

Butt-welding

5.2 Jointing methods

5.2.1 Butt-welding



Illustration 5.2

Butt-welding is an economical and reliable way of jointing without using additional components requiring only butt-welding equipment. All Akatherm products can be welded using this jointing method. Fittings can be shortened by up to the k-dimension (when indicated in the catalogue), still allowing butt-welding. This jointing method is very suitable for prefabrication and producing special fittings.

Preparations

The following guidelines are of importance when making a proper butt-weld:

- Establish a work space where the jointing can be done without being effected by major weather conditions.
- Check if the equipment functions properly. Welding equipment used on site deserves special attention.
- The fittings and or pipes need to be aligned in the welding machine to avoid a sagging in the pipe-wall. This sagging may maximally be 10% of the wall thickness.
- Clean the heating element before each jointing operation with a non clotted paper and suitable cleaner (see instructions welding machine).
- Cut the pipe and/or fitting with a pipe cutter to make the end square.
- Make sure that once the pipe and/or fitting ends have been machined, they do not get dirty. Do not touch them with your hands. The surface needs to be clear of oil, grease and dirt.
- Put the pipe parts into the welding machine to facilitate a firm hold during the jointing process.
- The temperature of the heating element has to be between 200°C and 220°C. With a thinner wall-thickness the higher temperature is recommended. The maximum deviations can be found in table 5.1. The temperature of the heating element needs to be checked at several spots on the heating element. Check the temperature set at the thermostat using thermal measuring sticks or a thermometer.

Used surface of heating element for welding diameter d_1	Δt_{tot}
$d_1 = 40-160$	8°C
$d_1 = 200-315$	10°C

Table 5.1 Maximum temperature variation heating element

Welding process

The butt-welding of Akatherm HDPE operates according to the following steps:

Machining the surface

Both sides should be machined until they run parallel. When the machining is finished, open the carriages (the plastic shavings must be continuous and uniform in both sides to weld). Take off the milling cutter. Verify the alignment between the machined surfaces. Remove the plastic shaving. Do not dirty or touch the machined surfaces.

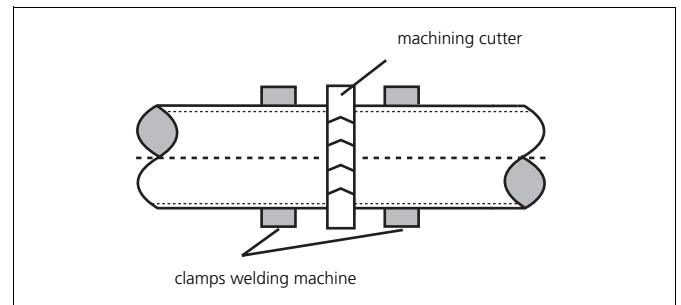


Illustration 5.3 Machining the surface

Preheating under pressure

Press the two ends to be jointed gradually to the heating element until a bead is created. The size of the bead is a good indication that the appropriate pressure and time is used. For pressure and bead size see table 5.2.

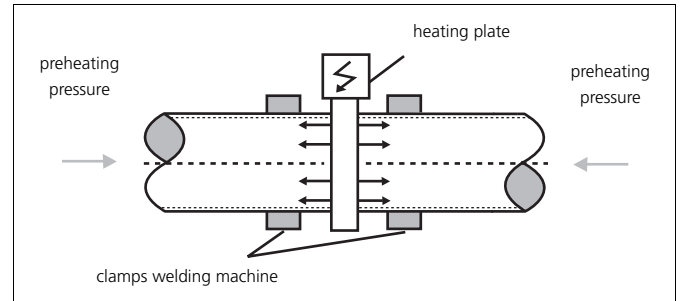


Illustration 5.4 Preheating under pressure

Heating up with less pressure

HDPE is a good insulator, therefore at this stage it is necessary that the correct heating depth of the pipe ends is obtained. Only a small amount of pressure 0,01 N/mm² is required to maintain the contact of the ends with the heating element. The heat will gradually spread through the pipe/fitting end. The size of the bead will increase a little. The time and pressure needed for this phase can be found in table 5.2.

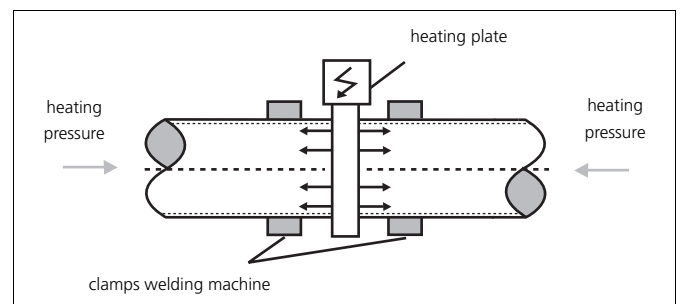


Illustration 5.5 Obtaining the correct heating depth

Change over

Remove the heating element from the jointing areas and immediately join the two ends. Do not push the ends abruptly onto each other. The removal of the heating element needs to be done quickly to prevent the ends from cooling down. The times for changing over can be found in table 5.2.

Welding and cooling

After the jointing areas have made contact they should be joined with a gradual increase in pressure up to the specified value. The building-up of pressure should be done linear and not differ more than $0,01 \text{ N/mm}^2$. When the buildup occurs too fast the plastic material will be pushed away. When the pressure buildup is too slow the material cools down. In both cases the quality of the weld is questionable. Keep the specified welding pressure at a constant level during the complete cooling period. There must not be any load or strain at the joint. Do not cool artificially.

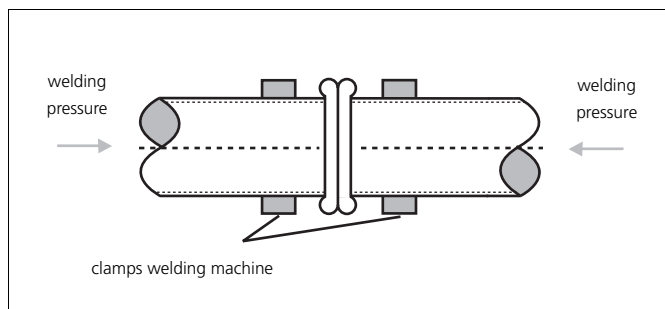
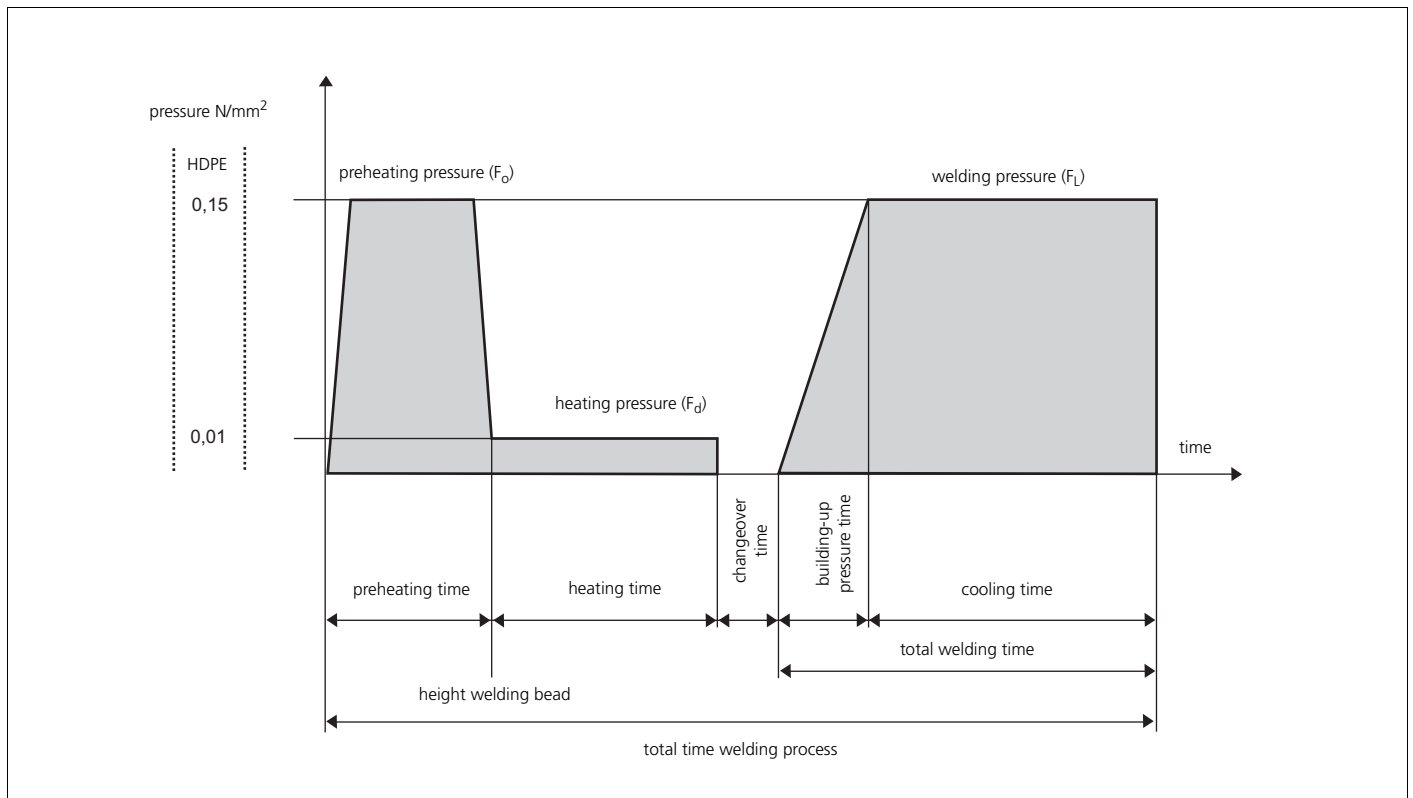


Illustration 5.6 Welding and cooling

The welded components can be removed from the machine when 50% of the cooling period has elapsed, providing that this is done carefully, with no load or strain being placed on the joint. The joint must then be left undisturbed for the remainder of the cooling period.

Butt-welding



Graphic drawing 5.1

Diameter d_1	Wall thickness e	Preheating pressure / welding pressure (0,15 N/mm ²)	Heating pressure (0,01 N/mm ²)	Height welding bead	Heating time	Changeover time	Building-up pressure time	Cooling time
mm	mm	F_O/F_L N	F_d N	mm	sec	sec	sec	min
40	3,0	55	4	0,5	29	4	4	4
50	3,0	70	5	0,5	30	4	4	4
56	3,0	75	5	0,5	30	4	4	4
63	3,0	85	6	0,5	31	4	4	4
75	3,0	105	7	0,5	32	5	5	4
90	3,5	145	10	0,5	35	5	5	4
110	4,2	210	14	0,5	42	5	5	6
125	4,8	275	18	1,0	48	5	5	6
160	6,2	450	30	1,0	62	6	6	9
110	3,4	175	12	0,5	35	5	5	4
125	3,9	225	15	0,5	39	5	5	5
160	4,9	370	25	1,0	49	5	5	7
200	6,2	570	38	1,0	62	6	6	9
250	7,8	900	60	1,5	77	6	6	11
315	9,7	1400	93	1,5	77	6	6	11
200	7,7	700	47	1,5	77	6	6	11
250	9,6	1090	73	1,5	97	7	7	13
315	12,1	1730	115	2,0	121	6	8	16

Table 5.2 Welding parameters Akatherm HDPE drainage

In table 5.2 the welding parameters can be found for Akatherm HDPE. The exact regulation of the welding machine depends on its mechanical resistance. The tables provided with the machine are to be used for regulating the machine.

Evaluating the butt-weld joint

The butt-weld can be evaluated using destructive and non destructive evaluation methods. For these evaluations special equipment has to be used. Butt-welds can easily be judged by a visual inspection, making this the recommended method for a first evaluation.

The shape of the welding bead is an indication for the proper operation of the welding process. Both welding beads should have the same shape and size. The width of the welding bead should approximately be $0,5 \times$ the height. Differences between the beads can be caused by the difference in HDPE material used in the welded components. Despite the differences in welding bead the butt-weld can be of sufficient strength. In illustration 5.7 a good weld is shown with a uniform welding bead. At a visual inspection this would be classified as an "acceptable" weld.

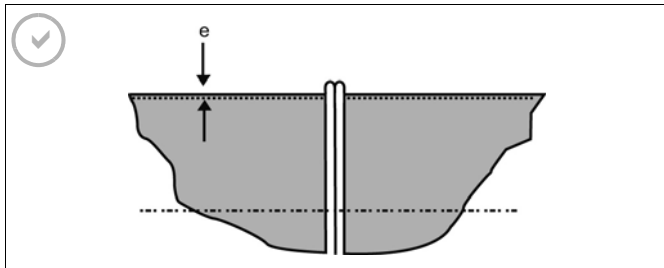


Illustration 5.7 Butt-weld with even welding beads (acceptable)

Mis-alignment between fittings and pipe can occur for several reasons. Oval pipe ends or irregular necking of the pipe can cause an incomplete fit. If this sagging is less than 10% of the wall thickness the weld can still be classified as "acceptable" (see illustration 5.8).

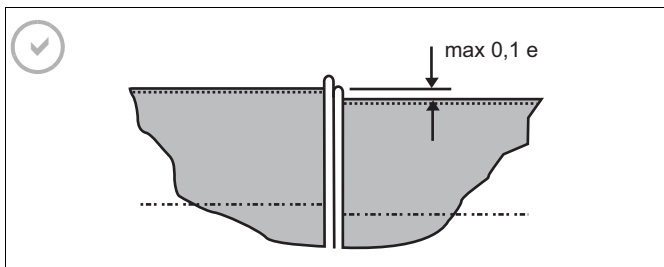


Illustration 5.8 Butt-weld with mis-alignment of pipe (acceptable)

Illustration 5.9 shows a joint with beads that are too big. The uniformity indicates a good joint preparation. Heat supply and jointing pressure settings, however, are too high. A purely visual assessment would still classify the weld as "acceptable".

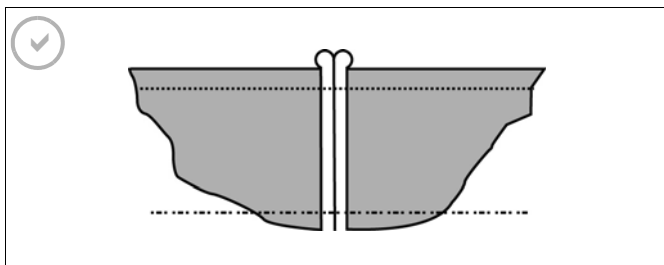


Illustration 5.9 Butt-weld with big welding beads (acceptable)

When there is either insufficient heating up or not enough welding pressure there are hardly any beads. In cases like this thick walled pipes often form shrinking cavities. The weld must be classified as "not acceptable".

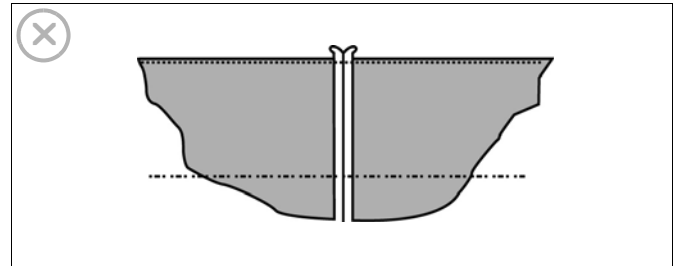


Illustration 5.10 Butt-weld (not acceptable)

In illustration 5.11 a cross-section of a regular, round fusion bead, free of notches or sagging is shown. Special attention should be paid to the fact that the collar value 'K' is greater than 0.

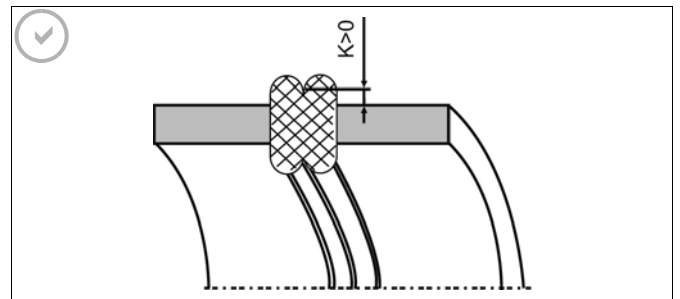


Illustration 5.11 Cross section of a good butt-weld

Welding by hand

In general butt-welds are made using an Akatherm butt-welding machine. However up to the diameter $d_1 = 75$ mm the weld can be made by hand. At 90 mm and above the welding pressures are too big to make a good weld by hand. The welding process is identical to butt-welding with a machine:

Preheating

Push the pipe/fittings against the heating plate until the required welding bead has been formed (for height of welding bead see table 5.2).

Heating up

Hold the pipe/fittings against the heating plate with no pressure (for time see table 5.2).

Change over/welding/cooling

As the spigots are thoroughly heated up both parts need to be joined as quickly as possible using a gently buildup of pressure. The jointing has to be carried out accurately because moving the parts during and after jointing is not possible.

Keep the parts jointed together under pressure as long as the welding bead is still plasticized (this can be checked by pressing your fingernail into the bead). The joint then needs to cool down without any additional load. The use of a support structure is recommended when jointing long pipe parts. Using a butt-welding machine gives a better result under all circumstances.