PLASTIDITE

ACRIDITE

Cast acrylic sheets of synthesis

1. General description

Cast acrylic sheets ACRIDITE are polymethyl-methacrylate (PMMA) obtained from pure monomers of synthesis.

The material is an acrylic, organic, rigid, thermoplastic glass, with elevated transparency and clearness; it is suitable to being worked with multiple systems, typically those used for hard wood, and also to being hot-molded; suitable to being cut with laser and being welded with different specific adhesives.
Resistant to the weather conditions and solar light, therefore suitable to external exposure.
The material is slowly flammable (like hard wood) with reduced smoke emission (Euroclass E).

The colourless transparent acrylic sheets have a light transmission and a clearness higher to common glass, compared to which they are considerably more resistant to accidental collision breaks or to solicitations for production and have a better thermal isolation coefficient compared to the single glass.

The range sheets are plane, rectangular, available in different dimensions, with variable thicknesses from 2 mm to 30 mm and superficially protected with polyethylene film.
The finishing of the surfaces is normally smooth, moreover are available in range also: the sheets satin on one or both faces, the speckled sheets and other effects of the texture for special requests.
Plane faces as well can be easily worked.

In range are available the standard and special qualities, both colourless transparent and in translucent version, that is opalines with various transmissions and light spread; in range there is wide availability of transparent colourations, full or fluorescent shade, and particular chromatic effects mainly dedicated to the design for furnishing.

Are available acrylic sheets with the following specific characteristics:

ACRILPAN ™	: acrylic sheet abrasion resistance
ACRISUN	: acrylic sheet transparent to the UltraViolet radiation
ACRILED	: acrylic sheet dedicated to Led lighting system
ACRILSHIP	: acrylic sheet with improved dimensional and chemical stability

2. Mechanical properties

Ref. : transparent colourless sheet, thickness 3 mm if not differently specified, datas at 23°C and UR=50%

Density	1,20	g/cm^3	ISO 1183-1
Charpy resilience without notch	15	kJ/m^2	ISO 179/2D - DIN 53453
Notched Izod resilience	1,6	kJ/m^2	ISO 180/1A - ASTM D256A
Tensile strength	75	MPa	ISO 527-2/1B/5
Tensile strength at 70°C	40	MPa	ISO 527-2/1B/5
Tensile strength at - 40°C	100	MPa	ISO 527-2/1B/5
Elongation at break	5,0	%	ISO 527-2/1B/5
Flexural strenght	115	MPa	ISO 178 (5mm/min)
Compression resistance	130	MPa	ISO 684 - DIN 53454
Modulus of elasticity	3300	MPa	ISO 527-2/1B/1 rapid test
Flexural modulus of elasticity	3100	MPa	ISO 178 (1mm/min)
Tangential modulus of elasticity	1700 G	10 MPa	ISO 537 to Hz
Dynamic torsional modulus	1700	MPa	DIN 53445
Rockwell Hardness (scale M)	100		ISO 2039 - ASTM D 785
Shore hardness (scale D)	65		ISO 868
Scratch resistance (load N=0,9)	4 E		DIN 68861:2011 part 4
Poisson Coefficient	0,37		ISO 527-1 (5%/min)

3. Optical properties

Ref.: transparent colourless sheet, thickness 3 mm if not differently specified, datas at 23°C and UR=50%

Visible light transmission	>= 92	%	380 - 780 nm	ISO 13468-1
Clearness (haze)	< 0,5	%		ISO 14782
Refractive index	1,49			ISO 489-DIN 3491
UV-A radiation transmission	<=3	%	315 - 400 nm	DIN 5036 Part 3
UV-A radiation transmission (25 mm)	0	%		
UV-B radiation transmission	0	%	280 - 315 nm	DIN 5036 Part 3
UV-C radiation transmission	0	%	100 - 280 nm	DIN 5036 Part 3
IR-A radiation transmission (NIR)	85	%	750 - 1400 nm	DIN EN 410
IR-A radiation transmission (25 mm)	50	%		
IR-B radiation transmission (SWIR)	50	%	1400 - 3000 nm	DIN EN 410
IR radiation transmission	0	%	> 3000 nm	DIN EN 410

The colouration of the sheets reduces considerably the light transmission in relation to the intensity of the colour and the opalescence up to eliminate it in case of full covering shades.

The sheets are resistant to the external exposure both to the solar rays and to the atmospheric agents keeping the original characteristics for a long time.
Coloured sheets are produced with pigments stable to the external exposure.

4. Thermal characteristics

Ref.: transparent colourless sheet, thickness 3 mm if not differently specified, datas at 23°C and UR=50%

Vicat softening temperatures	~ 109	°C	ISO306-DIN53460-ASTMD1525
Deformation temperature	> 85	°C	ASTM D 648
Max operating temperature	~ 80	°C	
Molding temperature	130 - 160	°C	
Max surface temperature	200	°C	
Cargo bending temperature	98	°C	ISO 75-2/A
Linear withdrawal after heating	~ 2	%	UNI EN ISO 7823-1 App. 3
Linear expansion coefficient	~ 0,07	mm/m °C	DIN 53752-A (T = 0 - 50 °C)
Fire resistance class	E		DIN EN 13501 Euroclass
Fire resistance class	3		BS 476, part 7 + 6
Fire resistance class	B 2		DIN 4102
Fire resistance class	HB		UL-94HB, IEC 60695-11-10, ISO 9772
Fire behaviour	M 4 not dripping		NF P 92 501, 505
Fire behaviour	TP (b)		BS 2782 method 508 A
Combusted gas volume	very low		DIN 4102
Combusted gas toxicity	not		DIN 53436
Combusted gas corrosivity	not		DIN VDE 0482-267
Oxygen index	18	%	ISO T 5107 - ASTM 2863 77
Chlorine level	0	%	
Nitrogen level	< 0,02	%	
Autoignition temperature	425	°C	DIN 51794
Flame ignition temperature	280 - 300	°C	DIN 51794
Combustion heat	26,000	KJ/Kg	
Specific heat	1,47	J /g K	ASTM C 351
Thermal conductivity	0,19	W /m K	DIN 52612
K coefficient of thermal isolation:			
3 mm thickness	5,4	W /m^2 K	ISO 12567-1
4 mm thickness	5,2	W /m^2 K	ISO 12567-1
6 mm thickness	5,0	W /m^2 K	ISO 12567-1
10 mm thickness	4,5	W /m^2 K	ISO 12567-1
15 mm thickness	4,2	W /m^2 K	ISO 12567-1
19 mm thickness	3,9	W /m^2 K	ISO 12567-1
22 mm thickness	3,7	W /m^2 K	ISO 12567-1
25 mm thickness	3,4	W /m^2 K	ISO 12567-1

5. Acoustic characteristics

Ref.: transparent colourless sheet, 3 mm thickness if not differently specified, datas at 23°C and UR=50%

RW sound insulation	25	dB	ISO 140
RW sound insulation (6 mm)	30	dB	ISO 140
RW sound insulation (10 mm)	32	dB	ISO 140
Speed of sound	2,700	m /s	

6. Electrical characteristics

Ref.: transparent colourless sheet, 3 mm thickness if not differently specified, datas at 23°C and UR=50%

Dielectric rigidity	20 - 25	KV/mm	DIN 53481
Pd mass resistivity	$> 10^{15}$	Ohm * cm	DIN 53482 VDE 0303 part 3
Ro surface resistivity	$5 * 10^{13}$	Ohm	DIN 53482 VDE 0303 part 3
1mm perforation resistivity	30	kV /mm	DIN VDE 0303 part 2
Dielectric constant (50 Hz)	3,6		DIN 53483 VDE 0303 part 4
Dielectric factor idex (50 Hz)	0,06		DIN VDE 0303 part 4
Stray currents resistance (CTI)	600		DIN VDE 0303 part 1

7. Physical characteristics

Ref.: transparent colourless sheet, 3 mm thickness if not differently specified, datas at 23°C and UR=50%

Max water absorption in 24 hours	0,2	% weight	ISO 62 - DIN 53495
Max water absorption in 8 days	0,5	% weight	ISO 62 - DIN 53495
Permeability coefficients:			
Water vapour	$2,3 * 10^{-10}$		g cm/cm^2 hPa
Nitrogen	$4,5 * 10^{-15}$		g cm/cm^2 hPa
Oxygen	$2,0 * 10^{-14}$		g cm/cm^2 hPa
Carbon dioxide CO2	$1.1 * 10^{-13}$		g cm/cm^2 hPa
Air	$8,3 * 10^{-15}$		g cm/cm^2 hPa

8. Chemical characteristics

Ref.: transparent colourless sheet, 3 mm thickness if not differently specified, datas at 23°C and UR=50%

Sheet component	: polymethyl methacrylate (PMMA)
CAS number	: 009011-14-7
Physical structure	: amorphous atatic polymer
Avarage molecular weight	: $3 * 10^6$ estimated

The chemical resistance of the sheet depends on the thickness and increases with its increase.

The contact conditions are decisive for the outcome of the chemical resistance: we must estimate the time of contact, the temperature necessary and the modality which can be: immersion in the substance, contact with its vapours, or contact for extended rubbing, short or short and repeated with many pauses as for example during the cleaning of the sheet.

The deterioration of the surface, or even of the sheet, is much sensitive to the temperature, therefore in case of contact with substances or with mixtures of substances apparently of discreet compatibility with moderate effects, the result could be more and more negative with increasing temperatures.

Moreover, the chemical resistance is compromised, or considerably diminished, if the sheets are exposed to curvings also light, and/or mechanical tensions, as in the event of implantation in structures lacking the appropriate precautions while installation, as later described. (see paragraph 15.12).

The material has a different behavior towards resistance to the chemical aggression according to the kind of substance or mixture of the substances about which some approximate information are listed later.

Attention must be paid to the composition of the substances with which there could be contact with products dedicated to common use sectors as perfume shops, cosmetics, beauty, pharmaceuticals and cleaning.
Datas reported are approximate, and considering also the variability of the thermal and mechanical conditions of the contact, an evaluation test must always be performed.

8.1 Substances with good chemical resistance

Outcome lacking visual effects except possible strains.

Water solutions	: water, hydrogen peroxide 40%, various salines, bleach, soaps, urines.
Alkaline solutions	: ammonia, soda, ammonium salt, potash.
Solvents	: ethanol 15%, methyl alcohol 15%, glycols, formaldehyde 40%, petroleum ether.
Hydrocarbons	: hexane, heptane, octane, aliphatics in general.
Acidic solutions 10%	: of acetic, formic, nitric, phosphoric, sulphuric, hydrofluoric acid.
Acidic solutions 50%	: of tartaric acid.
Pure acids	: hydrochloric, citric, oxalic, lactic, fat, stearic, amino and batteries acids.
Oils and fats	: mineral oil, olive oil, pine oil, glycerin and fats in general.
Various substances	: sulfur, mercury.
Gas	: oxygen, ozone, carbon dioxide, carbon monoxide, methane, butane, propane, ammonia.

8.2 Substances with moderate chemical resistance

Outcome with possible softening, swelling and cracks.

Aqueous solutions	: hydrogen peroxide > 40%, varies pesticide.
Solventi	: ethanol at 30%, methyl alcohol at 50%, propyl alcohol at 50%, butyl alcohol, ragia mineral, turpentine.
Hydrocarbons	: petrols, diesel oil, jet-fuel, coal oil.
Acidic solutions 25%	: of acetic acid.
Acidic solutions 50%	: of formic acid, nitric acid, phosphoric acid, salicylic acid.
Pure acids	: lactic, sulphuric.
Oils and fats	: silicone oil, paraffin, vegetable oil.
Gas	: freon, dry chlorine, dry bromine.

8.3 Substances not recommended for contact

Immediate damage: melting, strong swelling and cracking.

Aqueous solutions	: hydrogen peroxide at 90%.
Solvents	: acetone, aniline, acetates, ketones, ethers, ethanol at 50%, diaceton alcohol, phenols.
Hydrocarbons	: chlorinated, xylene, toluene, benzene.
Acide solutions 50%	: of acetic, hydrochloric acid.
Pure acids	: glacial, formic, nitric, phosphoric, sulphuric acids.
Various substances	: butyl lactate, phthalates.

8.4.1 Cleanser (chemical resistance)

Good	: alcohols at 30%, ammoniacal, soda, soap solutions, oil ether.
Moderate	: turpentine, paraffins.
Not compatible	: chlorinated, strain removers, pure alcohols.
Notes	: alkaline and acids see paragraphs 8.1, 8.2, 8.3. see paragraphs 15.3, 15.9, 15.10, 15.11 and 15.12.

8.4.2 Disinfectants (chemical resistance)

Good	: bleach, aqueous bleaches at 5%, hydrogen peroxide at 40%, iodine-iodurate solutions, mercuric solutions.
Moderate	: hydrogen peroxide > 40%.
Not compatible	: antiseptics, iodine dyeing at 5%, phenolics.
Notes	: see paragraphs 15.3, 15.9 and 15.12.

8.4.3 Paints and inks (chemical resistance)

Good : strippable protectives Grip-Mask type ™
non-aromatic hydrocarbons, oil paintings as well.
Moderate : acrylics
curing acrylic with Ultra-Violet radiation
generally spray
Not compatible : nitro cellulosics
generic thinners, chloride thinners, acetone and ketones, diaceton alcohol.
Notes : see paragraphs 15.3, 15.9, 15.11 and 15.12.

8.4.4 Adhesive and sealants (chemical resistance)

Good : neutral silicone (not acetic)
cyan acrylic glue
not plastic foams
Not compatible : acetic silicone
plastic foams
Notes : see paragraphs 15.3, 15.9, 15.10, 15.11 and 15.12.

8.4.5 Plastic materials (chemical compatibility)

Good :	PE	(polyethylene)
	PP	(polypropylene)
	PTFE	(poly tetra fluoro ethylene, Teflon ™)
	FKM	(carbon fluorine rubber, Viton ™)
	PA	(polyamide, Nylon™)
	PVC	(poly vinyl chloride) rigid type
	EPR	(ethylene propylene rubber)
	EPDM	(ethylene propylene diene rubber, Vistalon ™)
	CR	(poly chlorine butadiene rubber , Neoprene™)
		rigid rubbers
Not compatible :	PVC	(poly vinil chloride) plastic type
	GR-P	(polysulphides, Thiokol™)
	PUR	(polyurethanes) foam moulding type
		plasticised soft rubbers

Notes : the indications are orientative as every type of plastic material or elastomer depends on the formulation of the mixture, on the curing system and on the working technique (for every type indicated see the different degrees of material available).
see paragraphs 15.3, 15.10.4 and 15.12.

8.4.6 Building materials (chemical compatibility)

Good : cement, mortar, plaster.
Moderate : hot bitumen.
Not compatible : bituminous emulsions.

8.4.7 Chemical baths (chemical resistance)

Good : electrodeposition, photographic baths.

8.4.8 Food (chemical resistance)

Good : meat, fish, salt, pepper, ice cream, milk, honey, chocolate, marinate, beer, wine, spirits to 30%, coffee, tea, mineral waters, fruit juices.
Moderate : coffee berry.
Notes : see paragraph 12.

9. Standard specifications

9.1 Supply thickness

Thickness measurement sampling is performed with ultrasound equipment.

The standard supply includes the following tolerances for thickness from 1,50 mm to 25 mm and surfaces within 6 square metres for each slab and between sheet and sheet:

+/- (0.4 mm + 0.1 * s) where "s" is the nominal thickness of the sheet, expressed in mm (UNI EN ISO 7823-1).

9.2 Plane sheet dimensions

Size tolerances (UNI EN ISO 7823-1):

Side dimension (mm) < 1,000	+ 3 mm
Side dimension (mm) 1,000 - 2,000	+ 6 mm
Side dimension (mm) < 2.000 - 3.000	+ 9 mm
Side dimension (mm) > 3.000	+ 0,3 %

9.3 Sheet flaws

Surface flaws and mass inclusion flaws are considered acceptable if <= 3 mm^2 and far-between 500 mm while are considered negligible if <= 1 mm^2 reasonably distributed, in agreement with the customer (UNI EN ISO 7823-1).

9.4 Colour

The colour has to be homogenous at sight.

Coloured sheets are measured on sampling with reference to CIELAB norm illuminating source D_{65} (regulation UNI 8941).

The reproductive fidelity of colours is liable to tolerances typically dependent on the industrial scale in relation to plant factors subject to variations.
Therefore the colour reproducibility in production scale is subject to tolerances and deviations both by the standard colour range and by laboratory samples.

Production standards are usually maintained with tolerances of DE <= 0.7 unless specific requests agreed beforehand during negotiation (UNI EN ISO 7823-1).

Possible further production, executed from the purchaser and/or its customers, can alter the colour shades, both in relation to the adopted techniques are in relation to the type of colour.
Typically the alterations of colour depend on the thermal factor together with the time employed in the thermoforming (see paragraph 15.4) and in the laser cutting where the alterations mainly appear on the edge of the sheet (see paragraph 15.3).

The production of special coloured materials, that are outside the standard expected by the colours range, requires a specific preparation liable to shade variation from lot to lot. The most solid precision of the shade can be guaranteed only for minimum lots to be expected during the negotiations and/or with the purchase of the colouring, necessary also for further productions, whether the purchaser has a delivery schedule, also divided into minimum lots, to be agreed upon from time to time.

9.5 Surface appearance

The measurement of the sheet surface brilliance (gloss) is performed with an illuminant source D 65 /10° (regulation DIN 67530) provided for guidance.

10. Storage conditions

10.1 General characteristics for the warehouse

An overweight in stacking and/or imperfect support may cause an alteration of flatness especially with heat (avoid temperatures above 40° C).
Preserve the sheets repaired from heat and direct sunlight.
Outdoor storage may compromise the flatness for excess heat and also damage the protective film making difficult its removal for productions.

Store the sheets horizontally on the pallet supplied or surface-mounted on wagons and/or vertical oblique frames at about 80° to avoid capsizing.
It is important not to stack pallets on top of each other to avoid excessive load pressure which compromises the flatness.

The sheets should be stored with the protective film that protects them from scratches and dirt; sheets tend to charge electrostatically and the film avoids the accumulation of electric charge.
Handling must be done with care to ensure that the protective film remains intact for the protection of the same.

Keep away from solvents and aggressive chemical agents (see section 8.2 and 8.3).

Personnel assigned to warehouse operations must have protective equipment expected for safety such as gloves and safety shoes.
The edges of the sheets is often sharp: we recommend the use of gloves when handling.

Avoid sources of ignition such as flames, sparks and electrostatic charges, smoking is forbidden in the premises.
Rooms used as warehouse must meet the general requirements for electrical installations.

Specific signs expected for workers safety in the premises are suggested.

10.2 Fire safety measures

Suitable fire extinguishing means are: foam, dry powder or CO_2, nuke water.
Generally direct water extinction is not suitable.

In case of fire carbon monoxide, carbon dioxide and harmful and irritant organic decomposition products like methyl methacrylate are generated.

General advice for fire extinction responsibles are: rebreathers, chemical agents gloves resistant, accident-preventive boots resistant to solvents and chemical agents, head protective helmet.
Materials usually suitable for chemical agents are neoprene and vinyl rubber.
Appropriate individual protective equipment and in compliance with EN 469.

Isolate the area involved by unrelated people.

General first aid advice in case of exposition to combustion:

1. In case of doubt, or when symptoms persist, contact a doctor.
2. Late effects to exposure may be possible.
3. It is advisable to take the person to fresh air and keep at rest and warm.
4. Keep a position favourable to breathing.
5. Do not drink nor eat nor smoke.

Main symptoms in case of exposure to combustion are:
headache, stunned condition, skin and eye irritation, allergic skin reaction even with delayed effect and possible respiratory irritation.

11. Information on material security

11.1 Dangerous material components

Risks	:	Item not dangerous in normal manipulation and employment conditions. Item not labeled in compliance with the Regulations 1272-2008 EC. Security sheet not necessarily in compliance with Regulation 1272-2008 EC.
Components	:	No component classified as dangerous.
REACH legislation Reg. 1907-2006 EC	:	Compliant material.
Components Allergenic	:	No allergenic component. Possible traces of methyl methacrylate (CAS N° 80-62-6).
CMR components	:	No CMR components (carcinogenic substances, mutagenic or toxic to reproduction)
PBT components	:	No component classified as dangerous. No PBT components (substances that are persistent, bio accumulative and toxic) No vPvB components (very persistent and/or bioaccumulative substances).
SVHC components	:	No SVHC component (substances of high concern for health). Variously coloured plates may contain traces of contaminants such as heavy metals like lead, mercury, cadmium, chromium III, chromium VI, antimony, selenio, arsenic and other possible according to the colour.
Various component	:	The material does not contain components such as phthalate plasticisers, flame retardant (PBB and PBDE), bisphenol-A (BPA), polychlorophenyls (PCB and PCT), formaldehyde , chlorofluorocarbons (CFC).

12. Information on the material use in special cases

Food directives

Reg. 10-2011 EC Reg. 1935-2004 EC Reg. 1895-2005 EC Reg. 2023-2006 EC	:	The material has a macromolecular nature deriving from process of polymerization with possible minimun risk for health in products, containers and exhibitors intended for food. According to the regulation however, specific tests must be carried out that consider a possible release of substances from relative migration to the final use conditions such as contact duration, temperature and specific food simulant (Reg. 1935-2004 EC). Coloured sheets, or special sheets, may contain additives, colouring agents, and traces of impurity potentially migrant in food and therefore have to undergo a specific test for employment. The processes brought to the product could determine alterations of the polymeric matrix; moreover also the materials used during construction such as glues, inks, varnishes and adhesives have to pass the test. In all the use cases expected, the restriction of the norm concerning the final use for infants and children are applied. Specific declarations of conformity must be supported by analytical tests concerning the final use conditions expected by the customer.

RoHS 2 directive
Reg. 65-2011 EC : The material is suitable and respects the restrictions of specific dangerous components in the electrical and electronic equipments (AEE).

Toys directive
Reg. 48-2009 EC : With reference to the norm shall be carried out specific tests.
Estimate the degree of flammability.
No allergenic and/or dangerous component.
No aromatic amine component.
Possible presence of migrant substances according to the colour.
Possible traces of contaminants (see SVHC components).

Packing directive
Reg. 62-1994 EC : No component classified as dangerous.
Possible presence for cadmium, chromium VI, mercury, lead: < 100 ppm.

Euratom directive
Reg. 26-1996 EC : No component classified as radioactive.

Medical Devices Directive
Reg. 42-1993 EC : The material is a polymer highly bio-compatible, however specific tests have to be carried out according to the legislation.

13. Waste disposal information

13.1 Waste disposal

The treatment of the production waste does not create particular environmental problems, moreover the cuttings, solid particulates and the powders of the productions have to be collected and disposed as special waste.

Waste are recyclable with processes of cracking at very high temperature allowing the regeneration of methyl methacrylate.

Wastes are not biodegradable.

Production trimmings and sheet cuttings must be disposed by companies authorized to transport hazardous waste with the encoding of the European List of Wastes:

LoW code : 07 02 13
Waste description : Wastes from the manufacture, formulation, supply and use (MFSU) of plastics, synthetic rubbers and man-made fibers - plastic wastes

14. Transport information

14.1 Transport information

ADR - RID : Not dangerous material.
Overland transport

IMDG - IMO : Not dangerous material.
Maritime transport Reg. 59-2002 EC (MARPOL) : Not applicable.

ICAO-TI : Not dangerous material.
Air transport

Preferential origin : Material not listed in the goods which undergo a Community control and relative licences.
Reg. 750-2013 EC, Reg. 1232-2011 EC, Reg. 1005-2009 EC, Reg. 116-2009 EC, Reg. 1236-2005 EC, Reg. 267-2012 EC, Reg. 1523-2007 EC, Reg. 842-2006 EC.

15. General sheets manufacturing techniques

15.1 Security protection information

Use individual protective equipment in relation to the type and the method of processing.

Sheets are heavy and cumbersome: handle with care, wear gloves and accident-prevention shoes.
If broken or cracked, the edges are sharp and can cause skin cuts.
Powders and wood waste deriving from millers cut are dangerous because they can cause irritations due to small cutaneous lesions also to the eyes and also for accidental ingestion.

Work in areas protected from flames and sparkles with an electrical system suitable with the present legislation reminding that there could be static discharges and therefore the ground link systems must be active.

Ensure an adequate air turnover of the working area.
If the natural ventilation turns out as insufficient, use a localised aspiration as cut powder formation is possible.

The material can generate decomposition vapours in small quantity if worked at high temperatures, over 250° C, as in laser cutting (see paragraph 15.3).
It is impossible to determine exactly the vapours generated because they depend on the parameters used in the cutting process, on the cooling gas, on the film protection and any decoration applied to the sheet.

Most of the high-temperature vapours generated by the sheets are still made of methyl methacrylate (CAS N°. 80-62-6) and, minimally, from methyl acrylate (CAS N° 96-33-3).
Respiratory irritation and allergic phenomena are possible.
Sheets, moreover, do not contain ethyl acrylate (CAS N° 140-88-5) which may cause toxicity in these gases.

In laser processes it is recommended an adequate localised aspiration on board of the machine near the saw head and preferably also a ventilation for air turnover in the manufacturing environments.

15.2 Millers cutting

These operations produce hard and sharp wood wastes therefore it is recommended to use protective glasses.
Use headphones during mechanical processing with tools and / or machinery which exceed the prescribed noise thresholds in relation to personal exposure times.

Straight cut can be executed with circular saw blades with Widia teeth, pitch 3-4 mm, speed <= 3,000 m/min, progress speed 5 m/min, possible cut of several sheets together.
With blades in high speed or super express steel with protruding teeth it is possible to cut single sheets, speed <= 3,000 m/min, progress speed 15 - 25 m/min.
Curved cut with band saw blade for metals, cemented gear, teeth pitch of 1 mm, suitable also for sheets of middle-up thickness, the cut is not clean and requires a further finishing.

Millers cutting allows improved finishings and shiny edges if used diamond tools; the rotation speed is 10.000 - 30,000 turns/min, it is advisable to re-cook the piece in furnace (see paragraph 15.7).

15.3 Laser processings

Usually recommended the CO_2 - laser in order to optimize the power and the costs of complex working of the sheets.
The laser emits a beam of aligned and concentrated light which is absorbed by the material, at optimal wavelength, which causes vaporization along the incision track. The result is a concentrated thermal stress which depends on the cutting power, on the progressing speed and on the impulses of the laser beam.
The excavation created melts and vaporizes generating gases which, preferably, have to be able to get out of the material so that the edge is of excellent quality which means shiny, roughness free, non-corrugated and perfectly squared.

As far as the vapors generated with the cutting is concerned, see safety paragraph 15.1.

The resultant quality of the edge is closely dependent on the thickness of the sheet: flaws are more visible with the increase of the thicknesses.

Normally an increase in power, at equal advancement speed, gives shinier edges but increases the stress of the material in the areas near the cut.
Normally a greater advancement speed with greater pulsations gives less shiny edges but minor stress for the material.
Pay attention to the corners where more stress is concentrated due to the intersection of two cut edges.

Laser cut produces a strong heating localised along the cut track on the side of the beam, the material melts while on the opposite side it cools with a shock given by the thermal jolt.
Working at low power and reduced pulsation together with relatively rapid advancement speed, the heat absorbed by the sheet decreases and so the thermal shock is reduced.
In this case the edges are less shiny and can subsequently be finished with diamond tools (see paragraph 15.2).

Thermal stress locally weakens the sheet and there might be cracking phenomena when jointed (see paragraph 15.10), when applying decorations (see paragraph 15.11), when the sheets are mounted in frames and/or structures (see section 15.12) or when cleaned with unsuitable cleaning agents (see section 15.9).

In all cases the cracks can be reduced or even eliminated with a subsequent operation of tempering-hardening (see section 15.7).

Usually laser cutting machines are equipped with an inert gas injector that removes vapors generated and improves cut quality reducing small flames, carbonization, and unwanted residues.

The protective film of polyethylene sheets does not melt during the cut, its good adhesion prevents the detachment protecting the edge from heat and vapors generated.
Also films with reduced adhesion can be used, in this case, the detachment can be controlled by reducing the pulsations or the cutting power.
Can also be used non-adhesive films which do not leave cutting edges waste, usually are slightly more adherent after the passage of the laser beam.
In order to maintain the original optical characteristics of the sheet, it is advisable that the films are wrinkles free, in this case small imprints could appear due to vapour trapping generated preferably on the side exposed to the laser beam.

We recommend proper maintenance of the laser machine and in particular of the optical group which tends to get dirty and fuzzy, in that case the cut quality degrades: it is therefore suitable not only routine maintenance but also control power parameters, adapting them to the thicknesses, after a certain period of work.

Variously coloured sheets can be laser cut, moreover, given the different resistances both thermal and optical at various wavelengths of pigments, there may be variations in shade on the cut edges.
Tests must be carried out, from time to time, in order to check the suitability to processing of the colour, also according to the cutting parameters set on the machine.

Laser can be used also for the welding of the material to itself or to other plastic materials.
The welding is possible with thermoplastic materials (TPU) and not with elastomeric and thermoplastic materials.
The temperatures of fusion of the materials should coincide or at least be similar.

The difficulty level of the welding depends on the transparency of the material from the side of the laser beam and on the heat absorption of the material on the opposite side.
The welding becomes progressively more difficult if from the side of the beam the material is transparent (easy) - black - coloured - white.
The welding progressively becomes more difficult in case the material on the other side of the beam is black (easy) - coloured - transparent - white.

Good weldings are obtained between PMMA and:

PMMA	
ABS	(acrylonitrile-butadiene-styrene copolymer)
PC	(polycarbonate, (Makrolon™) only if the PMMA sheet is from the side of the laser beam
SAN	(Styrene-acrylonitrile copolymer)

Decent weldings are obtained between PMMA and:

POM	(polyformaldehyde)
PS	(polystyrene)

Difficult weldings are obtained between PMMA and:
- PE (polyethylene)
- PP (polypropylene)

PMMA not weldable with:
- PA (polyamide, Nylon™)
- PES (polyetersulfone, Ultrason™)
- PBT (poly butylene terephthalate, Ultradur™, Crastin™)
- PPS (poly phenylene sulphide, Ryton™)

See also bonding and junction (paragraph 15.10).

15.4 Thermic moulding and curving

Process to be performed at the temperature most suitable for the mould and for the object, between 130°C and the 160°C for an avarage period of approximately 3 - 4 min for every mm of thickness.

The behavior of the hot material is isotropic with the maximum withdrawal of 2% in all directions.
Later the sheet can be hot worked.

Thermoforming can occur by simple lay down on the mould.
The desired shapes can be created also with pressing through punch mould.

Processing can be done with depression action through the creation of void, or on the contrary, at pressure for air injection: in these cases the mechanical lenghtening of the sheet can create thickness variations in the artifact not dependent on the quality standards of the original sheet.

The cooling following the heating of thermoforming has to last as long as the sheet gradually reaches at least 60°C.

The thermoforming does not alter some original properties such as transparency, weather conditions and sunrays resistance, mechanic characteristics, surfaces characteristics such as satin finish.
On some colours it can produce a variation of shades that depends on the colour, the temperature reached and the time of exposure at that temperature: for reasons already said, being problems related to modalities of the working, the buyer has to perform a preliminary test that must estimate the possibility of being able to execute such working in the specific cases, the supplying company cannot therefore guarantee the quality and the constancy of the final result.

Before thermoforming check the integrity of the protective film in order to avoid blemishes and fingerprints on the finished product, perform preliminary tests to estimate whether the film is suitable for this process, or if it should be removed: the responsibility for this task is of the user.
The protective film is less resistant to heat on satin surfaces.
A long exposure of the protective film to high temperatures can cause a lower adhesiveness and can leave indelible signs on the sheet surface.

15.5 Bending

The bending is executed with localised heating, along the folding line desired, through electrical resistors supplied with low tension current, over 5 mm are suggested two resistances opposite the sheet faces, the width of heating must be almost twice as much the sheet thickness or 5 times bigger in case of straight fold, avoid excessive thermal shocks using wooden shapes and pay attention to possible grooves and deteriorations of the surface integrity of the sheets.

15.6 Drilling

Drilling with straight or conical twisted points, very fast, at carbide or Widia: frequentelly remove the tip in order to eliminate the wood wastes.
Tillage with high speed steels or high speed Widia.
Spin-forming as for high speed and slow advancement light metals possibly cooling with water and oil at 2%.

15.7 Annealing (toughened)

The sheet has to be annealed in the furnace in order to eliminate or at least to reduce the material inner tensions and the possibility of cracks formation.

The duration of the minimun annealing is of hours h = 2 + 0,3 * s (mm) at 70 - 80 °C with slow final cooling in furnace.

15.8 Polishing

Use soft non abrasive felts and car-refinishing polish at 900-1200 speed turns/min working without excessive pressure in order to avoid overheating and consequent “burns” (see paragraph 8).
The eventual smoothing for marked imperfections has to be performed with water abrasive papers.

It is possible to executed flame polishing at high temperature on enough regular edges for transparent sheets; use oxyacetylene torch at 2.700 – 2.900 °C with oxidising flame (oxygen regulated in excess); the operation creates strong tensions deriving from the thermal shock and consequent possible defects of resistance in the time and to the chemical products including glues.

15.9 Cleaning

Sheets without protective film normally load static electricity and, therefore, tend to attract dust.

Light dirt has to be removed with a soft and non-abrasive cloth, damp and without pressure in order to avoid scratches. Preferably use water based antistatic cleanser Cleaner CL 70.

The cleaning must be carried out only on sheets at room temperature and never under sunlight or hot conditions.

Use solvent based antistatic cleanser Cleaner DCL 80, in the case in which adhesive rests must be removed from adhesive stripes or part of adherent protective film, especially when sheets are aged.

Use solvent based cleanser Cleaner DCL 20, in the case in which rests of Collacryl adhesives must be removed, provided that it has to be done immediately after their application, in order to avoid or reduce rings and labeling on the sheet.

It is possible to use all the detergents usually indicated for glass or alcohol in solution for short contact and rapid use without exceeding in the quantity.

Graffiti removal can be performed with toluene based products, profusely pour the part avoiding the contact with the sheet where not soiled. Allow to react for almost 5 minutes and remove with a soft cloth.

Repeate as long as the graffiti is removed.

The hardened parts of the graffiti can be carefully removed with a plastic penknife, not metallic and/or too sharp. Wash the area with water and a bit of soap to remove the residuals.

Always control the chemical composition of other possible detergents before the use (see paragraphs 8.4.1 and 8.4.2).

15.10 Bonding and joint

15.10.1 Solvent glues

Special solvents based Collacryl adhesives act through partial dissolution of the surfaces to be welded and through evaporation and radiation of the solvents in order to create a solid bond of the two joined parties.
The pairs obtained are totally transparent and colourless, very solid and free of bubbles; good thickness fillers can also be executed.

The solvent based adhesives are not ideal to the bond of very extended flat surfaces as in the central areas there might be an excess of retention of the solvents and the resulting formation of bubbles.
Solvent based adhesives can also be used with the dipping technique, prior covering of the parts not involved with PE bands and films, polyester or cellulose acetate.
The submerged surface softens in a few seconds (see specific setting times), and then it must be bonded with the second part kept firm for at least 30 seconds until the initial stabilization of the bond.

Adhesives have to be chosen according to rapidity and viscosity.
Remember that usually there are volume retreats after curing.
The presence of possible opalescence in the junction shows excessive environmental humidity and compromises the final toughness of the bond.

Range available also in order to weld laser cut edges (see paragraph 15.3).

They can be exposed to external light and weather conditions with improved performance whether subjected to further annealing (see paragraph 15.7).

Suitable for transparent colourless or coloured acrylic sheets and also coloured with a covering paint and allow very rapid initial grip.
In case of coloured sheets, colour migration phenomena can occur.
In the case of very covering coloured sheets (for example white covering) reductions in the bond final toughness may occur.
In the case of satin sheets the surface aesthetic appearance is modified.

Further working processes can be performed already after the hardening, preferably after 3 hours, in any case, bear in mind that the stabilization will be definitive after 24 hours.
The heat tends to shorten the hardening process and could produce the formation of cracks, obtaining a lower final tenacity.

To join small surfaces it can be used also cyanoacrylic adhesive with rapid grid.

15.10.2 UV reactive glues

Collacryl adhesives based on special monomers act for partial dissolution of the surfaces to be welded and to subsequent polymerization if irradiated with ultra-violet radiation (UV) so as to create a new layer of PMMA solidly engaging the two sides together.

The pairs obtained are totally transparent and colourless, very solid and bubbles free; fillings to thickness can also be executed.
In case of very fluid glues can be used for capillary pairs, as for example in right angle joints.

Adhesives have to be chosen according to rapidity and viscosity.

Usually unsuitable to laser-cut edges junctions.

They can be exposed to external light and weather conditions with improved performance whether subjected to further annealing (see paragraph 15.7).

Suitable for colourless transparent or slightly coloured acrylic sheets and allow very rapid bonds, but are not suitable for full shade coloured sheets because of the impossibility of radiation.
In the case of satin sheets the surface aesthetic appearance is modified and the hardening is slowed.

The further working processes can be performed already after the hardening, preferably after a couple of hours, in any case, bear in mind that the stabilization will be definitive after 24 hours.
The final stabilization is obtained at least after 24 hours after the sunlight exposure, if occurred within the time and in the way expected, or at least 48 hours in case of shortened times.
The heat tends to shorten the hardening process and could produce the formation of cracks, obtaining a lower final tenacity.

After the application they can be immediately exposed to Ultraviolet radiation.
Check that the entire welding is then exposed to light for hardening.

It is advisable to expose at a distance of approximately 20 cm from the luminous source, eventually with the use of a mirror on the opposite side to improve the hardening efficiency; in case it is placed to a greater distance, for constructive characteristics of the lamp or for dimensions of the object to be sticked, there will be longer hardening times.
A lengthening of times can take place also in case of sheets with large tichkness.
Adhesive parts exposed to air can appear softer and slightly yellowish.

The fluorescent lamps UV (aesthetic tanning type) must be brought up to speed with a lighting of 4 continuous hours to execute only the first time by new ones; then it is recommended to turn them on at least 10 minutes before use on order that they are up to speed; usually they have a duration of 2000 continuous hours, therefore at a later stage it is advisable to to replace them to avoid longer hardening times, caused by the effectiveness loss.

15.10.3 Two components reactive adhesives

Collacryl adhesives based on special monomers and their catalyst, act for partial dissolution of the surfaces to be welded and to subsequent polymerization so as to create a new layer of PMMA solidly engaging the two sides together.
The results are filler joints with high structural tenacity.
Pairs obtained are totally transparent and colourless, very solid and bubbles free.
If dilute, can be used for capillary pairs, as for example in right angle joints.
The duration of the mixture to be applied is limited.
Remember that usually there are volume retreats, after curing, in the vicinity of 15- 20%.

Possible also the joint of laser cut edges (see paragraph 15.3).

They can be exposed to external light and weather conditions with improved performance whether subjected to further annealing (see paragraph 15.7).

Suitable for transparent or coloured acrylic sheets and allow quick couplings with maximum tenacity and maximum filling properties in the range available.
In case of coloured sheets, colour migration phenomena can occur.
In the case of very covering coloured sheets (for example white covering) reductions in the bond final tenacity may occur.
In the case of satin sheets the surface aesthetic appearance is modified.

The further working processes can be performed already after the curing, in any case, bear in mind that the stabilization will be definitive after at least 24 hours.
The indicative values of the final strength of the bond are obtained 24 hours after polymerization.
Heat tends to shorten the hardening cycle and could encourage the formation of cracks and bubbles.

15.10.4 Materials attachable with acrylic sheets

In all cases it is absolutely expected a preliminary test, being general information without a guarantee.
For different materials, take into account the different distensibility if thermally stressed.

In the case of non metals and non plastic materials, consider the possible humidity which creates both obstacles in the bonding and aesthetics.
In the case of porous materials it is always advisable to work with fluid adhesives which improve penetrability.

To join small surfaces it can be used also cyanoacrylic adhesive with rapid grid.

Materials weldable with acrylic sheets:
(See also paragraph 15.3)

PC	polycarbonate (Makrolon™) with solvent based adhesive for contact
PETG	polyethylene terephthalate (Vivak™) with solvent based adhesive for contact
ABS	acrylonitrile-butadiene-styrene copolymer

with 2 components reactive adhesives

PS	polystyrene with solvent based adhesives without chlorines
PVC	hard chlorines with solvent based adhesives with neutral non acetic silicones with co-polymer PVC based adhesives
UP	unsaturated polyesters with neutral non acetic silicones
PPO	polyphenylene oxide with neutral non acetic silicones
PES	polyethersulfone and polysulfones (Ultrason™) with PUR-acrylate adhesives prior primer application
CAB	cellulose acetate with 2 components reactive adhesives with neutral non acetic silicones
Glass	with adhesive reactive to processed UV beams with specific product with cyan acrylic glues with neutral non acetic silicones with PUR-acrylate adhesives prior primer application
Metals	with 2 components reactive adhesives (except copper and brass) with neutral non acetic silicones with cyan acrylic glues
Wood	with 2 components reactive adhesives with neutral non acetic silicones
Cork	with 2 components reactive adhesives with neutral non acetic silicones
Stones	with 2 components reactive adhesives with neutral non acetic silicones
Cloth	with 2 components reactive adhesives with neutral non acetic silicones
Leather	with 2 components reactive adhesives with neutral non acetic silicones
PE	polyethylene not weldable
PP	polypropylene not weldable
PTFE	fluorinated (Teflon™) not weldable

15.11 Decoration, serigraph and painting

The decoration of the sheets can be executed with serigraph, painting or applying adhesive films.
The choice of the product and the application lifecycle are important to reduce possible chemical aggression of the sheet.
The choice of serigraph products or varnishes must be made accurately, consulting their components so that they are chemically compatible with the material (see paragraphs 8.1, 8.2, 8.3 and 8.4.3).

The composition of the mixtures applied varies in relation to additives (plasticisers, matting agents, levelling silicones, drying retardants, solvents and catalysts) and also to colours.
Moreover, it is equally important to choose the right application cycle, that with the same components, can change the final characteristics of the sheet from an aesthetic point of view and, above all, from the mechanical point of view.

The application cycle determines the time of contact with the sheet and, therefore, it affects its final characteristics, usually as far as this period extends, the chemical aggression on the product increases.
Therefore it is advisable to work with very rapid drying cycles, reducing at minimun the wilting times, reminding that in such case, a lower adhesion on the sheet may occur.

Always perform tests after having chosen the type of product and the cycle of application.
Estimate the aesthetic aspect, the adhesion and the mechanical behaviour of the product decorated.

In case of inks and Ultraviolet (UV) cross-linking varnishes, pay attention to the type of monomers in their composition as they can be very aggressive (see paragraph 8.4.3) and always encourage an immediate irradiation with drying times as rapid as possible, considering the possibility of a later adhesion reduction.

In case of inks and water based paints, the presence of solvents in the composition has to be considered very carefully, in particular alcohols and additives that can be aggressive (see paragraphs 8.1, 8.2 and 8.3).

In any case great attention should be paid in the preparation of the sheet with specific detergents that may already have a negative effect towards the chemical aggression (see sections 8.1, 8.2, 8.3 and 8.4.1).

Is it possible to protect the parts not to decorate with suitable peelable paints and compatible masking films (see paragraphs 8.4.3 and 8.4.5).

A lot of attention should be paid to the applications of adhesives, sealants and plastic seals, to moderate compatibility (see paragraphs 8.4.4 and 8.4.5, 15.12), which can interfere, reducing chemical and mechanical characteristics of the final product.

A lot of attention should be paid to the processes performed on the products, particularly laser cut operations (see paragraph 15.3), folding (see section 15.5), cleaning (see section 15.9), bonding (see paragraph 15.10) and mounting in frames (see paragraph 15.12), which may all alter for thermal, chemical and/or mechanical, reasons, the sheet structure, making it more easily attackable during decoration.
Always perform specific tests to evaluate the final characteristics of the product in relation to its use.

In case of adhesive films application pay attention to the quality of the material and of its adhesive (see paragraphs 8.4.4 and 8.4.5).

15.12 Frames and structures installation

Frames and structures have to be measured considering the material expansion coefficient, allowing a corrected sliding in the profiles avoiding light tensions and forced curvings.

The holes must always be larger than the diameter of the screw protecting the hole with plastic compatible plugs and washers being careful not to apply excessive fixing efforts.

If the installation in the structure is forced and in combination with processes as laser cut, the serigraphy, the painting, the bonding or the cleaning with not recommended products, crackings and small rifts may happen in the areas of greater tension for the sheet.

If the material used for the seals where the sheet is stuck is not compatible, typical defects may occur such as cracks or even small rifts that appear in time after the installation of the frame, especially if it is mounted with force and without allowing expansion (see section 8.4.5).

The thickness of the sheet, together with the frame and installation chosen, are determinative of the final desired stiffness for the expected stresses and any accidental loads such as wind pressure and/or the weight of snow, therefore the choice has to be taken during the installation planning of the final use.

In the case of vertical or horizontal flat roof stained glasses, set on four sides in the correct way as described, the thickness choosen depends on the use of the project, on the depth of the joint in the frame, on the allowed expansion freedom in the joint point, on the implemented sheet surface and on the accidental load of snow/wind (see DIN 1055 regulation).
With these premises, guidance indication of usable thicknesses is given, without specific warranty and subject to assessment by the designer:

			thicknesses (mm) for cargo (N/m^2)					
L_1 (mm)	L_2 (mm)	load =	600	750	960	1.500	2.000	3.000
250	<= 4000		2	2	3	3	4	4
500	500		3	3	3	4	4	5
500	750		3	4	4	5	5	6
500	<= 4000		4	4	4	5	6	8
1000	750		5	5	5	6	8	8
1000	1000		6	6	6	8	10	12
1000	1500		6	8	8	10	10	12
1000	<= 2500		8	8	8	10	12	15
1000	<= 4000		8	8	10	12	12	15
1500	<= 2000		10	10	12	12	15	20
2000	1750		10	12	12	15	20	20
2000	2000		12	12	15	15	20	20
2000	2250		12	12	15	15	20	25
2000	<= 3000		15	15	15	20	20	25

16. Informative annotations for the sale

The buyer is responsible for verifying compliance and the suitability of the goods received.

Eventual damages during the transport and the eventual successive verification to the delivery for hidden damages must be recorded by a copy of the document of transport stamped and signed for receipt with the specific description in the notes of " acceptance with reserve " .

Any claim by the buyer must be received by the Company in writing with reference to the purchase invoice of material object of dispute and should be offered the opportunity to examine or to have examined on site the defects and its possible causes.

In case of complaint, verified the veracity of the complaint, the Company undertakes to replace the defective material with the same or with other equivalent if it is explicitly expressed the agreement by our sales department of returned material.

The ordering part is responsible for the use of the material received.

Eventual analyses and/or tests regarding the performances of the product supplied could be executed exclusively by qualified staff and under the exclusive responsibility of the buying part.

The material must be transported, stored, worked, installed and variably used by qualified staff and in compliance with the described specifications that, at the act of the confirmation order, are considered acknowledged by the purchaser together with the safety regulations described in the specific security technical sheet.

Information about the proper use and maintenance of the products have a knowledge-sharing scope, describing the characteristics and the possible use and do not constitute any warranty expressed or implied to the buyer who has the responsibility to verify the functionality and/or the possibility of application to its use with qualified personnel.

The duration of the sheets to weather conditions exposure, is guaranteed for 10 years if correctly used and processed as described in the technical sheet.

The conditions and existing working methods for the final user, are unknown and out of control by the supplier company and therefore fall under its full responsibility.

The buying part and eventual users of the material are responsible for observing all the enforced laws, allowing the workers and their representatives to access the information supplied in relation to their professional activity.

17. Additional information

The information of the technical sheet and any other advice yonder contained correspond to the present state of the knowledges and the experiences of the Company manufacturer.

The information of the technical sheet do not involve any obligation or responsibility by the part of the Company, also in presence of intellectual property rights of third parties and, in particular, of patent rights.

In particular the information of the technical sheet do not involve any responsibility and/or guarantee, expressed or implicit, on the qualities and the characteristics of the article described.

The manufacturer company reserves the right to modify the products in relation to knowledges and experiences deriving from the technological progress or further activities of development.

The content of the technical sheet is modifiable exclusively by the company manufacturer.

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