Operating Instructions

GF 315
Butt Fusion Machine

GEORG FISCHER
PIPING SYSTEMS

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0 About this manual

The warning notices, symbols and their meanings as used in this manual are explained below to help you quickly understand the format of this instruction manual and how to use the machine safely.

0.1 Warning notice

Warning notices are used in this manual to inform you of possible injuries or damage to property. Please read them and always abide by these warnings!

Symbol	Meaning
 **Danger**	Imminent accute danger! Failure to comply could result in death or extremely serious injury.
 **Warning**	Possible accute danger! Failure to comply could result in serious injury.
Caution	Dangerous situation! Failure to comply could lead to injury or damage to property.

Warnings are always structured in the same manner:

- Warning symbol
- Type and source of danger
- Possible consequences, explanation of danger
- Prohibited (if applicable) (symbol: ⃠)
- Ways to prevent the danger (symbol: ▶)

0.2 Other symbols and notices

Symbol	Meaning
Important	This notice contains especially important information.
Attention	
	Mandatory: you must observe this regulation.
1.	Call for action in a particular sequence. You must do something here.
▶	Single call for action. You must do something here.
▷	Call for action under certain circumstances. You must do something here if the condition beforehand has been fulfilled.

0.3 Abbreviations

Abbr.	Meaning
GF 315	Butt fusion machine d 90–315 mm
DVS	Deutscher Verband für Schweisstechnik (German Association of Fusion Technology)
HD-PE	High Density Polyethylene
PE	Polyethylene
PP	Polypropylene
PVDF	Polyvinylidene fluoride
PTFE	Polytetrafluorethylene
d	Pipe outer diameter

1 Safety instructions

The GF 315 Butt Fusion Machine (hereinafter referred to as GF 315) is designed according to the latest standards of technology. Using it for purposes other than those described in this manual may cause injury to the operator or to others. It may also cause damage to the machine or other equipment.

Any person in the company, who is involved in the assembly, disassembly, reassembly, installation, operation or maintenance (inspection, maintenance work, repair work) of the GF 315, must have read and understood the complete instruction manual, and in particular Section 1 on "Safety instructions".

It is recommended that the user has this confirmed in writing.

Thus:

- The machine should only be used when in perfect working order.
- Always follow the safety instructions.
- Complete documentation should be kept in the vicinity of the machine.

1.1 Proper use

The GF 315 is to be used exclusively for the fusion of pipes and fittings made of PE, PP and PVDF.

1.2 General safety measures

- Use only the materials and dimensions specified in this manual. Other materials may only be used after consulting Georg Fischer Omicron after-sales service.
- Use only original Georg Fischer Omicron spare parts and equipment.
- Inspect the GF 315 daily for visible signs of damage or defects. Have damage or defects repaired immediately.
- Any work on the electrical equipment may only be done by a specialist.

1.3 Working with safety in mind

"Make your contribution to safety in the workplace."

- Report any deviations from normal operation immediately to the person in charge.
- Always keep safety in mind while working.

For your own personal safety as well as for the safe and optimal handling of the machine, the GF 315 must be installed correctly.

Connect hydraulic hoses to and from the machine only when the hydraulic unit is shut off and not under pressure (observe manometer).

Warning

Danger of cutting hands!

The planer blades are sharp!

Danger of cutting hands on the planer disk.

⦸ Do not touch the rotating planer disk.

Warning

Danger of burning!

The heater is hot (210 °C)!

Danger of burning hands on the hot heater.

⦸ Do not touch the heater when on.

▶ Use the handles on the heater.

Warning

Danger of crushing hands!

The machine slide moves!

Danger of injury to hands in the moving machine slide!

⦸ Do not reach into the machine when moving to the end positions.

1.4 Disposal

- Shavings and used hydraulic oil should be disposed of properly.

1.5 Further safety guidelines

Observe all the regulations, standards and guidelines applicable in your country.

2 General

2.1 Introduction

This instruction manual was written for those persons responsible for the operation and care of the GF 315. It is expected and assumed that such persons have read, understood and will abide by the manual in its entirety.

Only with the knowledge contained in this manual can faults on the GF 315 be prevented and trouble-free operation be ensured. It is therefore imperative that the responsible persons are familiar with this manual.

We recommend that this manual be read carefully prior to putting the machine in operation, as we are not liable for any damage or interruptions in operation resulting from failure to comply with this manual.

Should problems nevertheless arise, please contact the nearest **Georg Fischer Omicron** representative.

This manual applies only to the GF 315.

We reserve the right to make the technical changes necessary to improve the GF 315 which may result in deviations from the illustrations and information contained in this manual.

2.2 Range of application

The GF 315 is designed exclusively for the fusion of plastic pipes, fittings and valves in the dimension range d 90–315 mm. Any other use is not authorized. The manufacturer cannot be held liable for damages resulting from unauthorized use; the user bears sole responsibility.

2.3 Copyright

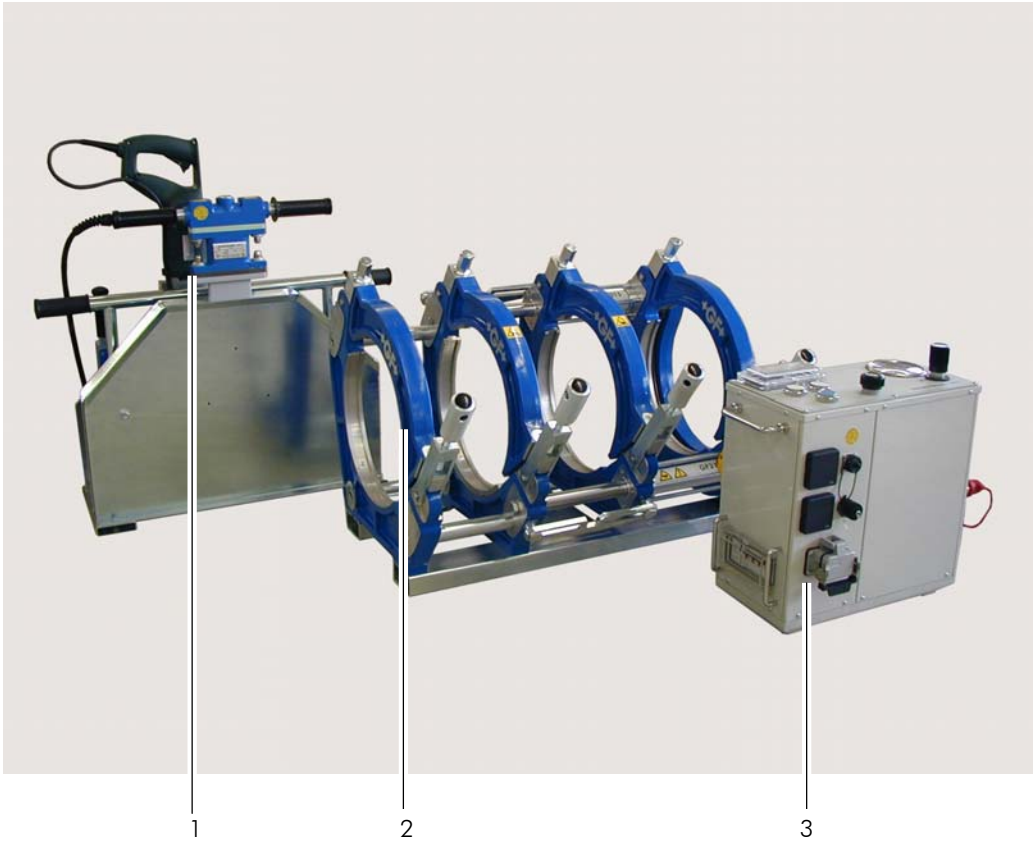
Georg Fischer Omicron S.r.l
Via E. Fermi, 12

I 35030 Caselle di Selvazzano
Padova (**Italy**)

Telephone +39 049 8971411
Fax +39 049 633324

3 Product design, equipment

3.1 Design



1 Storage case with heater and planer
2 Basic machine
3 Hydraulic unit

3.2 Standard equipment

- **Base machine**
  - Hardened and hard chrome-plated guide shafts
  - Removable outer left clamping station for clamping of T- fittings and special assemblies
  - Heater release mechanism to optimize the changeover phase
  - Tool and wrench set

- **Hydraulic unit**
  - Precise hydraulic control unit for a consistent setting of the fusion pressure
  - Easy accessible FI- Safety switch
  - Interface for SUVI 50 data recording device (optional)
  - Three integrated connecting plugs (planer, heater, spare plug)

- **Storage case with heater and planer**
- **Heating element**
  - PTFE-coating
  - Power cord 4 m
  - Temperature gauge
  - Electronic temperature controller
- **Electric planer**
  - Worm drive
  - Stop mechanism for safety
  - Safety microswitch to prevent unintentional start-up
  - Planer blades sharpened on both sides

- **Hydraulic hose package**
  - With anti-drip, rapid-action couplings

4 Technical specifications

Planer	Power:	Electromotor 800 W
	Voltage:	230 V/115 V
Heater	Power:	3000 W
	Voltage:	230 V/115 V
Hydraulic unit	Power:	360 W; 3.5 A
	Voltage:	230 V/115 V
	Oil type:	Viscosity 46
		2 liters of hydraulic oil in canister, Code No. 790 112 409
Machine complete	Power:	4170 W
	Voltage:	230 V/115 V

4.1 Characteristic data

Machine description:

Plastic butt fusion machine	
Machine type	GF 315
Machine no.	.....
Total piston area	510 mm^2
Maximum pressure	200 bar
Weight of basic machine	60 kg
Weight of hydraulic unit	30 kg
Weight of planer	18 kg
Weight of heater	12 kg
Noise level	70 dB(A)

5 Transport and assembly

5.1 Packaging

A decisive factor in the choice of packaging is the means of transport. Normally, the machine and all the accessories are delivered in a cardboard box on a pallet.

5.2 Sensitivity

Special care must be taken when transporting the GF 315 in order to prevent damage from impact or improper loading and unloading.

All movable parts must be fixed in place.

Transport insurance should be provided for according to the type and duration of transport. Condensation due to large temperature fluctuations and sharp jolts during shipment should be avoided.

Please handle the GF 315 with care.

5.3 Intermediate storage

If the GF 315 is not used immediately upon delivery, the machine must be stored in a safe place and properly covered.

5.4 Scope of delivery

The contents (number of tranport crates, pallets, packages) and their condition should be checked immediately upon receipt. Any damage and/or missing parts should be noted right away on the bill of lading and reported to Georg Fischer Omicron S.r.l. without delay.

6 Fusion preparation

6.1 General information

Chapter 6, Fusion Preparation, and Chapter 7, The Fusion Process, are based on the instruction sheets and guidelines issued by the DVS.

The fusion area should be protected against the influences of weather (humidity, ambient temperature <+ 5 °C, extreme direct exposure to sun) with such measures as pre-warming the fusion materials, tents, heating.

For optimal use of the GF 315, operating personnel should be specially trained by Georg Fischer. In-depth knowledge of the machine and it´s components and competence rule out handling errors thereby also preventing faulty fusion joints.

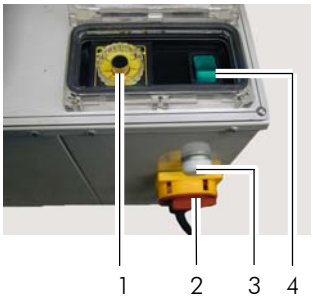
6.2 Preparations

Replace the heater if the PTFE -coating is damaged. Failure to comply could impair the quality of the fusion weld, see Chapter 9.1, pg. 30.

1. Connect heater and planer to the hydraulic unit.
2. Connect hydraulic unit to the power.

Caution **Check the voltage!**

▷ Main power (2) switch on. Control lamp (3) turns white.



3. Set temperature controller (1) to the correct fusion temperature. For guidelines, see the fusion tables in Chapter 7.5, from pg. 18.
4. Push heater switch (4). Switch turns green when heater on.

   Light on controller turns red during heating and starts blinking when setting temperature is reached.

Suggestion Before beginning with the first fusion, we recommend waiting approx. 10 minutes after the set fusion temperature has been reached to allow for even heat distribution.

5. Check the fusion surfaces with a quick-indication temperature measurement device for the set temperature.
6. Clean the couplings on the machine and the hoses.
7. Connect the hydraulic hoses to the machine and to the hydraulic unit.
8. If the hydraulic hoses are not used, seal the couplings with the protective caps. Clean the protective caps first.

7 Fusion

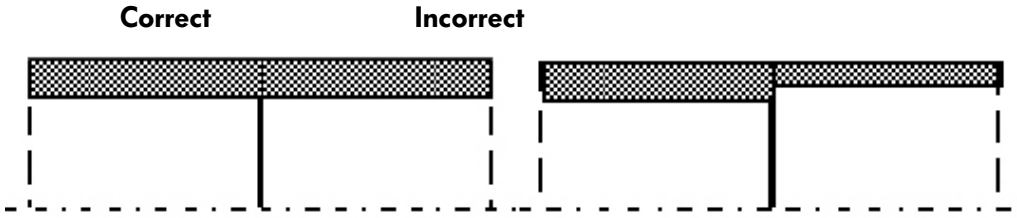
7.1 The basics of butt fusion

For butt fusion with a heating element, the parts to be joined (pipe/pipe, pipe/fitting or fitting/fitting) are heated to fusion temperature in the fusion area and are fused under pressure without the use of additional materials.

The heating element butt fusion joint must be done with a controllable equalization pressure. See pressure/time tables, Chapter 7.5, from pg. 18.

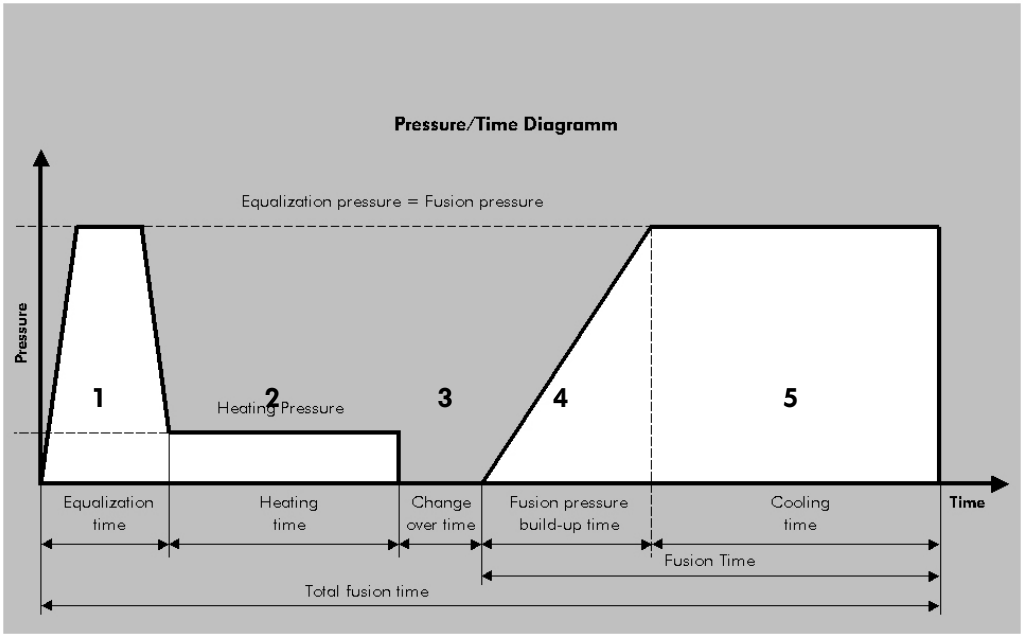
Attention Only the same type of materials are to fuse.

The wall thicknesses in the fusion area need to be the same.



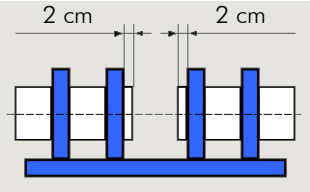
Only the same wall thicknesses in the fusion area!

Equalization- and fusion pressure are identical.
The heat soak pressure is significant lower, but the contact between the pipe/fitting and the heating element needs to be ensured.



7.2 The fusion process

In order to weld pipes and/or fittings d < 315 mm, insert matching clamping half shells and fasten them with the screws.



▶ Clamp pipe/pipe, pipe/fitting or fitting/fitting in the clamping element.
Pipe and/or fitting ends need to reach out at least 2 cm from the pipe clamps in order to perform a proper weld. Make sure they are exactly aligned in the axial direction.

If necessary, the pipes/fittings can be turned or the clamping force changed with the knurled handles to achieve a better clamping position.

Adjustable roller supports or a floating suspension assist horizontal movement of the pipes clamped in the slide.

7.2.1 Calculating drag pressure

Warning

Danger of crushing hands!

Machine slide moves!

Danger of injury in the moving machine slide!

⦸ When moving to the end positions do not reach into the machine.

The machine drag pressure must be calculated before each new fusion.

Fine adjustment pressure valve

9. Open machine to stop.
10. Reduce pressure with the fine-adjustment pressure valve (turn counter-clockwise).
11. Increase pressure with the fine-adjustment pressure valve (turn clockwise) while simultaneously pressing the push button “close >< ” direction.
12. Check the movement pressure on the manometer. As soon as the machine slide moves evenly.

7.2.2 Preparing the fusion surfaces

Warning

Danger of cutting hands!

Sharp planer blades!

Danger of injury to hands if the planer disk is touched.

⦸ Do not touch the rotating planer disk.

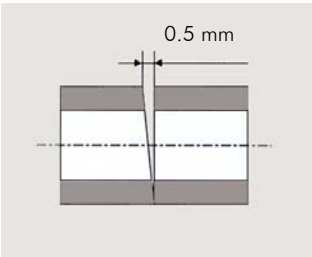
▶ Snap in the safety lock.

1. Open the machine by pressing the push button “open <>”.
2. Insert planer. Safety mechanism locks automatically. This prevents the planer unit from jumping out of the machine during planing.

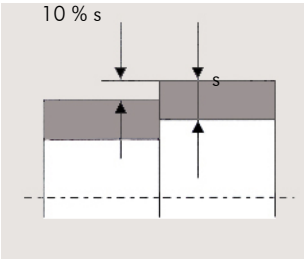
Caution **Constant high pressure when facing, can cause damage on the drive and/or the motor of the facer.**

3. Plane the facing surface of pipes/fittings until shavings are turned out in ribbons which are the same width as the pipe wall thickness. The max. planer pressure is 10 bar above the drag resistance.

To make sure the gap and the wall offset are in order, both sides must always be planed!



4. Switch facer off.
5. Open the machine by pressing “open<>”.
   ▷ Remove facer of the machine and place in the case.
6. Close machine until pipes/fittings. Touch each other.
7. Check the gap between the pipes: Maximum tolerance of the gap is 0.5 mm.



8. Check the alignment at the same time.
9. The wall offset on the outside may not exceed 10 % of the wall thickness.
10. If it is larger, the pipe/fitting can be turned or the clamping force on the inner clamping units can be changed to achieve a better clamping position.
11. In this case, the fusion surfaces need to be remachined.
12. Remove shavings which have fallen into the pipe e.g with a brush. Before each fusion, the fusion surfaces must be cleaned with lint-free paper and grease-free cleaner, e.g. industrial alcohol (Tangit KS).

Attention **Never touch the fusion surfaces with your hand after cleaning!**

7.2.3 Calculating of the fusion pressure

Attention **The fusion pressure is the sum of the “table value + movement pressure”**

(e.g. 31 bar* + 6 bar = 37 bar)

* for HD–PE d 200 mm, SDR 11see Chapter 7.5, pg. 18, Time/Pressure diagram

7.2.4 Adjusting of the fusion pressure

1. Reduce pressure with the fine-adjustment pressure valve (turn counter-clockwise).
2. Press the "close >< " button and increase pressure on the pressure valve (turn clockwise) until clamping carriage moves smoothly.
3. Adjust fusion pressure with the fine adjustment pressure valve as soon as both pipe ends are in contact (turn clockwise).

If the fusion pressure is set too high, re-adjust:

1. Open the machine by pressing the push button "open <>".
2. Turn the fine-adjustment pressure valve approx. 3 revolutions to the left.
3. Start fusion pressure again and set as described above.

7.2.5 Fusion process

The PTFE coating of the heating element must be protected from mechanical damage and/or dirt.
Heating element with demaged PTFE -covering has to be replaced. Non-observance affects the quality of the joining, see Chapter 9.1, from pg. 30.

Warning

Danger of burning!

The heater is hot (210 °C)!

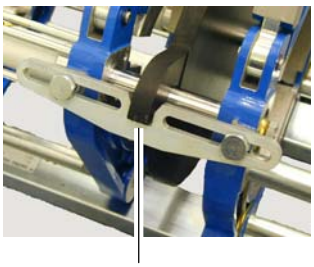
Danger of burning hands on the hot heater.

⦸ Do not touch the heater when on.

▶ Use the handles on the heater.

For fusion parameters, see Chapter 7.5, from pg. 18.

Equalization (fusion bead created on both sides)

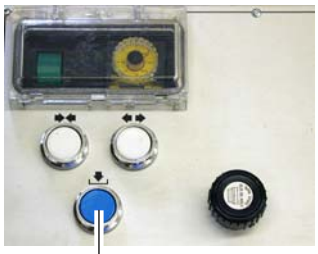


"pull off" device

1. Insert Heater into "pull off" device.
2. Move the parts to be joined together, by pressing the "close >< " button.
3. Until the preset pressure has been reached, remain in this position and hold 15 sec.

Equalization pressure = fusion pressure

Release (reduction of equalization pressure after formation of the fusion bead)



Pressure release button

1. After formation of the equalization bead around the entire pipe circumference (check fusion chart chapter 7.5, pg. 18), push blue button until pressure on manometer shows nearly 0.

Caution **Do not open the machine!**
Pipes have to keep contact with the heating element.

2. Start timer with preset heat soak time.

Change-over (removing the heating element)

The change-over time should be as short as possible.

When the heat soak has ended

▶ Push the "open <>" button as long as the heating element has no more contact to the pipes.

▷ Immediately remove the heating element from the machine.

Joining (Fusion process)

▶ Push the "close ><" button, position until pipes touch each other and the preset fusion pressure is reached. Hold this position for 15 sec.

The surfaces to be joined are fused.

▷ Place the heating element in the storage case without damaging or contaminating the fusion surfaces.

Cooling (the fusion joint)

Attention **The cooling time must always be observed.**
The use of cooling agents is not permitted during cooling.
During the cooling time the fusion pressure has to be supervised by the operator and if necessary readjusted!

Releasing (the hydraulic system) at the end of the complete cooling time

Warning

Danger of bruising!

Release the pressure of the hydraulic system before opening the clamping stations

1. Push blue pressure release button until pressure on manometers shows nearly 0.

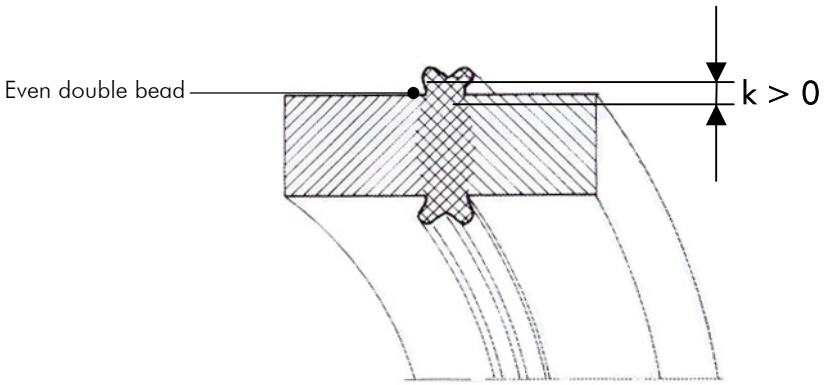
Caution **Do not open machine slides.**

2. Open clamping unit, remove welded pipes/fittings.

Caution **All fusion joints must have cooled completely before the pressure test is performed. This is generally the case approx. 1 hour after the last fusion operation.**

7.3 Visual check of welding bead

Immediately after removing the welded pipes/fittings visually check the part for correct cultivated double bead and the k-value.



7.4 Example

Pipe/fitting	PE	Heater temperature	210 °C
Pipe outer diameter	200 mm	Drag resistance	6 bar
Pressure rating	SDR 11	Table value	31 bar
Wall thickness	18.2 mm	Adjustment value on hydraulic unit	37 bar

Equalize with a pressure of 31 bar until a bead height of 2.0 mm results (column 1)

Heat soak for 182 sec with a pressure of 0.02 N/mm^2 (column 2)

Change-over within max. 8–10 sec (column 3)

Join for max. 11 sec (column 4)

Cooling for 23 min (column 5)

7.5 Fusion data

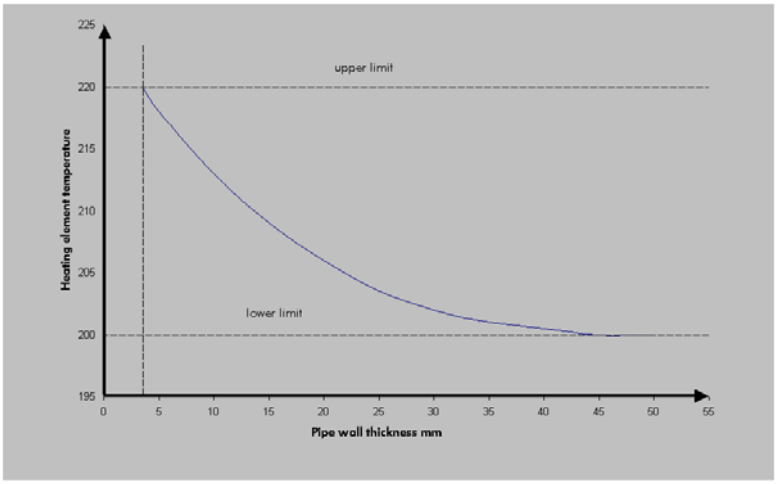
Heating element butt fusion of HD-PE

Fusion table/DVS 2207/1 guidelines

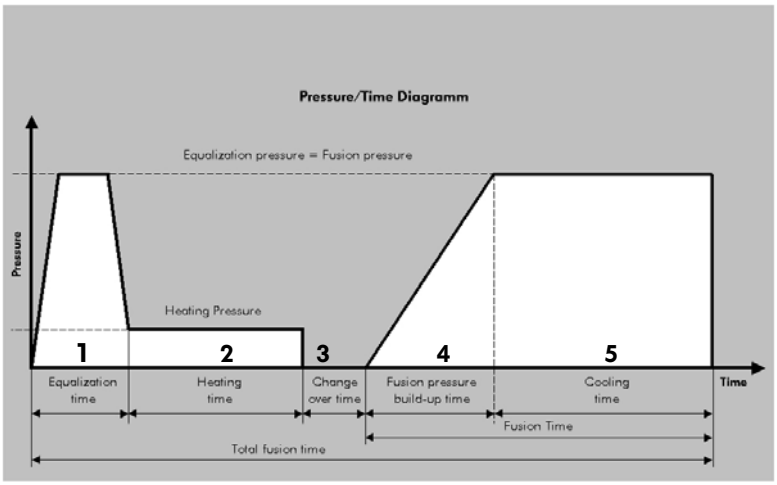
Heating element temperature 210 °C ± 10 °C

	1	2	3	4	5
Nominal wall thickness mm	**Equalize** Bead height on heating element after equalization (equalization at 0.15N/mm^2) mm (min.value)	**Heat soak** Heat soak time = 10 x wall thickness (heat soak at 0.02 N/mm^2) sec	**Change-over** sec (max. time)	**Join** Time until max pressure reached sec	**Cooling** Cooling time at fusion pressure p = 0.15 N/mm^2 ± 0.01 min (min.value)
up to 4.5	0.5	45	5	5	6
4.5 – 7.0	1.0	45 – 70	5 – 6	5 – 6	6 – 10
7.0 – 12.0	1.5	70 – 120	6 – 8	6 – 8	10 – 16
12.0 – 19.0	2.0	120 – 190	8 – 10	8 – 11	16 – 24
19.0 – 26.0	2.5	190 – 260	10 – 12	11 – 14	24 – 32
26.0 – 37.0	3.0	260 – 370	12 – 16	14 – 19	32 – 45
37.0 – 50.0	3.5	370 – 500	16 – 20	19 – 25	45 – 60
50.0 – 70.0	4.0	500 – 700	20 – 25	25 – 35	60 – 80

Curve for standard values for heater temperatures in relation to pipe wall thickness



Process steps for heating element butt fusion



Heating element butt fusion of HD-PE

Time/Pressure tables according to DVS 2207/1

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
S 20 SDR 41	Wall thickness	mm	–	–	3.1	3.5	4.0	4.4	4.9	5.5	6.2	6.9	7.7
	Fusion surface	mm^2	–	–	1187	1500	1960	2427	3003	3792	4748	5919	7432
	Equalization/fusion pressure	bar	–	–	4	5	6	7	9	11	14	18	22
	Bead height	mm	–	–	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.5
	Heating pressure	bar	–	–	1	1	1	1	1	2	2	2	3
	Heat soak time	sec	–	–	31	35	40	44	49	55	62	69	77
	Change-over time	sec	–	–	5	5	5	5	5	5	6	6	6
	Pressure build-up time	sec	–	–	5	5	5	5	5	5	6	6	6
	Cooling time	min	–	–	5	5	5	5	7	8	9	10	11

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
S 16 SDR 33	Wall thickness	mm	–	3.4	3.9	4.3	4.9	5.5	6.2	6.9	7.7	8.6	9.7
	Fusion surface	mm^2	–	1138	1484	1833	2387	3015	3775	4727	5861	7332	9303
	Equalization/fusion pressure	bar	–	3	4	5	7	9	11	14	17	22	27
	Bead height	mm	–	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.5	1.5	1.5
	Heating pressure	bar	–	1	1	1	1	1	1	2	2	3	4
	Heat soak time	sec	–	34	39	43	49	55	62	69	77	86	97
	Change-over time	sec	–	5	5	5	5	5	5	6	6	6	7
	Pressure build-up time	sec	–	5	5	5	5	5	6	6	6	6	7
	Cooling time	min	–	6	6	6	7	8	9	10	11	12	13

Heating Element butt fusion of HD–PE

Time/Pressure table according to DVS 2207/1

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	–	4.2	4.8	5.4	6.2	6.9	7.7	8.6	9.6	10.7	12.1
	Fusion surface	mm^2	–	1396	1812	2283	2995	3752	4651	5846	7250	9052	11513
	Equalization/fusion pressure	bar	–	4	6	7	9	11	14	18	22	27	34
S 12.5	Bead height	mm	–	0.5	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0
SDR 26	Heating pressure	bar	–	1	1	1	1	2	2	2	3	4	5
	Heat soak time	sec	–	42	48	54	62	69	77	86	96	107	121
	Change-over time	sec	–	5	5	5	6	6	6	7	7	8	8
	Pressure build-up time	sec	–	5	5	5	6	6	6	7	7	8	8
	Cooling time	min	–	5	7	7	9	10	11	12	13	15	16

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	4.1	5.0	5.7	6.4	7.3	8.2	9.1	10.3	11.4	12.8	14.4
	Fusion surface	mm^2	1106	1649	2136	2686	3502	4425	5457	6947	8545	10744	13598
	Equalization/fusion pressure	bar	3	5	6	8	10	13	16	20	25	32	40
S 10.5	Bead height	mm	0.5	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0	2.0
SDR 22	Heating pressure	bar	1	1	1	1	1	2	2	3	3	4	5
	Heat soak time	sec	41	50	57	64	73	82	91	103	114	128	144
	Change-over time	sec	5	5	5	6	6	6	7	7	8	8	9
	Pressure build-up time	sec	5	5	5	5	6	6	7	7	8	8	9
	Cooling time	min	6	6	7	8	10	11	13	14	16	17	19

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	4.3	5.3	6.0	6.7	7.7	8.6	9.6	10.8	11.9	13.4	15.0
	Fusion surface	mm^2	1158	1743	2243	2806	3684	4631	5742	7267	8901	11222	14136
	Equalization/fusion pressure	bar	3	5	7	8	11	14	17	21	26	33	42
S 10	Bead height	mm	0.5	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0	2.0
SDR 21	Heating pressure	bar	1	1	1	1	1	2	2	3	3	4	6
	Heat soak time	sec	43	53	60	67	77	86	96	108	119	134	150
	Change-over time	sec	5	5	5	6	6	6	7	8	8	8	9
	Pressure build-up time	sec	5	5	5	6	6	7	7	8	8	9	9
	Cooling time	min	6	7	8	10	10	12	13	15	16	18	19

Heating Element butt fusion of HD–PE

Time/Pressure table according to DVS 2207/1

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	5.1	6.3	7.1	8.0	9.1	10.2	11.4	12.8	14.2	15.9	17.9
	Fusion surface	mm^2	1360	2052	2629	3317	4314	5441	6754	8533	10518	13191	16706
	Equalization/fusion pressure	bar	4	6	8	10	13	16	20	26	31	39	49
S 8.3	Bead height	mm	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0
SDR 17.6	Heating pressure	bar	1	1	1	1	2	2	3	3	4	5	7
	Heat soak time	sec	51	63	71	80	91	102	114	128	142	159	179
	Change-over time	sec	5	6	6	6	7	7	8	8	9	9	10
	Pressure build-up time	sec	5	6	6	6	7	7	8	8	9	10	11
	Cooling time	min	7	9	10	11	13	14	16	17	19	20	23

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	5.4	6.6	7.4	8.3	9.5	10.7	11.9	13.4	14.8	16.6	18.7
	Fusion surface	mm^2	1435	2144	2734	3434	4491	5691	7032	8907	10935	13736	17406
	Equalization/fusion pressure	bar	4	6	8	10	13	17	21	26	32	40	51
S 8	Bead height	mm	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0
SDR 17	Heating pressure	bar	1	1	1	1	2	2	3	3	4	5	7
	Heat soak time	sec	54	66	74	83	95	107	119	134	148	166	187
	Change-over time	sec	5	6	6	6	7	7	8	8	8	9	10
	Pressure build-up time	sec	5	6	6	7	7	8	8	8	9	10	11
	Cooling time	min	8	9	10	12	13	14	16	18	19	21	24

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	6.7	8.1	9.2	10.3	11.8	13.3	14.7	16.6	18.4	20.6	23.2
	Fusion surface	mm^2	1753	2593	3347	4197	5494	6965	8557	10867	13387	16787	21267
	Equalization/fusion pressure	bar	5	8	10	12	16	20	25	32	39	49	63
S 6.3	Bead height	mm	1.0	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.5	2.5
SDR 13.6	Heating pressure	bar	1	1	1	2	2	3	3	4	5	7	8
	Heat soak time	sec	67	81	92	103	118	133	147	166	184	206	232
	Change-over time	sec	6	6	7	7	8	8	9	9	10	10	11
	Pressure build-up time	sec	6	6	7	7	8	9	10	10	11	11	11
	Cooling time	min	10	11	13	14	16	17	19	21	23	26	29

Heating Element butt fusion of HD–PE

Time/Pressure table according to DVS 2207/1

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	8.2	10.0	11.4	12.7	14.6	16.4	18.2	20.5	22.7	25.4	28.6
	Fusion surface	mm^2	2107	3141	4068	5078	6669	8429	10394	13170	16209	20315	25731
	Equalization/fusion pressure	bar	6	9	12	15	20	25	31	39	48	60	76
S 5	Bead height	mm	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.5	2.5	2.5	3.0
SDR 11	Heating pressure	bar	1	1	2	2	3	3	4	5	6	8	10
	Heat soak time	sec	82	100	114	127	146	164	182	205	227	254	286
	Change-over time	sec	6	7	8	8	9	9	10	10	11	12	13
	Pressure build-up time	sec	6	7	8	8	9	10	11	12	13	14	15
	Cooling time	min	11	14	15	17	19	21	23	26	28	31	35

	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	10.1	12.3	14.0	15.7	17.9	20.1	22.4	25.2	27.9	31.3	35.2
	Fusion surface	mm^2	2535	3775	4882	6130	7990	10096	12497	15817	19466	24454	30940
	Equalization/fusion pressure	bar	7	11	14	18	24	30	37	47	57	72	91
S 4	Bead height	mm	1.5	2.0	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0
SDR 9	Heating pressure	bar	1	1	2	2	3	4	5	6	8	10	12
	Heat soak time	sec	101	123	140	157	179	201	224	252	279	313	352
	Change-over time	sec	7	8	8	9	10	10	11	12	13	14	15
	Pressure build-up time	sec	7	8	9	10	11	12	13	14	15	16	18
	Cooling time	min	14	16	18	20	22	25	28	31	34	38	43

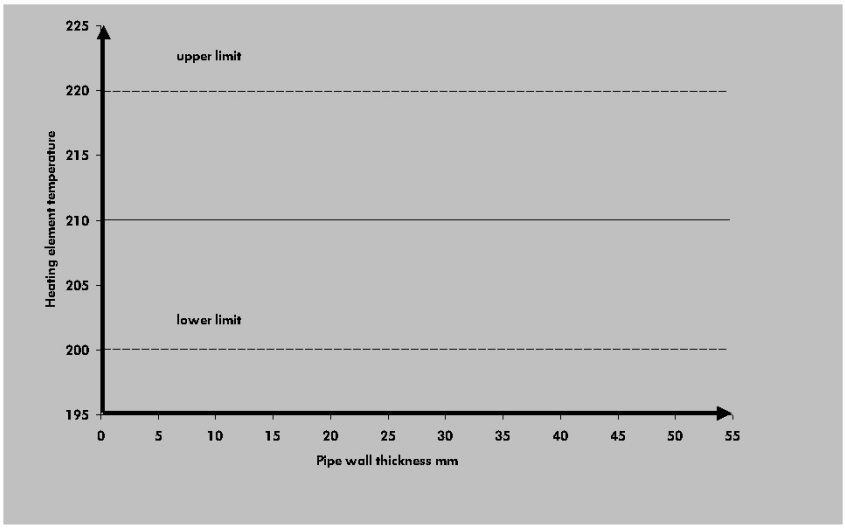
	Pipe outer diameter		**90**	**110**	**125**	**140**	**160**	**180**	**200**	**225**	**250**	**280**	**315**
	Wall thickness	mm	12.3	15.1	17.1	19.2	21.9	24.6	27.4	30.8	34.2	38.3	43.1
	Fusion surface	mm^2	3002	4502	5796	7286	9501	12009	14856	18790	23185	29080	36814
	Equalization/fusion pressure	bar	9	13	17	21	28	35	44	55	68	86	108
S 3.2	Bead height	mm	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0	3.5	3.5
SDR 7.4	Heating pressure	bar	1	2	2	3	4	5	6	7	9	11	14
	Heat soak time	sec	123	151	171	192	219	246	274	308	342	383	431
	Change-over time	sec	8	9	10	10	11	12	13	14	15	16	18
	Pressure build-up time	sec	8	9	10	11	12	13	14	16	18	19	22
	Cooling time	min	16	20	22	24	27	30	34	38	42	47	52

Heating element butt fusion of PP

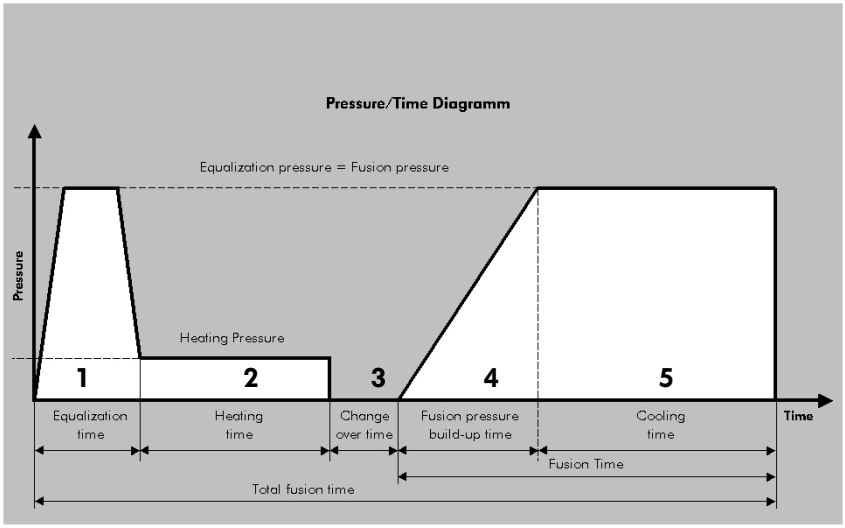
Fusion table/DVS 2207/11 guidelines
Heating element temperature 210 °C ± 10 °C

	1	2	3	4	5
Nominal wall thickness	**Equalize** Bead height on the heating element after equalization time (equalization at 0.10 N/mm²)	**Heat soak** (heat soak ≈ 0.01 N/mm²)	**Change-over**	**Join** Time until max pressure reached	**Cooling** Cooling time at fusion pressure (p = 0.10 N/mm² ± 0.01)
mm	mm (min.value)	s	s (max. time)	s	min (min.value)
up to 4.5	0.5	up to 135	5	6	6
4.5 – 7.0	0.5	135 – 175	5 – 6	6 – 7	6 – 12
7.0 – 12.0	1.0	175 – 245	6 – 7	7 – 11	12 – 20
12.0 – 19.0	1.0	245 – 330	7 – 9	11 – 17	20 – 30
19.0 – 26.0	1.5	330 – 400	9 – 11	17 – 22	30 – 40
26.0 – 37.0	2.0	400 – 485	11 – 14	22 – 32	40 – 55
37.0 – 50.0	2.5	485 – 560	14 – 17	32 – 43	55 – 70

Curve for standard values for heater temperatures



Process steps for heating element butt fusion



Heating element butt fusion of PP

Time/Pressure tables according to DVS 2207/11

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	–	–	–	–	4.0	4.4	4.9	5.5	6.2	6.9	7.7
	Fusion surface	mm^2	–	–	–	–	1960	2427	3003	3792	4748	5920	7433
S20	Equalization/fusion pressure	bar	–	–	–	–	4	5	6	7	9	12	15
SDR 41	Bead height	mm	–	–	–	–	0.5	0.5	0.5	0.5	0.5	0.5	1.0
	Heating pressure	bar	–	–	–	–	1	1	1	1	1	1	2
PN 2.5	Heat soak time	sec	–	–	–	–	120	132	141	151	162	173	185
	Change-over time	sec	–	–	–	–	5	5	5	5	6	6	6
	Pressure build-up time	sec	–	–	–	–	6	6	6	6	7	7	7
	Cooling time	min	–	–	–	–	6	6	7	8	10	12	13

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	–	–	–	4.3	4.9	5.5	6.2	6.9	7.7	8.6	9.7
	Fusion surface	mm^2	–	–	–	1833	2387	3015	3775	4727	5861	7332	9303
S 16	Equalization/fusion pressure	bar	–	–	–	4	5	6	7	9	11	14	18
SDR 33	Bead height	mm	–	–	–	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0
	Heating pressure	bar	–	–	–	1	1	1	1	1	1	1	2
PN 3.2	Heat soak time	sec	–	–	–	129	143	151	162	174	185	197	213
	Change-over time	sec	–	–	–	5	5	5	6	6	6	6	7
	Pressure build-up time	sec	–	–	–	6	6	7	7	7	8	8	9
	Cooling time	min	–	–	–	6	7	8	10	12	13	15	16

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	–	–	4.8	5.4	6.2	6.9	7.7	8.6	9.6	10.7	12.1
	Fusion surface	mm^2	–	–	1812	2283	2996	3752	4652	5846	7250	9052	11514
S 12.5	Equalization/fusion pressure	bar	–	–	4	5	6	7	9	11	14	18	23
SDR 26	Bead height	mm	–	–	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0
	Heating pressure	bar	–	–	1	1	1	1	1	1	1	2	2
PN 4	Heat soak time	sec	–	–	140	149	162	173	185	197	211	227	246
	Change-over time	sec	–	–	5	5	6	6	6	6	7	7	7
	Pressure build-up time	sec	–	–	6	6	7	7	8	8	9	10	11
	Cooling time	min	–	–	7	8	10	12	13	15	16	18	20

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	–	6.3	7.1	8.0	9.1	10.2	11.4	12.8	14.2	15.9	17.9
	Fusion surface	mm^2	–	2052	2629	3317	4314	5441	6754	8533	10519	13191	16706
S 8.3	Equalization/fusion pressure	bar	–	4	5	7	9	11	13	17	21	26	33
SDR 17.6	Bead height	mm	–	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Heating pressure	bar	–	1	1	1	1	1	1	2	2	3	3
PN 6	Heat soak time	sec	–	164	176	189	204	220	237	255	272	292	317
	Change-over time	sec	–	6	6	6	6	7	7	7	8	8	9
	Pressure build-up time	sec	–	7	7	8	9	10	11	12	13	14	16
	Cooling time	min	–	11	13	14	15	17	19	21	23	26	28

Heating element butt fusion of PP

Time/Pressure tables according to DVS 2207/11

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	8.2	10.0	11.4	12.7	14.6	16.4	18.2	20.5	22.7	25.4	28.6
	Fusion surface	mm^2	2107	3141	4068	5079	6669	8429	10394	13170	16209	20315	25731
S 5	Equalization/fusion pressure	bar	4	6	8	10	13	17	20	26	32	40	50
SDR 11	Bead height	mm	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	2.0
PN 10	Heating pressure	bar	1	1	1	1	1	2	2	3	3	4	5
	Heat soak time	sec	192	217	237	254	277	298	320	345	367	394	420
	Change-over time	sec	6	7	7	7	8	8	9	9	10	11	12
	Pressure build-up time	sec	8	9	11	12	13	15	16	18	20	22	24
	Cooling time	min	14	17	19	21	24	26	29	32	35	39	44

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	12.3	15.1	17.1	19.2	21.9	24.6	27.4	30.8	34.2	38.3	–
	Fusion surface	mm^2	3002	4502	5796	7286	9501	12009	14856	18790	23185	29080	–
S 3.2	Equalization/fusion pressure	bar	6	9	11	14	19	24	29	37	45	57	–
SDR 7.4	Bead height	mm	1.0	1.0	1.0	1.5	1.5	1.5	2.0	2.0	2.0	2.5	–
PN 16	Heating pressure	bar	1	1	1	1	2	2	3	4	5	6	–
	Heat soak time	sec	249	283	307	332	359	386	411	437	463	493	–
	Change-over time	sec	7	8	8	9	10	11	11	12	13	14	–
	Pressure build-up time	sec	11	14	15	17	19	21	23	26	29	33	–
	Cooling time	min	20	24	27	30	34	38	42	47	51	57	–

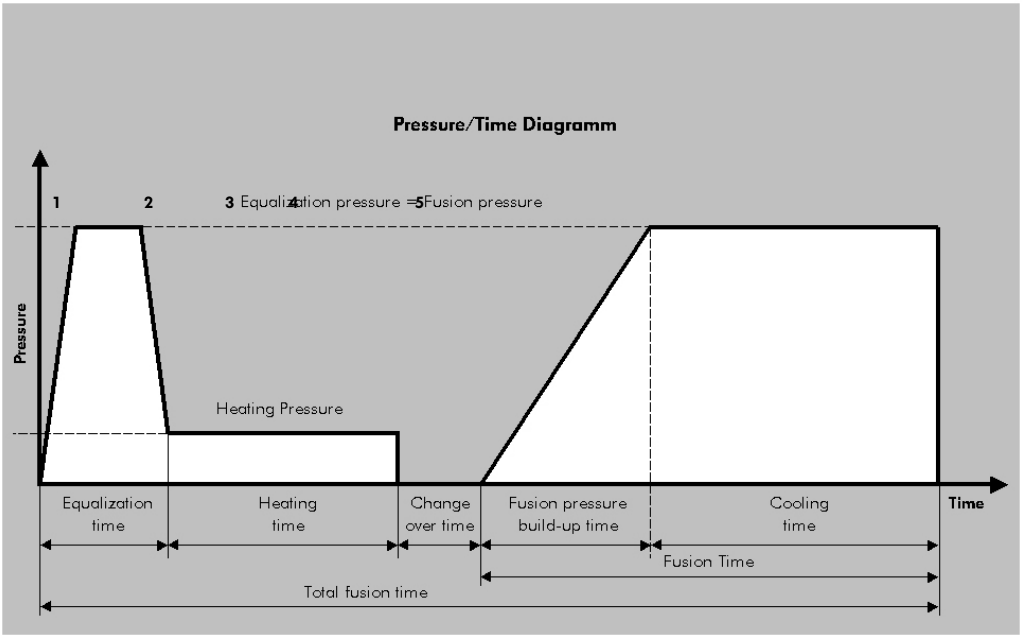
	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	15.0	18.3	20.8	23.3	26.6	29.0	33.2	37.4	–	–	–
	Fusion surface	mm^2	3534	5272	6809	8542	11147	13756	17396	22041	–	–	–
S 2.5	Equalization/fusion pressure	bar	7	10	13	17	22	27	34	43	–	–	–
SDR 6	Bead height	mm	1.0	1.0	1.5	1.5	2.0	2.0	2.0	2.5	–	–	–
PN 20	Heating pressure	bar	1	1	1	2	2	3	3	4	–	–	–
	Heat soak time	sec	281	322	348	373	405	423	456	487	–	–	–
	Change-over time	sec	8	9	10	10	11	12	13	14	–	–	–
	Pressure build-up time	sec	14	16	18	20	23	25	29	32	–	–	–
	Cooling time	min	24	29	33	37	41	44	50	55	–	–	–

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
	Wall thickness	mm	18.1	22.1	25.1	28.1	32.1	36.1	–	–	–	–	–
	Fusion surface	mm^2	4088	6102	7877	9878	12897	16319	–	–	–	–	–
S 2	Equalization/fusion pressure	bar	8	12	15	19	25	32	–	–	–	–	–
SDR 5	Bead height	mm	1.0	1.5	1.5	2.0	2.0	2.0	–	–	–	–	–
PN 25	Heating pressure	bar	1	1	2	2	3	3	–	–	–	–	–
	Heat soak time	sec	319	361	391	416	447	478	–	–	–	–	–
	Change-over time	sec	9	10	11	12	13	14	–	–	–	–	–
	Pressure build-up time	sec	16	19	21	24	28	31	–	–	–	–	–
	Cooling time	min	29	34	39	43	48	54	–	–	–	–	–

Heating element butt fusion of PVDF

Fusion table/DVS 2207/15 guidelines
Heating element temperature 240 °C ± 8 °C

	1	2	3	4	5
Nominal wall thickness	**Equalize** Bead height on the heating element after equalization time (equalization at 0.10 N/mm²)	**Heat soak** Heat soak time = 10 x wall thickness +40 s (heat soak ≈ 0.01 N/mm²)	**Change-over**	**Join** Fusion pressure build-up time	**Cooling** Cooling time at fusion pressure (p = 0.10 N/mm² ± 0.01) Cooling time = 1.2 x wall thickness + 2 min
mm	mm (min.value)	s	s (max. time)	s	min (min.value)
1.9 – 3.5	0.5	59 – 75	3	3 – 4	5.0 – 6
3.5 – 5.5	0.5	75 – 95	3	4 – 5	6.0 – 8.5
5.5 – 10.0	0.5 – 1.0	95 – 140	4	5 – 7	8.5 – 14
10.0 – 15.0	1.0 – 1.3	140 – 190	4	7 – 9	14.0 – 19



Heating element butt fusion of PVDF

Time/Pressure tables according to DVS 2207/15

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
PN 10	Wall thickness	mm	–	–	–	4.4	4.9	–	6.2	7.0	7.7	8.6	9.7
	Fusion surface	mm²	–	–	–	1874	2388	–	3773	4792	5861	7332	9303
	Equalization/fusion pressure	bar	–	–	–	4	5	–	7	9	11	14	18
	Bead height	mm	–	–	–	0.5	0.5	–	0.6	0.7	0.8	0.9	1.0
	Heating pressure	bar	–	–	–	0.4	0.5	–	0.7	0.9	1.1	1.4	1.8
	Heat soak time	sec	–	–	–	84	89	–	102	110	117	126	137
	Change-over time	sec	–	–	–	3	3	–	4	4	4	4	4
	Pressure build-up time	sec	–	–	–	4	4	–	5	5	6	6	6
	Cooling time	min	–	–	–	7	8	–	9	10	11	12	14

	Pipe outer diameter		90	110	125	140	160	180	200	225	250	280	315
PN 16	Wall thickness	mm	–	5.3	6.0	6.7	7.7	–	9.6	10.8	11.9	13.4	15.0
	Fusion surface	mm^2	–	1742	2243	2806	3684	–	5742	7267	8900	11222	14136
	Equalization/fusion pressure	bar	–	3	4	6	7	–	11	14	17	22	28
	Bead height	mm	–	0.5	0.6	0.7	0.8	–	1.0	1.0	1.1	1.2	1.3
	Heating pressure	bar	–	0.3	0.4	0.6	0.7	–	1.1	1.4	1.7	2.2	2.8
	Heat soak time	sec	–	93	100	107	117	–	136	148	159	174	190
	Change-over time	sec	–	3	4	4	4	–	4	4	4	4	4
	Pressure build-up time	sec	–	5	5	5	6	–	6	7	7	8	9
	Cooling time	min	–	8	9	10	11	–	14	15	16	18	20

8 Failure analysis

1. On **cracks parallel to or across the fusion** joint, check:
   – in the joint
   – in the heat flow zone
   – in the basic material
2. **Bead notches** traversing or local notches parallel to the joint with their roots in the basic material, due to
   – insufficient fusion pressure
   – heat soak time too short
   – cooling time too short
3. **Notches and grooves in the basic material**, running parallel to or across the joint, due to
   – clamping tools
   – improper transport
   – faulty fusion preparation
4. **Displaced fusion surfaces** due to
   – oval shaped pipe ends (improper storage of pipes!)
   – improper fastening in the clamps
5. **Angular deflection of fused components** due to
   – machine error
   – adjustment error
6. **Fusion bead is narrow, raised, sharp-edged**, over the entire or part of the joint circumference due to
   – incorrect fusion parameters
7. **Fusion bead is too wide or too narrow**, over the entire or part of the joint circumference due to
   – wrong heat soak time
   – wrong heater temperature
   – wrong fusion pressure
8. **Fusion bead is uneven** over the entire or part of the joint circumference due to
   – non-angular fusion surfaces

9. **Jointing error on the fusion surfaces**, over the entire or part of the joint circumference due to
   – dirty and/or oxidized fusion surfaces
   – change-over time too long
   – heater temperature too high/too low
10. **Cavities in the fusion surfaces** due to
   – insufficient fusion pressure
   – cooling time too short
11. **Single, very widespread** or local concentrations of pores due to
   – soiled heating element
   – vapors formed during fusion (water/solvents)

9 Maintenance

The GF 315 should be checked and cleaned periodically.

Normal care of the GF 315 is limited to periodic cleaning of the outside.

9.1 Replacement of worn parts

- **PTFE coating of the heating element:**

  Clots, cracks or other damage:

  – heating element needs to be recoated

  – send the heating element to the nearest service center or to the manufacturer.

Caution **Danger of injury!**

Sharp planer blades!

Danger of cutting if the planer blades, which are sharp on both sides, are touched.

- The planer blades on the planer should be replaced periodically.
  For order number see spare parts list.

9.2 Hydraulic system

- The hydraulic connections on the machine and on the hydraulic unit need regular cleaning.
- When not in use, the hydraulic connections on the GF 315 and on the hydraulic unit should be protected with the protective caps.

9.3 Hydraulic unit

Maintenance

- **Oil level check**

  Check the hydraulic oil level regularly.
  If necessary, refill the hydraulic oil according to Chapter 4, pg. 9.

- **Changing the hydraulic oil**

  After 3000 operating hours hydraulic oil need to be changed.

Oil filler neck

1. Let off the old hydraulic oil.
2. Pour in 2 liters of new hydraulic oil.

Attention Dispose of used, dirty oil properly.

Service booklet We recommend having a service booklet to record maintenance work for each GF 315 machine.

Example:

Date	Service	Repair	Comments
15.09.2004	GFO		Everything OK
25.10.2005	GFO	Heater	Cable replaced

10 Customer Service

There is a separate spare part list for ordering replacement parts.

If repairs are necessary, please contact your local representative.

Please indicate the following information:

- Machine type GF 315
- Machine no. (see type plate)

+GF+

GEORG FISCHER
PIPING SYSTEMS

Georg Fischer Omicron S.r.l.
Via Enrico Fermi, 12
I 35030 Caselle di Selvazzano (Padova) – Italy
Tel.: +39 49 89.71.411 - Fax: +39 49 63.33.24
Internet: http//www.georgfischer-omicron.com e-mail: omicron.ps@georgfischer.com