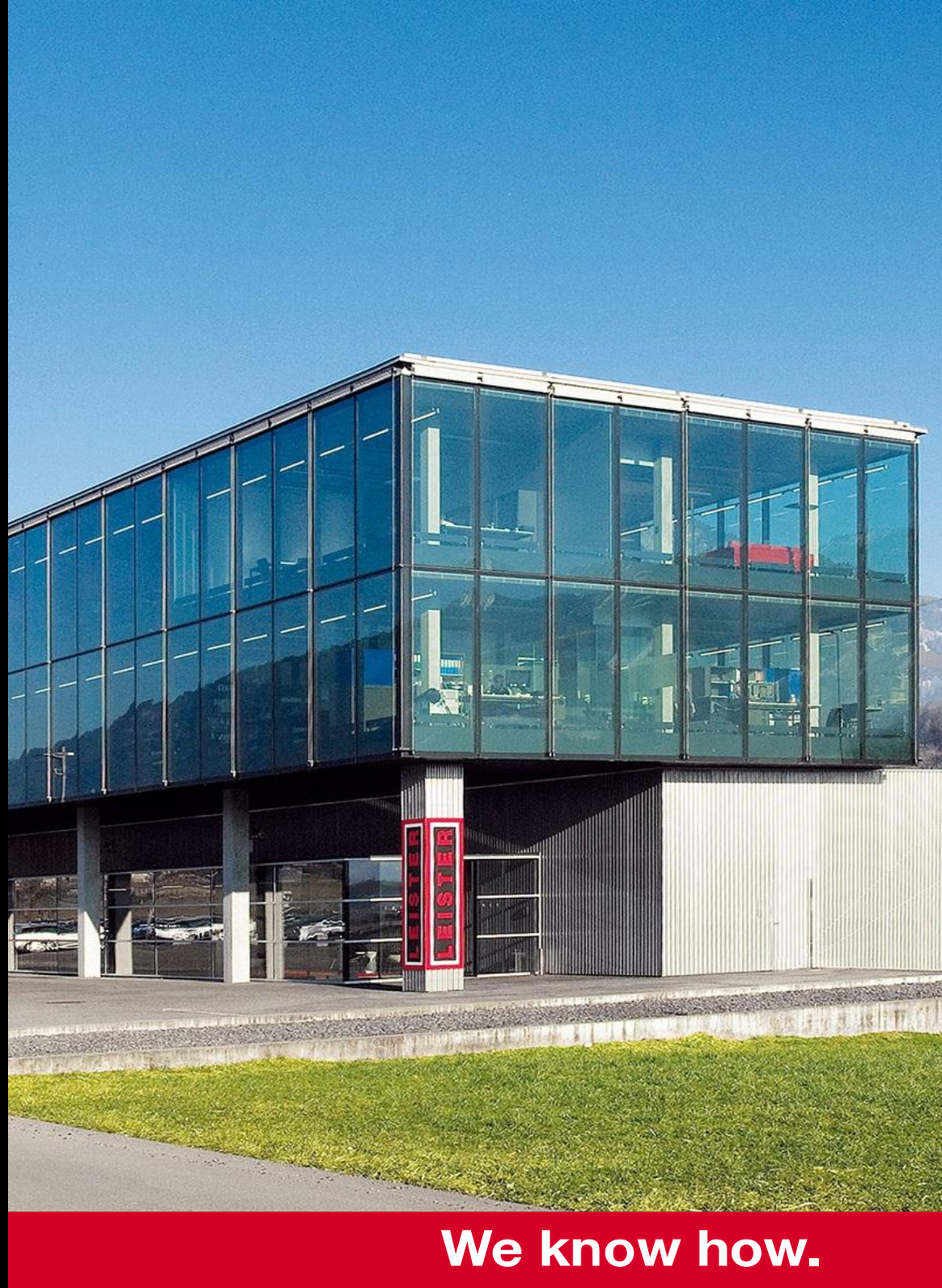
Plastic Welding

Part 3: Fundamental Principals of Welding



We know how.

Definition

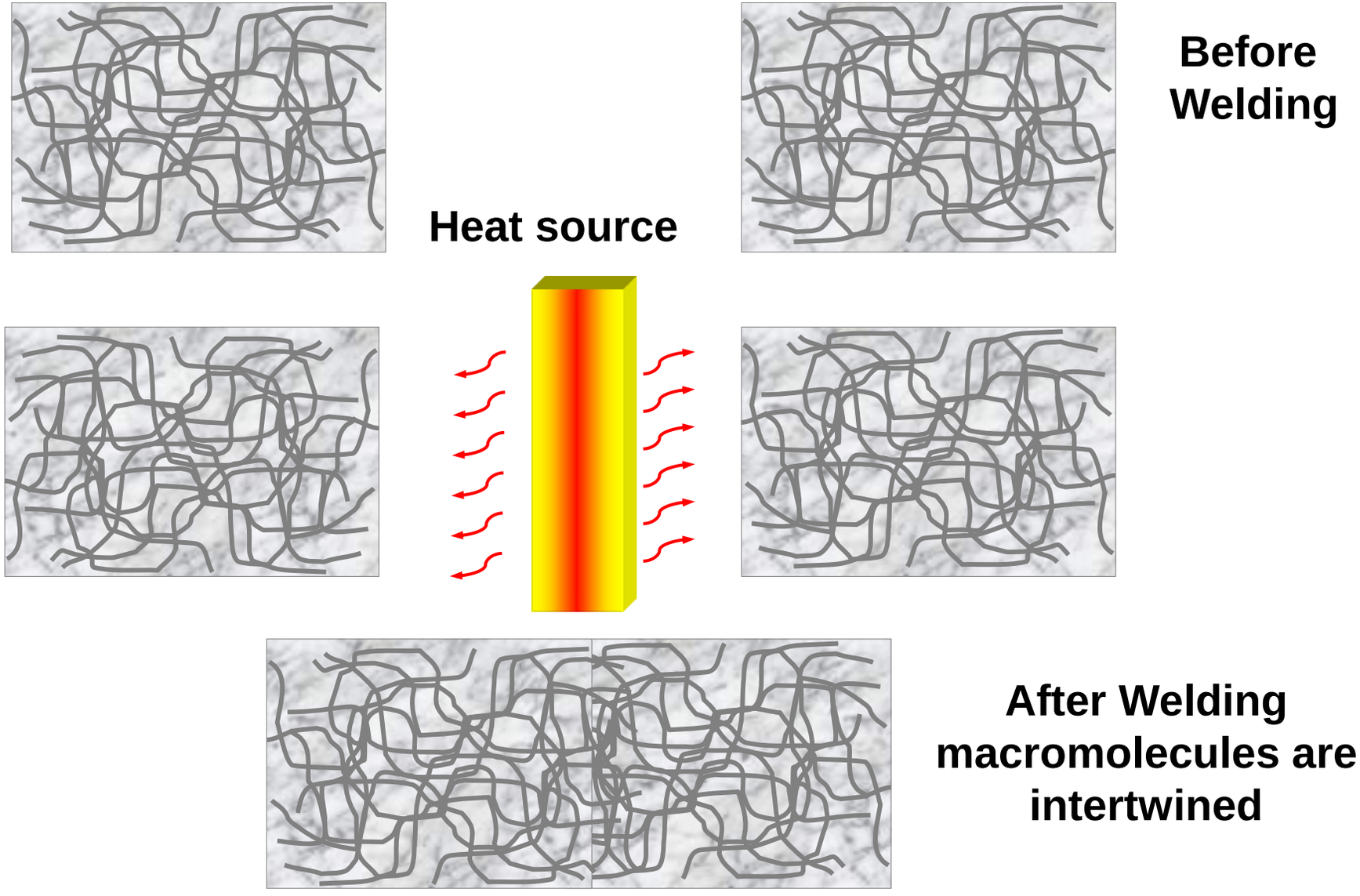
Plastic welding according to German Industrial Norm (DIN)1910, Part 3 is the joining of thermoplastics using heat and pressure.

The fusion surfaces must be in the thermoplastic condition. A filler material may or may not be added

Three important welding parameters

- **Temperature**
- **Pressure**
- **Time**

Welding Discharge



Basics

High quality of the weld depends on the following aspects:

- Material and welding rod properties (e.g.flame-retardant)
- The welding method
- The quality of the welding equipment and machines
- Take care on the parameters of the welding method
- The ambient influences
- The construction of the container/apparatus/pipeline
- The preparing of the form of joint (opening angle, x-joint)
- The knowledge and responsibility of the welder

Welding of Plastics

As a rule only the same thermoplastics are weldable with each other.

Due to their extremely high molecular weight some thermoplastics don`t attain sufficient flowability. Such thermoplastics have limited weldability.

e.g.
- ultra high molecular PE-HD (UHMW)
- cast PMMA
- PTFE

Influences of Material Properties

Material	Thermal conductivity λ =W/mK	Coefficient of linear thermal expansion α=mm/mK	Example 100m Pipe Δ 20°C [cm]
Steel	52	0.011	2.36
Copper	372	0.016	3.3
PVC	0.15	0.08	16
PE-HD	0.41	0.20	40
PP	0.23	0.15	30
PVDF	0.14	0.13	26

Influences of Material Properties

- High thermal expansion results in great shrinkage during cooling, this leads to stress.
- Sufficient heating up of the welding surface must take place slowly.
- If heating of the welding area is performed to quickly, the material suffers thermal damage because plastics have a very poor heat conductivity.

Influence of the Welding Parameters

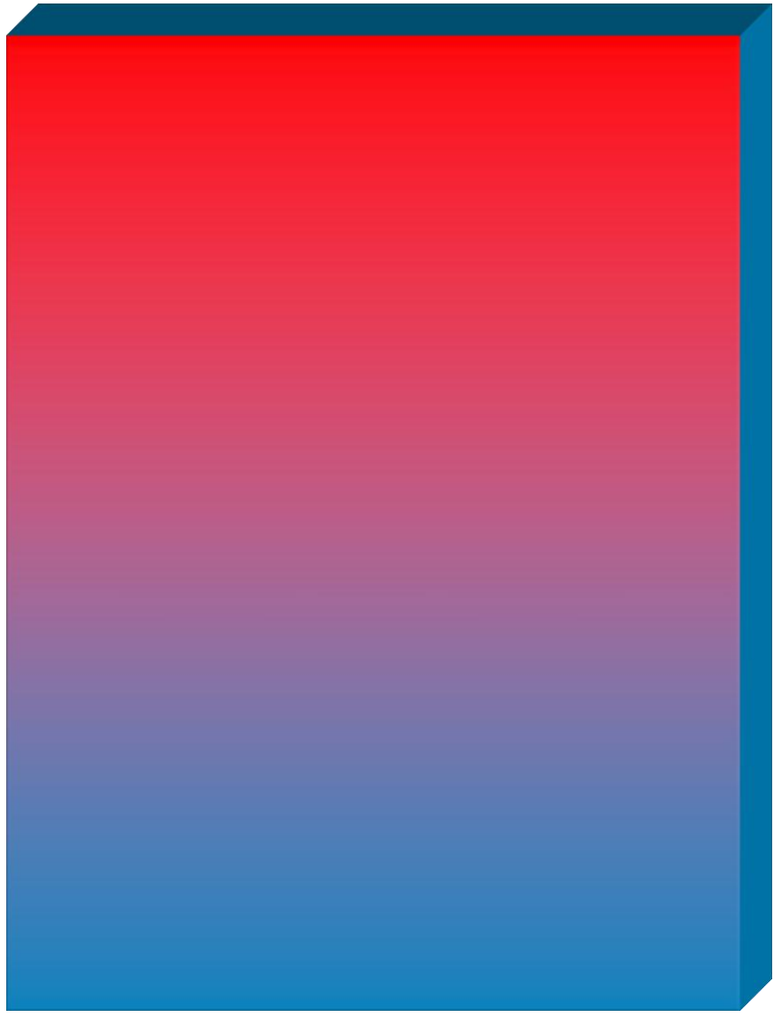
Low-stress welded joints are produced if the following measures are adhered to:

- Steady heating of the welding zone
- Constant welding speed
- Constant welding pressure
- Heating of the welding zone to a sufficient depth
- Slow and even cooling. Shrinkage must not be impeded

Tuning of the Welding Parameters (1)

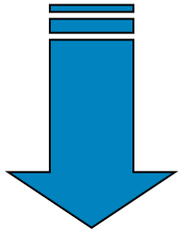
Low welding temperature and longer period of exposure results in

- **plastification of a big material volume**
- **low residual welding stress**
- **slow temperature drop**

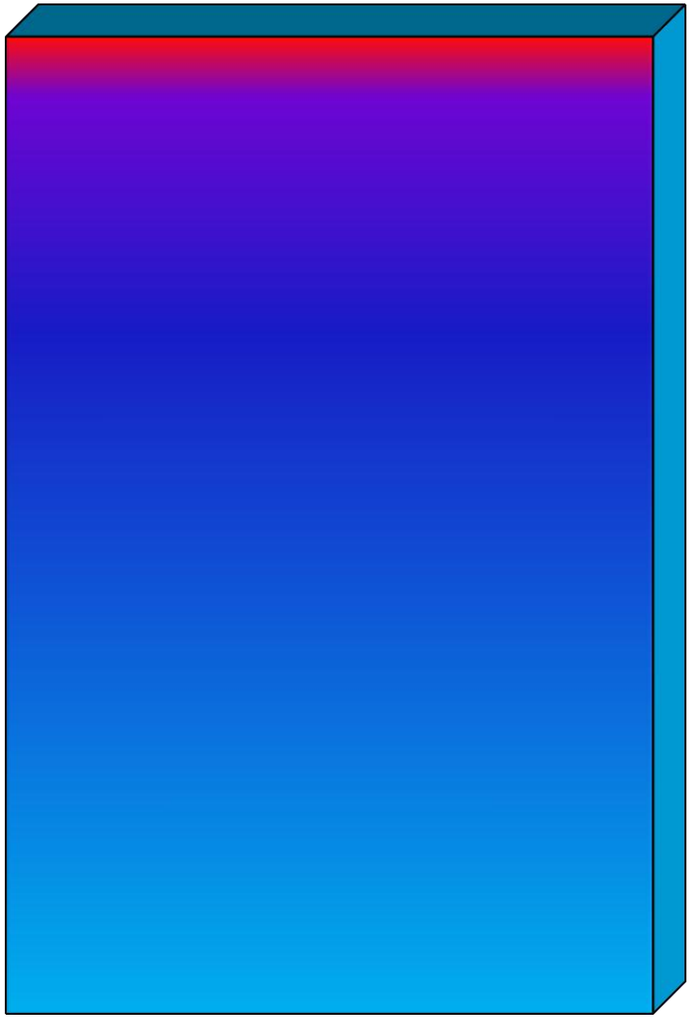


Tuning of the Welding Parameters (2)

Higher welding temperature and a shorter period of exposure results in:



- **plastification of a small material volume**
- **high residual welding stress**
- **steep temperature rise**



Influences During Welding

(DVS 2207)

- Ambient temperature (>5°C, 41°F)
- Wind, draft
- Air humidity
- Rain
- Sunshine

Welding Processes used in Plastic Fabrication

- Hot Gas Free Hand welding (WF) or Fan welding

- Hot Gas draw welding (WZ) or speed welding

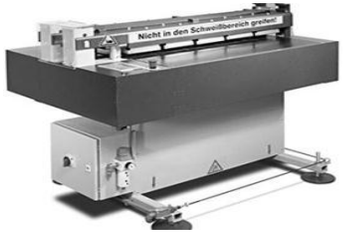
- Hot Gas Overlap welding (WU)

- Hot Gas Extrusion welding (WE)

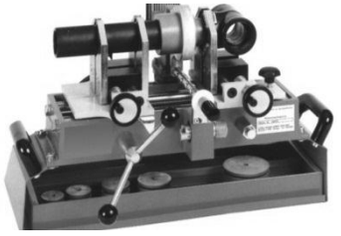
Welding Processes used in Plastic Fabrication

- Heated plate welding (Butt welding) HS

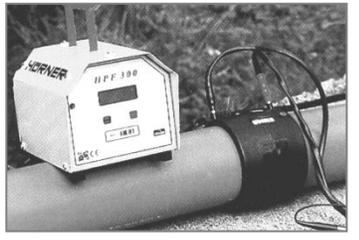
- Welding by bending and edging HB



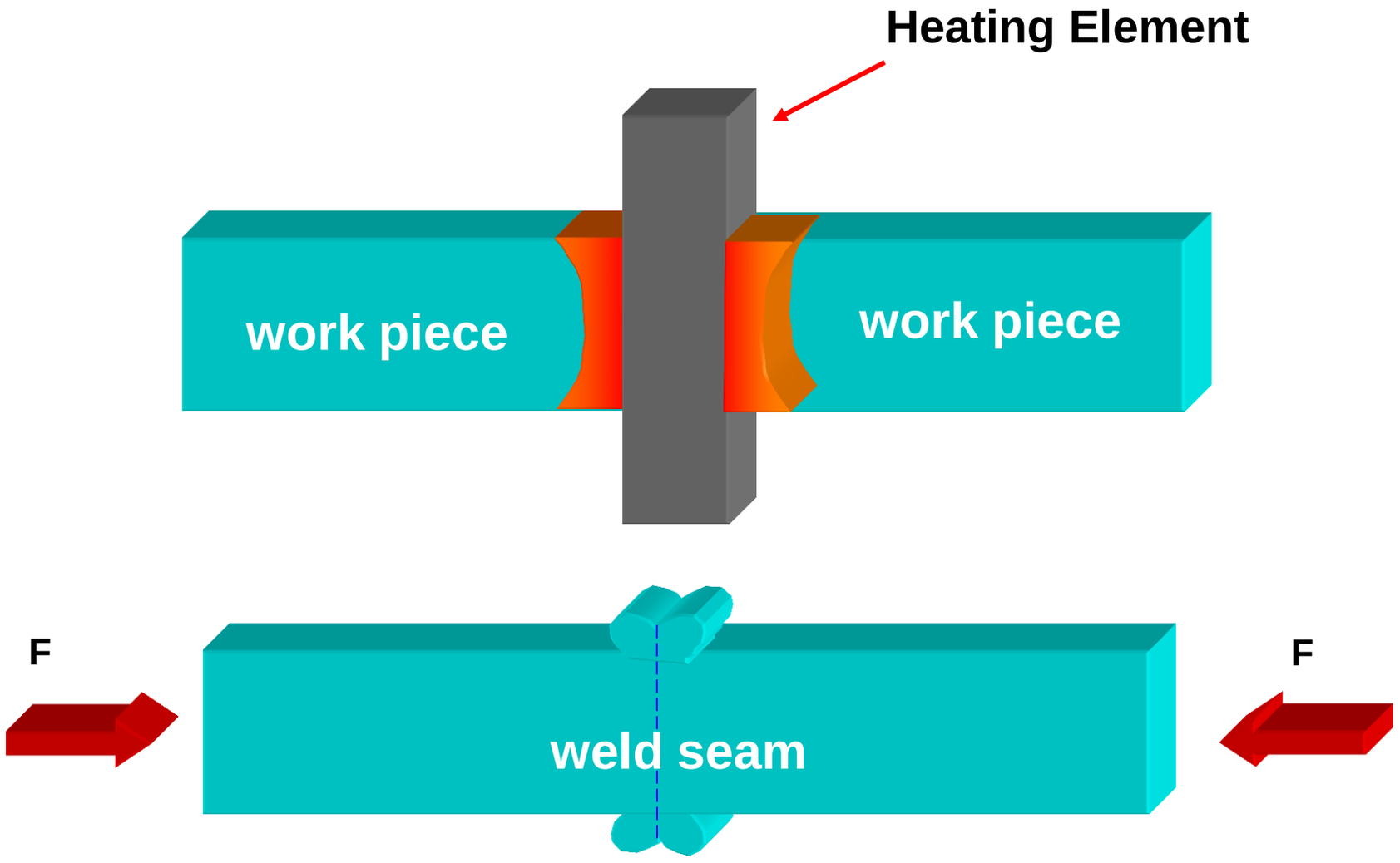
- Sleeve welding with spigot and Sleeve HD



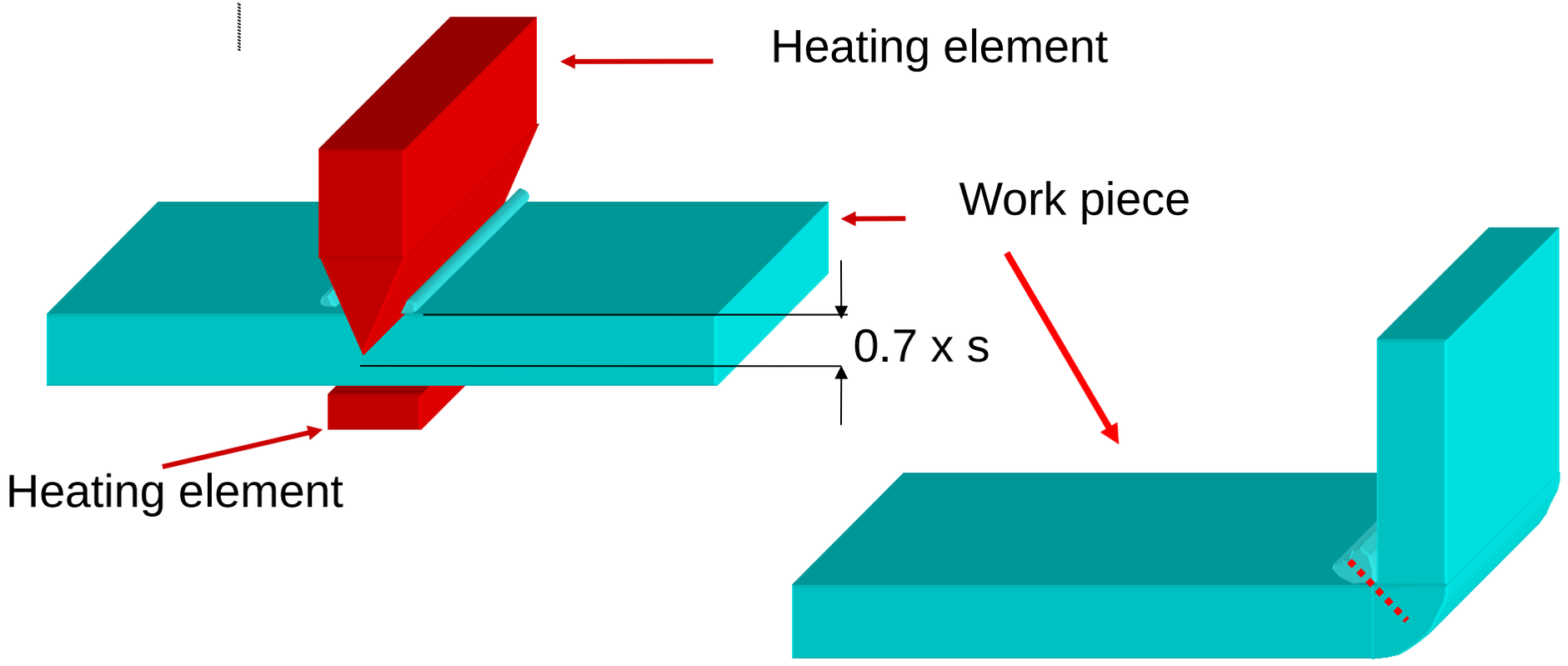
- Electro fusion welding (Coil welding) HM



Heated Plate Welding (Butt welding)

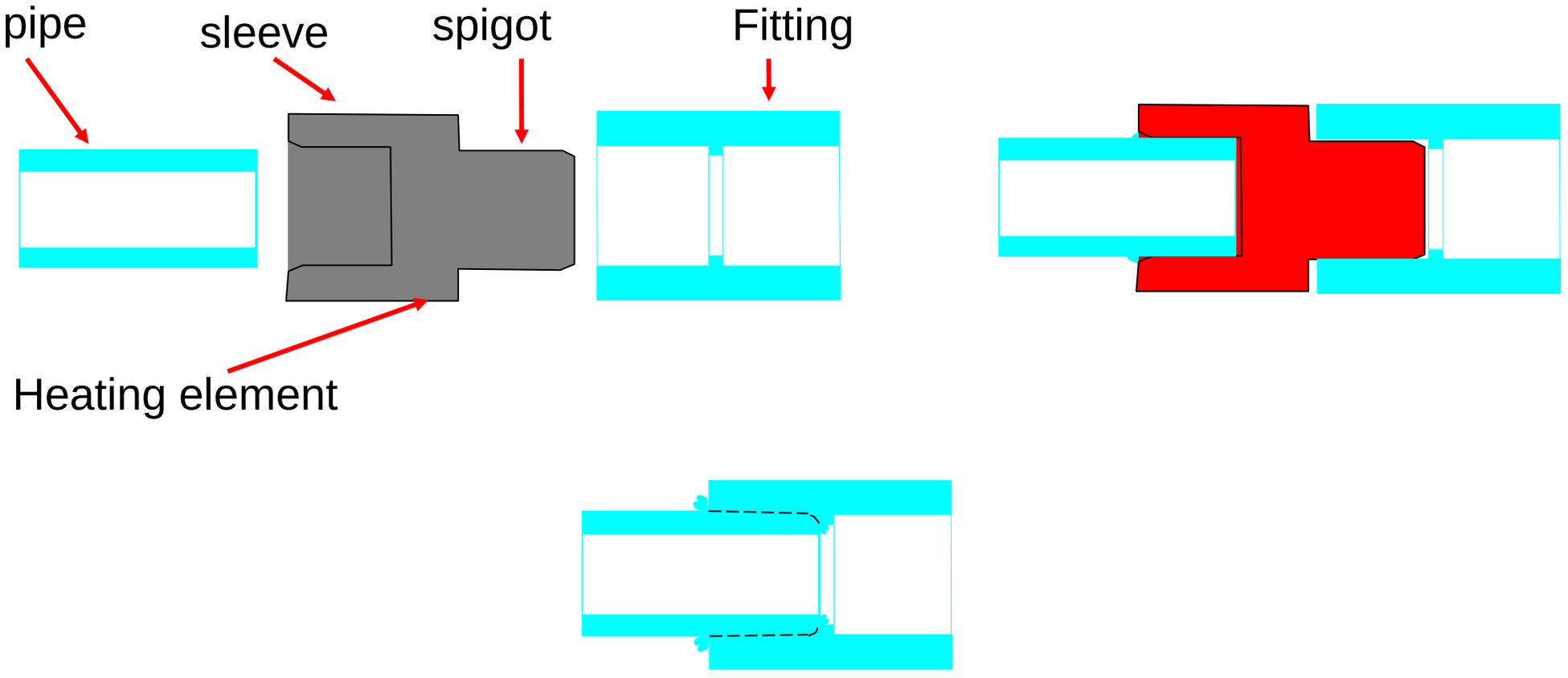


Welding by Bending using a Heated Tool (HB)



S= material thickness

Sleeve Welding with Spigot and Sleeve (HD)



Sleeve Welding with Incorporated Heating Element (HM) (Coil or Electrofusion welding)