

Electrofusion

5.2.2 Electrofusion

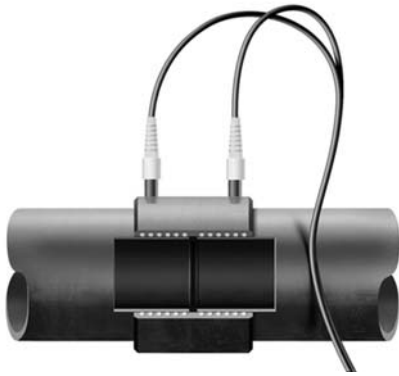


Illustration 5.12

Electrofusion is a rapid and simple way of permanent jointing. Using the Akafusion couplers and equipment, pipes, fittings and prefabricated pipe sections can efficiently be assembled. Most Akatherm products can be welded by electrofusion.

Preparations

The following guidelines are of importance when making a proper electrofusion joint:

- Establish a work space where the welding can be done without being effected by major weather conditions. Temperature $-10^{\circ}\text{C}/+40^{\circ}\text{C}$.
- Check if the equipment functions properly. Welding equipment used on site deserves special attention.
- The resistance wire in the Akafusion coupler lies at the surface for a good heat exchange. The resistance wires need to be covered by the inserted pipe or fitting to guarantee a proper working.
- Complete insertion is essential to utilize the fusion and cold zones in the coupler.

The resistance wires are positioned in the fusion zone. On both sides of a fusion zone a cold zone prevents the molten HDPE from outpouring thereby containing the fusion process.

During the fusion process the pipe/fitting expands and touches the inner coupler wall. The electrofusion joint is made with the pressure caused by the expanding HDPE and the heat from the resistance wires.



Illustration 5.13 Akafusion coupler with fusion and cold zones

Multiple welding

The control boxes CB315 is capable of welding several electrofusion couplers simultaneously in the same time that is needed for producing one electrofusion weld.

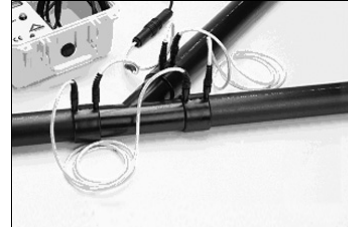
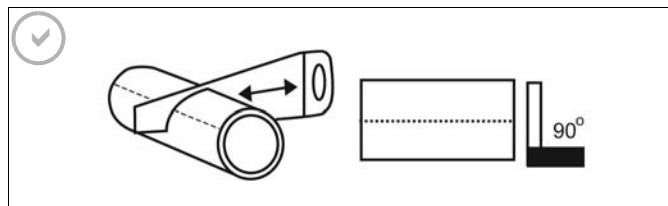


Illustration 5.14

The combined diameters of the couplers to be joined should not exceed 200 mm. For example in the case of a 45° 75/50 mm tee: both the diameters 75 mm and the branch 50 mm can be welded in one cycle.

Rule of thumb:

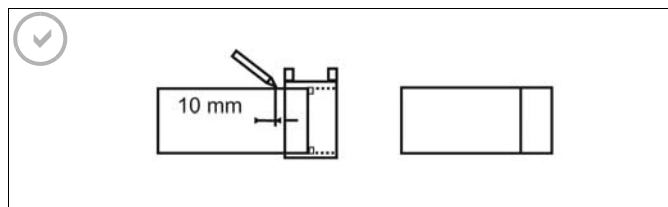
Sum of couplers diameters \leq 200 mm

Welding process
Cut pipe square

Illustration 5.15

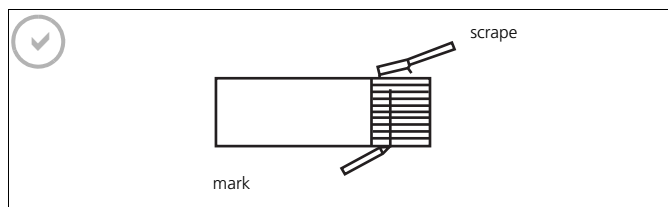
The pipe ends must be cut square to ensure that the resistance wire in the coupler is completely covered by the pipe or fitting.

Mark surface for scraping

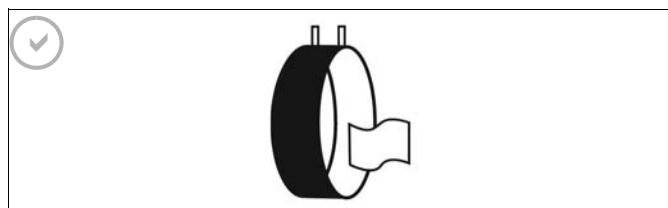
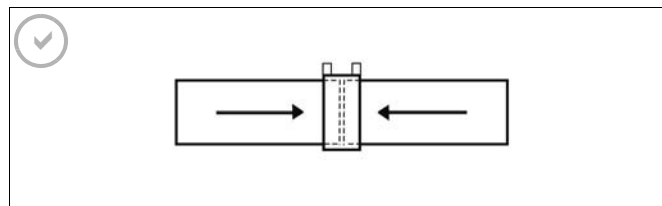
Mark insertion depth +10 mm to ensure that across the full welding zone the oxidized layer will be removed.


Illustration 5.16
Scrape pipe and mark insertion depth

The full outer surface of the pipe that will be covered by the coupler, must be scraped (approx. 0,2 mm deep) to remove any surface 'oxidation'. The insertion depth should be marked again to safeguard full insertion.


Illustration 5.17
Clean electrofusion coupler

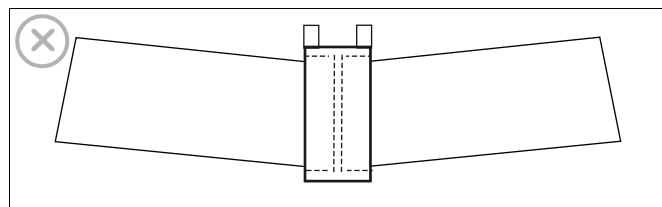
Before assembling the pipes into the coupler ensure that all surfaces are clean and dry.


Illustration 5.18
Insert pipe/fitting until marked line

Illustration 5.19

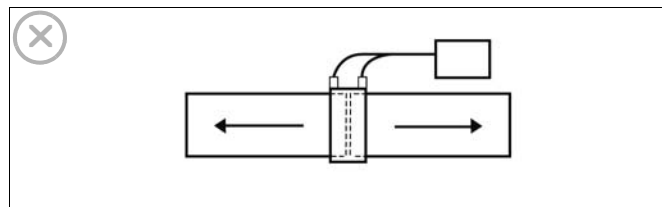
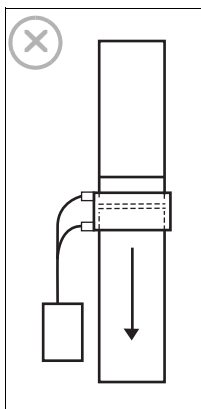
Ensure that the pipe is pushed into the coupler as straight as possible and up to the marked insertion depth. This will ensure that all the wires are covered with HDPE during the fusion cycle.

Prevent misalignment

Misalignment will cause extra load on the fusion zone causing additional HDPE to melt resulting in the outpouring of HDPE or wire movement.


Illustration 5.20
Prevent joint movement during welding

The movement of the pipe can cause melted HDPE to flow out of the joint. This can result in wire movement and possibly a short circuit and thus a bad weld or fire hazard.

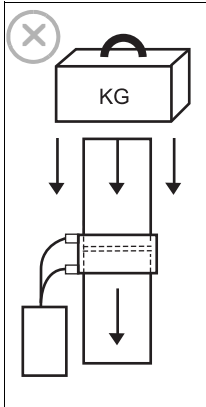

Illustration 5.21
Prevent coupler from sliding down when center stop removed


An electrofusion coupler sliding down will cause movement of the wires and possibly a short circuit and thus a bad weld or fire hazard.

Illustration 5.22

Electrofusion

Remove vertical loading during welding



An additional load on the vertical pipe will transfer extra HDPE material to the fusion zone. This will cause movement of the wires and possibly a short circuit and thus a bad weld or fire hazard.

Illustration 5.23

Welding electrofusion coupler and cooling down

After connecting the cables of the control box the fusion process can be commenced by pushing the start button. Both the CB315 and CB160 control boxes adapt the welding time to the ambient temperature. When it is colder than 20°C the welding time is extended and when the ambient temperature exceeds 20°C the welding time is shortened. Welding below an ambient temperature of -10°C is not recommended. For welding times and cooling down times see table 5.3. For extensive instructions see the manual of CB315 and CB160. The joint assembly should not be disturbed during the fusion cycle and for the specified cooling time afterwards.

diameter d_1	system	welding time	cooling time
mm		sec	min
40-160	Constant current 5A	80	20
200-315	Constant power 220V	420	30

Table 5.3 Welding parameters Akafusion couplers

The full load can only be applied after the complete cooling time.

The cooling period can be reduced by 50% when there is no additional load or strain during cooling.

Never weld coupler twice

During the fusion cycle the right amount of energy is put in to the fusion zones to make a good electrofusion joint. A second fusion cycle would put so much energy into the joint causing the HDPE to melt extensively. This will cause movement of the wires and possibly a short circuit. In the extreme case it can even cause fire.

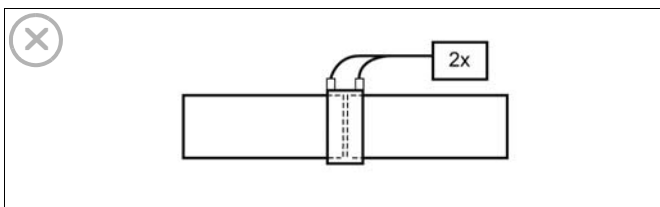


Illustration 5.24



Illustration 5.25

Assessing an electrofusion weld

It is harder to judge an electrofusion weld than a butt-weld. An indication of a good weld is the welding indicator (see illustration). The pop-outs on the fitting are however only an indication of a weld having been executed. They do not guarantee the integrity of the joint. The amount of movement of the pop-out depends on a number of factors including the size tolerances of the components and any ovality of the pipe/fitting. If all preparations have taken place successfully, like marking the insertion depth, scraping etc. and the pipe assembly wasn't under any additional load during welding and cooling, a joint can be marked OK when the welding indicators are protruded. If a significant quantity of melt exudes from the fitting after welding there may be a misalignment of the components, excessive tolerances or an accidental second welding of the fitting. The integrity of such joints is suspicious.

Please note that the fitting will become too hot to be touched during the welding process. The temperature will continue to increase for some time after the fusion process has ended.

Deformation

A too big deformation can cause problems during assembly and welding of the components. The maximum allowed deformation is $0,02 \times d_1$. This results in a maximum difference between the largest and smallest diameter corresponding with table 5.4. The pipe needs to be "rounded" using clamps when the deformation is larger.

diameter d_1	$d_1 \text{ max} - d_1 \text{ min}$ (mm)
40	1,0
50	1,0
56	1,0
63	1,0
75	1,5
90	2,0
110	2,0
125	2,5
160	3,0
200	4,0
250	5,0
315	6,0

Table 5.4 Deformation pipe