LEISTER

PLASTIC WELDING

Plastic Welding with TRIAC ST

Plastic Welding with the Welding Tool TRIAC ST

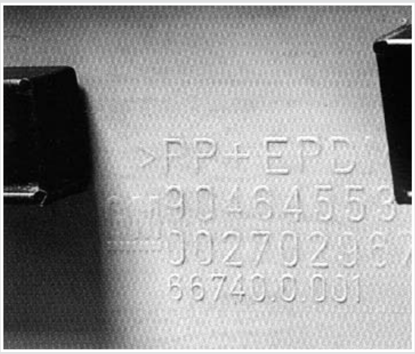
Almost every motor vehicle built today has components made from a variety of plastics. Bumpers, grilles, spoilers, light, surrounds and even complete body panels enable designers to enhance aerodynamic styling and cosmetic appeal while retaining impact resistance and eliminating corrosion.

Plastic offers the structural strength of steel by virtue of its greater elasticity. Minor impacts that could deform steel beyond repair can be absorbed by plastic. Where damage is incurred it is capable of repair by welding with no loss of component strength.

Plastics components that would be expensive to renew can be repaired by welding with the Leister hot air tools TRIAC ST.

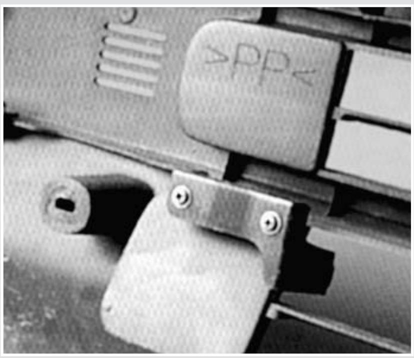
Cracks, splits, warping and even the loss of material can be remedied with the aid of the Leister TRIAC ST hot-air welding equipments. Where a steel component, with the equivalent damage, would be renewed at some cost, the repair of the plastic part can save time and expense, particularly when winter accident periods make great demands of the repairer's parts stock.

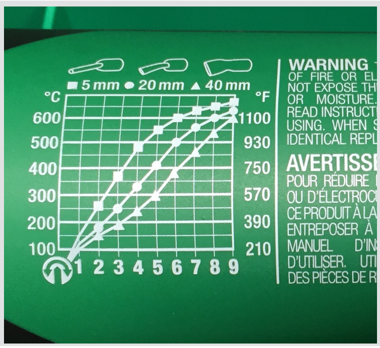
Welding plastics does not produce fumes when the correct procedure is followed. A plastic component can be quickly restored to an ‘as new’ condition without the need for fillers or special treatments. The combination of welding and the recommended repaint procedures will show no trace of a repair that should last the life of the vehicle.



Most vehicle manufacturers mark plastic components with material identification codes. ABS and PP/EPDM are easily welded.

The Leister TRIAC ST hot-air tool on its safety stand.



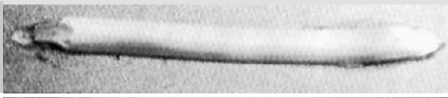


Charts on the body of the hot-air tool indicate the control settings for specific nozzles/temperatures.

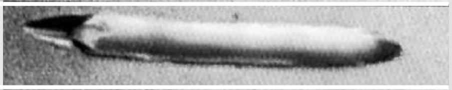
Welding defects

The table and pictures below detail common cause of weld defects.

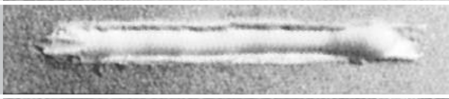
The weld was started correctly but completed too quickly. No wash indicates haste or too low a temperature.



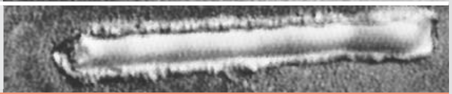
The hot-air tool was not allowed to attain the correct operating temperature and the weld was finished too soon, leaving a hole.



Too much pressure has been applied to the rod leaving a low and deformed bead. Filling may be necessary.



The welding temperature was too high, blistering the sides of the weld. The repair area may be brittle.



Welding defects and causes

Defect	Causes
Poor weld penetration or poor bonding	• Incorrect weld site preparation • Weld speed too fast / temperature too low • Weld attempted with dissimilar materials • Poor technique
Uneven weld bead width	• Welding rod stretched • Uneven pressure applied to weling rod
Charred weld	• Weling speed too slow • Temperature too high
Warping	• Repair area overheated • Parts fixed under tension • Poor site preparation

Welding dressing

A successful weld forms a slightly raised, smooth, even bead across the component surface. Welds must be flatted only when they are cold, warm welds will clog the sanding disc.

Remember that plastic is a soft material that yields easily to abrasives. For this reason use a 120 grit disc first then progress to 180 and finally 320 to produce a smooth finish. Always use new clean, sharp papers. Allow a 7 to 10 cm margin around the weld area for dressing to provide a key for painting.

The weld should be flatted with a 120 grit abrasve disc followed by 180 and 320 grit to obtain a smooth finish. Further smoothness can be obtained using very fine abrasive paper. Prepare up to 10 cm each side of the weld but beware of over flatting.

Painting plastics

There are many paint schemes that are suitable for use on Plastic components. Check with the vehicle manufacturer for approved schemes.

Surface preparation prior to painting can be completed with fine grade abrasive paper followed by thorough deaning essential for good paint adhesion. Cleaning agents shoud be compatible with the recommended paint scheme.

A repaired plastic component should be completely repainted to ensure invisibility of the repair.

The finished component should be as strong as the original and provide an unblemished cosmetic finish.

Refinish the entire component to make the repair invisible.
Use only recommended plastic paint schemes.

The weld should-be a slightly raised, largely smooth, continuous bead.

Correct mating between the welding rod and the material occurs when the rod is seen to soften and the new rod moves down the nozzle feed. As the rod melts into the groove two smooth continuous ridges will appear at the edges, accompanied by a slight wash at the sides of the weld. Do not move too fast, failing to create a wash, nor too slowly, overheating and even scorching or distorting the plastic.

When the weld has been completed, remove the hot-air tool, sliding the nozzle off the remaining welding rod. Once cool, the unwelded rod end is cut off as close to the weld as possible.

The completed weld appears as a smooth continuous line with the wash still visible alongside it, confirming that the rod has welded successfully with the component.

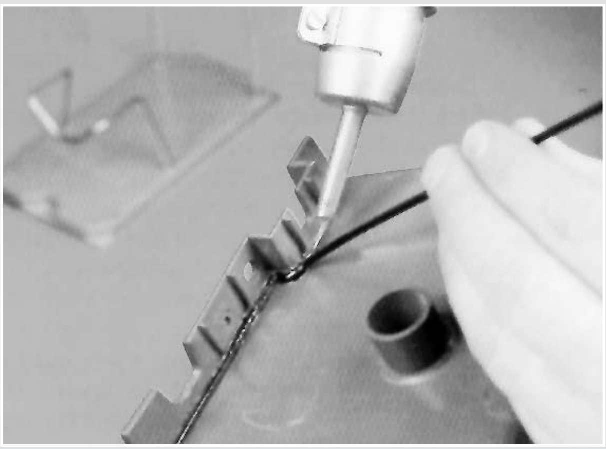
During the welding, previously unseen cracks may open up. These are not new but impact cracks that have been present since the initial damage. These must be treated and welded as any other crack damage.

If the weld is successful, reinforcement welds can be added to the reverse of the material across the axis of the repair. The same preparation and weld operations apply.

Potentiometer control setting for Leister TRIAC ST with:

Thermoplastic Code	Welding Temperature °C	Tack Weld Nozzle 28	Pendulum Weld Standard Nozzle	Speed Weld Nozzle (3 mm)	Speed Weld Nozzle (5,7 mm)
ABS	350	3,4	3,4	4,0	4,2
ABS/PC	350	3,4	3,4	4,0	4,2
PA	400	4,1	4,1	4,6	4,8
PBT	350	3,4	3,4	4,0	4,2
PC	350	3,4	3,4	4,0	4,2
PE hard (HDPE)	300	3,0	3,0	3,3	3,5
PE soft (LDPE)	270	2,8	2,8	2,8	3,0
pp	300	3,0	3,0	3,3	3,5
PP EPIDM	300	3,0	3,0	3,3	3,5
PUR Thermoplastic	300/350	3,0/3,4	3,0/3,4	3,3/4,0	3,5/4,2
PVC hard	300	3,0	3,0	3,3	3,5
PVC soft	350	3,4	3,4	4,0	4,2
XENOY (PC Alloy)	350	3,4	3,4	4,0	4,2

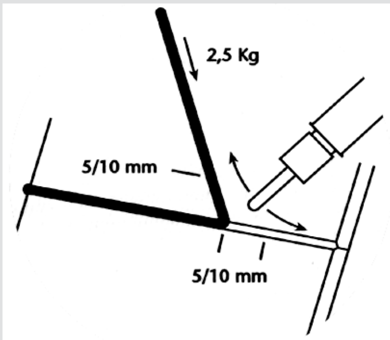
Pendulum welding



Pendulum welding enables cracks in tight corners to be repaired using standard nozzle. Feed the rod into the groove at 80 to 90° and direct heat in a pendulum action onto the base of the rod and the groove.

Where cracks or splits pass through tight corners it may be difficult to use the normal speed welding nozzle. In such cases the technique of pendulum welding is effective.

Prepare the crack in the normal way then feed the welding rod manually into the V groove, at an angle of between 80 and 90° to the groove. Exert about 2.5 kg downward force on the rod while playing the hot-air tool, fitted with standard nozzle, onto the base of the rod and into the V groove in a constant pendulum action. The bias of the action is determined by the comparative thicknessess of the component material and the welding rod. Both must be in the same molten state at the point of fusion. Dressing and finishing is the same for speed welded material.



Identifying plastics

The majority of plastics used in vehicle manufacturing are thermoplastics. Heated until they soften, they can be moulded or welded. There are different types of thermoplastics, each having a specified temperature for welding operations.

Plastic Identification Codes

Code	Plastic
ABS	Acrylonitrile Butadiene Styrene
ABS/PC	Polymer alloy of above
PA	Polyamide (Nylon)
PBT	Polybutylen Terephtalate (POCAN)
PC	Polycarbonate
PE	Polyethylene
PP	Polypropylene
PP/EPDM	Polypropylene/Ethylenediene Rubber
PUR	Polyurethane (Not all PUR is weldable)
PVC	Polyvinyl Chloride
GRP/SMC	Glass Fibre Reinforced Plastics (Not weldable)

Recognition by test welding

If all other information is unavailable a test weld can be tried on the back of the component using a rod from the identified mixed bundle of plastic welding rods.

Method

1. Fit the appropriate welding nozzle for the selected welding rod to the Leister TRIAC ST hot-air tool.
2. Set the welding temperature on the rotary control according to the welding rod material to be employed in the test (see table on page 4). Allow the tool to attain the operating temperature.
3. Scrape the surface in the area of the test to remove any contamination.
4. Feed the welding rod through the nozzle and into the contact with the surface of the component.
5. Following the technique described in Main Welding operations, weld 2 cm of the test rod to the surface of the component.
6. Remove the welding tool from the rod and then cut the rod approximately 2 cm from the component surface.
7. Allow the weld to cool and then try to pull the rod from the surface of the component. If it can be pulled from the component repeat the test with a different rod. If it stays firmly in place the component plastic has been positively identified.

Surface preparation

Following the simple preparatory steps will ensure a successful repair.

Plastic components can be repaired from the front or rear according to ease of access. Reinforcement welds can be used across the rear of a front repair to restore strength to areas designed to withstand impact. The photographs in this brochure demonstrate a repair on the front of a component.

If the damage passes behind a decorative or protective trim this must be removed from the damaged component to provide complete access to the repair area. Trims are usually fixed with an adhesive that softens with heat treatment. Attempting to remove a trim that is cold can damage it beyond repair.

The Leister TRIAC ST hot air tool can supply 230 litres of air per minute at a pre-cise temperature between 20°C and 700°C. For trim removal the hot air tool is used without a welding nozzle at a temperature setting of 300°C. The tempera-ture charts on the tool body show the rotary control setting to achieve the cor-rect air temperature. Whenever the hot-air tool is in use the end of the element housing becomes extremely hot, always rest the tool on its stand when not in use.

Moving the hot-air tool over the trim surface aids even heat absorption to soften the adhesive. It also prevents localised heat build-up. When the adhesive is soft the trim should pull away neatly, allowing re-use after the repair.

The rotary control on the rear of the hot-air tool enables accurate setting of welding temperatures up to 650°C.

Welding groove

A 90 V shaped groove must be prepared along the crack to accept the welding rod.

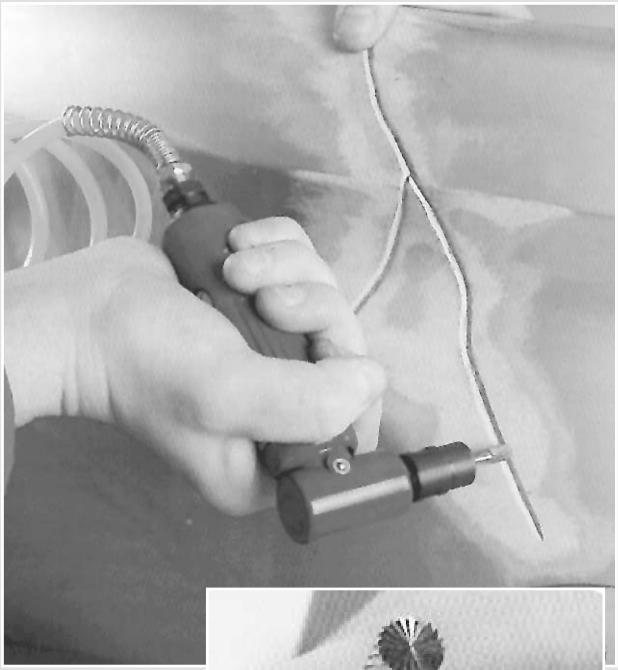
Begin by removing any paint from the repair area with a body file or D/A sander. An area 10 to 15 mm around the damage should be sufficient. If sections of the material have been impacted and become trapped the application of heat up to 200°C will help to free them. A screwdriver blade can also be used to free trapped sections.

The V groove can be formed with careful use of a square edged file but the best tool is a rotary burring bit with a cutting edge on its circumference and end face. This creates the 90° groove in one operation even following the most erratic of crack courses. The depth of the groove should be no more than 2/3 of the thickness of the material.

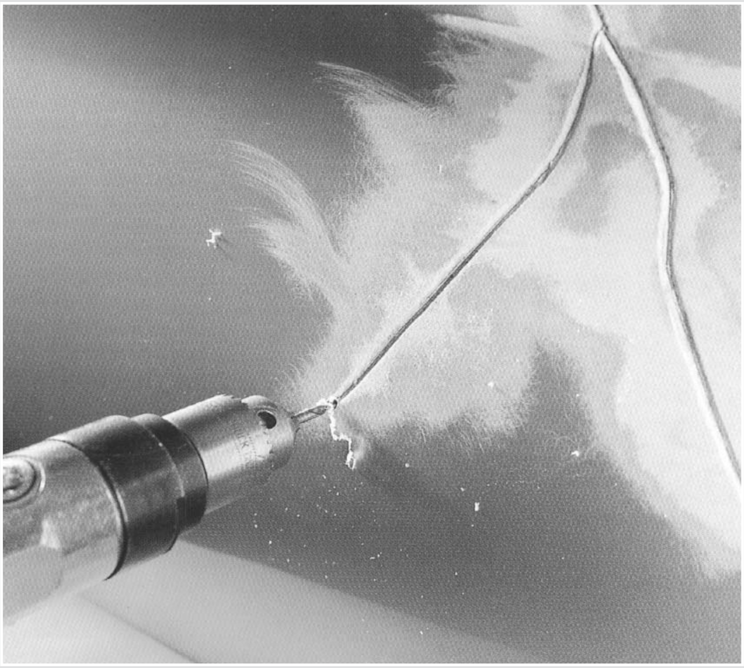
Best results are obtained when a high speed drill is employed. A slow drill or the use of a single cutting face burring tool may lead to it jumping from the groove.

During the burring operations always wear eye protectors and a dust mask to prevent irritation from fine particles of plastic. When the groove is finished the welding rod for the material should rest neatly in it, the upper curve face of the rod protruding 1 to 2 mm above the surface of the repair. This allows for weld dressing operations, eliminating the need for fillers and ensuring enough depth of penetration for the rod.

This test relates to larger components such as bumpers where 5 mm profile welding rod should be used. If 3 mm welding rod is used more than one run may be necessary. For small or thin walled components one run of 3 mm rod may be sufficient.



A rotary burring tool is best to form the 90° V groove for main welding operations. The 5.5 mm diameter bit (available with Leister hot air welding equipment) has cutting edges on the circumference and end face.



Crack prevention

After removing decorative trims and adhesive, the end of each crack or split should be drilled with a maximum 3 mm diameter drill to prevent further lengthening of the crack. Remember, plastic swarf can be as abrasive to the eyes as metal. Wear eye protectors.

Missing material

Where small sections of plastic are lost a piece can be used from a spare unsalvageable part of the same material. This can be shaped and inserted, though success will depend on the availability of spare plastic, the intricacy of the design and the experience of the operator.

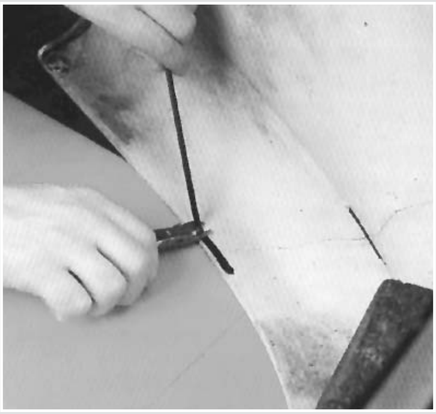
Drill the end of each crack to prevent its spreading.

Tack welding

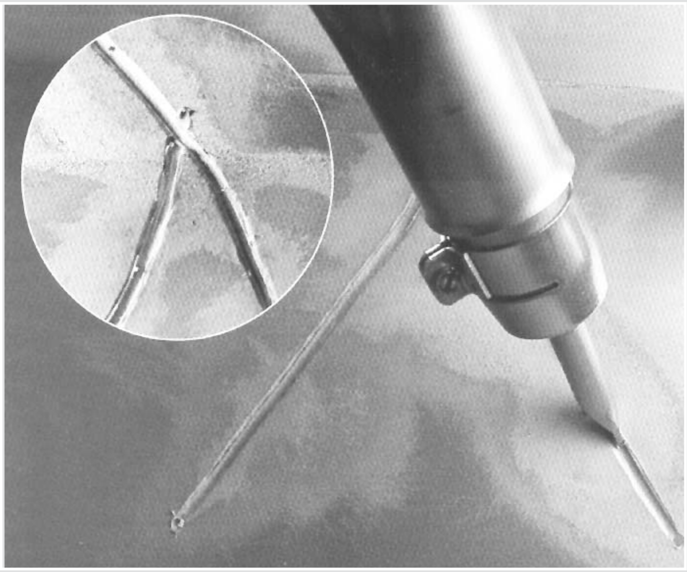
Welding operations are completed in two stages. First, tack weld the base of the crack. The heat knits the sides of the crack together and holds both sections of the component in alignment.

Tack welding nozzle 28 (push fitted onto the standard nozzle of the Leister TRIAC ST is used at the temperature specified for the material see table overleaf. The weld is best completed in one continuous run from end to end, drawing the welding nozzie tip along the base of each V groove.

The nozzle should be held with its toe in contact with the base of the groove and the heel slightly raised. The sole of the nozzle should be inclined at an angle not exceeding 20° to the groove base. As the nozzle is drawn along, hot-air softens the plastic below the heel of the nozzle and the toe draws the softened material together. Avoid applying pressure to the weld via the tool as the material at the base of the groove is thin and not strong. While tack welding, minor misalignment of the panel sides or new inserted material can be corrected by holding the sections in position until the weld has knitted and cooled.



To strengthen weld further, cross welds can be added to the under side.



Tack welding with nozzle 28 allows realignment before main welding operations commence.

After each welding run brush the nozzle clean with a brass suede brush. Remove any difficult residue by increasing the heat level to maximum to soften it.

Main welding

The most important rule in plastic welding is that it is only possible to weld like. Hence the need to identify the plastic material and select a matching welding rod.

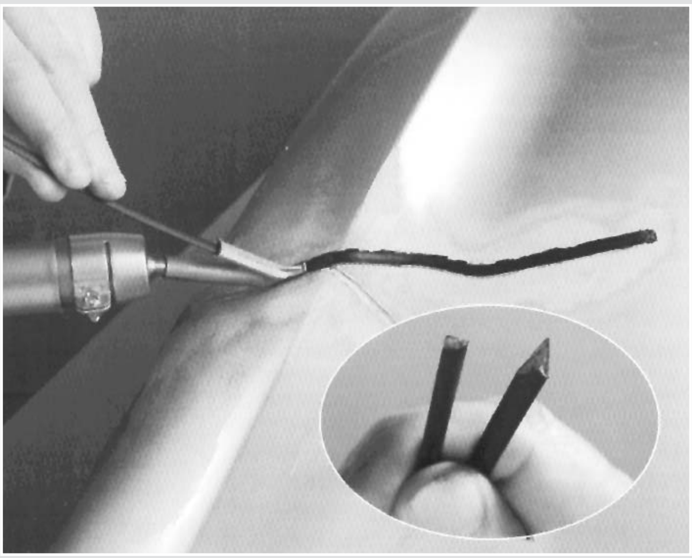
The main welding operation begins with preparation of the welding rod. Cut the end to a pencil point using a trimming knife or side cutters; this provides a progressive fill in the V groove, particularly where it starts in the centre of a panel, preventing the formation of bulbous protrusions of plastic.

Fit speed welding nozzle 5,7 or 7 mm to the Leister TRIAC ST hot-air tool, set the correct temperature for the material and allow the tool to warm up for two minutes before starting.

Insert the trimmed welding rod through the nozzle feeder until approximately 5 mm protrudes on the underside. Hold the tool so that the speed welding nozzle sole runs along the crack parallel to the component surface.

The protruding rod must be held beyond the start of the V groove so that heat is directed onto the start point for welding.

When the surface plastic shows signs of slight wetting move the welding nozzle along the groove. The nozzle toe should rest on the rod in the groove while under the heel there should be an air gap of 3 mm. Feed the rod steadily into the nozzle with a downward hand pressure of about 2.5 kg sufficient to push the softened rod into the groove. To judge what a pressure of 2.5 kg feels like, take a short piece of weld rod and use it to press down on an set of scales until 2.5 kg registers. (Do not apply downward force to the weld via the hot air tool itself). Wherever possible the weld should be completed in one continuous run along the contour of the crack.



Trim welding rods to a pencil point to provide progressive fill to the start of the V groove. Main plastic welding operations are easier than conventional metal welding. Keep speed welding nozzle 5,7 or 7 mm parallel to the coponent surface exerting force only on the rod, not the tool.

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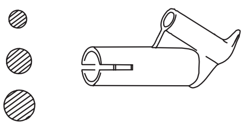
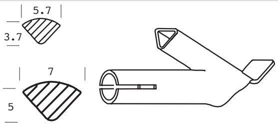
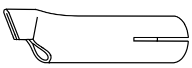
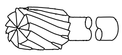
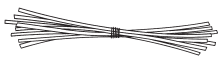
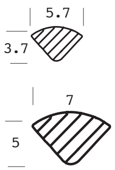
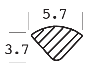
TRIAC ST

- Voltage V~: 120
- Air flow 20 CFM at max temp
- Temperature: 104 – 1292 °F
- Adaptor tube with heat protection
- Eletronic heating element protection
- Motor shut-off at minimal varbon level
- Quick clean air filters
- Suitable for the work site

100.303		Tubular nozzle ∅ 5mm push-fit on TRIAC ST / AT
106.989 **106.990** **106.991**		Speed welding nozzle 3 mm push-fit on tubular nozzle ∅ 5 mm Speed welding nozzle 4 mm push-fit on tubular nozzle ∅ 5 mm Speed welding nozzle 5 mm push-fit on tubular nozzle ∅ 5 mm
106.992 **106.993**		Speed welding nozzle 5.7 mm push-fit on tubular nozzle ∅ 5 mm Speed welding nozzle 7 mm push-fit on tubular nozzle ∅ 5 mm
106.996		Tacking nozzle, push-fit on tubular nozzle ∅ 5 mm

106.997		Rotary burr ∅ 6 mm
107.036		Test bundle profiled welding rod
	 **Profil A** **Profil B**	Endless profiled welding rod 5.7 x 3.7 mm, 7 x 5 mm, PVC-U (grey), PVC-P (transparent), PE-HD (black), PE-LD (black), PP (beige), ABS (white).
	 **Profil A**	Enless profiled welding rod 5.7 x 3.7 mm PC (transparent), PA (black), POM (nature), PC (Xenoy grey), ABS (black).