

buttfusion jointing

UNI 10520 is the correct reference standard for the carrying out of the buttfusion jointing.

With this process the surfaces to be welded are heated by contact with an heating element and subsequently joined together using a special buttfusion machine.

compatibility

The buttfusion jointing is used to weld pipes and/or fittings with the **same thickness and diameter**. For nominal diameter lower than 63 mm the buttfusion jointing is not advisable. Pipes and fittings to be welded must respect the compatibility of melt flow index and density. In details the MFI value of both elements to be welded must be inside the range:

0,2 - 1,4 g/10 min (190°C – 5 Kg)

ambient conditions

Welding must take place in a dry and protect site. Suitable measures must be taken to protect the welding operation from adverse ambient conditions (rain, high humidity, wind). Ambient temperature must be between

-5°C and +40°C

welding operations

It is good practice, before carrying out the welding, to check the materials integrity, efficiency and safety of the equipment. The Operator must have the total visual control over all procedures and have enough space to work without restrictions, in a dry and on a level ground, if possible.

Preparation of welding surfaces is of main importance for the quality of the jointing, as per the following operations:



cleaning and facing

The ends of the pipes/fittings must be cleaned of dirt, mud or similar residuals, using a wet strong soft cloth and then must be clamped in the welding machine jaws. Subsequently they must be faced using a facer tool, which is part of the welding machine.

Bring pipe ends near to the electric facer tool, only after starting up, set gradual pressure avoiding the motor stops during operation. If that, slightly release pressure and quickly separate pipe ends avoiding to damage the facer tool motor.

Facing is completed when the shavings are continuous and of equal size on both ends.

In the way to protect the facer knives life, sharpen or replace them whenever there are problems or faulty conditions during the facing cycle.

inspections

When facing is completed, remove the facer tool and bring the faced ends together, checking that:

- the **mismatch does not exceed 10%** of the thickness of the elements to be welded with a maximum of 2 mm, on the contrary it is possible to adjust on the fixing system of the jaws or rotate the pipes up to the best connection condition, then repeat the facing cycle.
- the possible detachment between the ends is lower than the values reported in the following table. Facing must be repeated when these values are not achieved.

Outside diameter	max distance
up to d_n 200 mm	0,3 mm
over d_n 200 up to d_n 400 mm	0,5 mm
over d_n 400 mm	1,0 mm

The ends must be cleaned with proper detergent (alcohol isopropyl) to remove traces of grease, dust or polyethylene residuals.

heating plate temperature

The heating plate must guarantee the reaching of the **working temperature within 20 minutes** from its start-up. Temperature over the whole surface must be inside $\pm 10^\circ\text{C}$ tolerance with respect to the value set on the thermostat and measured with a digital thermometer.

Temperature values depend on the thickness e_n of the elements to be welded:

$210^\circ \pm 10^\circ\text{C}$ for $e_n \leq 12$ mm
 $200^\circ \pm 10^\circ\text{C}$ for $e_n > 12$ mm

cautions

The Operator must make sure no external troubles interfere with correct execution of the joint during the welding.

Frequently it could happen that the heating plate is cooled because of air channeled inside the pipelines. We recommend to close the pipeline ends with protective caps, taking them off only when welding is completed.

The heating plate must always be placed in its special support to prevent damages on the teflon coating. This one must be periodically reconditioned according to its use. It must be cleaned, when cold with alcohol isopropyl whenever it presents traces of grease, dust or PE residuals.

welding pressure

Polyethylene material requires a welding pressure value of **0,15 N/mm²**.

The welding machine manufacturer will supply special tables reporting the pressure values necessary for welding different diameters and thickness, in accordance to the section of the pressure cylinder which drives the movement of the jaws.

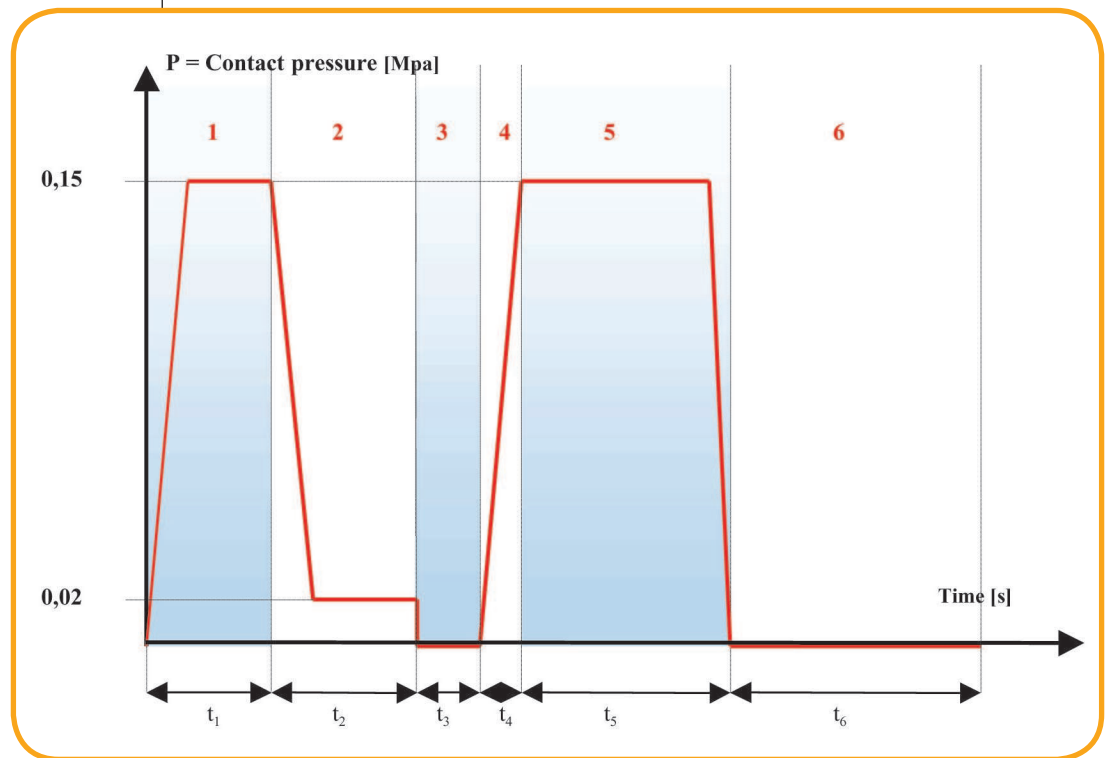
Pressure monitored by the pressure gauge is adjusted using the specific device.

drag pressure

Drag pressure is the pressure value necessary to move the jaws of the welding machine carrying the pipe. Its value mainly depends on the weight of the pipes to be welded, but it also depends on the oil temperature in the hydraulic circuit and on the jaws clamping force. This value must be **always verified** for each welding and added to the welding and heating pressures reported in the tables.



welding cycle



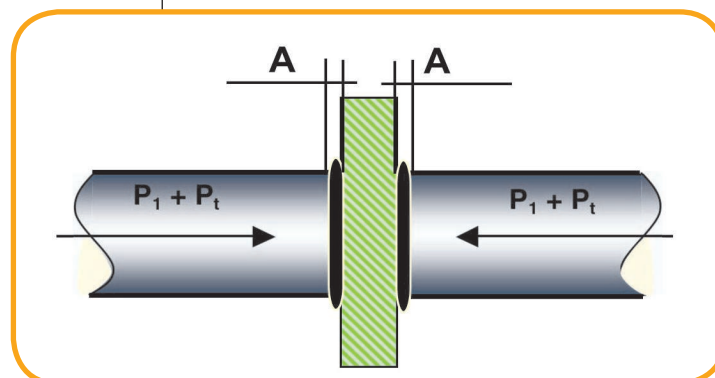
phase 1

hauling and pre-heating (with pressure)

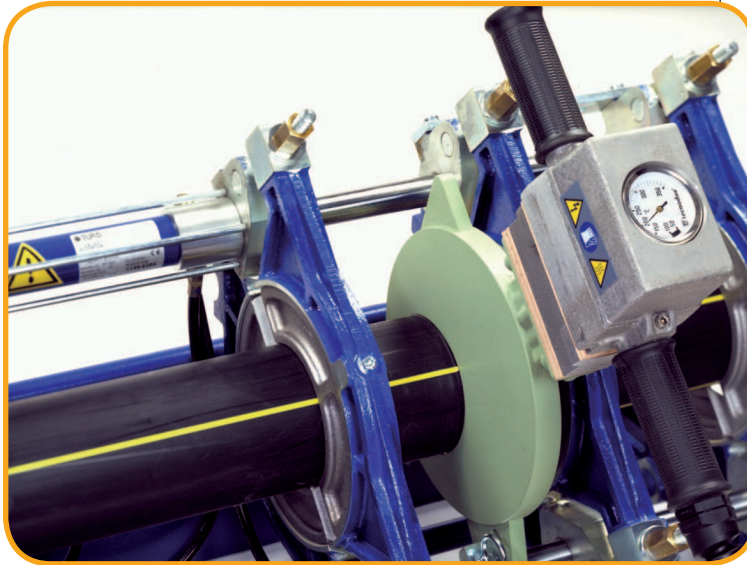
The two ends to be welded are pushed against the heating plate with a pressure P_1 which is the sum of P (from table) and P_t (drag pressure). The “pre-heating with pressure” ends after a t_1 time as long as it forms on both ends to be welded a **ring** of fused material, whose **width A** depends on the pipe thickness and is shown on the welding tables supplied with the machine.

The following formula allows to estimate the A value:

$$A = 0,5 + 0,1 \cdot e_n \quad [\text{mm}]$$



phase 2 heating (without pressure)



In a relative short time it forms a melted plastic ring which shows that the material has started the fusion process.

At this step, pressure must be released avoiding the pushing out of melted material as otherwise there will be a lacking of PE material necessary for a good quality jointing obtaining only a “cold” welding which is extremely fragile.

Pressure is released to value P_2 equal to $0,02 \text{ N/mm}^2$.

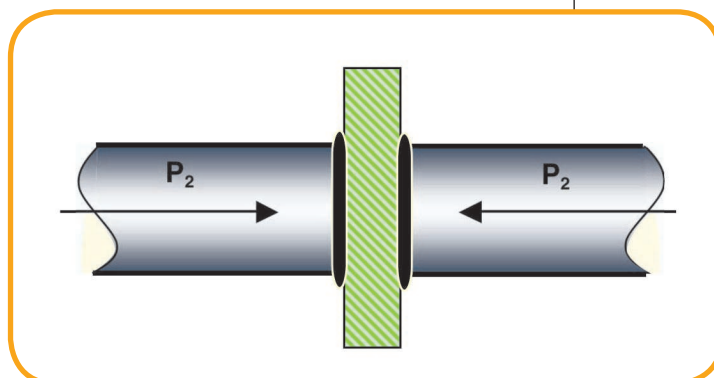
Whenever pressure P_2 is not specified in the welding table supplied with the machine, in the practice it is recommended to set the pressure gauge on a value that is near to zero but never less than the drag pressure.

If the procedure is correct during this step which lasts for a t_2 time, the surfaces are continuously heated but there is no increase of the ring overthickness.

There is an approximate relation that shows the value of heating without pressure t_2 , expressed in seconds which is equal to:

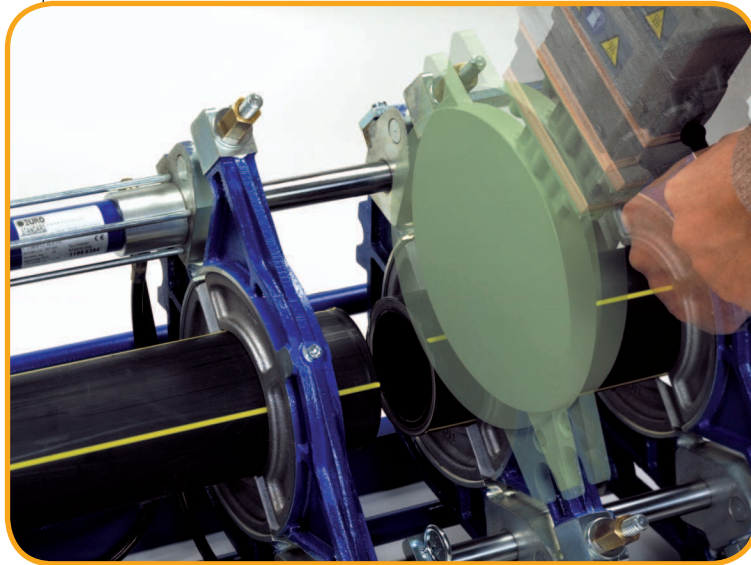
$$t_2 = 12 \cdot e_n \pm e_n \quad [\text{s}]$$

Anyway the exact value is shown in the welding tables.



phase 3

removal of the heating plate

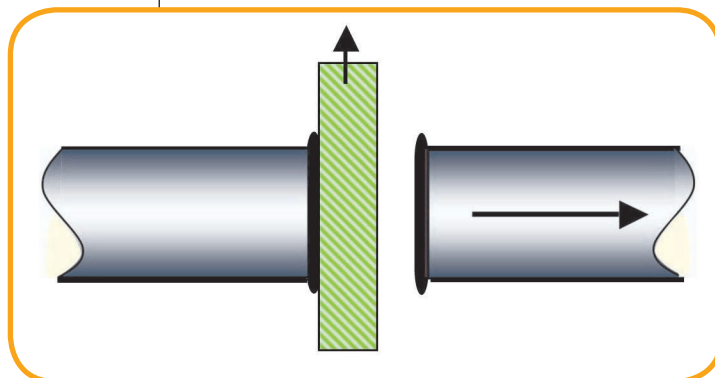


At expiring of time t_2 , the ends are separated to allow the heating plate removal and subsequently brought together for jointing.

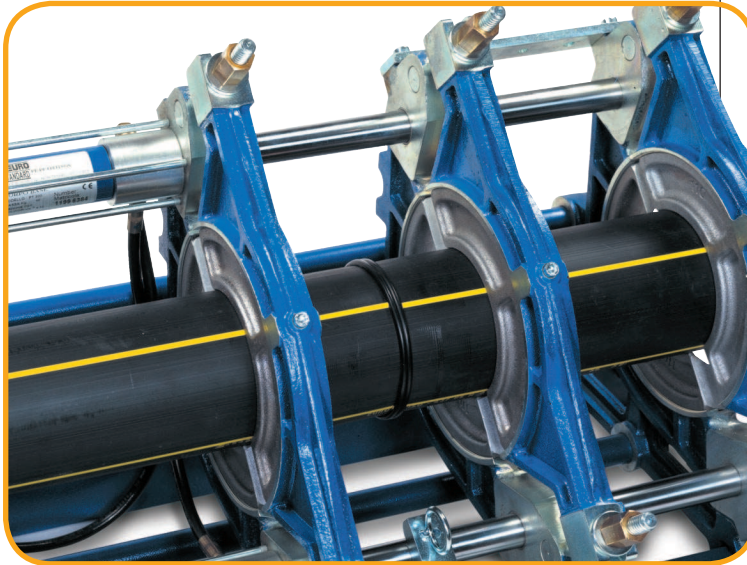
This step is the most critical part of the intire jointing cycle. The correct performance of this phase is essential for a successful welding. Separation speed must be as fast as possible to avoid cooling of the ends.

Smaller is the thickness of the pipes/fitings, faster must be the separation speed. In any case it must be completed in a time t_3 which is equal to:

$$t_3 = 4 + 0,3 \cdot e_n \quad [s]$$



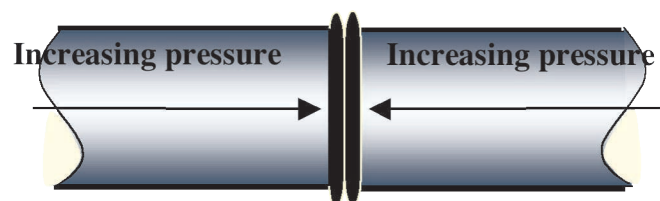
phase 4 build-up pressure



Bring together the two ends by increasing pressure up to the value P_5 . Closing speed must be enough to avoid that melted material may be pushed out. This cycle must be completed within the t_4 time which is equal to:

$$t_4 = 4 + 0,4 \cdot e_n \quad [\text{s}]$$

Whenever the stated pressure value P_5 exceeds, absolutely avoid a subsequent drop which will origin a decompression stress damaging the jointing.



phase 5

welding with pressure

Keep the welding pressure for a time t_5 ; once completed the temperature in the welding area decreases from the starting 220°C to about 70°C. There is an approximate relation for pressure welding time t_5 expressed in minutes:

$$t_5 = 3 + e_n \quad [\text{min}]$$

Welding pressure P_5 is equal to the “pre-heating” pressure P_1 . When value P_5 is achieved, a **ring** is formed whose width **B** must be within the range according to UNI 10520 point 11.1.2 table 2, as shown in the following table:

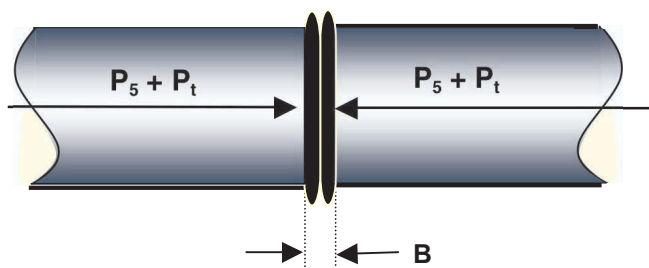
thickness e_n [mm]	width B [mm]	thickness e_n [mm]	width B [mm]
3	4 - 6	22	13 - 18
4	4 - 7	24	14 - 19
5	5 - 8	27	15 - 20
6	6 - 9	30	16 - 21
8	7 - 10	34	17 - 22
9	8 - 11	40	18 - 23
11	9 - 12	45	20 - 25
13	10 - 14	50	22 - 27
16	11 - 15	55	24 - 30
18	12 - 16	60	26 - 32
19	12 - 18	65	28 - 36

The ring must be uniform over the entire length of the circumference: its width **B** at any point on the welding must never vary more than $\pm 10\%$ with respect to the average value.

$$B_m = \frac{B_{\min} + B_{\max}}{2}$$

where B_{\min} and B_{\max} are respectively the minimum and the maximum values measured.

The maximum difference between the half-rings b_1 and b_2 must be at any point in the welding less than 10% of the ring width **B** for pipe-pipe jointing and 20% for pipe-fitting jointing.



phase 6

cooling – safety time

At expiring of time t_5 pressure is released and the joint removed from clamps.

It is recommended to wait for a further time t_6 before stressing the joint. This time expressed in minutes must never be lower than 1,5 times the pipe/fitting thickness (safety time) and allows the joint to achieve a temperature of approximately 40°C.

$$t_6 = 1,5 \cdot e_n \quad [\text{min}]$$

Absolutely avoid quick forced cooling methods like water, compressed air or other external agents.



tables

BUTTFUSION phases and welding parameters

phase		contact pressure	time [sec]	note
1	hauling and pre-heating (with pressure)	$0,15 \text{ N/mm}^2 + P_t$		t_1 which forms a ring having thickness $A=0,5+0,1 \cdot e_n$ [mm] (e_n nominal thickness of pipe)
2	heating (without pressure)	$0,02 \text{ N/mm}^2$	$12 \cdot e_n \pm e_n$	
3	heating plate removal		$<4+0,3 \cdot e_n$	Separate the jaws and remove the heating plate; do not damage the fused material
4	build-up pressure	$0 - 0,15 \text{ N/mm}^2 + P_t$	$<4+0,4 \cdot e_n$	Bring together the two ends avoiding the pushing out of melted material
5	welding with pressure	$0,15 \text{ N/mm}^2 + P_t$	$(3+e_n) \cdot 60$	
6	cooling		$1,5 \cdot e_n \cdot 60$	Do not stress the joint

welding sizes

The table, which reports the parameters necessary for the welding (times and pressures related to thickness and diameters) must be supplied by the manufacturer of the welding machine and is specific for each model. THEY ARE NOT INTERCHANGEABLE.

		MIN. PIPE THICKNESS	PRE-HEATING PRESSURE	MELTED RING	HEATING PRESSURE	HEATING TIME	WELDING PRESSURE	WELDING TIME	COOLING TIME
SDR	PN	e_n	P_1	A	P_2	t_2	P_5	t_5	t_6
		mm	bar	mm	bar	s	bar	min	min
17 11 7,4	10 16 25	values supplied by manufacturer							

The tables must be always available whenever the welding machine is used. A copy should be filed.

buttfusion machine



The buttfusion machine must be in accordance to UNI 10565 standard and provided with CE marking; it is also guaranteed to give:

- a correct axial adjustment/movement of the pipes through the clamps;
- a proper and true facing of the pipes/fittings ends through the facer tool;
- an accurate control of the welding pressure and of the temperature of the heating plate;
- the conformity to the safety standard regulations.

Each machine can butt weld different diameters; according to the pipe diameter, the reducing inserts are fitted into the standard clamps.

The buttfusion machine consists of the supporting mounting with fixed and movable jaws. Those movable hydraulically driven are rolling on two guides.

The machine is provided with an electrical facer tool, a heating plate and electro-hydraulic unit with distributor and pressure gauge with manometer.



The heating plate must guarantee uniform temperature on its whole surface and is supplied with a graduated thermometer which gives information with accuracy within $\pm 10^{\circ}\text{C}$.

The temperature control is carried out with an adjustable thermostat which guarantees a maximal variation of $\pm 2^{\circ}\text{C}$ of the stated temperature.

The buttfusion welding machine must be submitted to period overhaul (biennial) by the manufacturer according to UNI 10565 standard.



ancillary equipment

For a correct and safe execution of welding cycles, it is recommended that the power supply of the electrical equipment is fed through an electrical connection safety box.

Furthermore it is important to avoid excessive drag stress on the buttfusion machine when welding pipes in bars. It is suggested the use of proper rollers.

