



# Architectural and Technical Guide

December 2007

## A1. ALUMINUM PROFILES

### Introduction

EPAL S.A. makes use of aluminum profiles of its own design for the manufacturing of window & door systems, which are all patented. These patents are owned and exclusively used by EPAL only.

### Geometry of Aluminum Profiles

The aluminum profiles are extruded by approved Greek and foreign manufacturers and by the use of extrusion moulds owned exclusively by EPAL S.A. All aluminum profiles extruded by the use of these moulds are exclusively used for the manufacturing of the window & door systems by EPAL, which has full control of the quality of the profiles by performing continuous checks and inspections to prevent any possible deviations from the specified dimensions.

The dimensions of the aluminum profiles (frame and sash) and the weight of its elements are as follows:

Width of frame (mm)	Height of frame (mm)	Weight of frame* (gram/m)	Weight of sash* (gram/m)
100 & 80	71	1999 & 1838	1489

*\* The values of weight refer to the net weight, excluding the weight of thermo-break material*

The geometry of aluminum profiles is designed through CAD (Computer Aided Design) and patented by EPAL S.A. The window frames are assembled by the use of special rigid aluminum angles, which are placed internally in the profiles and then pressed by special equipment to create the frame. The hinges are adjusted externally on the rigid angles by screws.

The design of all opening systems provides the same external form, appearance and design.

### Mechanical and Physical Properties of Aluminum Profiles

The production of the aluminum profiles of EPAL is made by the use of aluminum material according to the following standards.

**Tension and Hardness properties meet the requirements of DIN 1748/1968 standard as follows:**

Al Alloy	Hardness (Brinell)	Stress for Rupture (N/mm <sup>2</sup> )	Yield Stress (N/mm <sup>2</sup> )	Elongation A10 (%)
AlMgSi 0.5 F22	70	215	160	10

### Thermo-break elements of Aluminum Profiles

Aluminum profiles used in some series of EPAL products (i.e. EPAL 14200, 14300, 14400) carry a thermo-break region along the profile (i.e. a channel), which is filled-in with an appropriate material leading to the reduction of thermal conductivity and consequently to the heat loss due to heat conduction through the window frame.

EPAL makes use of a unique technology for filling-in the thermo-break region (AMERICAN SYSTEM THERMO-BREAK by AZON Ltd.). The thermal barrier pour and de-bridge consists of a special polyurethane material, which is formed by injection of two components (monomer and catalyst) and in-site polymerization in the thermo-break region by the use of special equipment in the facilities of EPAL. The specifications of the poured thermo-break material are presented in the following table.

**Specifications of Poured Thermo-break Material**

PROPERTY	DESCRIPTION	STANDARD
Nature	Viscous liquid	
Color	Braun	
Density	1.24 gr/cm3	DIN 51757
Viscosity	300 mPa.s	
Boiling temperature	> 500C	DIN 51794
Solubility in water	Insoluble - reactive	

In addition to this technology for creating an extra thermal barrier along the thermo-break region of the profile, EPAL makes use of polyamide instead of polyurethane, which is mechanically placed in the thermo-break region along the profile.

**Specifications of Polyamide**

PROPERTY	UNIT	VALUE	STANDARD
Density	gr/cm3	1,14	ASTM D792
Hardness (Rockwell)	R scale	105 - 120	ASTM D785
Tension	Mpa	60 - 85	ASTM D638
Impact	MJ/mm2	12 - 15	ISO 180
Dimensions	Width 22mm and geometry according to the detailed design		

A comparison between the two systems (i.e. polyurethane and polyamide) with respect to their properties is provided in the following table.

**Comparison of properties between polyurethane and polyamide systems**

<i>PROPERTIES</i>	<i>POURED THERMO-BREAK MATERIAL</i>	<b>POLYAMIDE</b>
Shear Strength	1.171 gr/m2	439 g/m2
Impact Strength, ASTM D 256	1,9 ft/lbs/in	1,0 ft/lbs/in
Percent Elongation, ASTM D 638	80 %	3 %
Flexural Strength, ASTM D 790	19.000 psi	17.800 psi
Thermal Conductivity, ASTM C 518	0.84 Btu *in2/ft *h*F	2.14 Btu in/ft2*h*F

## A2. SERIES OF EPAL WINDOW & DOOR SYSTEMS

### *Introduction*

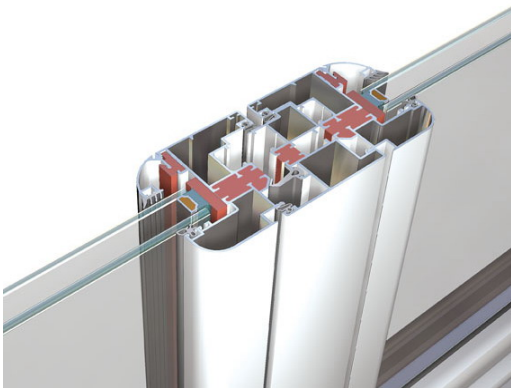
The systems of window & door – frames of EPAL S.A. are classified in the following series, depending upon their use and functional properties:

**14200 Series:** Opening – tilting systems with thermal de-bridged aluminium with pour & de-bridge thermo-break material.

**14400 Series:** Opening – tilting systems with polyamide thermo-break.

**14600 Series:** Lift and slide systems of heavy duty made of thermal de-bridged aluminum with pour & de-bridge thermo-break material, stainless steel drive for better and easier slide of the sash and peripheral gaskets instead of brushes.

### **14200 Series**

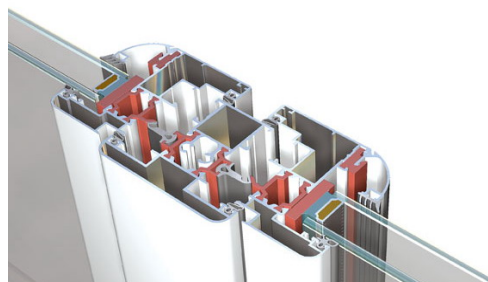


The opening – tilting EPAL14200 systems have exactly the same technical properties with EPAL14100 systems. In addition, EPAL 14200 systems carry de-bridged aluminium with pour & de-bridge thermo-break material, for a higher thermal insulation and excellent mechanical and physical properties due to high affinity of the thermo-break polyurethane material to aluminium surface, which makes impossible any separation of the two materials by mechanical of other means.

It is noted, that the poured thermo-break of polyurethane provides better thermal insulation and mechanical properties than polyamide (used in EPAL14400 systems), according to tests performed by [AZON](#), which developed the technology of thermal barrier de-bridging of aluminium profiles by pouring and in-site polymerization of polyurethane.

### **14400 Series**

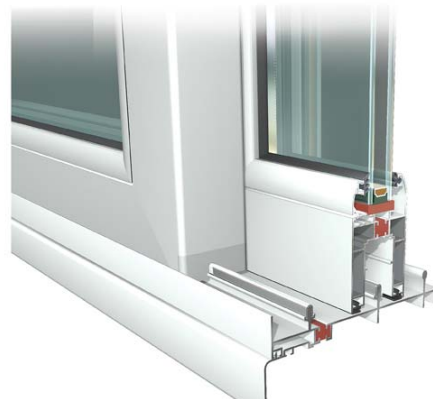
An alternative choice of the EPAL14200 systems with a pour & de-bridge thermo-break of polyurethane, are the EPAL14400 systems with a thermal barrier of polyamide, which is



mechanically placed to fill-in the thermo-break region along the aluminum profile. Polyamide is a polymer material providing the desired mechanical and physical characteristics due to its properties.

### **14600 Series**

The systems of EPALRR series are lifting & sliding for heavy use, made of thermal de-bridged aluminium with a pour & de-bridge thermo-break. These systems carry peripheral gaskets of EPDM and double window glazing for high thermal- and -sound isolation, respectively. The mechanisms are of special type, manufactured by SIEGENIA of Germany, and lock in 2, 3 or 4 points peripherally, depending upon the size of the frame, providing high security.



### **A3. HARDWARE**

The mechanisms used for the manufacturing of the EPAL door & window systems, are manufactured by SIEGENIA and ROTO of Germany and have a guaranty for 10 years. The mechanisms are adjusted peripherally in the window/door systems, include the hinges, lock in up-to 12 points and allow for tilting.

The hinges of entrance doors are of heavy-duty type, manufactured by HAPS of Germany. They are unique in the market and allow multiple adjustments. The hinges are part of the mechanisms.

Additional information on the mechanisms is provided in the technical brochures of the manufacturers.

#### **A4. INSULATING GLASS UNITS**

EPAL imports glass (float glass) from the biggest suppliers of the world, Pilkington, Saint-Gobain, Glaverbel etc.

All window and door systems carry standard double glazing of 4mm on the inside and 5mm on the outside, and a glass – spacer of 12mm or 16mm thickness between the two panes.

This design achieves a low thermal conductivity through the surface of the window. In addition, the difference in the thickness of the two glass panes results in an excellent performance with respect to sound insulation (36 dB\* from tests results according to ISO140/3-78 and ISO 717/1 – Test No.A6.121.96).

The sealing of the glass units is carried out initially by the use of an inner adhesive/sealant based on polyisobutylene (PIB), (a special adhesive/sealant which is placed along the sides of the glass – spacer) together with a two – component, solvent free adhesive/sealant as an external sealant.

These materials have high thermal resistance in temperature variations from – 30C up-to 80C and 160C in short exposure (up to 1h) and a low thermal conductivity. In this respect, there is a complete seal of the air in between the two glass panels and there is no contact with the atmospheric air of the environment, preventing fogging of the glass.

Besides the standard glazing 4 – 12 – 5 which has a U – Value of 2.8W/m<sup>2</sup> – K, EPAL uses special coated glazing units\*\* with gas mixtures inside to meet the requirements of the customers and the legislation in each country.

\* 36dB is the sound insulation achieved with the standard glazing. The highest sound insulation that can be achieved is 52dB.

\*\* Special soft – coated double glazing units with gas mixtures can reach the U – Value of 1.1W/m<sup>2</sup> – K.

## A5. GASKETS

All window & door systems carry three gaskets (two on the frame and one at the sash) at the perimeter to prevent water and air permeability and to achieve sound insulation.

The gaskets are made of EPDM and manufactured by PRODUCTA. EPDM provides excellent mechanical & physical properties, high resistance to UV radiation and weathering. In addition, the gaskets contain a special silicone additive to prevent their consolidation with the aluminum during the winter due to low temperatures.

**The technical specifications of EPDM are according to the following table.**

PROPERTY	UNITS	22 hrs/70 C	22 hrs/100 C	Standard
Hardness	Shore A	60-70	70-80	DIN 53505
Elastic Modulus (100%)	MPa	5,0-5,5	5,2-6,0	DIN 53504
Stress in break in tension	MPa	8,0-9,0	8,0-9,0	DIN 53504
Elongation at break	%	75-85	90-105	DIN 53504

## A6. PANELS

PANEL is a sandwich, which consists of two aluminum sheets with thickness 1,2 mm each and an intermediate sheet of 20 mm thickness as a thermal barrier, made of a polystyrene DOW type-material. The decoration of the panel is made of extruded aluminum providing perfect affinity of the painting to the aluminum. The panels are available in various designs and carry electrostatic painting according to the color of the door & window systems.

## **A7. PRODUCTION – INSTALLATION – TECHNICAL SUPPORT OF DOOR & WINDOW SYSTEMS**

### *Introduction*

The design, development, production planning and the installation of door & window systems of EPAL S.A. are fully specified and implemented according to an operating system, which meets the requirements of the following standards:

1. ISO 9001:2000 for quality management
2. ISO 14001:1996 for environmental management
3. OHSAS 18001 for health and safety

### **Procedures for design, planning and production**

The design of the door & window aluminum systems is carried-out through fully controlled procedures by the use of state of the art design tools (CAD –Computer Aided Design). The design is carried –out according to specific requirements with respect to the system and its elements.

Each new door & window aluminum system of EPAL, at the first stages of design control and product verification, is tested in the testing laboratory of EPAL as well as in external testing laboratories to examine its properties (i.e. air- and water permeability, sound isolation and mechanical strength), according to the requirements of international standards. The new product is approved and put in production only if the standard requirements are met. In any other case, changes and modification are introduced in the design, according to specified procedures to fully meet the standard requirements.

In addition, the design of all products of EPAL is reviewed throughout their whole life-cycle (i.e. from design to use by the customer), to improve their performance and their properties.

### **Procedures for planning and production**

All processes for planning and production of products, which directly or indirectly affect the quality of products or services, the environment, the use of resources and the health & safety of employees are under full and continuous control and inspection by the implementation of specific procedures and tools. In this respect, the processes of planning and production are fully monitored and controlled by the use of:

1. Information technology and electronic communication between various processes and operations in the company for information and data transfer, which eliminates human intervention and possible errors.
2. Software for planning and continuous monitoring of production to meet time requirements.
3. Automated and state-of-the art equipment in the production to meet specifications with the required accuracy and consistency in quality and manufacturing.

In addition, all necessary measures and actions are taken at any stage of the processes before and after the manufacturing of the end-product, such as storage, transportation and installation, according to specified procedures to fully protect and assure the quality of the products.

### **Installation of Window & Door Systems of EPAL S.A.**

All systems are installed with no need of any artificial additional frame, since they are adjusted directly to the wall by the use of special type supporting screws (High-Low) made of stainless steel for high resistance in corrosion. Any gaps between the wall and the frame after the adjustment of the frame to the wall with the screws (i.e. in the case of a wall of bricks) are filled-in with special foaming material of polyurethane. Silicone is added in both sides (i.e. external and internal side) for perfect insulation. The installation is carried-out by specialized technicians of EPAL S.A., who are exclusively employed in this task.

It is noted that the construction of an artificial frame between the wall and the door & window system causes serious problems, since the artificial frame:

1. Is affected by the asbestos of the wall.
2. Has different dimensional stability from the aluminum.
3. Does not achieve sufficient insulation between the wall and the door & window system.
4. Leads to electrostatic corrosion of the aluminum (galvanic corrosion).

### **Technical Support**

Technical support, whenever is needed, is provided throughout the life cycle of the door & window systems of EPAL by its specialized technicians. In this respect, EPAL considers that its commitments its customers do not end just at the time of installation.