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WeldTech Hot Air Welder

Operation Manual

Corrosion Resistant Fluid and Air Handling Systems.

WARNING



Danger to life when opening the tool as live components and connections are exposed. Unplug the tool before opening it.



Incorrect use of hot-air blowers can cause fire and explosion hazard, especially near combustible materials and explosive gases.

Do not touch heater tube and nozzle when they are hot. They may cause burns. Let the tool cool down. Do not point hot air flow in the direction of people or animals.

CAUTION



The voltage rating stated on the tool must correspond to the line/mains voltage.



For personal protection on building sites we strongly recommend the tool be connected to a GFCI (Ground Fault Circuit interrupter) or a RCCB (Residual Current Circuit Breaker).



The tool must be operated with supervision. Heat can reach combustible materials, which are out of sight.
Store the tool Indoors when not in use



Protect tool from getting wet.

TECHNICAL DATA

Voltage	V~	42 100 120 200 230 50/60 Hz
Power Consumption	W	1000 1400 1600 1400 16000
Temperature	°C	200-700, Infinitely Controlled
Air Flow	l/MIN	Max 300
Air Pressure	PA	ca 3000 (30mbar) after about 24 hours operation Time
Noise Emission Level	L_{PA} (db)	65
Weight	kg	1.3 With 3m cor
Size	mm	Ø 100mm x 330mm Handle Ø 56mm

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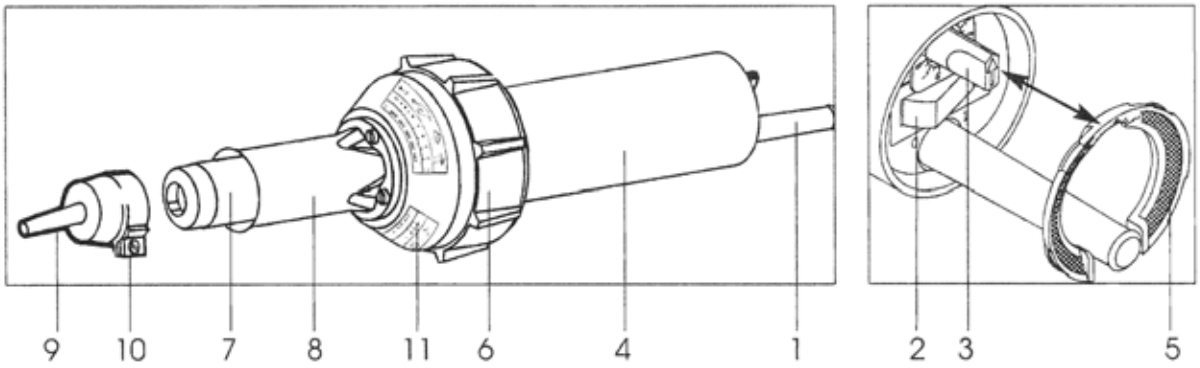
APPLICATION

- Welding of thermoplastic materials as well as single-ply flexible plastics and modified bitumen in the form of boards, tubes, profiles, lining membranes, coated materials, films, foams, tiles, and sheets. The following procedures are possible: overlap welding, welding with rod, with tape, butt welding and melt welding
- Heating-up for forming, bending and sealing of thermoplastic semi-finished materials and plastic granules
- Drying of water-damp surfaces
- Shrinking of heat-shrink sleeves, films, tapes, solder sleeves, pre formed and moulded parts
- Soldering of copper pipes, solder joints and metal foils
- Defrosting of frozen water pipes
- Activating/dissolving of solvent free adhesives and fusion adhesives
- Igniting of wood shavings, paper, coal or straw in furnaces



APPROVAL MARKS

This Tool Is **CCA** Certified (**C**ENELEC **C**ertification **A**greement)



1 - Power supply cord
2 - Main switch
3 - Potentiometer for temperature adjustment
4 - Handle
5 - Air filter
6 - Rubber stand
7 - Heater tube
8 - Heat protection tube
9 - Nozzle (not included)
10 - Screw on the clamp
11 - Temperature scale

Readiness for working

- Fit appropriate nozzle as required.
- Connect tool to the line/mains.
- Adjust hot air temperature:
  PP set to 4-5 with the potentiometer (3).
  PVDF set to 7 with the potentiometer (3).
- Switch on **main switch (2)** and heat up the tool for approximately 5 minutes

Operation

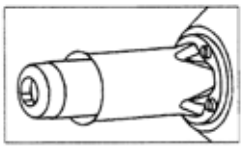
- Carry out a test weld in accordance with the material manufacturer's welding instructions and national guidelines or regulations.
- Check the test weld
- Set welding temperature (welding parameter) as required.
- Cool down the tool after use.
- For more details reference instructions section (Page 6)

Change of nozzles

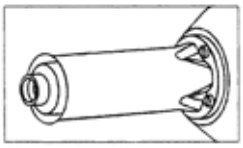
- Before changing nozzles cool down the tool or use only pliers/wrench.
- Do not touch hot **nozzle (9)** and make sure to place it on a heat resistant surface, because of fire hazard,
- Push the **nozzle (9)** on the **heater tube (7)** and secure the nozzle by the **screw on the clamp (10)**
- Screw the **nozzle (9)** and secure by wrench.
- Use, SIMTECH nozzles only.

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VERSIONS



Heater tube with heat protection tube for SIMTECH **push-fit nozzles**



Heater tube with heat protection tube for SIMTECH **Screw-on Nozzles**

ACCESSORIES

- Use SIMTECH accessories only

MAINTENANCE

- Clean polluted **air filter (5)** with a small brush or replace it,
- Clean welding nozzle with brush.
- Check mains **cable (1)** and plug for electrical and mechanical damage.

SERVICE AND REPAIRS

- The motor switches off automatically when the brushes reach their minimum length. Have the tool checked by your Service Centre The life of the brushes is about 1600 running hours of the welding tool's motor,
- Repairs should be carried out by authorised SIMTECH Service Centres only. They guarantee a specialised and reliable Repair Service within 24 hours using original spare parts according to schematics and spare parts lists,

GUARANTEE AND LIABILITY

- Guarantee and liability are in accordance with the guarantee certificate as well as with the currently valid general business and sales conditions
- SIMTECH rejects any guarantee claims for tools which are not in their original condition. The tool must never be altered or changed.

Technical data and specifications are subject to change without prior notice.

1 COMMON THERMOPLASTICS AND WELDING TECHNIQUES

The most commonly weld thermoplastic materials are PVC, PP, PE, PVDF and CPVC. Other materials such as ABS, PS, PC and PMMA have limited weldability and do not warrant any further discussion.

The most common methods of welding include hot air (gas) welding, extrusion, butt fusion (heated element welding), friction welding and high frequency welding. In the following, hot air (gas) welding is being addressed since it plays a major role in the fabrication of low quantity structures and equipment.

2 HOT AIR WELDERS

2.1 THE PROCESS IN GENERAL

In order to weld thermoplastics, the material has to be heated to reach its plasticized state. The pieces to be welded must then be pressed together with a certain amount of pressure over a given amount of time. This will cause the surface molecules of the welded parts to interlock, provided resin compatibility is present. In hot air (gas) welding, the heat transfer medium is a heated gas, either Nitrogen or clean air. In the infancy of plastic welding, the use of Nitrogen proved most successful for prevention of material contamination and oxidation. With today's material quality and equipment technology, Nitrogen is becoming more and more a relic of the past. The combination of clean, oil and moisture free air with controlled temperature proves equally successful, eliminating the continuous expense of the inert gas. The temperature of the hot air ranges between 250°C (480°F) and 450°C (850°F) depending on the type of material (different melting points), material mass to be risen in temperature (usually the material thickness) and the conditions under which the welding process takes place (indoors or outdoors, ambient temperature, and so on).

2.2 THE HOT AIR GENERATING EQUIPMENT

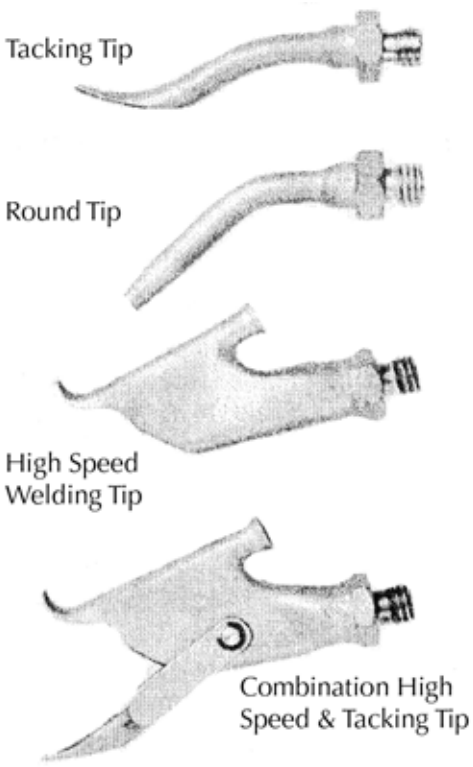
The air flows through a hand welding gun where it is heated up by an electrical heating element. Two principles are used to control the air temperature. The older principle uses a constant wattage heating element and varies the amount of air flow in order to increase or decrease the air temperature. The drawback to this method is that a wider area than necessary is heated up. This introduces heat stress related problems into the material that may cause cracks based on the material expansion and contraction factors.

The newer method of controlling hot air temperature involves the use of electronic circuitry to control the actual applied wattage of the heating element using a constant, minimal air flow. This way the area heated up on the plastic material can be kept to a minimum. The second advantage of electronic controls is a safety feature preventing burn out of the element or melt down of the gun in case of air flow interruption.

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The latest trend in developing electronic controls for hot air heating elements incorporates closed loop controls that hold the temperature constant even while air flow or supply voltage fluctuate.

An equally important factor in hot air welding is the style and type of welding nozzle (tip). Their function is to properly distribute the hot air onto the parent sheet and to heat up and guide the welding rod in the high speed welding process. A variety of tips are available for specific applications. In the field of plastics fabrication, the most common nozzles are the round (freehand), tacking high speed and the combination high speed welding and tacking tips.



2.3 MATERIAL PREPARATION

A good homogeneous weld requires proper preparation of the material. The part should be free of any impurities such as dirt, oil, etc. Additionally, some thermoplastics develop a thin layer of oxidized molecules on the surface that have to be scraped or ground off. Another effect, especially with HDPE, is the migration of unchained, lower density molecules to the surface caused by internal pressure of the material. This gives the usually “waxy” surface appearance of PE. Grinding or scraping the weld area is therefore strongly recommended. Any dust should be wiped off with a clean cloth.

2.4 TACK WELDING

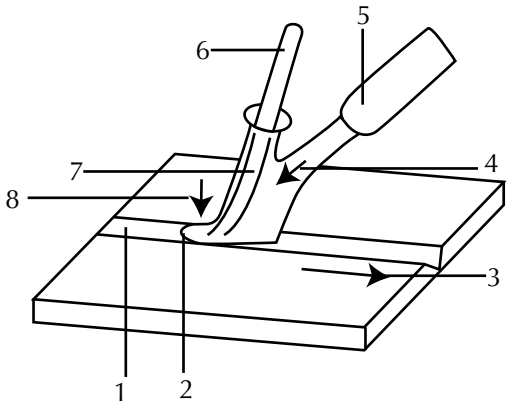
The initial step in the welding process is the “Tack weld.” The objective is to put the parts into place, align or realign them and to prevent slippage of the material during the structural welding process (high speed weld, extrusion weld, etc.). Common sense should determine whether an intermittent or continuous tack weld is applied. Larger structures and thick gauge materials may even require additional clamping. All tanks should be properly tack welded to achieve a leak free connection. This avoids solutions from penetrating between the tank wall and bottom in case of a problem with the filler weld.

2.5 HIGH SPEED WELDING

As far as hand welding is concerned, more than 90% of the structural welds are high speed welded. In this process a filler material, the welding rod, is introduced into the seam to give supportive strength. Standard rod profiles are round and triangular. Triangular rod is applied where cosmetic appearance is important, e.g., furniture, laboratory equipment, etc. It can only be used as a single supportive weld and does not allow for the kind of surface penetration that can be achieved with round welding rod.

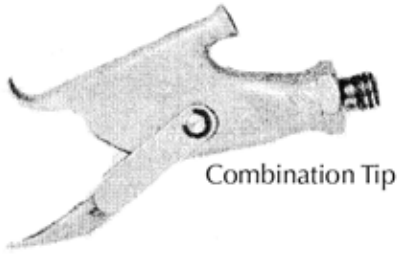
Round welding rod is used where "heavy duty" welds are required. It allows the fabricator to lay several beads of welding rod on top of each other. This way, a relatively thin welding rod can be used to produce a strong weld even on heavy gauge material. Common rod diameters are 1/8, 5/32, 3/16, 1/4" and their metric equivalents 3, 4, 5, 6mm.

The design of the high speed welding nozzle needs to satisfy 3 conditions: pre-heating the base material, guiding and pre-heating the welding rod and allowing for the application of pressure on both the rod and substrate.



1. Welding Bead
2. Wash
3. Welding Direction
4. Hot Air
5. Air Heater
6. Welding Rod
7. Welding Rod at Plasticized State
8. Pressure

It is important to select the correct diameter tip for the selected welding rod. An oversized nozzle will negatively affect the guidance and applied pressure and may also cut into the welded sheet.
For quick trouble-free change over from tacking to high speed welding, a combination nozzle with both features prevents worn tip threads and burnt fingers.



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3. BEAD FORMS

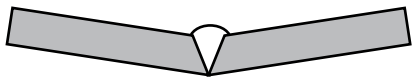
There are a great number of bead forms that can be specified; most common ones are shown on the following page. Certain aspects must be taken into consideration before starting to weld. A smaller diameter welding rod is preferable to a large one since it is easier and faster to control the plasticizing process. The disadvantage is that multiple beads are required for thicker gauged sheet. This could cause excessive heat stress due to the alternating heating and cooling cycles. Therefore, it is sometimes advisable to choose a different method of welding, e.g., extrusion or butt welding. Heat stress should also be taken into consideration when bead forms are selected. For example, a butt joint performed with a double V design will generate less stress than a single V design. Here both sides of the base material are heated up an even amount of times that equalizes the expansion and contraction cycles.

Another consideration is the human factor. Hot air welding depends heavily upon the skill of the operator, and sufficient margins should be designed into the finished product, A little extra time spent on proper design and fabrication will help you to avoid the headaches caused by improper design and hastily performed welds.

4. HEAT STRESS PROBLEMS

We will discuss heat stress in a little more detail in this section. Physical law dictates that when materials are heated they expand, and they contract when cooled. This is known as the coefficient of linear thermal expansion. Compared to metals, commercially used thermoplastics have a much higher expansion factor under identical temperature conditions.

During hot air welding, the material will expand while it is forced into a given position by the welding rod. When cooling down, it will shrink back to its original volume but since it is fixed , it will not shrink to its original shape. A sheet that was straight may now be bowed. Due to their flexibility, thin gauge materials may be bent back into their original shape Thicker gauge materials create more difficulties. An experienced operator will “pre-bend” the pads prior to the welding operation.

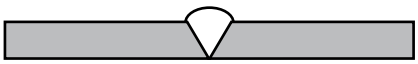


Sheet Warpage caused by shrinkage during the colling process



“Pre-Bending” prior to welding

An additional factor to take into consideration is the eventual service operating temperature of the finished product. A prime example of this phenomenon experienced by many fabricators is a PP tank with steel reinforcement. At a high operating temperature, the tank walls will expand considerably. If the steel bracing was fit too tightly around the tank, the tank will crack. To avoid this, service temperatures must be taken into consideration during the design to allow for adequate tolerances.



After welding, the sheet pulls itself straight

5. WELDING PARAMETERS

Material	Welding procedures	Welding force **F** (N) 3mm	Welding force **F** (N) 4mm	Hot air temp. (°C)	Airflow l / min
PE-HD	PW DW	6 – 10 10 – 16	15 – 20 25 – 35	300 – 320	40 – 50
PP	PW DW	6 – 10 10 – 16	15 – 20 25 – 35	305 – 315	40 – 50
PVC-U	PW DW	5 – 9 8 – 12	8 – 12 15 – 25	330 – 350	40 – 50
PVC-C	PW DW	10 – 15 15 – 20	15 – 20 20 – 25	340 – 360	40 – 50
PVC-P	PW DW	15 – 20 4 – 8	18 – 25 7 – 12	300 – 370	40 – 50
PMMA	PW DW	12 – 16 12 – 16	12 – 16 20 – 30	320 – 370	40 – 60
PVDF	PW DW	10 – 15 12 – 17	15 – 20 25 – 35	365 – 385	45 – 55

PW = Pendulum Welding
DW = Draw Welding

The hot air temperature is measured in the hot air stream, approx. 5mm in the middle of the nozzle.

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5.1 Welding Seam Preparation

Welding area and welding rod:

- Dry, clean, free of oil and grease
- Free of splints
- Free of notches
- Free of oxidation

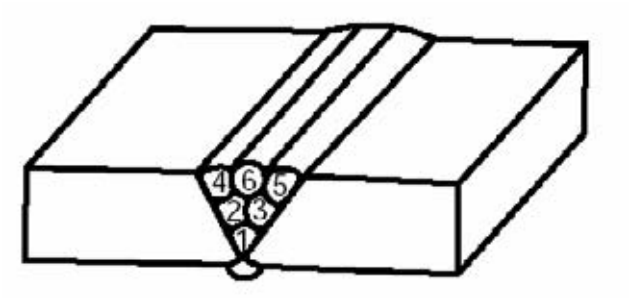
(Joining area has to be scraped off right before the welding process)

Air pressure:

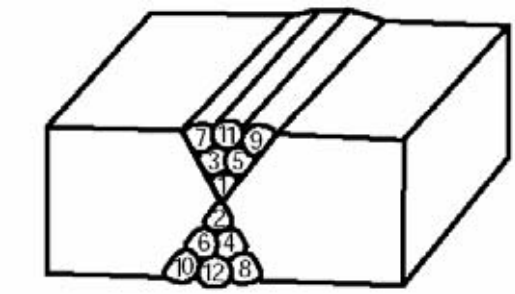
- The use of air pressure requires the installation of pressure

5.2 Evaluation of the Welding Seams

V-Seam

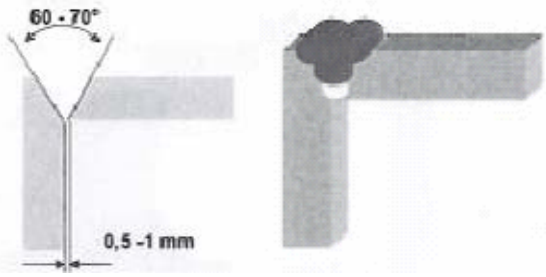


X-Seam (double-V-seam)

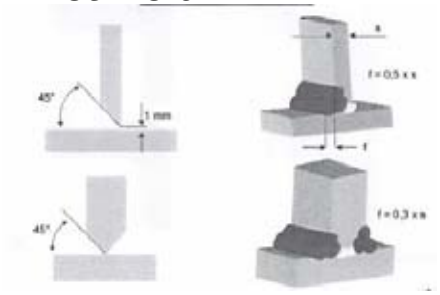


X-seam for thickness of 5mm and more

Angle Joints



Fillet weld



5.3 Evaluation of the Welding Seams

Correctly Welded Seams:

- Slight flattening of the welding rod
- No notches between the welding layers
- Flat seam raise
- In particular for PVC:
  - Foamy to smooth bead
  - No discolouring (e.g. brownish colour)
- In particular for PE, PP, PVDF:
  - Smooth double bead on both sides
  - Dull surface in the area of the welding zone

5.4 Evaluation of the Welding Seams

Flawed welding seams:

- No building of bead or welding rod hardly flattened
  - Temperature too low or
  - Speed too fast or
  - Welding force too small
- Notches between the welding layers
  - Distance between the layers too big

5.5 Evaluation of the Welding Seams

Flawed welding seams:

- In particular for PVC:
  - Brownish discoloring of the welding bead
  - Temperature too high or speed too slow
- In particular for PE, PP, PVDF:
  - Shiny welding zone
  - Temperature too high or speed too slow

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