Welcome

Civil Engineering – Tunnel Construction

FURRER Thomas
Product Manager Plastic Welding

Scope

Civil Engineering

Tunnel construction - drilling and blasting technologies

→Sealing inside

Civil Engineering

Tunnel construction open mining technologies

→ sealing outside

Civil Engineering

Landfil (to store toxic materials)

Civil Engineering

Landfil (Goldmine)

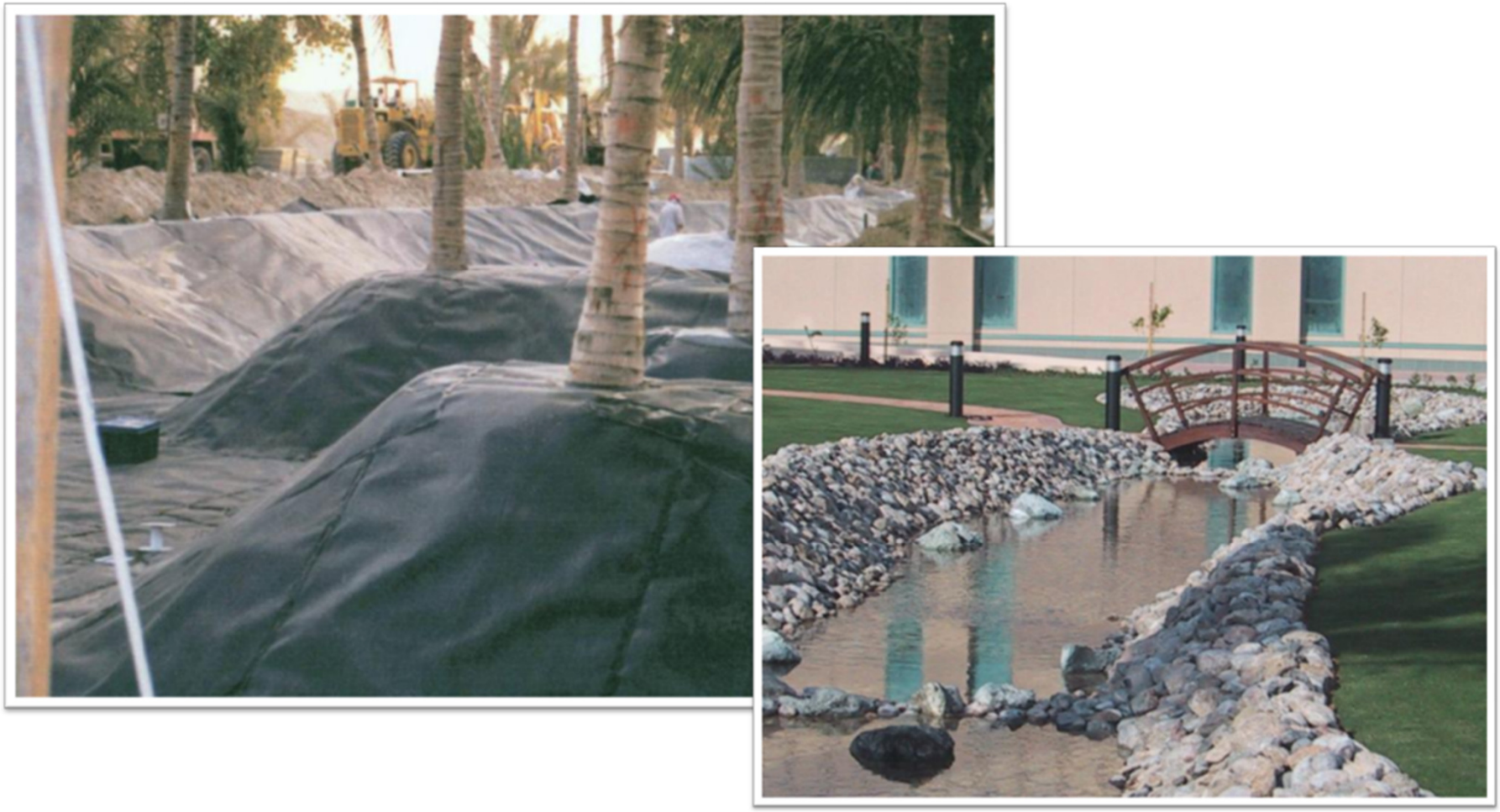
GOLD MINE, SAUDIA ARABIA
MATERIAL: HDPE 1.50 mm2 QUANTITY : 600,000 M2

Civil Engineering

Artificial lakes and rivers

Civil Engineering

Park and gardening

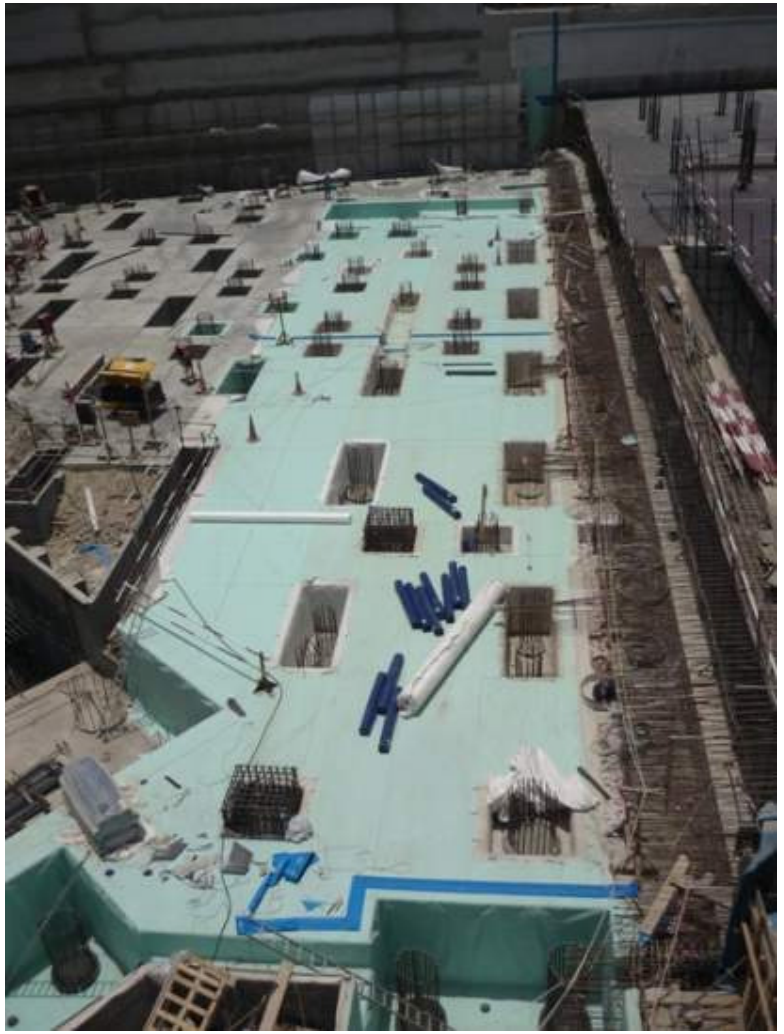


Civil Engineering

Sealing of dams (Colombia 2002)

Civil Engineering

Sealing of buildings



Civil Engineering

Secondary containment for ground water protection

Anwendungen

Secondary containment under oel thanks (Venezuela, 2009)

皮划艇激流回旋
Canoe/Kayak-Slalom

皮划艇激流回旋赛道照片

Wathersport, Olympia, China 2008

Beijing 2008

GSE公司0.75毫米厚
HDPE土工膜，幅宽7米
采用TWINNY S焊接机
垂直爬行焊接，双轨焊
缝质量完美无缺。

北京飞色塑料锲焊技术有限责任公司 Tel: 010-68230516 http://www.refeng.cn

feise

Welding Procedure

- Hot air welding
- Extrusions welding
- Hot wedge welding (element)
- Hot air welding

Welding Procedure

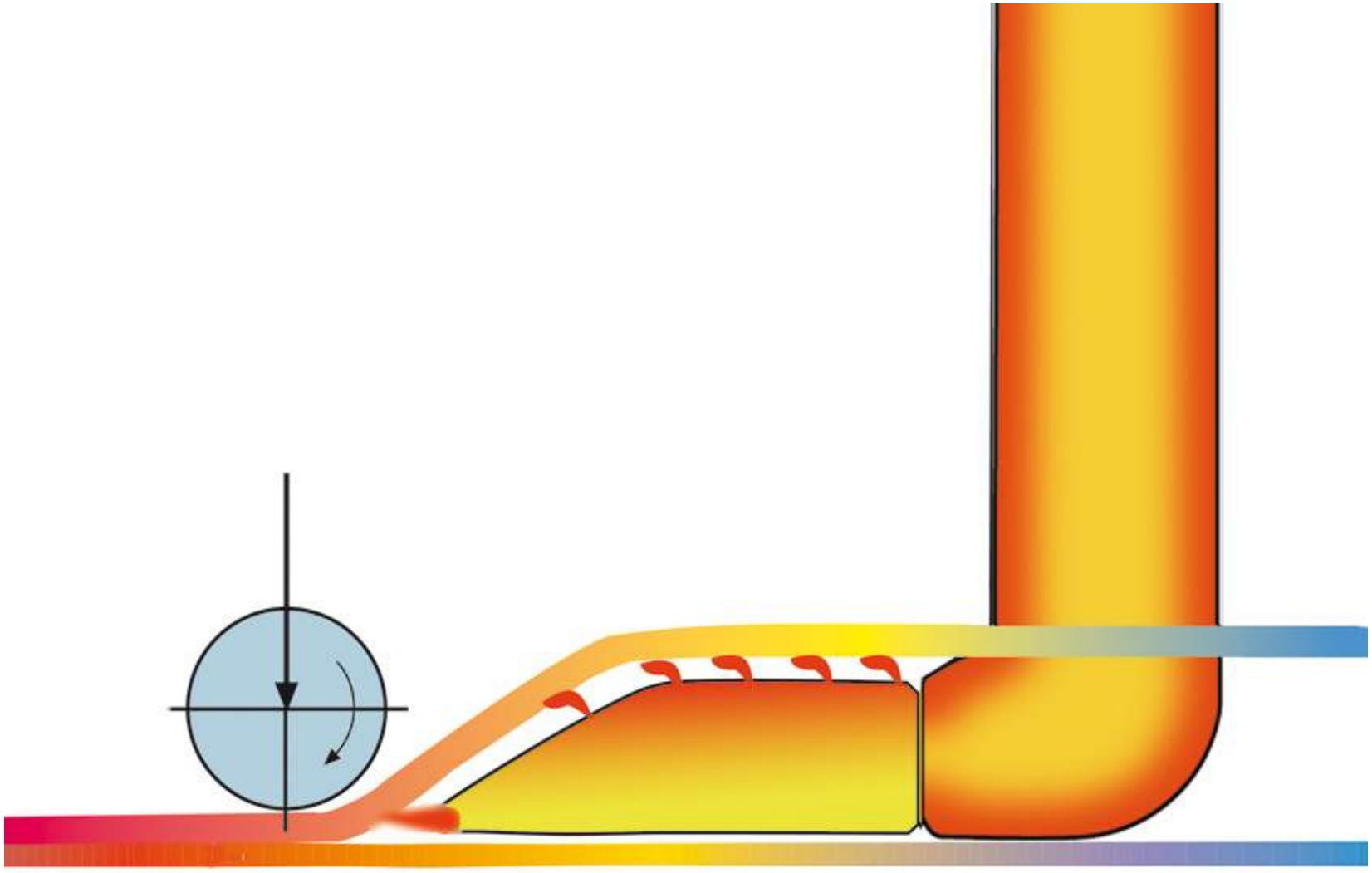
Following welding procedures are possible:

- Extrusion welding
- Hot wedge welding (element)
- Hot air welding

All welding procedures require an accordance of the following parameters:

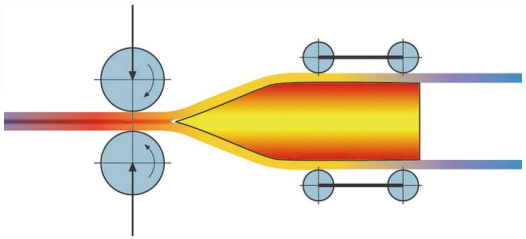
- Temperature
- Pressure
- Speed

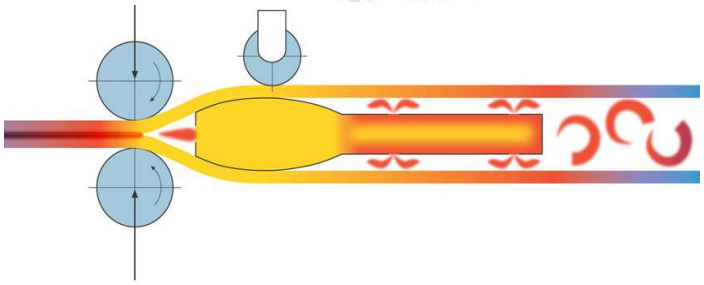
“Hot Air” Welding Procedures



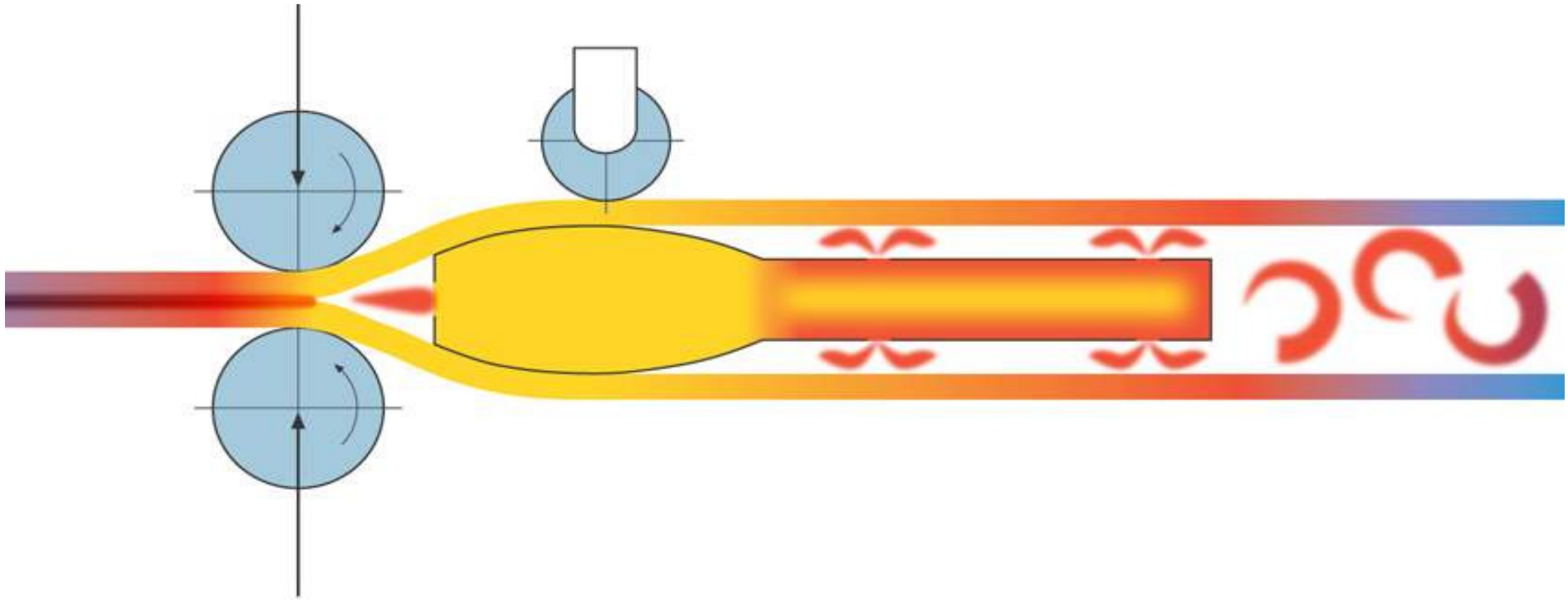
“Hot Air” Welding Procedures

Most common welding machines



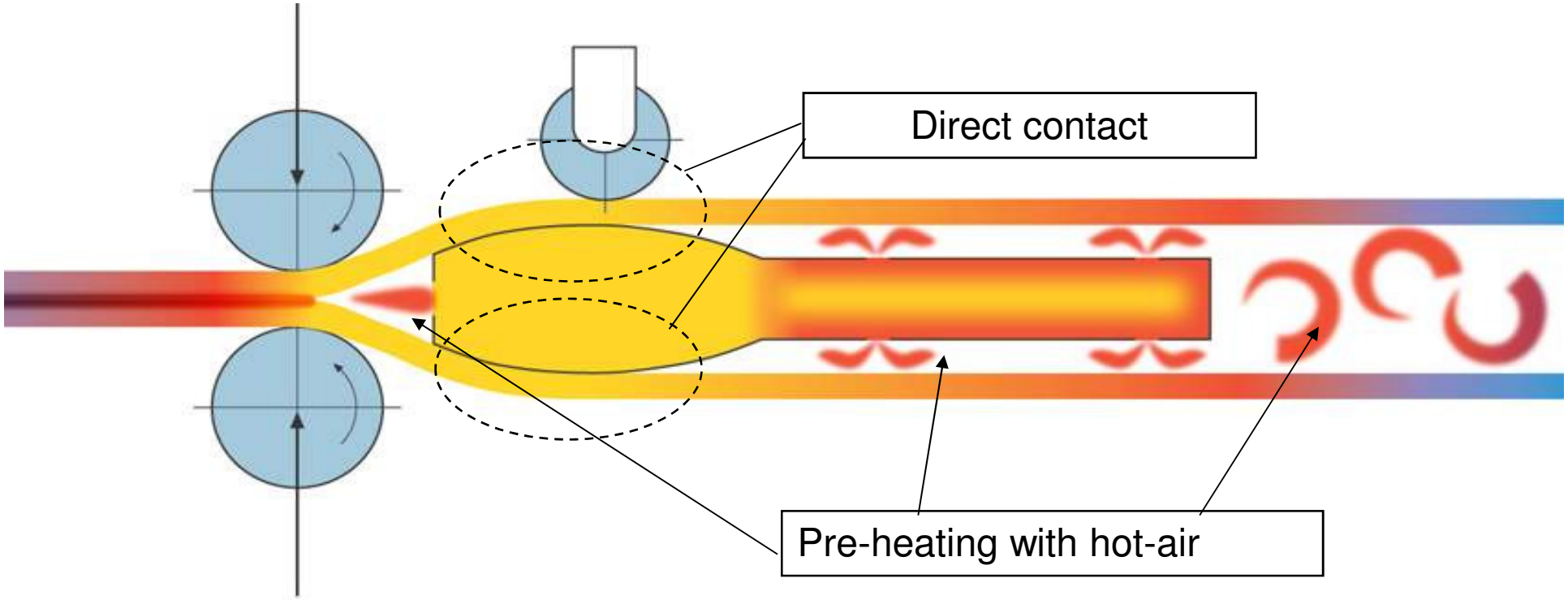


“Combi Wedge” Welding Procedures



TWINNY S **TWINNY T**

“Combi Wedge” Welding Procedures

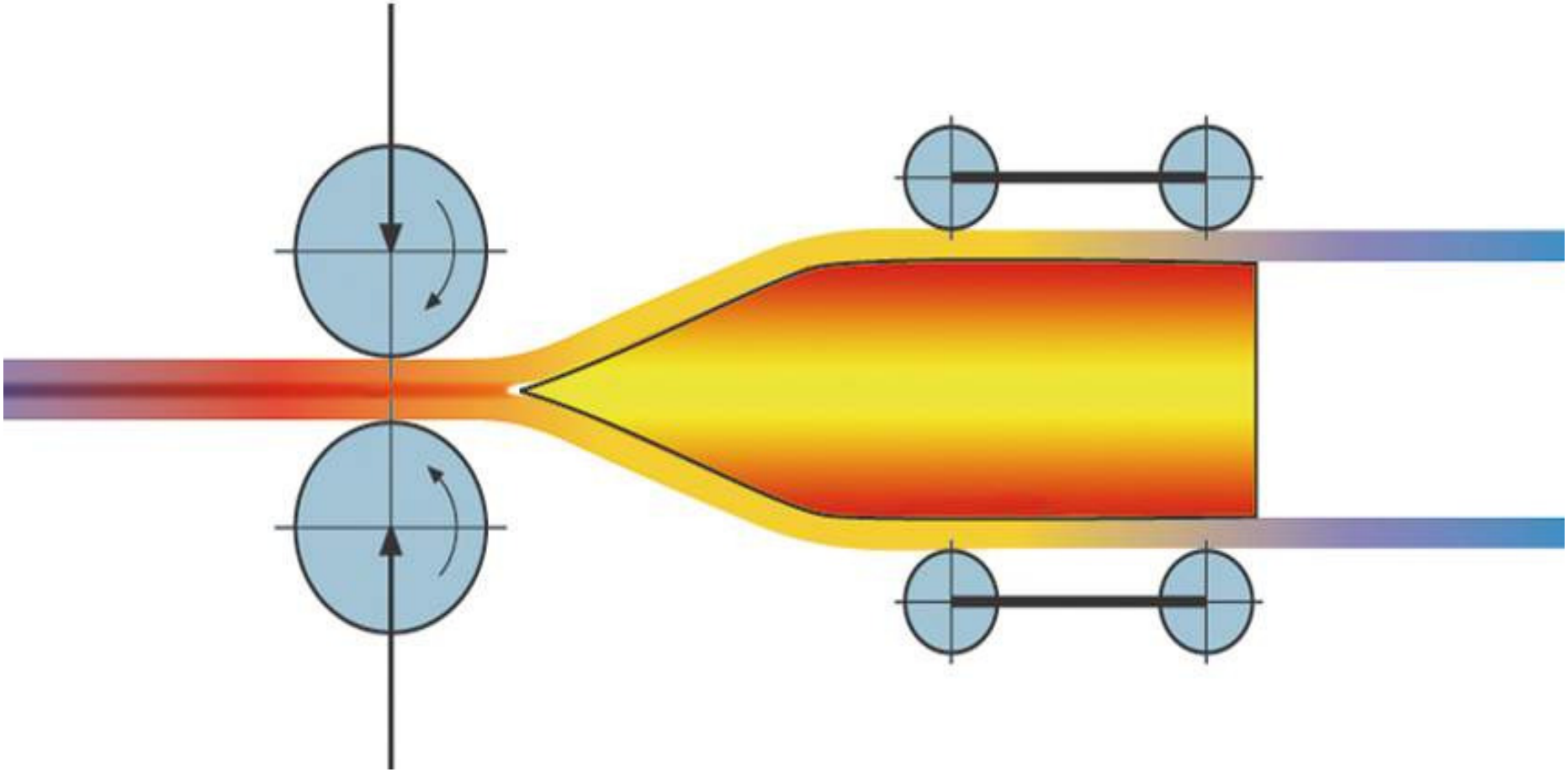


TWINNY S **TWINNY T**

“Combi Wedge” Welding Procedures

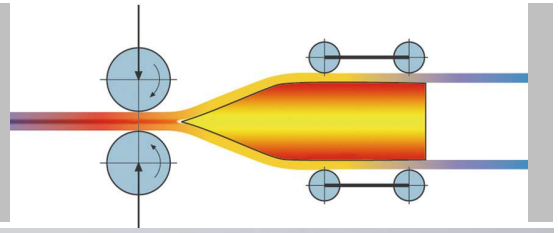
Combi wege long with test channel for Twinny T/S

“Wedge” Welding Procedures



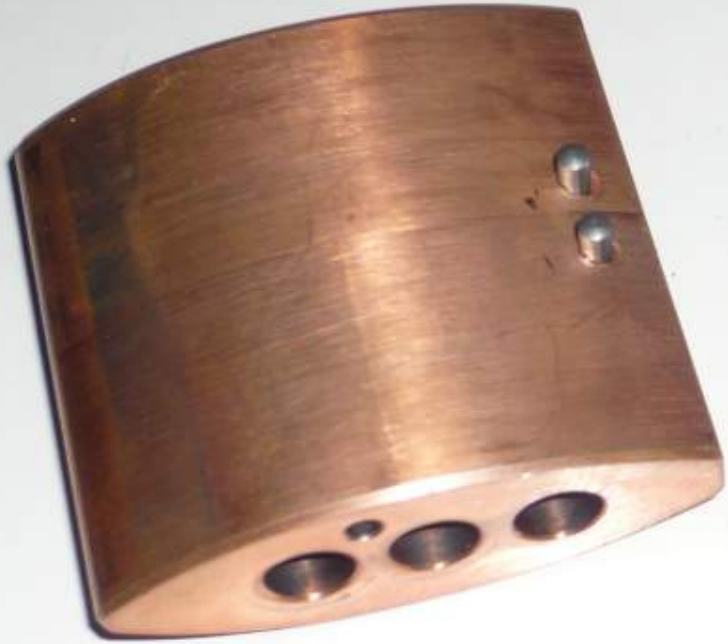
COMET ASTRO

Copper - Steel



Wedge Steel with test channel

Wedge Cooper without test channel

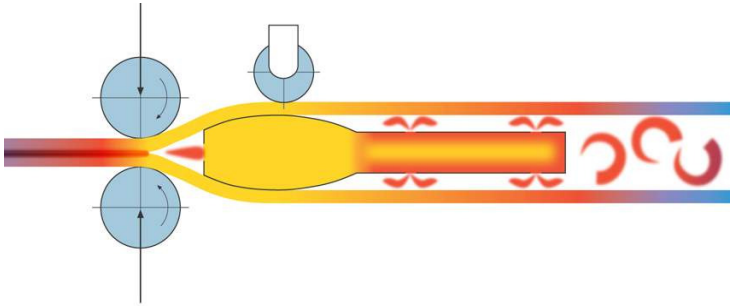


Overview “Combi-wedge” – “Wedge”

Combi-wedge

+ Thin material (down to 0,5 mm)
+ Blows away sand/dirt/humidity
+ No change of nozzle for PE and PVC

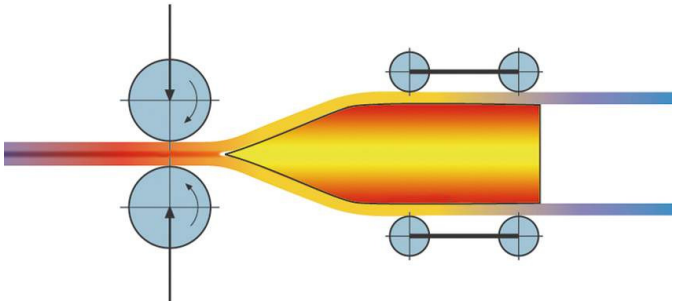
- Slower speed
- Energy consumption/noice
- Easy change of combi-wedge



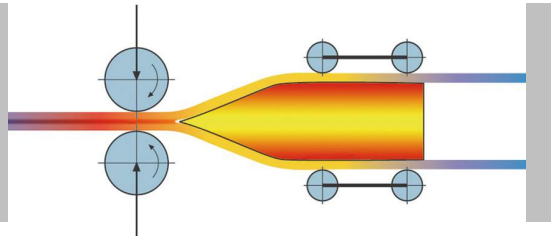
Wedge

+ Speed
+ No noice
+ Less energy consumption

- Unsoiled plastic sheets
- Absolutely dry plastic sheets
- Wedge is difficult to change



Overview Wedge Technologies



- Steel
- Copper
- Silver
- Ceramic

Overview Wedge Technologies

Steel, CrNi (PVC)

+ Low Costs

- Speed

Cooper (PE/PP)

+ Speed

- Corrosion with PVC

- Cost

Silver (PE/PP)

+Speed

- Costs

- Corrosion (connections)

Ceramic (PE/PP/PVC)

+ All types of material

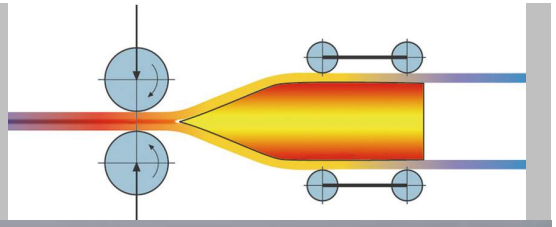
+ Free from wear

- Costs

- Mechanical stress/water

- Heat transfer

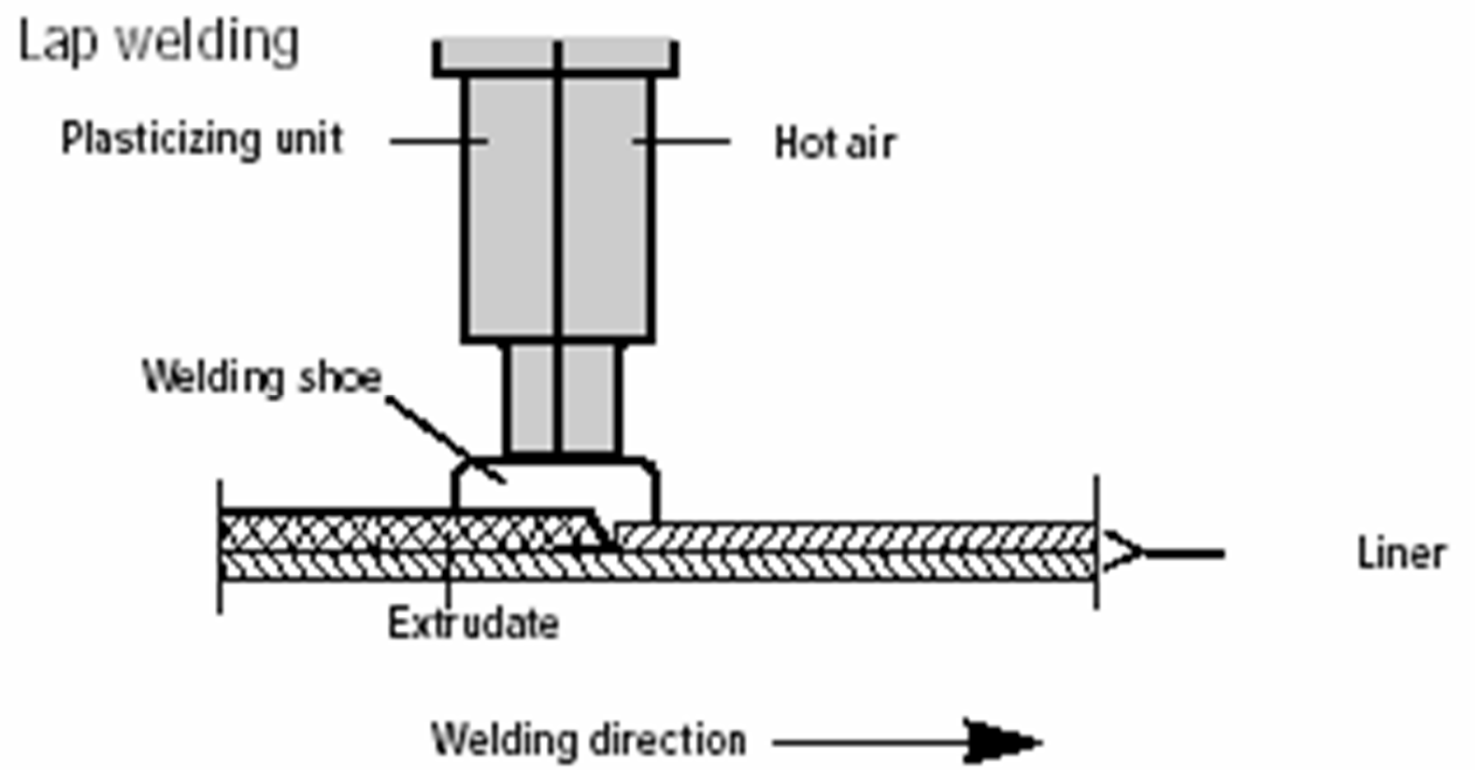
Copper – using PVC



Bad Example: wrong use of copper wedge!

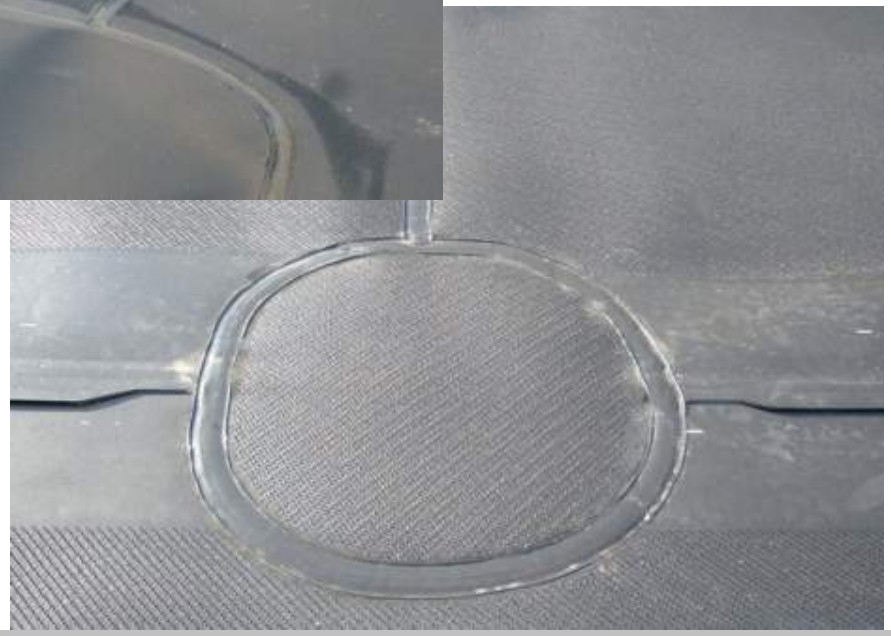
Corrrosion caused by PVC!

Extrusionswelding



FUSION 3 **WELPLAST** **WELDMAX**

Extrusionswelding



Welding Procedure Under Construction Site Conditions

Condition of Surface

- solid underground with smooth surface without bumps
- Building sites should be free of sharp items, roots and stones.

Environment Conditions / Weather Conditions / Rain

- In case of rain it must not be welded without any special safety measures.

Air Temperature

- Welding procedures have to be stopped at temperatures under +5°C in order to prevent high thermal strains of the membrane.

Welding Procedure Under Construction Site Conditions

- **Air Humidity**

High air humidity might cause perspiration water on the welding surface which is unfavourable for the seam strength (towel or pre-heat).

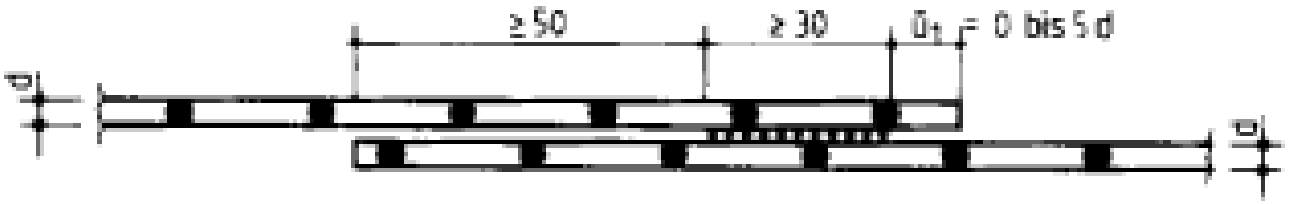
- **Wind**

Due to strong wind the required welding temperature might not be reached. To solve this problem, the welding temperature has to be increased up to 20–30 °C. If the wind is too strong, the welding area should be protected, or the welding process has to be stopped.

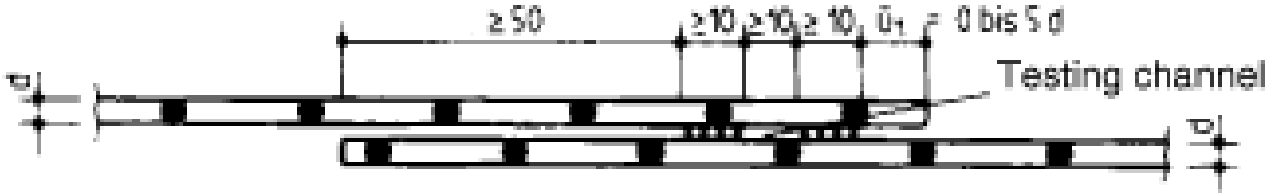
- **Sunshine**

Sunshine causes strong heat, especially of black membranes. This causes an increased thermal expansion of the membrane and results in wrinkles. The welding process becomes more difficult, and when cooling down abnormal strain in the seam area occurs.

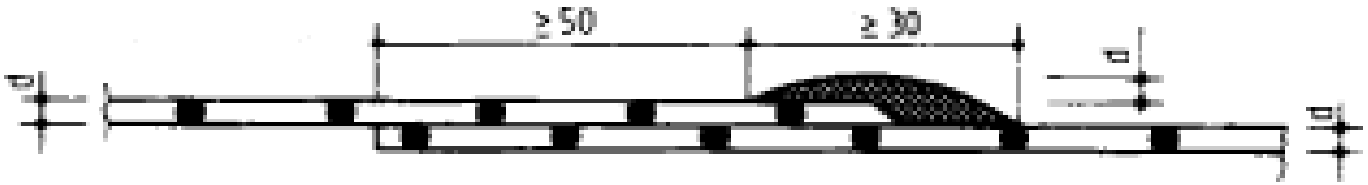
Welding shape according DVS 2225 Teil 1



Lap joint without testing channel – single weld
(Welding with or without welding filler)



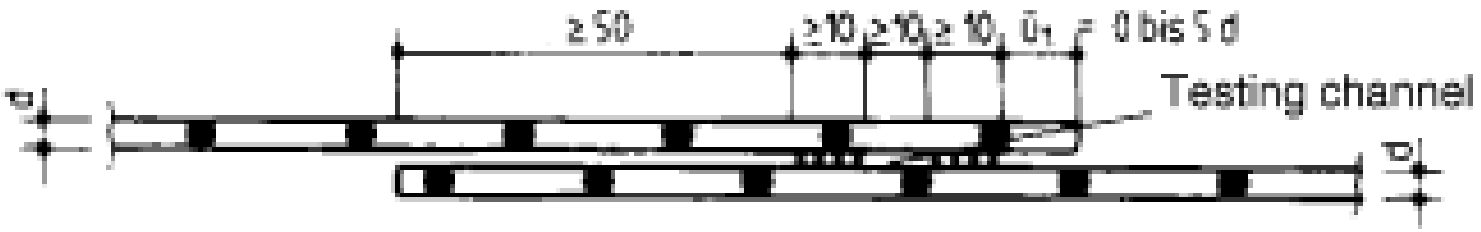
Lap joint with testing channel – double weld
(Welding with or without welding filler)



Coating weld (extrusion welding)

Test procedure: Test according DVS 2225 Teil 2

- **Outer appearance of the seam**
  (visual control of notches, grooves and irregularities)
- **Examination of the dimension** (measuring)
- **Strength test** (tensile test)
- **Leak-tightness test** (Testing with compressed air)



Lap joint with testing channel – double weld
(Welding with or without welding filler)

LEISTER

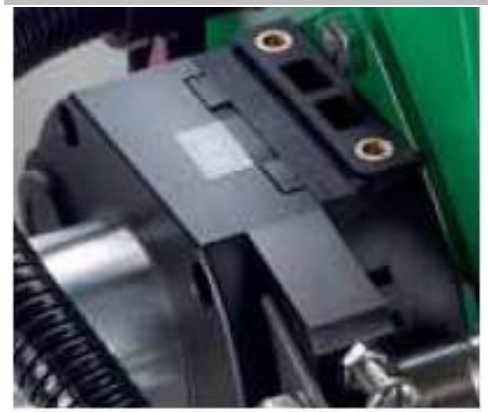
Automatic Machines

- COMET
- ASTRO

- TWINNY T
- TWINNY S

Automatic Machines

COMET (Hot wedge welding)



Drive technology designed for the highest demands

Digital temperature and speed display

Adjustment of welding force for different materials

Double drive and pressure system for constant pressure

COMET (Hot wedge welding)

Power consumption	1500 W		1200 W		700 W	
Type of material	Wedge length	Material thickness	Wedge length	Materialf thickness	Wedge length	Material thickness
PE-HD, PE-C, PP	70 mm copper	1.5 – 2.0 mm	50 mm copper	0.5 – 1.5 mm	20 mm steel	0.5 – 1.0 mm
PE-LD	70 mm copper	2.0 – 3.0 mm	50 mm copper	1.0 – 2.0 mm	20 mm steel	0.5 – 1.0 mm
PVC-P	70 mm steel	2.0 – 3.0 mm	50 mm steel	1.0 – 2.0 mm		

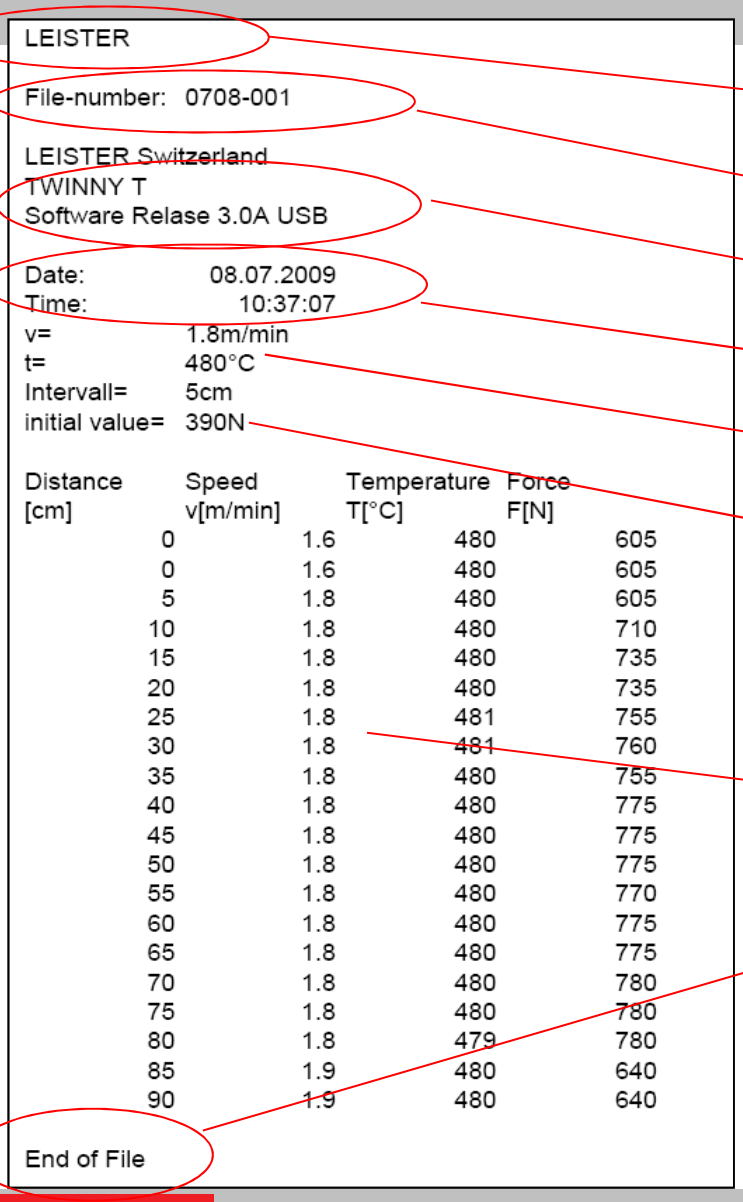
COMET USB

- Recording of welding parameters
- Very easy handling
- Proved under heavy duty conditions

COMET USB

- Pressure measurement with very precise sensor
- Display read out of pressure

USB-Report COMET USB



LEISTER

File-number: 0708-001

LEISTER Switzerland
TWINNY T
Software Relase 3.0A USB

Date: 08.07.2009
Time: 10:37:07
v= 1.8m/min
t= 480°C
Intervall= 5cm
initial value= 390N

Distance [cm]	Speed v[m/min]	Temperature T[°C]	Force F[N]
0	1.6	480	605
0	1.6	480	605
5	1.8	480	605
10	1.8	480	710
15	1.8	480	735
20	1.8	480	735
25	1.8	481	755
30	1.8	481	760
35	1.8	480	755
40	1.8	480	775
45	1.8	480	775
50	1.8	480	775
55	1.8	480	770
60	1.8	480	775
65	1.8	480	775
70	1.8	480	780
75	1.8	480	780
80	1.8	479	780
85	1.9	480	640
90	1.9	480	640

End of File

- Client text can be edited
- File-name (date and number)
- Type of tool and software-version
- Date and time
- Welding parameters
- Pressure value for start of recording
- Recording of welding parameters every 5cm
- End of recording

Wedge Welding Machine

ASTRO
Wedge welding machine

- Worldwide the fastest wedge welding machine
- Very robust
- One-handle operation
- HD-PE 1.5 - 3 mm

ASTRO USB

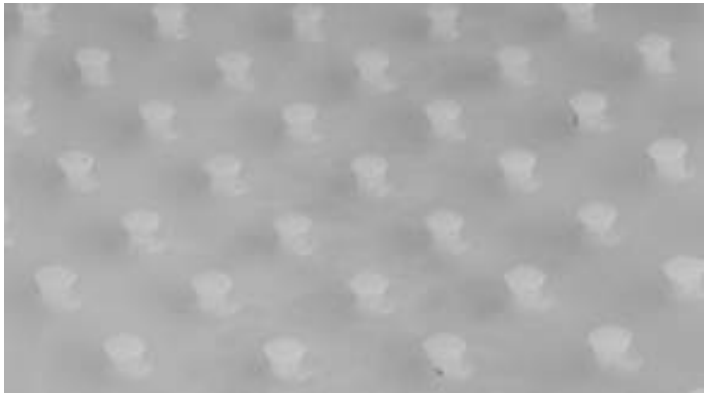
- Data recording all important welding parameters
- Akustical alarm funktion
- For work according DVS 2225-4

ASTRO CPL

- For conrete protection liner
- Faster than conventional welding procedures
- Up to 3.5mm membranes /up to 19mm nap-material

Concrete Guard Plates – Nap Membranes

Omega - naps



T - naps

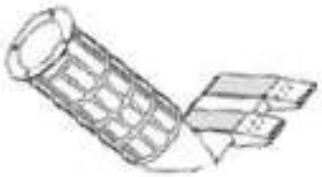
V - naps

Flat naps

TWINNY T Combi wedge

- Small and handy
- Combi wedges easy to change
- Suitable for all materials
- For Membranes of 0.3 - 2.0mm
- Digital controlled
- USB-Data-Recording possible

100.517	Short combiwedge, 50 mm with test channel
100.518	Short combiwedge, 50 mm without test channel
	> TWINNY T > TWINNY S



100.525	Long combiwedge, 50 mm with test channel
100.526	Long combiwedge, 50 mm, without test channel
	> TWINNY T > TWINNY S

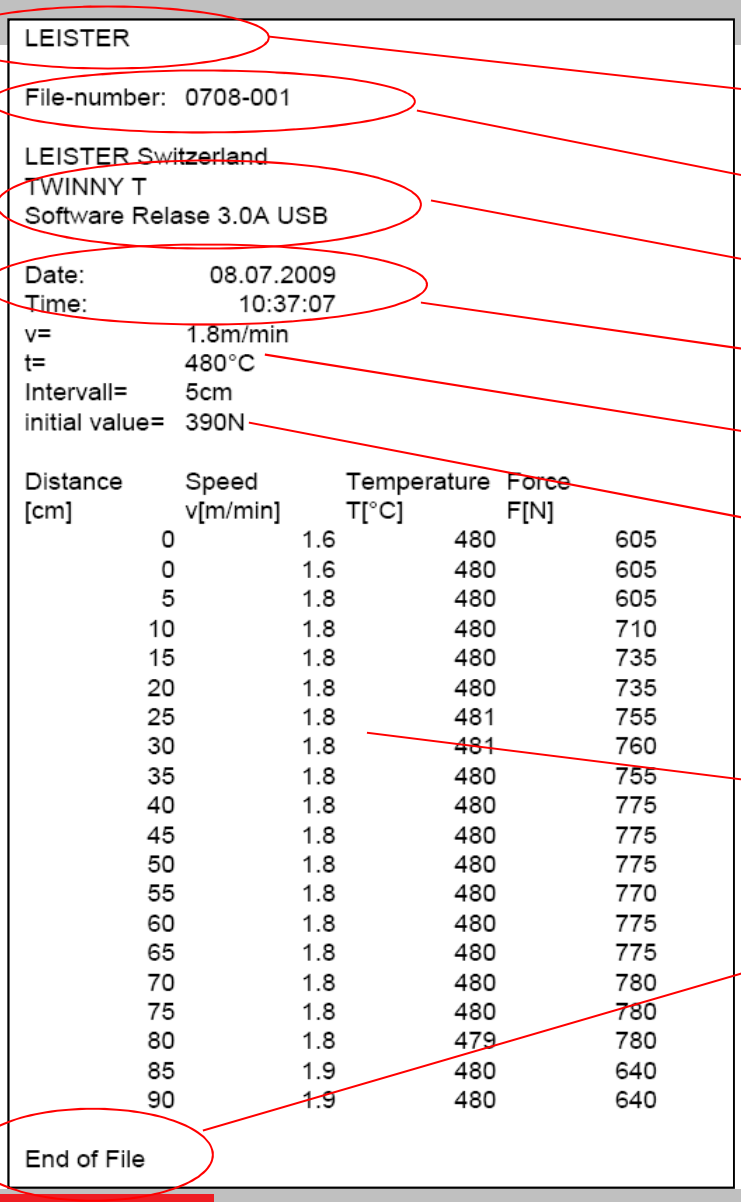
TWINNY T USB – Data recording

- Recording of welding parameters
- Very easy handling
- Proved under heavy duty conditions

TWINNY T USB – Data recording

- Pressure measurement with very precise sensor
- Display read out of pressure

USB-Report TWINNY T



LEISTER

File-number: 0708-001

LEISTER Switzerland
TWINNY T
Software Relase 3.0A USB

Date: 08.07.2009
Time: 10:37:07
v= 1.8m/min
t= 480°C
Intervall= 5cm
initial value= 390N

Distance [cm]	Speed v[m/min]	Temperature T[°C]	Force F[N]
0	1.6	480	605
0	1.6	480	605
5	1.8	480	605
10	1.8	480	710
15	1.8	480	735
20	1.8	480	735
25	1.8	481	755
30	1.8	481	760
35	1.8	480	755
40	1.8	480	775
45	1.8	480	775
50	1.8	480	775
55	1.8	480	770
60	1.8	480	775
65	1.8	480	775
70	1.8	480	780
75	1.8	480	780
80	1.8	479	780
85	1.9	480	640
90	1.9	480	640

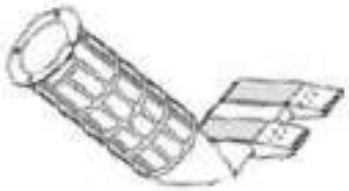
End of File

- Client text can be edited
- File-name (date and number)
- Type of tool and software-version
- Date and time
- Welding parameters
- Pressure value for start of recording
- Recording of welding parameters every 5cm
- End of recording

TWINNY S Combi wedge

- Ideal for tunnel construction
- Low weight
- For membranes of 0.3mm – 2.0mm
- Suitable for all materials
- Easy to use
- Highest speed up to 6 m/min

100.517	Short combiwedge, 50 mm with test channel
100.518	Short combiwedge, 50 mm without test channel
	> TWINNY T > TWINNY S



100.525	Long combiwedge, 50 mm with test channel
100.526	Long combiwedge, 50 mm, without test channel
	> TWINNY T > TWINNY S

TWINNY S Combi wedge

Technical Data

Voltage	V~	230		
Power consumption	W	2900		
Frequency	Hz	50 / 60		
Temperature	°C	20 – 600		
Speed	m/min	0.2 – 2.5	0.8 – 4	1.2 – 6
Welding pressure	N	max. 1000	max. 500	max. 500
Air flow (20°C)	l/min	Level 2: 150 Level 3: 190		
Noise emission level L_{pA}	dB	71		
Size (L × W × H)	mm	350 × 390 × 270		
Weight	kg	6.5 – 6.9 (with 3 m cord)		
Marking of conformity		CE		
Approval mark		GS		
Certification scheme		CCA		
Protection class II		⧈		
Article no with Euro plug		119.027	119.008	128.808
Accessories page 14		Further models on request		

TWINNY S: Different Gears

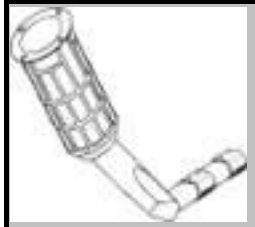
Gear 144:1

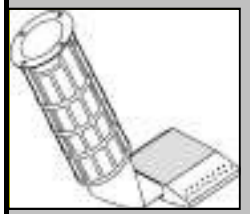
- Speed of *1.4 – 4.0 m/min*
- Version up to 6m/min (128.808)
- Max. pressure of 500N
- Thin materials are suitable
- Current limiter (motor switches off)

Gear 256:1

- Speed of *0.8 – 2.5 m/min*
- Max. pressure of 1000N
- Thick materials are suitable
- Current limiter (motor switches off)
- Version rapida up to 6 m/min

TWINNY S / T: Application Range Nozzles

Combi Wedge		Material	Thickness
	1	PE-HD, PE-C, PFA, PP PVC-P, PE-LD, EVA	0.3 - 1.0mm 0.3 - 2.0mm
	2	1 short combi wedge with test channel 2 short combi wedge without test channel	

Combi Wedge		Material	Thickness
	3	PE-HD, PE-C, PFA, PP PVC-P, PE-LD, EVA	0.8 - 2.0mm 1.0 - 3.0mm
	4	3 long combi wedge with test channel 4 long combi wedge without test channel	

Differences of Hot Wedge and Combi Wedge

	Hot Wedge	Combi Wedge
		
Advantages:	▪ Small heat output ▪ Compact design ▪ Low noise	▪ No change of nozzle (PVC/PE) ▪ Suitable for thin materials ▪ Blows away dirt in the seam ▪ Stress-free welding procedure
Disadvantages:	▪ Change of wedge PVC/PE ▪ Depending on weather ▪ Cleaning of seam absolutely ▪ Necessary when wet	▪ High heat output (wattage) ▪ Slow speed

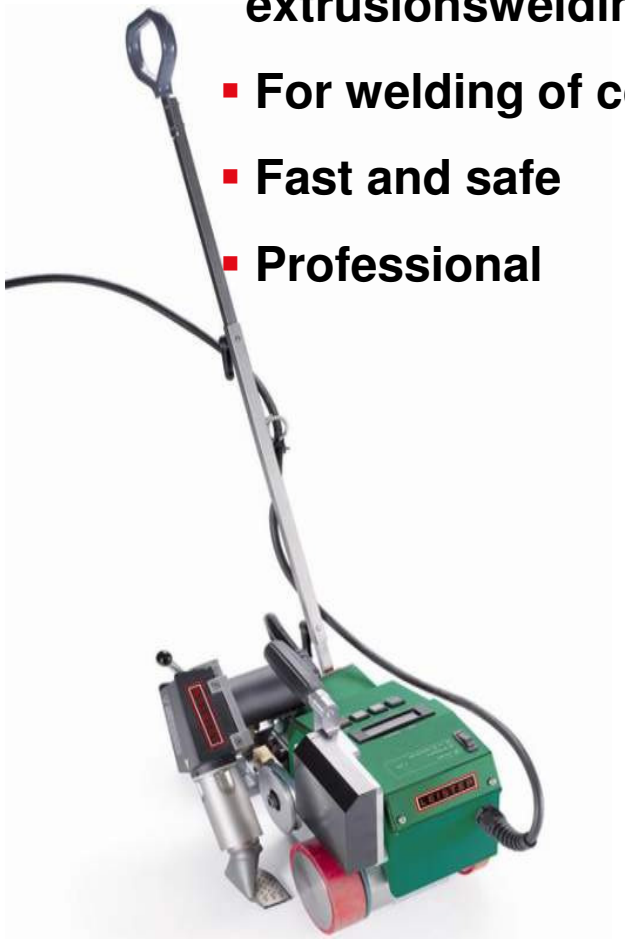
Useful welding parameter for HDPE Membranes

Please note: the indicated welding parameter may vary depending on the ambient temperature and the material configuration. Test welds needs to be done and the parameter aligned accordingly !

Wedge			HD-PE							LD-PE					PVC					
			0.3	0.5	1.0	1.5	2.0	2.5	3.0	0.3	0.5	1.0	1.5	2.0	0.8	1.0	1.5	2.0	2.5	3.0
COMET	copper	95 mm			380° C 3.2 m/min 600 N	420° C 3.0 m/min 800 N	420° C 2.8 m/min 1000 N	420° C 2.5 m/min 1000 N					400° C 3.2 m/min 600 N	400° C 3.0 m/min 800 N						
	copper	70 mm			380° C 2.5 m/min 600 N	420° C 2.5 m/min 800 N	420° C 2.2 m/min 1000 N	420° C 2.0 m/min 1000 N					400° C 2.8 m/min 600 N	400° C 2.5 m/min 800 N						
	copper	50 mm		380° C 2.3 m/min 500 N	420° C 2.2 m/min 600 N	420° C 2.0 m/min 800 N					380° C 2.5 m/min 500 N	420° C 2.5 m/min 600 N								
	steel	70 mm																400° C 2.8 m/min 700 N	420° C 2.5 m/min 800 N	420° C 2.4 m/min 1000 N
	steel	50 mm														400° C 2.8 m/min 600 N	420° C 2.5 m/min 600 N			
	steel	20 mm	400° C 2.0 m/min 400 N	420° C 1.5 m/min 500 N						350° C 2.0 m/min 500 N					350° C 2.0 m/min 400 N					
ASTRO						420° C 5.0 m/min 1250 N	420° C 4.5 m/min 1500 N	420° C 4.2 m/min 1500 N	420° C 4.0 m/min 1500 N											
Combi Wedge																				
TWINNY S		short	450° C 3.5 m/min 400 N	500° C 3.0 m/min 600 N	500° C 2.0 m/min 800 N					480° C 3.5 m/min 400 N	500° C 3.0 m/min 500 N	500° C 2.0 m/min 600 N			500° C 2.5 m/min 400 N	550° C 2.5 m/min 500 N	600° C 2.5 m/min 600 N			
		long				550° C 2.0 m/min 800 N	550° C 1.8 m/min 1000 N						500° C 2.5 m/min 600 N	550° C 2.0 m/min 700 N				550° C 2.5 m/min 600 N	580° C 2.5 m/min 700 N	000° C 2.0 m/min 800 N
TWINNY T		short	420° C 3.2 m/min 400 N	500° C 3.0 m/min 600 N	500° C 2.0 m/min 800 N					450° C 3.2 m/min 400 N	500° C 3.0 m/min 500 N	500° C 2.0 m/min 600 N			500° C 2.5 m/min 400 N	550° C 2.5 m/min 500 N	560° C 2.3 m/min 600 N			
		long				550° C 2.0 m/min 800 N	550° C 1.8 m/min 1000 N						500° C 2.5 m/min 600 N	550° C 2.0 m/min 700 N				550° C 2.5 m/min 600 N	550° C 2.5 m/min 800 N	560° C 2.0 m/min 1000 N

UNIROOF (Tacking)

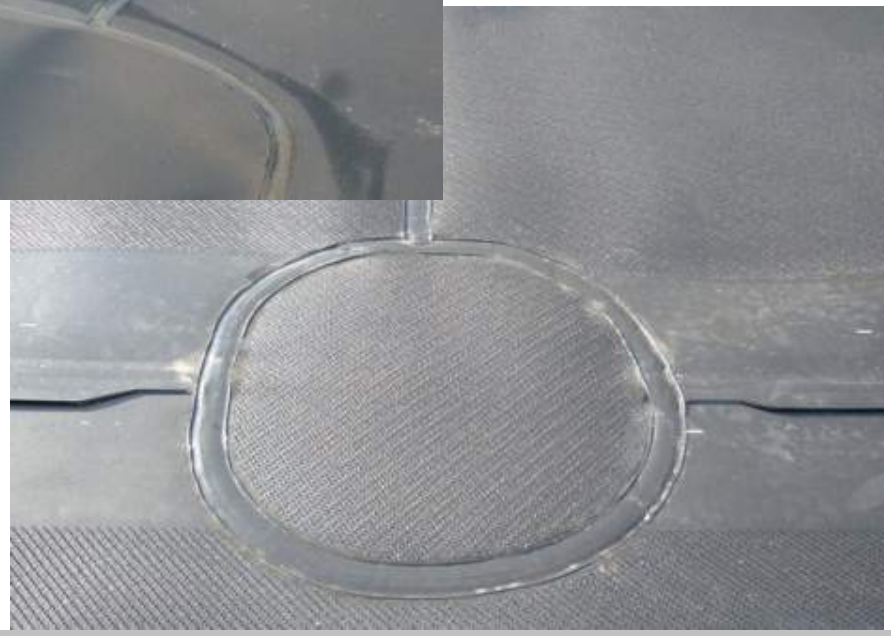
- For tacking of membranes as a preparation for long extrusionsweldings
- For welding of covers
- Fast and safe
- Professional



Handextruder

- FUSION 3
- WELDPLAST S6
- WELDPLAST S4
- WELDPLAST S2

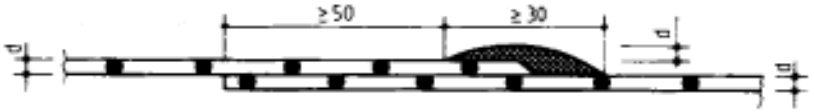
Application



Extrusions welding

Connections and drainages

Repair badge



Coating weld (extrusion welding)

Extrusions welding

- Test welding landfil

LEISTER-Extruder

Weldplast S2

Weldplast S2 TPO/FPO

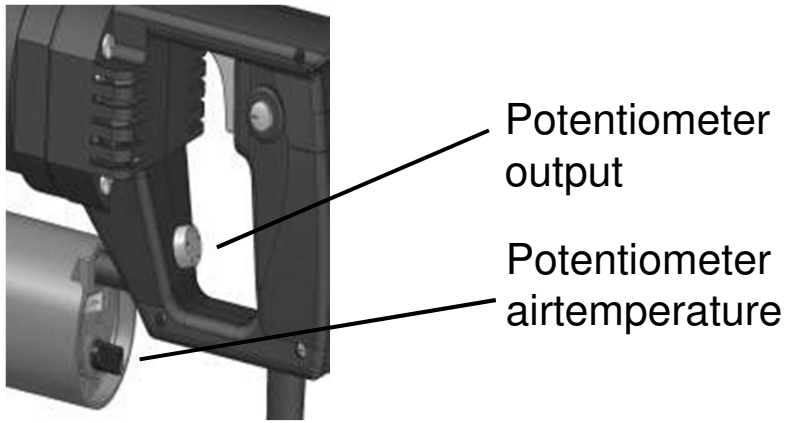
Fusion 3

Weldplast S4

Weldplast S6

Extrusion Welding
FUSION 3

- **Compact and handy**
- **Very simple handling**
- **Unique price/performance ratio**
- **Protection of drive with overload and temperature protection**
- **Welding shoe 360 degrees swiveling**
- **output**
  PE (3mm) 1.6 – 2.3 kg/h
  PE (4mm) 2.0 – 3.5 kg/h
  PP (3mm) 1.3 – 2.0 kg/h
  PP (4mm) 1.5 – 2.7 kg/h
- **weight 7.2kg**
- **dimension 670 x 90 x 180 mm**
- **Delivery in a strong case**



WELDPLAST S6

- Very high output with 6kg/h
- Extremely strong preheat
- Ergonomic “steering wheel” handle
- Also for Tool rest
- Digital control of welding parameter
- Compact housing
- Protects electronics, motor & mechanics in rough conditions
- Security through restart protection
- User friendly
- Maintenance free blower unit
- CE Conformity, Tested externally by SEV (official certification body by IEC)
- Extrem strong carring box

WELDPLAST S4

- Digital close loop control and read out of plast and air
- Multifunctional display
- Maintenance-free blower
- DVS und CE-Conform
- Twist free welding rod feed on both sides
- Output 4kg/h
- Gewicht 8.7 kg
- Dimension 560 x 110 x 300 mm
- Delivery in strong LEISTER-Case

WELDPLAST S2

- Closed-loop control for plast and pre-heating
- Multifunctional display
- Twist free welding rod feed on both sides
- 360° turnable welding shoe
- Stepless adjustable handle
- Electronic drive protection
- Maintenance-free blower
- Small and powerfull
- One push settings for common materials
- Free configurable menus

LEISTER

Semi automatic and hand tools

Hand Tools – Semi Automatic Welding Tools

TRIAC PID

TRIAC S

TRIAC DRIVE

TRIAC DRIVE – Application

- Horizontal, vertical, diagonal
- Different welding seam widths
- Applicable in the most confined spaces
- Ideal job for diagonal connections in a tunnel

Civil Engineering

Triac Drive for sealing strips

TRIAC S / PID – Application

Overlap welding of connections with TRIAC PID (PVC-P or modified PE)

Tacking of HDPE membrane prior to extrusion welding

Test equipment

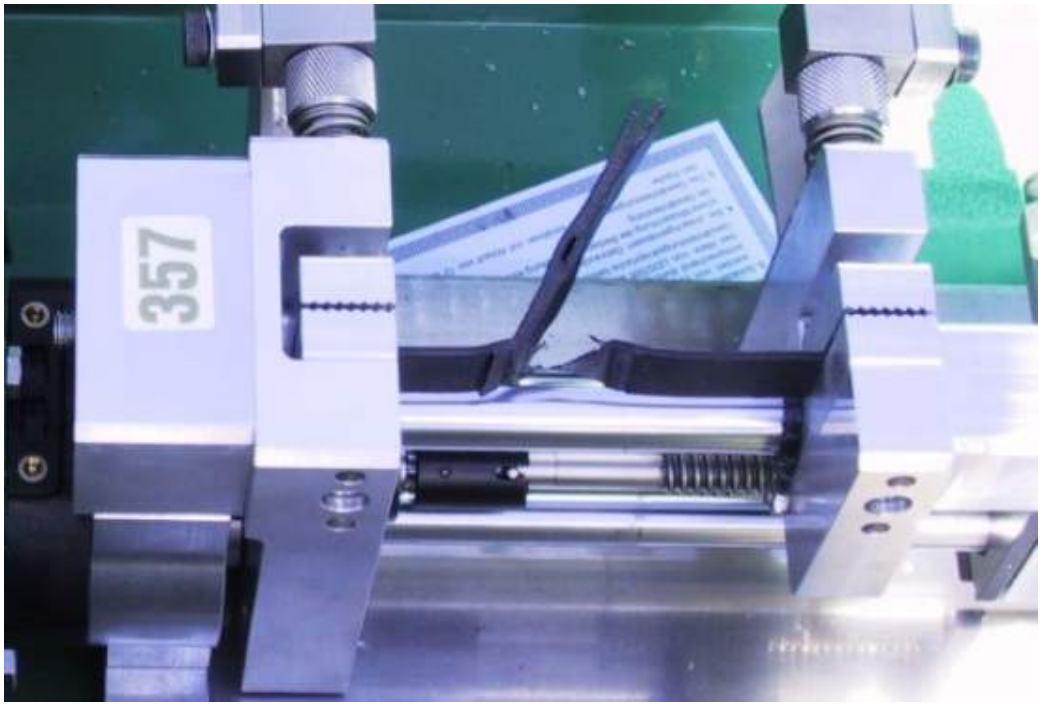
- EXAMO
- EXAMO USB
- AIRPRESSURE TEST
- VAKUMTESTING

EXAMO for peeling, tensile and shearing tool

- Portable and designed for construction site conditions
- USB-Data-Recording
- Optional for geotextiles
- Calibration-KIT availabel

Test Procedure: Test according DVS 2225 Part 2

Strength test (tensile test)



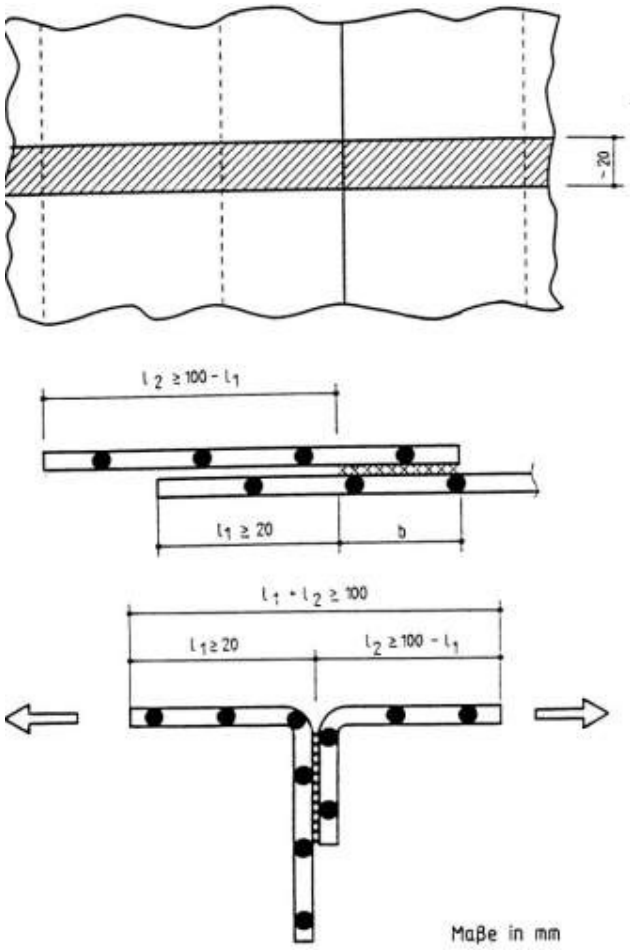
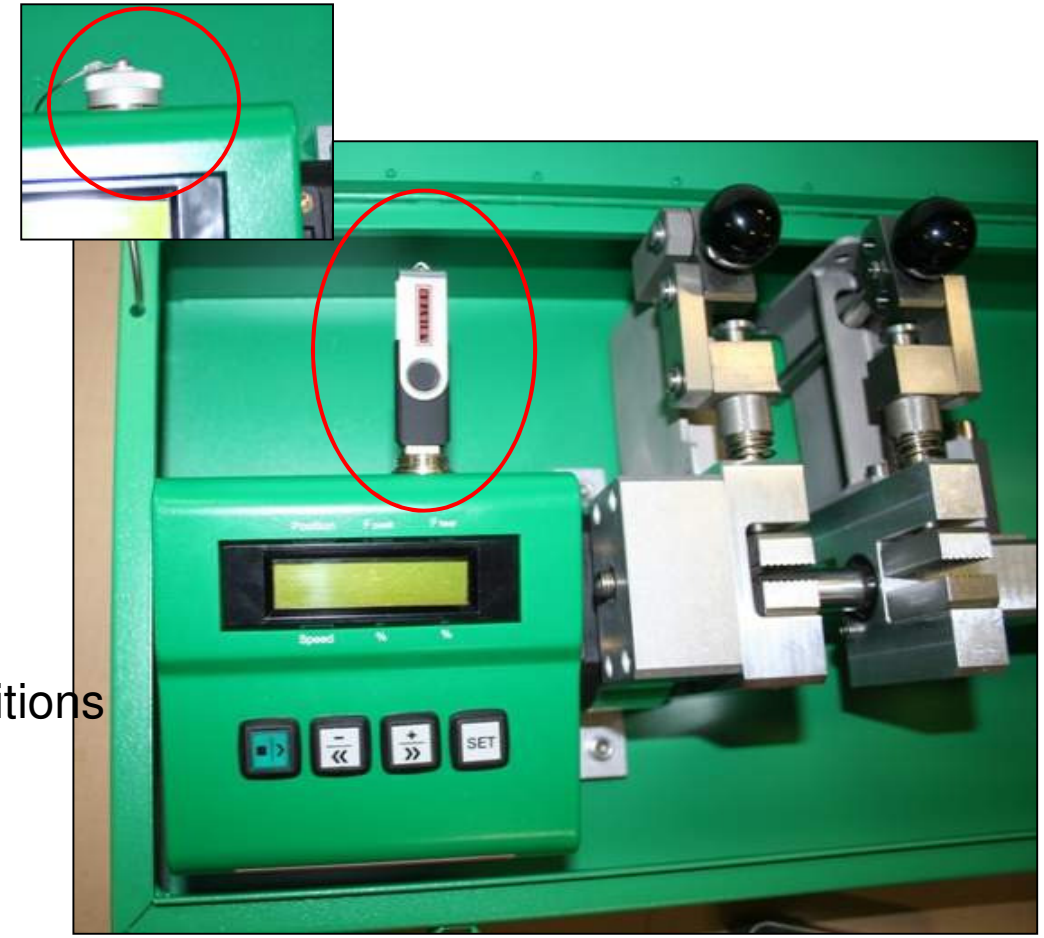


Bild 4. Probenahme und Beanspruchung beim Schälversuch.

EXAMO USB



- Recording of measurements values direct to USB-Memory stick
- Very easy to use
- Proved also under heavy duty conditions

EXAMO USB report

File-number: 0515-003

LEISTER Switzerland
EXAMO
Software Relase 2.0

Date: 15.05.2009
Time: 10:32:18
Speed= 2.0inch/min
Init.Length= 3.9inch
Init.Tension= 2lb

Strain [%]	F_PV [lb]	Speed_PV [inch/min]
0	12	0
0	6	1.96
1	10	1.96
2	12	1.96
3	16	1.96
4	17	1.96
5	20	1.96
6	21	1.96
7	24	1.96
8	24	1.96
9	26	1.96
10	26	1.96

487	65	1.96
488	66	1.96
489	65	1.96
490	66	1.96
491	66	1.96
492	66	1.96
493	65	1.96
FPeak:		
494	66	1.96
FTear:		
494	61	1.96

End of File

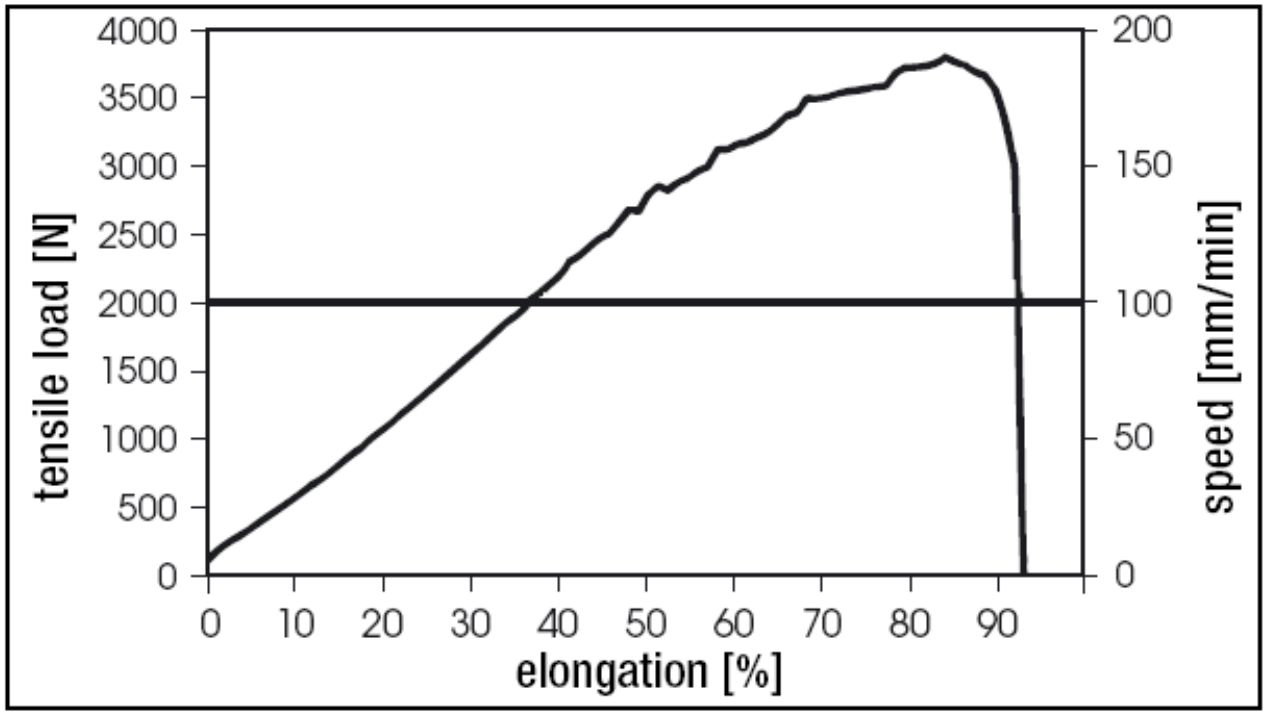
Name	Geändert am	Größe
0515-002	15.05.2009 10:03	7 KB
0515-003	15.05.2009 10:32	7 KB

Reporting of:

- Date, time
- Type, software-version
- File-number
- Start-parameters
- Tensile, elongation, speed
- Max. tensile, max. elongation

EXAMO USB visualisation

- It‘s very easy to make diagrams !



Test Procedure: Test according DVS 2225 Teil 2

Leak-tightness test (Testing with compressed air)

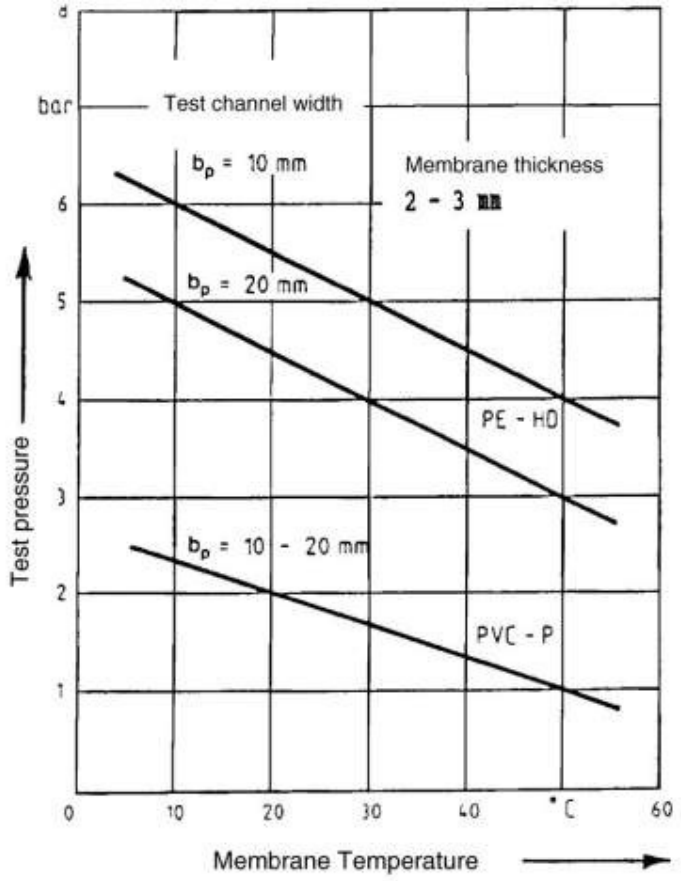


Figure 5. Test pressure as a function of the membrane temperature during the compressed air test.

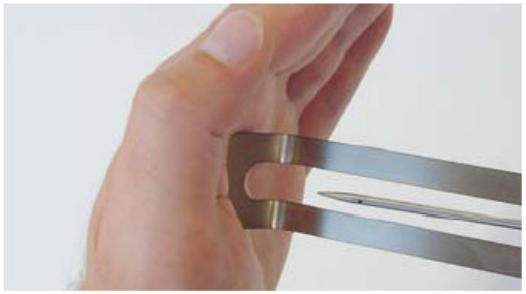
Test Procedure: Test according DVS 2225 Teil 2

- Easy and precise seam testing
- High security due to hand and needle protection
- Practical storage case

Article no.:

142.475	Air pressure test manometer with testing needle
142.569	Spare needle

Included in delivery are storage case and o-rings



More security for user and device:
hand and needle protection

Easy and precise non-destructive seam testing on the construction site

Vacuum bell

- **109.795 Vacuum bell Ø320mm**
- **For vacuum testing of T-connections and extrusionsweldings**

109.795	Vacuum bell Ø 320 mm

LEISTER

Promotion
Civil Engineering – Tunnel Construction

- Leaflet
- Flyer
- DVD‘s
- Success stories
- Poster

LEISTER Promotion

- **Posters**
- **Leaflet civil engineering**
- **Flyer WELDPLAST S6**
- **Flyer WELDPLAST S2**

LEISTER Promotion

- **Success stories**
- **www.LEISTER.com → down loads**

LEISTER Promotion

- **DVD COMET**

LEISTER Promotion

Internet

- Internet www.leister.com
- Data sheets
- Instruction manuals
- youtube videos

Extranet

- Product- and application pictures
- Leister Logos

Additional

- Leister Promotion in magazins
- Powerpoints

Many thanks for your attention!

FURRER Thomas
Product Manager Plastic Welding