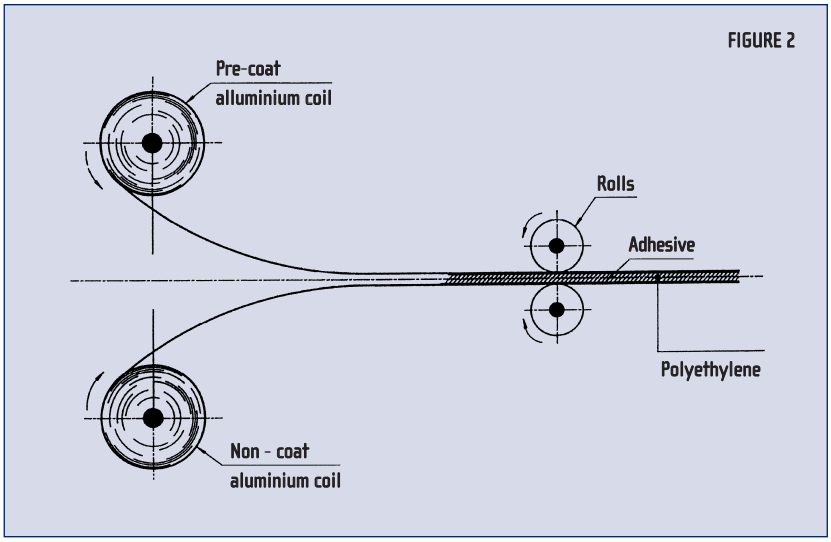
Redaction by **"Aluminium Magazine"** (www.aluminium.gr)



etalbond® is a sandwich - type composite panel consisting of a non-toxic polyethelene core firmly bonded between fine aluminium facing and backing sheets. etalbond® sheets are produced in different core thickness 2,3, 5, mm with aluminium thickness 0.50 mm or 0.30 mm, 1000, 1250, 1500 and 2000 mm widths and lengths from 1000 to 5000 mm. The total thickness of etalbond® is 3, 4, 6 mm. The bonding of aluminium sheets with the core is realized with simultaneous application of mechanical and chemical methods under high temperatures. The final stage of production results in a strong and exceptionally rigid flat sheet of composite panel of which the total thickness can vary from 3 to 6 mm. etalbond® is a technologically advanced product whose unique features fit in a variety of applications.

etalbond® production process

The raw materials used in the etalbond® production are: aluminium sheet, 0.50 or 0.30 mm of thickness in the form of coils, polyethelene and a special adhesive in pellet form. The production process of etalbond® is schematically shown in figure 2. The two rolls (upper and lower) unwind the aluminium coil driving it to the pressing unit. The melted plastic is blended with the special adhesive and leaks between the two aluminium sheets. The three parts (two aluminium sheets and adhesive along with the polyethelene) are highly compressed within the rolls resulting in a rigid and durable material.



etalbond® advantages

The main advantages that etalbond® offers, whose unique features facilitate the supplant of the tradional constructive materials are:

- **In spite of its lightness is exceptionally strength**
- **Elevate rigidity**
- **Simple forming technique:** Routing and folding can even be performed on site. It can be easily worked into a variety of shapes. Due to its lightness reducing frame lodgings - cost of fabrication and installation.
- **Short time for mounting:** Like a result is the short cut for the construction time.
- **Resistant to extremes of weather exposure and temperature:** The most accreditate international organizations certify the resistance capability of this material to the most severe conditions.
- **Easy maintenance:** The clearance of the panels can be done with a soft detergent due to the smooth, monolithic surfaces that creates.
- **Appearance:** Curved and multiplanar surfaces in striking colours create a new elegance in buildings and constructions of all kinds. Attractive and versatile, etalbond® is the ideal cladding for interior and exterior surfaces on new constructions and renovations.

ATHENS 2004 OLYMPIC GAMES VENUE: OLYMPIC TENNIS CENTRE, 4.000 m²

etalbond®: Technical Data Sheet

Panel thickness	mm	3	4	6
1. PANEL DIMENSIONS				
1.1 Aluminium thickness	mm	0,5	0,5	0,5
1.2 etalbond® weight	kg/m²	4,6	5,5	7,4
1.3 Max. standard width	mm	1000, 1250, 1500		
1.4 Standard length	mm		3200	
1.5 No. of panels/standard bundle	pcs	-	38	-
1.6 Weight of standard bundle	kgs	-	= 1000	
2. PANEL DIMENSION TOLERANCES				
2.1 Panel thickness	mm	±0,20		
2.2 Panel width	mm	-0,00, +2,00		
2.3 Panel length	mm	-0,00, +4,00		
2.4 Diagonal difference	mm	3,00		
3.MECHANICAL CHARACTERISTICS OF ALUMINIUM COVER SHEETS (0,50mm)				
3.1 Tensile strength tolerances (Rm)	N/mm²	140		
3.2 Yield strength (Rp0.2)	N/mm²	120		
3.3 Elongation (A5)	%	4%		
3.4 Modulus of elasticity	N/mm²	70000		
3.5 Rigidity (EJ)	KN m²/m	0,13	0,25	0,60
4. ALLOY	Al. 3105 H44			
5. SURFACE PAINT CHARACTERISTICS				
5.1 Visible Surface 3 layers	3 layers PVDF 70% KYNAR - 500			
6. TEMPERATURE BEHAVIOUR				
6.1 Excellent behaviour in temperatures	From - 50 °C to + 80 °C			

etalbond®: Technical Data Sheet

Panel thickness	mm	3	4	6
6. TEMPERATURE BEHAVIOUR				
6.2 Thermal expansion (aluminium cover sheets)	1.4 mm per linear meter for temperature difference of 60 °C			
7. THERMAL INSULATION				
7.1 Thermal insulation of Polyethelene, ΠPE	W/ m^2 K	0,29		
8. FIRE BEHAVIOUR				
COUNTRY	Test according to...	Classification		
8.1 Germany	DIN 4102	B2		
8.2 France	NFP 92-501	Class M1		
8.3 England	BS 476 Part 6, BS 476 Part 7	Δείκτης 0 Class 1 Class 0 (Bldg. Reg)		
8.4 Italy	CSE RF 2/75/A, RF 3/77	Class 1		
8.5 Russia	ГОСТ, 30244-94 ГОСТ, 30402-96	Fire classification $Г_1$ Flash classification $В_1$		
8.6 Austria	ONORM B 3800 /Teil 1	Brennbarkeitsklasse B_1		
9. SOUND INSULATION				
Average airborne sound transmission loss	db	23	24	25

10. VISIBLE SURFACE PROTECTION	
Surface covered with self-adhesive film, for protection against damage from handling and placing of the material	Film thickness of 80 microns. Film to be removed the soonest possible after installation.
11. DIRECTIONAL ARROWS FOR PLACING THE PANELS	
The directional arrows are printed on the protective film and at the back of the panel	CAUTION! The placing and handling of the panels must NECESSARILY follow the arrows, for all of the colours, but especially for the metallic ones.

Applications:

- **Architectural Claddings**
- **Internal Wall coverings**
- **Building Renovations**
- **Internal Partitions**
- **False Ceilings**
- **Gas Stations**
- **Highway Toll Stations**
- **Internal Decoration**
- **Signage**
- **Exhibition Stands**
- **Bus terminals**
- **Container constructions**
- **Machine Coverings**

etalbond® support systems

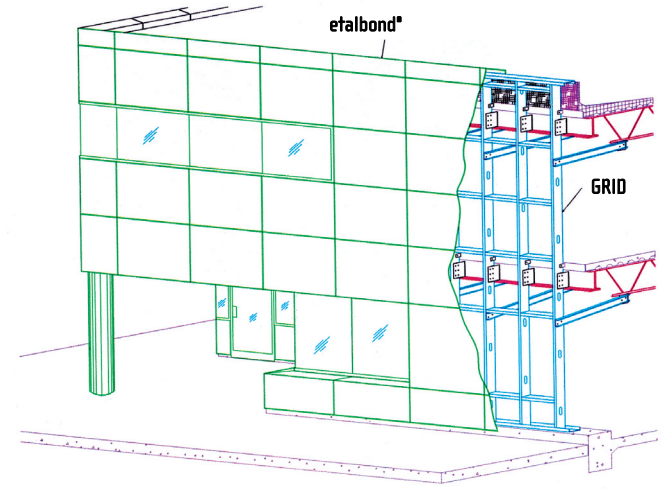
Selection of an etalbond® support system

1.1 The selection of an outer covering suitable support system with cassettes has to be realised at the phase of the architectural design, and after serious study.

1.2 This means that the structural engineer or architect should have considerable experience on architectural cladding subjects with respect to aluminium constructions. The system he is going to propose, has to fulfil the peculiarities of construction stability and the aesthetic demands in combination with the building demands for more flexible and economical solutions that maintain construction easiness and technical performance.

1.3 The industries that produce composite panels in large scale usually propose their own support system. While, various other construction enterprises in the field of architectural cladding propose their own support systems.

FIGURE 3



1.4 Consequently with regards to the selection of the support system there is not only a vast amount of information, but there is also and the equivalent field experience. The various support systems in existence can cover almost any constructural demand.

1.5 ETEM drawing from its experience on a multitude of construction projects in Greece and elsewhere, proposes its own support systems along with the equivalent technical information, that accompany them.

1.6 The many years of experience in the construction field and the architectural aluminium applications are combined in the most efficient way on the architectural cladding applications using etalbond® composite aluminium panels.

Selection of the support system

2.1 Independently from the system of support that is going to be selected, each work must dispose indispensably: Flat profile (all cassettes must be on the same level) Straightness of the vertical and the horizontal seams (scotias) Perfect appearance and link at the inserted positions respecting the various openings (e.g. windows, windowpanes etc.), as well as and the "finishing" (or the projections) for instance parapets, balconies etc.

2.2 Besides the appearance, there are many other factors, that can characterize the applicable etalbond® support system each time, as:

- The watertightness
- The possibility of intervention respecting the restitution of any fault or damage during construction, during positioning, or after the completion of the work.
- Durability against corrosion.
- Interventions respecting the appearance of the building.

2.3 The success of a support system depends on:

- The study, the design, and the organization respecting the project materialization.
- The contractor's knowledge level.
- Contractor's experience with respect to the specific system.
- The gear respecting the construction of the work.
- The **controlling gear**, during the construction of the work.
- The accurate application of the system as it is designed, without any occasional inventions, artless reproductions and "seeing and acting" techniques.
- In case that the selected system it is accompanied from some **precision** fixtures or profile, then those original parts must be **indispensably** used by the supplier.
- The applied corrected actions when ascertained that there are application problems.
- From the above mentioned it is rendered obvious that, the contractor has the exclusive responsibility respecting the quality of cladding work either for the proposed by himself system, or any assigned cladding system, accepted by the contractor.


ATHENS 2004 OLYMPIC GAMES VENUE: INDOOR ARENA (BASKETBALL), 4.000 m²

etalbond® support system classification

The etalbond® support systems are classified in:

- Systems of support for simple panels
- Systems of support for the shaped panels in "Box-shaping" or cassettes

3.1 Support systems for etalbond® panels

ETEM disposes equivalent systems; several of them accompanied by special profiles, which have been developed for this purpose. There is more information in the following drawings:

3.2 Support system for cassettes

The support of the cassettes it is possible to be realized with the following manners:

- Support with suspending (hanging) of the cassette on the vertical carriers of the related sub-structure.
- Support of the- cassettes with bolts or rivets on the related sub-structure, (grid), with the support of various components. (See figures 4, 5).

FIGURE 4

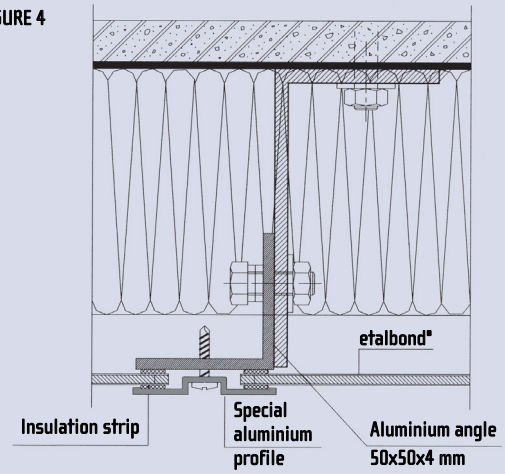


FIGURE 5

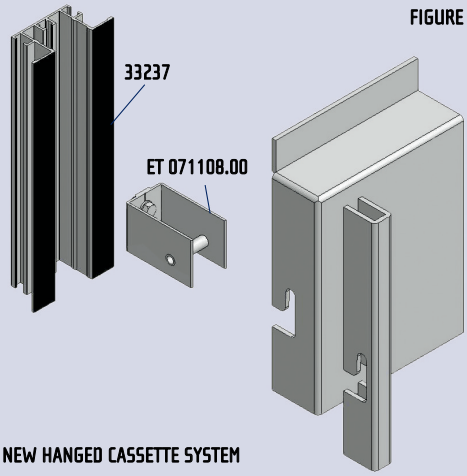
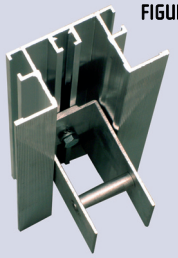


FIGURE 6



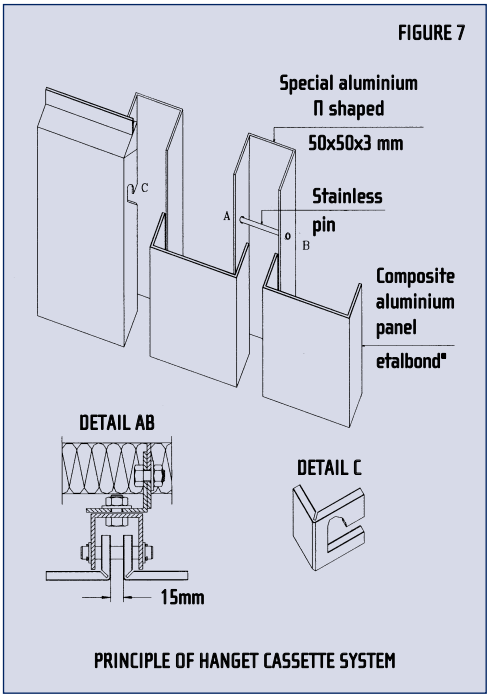
3.2.1. Support system with hanged cassettes

3.2.1.1. General

- The principle of the system appeared in the following scheme.
- The origin of the hanged cassette derived from the systems disposed by the compact aluminium plates manufacturing companies that of course pre existed of composite panels.
- The hanged cassette system is available in many types (various support system manufacturers). Each manufacturer proposing its own support system.

3.2.1.2 Method advantages:

- The positioning of the ready-made cassette is a fast procedure which means low labour cost and short delivery time of the work.
- It is possible to realize seams (scotias) of small width, with a low labour cost.
- As much as the preparation of the sub-structural support grid and the cassette manufacturing, have no deviations, so the quality is very good.
- The sub-construction support is focused nearly exclusively at the positioning of the vertical carriers on which the cassettes hanged through the side hooks.



3.2.1.3 Remarks about the system of the hanged cassette.

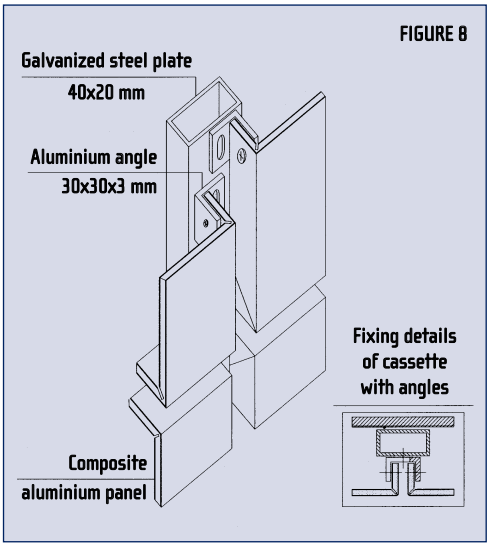
It is obvious, that contractor's experience, the level of the available mechanical gear, the drawing department and other factors, play a decisive role respecting the final quality of construction. For this reason, the previous experience of cladding contractor must be taken into account seriously, respecting the constructions of the cassette.

3.2.2 System of support with marginally riveted angles on the iron sub-construction.

In the drawings of the previous pages, we observed the principle of the above mentioned system of support, and the covering with strip from etalbond®, that is welded with SIKAFLEX 252 (single component elastomeric polyurethane), or with silicone.

3.2.2.1 Advantages

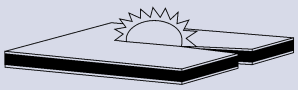
- The system is simple, so much respecting the construction, as and the preparation of the cassette.
- The iron sub-construction (grid) could be prepared and controlled with a great easiness. Nevertheless, any change could be corrected, in the space of the work locally.
- The support of the cassettes and the correct position it could be controlled very easy and the restitution of mistakes is exceptionally simple.
- Even-though the constructor has a little experience; it is possible the quality of the work be secured, since are possible any corrections or interventions, till the completion of construction.
- The covering is tight. The work respectively to the "finishing" is easy and it is absolutely controlled.



Processing etalbond®

Chapter 1: Saw-cutting

FIGURE 9



Existing machinery and tooling used for woodworking and metal can be used for the saw cutting of etalbond®. Below an indicative list of saw cutting equipment with nominal values for tool geometry and working conditions is supplied for easy reference. Prior to processing large quantities trial saw cuttings should be done to evaluate both the tool working conditions and the recommended cutting speeds.

For markings the use of a soft pencil is just fine. Hard marking tools should be avoided as they can fracture the Aluminium surface. The chips formed during saw cutting should be taken away with compressed air. Due to the nature of etalbond® material it is best to move the saw blade than the material as no scratch will remain on the panel. etalbond® can be cut to any shape with a jig saw and if circular shaped by using an auxiliary circular cutting tool.

If good saw cutting practices are applied and recommendations followed the result should be clean cuts with little burr. If despite following the recommendations ragged cuts are produced check the following causes; poor tool support, tool vibration, blunt cutting edges, high frictional heat at the cutting edge.

etalbond® as having low thermal conductivity cannot be cooled easily with compressed air or any other means. Thus it is recommended to select the tool geometry and cutting conditions in such a manner as to minimize the frictional forces developed at the cutting point and keep the resulting heat at a low level.

	Circular Saw	Band Saw	Fret or Jig Saw
Blade material	High- speed steel (HSS) or Carbide tipped (CT)	Hardened spring steel	HSS
Blade or Band Geometry	Blade thickness: 2 to 4mm Blade shall be thinner between hub and outside diameter to prevent jamming	thickness: 0.8 to 1.2 mm width: 15 to 25 mm	thickness: 1.0 to 1.2 mm width: 5 to 15 mm
Tooth Geometry	Space width and round groove	Hook teeth	Alternating or wavy tooth setting
Tooth Pitch	HSS: 10 to 20 mm CT Blade: 10 to 12 mm	4 to 12 mm	1.2 to 3 mm
First working orthogonal clearance angle, 'α'	HSS: 10, CT blade: 15	35	—
Contact Angle, 'γ'	HSS: 25, positive (cww) CT blade: 10, positive	3 to 5	—
Max Cutting speed, 'v'	HSS: 3 000 m/min CT blade: 5 000 m/min	3 000 m/min	200 m/min
Max Feed speed, 's'	HSS: 25 m/min CT blade: 30 m/min	25 m/min	10 m/min

1. Saw Cutting

In case of horizontal or vertical cutting, the circular saw blades can be used. If required the aluminium composite panel can be placed with an angle so as to produce finally inclined cuttings

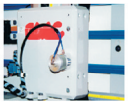
1.1 Required machinery

Usually vertical panel saws, of good quality are being used (figure 10).

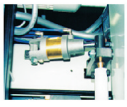
Obviously in case of small extend projects Portable circular saws (figure 11)

Standard accessories

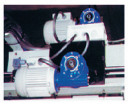
90° rotation of the saw unit in automatic mode



Pneumatic locking of the saw carriage



Pneumatic locking of the beam carriage



Feed motors for vertical and horizontal movement

Automatic vertical panel saw with electronic programmer for vertical and horizontal cuts with movable aluminium supports

FIGURE 10

equipped with a system of guides can be used, so as to ensure straight line cuttings.

FIGURE 11

1.2 Saw blades technical characteristics

Diameter	8"-14"
No. of teeth	Maximum available
Teeth quality	Carbides designed for cutting non-ferrous material
Cutting speed	Maximum 5500 rpm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Notes:

1. The vertical panel saws must always be equipped with "reliable" system of "chips collector".

Shear cutting clearance and contact angle (rake):		
etalbond® thickness	Clearance	Contact angle
3 milimetres	0,04 mm	1°
4 milimetres	0,04 mm	1° 30'
6 milimetres	0,2 mm	2° 30'

FIGURE 12

2. Cut the panels using always the same direction, being helped with the arrows printed on the aluminium composite panel

2. Shear-Cutting

etalbond® can be easily sheared either by using rotary shears.The tolerance between the shearing blades must be regulated in a way to prevent edge rounding of the panel. To avoid this rounding from happening on the upper side it is recommended to lay this side towards the table of guillotine. Protective cover must be placed between the clamping system of the shearing machine and the panel, so as to prevent damage to the etalbond® surface. The most suitable cutting method for large panels is by square cutting.

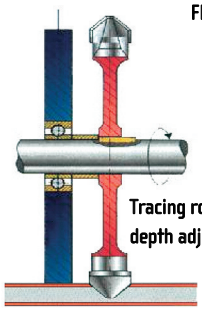
3. Required machinery

For shearing etalbond®, guillotine shears with advanced cutting technology, hydraulically operated can be used (figure 12).

Chapter 2: Routing

Routing: etalbond® can be routed by using conventional equipment (horizontal and vertical routing machines) (figure 13). For an accurate and precise by hand folding of the etalbond® composite panels, giving a good finish, we route the rear side of the panels and extract the aluminium sheet and a part of polyethelene core. Normally 25mm from the edge is grooved and folded.

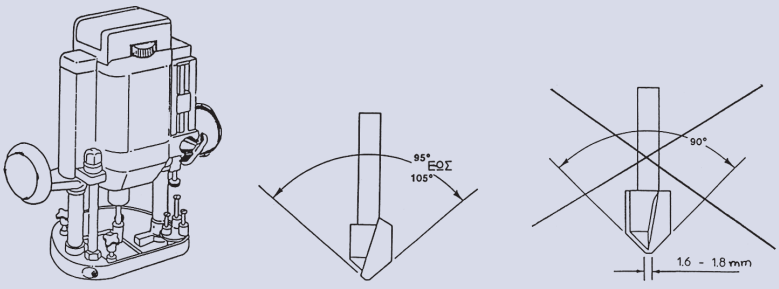
FIGURE 13



For grooving work panel saws with routing devices or just hand routing machines guided with rails are the proper equipment for the job.

Mechanical equipment for routing: In order to route etalbond® panels the following mechanical equipment is necessary.

FIGURE 14



ROUTER WITH ROUTING BITS | CUTTER FOR etalbond® | CUTTER FOR WOOD PROCESSING

Vertical panel saw, equipped with special shaped routing saw blades: The equipment needed is the same vertical saw with the one used for the cutting, but with a different saw blade and a relevant equipment for adjusting the routing thickness. Exactly as with the cutting process with the vertical saw vertical, horizontal or even angular on the axes of the panel- routing can be made provided that etalbond® panels are placed. The use of chips collector is essential.

Portable circular saw: A portable circular saw equipped with a suitable routing disk can be used only for limited number of processings. Note that special care should be given on the stability of the portable circular saw during processing of the material, as well as the precision of the routings with the help of the chosen guided system.

Hand operated router with routing bits:

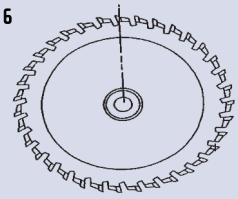
These tools are consisted of routers that are available in the market and are used for wood processing. If they are equipped with special routing bits -carbide tipped cutter- the hand operated router can be used for a limited number of processes. In this case the Stability of the tool and the guide-system considerably affect the quality of the routing. A special hand operated router is shown on figure 15.

FIGURE 15

Circular routing blades and router bits:

Details of various types of circular blades and router bids are shown on figure16. The supplier of vertical panel saw offer special circular blades for the routing- process of composite aluminium panels.

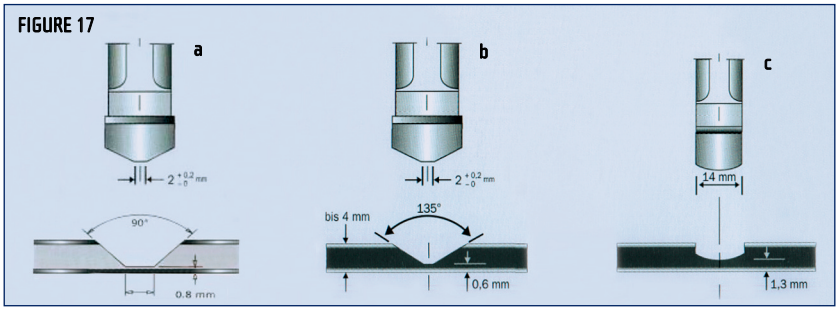
FIGURE 16



HOLIDAY INN, "AT. ODOS" 4.000 m²

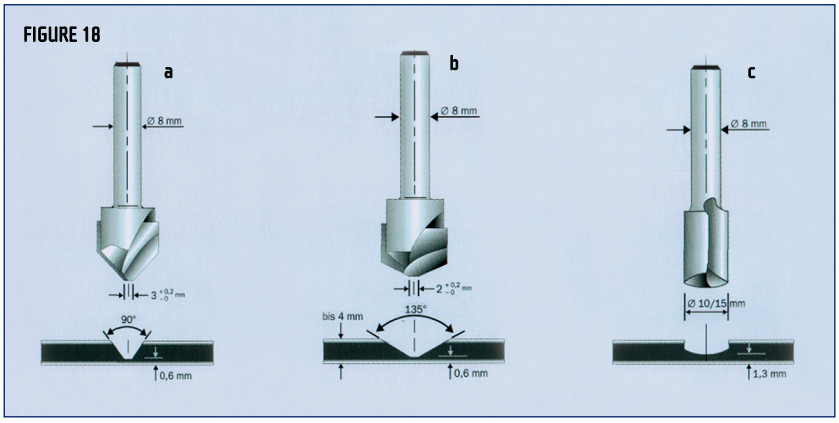
Carbide tipped disk milling cutters for panel saws

Fig. 17a: milling cutters for grooves 90°
Fig. 17b: for grooves 135°
Fig. 17c: milling cutter for rectangular grooves



Milling cutters for hand routing machines

Fig. 18a: Cutter for V-shaped grooves 90°
Fig. 18b: Cutter for V-shaped grooves, 135°
Fig. 18c: Cutter for rectangular grooves



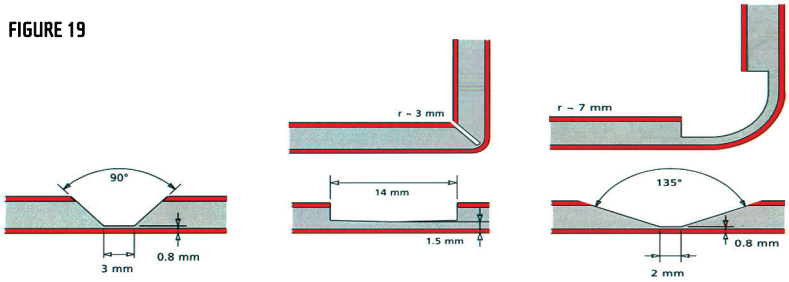
Advantages of routing and folding

An important feature of etalbond® panels is the ability to be formed cold by using a simple technique that of routing and folding.

- Simple technique
- Low cost production of shaped elements
- Folding of routed elements can take place on job site
- Variety of design possibilities

Work directions: For shaped elements with radius between 2 to 7 mm proceed as follows. First a V-shaped or rectangular groove is routed by a milling cutter on the inside of the fold making sure to leave on the lower cladding sheet about 0.3 to 1.00 mm of core material. It is the shape of the groove and its respective depth that determines the folding radius. Bear in mind that smooth bending (shape forming of elements) cannot be obtained without uniform thickness of polyethelene remaining.

FIGURE 19



V-shape groove for folding up to 90°

Rectagular groove for folding up to 150° regarding the panel thickness

V-shape groove for folding up to 135°

When a U-groove is bend at 90° angle the bending radius of the final product will 3-3.5 mmR and the element will elongate between 0.5 and 1mm. That means the original panel should be cut shorter by that proportion.


ATHENS 2004 OLYMPIC GAMES VENUE: INTERNATIONAL BROADCASTING CENTRE (IBC), 20.000 m²

Grooving equipment

For processing small quantities of panels a router and rimmer can be used

Technical characteristics:
Material: carbide
No of teeth: 2 - 4
Feeding speed: 3 - 5 m/min
RPM: 20 000 - 30 000

For processing large volumes of U-grooving as standard industrial production then a circular saw and a grooving cutter are needed along with a lifter.

Technical characteristics of carbide saw-tip:
Outside diameter: 305 mmΦ
No of teeth: 24
RPM: 3 000 to 5 000
Feeding speed: 5 m/min
Material: carbide

Corner Cut outs - Punching - Notching:

The use of Composite panels for cladding purposes in relation to the support system that it will be used, requires the construction of box-type shapes, known as cassettes (figures 21 - 23). The construction of a cassette includes - as it will be explained on a separate chapter - the sizing, routing, cut out of corners so for the folding and the joining.

FIGURE 20

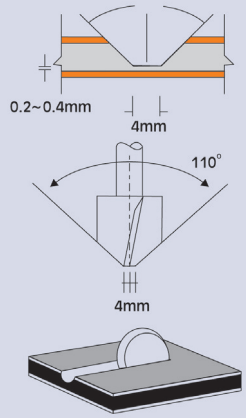


FIGURE 21

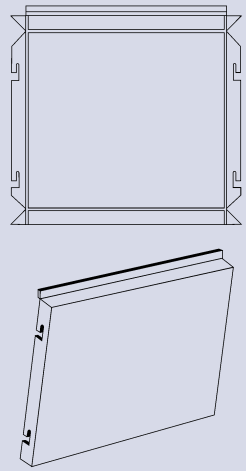


FIGURE 22

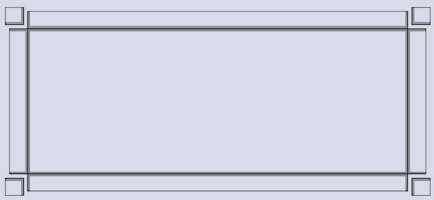
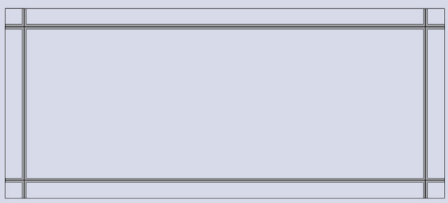


FIGURE 23



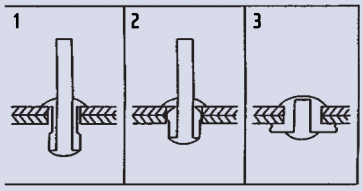
Joining:

The joining of etalbond® panels refers to the following:

a) Joining of etalbond® panels with one another by some joining material.
b) Joining of etalbond® panels with other materials.

The adjoining of etalbond® panels can be obtained:

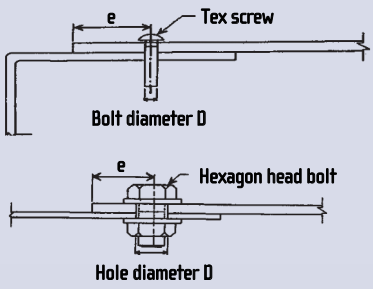
FIGURE 24a



Using rivets and bolts:

etalbond® panels can be fasten together or joined to aluminum extruded elements with rivets which are quite common to aluminum construction works. Use of either blind or pop rivets have the advantages of reducing labor cost, are easily worked as it enables work from one direction as it seems below at figure 24a, reduces the shock effect on the structure and lowers the potential for surface damage.

FIGURE 24b



Joint work with blind rivet

Placing directions:

Place the set-head on the side of the extrusion element. When the situation does not allow to do this or when two etalbond® panels are to be joined then rivets with special wide closing heads or equipped with tightly fitting washers as bulb-tite can be used. Allow a minimal spacing of 25 mm from the panel edge. Always be attentive to manufacturers specifications for shank lengths and grip lengths which should never be violated.

When panels are connected by junction hole observe that the relation **e>2D** holds (where **e:** distance from panel edge to the center of the hole, **D:** hole diameter) to ensure sufficient tensile strength of the hole.

- **Design guidelines:** Direct contact of the aluminium surface of etalbond® is only permissible with aluminium, zinc, stainless steel or plastic. Direct contact with metals such as copper, brass, steel and bronze will result in corrosion. When calculating the rivet hole dimensions for effective bearing consider the

thickness of the cover flanges(sheets) only. The possible strain on the hole should be taken as a maximum of 0.8 times the tensile strength.

In high-demand joints (localized tearing is a possibility) due to tensile stresses developed on the blind rivets, the head tends to either pull through the hole or unbutton from the etalbond® panel. Aluminium alloys such as Al Mg2.5 or AlMg3.5 are best suited for riveting material. AlMg5 alloy should be avoided if service temperature of the rivets is expected to rise above 60°C, due to stress corossion. Riveted joints are having good strength and endurance and are well suited for joints which may subjected to frequent jolting and vibration. It is recommended to use a large head with washer to allow for a better load transmission.

- **Using bolts and screws:** When etalbond® is riveted or bolted the tensile force is applied on the junction, a resulting stress will apply on the inside of the hole which in turn will lead to a deformation of the hole. The maximum stress is given by the formula:

$$\sigma_c = F_e / t\,D$$

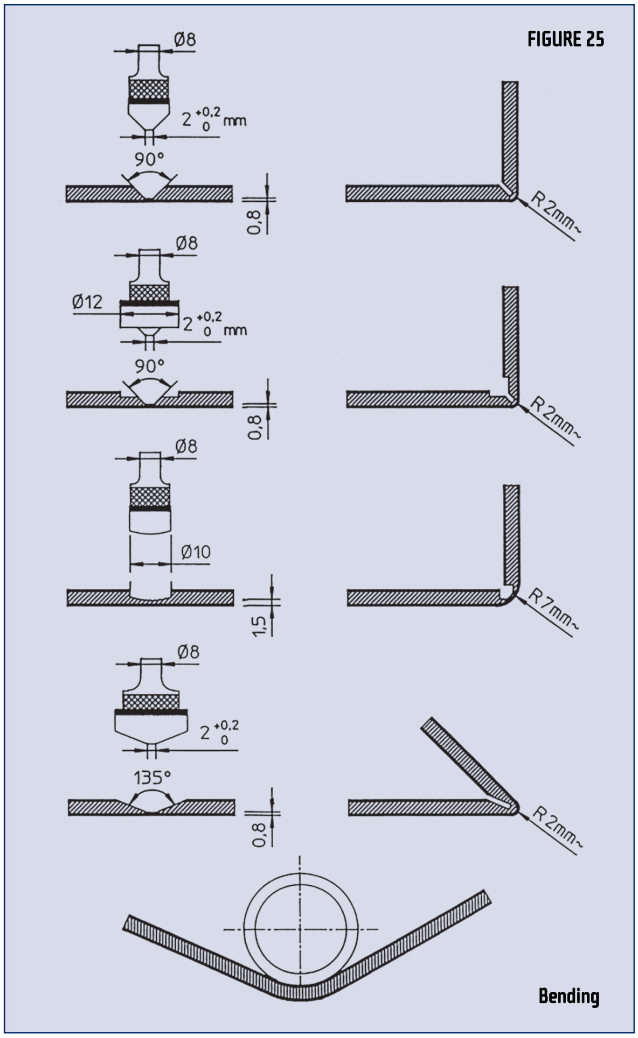
where:

σ_c: max stress (kgr/mm^2)
F_e: Tensile force (kgr)
t: Thickness of etalbond® (mm)
D: hole diameter (mm)

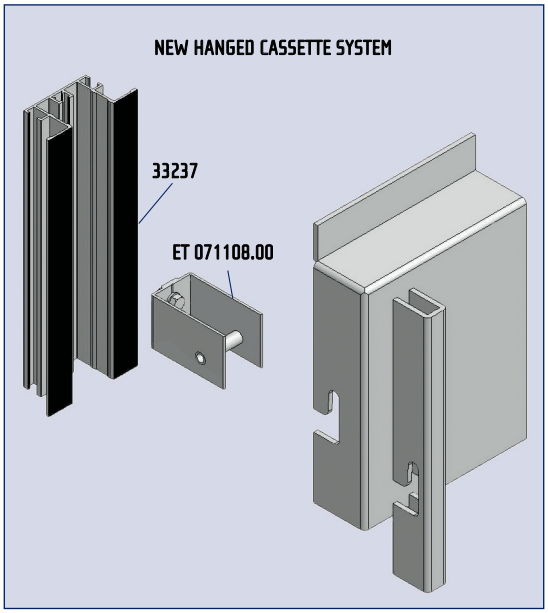
- **Using a structural adhesive:** Structural adhesives can be used along with double face tape for fastening etalbond® on flat surfaces as wall, ceiling, furniture, coverings etc. The use of double faced tape is for temporary adhesion. Extreme care should be paid to the right selection of the adhesive so as to be chosen according the application and the environmental conditions. It is important that the manufacturer is consulted prior to the usage of the adhesive for further instructions. The substrate surface should be clean before the application of structural adhesive.

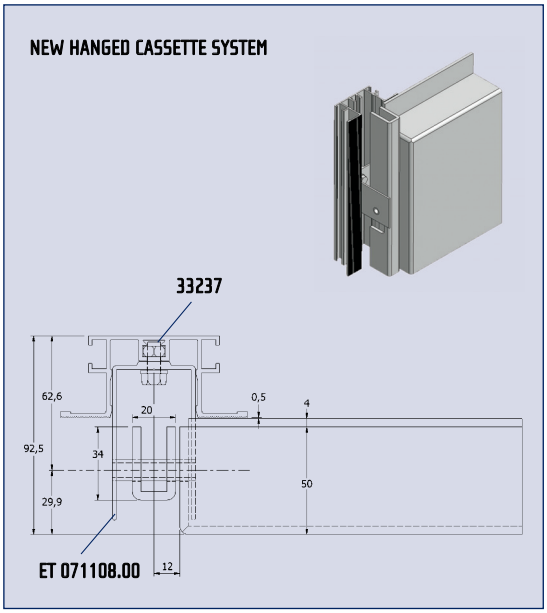
Categories of deformation

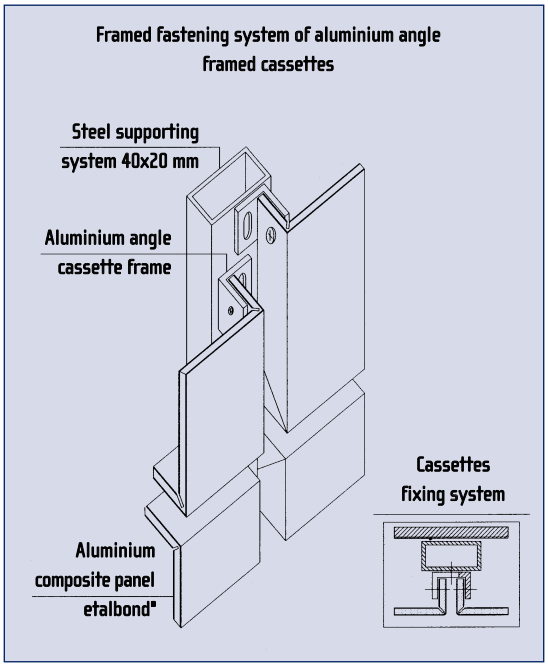
FIGURE 25

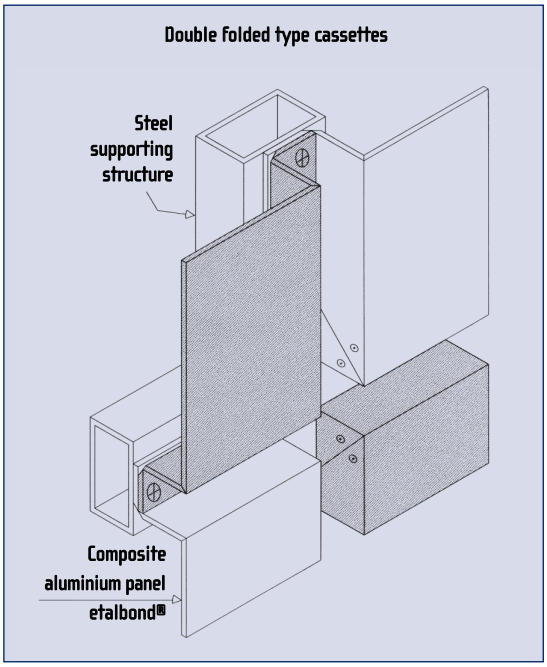


MOUNTING DETAILS



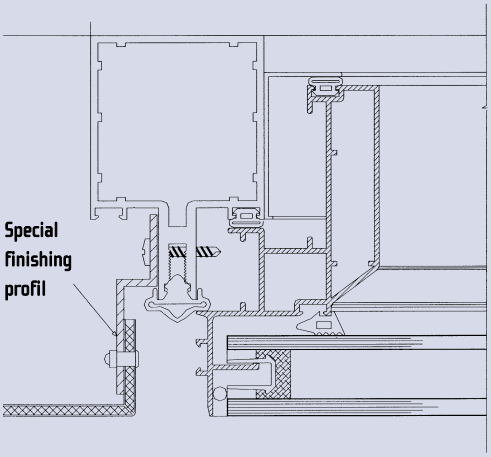




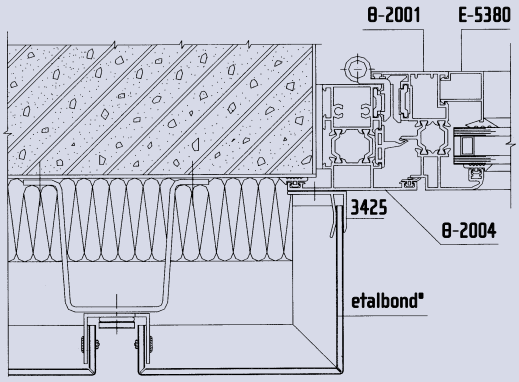


FINISHING DETAILS

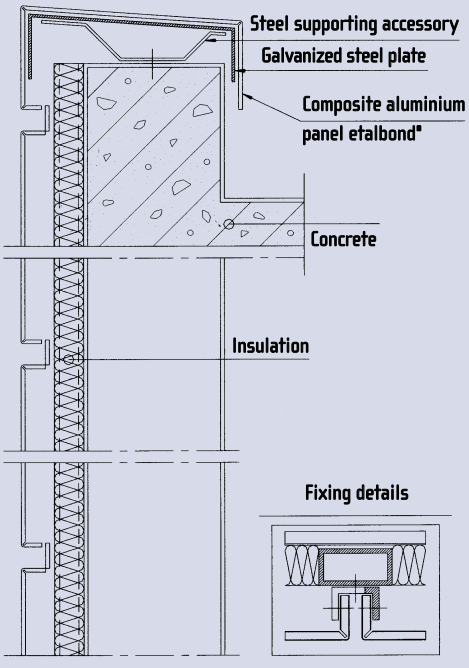
Detail of finishing mixed structure curtain wall- etalbond®



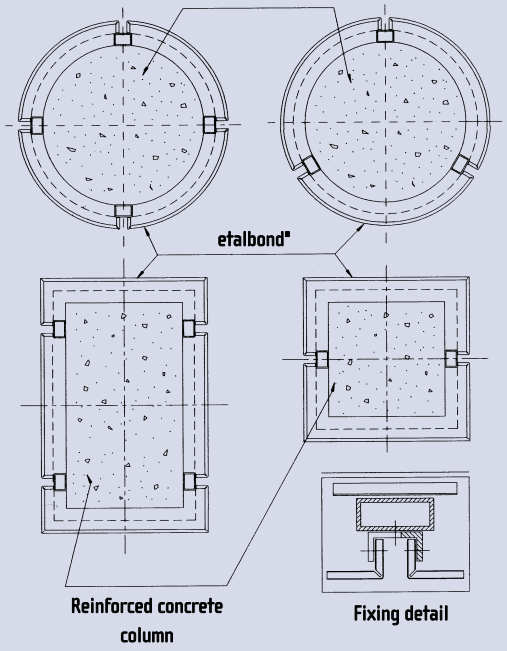
Finishing details



Detail of end top cassette



Covering of round surfaces




WANDSWORTH TOWER, LONDON, UK, 8.000 m²


A/A HOLDINGS BUILDING, ATHENS, 2.000 m²


SOFITEL, EL. VENIZELOS AIRPORT, 8.000 m²


OFFICE COMPLEX, 12.000 m²


SUBURBAN TRAIN STATION "EL. VENIZELOS", 6.000 m²

HOLIDAY INN, "AT. ODOS", 4.000 m²

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