



Plastic Welding

Part 4: Hot Gas Welding



We know how.

Part 4: Hot Gas Welding

- The joining faces are heated up by means of hot gas. The most common welding gas used is air. It must be
dry, free of oil and dust
- Requirements for welding devices for hot gas welding can be found in DVS Publication 2207 Part 4.

Part 4: Hot Gas Welding

hot air hand tools with external air



hot air hand tools with a built in fan



Part 4: Hot Gas Welding

Equipment

mobile blower



stationary blower



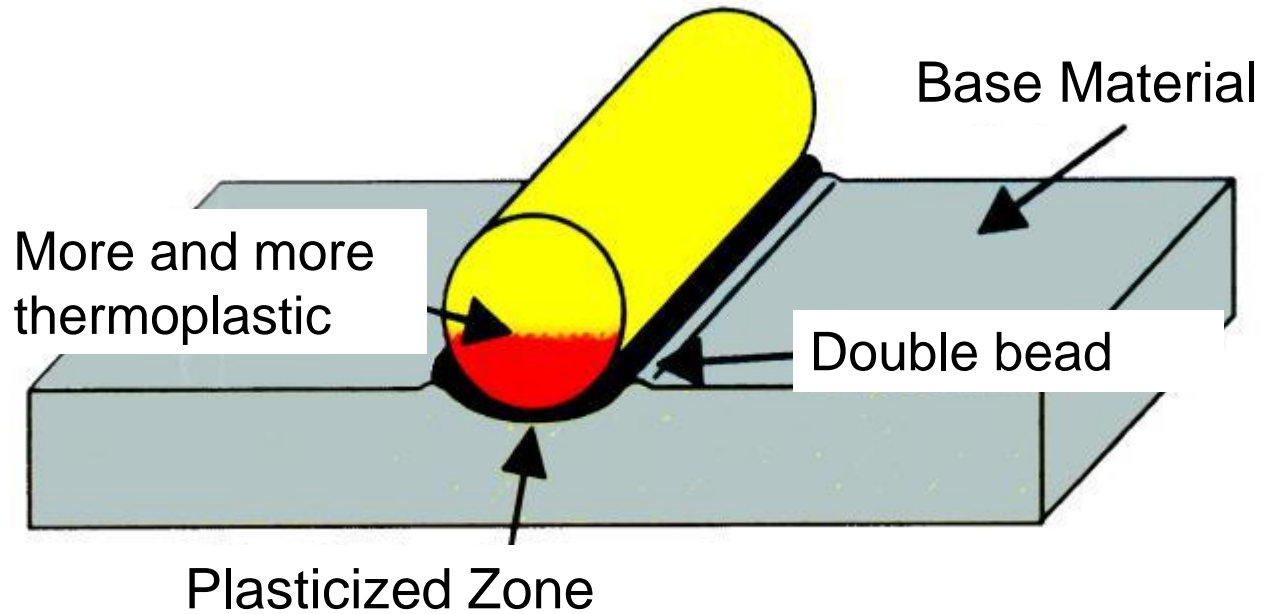
flow meter



filter regulating valve



Part 4: Hot Gas Welding



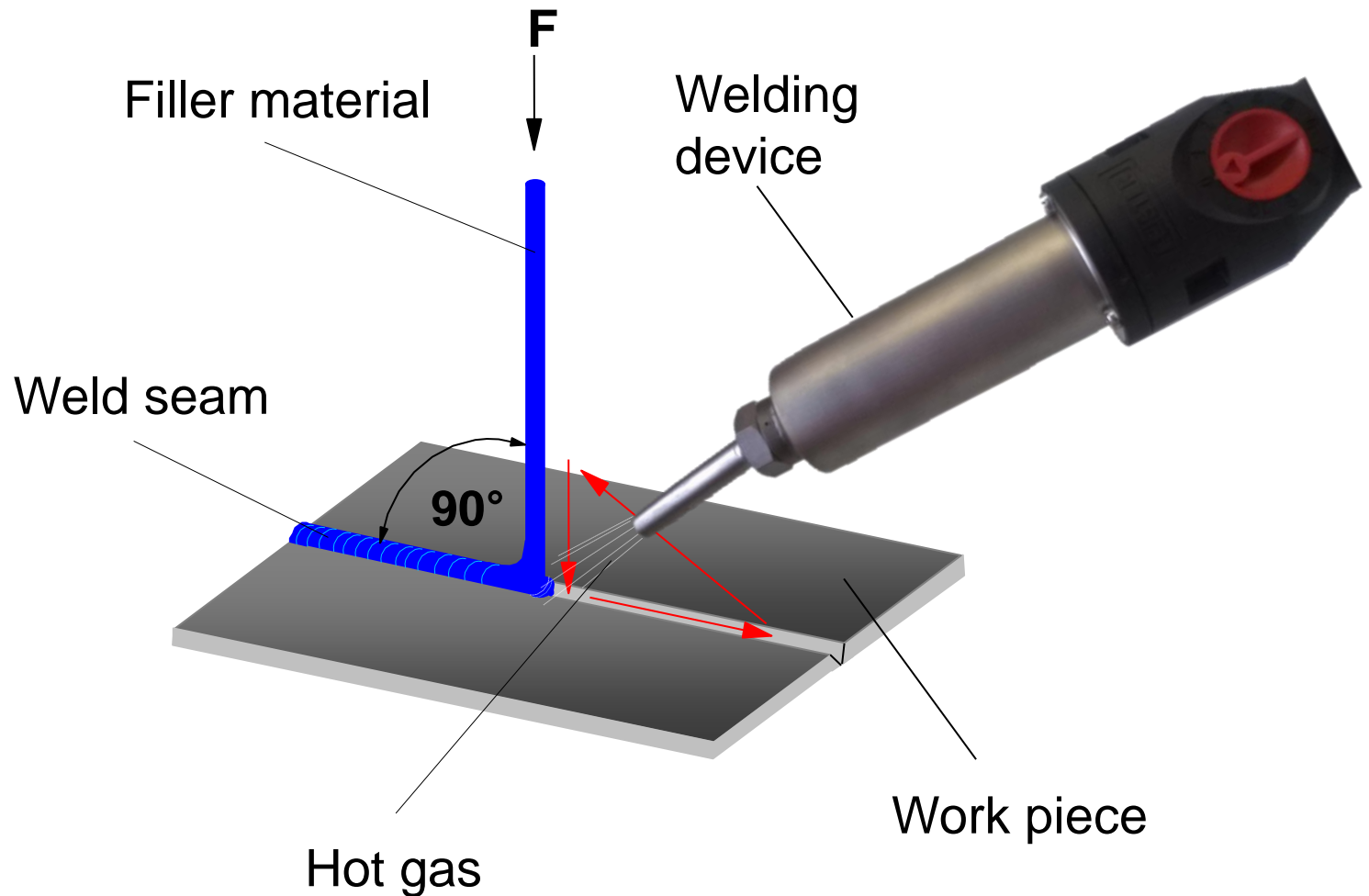
Part 4: Hot Gas Welding

Free Hand Welding

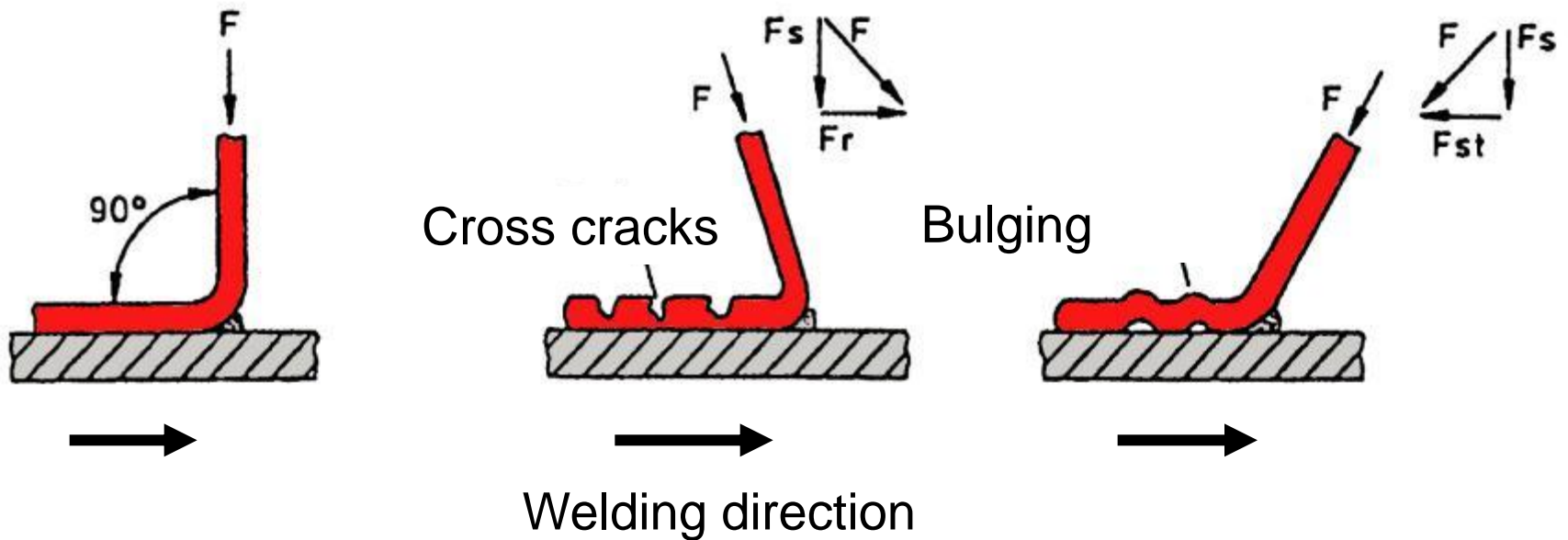
- The base material and the filler material are heated by a triangular movement of the hot air hand tool, first along the seam, then up the welding rod, and then back to the next segment of seam and so on. Heat the base- and filler material evenly.
- The Pressure applied to the filler rod depends on the material being welded.
- Hold the filler material vertically.
- With correct pressure and correct heat, side lobes form along the welded seam.

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Pendulum Welding (WF)



Part 4: Hot Gas Welding



Part 4: Hot Gas Welding

Hot Gas Draw Welding

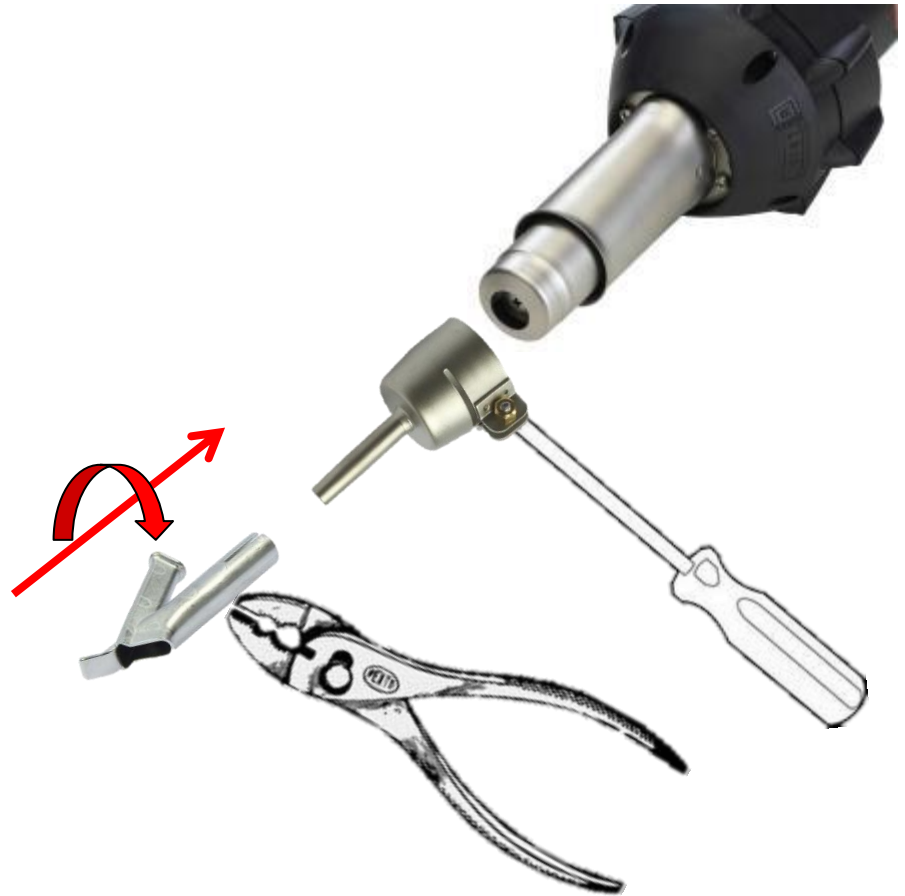
- Due to the design of the nozzle, the hot gas stream is divided and heats both the parent and the filler material. The filler material is fed through a preheating chamber and plastification occurs just before the meeting of both materials. The welding force is provided by the bead-forming shoe (nose). During the welding process the nozzle must be uniformly drawn along the joint.
- The cross section of the nozzle must conform to the shape of the filler material.
- Higher welding speed
- Greater cross section of welding rod, therefore less residual welding stress
- Triangular welding rod possible

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Draw Welding

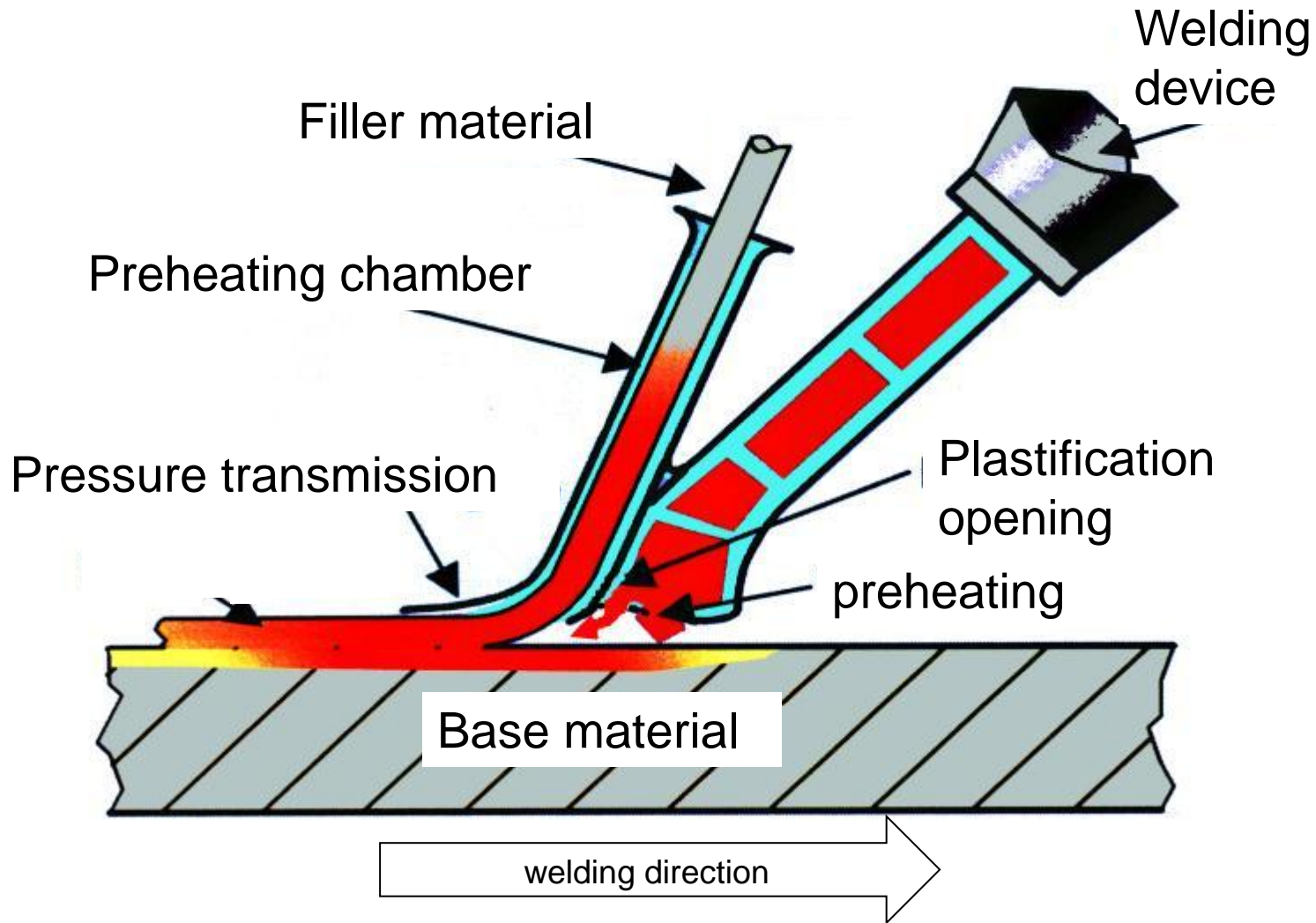


Speed Welding



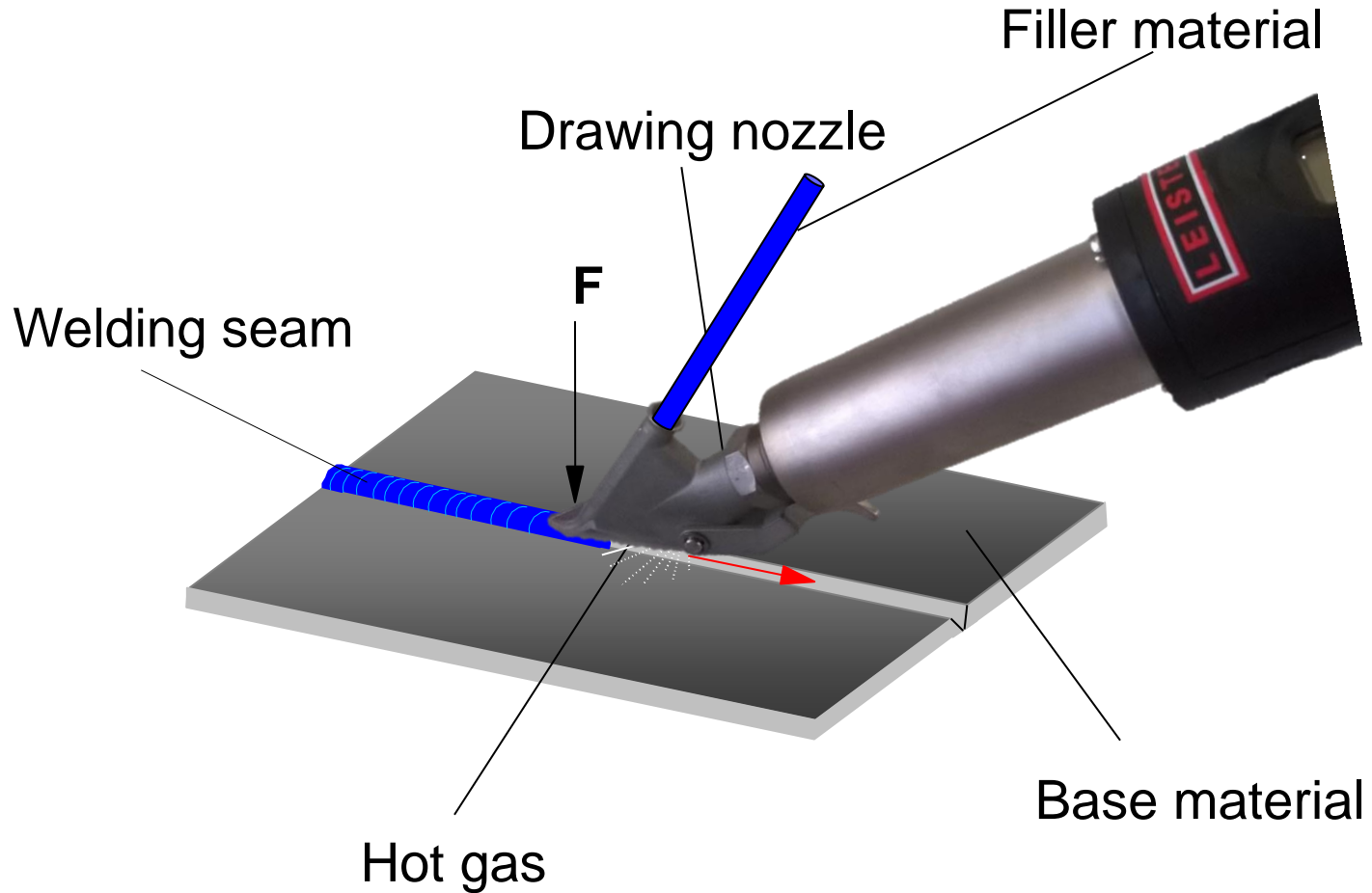
Part 4: Hot Gas Welding

Hot Gas Draw Welding



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Hot Gas Draw Welding



Part 4: Hot Gas Welding

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 and the filler rod must be scraped prior to welding

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Weld Preparation

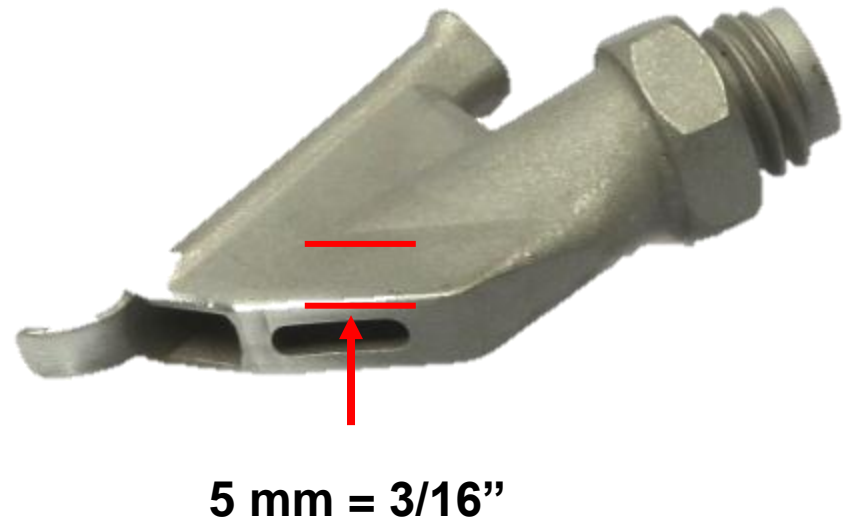
Surfaces which are damaged as a result of weathering or chemical influence must be scraped down to undamaged zones



UV-damaged material

Part 4: Hot Gas Welding

Point of Temperature Measurement



Part 4: Hot Gas Welding

Draw and pendulum welding according DVS 2207-3

The figures for WF and WZ quoted in the table of DVS 2207 Part 3 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	Hot gas temperature ¹⁾	Hot gas volume flow ²⁾	Welding speed ³⁾	Welding force (N) with wire ø	
			°C	l/min	mm/min	3mm	4mm
Free hand welding (WF)	High-density polyethylene	PE-HD ⁴⁾	300 ... 320	40 ... 50	70 ... 90	8 ... 10	20 ... 25
	Polypropylene, Types 1, 2, 3	PP-H; PP-B; PP-R	305 ... 315	40 ... 50	60 ... 85	8 ... 10	20 ... 25
	Unplasticised polyvinyl chloride	PVC-U	330 ... 350	40 ... 50	110 ... 170	8 ... 10	20 ... 25
	Chlorinated polyvinyl chloride	PVC-C	340 ... 360	40 ... 50	55 ... 85	15 ... 20	20 ... 25
	Polyvinylidene fluoride	PVDF	350 ... 370	40 ... 50	45 ... 50	15 ... 20	25 ... 30
Draw welding (WZ)	High-density polyethylene	PE-HD ⁴⁾	300 ... 340	45 ... 55	250 ... 350	15 ... 20	25 ... 35
	Polypropylene, Types 1, 2, 3	PP-H; PP-B; PP-R	301 ... 340	45 ... 55	251 ... 350	15 ... 20	25 ... 35
	Unplasticised polyvinyl chloride	PVC-U	350 ... 370	45 ... 55	252 ... 350	15 ... 20	25 ... 35
	Chlorinated polyvinyl chloride	PVC-C	370 ... 390	45 ... 55	180 ... 220	15 ... 25	30 ... 35
	Polyvinylidene fluoride	PVDF	365 ... 385	45 ... 55	200 ... 250	15 ... 25	30 ... 35
	Ethylene Chloro Tri Fluoro Ethylene	E/CTFE	350 ... 380	50 ... 60	220 ... 250	10 ... 15	N/A
	Fluorinated ethylene propylene	FEP	380 ... 390	50 ... 60	60 ... 80	10 ... 15	N/A
	Tetrafluorethylen Perfluormethylvinyle ther	MFA	395 ... 405	50 ... 60	60 ... 80	10 ... 15	N/A
	Perfluoroalkoxy alkanes	PFA	400 ... 410	50 ... 60	70	10 ... 15	N/A

¹⁾ Measured 5mm in the nozzle, in the centre of the nozzle opening.

²⁾ Draw n-in cold air volume at the ambient pressure.

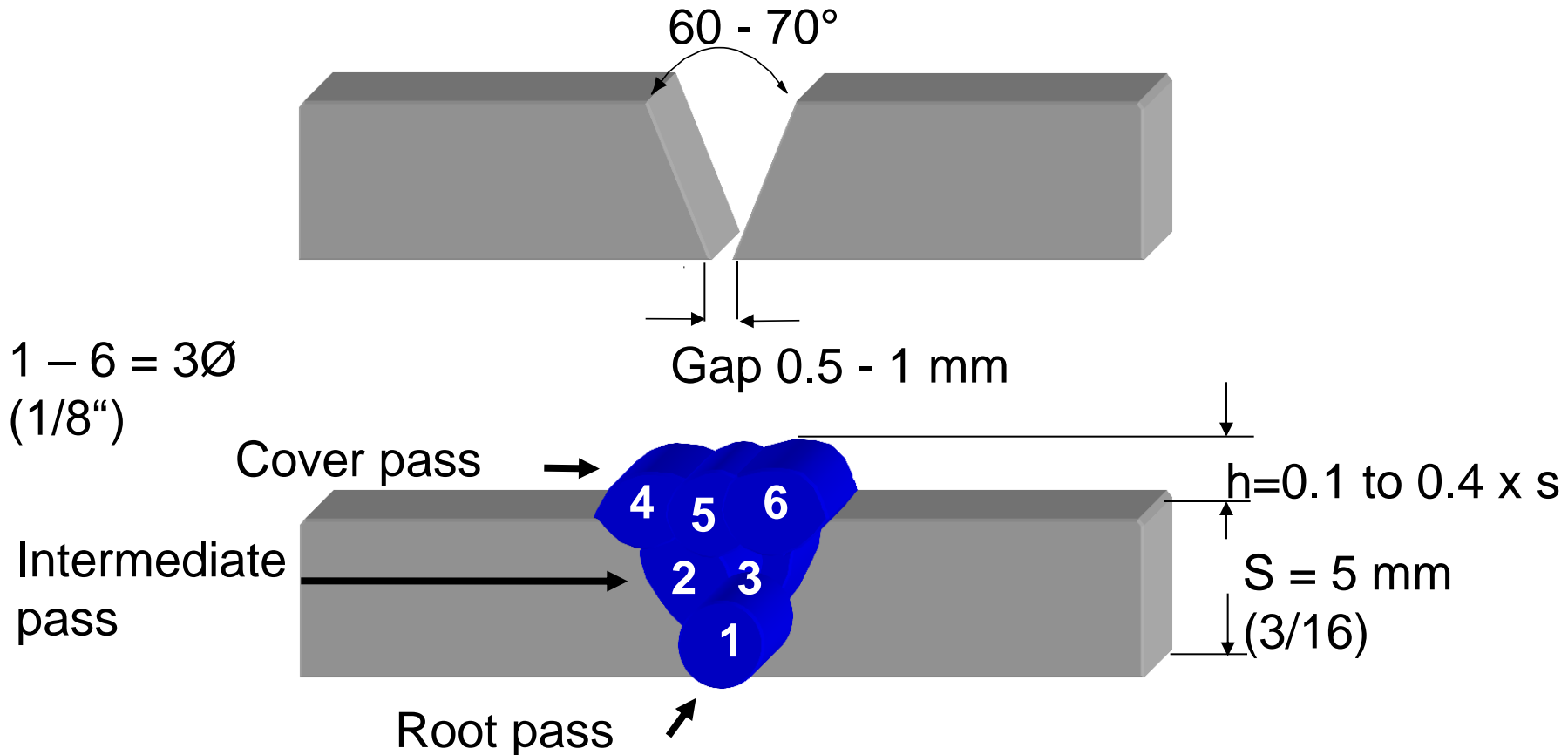
³⁾ Depending on the welding filler material diameter and the welding groove geometry.

⁴⁾ PE 63, PE 80, PE 100

Part 4: Hot Gas Welding

Types of Welding Seams

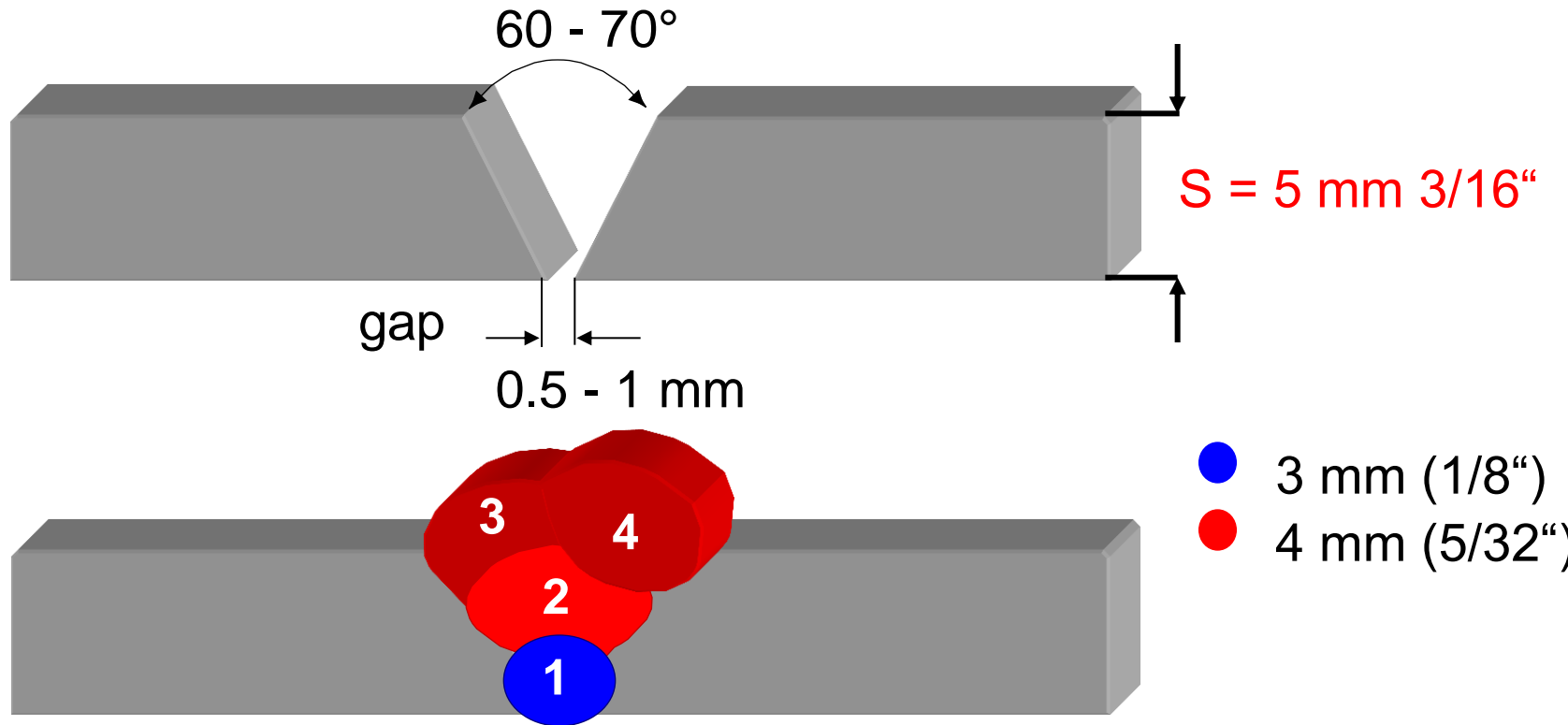
Single-V-butt weld



Part 4: Hot Gas Welding

Types of Welding Seams

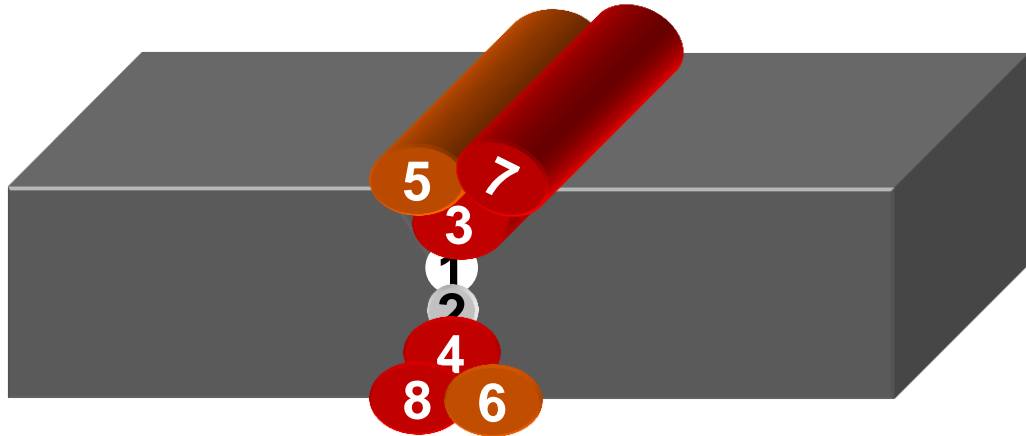
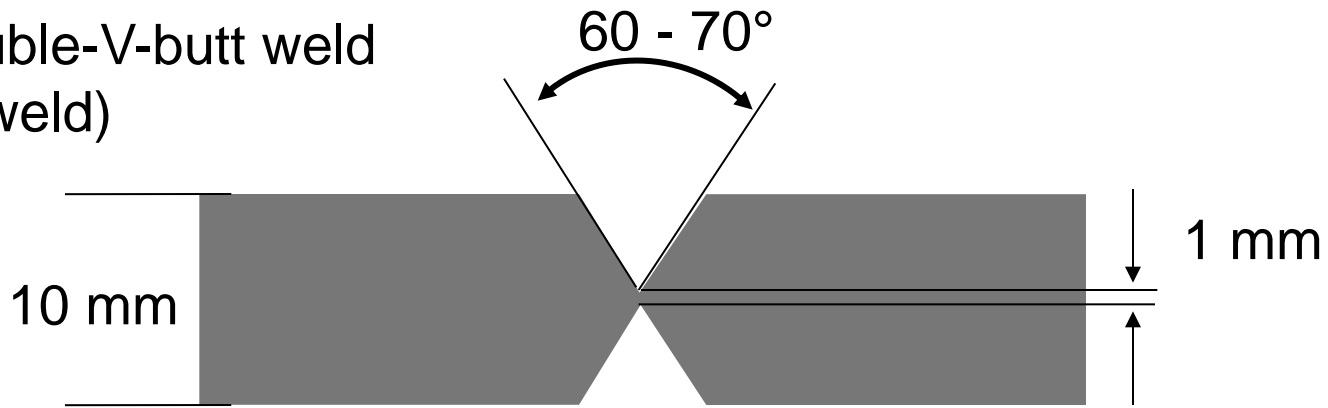
Single-V-butt weld



Part 4: Hot Gas Welding

Types of Welding Seams

Double-V-butt weld
(X-weld)

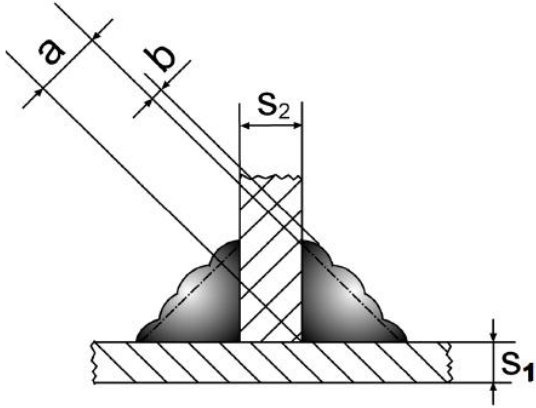


$$1 + 2 = 3\emptyset$$

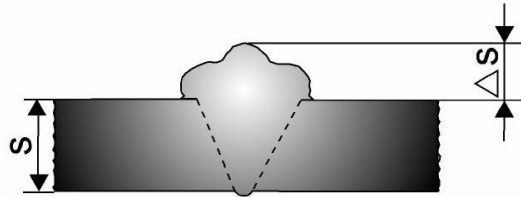
$$3 - 8 = 4\emptyset$$

Part 4: Hot Gas Welding

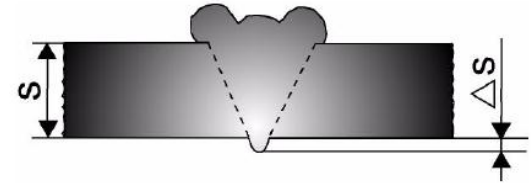
Welding Seam Measurements



$$a = 0.7 s_1, s_2 > s_1$$



$$0.1 s \leq \Delta s \leq 0.4 s$$



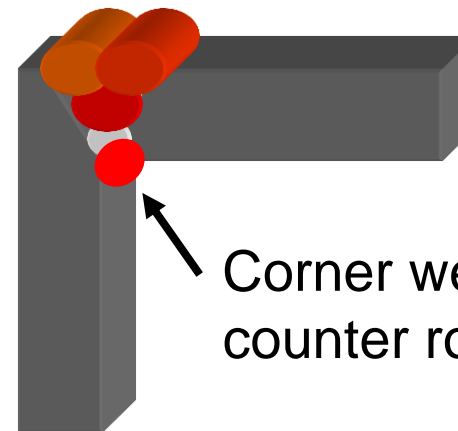
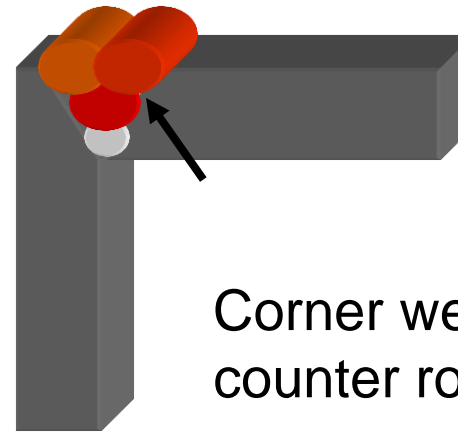
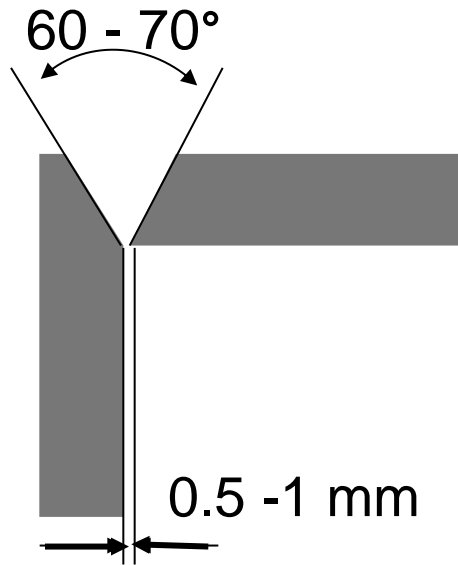
$$\Delta s \leq 0.15 s \text{ max } 2\text{mm}$$



Check DVS 2202-1

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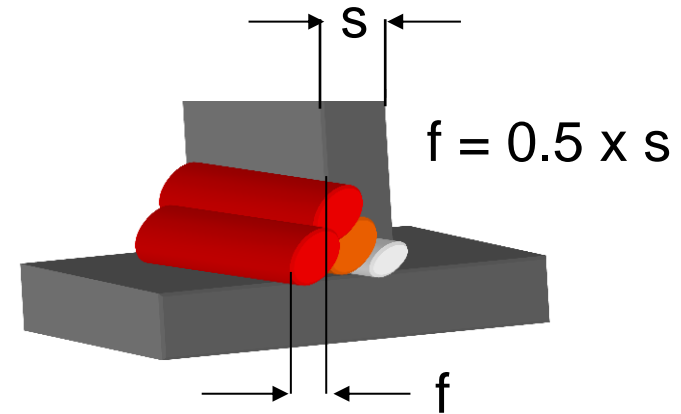
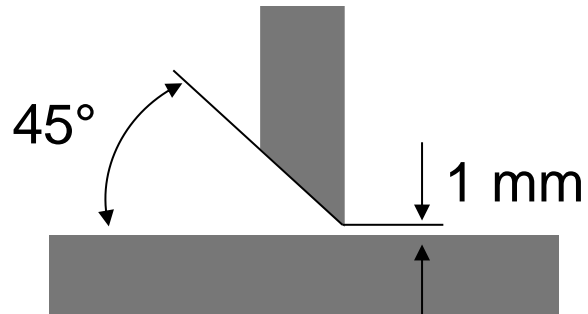
Types of Welding Seams



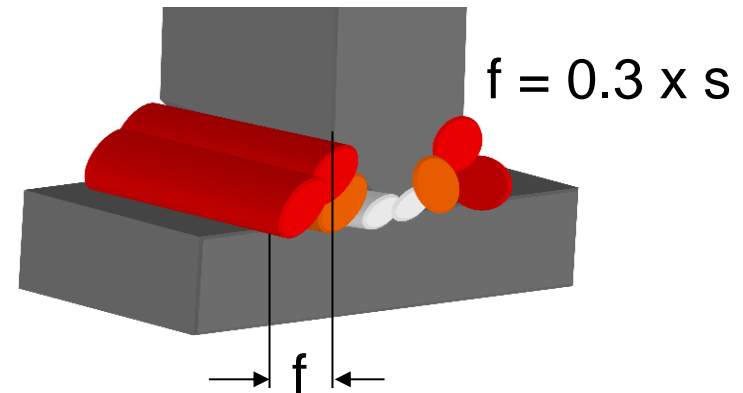
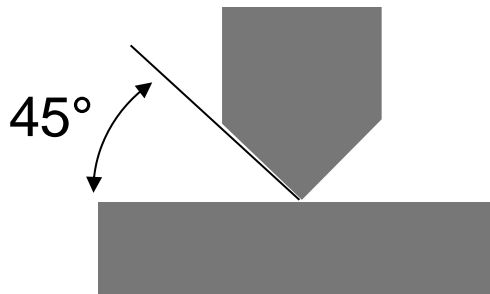
Part 4: Hot Gas Welding

Types of Welding Seams

Single bevel T-butt weld with fillet



Double bevel T-butt weld with double fillet



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Weld Build Up

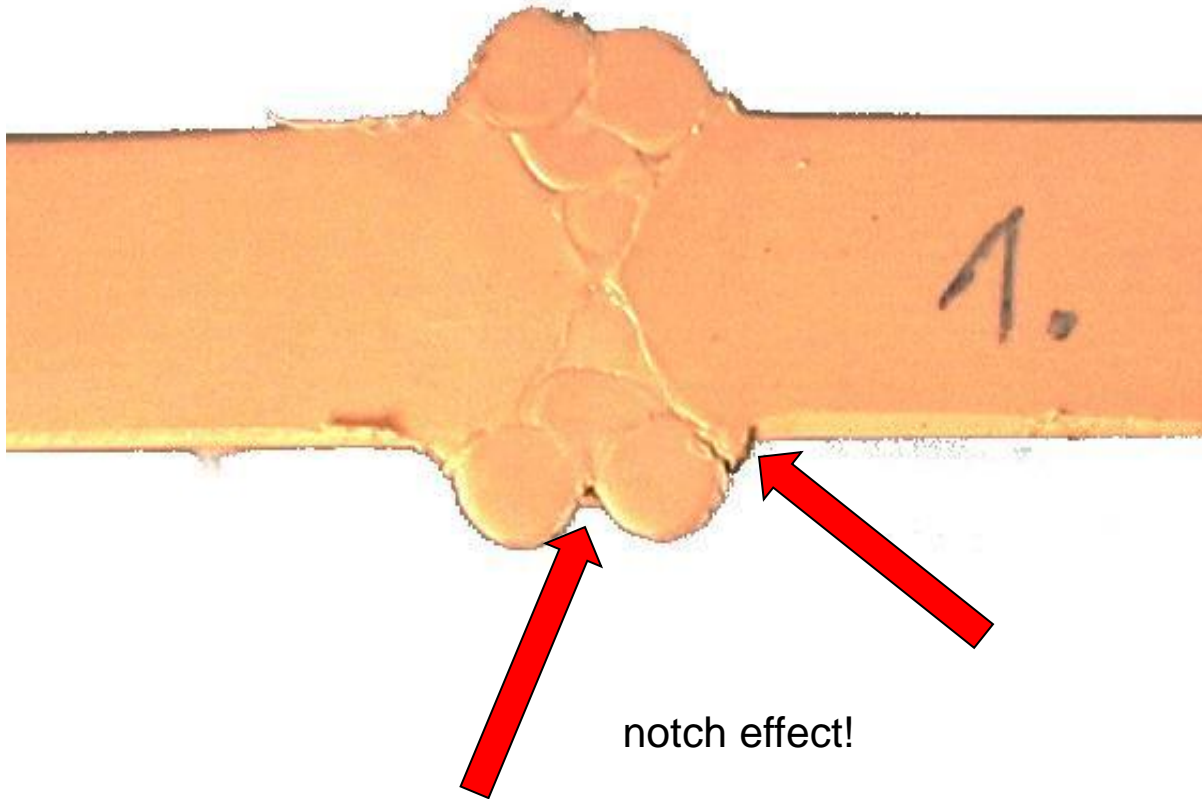
According to DVS 2207 Part 4 the weld has to be completely filled with filler material.

Attention:

- The upper edges must overlap
- Welding flash must be flat, or in case of T-joint must conform with DVS 2205 Part 4
- Notches must be avoided
- For full penetration weld the root pass with 3 mm welding rod (recommendation).
- Further weld build-up can be performed with welding rod which are larger in diameter

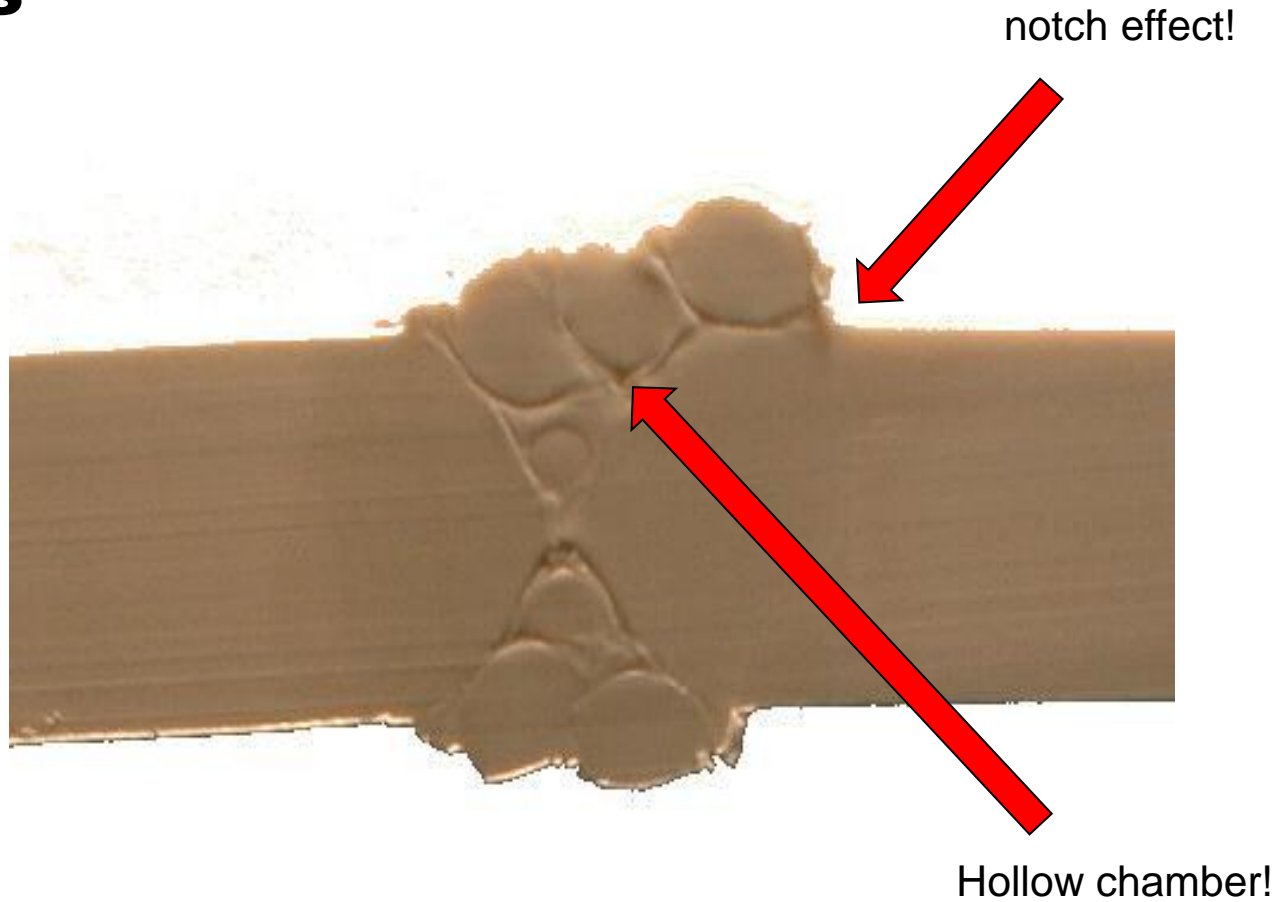
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Faults



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Faults



Overheated!

notch effect!