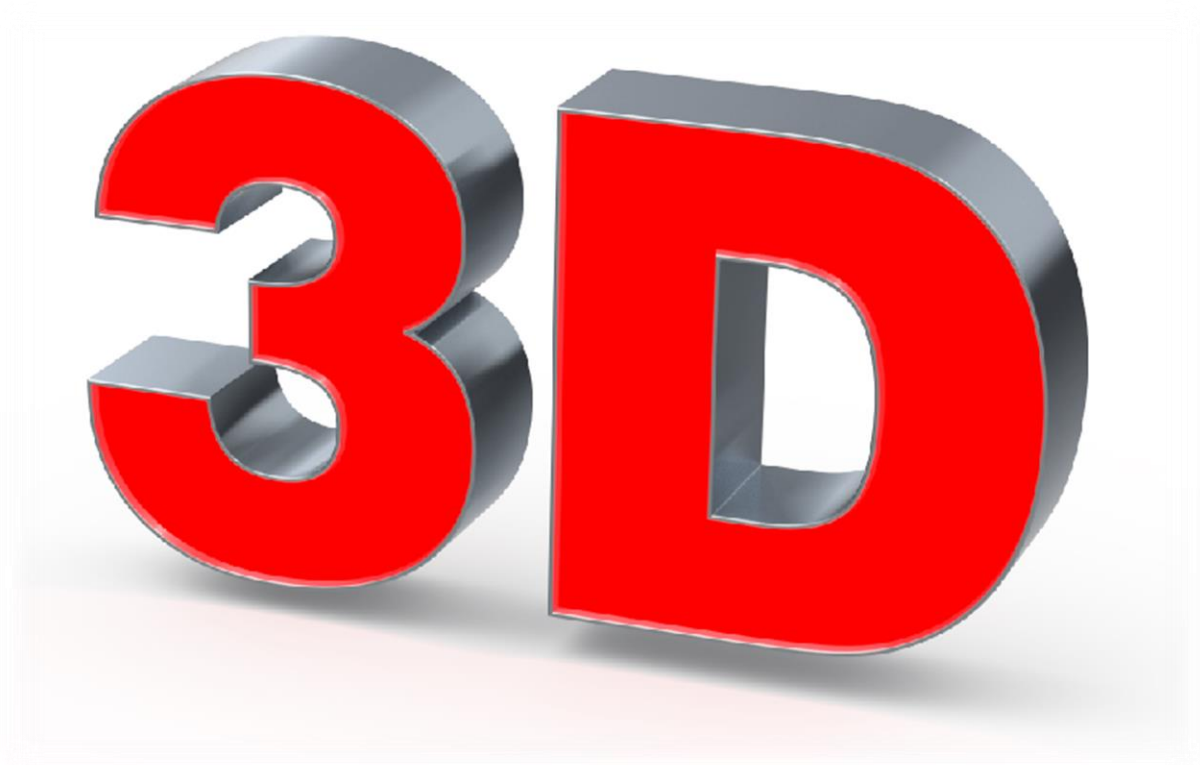


LETTER BUILDING MANUAL



3D[®]
SYSTEM

www.3dsystem.pl

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1. Introduction

The letter construction manual describes how to build spatial letters using aluminium profiles manufactured by 3D System®. The profiles produced by the 3D System® company are called "Profile-3D" and "Edge Profile-3D". The system of building letters with the use of Profile-3D is the fastest and cheapest way of building three-dimensional letters, giving high aesthetics and long life to the letters made. Our profile system allows for the construction of letters from approx. 30 cm to 2 metres high, depending on the shape of the letter. Letters made using our profiles are perfect for external signage for offices, halls and other public buildings. Letters made with 3D System profiles are a proven lettering construction system which are widely used by advertising manufacturers all over the world since over 20 years.

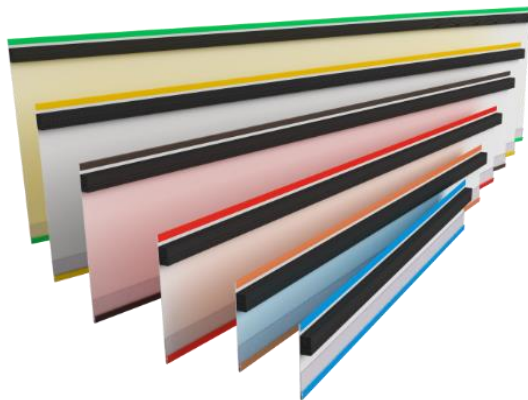
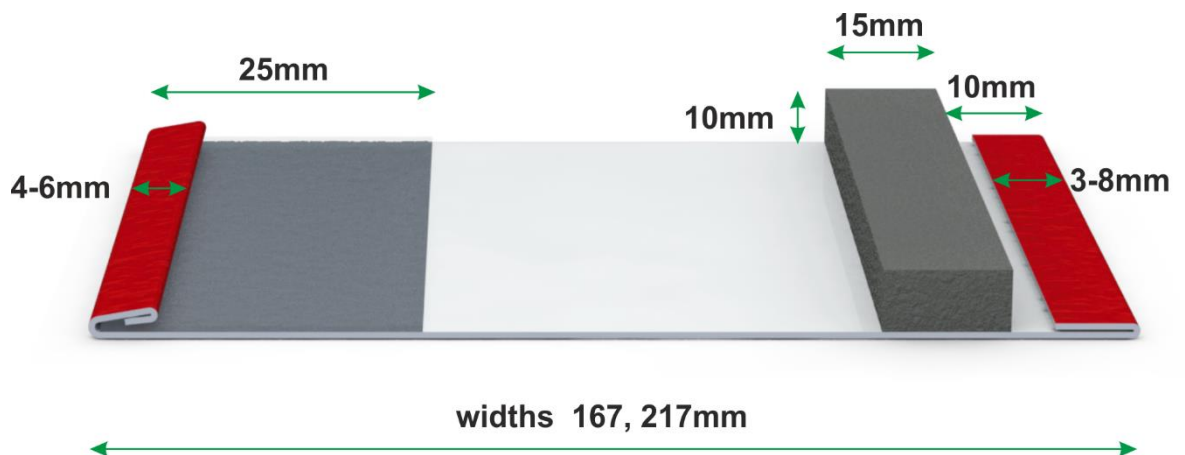
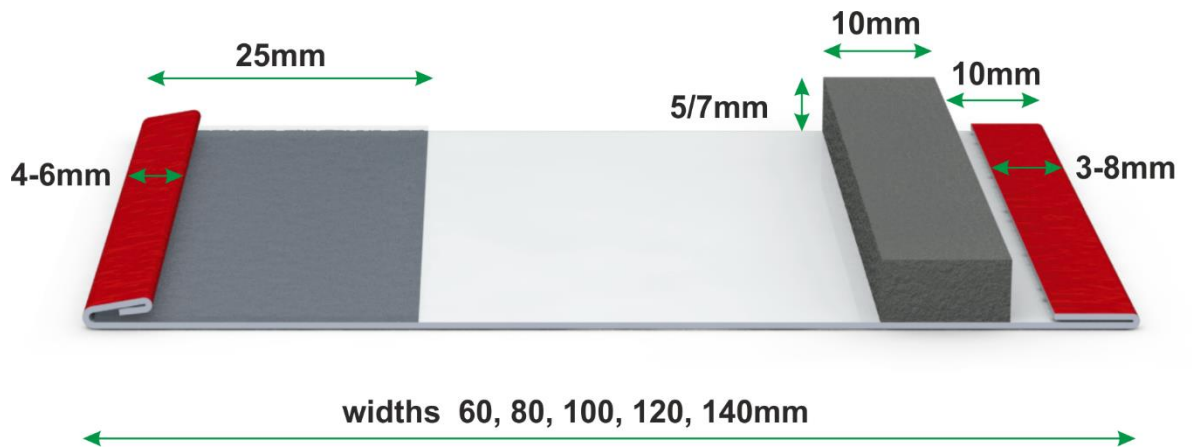
2. Types of tape - Profiles



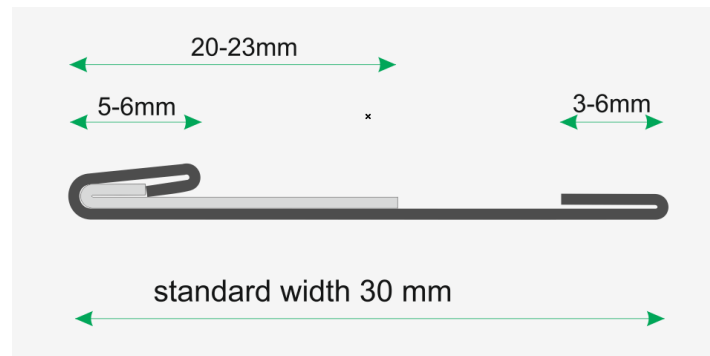
The profiles produced by 3D System® are made of aluminium sheet 0.45mm thick + the thickness of the lacquer coating, which gives a total thickness of approx. 0.5mm of the lacquered sheet. The lacquered profile has a high resistance to external conditions. The manufacturer assures a durability of 10 years for the lacquer and a corrosion resistance of 25 years for the aluminium. Such durability and resistance to external conditions distinguish our profiles from other lettering systems. All profiles are also protected by a transparent protective film.

There are two types of profiles:

- 1) the profile called "Profile-3D": the most popular and widely used



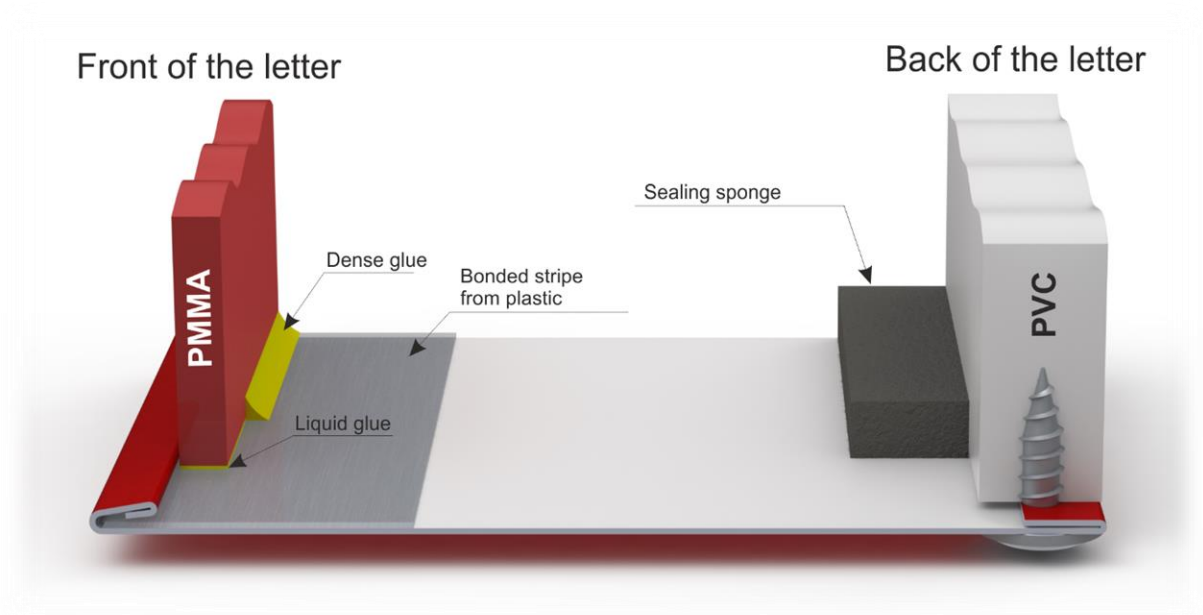
- 2) a profile called **"Edge Profile-3D"**: this has been developed at the request of our customers and is produced to order. Advertising companies use it as a substitute for the popular "Elkamet" type tape, with the difference that our Edge-3D Profile is made of aluminium, and therefore has much greater mechanical strength and resistance to ageing than the Elkamet, which is made of plastic.



3. Types of letters

With 3D System® profiles, we can produce letters in two ways:

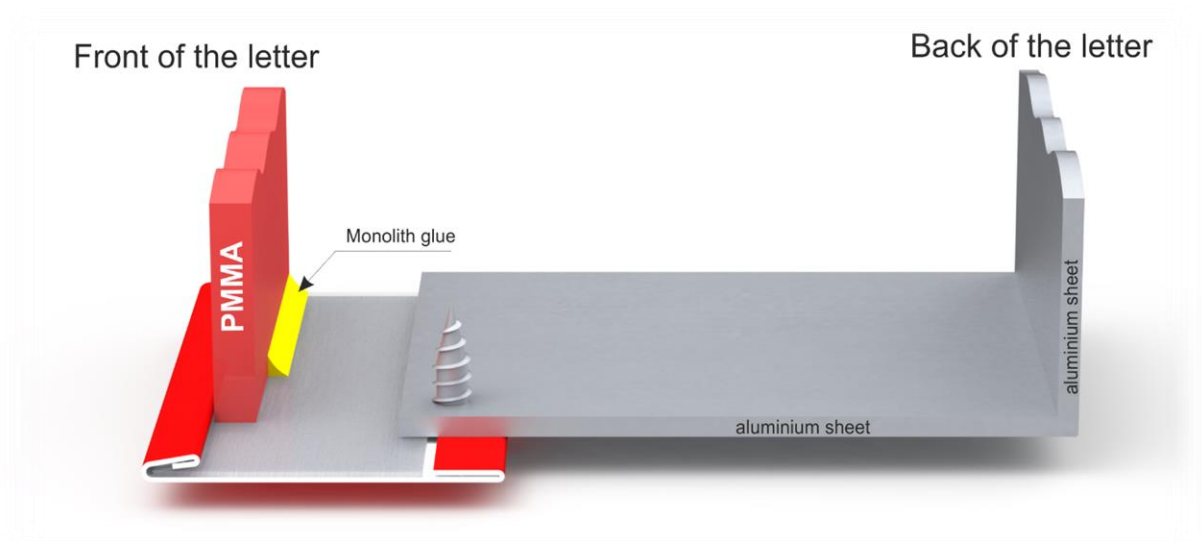
- The first way: the most popular, fastest and cheapest, is to use the "Profile-3D". It is used to make letters, where the front is glued together with the Profile-3D and constitutes a uniform and inseparable structure, while the detachable part is the back of the letter, made of 10 mm thick PVC. The advantage of letters made this way is also their lightness- a 100 cm high letter weighs only about 12 kg.





- The second way: more difficult and laborious, is the use of the "Edge Profile-3D". It is used to create letters in which the back and side form a single, integrated structure, usually made from welded aluminium sheet 2-3 mm thick, powder-coated. The front, on the other hand, is glued to the Edge Profile-3D and tightened with screws to the aluminium sheet side. Letters made in this way are much heavier than those made in the first way, but structurally they are more resistant to mechanical damage.

In the instructions, we do not show in more detail how to build a letter made of 30 mm Edge Profile, as this method is used occasionally.



4. Materials for the building of letters

For the front and back of the built letter we need:

FOR THE FRONT OF THE LETTER - we usually use Cast Plexiglass (PMMA) in thicknesses from 3mm to 6mm. Plexiglass is the most commonly used material, but it is not crack resistant. If we need more resistance to cracking of the front of the letter being built, then we use Solid Polycarbonate with UV filter in thicknesses from 4mm to 5mm. Thus, we choose it when we need higher resistance to cracking of the front of a letter, when we build large letters (more than 1m high), or when the letter's shape is so-called "skinny" - "thin", and when we want to achieve high resistance of the front of a letter to cracking during production, transport and installation.

Attention:

You should use Cast Plexiglass (PMMA) for the construction of letters, do not use Extruded Plexiglass!!!

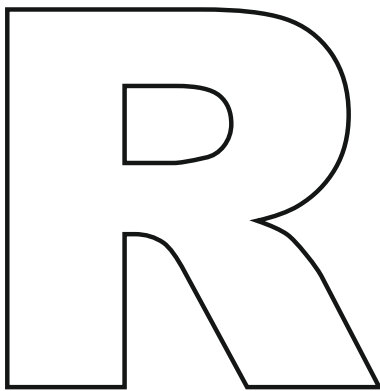


fig. letter "Thick"

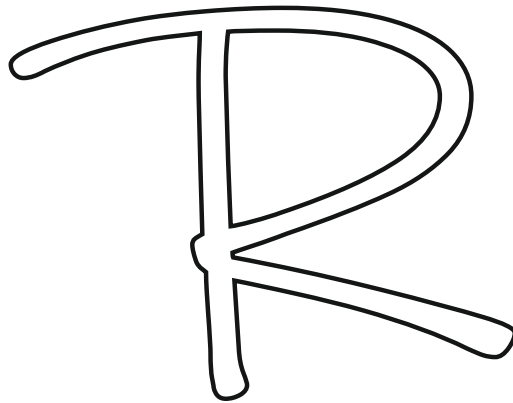


fig. letter "Thin"

The standard and most economical material is 4mm white Plexiglas (PMMA). The colour of the letters is then determined using a self-adhesive translucent film. We do not recommend using a lower series of foil, as this risks cracking the foil on the lettering during its exposure to external conditions. The translucent film also has the advantage of matt surface, which makes the wavy front less visible due to the uneven reflection of sunlight, as happens on Plexiglass with a glossy surface. The wider colour range of translucent films compared to Plexiglas is also a major advantage. The company also generates less waste by using only one type of material (white 4mm Plexiglass). The light transmittance should be at the level 50% , and attention should also be paid to whether the light diffusion is sufficient. In order to do this, we carry out illumination tests with a Led module. The choice of Plexiglass should be made once, when choosing the right supplier.

THE THICKNESS OF PLEXI (PMMA) AND POLYCARBONATE is selected according to the size of the letter and its shape - the font of the letter: "thick" or "thin". For the "thick" shape we can use 3mm Plexiglas, and for the "thin" shape we try to select the thickest Plexiglas possible. Optimal material is 4mm Plexiglass and we use this thickness for letters up to 1m high (maximum 1.30m). For larger letters, use 5mm-6mm Plexiglas or 4mm-5mm Solid Polycarbonate. Plexiglass 3mm can be used due to its colour variety, but its main disadvantage is that the front of the constructed

letter is definitely more wavy and more prone to breakage during production, transport and installation of the letters.

It is not true that for small letters (20cm -50cm) you can use a thinner Plexiglass. On the contrary, for small letters we should use 5mm or 6mm thick Plexiglass, because we need the mechanical stiffness of the Plexiglass for safe side pressing with wedges. The pressure induced during wedging is higher for smaller letters because they have denser bending points and curves. Smaller letters are more difficult to drape over the Profile, so more wedges and pegs are used to shape the Profile. Pressure is then exerted on the Profile (significantly more than in the case of large letters), which the Plexiglass must then resist.

Dibond type material is also sometimes used for the front of letters. We use it most often when we do not need to illuminate the letter, or when we make a letter with the so-called "halo effect", i.e. shining through the back, creating a glow on the facade. The halo effect is often used for black letters. The most common thicknesses chosen are 3mm or 5mm. Here, too, we use the rule that the larger the letters, the thicker the material. With Dibond, however, there is no risk of the letter breaking, as can happen with Plexiglass. The use of thicker material is purely for aesthetic reasons, i.e. to reduce rippling of the front when exposed to the sun.



Dibond

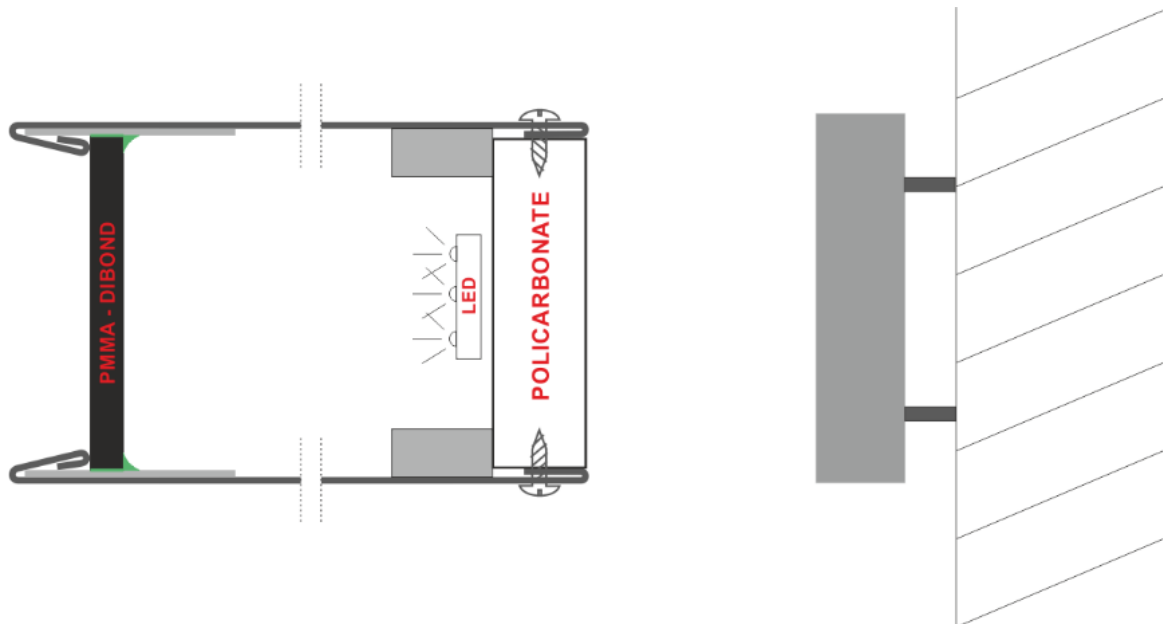
Letters fronted in black:

When a letter has a black front, sometimes we use 3mm or 5mm Black&White Plexiglass, it is a light transmitting material. Plexiglass Black&White is black, but when you illuminate it with white light, it turns from black to dirty white, often turns into light pink. The reason we don't recommend using Plexi Black&White is that by giving the customer a logo that is black during the day and white at night, we are in a way deceiving him. It would be like the 'McDonald's' logo being yellow during the day and green at night, for example. Black letters and logos should be black both- during the day and at night when illuminated.



Properly made illuminated letter with black front

Black letters should have a front made of a light-impermeable material (e.g. black Plexiglass or preferably Dibond), and backlighting is achieved by letting light back onto the facade through transparent Solid Polycarbonate (halo effect). To achieve a good effect, the letter should be mounted at a distance of 3-10cm from the facade.



Cross-section of construction of a letter
with a black front

Letter on a 3-10 cm distance on the facade

Attention:

Black&White Plexiglass is difficult to illuminate, it is a thin material with poor light diffusion, making the Led modules and the glue very visible. It is therefore necessary to use low-power Led modules (they are difficult to find), or to use additional obscuras of diffusing milky material.

Attention:

When using Dibond for the front of your letters, the best solution is black Dibond on the front and white matt on the inside (for better light reflection). If the Dibond on the inside is, for example, blue and illuminated with white Leds, you will get a blue glow.

Important:

Exposure of the letters with a lot of sunlight (south-facing) should be taken into account when choosing the right material for the front. In this case, you should always use a thicker material, preferably covered with foil for a matt surface. Similarly, when the letters have a large surface area, i.e. letters with a 'thick' shape.

For the back of the letter, we use 10 mm thick PVC, which is used in the letters of front lit. However, when building letters with a "halo" effect, i.e. when the light comes out of the back of the letter and illuminates the facade, we use 10 mm thick transparent Solid Polycarbonate with a UV filter. The assembly of Led modules on transparent Polycarbonate is carried out in the same way as the assembly of Leds on PVC- inside the letter.

Attention:

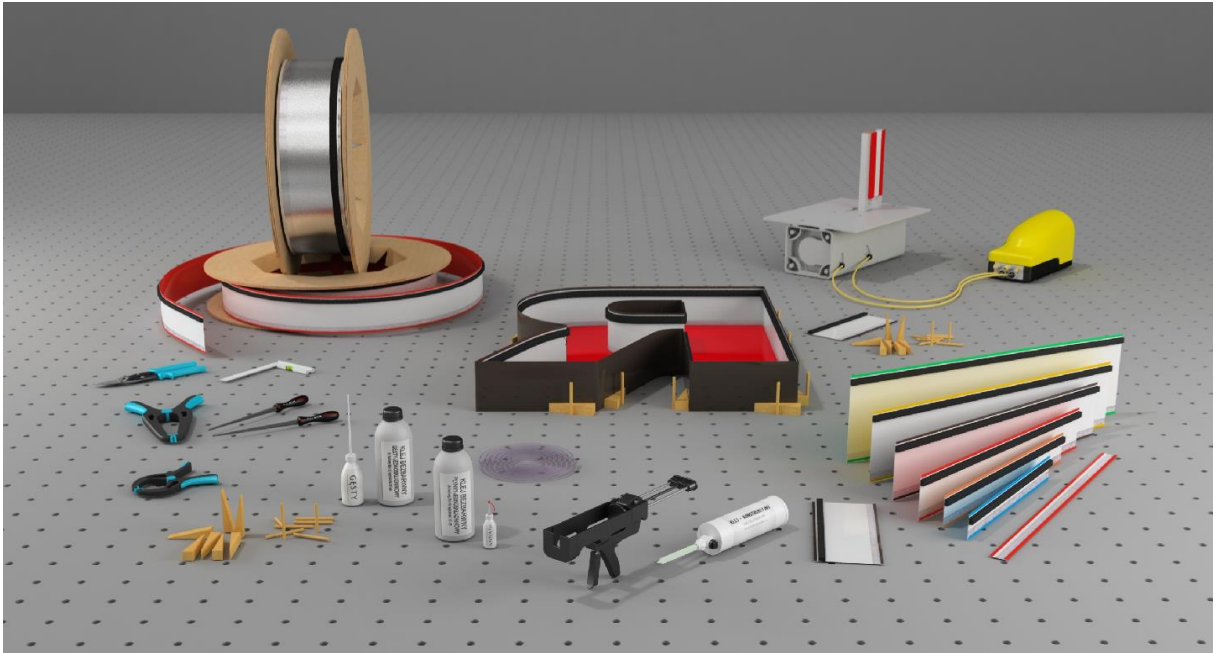
When mounting the letter with the "halo" effect, beware of facades or walls that look like mirror surfaces. Mounting on such a wall will show the inside of the letter and the luminous Led modules. To avoid this, cover the Polycarbonate with a light-diffusing film.

SIDES OF LETTERS IN A DIFFERENT COLOUR - If you do not want to use a Profile from the available colour palette, you can obtain any colour by painting the Profile white matt. Painting is made with a painting gun and with paints which are not aggressive so that the new paint does not destroy the already existing lacquer coat. The profile is painted after the letter has been made, laying the letter backwards, so PVC to the tabletop. We use a painting gun to spray the paint starting from the hard-to-reach areas, i.e. from the centre of the letter towards the outside of the letter.

Attention:

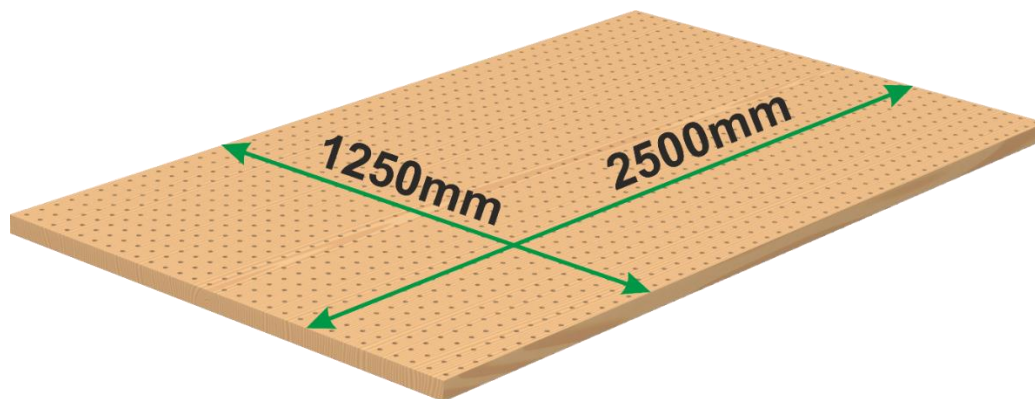
If you want to paint the Profile, make sure to keep undamaged film on the Plexiglass (front of the letter), as it is an excellent protection for the Plexiglass during painting.

5. Supporting materials for the building of letters



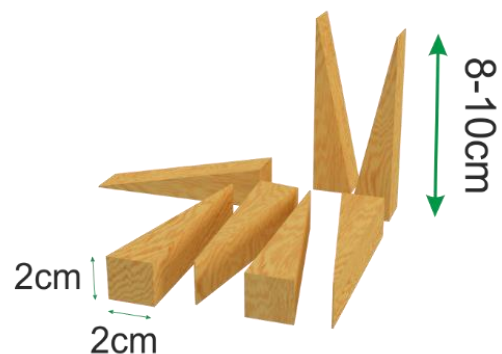
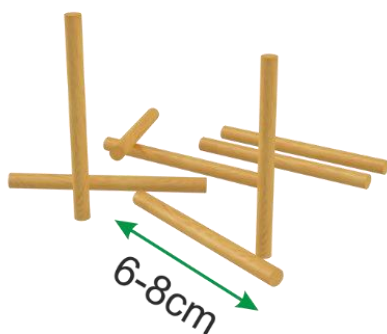
To build the letter we need:

- **assembly table top**



- **pegs and wedges**

Ø 6mm



- adhesives

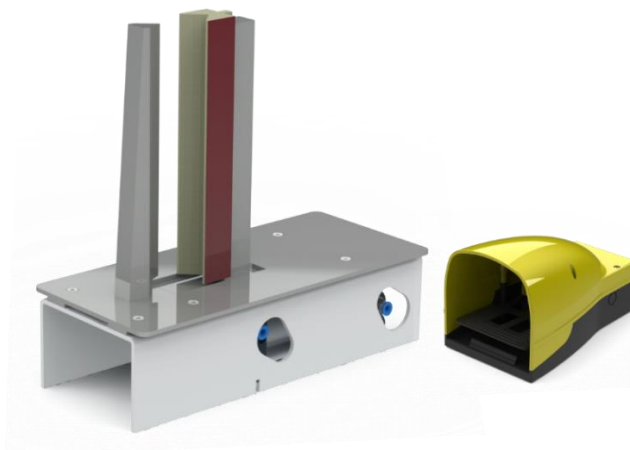


Transparent glue for small letters up to 80 cm height

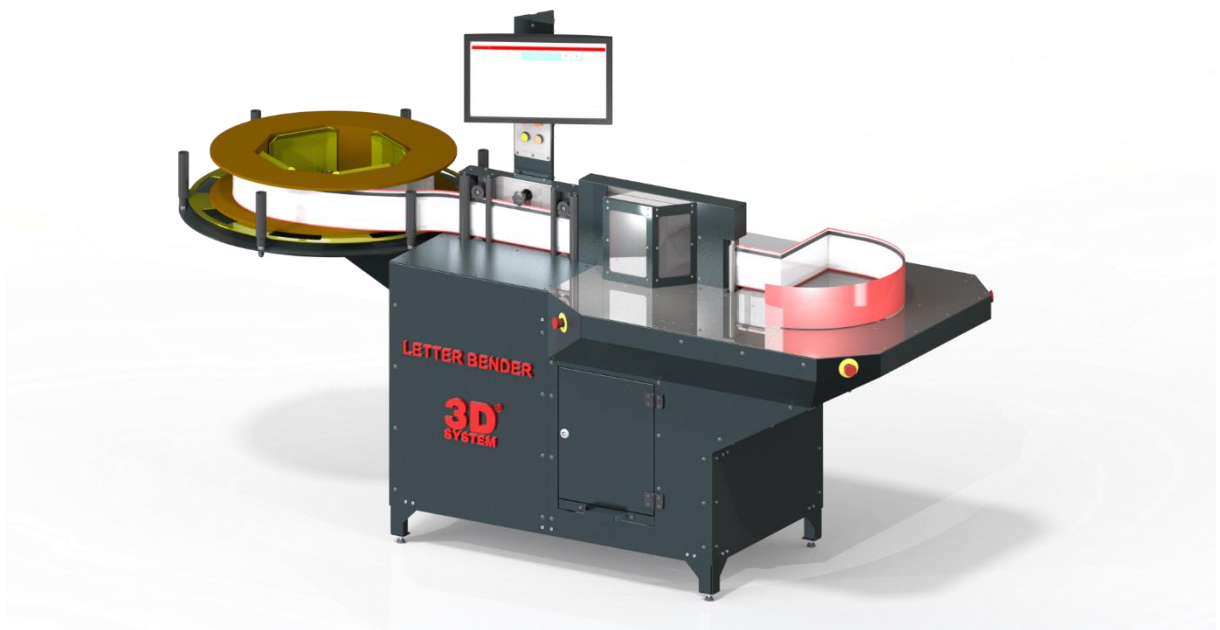


Two-component adhesive for large letters up to 2m height

- pneumatic press or automatic bending machine



Pneumatic press for making letters manually

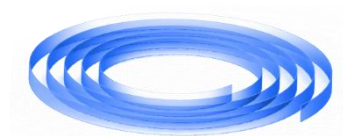


Automatic profile bending machine

- a roll for curving



- measuring tape or bending points table



Measuring tape

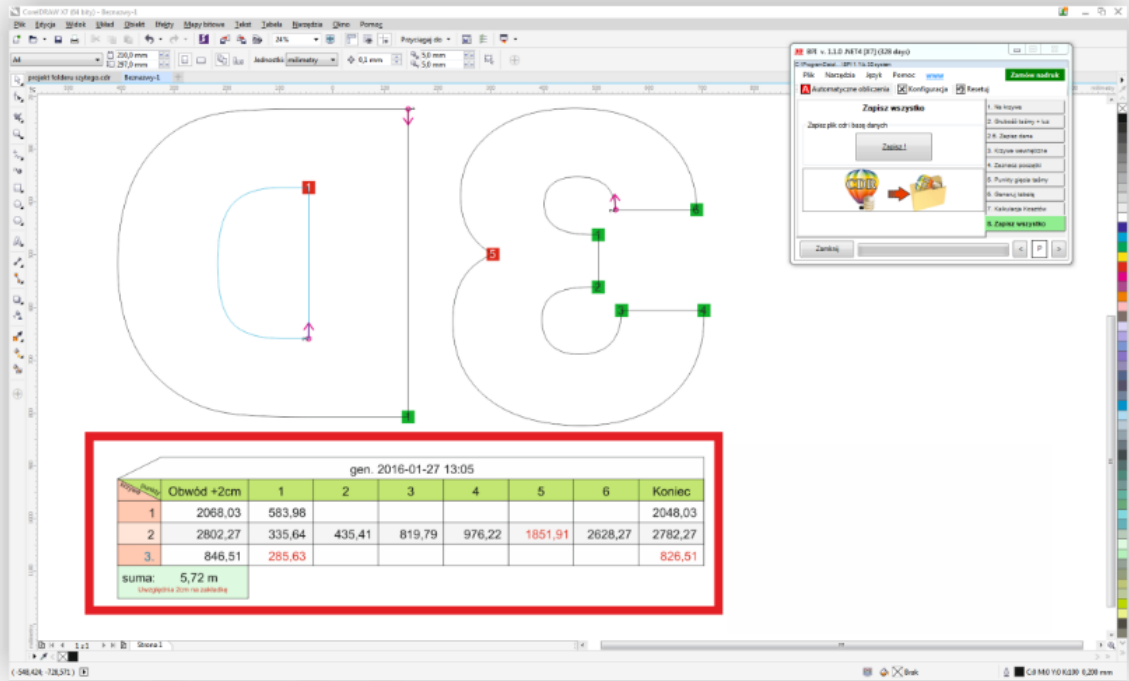


Table with bending points

Link to BPI software: <https://3dsystem.pl/en/software/>

- knife, file and metal screws

6. Ways of making a letter

We start making the letter by cutting out the front and back of the letter preferably on a milling plotter. We use a milling cutter with a diameter of 4mm, as the Profile forms a bend of this diameter when it is bent. The second, less common, machine for cutting fronts is a laser plotter. In this case, it is necessary to prepare the file for cutting properly, so that all the indentations in the letters are finished with a 4mm diameter rounding, and not sharply. If you don't do the rounding and make the notches sharp, you won't be able to fill the area with Profile and in the front of the letter appear a hole.

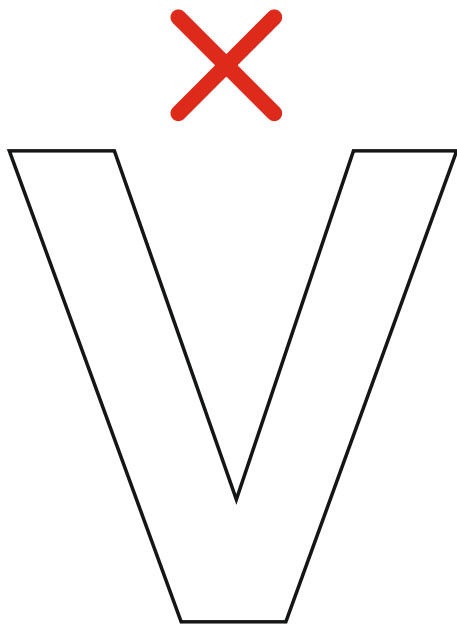


Fig. the shape of a letter
not suitable for laser cutting

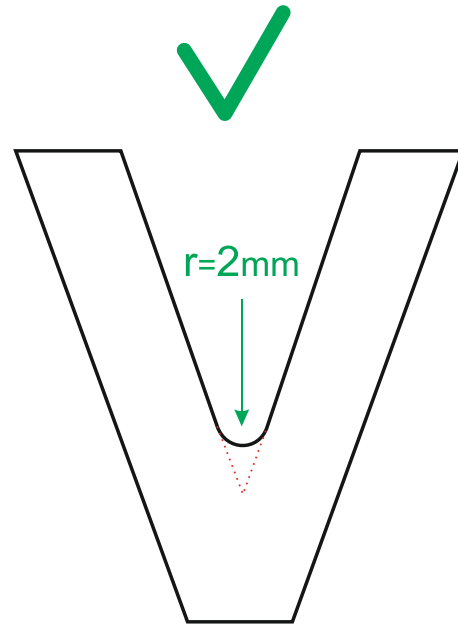


Fig. the shape of the letter
prepared for laser cutting

We cut the front and back of the letter the same size.

Advice:

A simplification for the later folding of letters (especially small ones, 30-70 cm high) containing a centre ("R", "O", "B", "P", etc.) is to mill an enlarged centre shape in PVC (the back of the letter), other than in Plexiglass. We then enlarge the centre of the letter by approximately 0.5-1mm around the circumference.

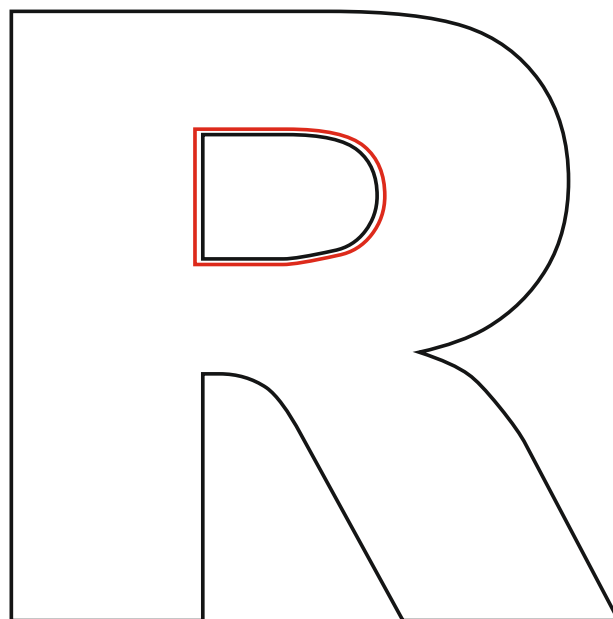


Fig. example of enlargement of the centre
of a letter marked in red

When milling the back of a letter in PVC, it is necessary to chamfer the edges to make it easier to assemble. This can be done straight away on the milling plotter by inserting a conical cutter and performing the chamfering before the main milling with a 4mm diameter cutter.

The chamfer should be up to 3mm in length.



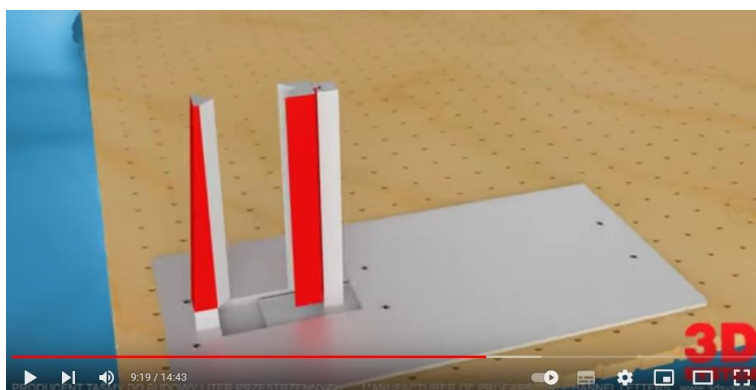
Attention:

Chamfering is carried out for letters up to a height of 1m, for larger letters chamfering is not recommended.

Attention:

The protective film from Plexiglass and PVC should not be peeled off after milling, as it protects the surface from scratches throughout the production process. The protective film should be peeled off before packing the finished letter and going for installation. We do not recommend peeling the protective film off the Profile or the Plexiglass and PVC during assembly. It takes less time, and it is easier and more convenient to remove the film while the letters are still on the assembly table.

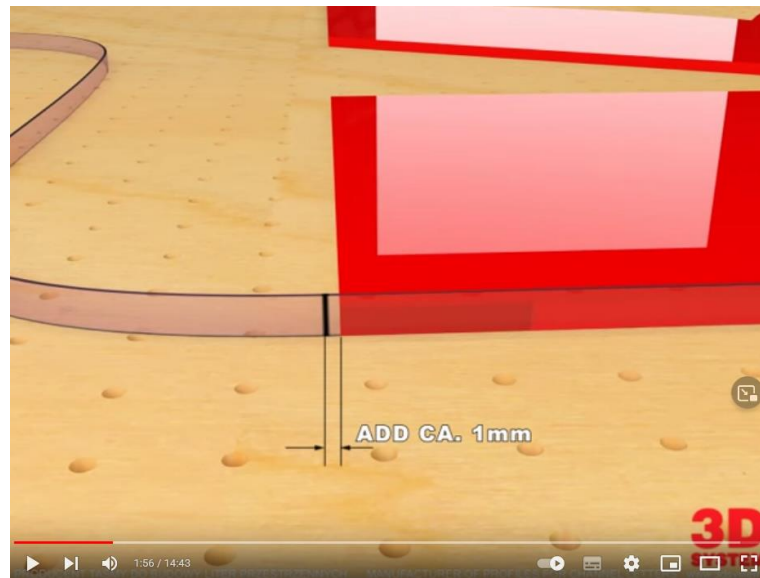
Place the front of the letter cut from Plexiglass or other material on the assembly table top with the front facing the table. Then cover it with Profile bent to the shape from Plexiglass. To prepare the Profile, the circumference of the Plexiglass is measured. Using a special measuring tape, we transfer all the bending points to the Profile. Large bends are made by hand and small bends are made with the help of a roll for curving. Corners are bent using a pneumatic press.



Pneumatic press

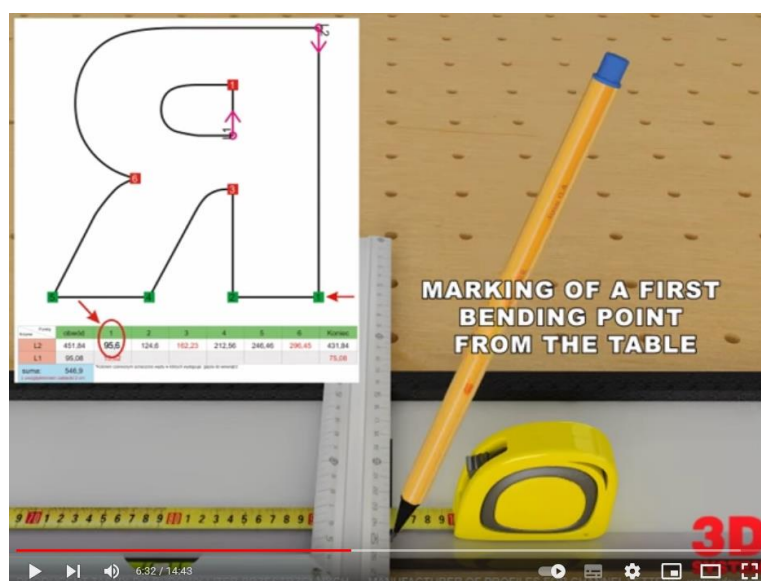
Below is a link to an animation showing how to mark the bend points on the measuring tape, which we transfer to the aluminium profile.

Link: <https://youtu.be/YBSeDx2ehWA?t=91> (from minute: 1:36 to 5:57)



A method for making it easier to mark bending points on the tape is to use a bending points generator program. The program called "Bending Points Indicator" you can download from our website: <https://3dsystem.pl/pl/program-bending-points-indicator/>. Below is a link with an animation showing how to mark the bending points generated by the BPI program on the Profile.

Link: <https://youtu.be/YBSeDx2ehWA?t=360> (from minute: 6:00 to 7:12)



Another method of preparing the Profile, is to bend it on an automatic bending machine of our production. The "Letter Bender 3D" machine automatically performs bends and curves of any shape.

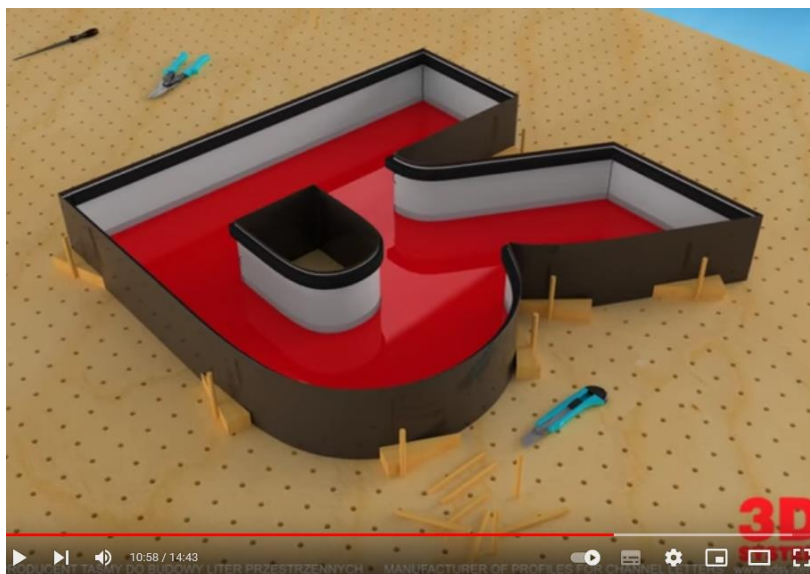
Link showing automatic bending: <https://www.youtube.com/watch?v=RIHqL8u5EzA>



The next step after bending the aluminium Profile is to drape the cut-out letter and to immobilise the Profile against the cut-out letter on the assembly table in order to glue the Profile and the cut-out letter into one inseparable element. Special wedges and pegs are used for this purpose, with the help of which we immobilise the front of the letter with the side for the time of gluing. Below is a drawing and animation showing the draping of the letter with the Profile and its wedging with pegs and wedges.

Link showing pegging: <https://youtu.be/YBSeDx2ehWA?t=640>

(from minute 10:41 to 11:03)



7. Gluing of the letter

The next step after wedging is to apply glue at the point of contact between the Plexiglass and Profile. Depending on the size of the letters, we use the appropriate adhesive.

Attention:

Before using the adhesive, read its Safety Data Sheet carefully and take appropriate personal protective equipment!

Small letters

Single-component adhesives are used for small letters (up to a height of 80 cm) because of their ease in dispensing and applying the joint. We use two adhesives: the first is a liquid adhesive called 'No. 1' and the second is a thick adhesive called 'Plex 9021-0'. Both adhesives are transparent. We apply them at 30-minute intervals. We apply the liquid glue once and the thick glue 2-3 times. The liquid glue is applied using a 50ml dispensing bottle, in which we put a pharmacy needle, and through this we apply the glue in small portions. In the case of Plex glue, we use a 250ml dispensing bottle tipped with a straw, and the best effect is achieved by applying two or three thin layers - do not make one thick layer. We recommend gluing at the end of the working day because of the evaporation of the glue compounds, besides, by the next morning the glue is hardened enough that you can take the finished letter off the assembly table without any problems.

Attention:

Any acrylic glass-based solvent adhesives will harden for a few more days, but this does not significantly affect the subsequent construction of the letter and its installation.

Attention:

Do not pour unused glue into the main bottle, as this risks hardening the glue throughout the bottle. This phenomenon applies to all adhesives based on dissolved acrylic glass.

Advice:

Pour only enough glue into the dispensing bottle to use it up completely. Store the glue in a shaded and cool room (the cooler the better, but do not freeze). In order to preserve the liquid consistency of the glue in the dispensing bottle for as long as possible, after gluing we recommend pressing the dispensing straw to the bottom of the bottle so that the straw is immersed in the glue to reduce the evaporation surface, and seal the end of the straw with, for example, insulating tape. Thickened glue that has not cured as a result of long storage in the dispensing bottle can be diluted by adding fresh glue to it a few days before use. The dissolved glue will be denser in total than the glue in the main bottle.

Link showing the application of the adhesive: <https://youtu.be/YBSeDx2ehWA?t=771>

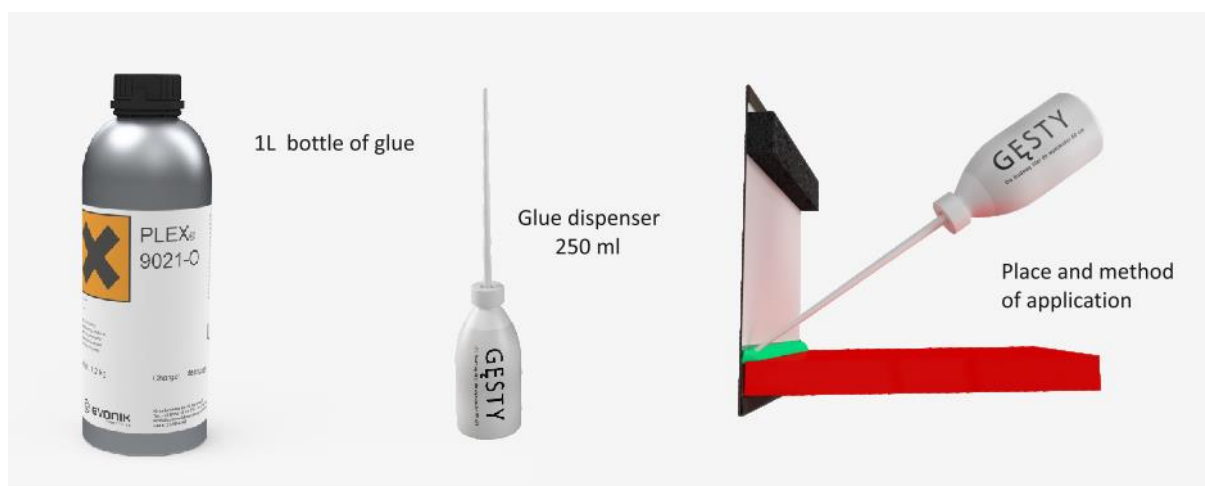
(from minute 12:50 to 12:30)



Liquid glue No. 1



Plex 9021-0 - thick adhesive



Large letters

For large letters (from 80cm to 2m high), we use two-component adhesives.

There are 2 two-component adhesives to choose from:

1. Monolith 342-1 - opaque, blue colour. Due to its bonding of metals to plastics, it is a frequently used and popular with advertising manufacturers.
2. Scigrip-42 - transparent, does not glue Polycarbonate or Dibond!

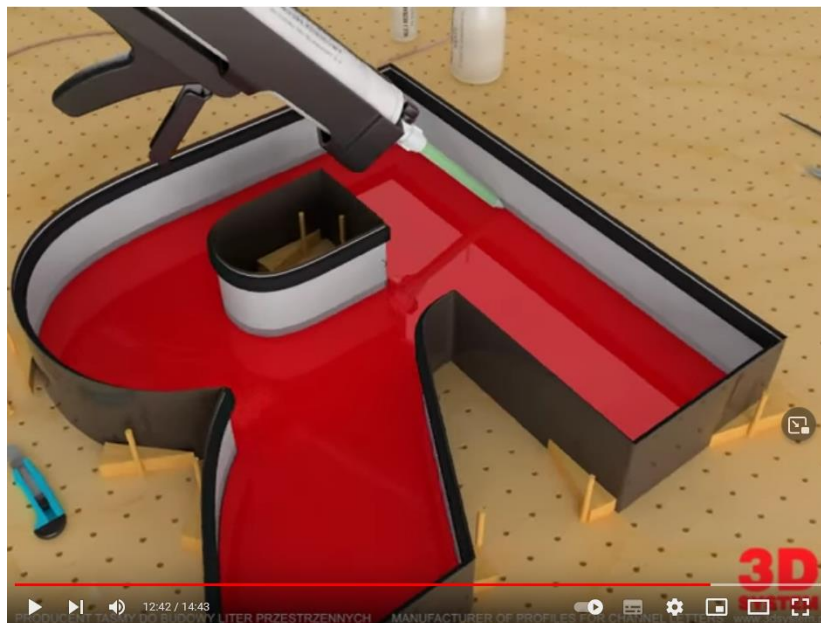
Attention:

Monolith glue has a very high strength. It can be used to increase the strength of small letters, but it is sometimes difficult to approach with a dispenser to the site of glue application to apply the layer.

Link showing how to apply the adhesive:

<https://youtu.be/YBSeDx2ehWA?t=670><https://youtu.be/YBSeDx2ehWA?t=670>

(from minute 11:10 to 12:48)



Monolith adhesive 342-1



Scigrip 42 adhesive

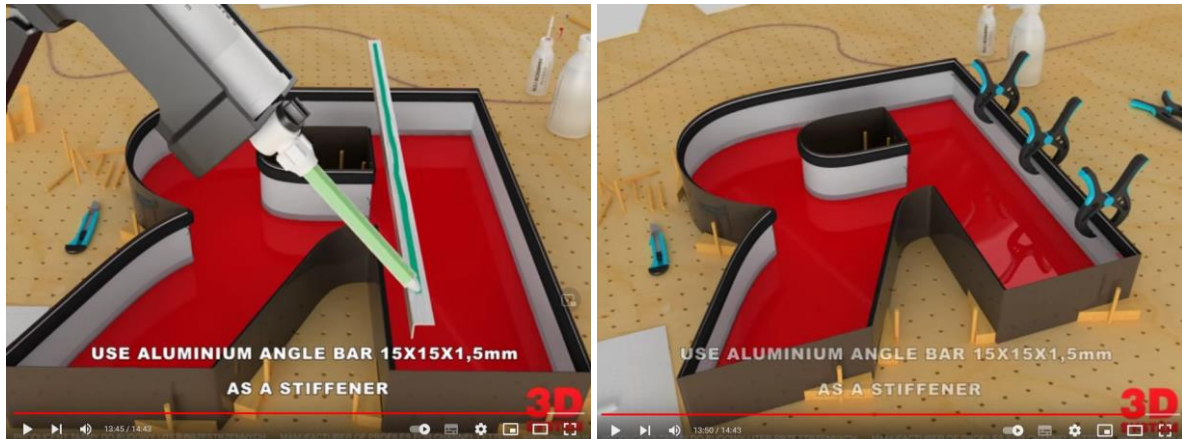


Advice:

In order to reduce the ripple effect on the side of the letter, which is the most visible at the point where the edge of the Profile meets the PVC, we recommend gluing a small 15x15x1.5mm aluminium angle bar to the Profile using Monolith 342-1. The ripple effect of the tape caused by exposure to the sun is due to the expansion of the thin material between the screws. We recommend placing the angle bar in straight sections longer than 50 cm. During gluing, the whole thing is held in place with clamps. While the clamps are taking place, you can use the second Profile as a support to achieve a straight line during gluing.

Link showing how to glue the aluminium angle: <https://youtu.be/YBSeDx2ehWA?t=815>

(from minute 13:35 to 13:50)



The next stage, after gluing the front and the Profile, is to insert the back of the letter cut from 10mm thick PVC so that the back of the Profile is touching the plane of the PVC. If you have difficulties with the insertion of the PVC, the areas which do not match the shape of the bent Profile should be undercut with a knife, but in the same time you should avoid making too large gap between the Profile and the PVC.

Attention:

Fitting the back should always be carried out on a letter draped in Profile and pegged on the table. When the back of the letter is fitted you can remove the letter from the assembly table. Otherwise, when the back of the letter is inserted, the Plexiglass front may break and the whole letter may be twisted, so that the whole surface of the letter does not adhere to the structure or facade. The larger the letter, the greater this problem is.

Attention:

You may get the impression that the PVC is too tightly fitted to the whole letter and that it is difficult to remove. Do not worry about this - after a while the problem disappears when the letter is exposed to the outdoors.

The next step is to screw the back of the letter (made of PVC) through the side made of the Profile with the disc screws. For convenience you can drill holes for the screws in the Profile, although this is not the rule.

Optimum disc screw for the letter:



Attention:

The screws should be used no more than 30cm apart.

Advice:

It is good practice to paint the screws to match the colour of the Profile.

8. Letter illumination

Letter illumination is a huge subject, difficult to describe in a few words. Certainly, more information on current systems can be provided by professional Led module dealers, who analyse novelties, perform tests, and sell modules.

For our part, we can share some basic recommendations for illuminating letters:

- use Plexiglass with high light transmission and high light diffusion at the same time. These two properties are closely dependent on each other and do not occur at the same time in high values. It always has to be a compromise solution. Dedicated Plexiglass for Led backlighting is now available, but this material is much more expensive than standard Plexiglass.
- the deeper the letter, the easier it is to illuminate it
- dark front colours such as navy blue, brown, gold, grey etc. are difficult to light up, so it is a good idea to use a white 'outline' effect to illuminate and bring out the dark colour of the letters at night.



- if the letters are exposed to outdoor conditions, use only waterproof Led modules
- we do not recommend using power supplies separately for each letter, unless the specific nature of the letters and the installation requires it. This increases the risk of failure.
- do not use twilight switches, they are very unreliable devices
- as the Led modules cannot withstand high temperatures very well, it is necessary to build a system for switching on the advertisements so that there are not too many failures or forgetting to switch them off, resulting in the Led modules being lit during the day (as is often the case with manual control using an ordinary switch). A control based on an astronomical time switch with a separate contactor as a disconnecting element works the best.

- in the case of letters at great heights (on "skyscrapers"), and with difficult access, we recommend installing an additional emergency lighting system (a duplicate power supply and Led system). This will make it easy to switch to the second system without incurring large repair costs in the event of a breakdown.
- avoid twisted connections of the cables in the letters. We recommend using the soldering method and protecting the solder by applying heat shrink sleeves.
- drain the condensed water vapor through the holes in the lower part of the letters
- choose Led modules with current stabilisation, they are better
- we do not recommend using the cheapest and untested Led modules bought from a random seller (e.g. on AliExpress). The price of the module should not be the most important criterion. Sometimes a module is no longer available after a few years and it is no longer possible to buy the same ones as those installed in the letters. Even the same Led modules will differ in luminosity from new ones after several years. It is important to have a stock of modules ready in case of failure. We also advise you to warn the customer at the agreement stage about possible problems, as an informed customer means less problems in the future.
- never clip the cables to the PVC with metal staples (e.g. using taker). This often results in uncontrolled damage to the insulation of the electrical cable, causing subsequent short circuits and failure of the entire system
- do not use 100% of power of the power supply, it is advisable to leave a reserve of approx. 20%, even if the manufacturer claims that there is already a power reserve in the power supply
- the power supply must be able to emit heat and should not be enclosed in small, unventilated spaces.
- the cable supplying the letter, coming out through the PVC, should not go up, but down. Then there is no risk of flooding the letter with water running down the cable if this passage is not sealed.

Attention:

There is a lot of heating inside the letters when exposed to the sun.

9. Assembly

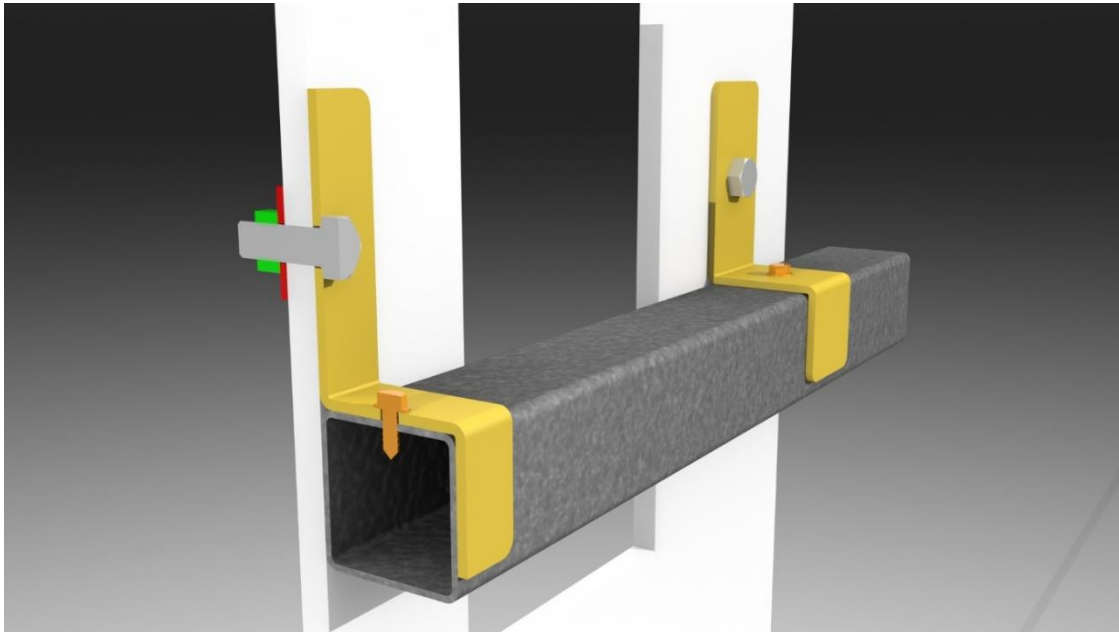
Assembly is a separate issue and a very broad topic. Each assembly differs, is something individual and must be based on appropriate strength calculations on the basis of engineering expertise in the construction field.

The letters themselves do not require a separate calculation, as their compactness and weight are not that important, apart from the exposure to wind, which must always be taken into account when calculating the strength of the support structure of the entire advertisement.

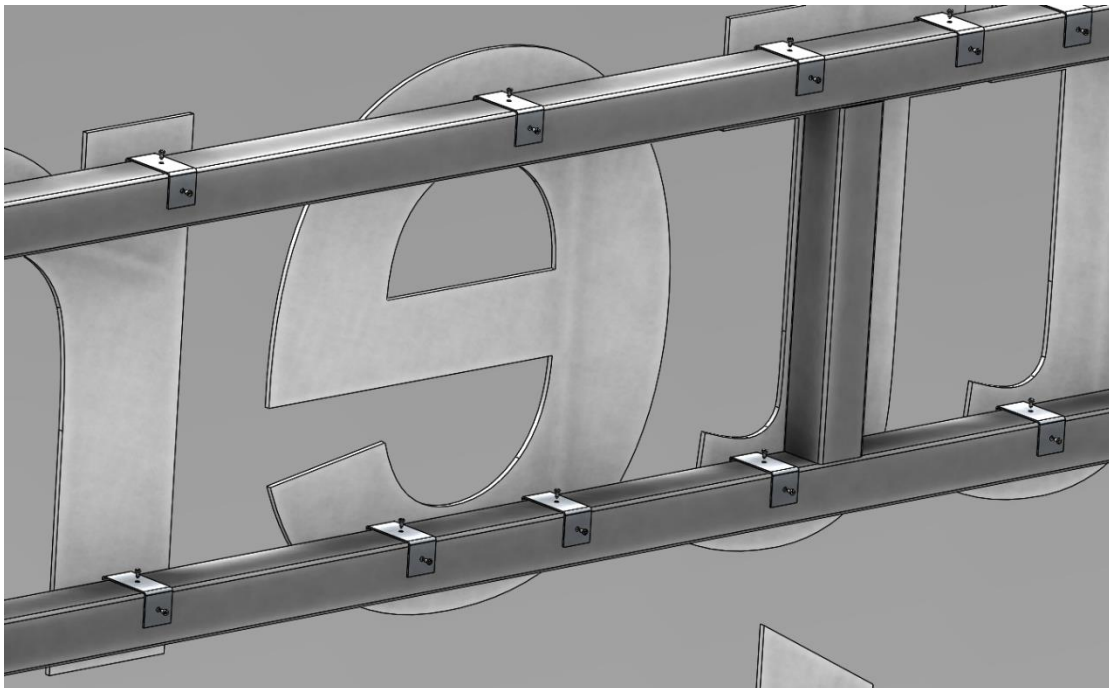
When tightening the back of the letter made of PVC to the structure, use shims under the screw head. For large letters (over 1m), we recommend using aluminum flat bars inside the letter and tightening the back of the letter to the support structure through those flat bars.

Advice:

Particularly in the case of large letters, it is advisable to carry out the installation in such a way that the individual letters are hung like "pictures on the wall", i.e. the entire letter is hung on the structure without being assembled on the scaffolding or in the lifting basket, etc. Of course, if the conditions and possibilities are right for this. This reduces the installation time, and also the time for subsequent maintenance.



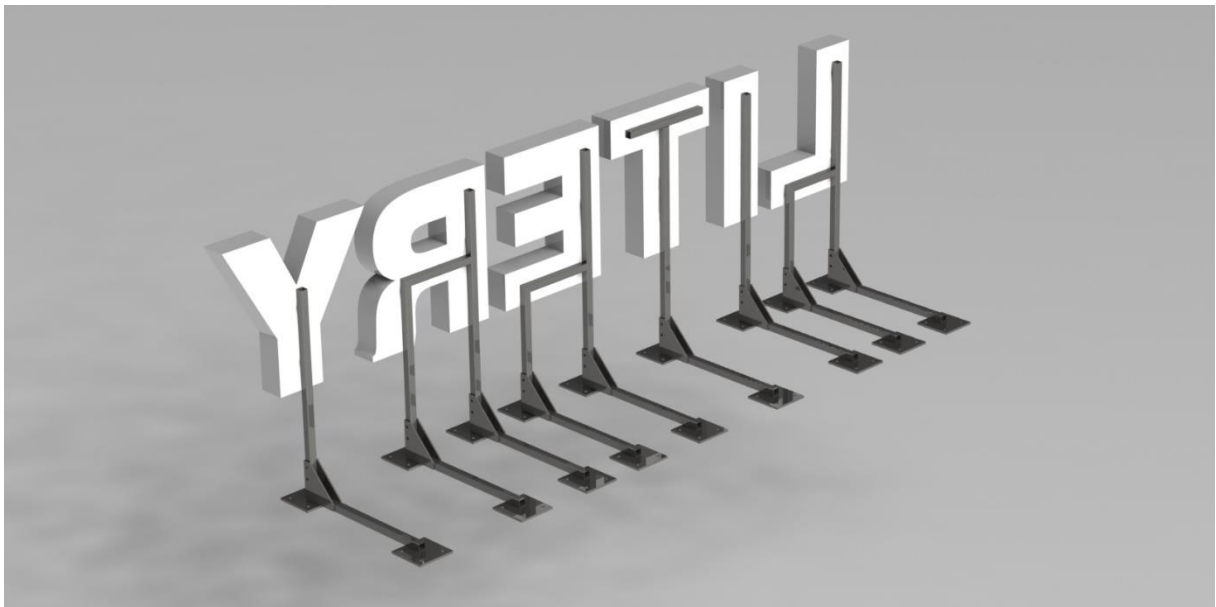
Example of the most popular "Z" attachment

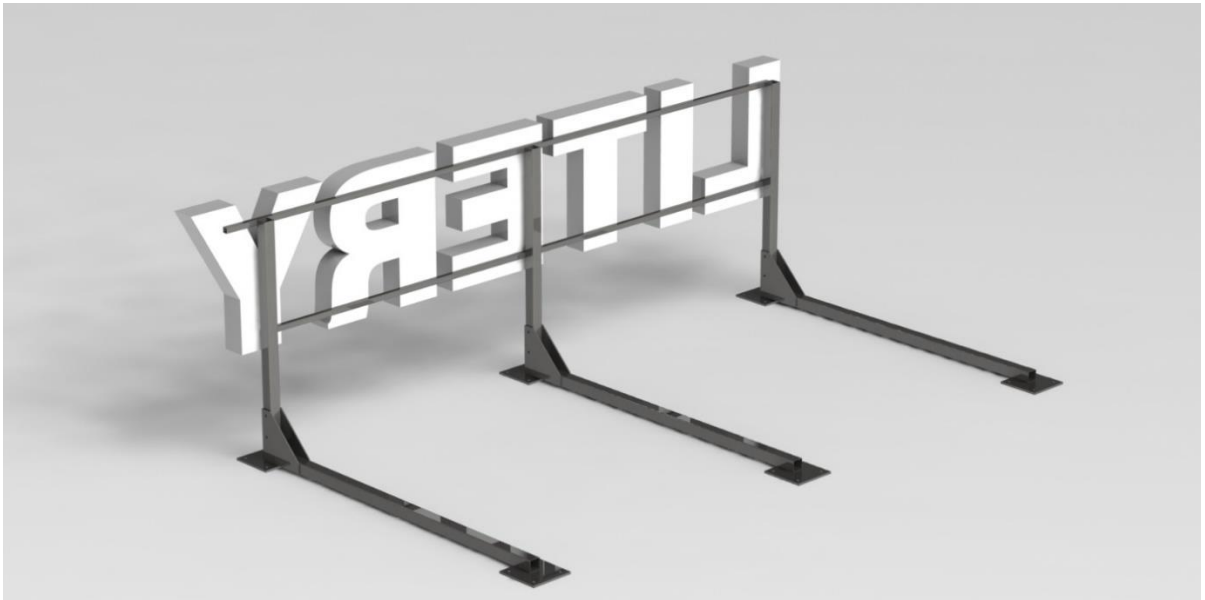


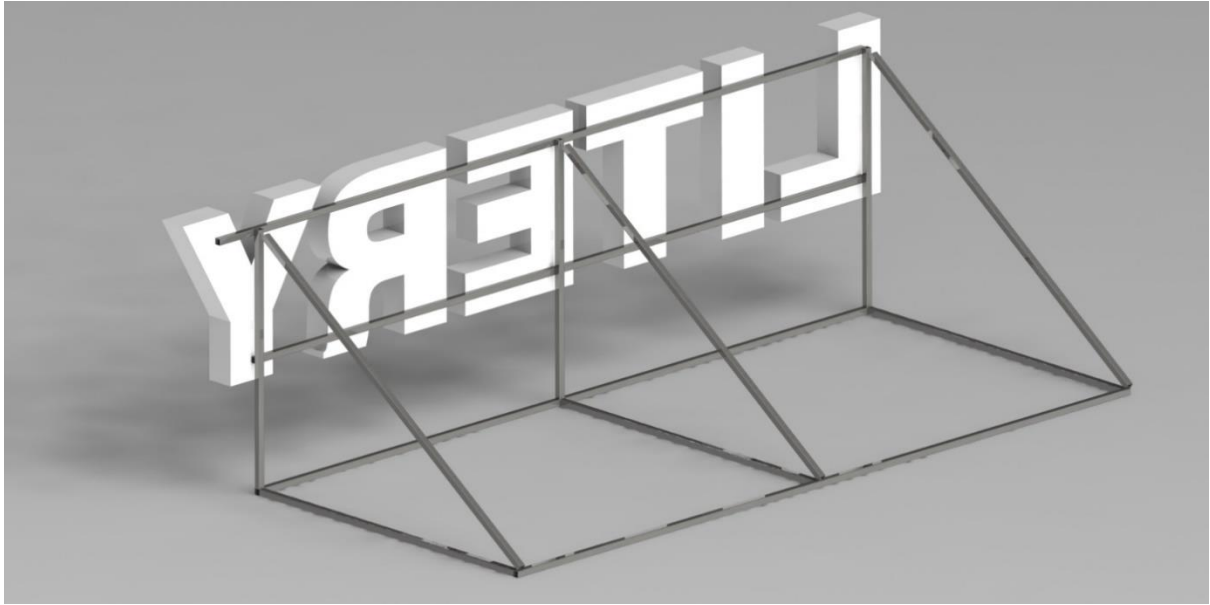
The „C” clamp

Various examples of assembly:

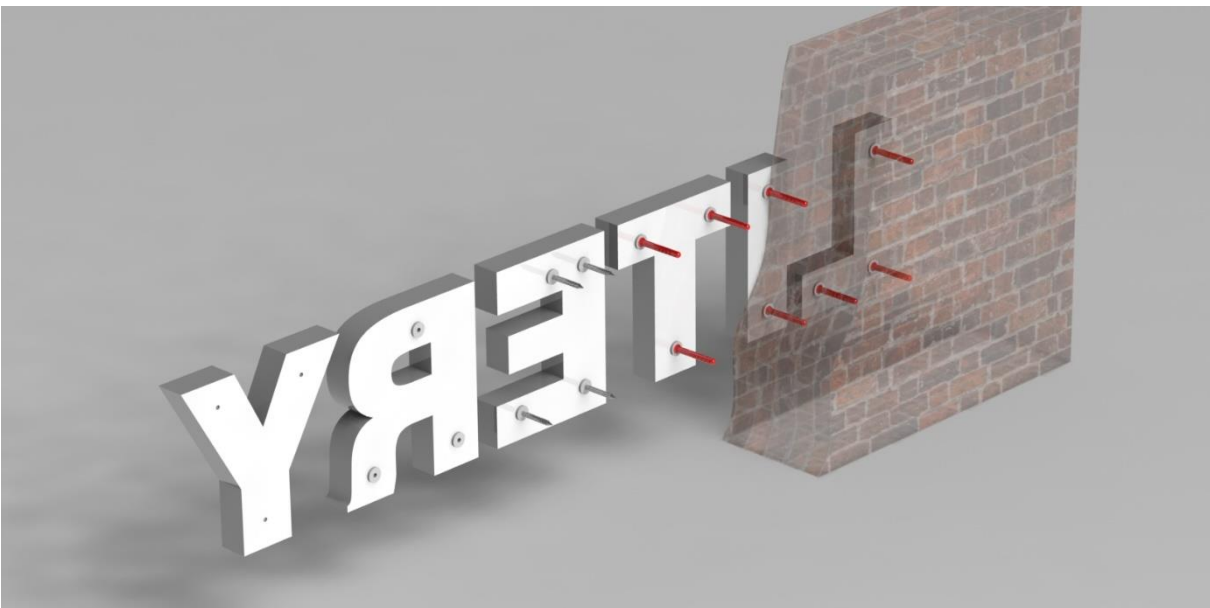
- a) Example of installation of letters on a structure on the roof of a building





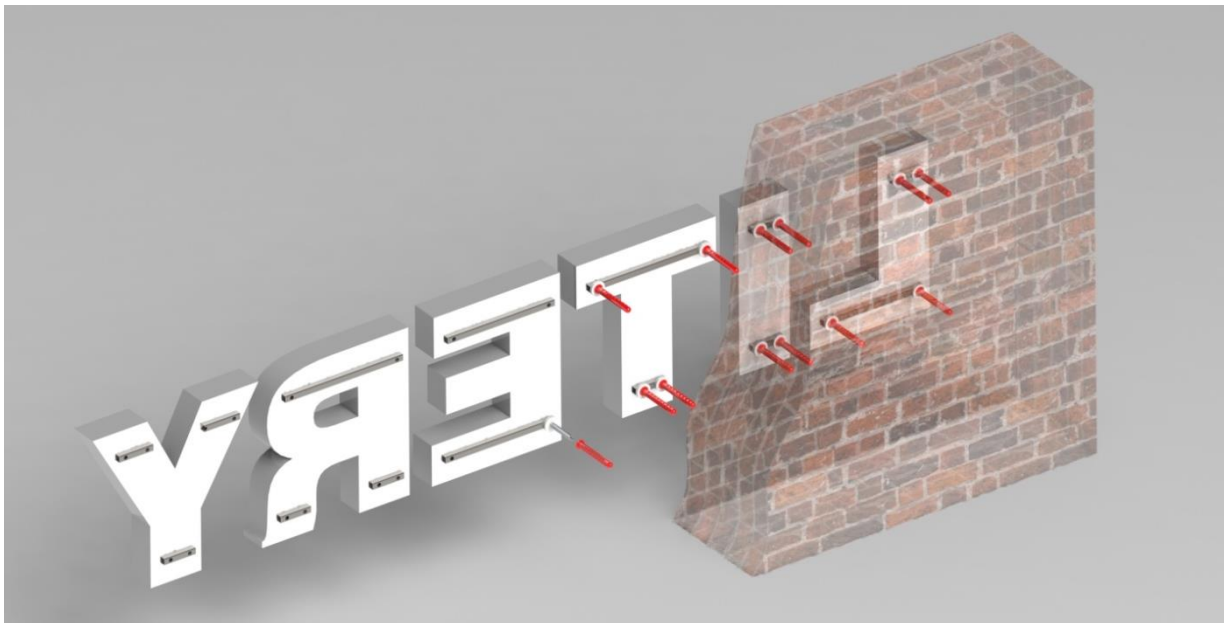
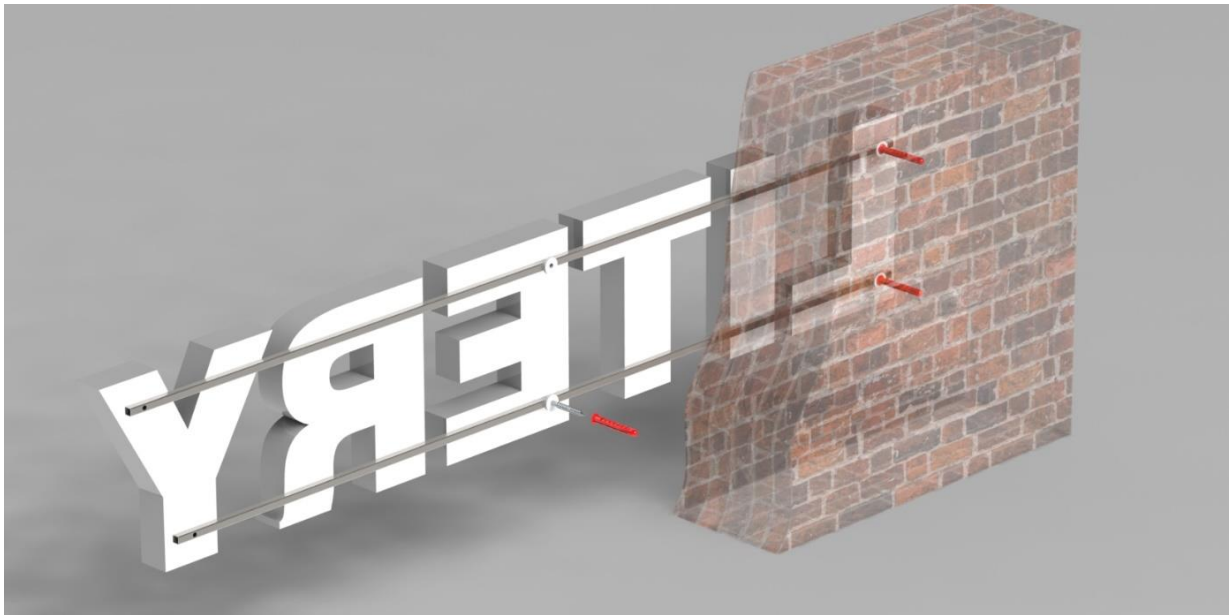


b) Example of installation of letters on a building facade



Important Advice:

Do not install the letters with their backs touching the facade, but leave a certain distance so that the air can flow freely, thus avoiding the formation of mould on the facade and the visible wet stains caused by dirt rinsing off the surface of the letter or the structure.



10. Maintenance

For every letter or advertisement we advise you to agree with the customer its aftercare at the order acceptance stage. If the advertisement is not cleaned systematically, it becomes dirty and unsightly, which often results in a decision to dismantle it early. Maintenance should be carried out twice a year (spring, autumn), if the client agrees. If not, the letters should be washed at least once a year and then checked to make sure everything is in order. During maintenance, it is also good moment to repair minor damage.

Attention:

The weakest link of a three-dimensional letter built with the 3D System Profile is the front of the letter made of plastic (Plexiglass, Polycarbonate). Over time and when exposed to sunlight, plastic becomes brittle, loses its mechanical properties and its correct luminosity (begin showing of Led points). You should also be careful when dismantling the letters after a few or several years during maintenance, as it is much easier to damage the front of a letter than at the very beginning during its assembly.

We do not recommend doing on site maintenance of the letters (especially large ones). A good solution is to take the letters to a workshop and have the appropriate maintenance done there.

If the above instructions are not sufficient for you or if you have any comments, you can always e-mail us with your questions at biuro@3dsystem.pl , or call +48 22 652 60 11, <https://3dsystem.pl/en/>



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