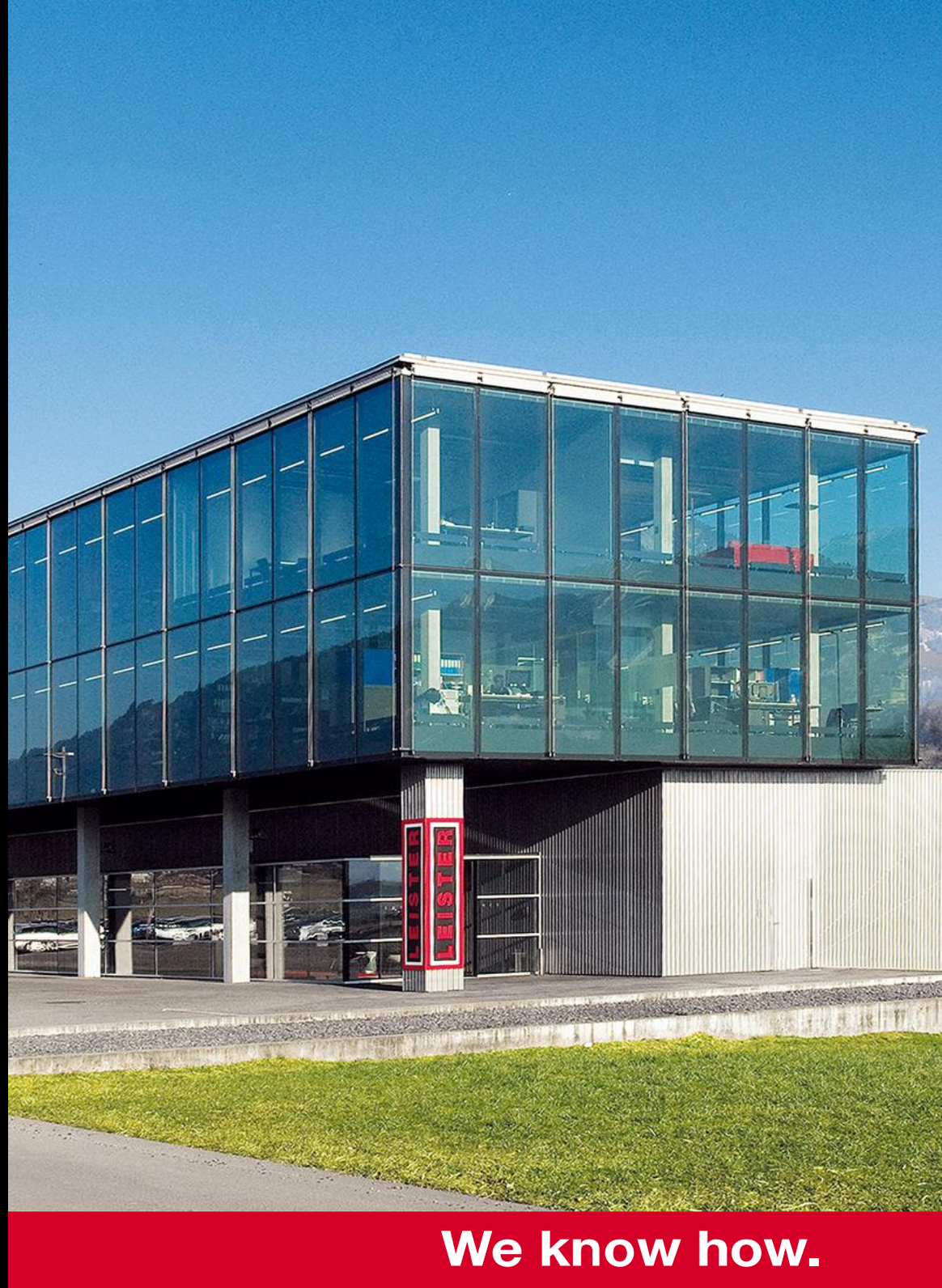
Plastic Welding

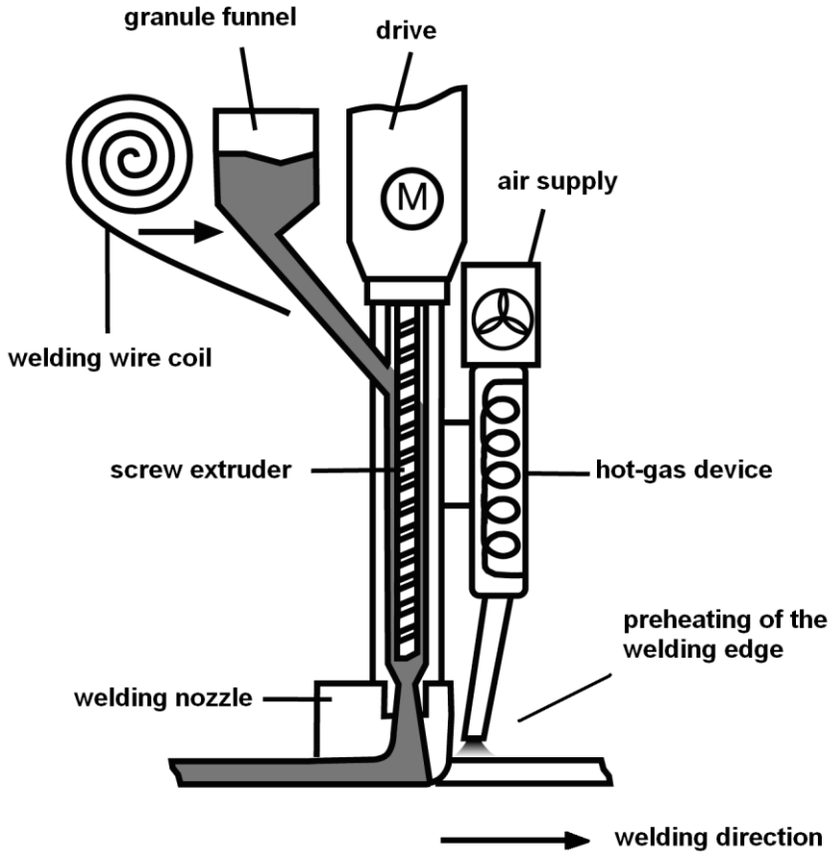
Part 5: Extrusion Welding



We know how.

Part 5: Extrusion Welding

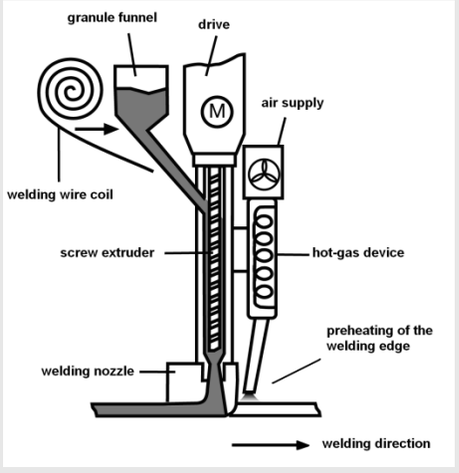
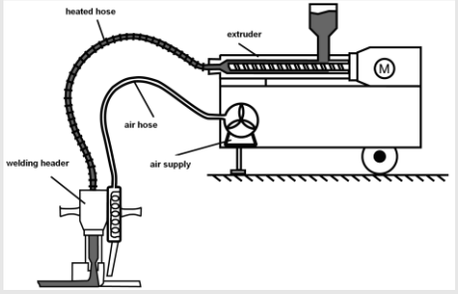
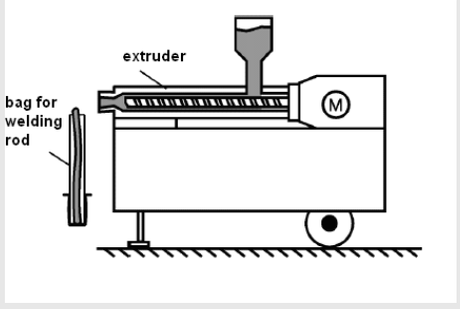
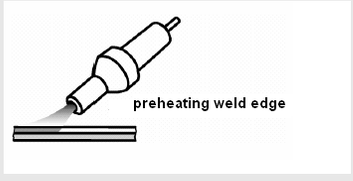
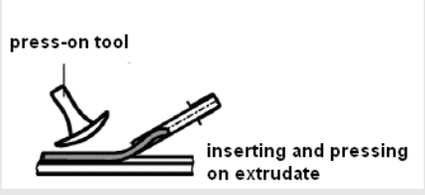
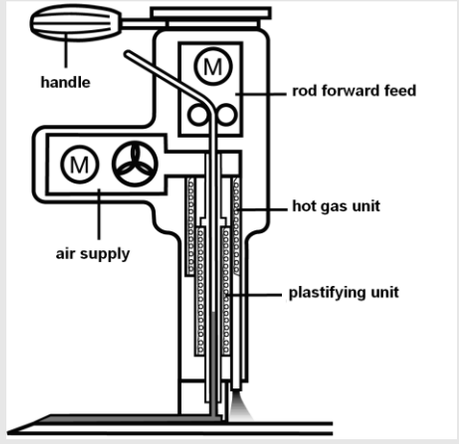
Extrusion welding allows the application of bigger welds in a single weld pass. It is the preferred technique for joining material over 6 mm thickness. Welding rod is drawn into a miniature hand held plastic extruder, plasticized, and forced out of the extruder against the parts being joined, which are softened with a jet of hot air to allow bonding to take place.



Part 5: Extrusion Welding

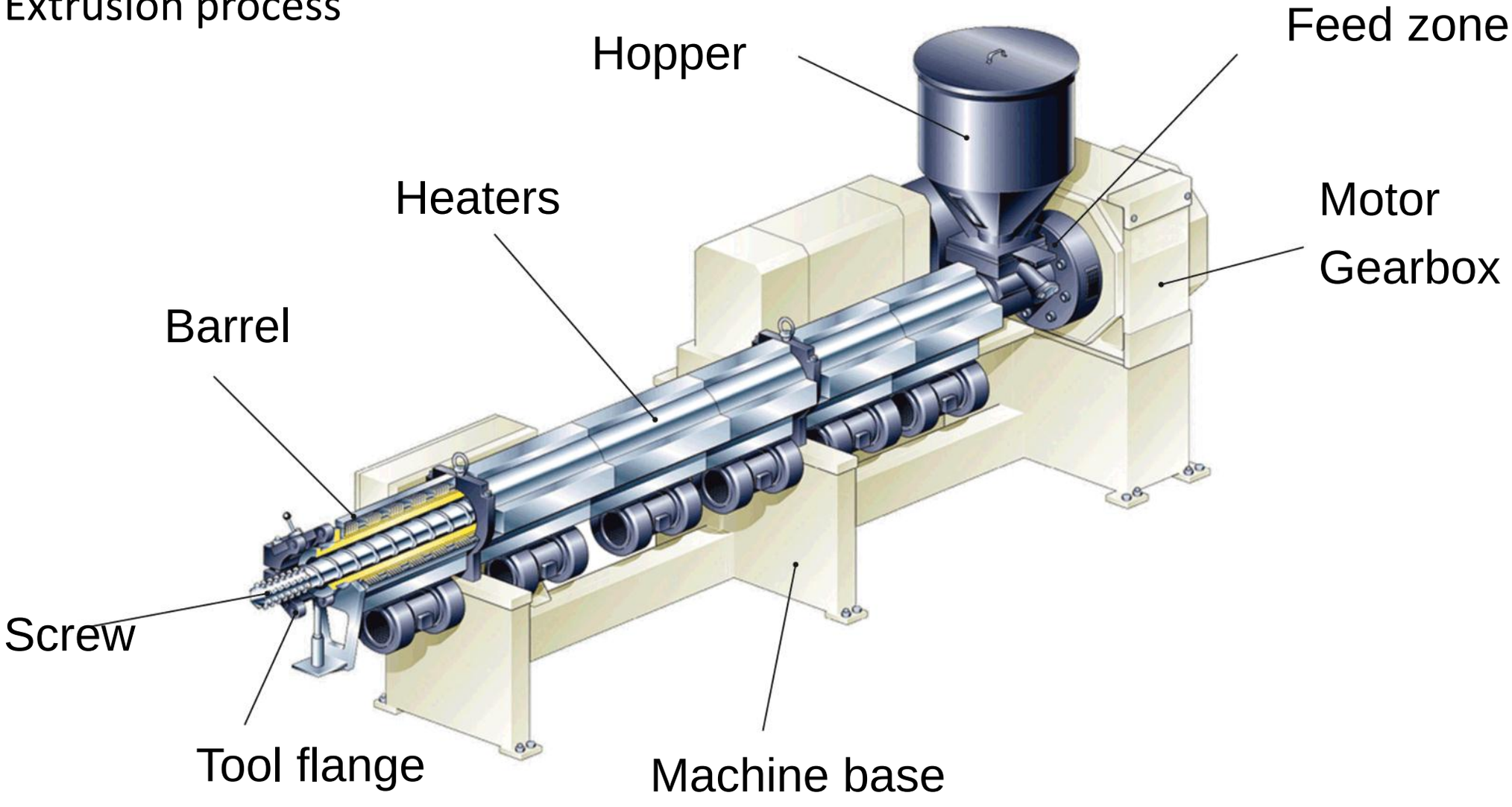
Based on DVS 2207-4

Machine variants

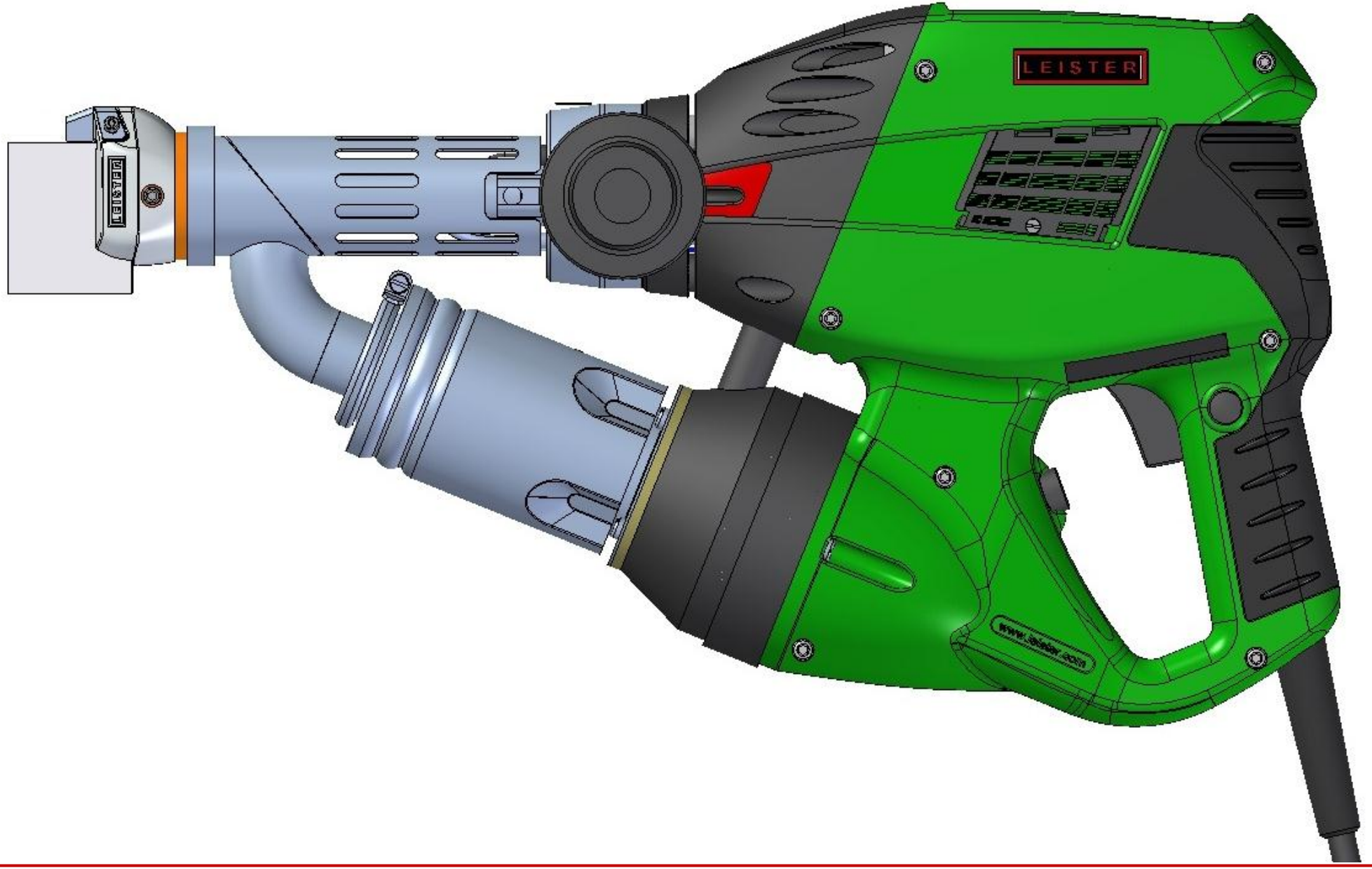
Extrusion machine in which all the device components form one unit. *Weldplast / Fusion*	The extruder and the welding head are structurally separate connected by a heated hose.	The extruder and the welding head are structurally separate. Preheating with hot air gun. Pressing by a hand tool.	Melting chamber machine in which all the device components form one unit. *Weldmax*
		  	

Part 5: Extrusion Welding

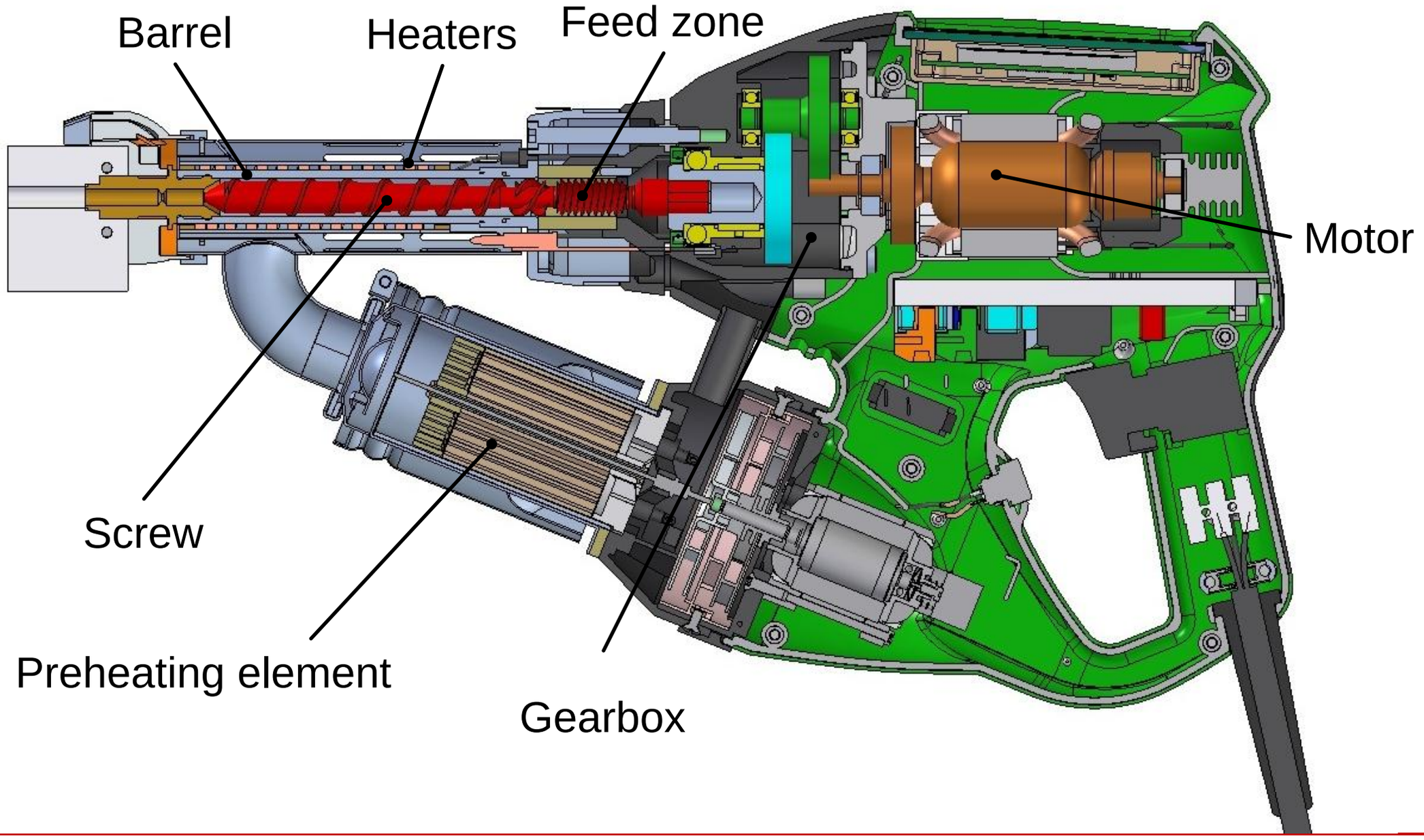
Extrusion process



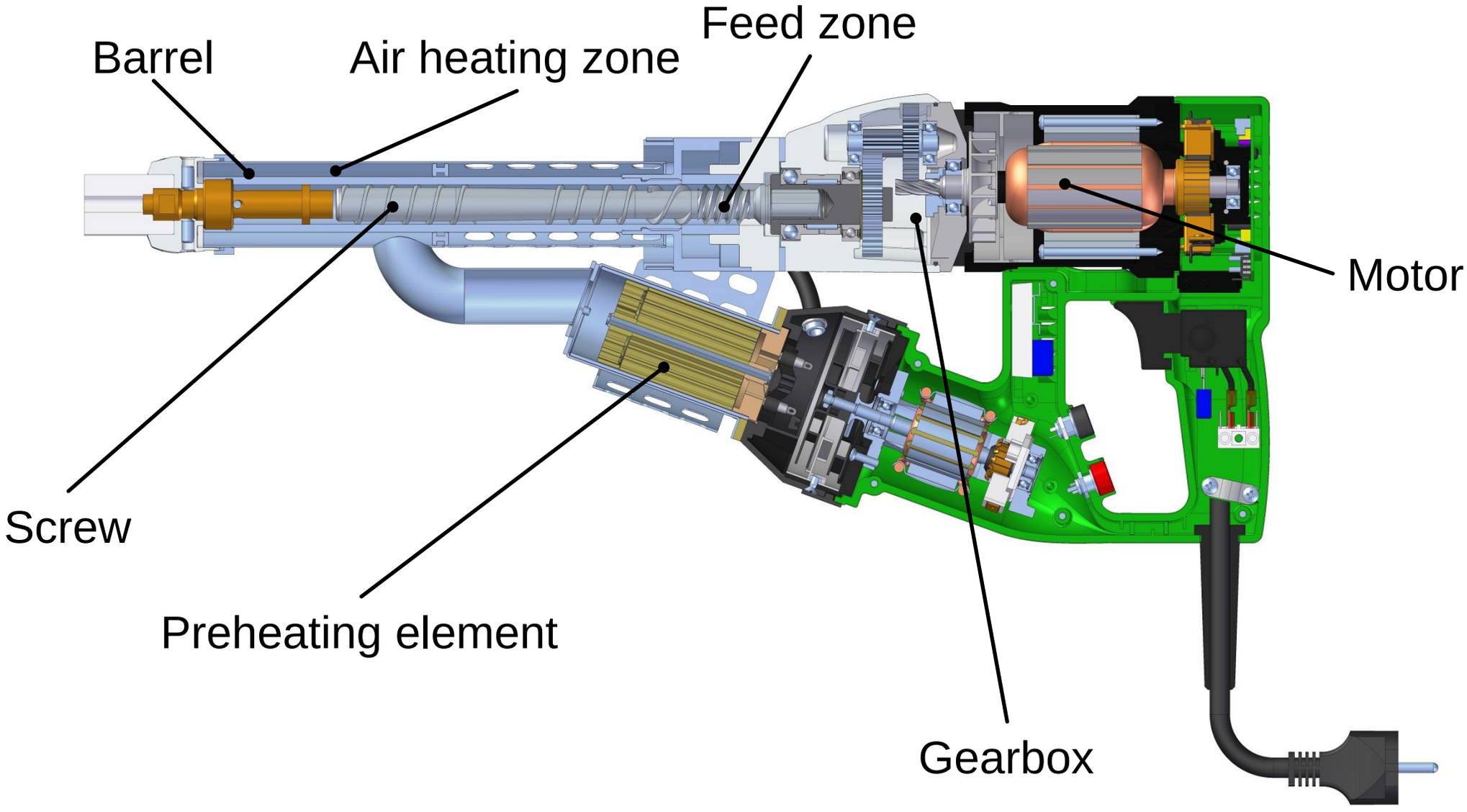
Part 5: Extrusion Welding



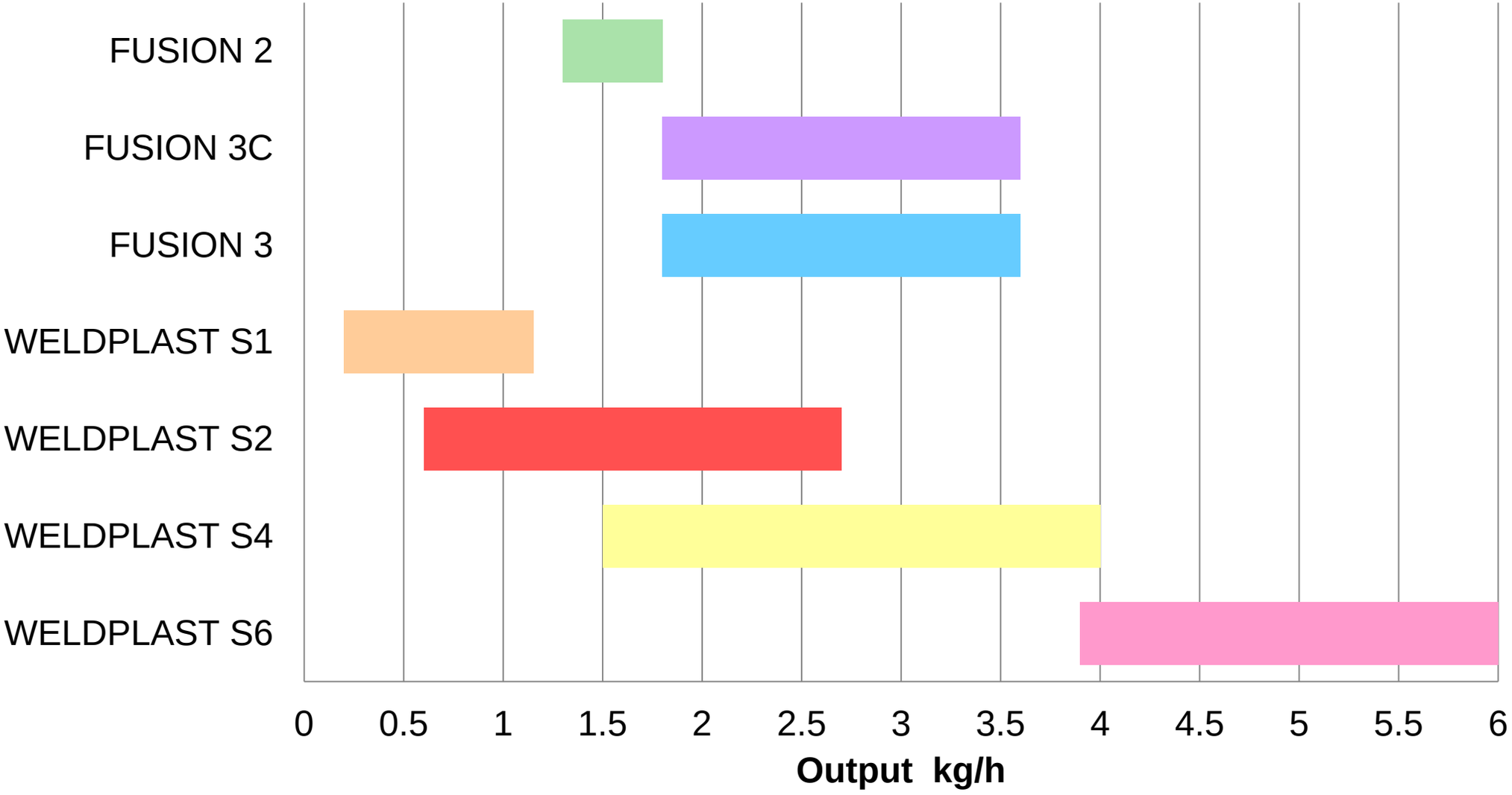
Part 5: Extrusion Welding



Part 5: Extrusion Welding



Part 5: Extrusion Welding



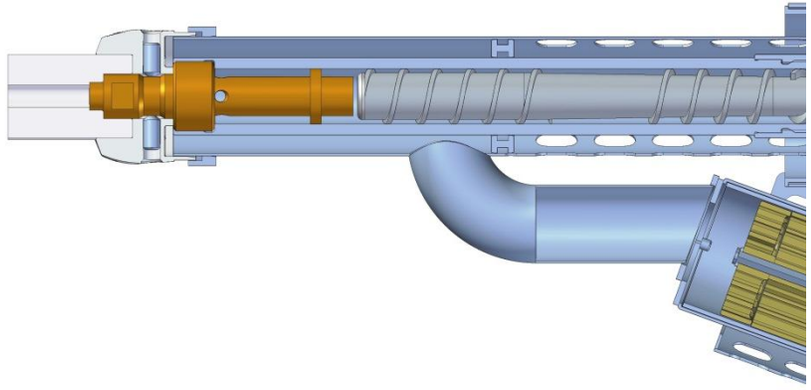
Part 5: Extrusion Welding

	Digitally regulated extrusion welders				Compact hand welder
					
Device type	**WELDPLAST S6**	**WELDPLAST S4**	**WELDPLAST S2**	**WELDPLAST S1**	**WELDMAX**
Output (HDPE) kg/h	3.9 – 6	1.5 – 4	0.6 – 2.3	0.2 – 0.8	0.3 – 0.8
Material	HD-PE, PP	HD-PE, PP	HD-PE, PP, PVC	PE, PP, PVC, etc.	HD-PE, PP, PVDF
Wall thickness mm	15 – 40	8 – 35	4 – 20	4 – 10	4 – 10
Welding rod ∅ mm	4 – 5	3 – 4 / 4 – 5	3 – 4	3 – 4	4
Weight kg	14	8.7	5.8	4.7	3.8
Length mm	821	560	450	435	433
Voltage V~	230	230	230	230 / 120	230 / 120
Screw extruder	yes	yes	yes	yes	no
Container construction	✓✓	✓✓	✓✓	✓✓	✓✓
Pipeline construction	✓✓	✓✓	✓✓	✓✓	✓✓
Landfills / civil engineering	✓✓	✓✓	✓	○	○
Brushless blower	yes	yes	yes	yes	no
Remarks	1	1	1	1	1

LEISTER

Part 5: Extrusion Welding

	Air heated extrusion welders		
			
Device type	FUSION 3	FUSION 3C	FUSION 2
Output (HDPE) kg/h	1.8 – 3.6	1.8 – 3.6	1.3 – 1.8
Material	HD-PE, PP	HD-PE, PP	HD-PE, PP
Wall thickness mm	8 – 25	8 – 25	6 – 15
Welding rod mm	3 – 4 / 4 – 5	3 – 4 / 4 – 5	4
Weight kg	7.2	6.9	5.9
Length mm	690	588	450
Voltage V~	230	230	230
Screw extruder	yes	yes	yes
Container construction	✓✓	✓✓	✓✓
Pipeline construction	✓✓	✓✓	✓✓
Landfills / civil engineering	✓✓	✓	❍
Brushless blower	no	no	no
Remarks	2	2	2

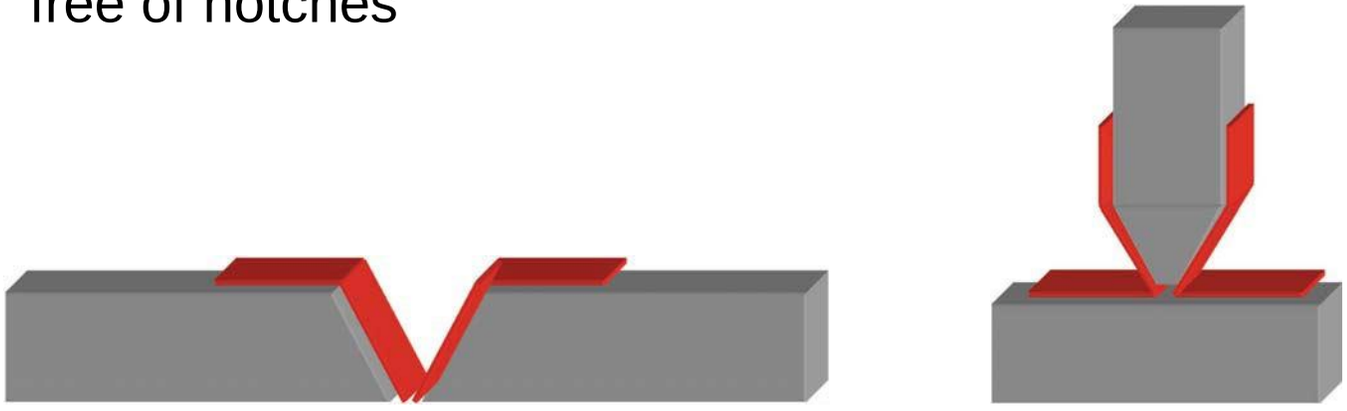


LEISTER

Weld Preparation

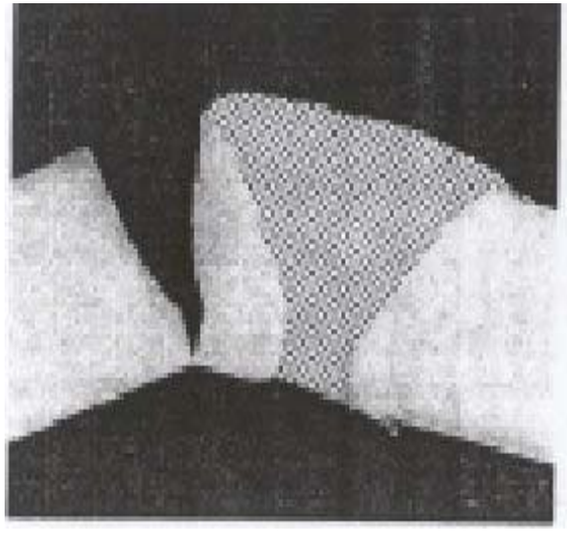
The welding surfaces must be:

- dry, clean, oil- and grease-free
- free of loose shavings and
- free of notches



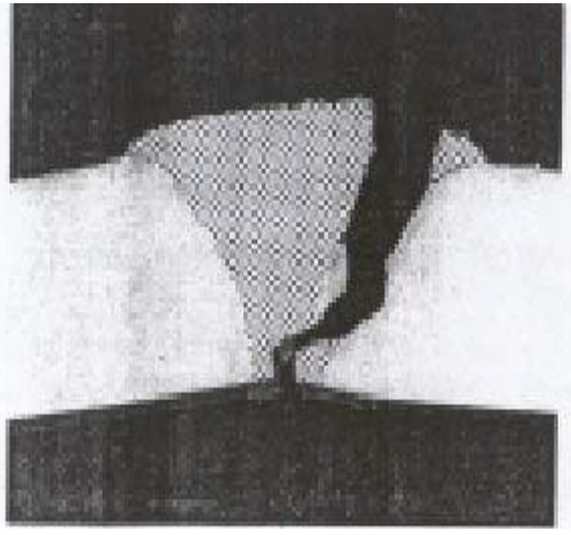
Joining surfaces, adjacent heat-affected zones must be scraped prior to welding

Part 5: Extrusion Welding



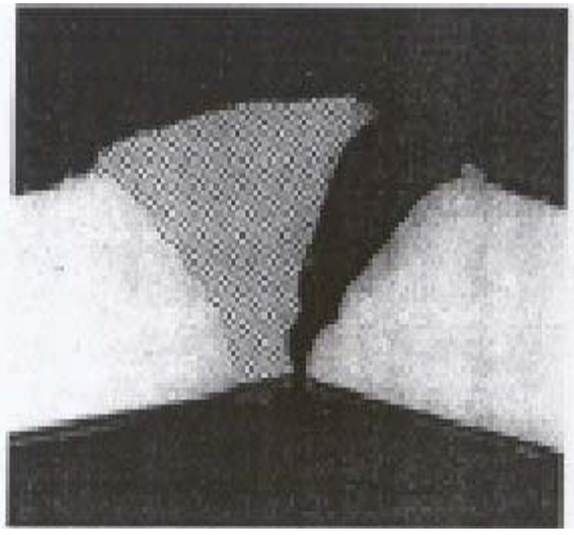
Crack in the base material

Welding speed: 180 mm/min



Mixed crack

Welding speed: 300 mm/min



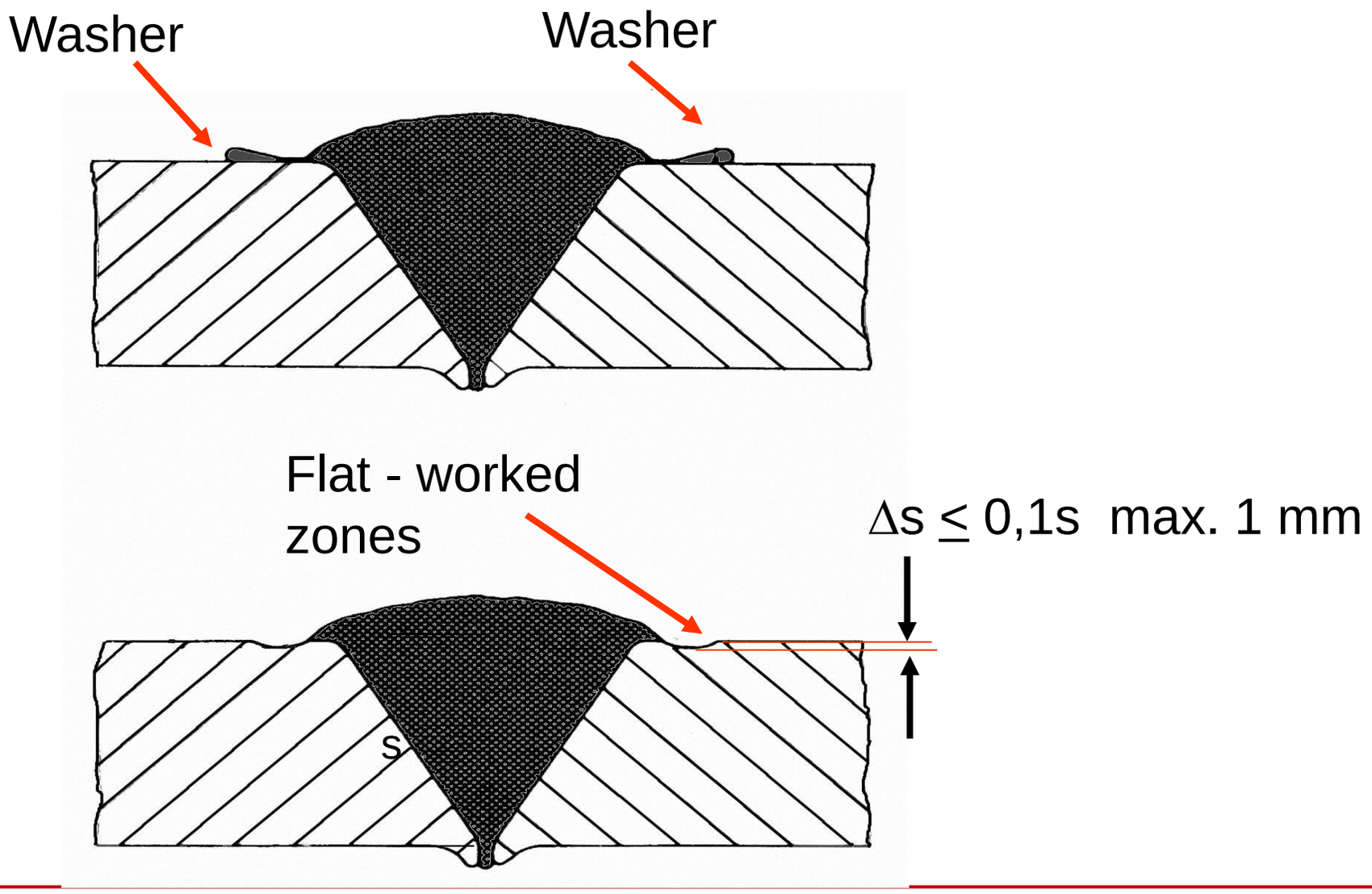
Crack close to the flank

Welding speed: 480 mm/min

Material:	PP-H	
Hot gas temp.:	300°C	
Air volume :		200L/min
material thickness:	5mm	

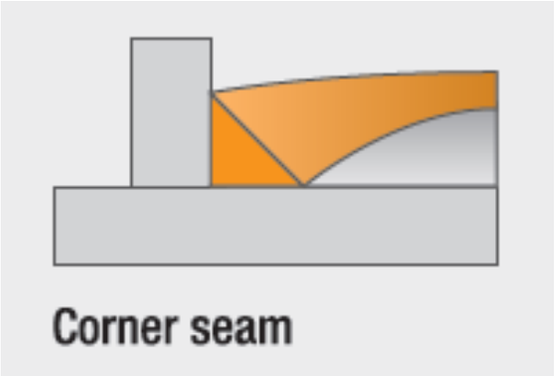
Part 5: Extrusion Welding

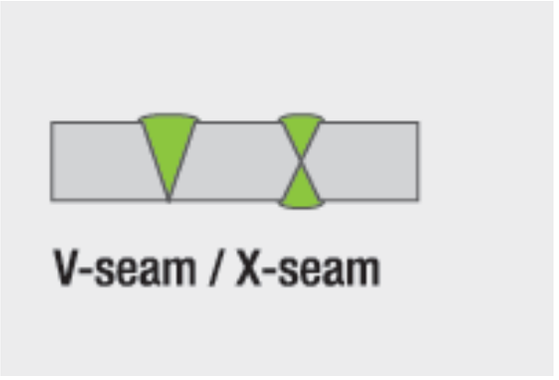
Weld Clean Up

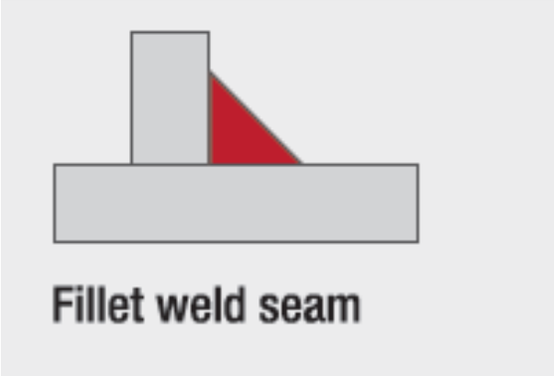


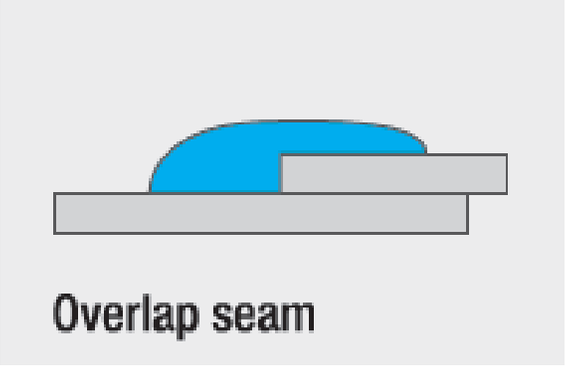
Part 5: Extrusion Welding

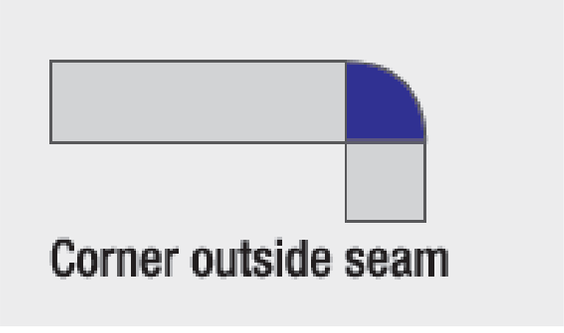
Types of Welding Seams







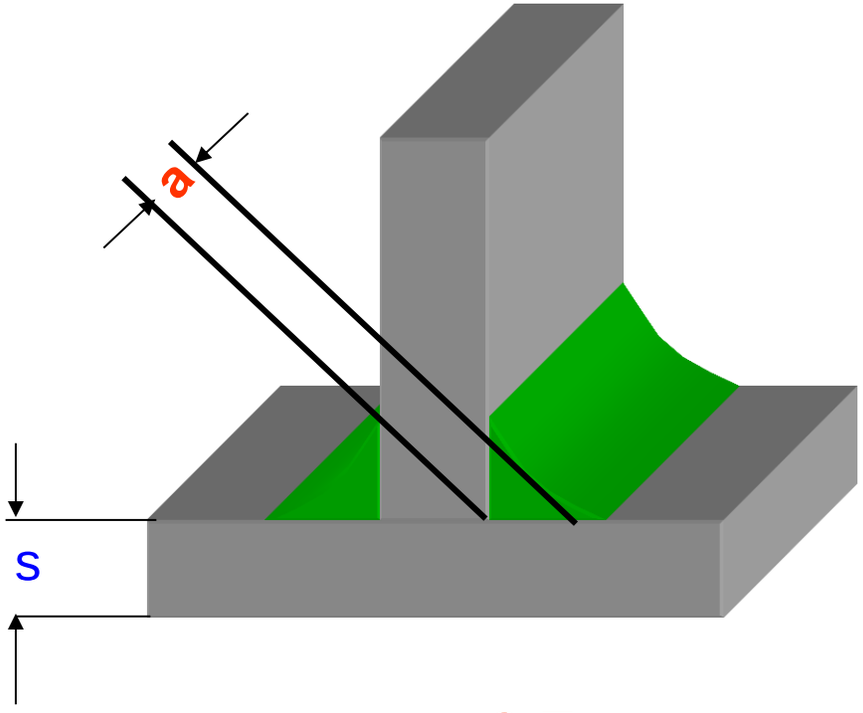




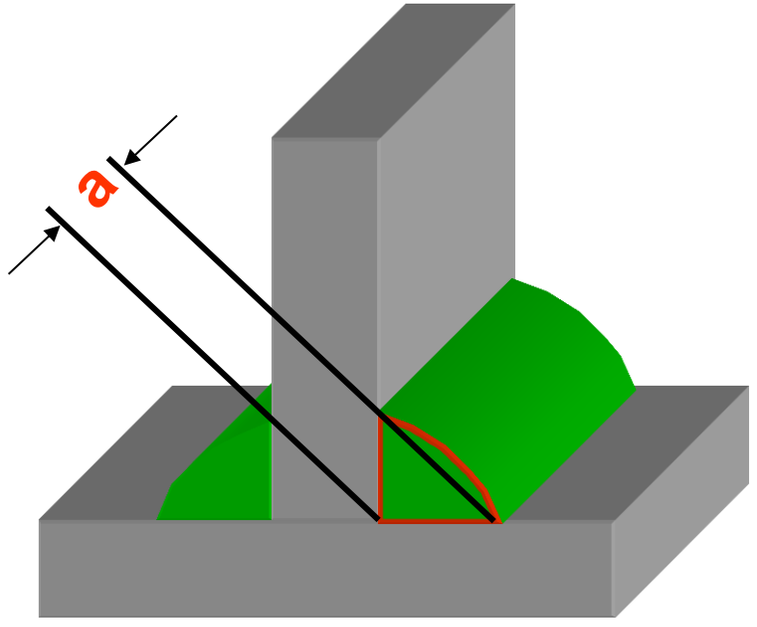
Types of Welding Seams

Double fillet T-butt weld

Concave weld



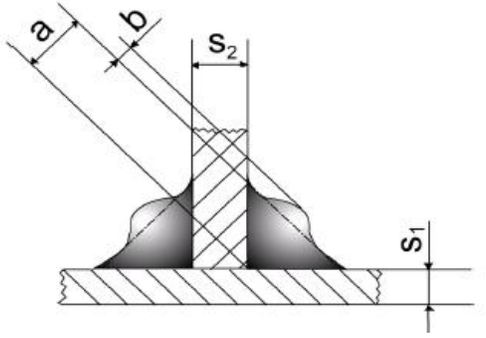
Convex weld



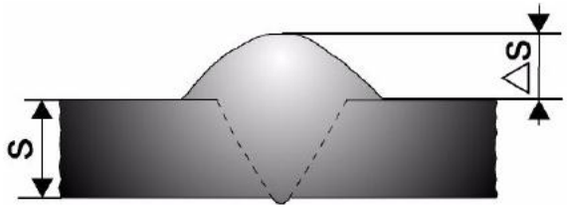
a = 0,7 x s

Part 5: Extrusion Welding

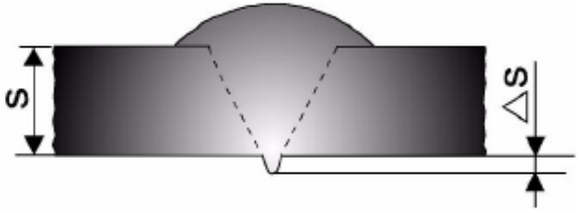
Welding Seam Measurements



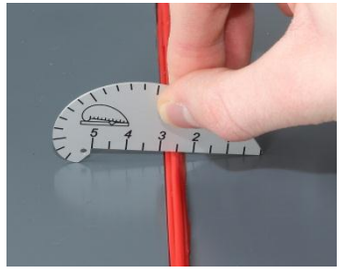
a = 0.7 s1, s2 > s1



0.1 s ≤ Δs ≤ 0.3 s



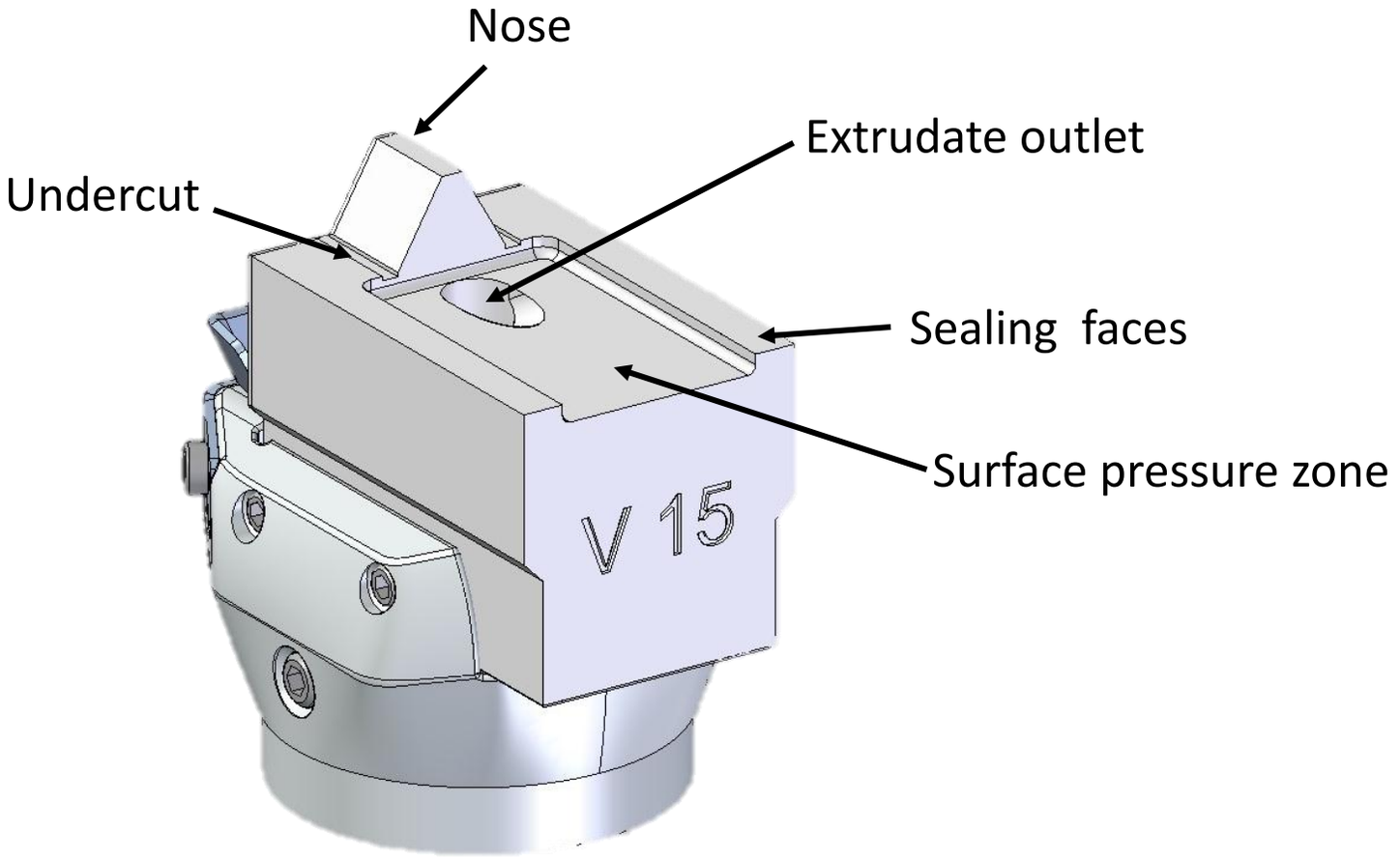
Δs ≤ 0.15 s max 2mm



Check DVS 2202-1

Part 5: Extrusion Welding

Welding Shoe Design



Part 5: Extrusion Welding

Extrusion Welding
according DVS 2207-4

The figures for WE quoted in the table of DVS 2207 Part 4 shown below should be taken as a guide.
The properties of the actual material to be welded may differ from those listed. Therefore the given welding parameters are only approximate and intended as a guide.

Welding Process	Materials	Abbreviations	Material temperature [1]	Hot gas temperature [2]	Hot gas volume flow [3]	Welding speed [5]
			°C	°C	l/min	mm/min
Extrusion welding (WE)	High-density polyethylene	PE-HD [4]	210 … 230	210 … 300	300	300
	Polypropylene, Types 1, 2, 3	PP-H; PP-B; PP-R	210 … 240	210 … 300	300	300
	Unplasticised polyvinyl chloride	PVC-U	190 … 200	330 … 360	300	300
	Impact resistant polyvinyl chloride	PVC-HI	170 … 180	280 … 340	300	300
	Chlorinated polyvinyl chloride	PVC-C	195 … 205	300 … 360	300	300
	Polyvinylidene fluoride	PVDF	240 … 260	280 … 350	300	300

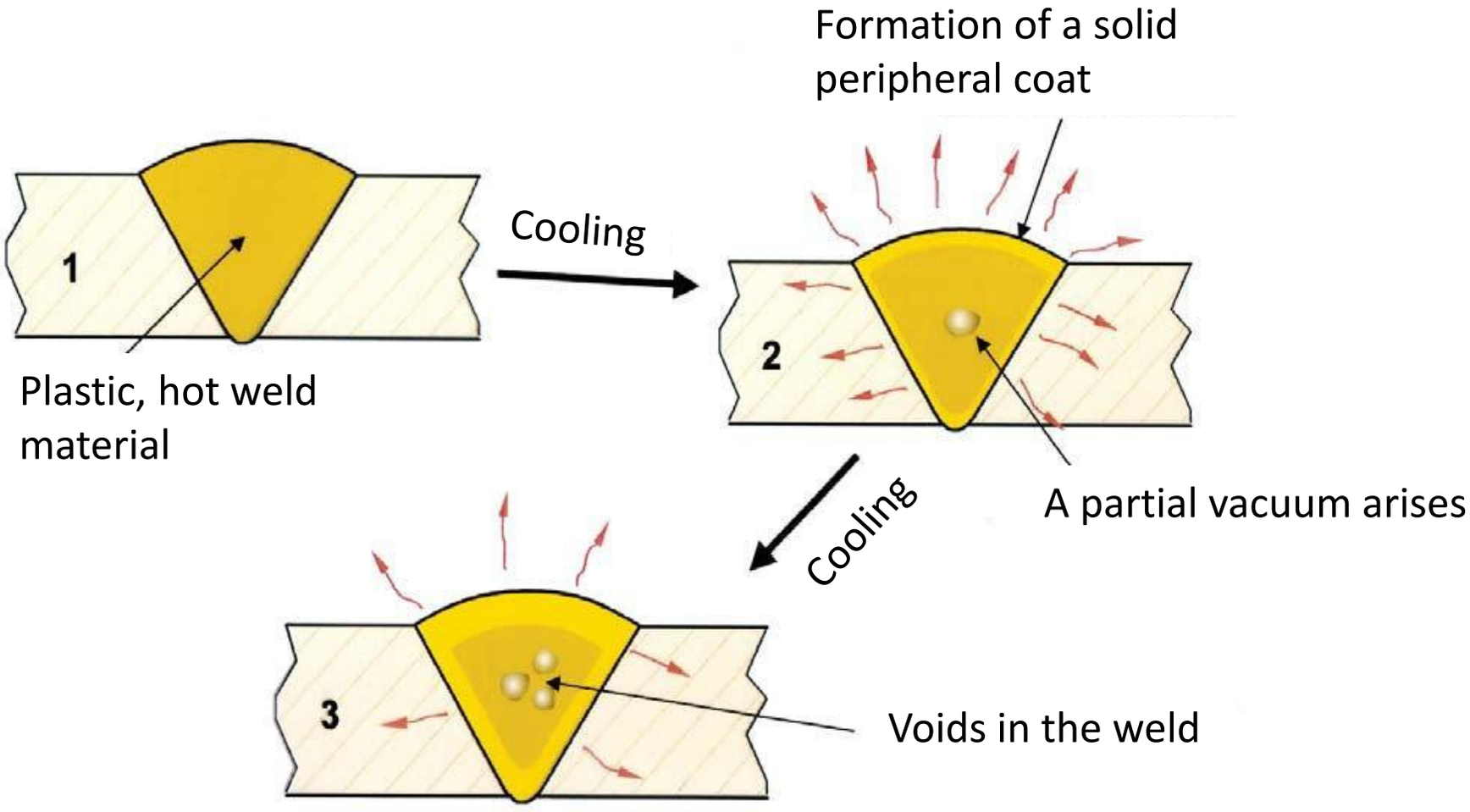
1) Measured with an insert thermometer at the exrudate outlet of the hand extruder.
2) Measured 5mm in the nozzle, in the centre of the nozzle opening.
3) Drawn-in cold air volume at the ambient pressure.
4) PE 63, PE 80, PE 100
5) Depending on the preheating

General Requirements

The quality of welded joints depends on:

- **The qualification of the welder**
- **The suitability of the machines and devices**
- **The material properties (e.g. melt viscosity)**
- **Observation of the AWS or DVS welding regulations (parameter, ambient influences)**

Faults


Formation of a solid peripheral coat
1
Cooling
2
Plastic, hot weld material
Cooling
A partial vacuum arises
3
Voids in the weld

Faults

Building of blowholes and vacuoles

- Temperature of the material too high
- Rest humidity in the welding addition
- High humidity
- Welding beads or wet hands
- Welding shoe too cold

Faults

Rough surfaces of the welding seam

- Welding shoe too short
- Welding shoe too cold (always pre-heat welding shoe!)
- Welding shoe sliding surface too rough