

BRUGG

Pipes

FLEXWELL®-LPG

Pipe Systems for Petrol Stations
Technical Details



**PIONEERS IN
INFRASTRUCTURE**

FLEXWELL®-LPG Pipe Systems for Petrol Stations

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FLEXWELL®-LPG Pipe Systems for Petrol Stations

System description

FLEXWELL®-LPG is a single walled flexible pipe system suitable for automotive LPG (Autogas) installations of service stations in both vapour and liquid phase.

LPG's main constituents are Propane (C₃H₈) and Butane (C₄H₁₀) which have different boiling points : -42 °C for propane and -1 °C for butane. The actual mixture of propane and butane of any automotive LPG marketed varies considerably from one country to another, depending on their sources of LPG.

The mix of propane and butane has a profound impact on design requirements of LPG fuelling components; the one for a propane only mix being the most stringent. The selection of the material depends on the minimum temperatures, which can occur during failure of the equipment, and has been carried out in accordance with the european Pressure Equipment Directive PED 2014/68/EG.

FLEXWELL®-LPG Piping is designed for operating temperatures from -50 °C up to +60 °C and operating pressures of PN 25 (360 PSI).

System advantages

- fast and simple to install without welding and x-raying of welds on site
- no downtime and only minimal interruptions to petrol sales on retrofits
- the most cost effective pipe system

Application

Typically FLEXWELL®-LPG Piping is used as an underground or above ground liquid feedline and vapour return between the LPG storage tanks and the liquid gas dispenser in fuelling stations.

Construction

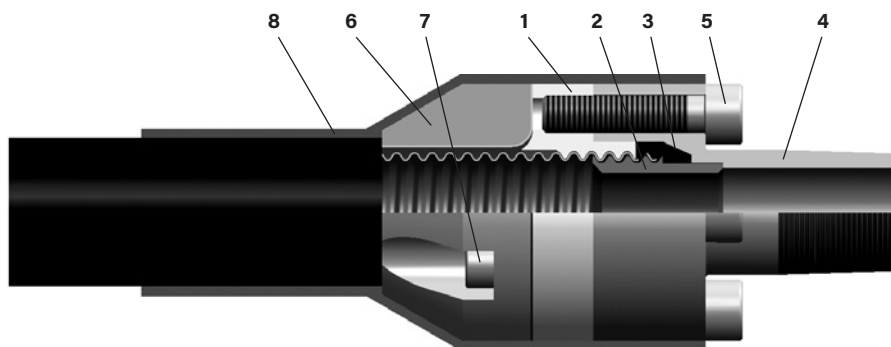
The flexible composite pipe has a helically corrugated primary pipe. This is manufactured of EN 1.4404 stainless steel (US equivalent: AISI TP 316 L) and has excellent corrosion resistance characteristics as a result. Around this carrier pipe, high-strength reinforcing bands are fitted, which effectively limit longitudinal expansion even at high operating pressures. Corrosion protection for buried installation in the ground is afforded by an external PE-LD jacket.

Installation

FLEXWELL®-LPG Piping is manufactured in standard factory lengths up to 700 m. The pipework is supplied on a cable reel or coil allowing it to be run directly off the reel or coil into position in the pipe trench. The corrugated primary pipe and the helically fitted reinforcing bands give this piping system remarkably good flexibility and ease of laying. FLEXWELL®-LPG pipework can be cut to the required length on site and, as necessary, bent through very tight angles to run around, under or over existing services.

Type testing, approvals

- Certificate for pressure equipment acc. to directive PED 2014/68/EU Module A2, CE 0045, KIWA BRL-K780/04
- TÜV-Nord, Germany, report to burst pressure testing of FLEXWELL® end couplings with graphite sealing




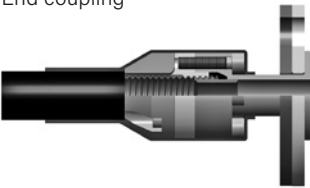

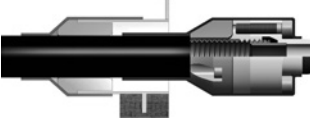


- 1 pressure ring
- 2 core piece
- 3 graphite sealing
- 4 connecting piece with thread
- 5 cylindrical screw
- 6 clamping ring
- 7 cylindrical screw
- 8 heat shrink tube

FLEXWELL®-LPG Pipe Systems for Petrol Stations

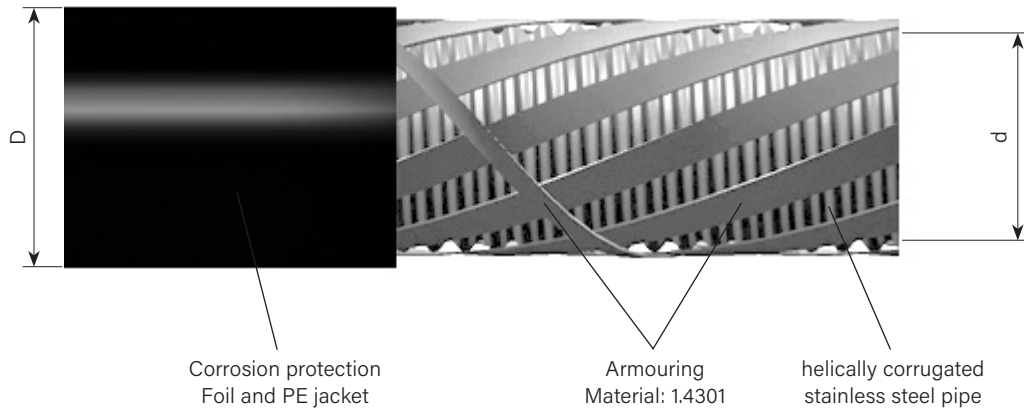
Product scheme

Pipelines, end couplings, straight couplings, steel ducts

| Execution | Type LPG | Nominal diameter | Pressure PN | Connection connection method remarks | Material No. | Work- sheet | |
|--|-------------|---------------------|----------------|---|--|--|-----------|
| Pipeline  | 22/33 | 20 | 25 | helically corrugated primary pipe armouring | 1.4404/1.4571 1.4301 | LPG 5.120 | |
| | 30/40 | 25 | | | | | |
| | 39/50 | 32 | | | | | |
| | 48/61 | 40 | | | | | |
| | 60/74 | 50 | | | | | |
| End coupling  | 22/33 | ¾" | 25 | with welding end up to -20 °C up to -50 °C | 25CrMo4 ST 52.3 (1.0570) CrNi 1.4404 | LPG 5.201 | |
| | 30/40 | 1" | | | | | |
| | 39/50 | 1 ¼" | | | | | |
| | 48/61 | 1 ½" | | | | | |
| | 60/74 | 2" | | | | | |
| End coupling  | 22/33 | ¾" | 25 | with NPT thread up to -50 °C | 25CrMo4 | LPG 5.211 | |
| | 30/40 | 1" | | | | | |
| | 39/50 | 1 ¼" | | | | | |
| | 48/61 | 1 ½" | | | | | |
| | 60/74 | 2" | | | | | |
| End coupling  | 30/40 | ¾" | | with NPT thread reduced | 25CrMo4 | LPG 5.221 | |
| | 39/50 | ¾" | | | | | |
| | 22/33 | 20 | 25 | with collar and split flange acc. to DIN EN 1092-1, PN 40 up to -50 °C | 25CrMo4 P355NL | | |
| | 30/40 | 25 | | | | | |
| | 39/50 | 32 | | | | | |
| | 48/61 | 40 | | | | | |
| | 60/74 | 50 | | | | | |
| | 22/33 | 20 | | with collar and split flange acc. to ANSI (300lb/B16.5) | 25CrMo4 P355NL | | |
| | 30/40 | 25 | | | | | |
| | 39/50 | 32 | | | | | |
| Straight coupling  | 22/33 | 20 | 25 | up to -50 °C | 25CrMo4 1.4571 | LPG 5.401 | |
| | 30/40 | 25 | | | | | |
| | 39/50 | 32 | | | | | |
| | 48/61 | 40 | | | | | |
| | 60/74 | 50 | | | | | |
| Steel duct  | 22/33 | 20 | | | 76.1 x 2.9 | split plastic spacer and heat shrink tube | LPG 5.515 |
| | 30/40 | 25 | | | 88.9 x 3.2 | | |
| | 39/50 | 32 | | | 114.3 x 3.6 | | |
| | 48/61 | 40 | | | 114.3 x 3.6 | | |
| | 60/74 | 50 | | | 139.7 x 4.0 | | |

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Petrol Station Pipeline



Material

Primary pipe: Material No. 14404/1.4571

| Type | DN | Dimensions | | Bending radius* | Weight | Volume | Article No. |
|-----------|----|------------|---------|-----------------|--------|--------|-------------|
| | | d mm | D mm | | | | |
| LPG 22/33 | 20 | 22.0 | 33 | 0.2 | 0.74 | 0.37 | 1014379 |
| LPG 30/40 | 25 | 30.0 | 40 | 0.2 | 0.94 | 0.80 | 1014380 |
| LPG 39/50 | 32 | 38.9 | 50 | 0.3 | 1.52 | 1.30 | 1014382 |
| LPG 48/61 | 40 | 48.5 | 61 | 0.4 | 1.94 | 2.00 | 1014384 |
| LPG 60/74 | 50 | 60.0 | 74 | 0.6 | 2.72 | 3.00 | 1014385 |

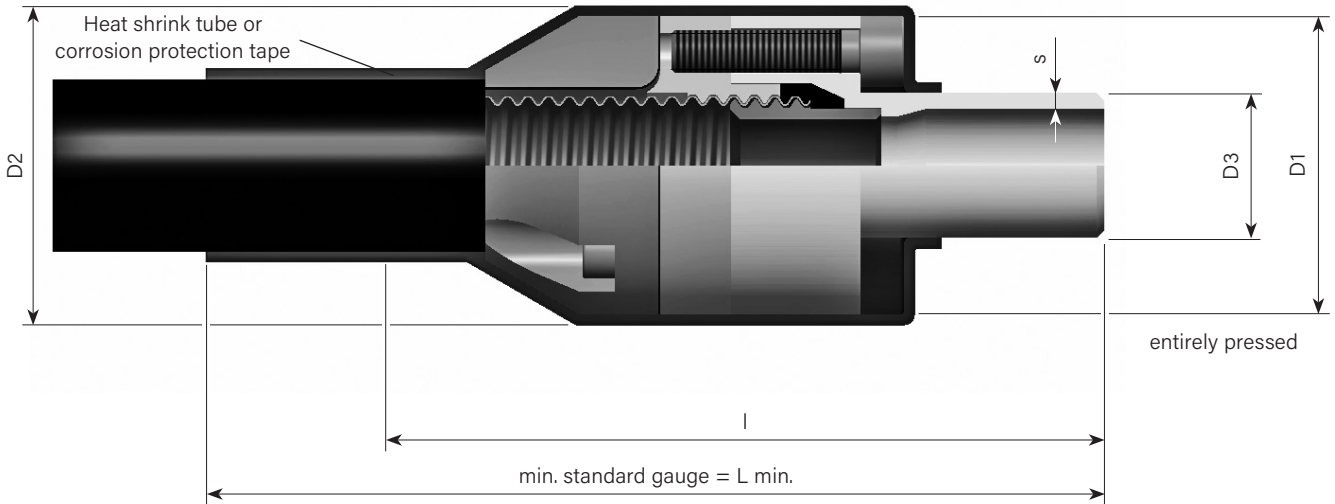
* Bending of the pipe by means of a bending template.

FLEXWELL®-LPG Pipe Systems for Petrol Stations

End coupling

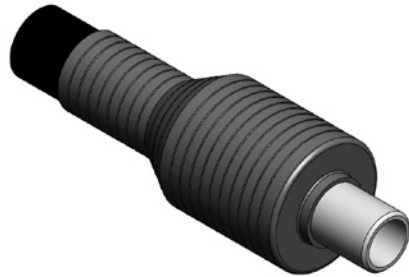
screwed with graphite sealing, connection with welding end

Heat resistant up to -50 °C, nominal pressure 25 bar



Material composition:

- Connecting piece with welding end Material No. 1.0570 (St 52-3) -20 °C
Material No. 1.4404 -50 °C
- Pressure ring cryogenic steel 25CrMo4 (No. 1.7218)
- Sealing ring graphite (SIGRAFLEX F...Z)
- Core piece stainless steel (No. 1.4571)
- Clamping ring cryogenic steel 25CrMo4 (No. 1.7218)



End coupling GRAPA with welding end

| Type | DN | l | L min. | s | D1 | D2 | D3 | Article No. | |
|-----------|----|-----|--------|------|-----|-----|------|--------------------------------------|--------------------------------------|
| | | | | | | | | Connection -20 °C Material 1.0570 | Connection -50 °C Material 1.4404 |
| | | mm | mm | mm | mm | mm | mm | | |
| LPG 22/33 | 20 | 125 | 210 | 2.95 | 55 | 61 | 26.7 | 1014392 | 1014393 |
| LPG 30/40 | 25 | 129 | 210 | 3.40 | 65 | 71 | 33.4 | 1014399 | 1014400 |
| LPG 39/50 | 32 | 140 | 220 | 3.55 | 81 | 87 | 42.2 | 1014407 | 1014408 |
| LPG 48/61 | 40 | 154 | 230 | 3.70 | 93 | 99 | 48.3 | 1014415 | 1014416 |
| LPG 60/74 | 50 | 158 | 240 | 3.90 | 109 | 115 | 60.3 | 1014421 | 1014422 |

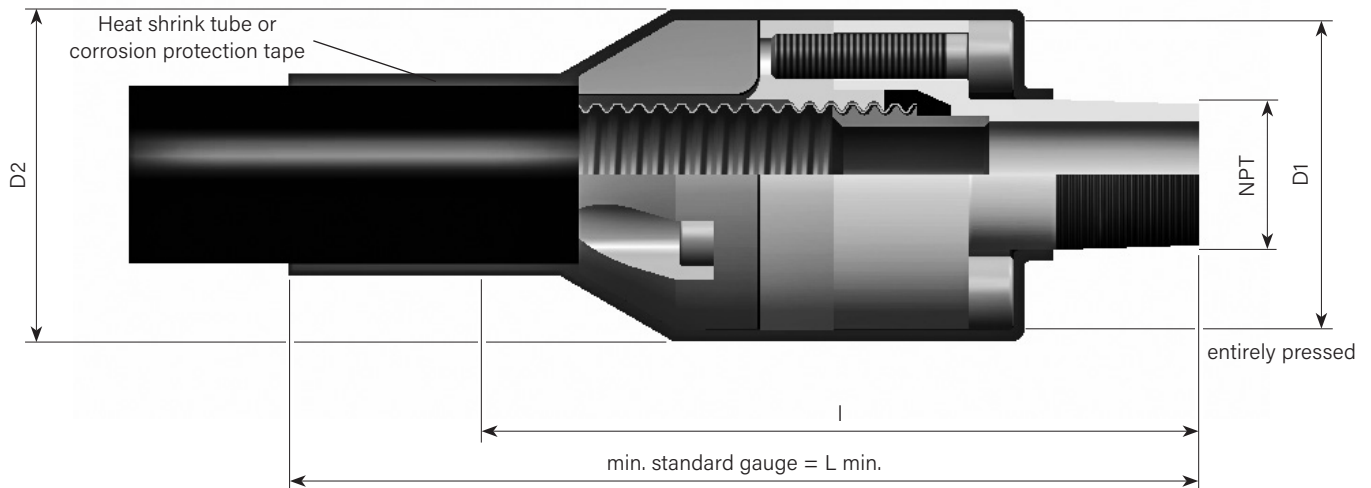
Testing of quality, treatment, pressure and material in line with the system approval by external inspection authorities and the internal quality management.

FLEXWELL®-LPG Pipe Systems for Petrol Stations

End coupling

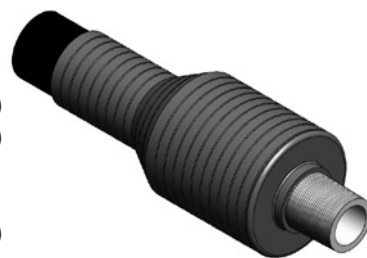
screwed with graphite sealing, connection with NPT male thread

Temperaturbeständig bis -50 °C, Nenndruck 25 bar



Material composition:

- Connecting piece with NPT male thread cryogenic steel 25CrMo4 (No. 1.7218)
- Pressure ring cryogenic steel 25CrMo4 (No. 1.7218)
- Sealing ring graphite (SIGRAFLEX F...Z)
- Core piece stainless steel (No. 1.4571)
- Clamping ring cryogenic steel 25CrMo4 (No. 1.7218)



End coupling GRAPA with NPT male thread

| Type | DN | l mm | L min. mm | NPT thread inch | D1 mm | D2 mm | Article No. |
|-----------|----|---------|--------------|--------------------|----------|----------|-------------|
| LPG 22/33 | 20 | 121 | 210 | ¾" | 55 | 61 | 1014394 |
| LPG 30/40 | 25 | 129 | 210 | 1" | 65 | 71 | 1014401 |
| LPG 39/50 | 32 | 140 | 220 | 1 ¼" | 81 | 87 | 1014409 |
| LPG 48/61 | 40 | 154 | 230 | 1 ½" | 93 | 99 | 1014417 |
| LPG 60/74 | 50 | 158 | 240 | 2" | 109 | 115 | 1014423 |

End coupling GRAPA with NPT male thread, reduced

| Type | DN | l mm | L min. mm | NPT thread inch | D1 mm | D2 mm | Article No. |
|-----------|----|---------|--------------|--------------------|----------|----------|-------------|
| LPG 30/40 | 25 | 129 | 210 | ¾" | 65 | 71 | 1014402 |
| LPG 39/50 | 32 | 140 | 220 | ¾" | 81 | 87 | 1014410 |

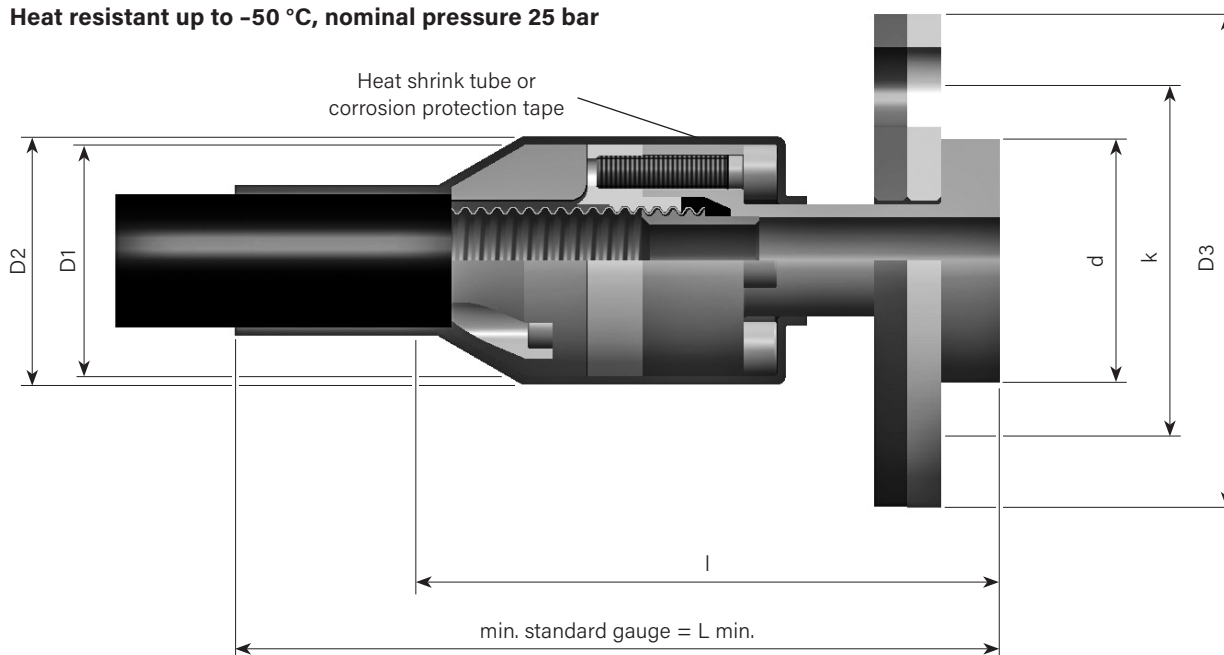
Testing of quality, treatment, pressure and material in line with the system approval by external inspection authorities and the internal quality management.

FLEXWELL®-LPG Pipe Systems for Petrol Stations

End coupling

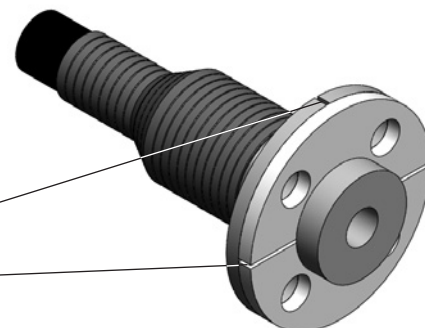
screwed, with graphite sealing, connection: collar and split flange

Heat resistant up to -50 °C, nominal pressure 25 bar



Material composition:

| | |
|------------------------------|---|
| Connecting piece with collar | cryogenic steel 25CrMo4 (No. 1.7218) nickel-plated |
| Pressure ring | cryogenic steel 25CrMo4 (No. 1.7218) nickel-plated |
| Sealing ring | graphite (SIGRAFLEX F...Z) |
| Core piece | stainless steel (No. 1.4571) |
| Clamping ring | cryogenic steel 25CrMo4 (No. 1.7218) nickel-plated |
| split flange | fine grained steel P355NL2 (No. 1.1106) nickel-plated |



Installation advice split flange:

The split flanges have to be installed in a 90° offset pattern

End coupling GRAPA with split flange acc. to EN 1092-1

| Type | Pipeline DN | l mm | L min. mm | Flange DN | Screws | d mm | D1 mm | D2 mm | D3 mm | k mm | Article No. |
|-----------|-------------|------|-----------|-----------|--------------|-------|-------|-------|-------|------|-------------|
| LPG 22/33 | 20 | 140 | 220 | 20 | 4 x M12 x 65 | 58.0 | 55 | 61 | 105 | 75 | 1014391 |
| LPG 30/40 | 25 | 144 | 230 | 25 | 4 x M12 x 70 | 68.0 | 65 | 71 | 115 | 85 | 1014398 |
| LPG 39/50 | 32 | 155 | 240 | 32 | 4 x M16 x 75 | 73.1 | 81 | 87 | 140 | 100 | 1014406 |
| LPG 48/61 | 40 | 176 | 260 | 40 | 4 x M16 x 75 | 88.0 | 93 | 99 | 150 | 110 | 1014414 |
| LPG 60/74 | 50 | 181 | 260 | 50 | 4 x M16 x 80 | 102.0 | 109 | 115 | 165 | 125 | 1014420 |

End coupling GRAPA with split flange acc. to ANSI B16.5 - 300 lb

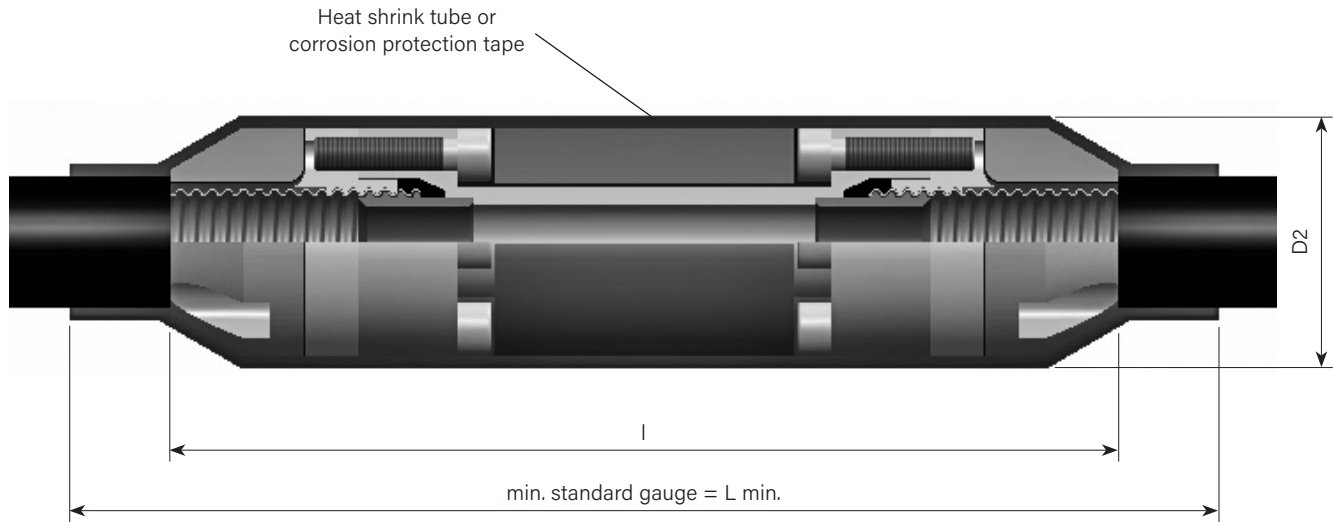
| Type | Pipeline DN | l mm | L min. mm | Flange DN | Screws | d mm | D1 mm | D2 mm | D3 mm | k mm | Article No. |
|-----------|-------------|------|-----------|-----------|--------------|------|-------|-------|-------|-------|-------------|
| LPG 22/33 | 20 | 140 | 220 | 20 | 4 x M16 x 70 | 42.9 | 55 | 61 | 117.3 | 82.5 | 1014390 |
| LPG 30/40 | 25 | 144 | 230 | 25 | 4 x M16 x 75 | 50.8 | 65 | 71 | 123.9 | 88.9 | 1014397 |
| LPG 39/50 | 32 | 155 | 240 | 40 | 4 x M20 x 80 | 73.1 | 81 | 87 | 155.4 | 114.3 | 1014405 |

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Straight coupling

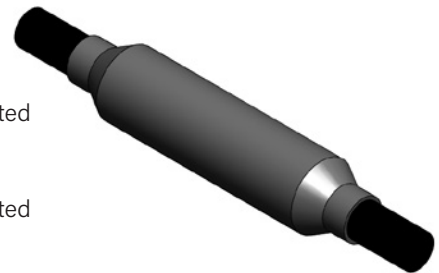
screwed, with graphite sealing

Heat resistant up to -50 °C, nominal pressure 25 bar



Material composition:

| | |
|-----------------------------|--|
| Both-sided connection piece | stainless steel (No. 1.4571) |
| Pressure ring | cryogenic steel 25CrMo4 (No. 1.7218) nickel-plated |
| Sealing ring | graphit (SIGRAFLEX F...Z) |
| Core piece | stainless steel (No. 1.4571) |
| Clamping ring | cryogenic steel 25CrMo4 (No. 1.7218) nickel-plated |
| Cylindrical fill body | plastic PE-HD |



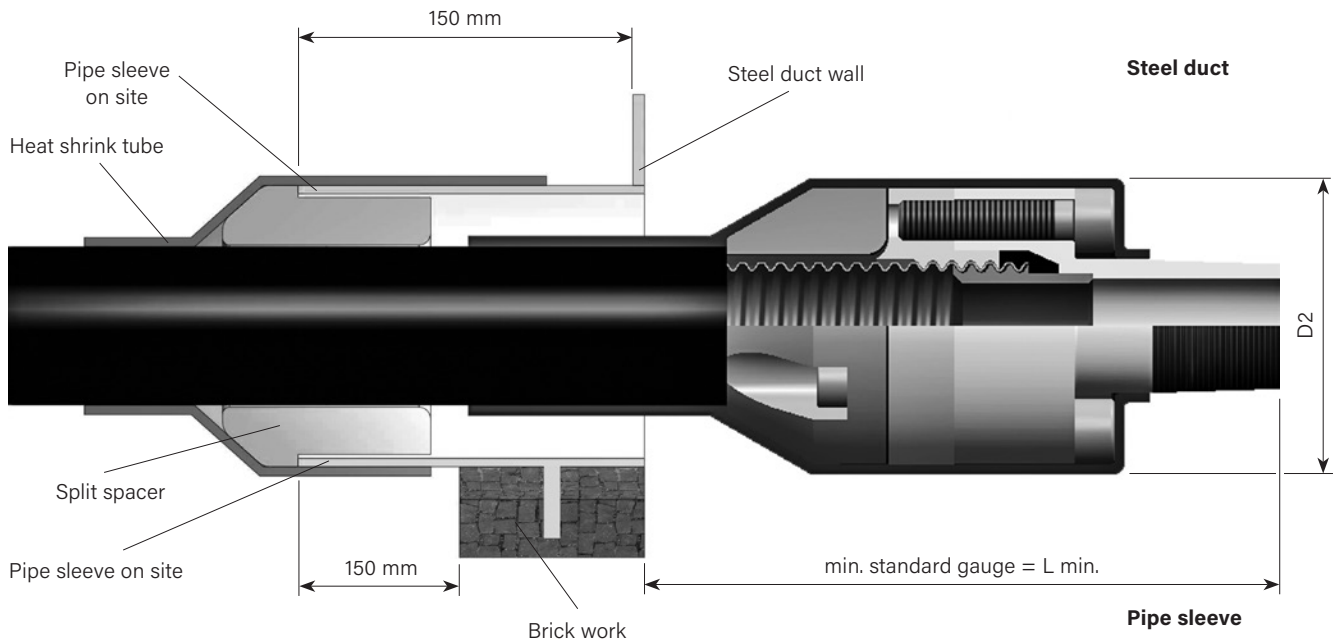
| Type | Nominal diameter DN | L min. mm | l mm | D2 mm | Article No. |
|-----------|------------------------|--------------|---------|----------|-------------|
| LPG 22/33 | 20 | 410 | 250 | 61 | 1014395 |
| LPG 30/40 | 25 | 420 | 260 | 71 | 1014403 |
| LPG 39/50 | 32 | 440 | 280 | 87 | 1014411 |
| LPG 48/61 | 40 | 470 | 310 | 99 | 1014418 |
| LPG 60/74 | 50 | 480 | 320 | 115 | 1014424 |

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Steel duct and pipe sleeve

General

The FLEXWELL®-LPG steel duct type SSE is constructed for fixed dimensioned pipe sleeves. The pipe sleeves have to be provided on site.



| Type SSE | Pipe sleeve on site mm | D2 mm | L min. mm | Article No. |
|-----------|---------------------------|----------|--------------|-------------|
| LPG 22/33 | 76.1 x 2.9 | 61 | 150 | 1014389 |
| LPG 30/40 | 88.9 x 3.2 | 71 | 150 | 1014396 |
| LPG 39/50 | 114.3 x 3.6 | 87 | 200 | 1014404 |
| LPG 48/61 | 114.3 x 3.6 | 99 | 200 | 1014412 |
| LPG 60/74 | 139.7 x 4.0 | 115 | 200 | 1014419 |

BRUGG delivery scope: split spacer and heat shrink tube

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Verlegeanleitung

Safety Requirements

This Installation Guide should be read in full prior to system specification and installation. Installations should only be carried out in accordance with the statutory requirements and LPG codes of practice of the country of installation and all Health and Safety guidelines must be followed.

FLEXWELL®-LPG is suitable for LPG (Autogas) buried installations on Propane and Butane in both vapour and liquid phase.

Requirements for the installer

The installer

- is qualified for installation and testing of LPG and liquid fuel equipment
- follows Codes of Practice for the country in question
- has completed installation training by BRUGG or its Authorised Partner
- carries out the installation as per current BRUGG Installation Instructions

Pipe trench

FLEXWELL®-LPG Piping needs a top covering of at least 60 cm above the pipe crown when laid into trenches not subject to traffic loading. Under traffic loading, cover of at least 75 cm is necessary. Allow a minimum of 10 cm trench depth on top of this for the sand bedding under the pipe. When digging the trench, carefully remove all sharp-edged stones or fragments of masonry, piping etc.

The floor of the trench must then be tamped flat and level. Cover this flat surface with a layer of at least 10 cm of closely packed sand. This should have a grain size of < 2 mm and be free of sharp-edged foreign objects. The sand bedding must be in place before the pipe is drawn in. If several parallel pipes are being laid, calculate at least 10 cm lateral distance between pipes and trench wall. FLEXWELL®-LPG Piping must be covered by a layer of sand at least 10 cm thick above the pipe crown when filling in the trench. The top filling can then be added. A yellow plastic indicator tape, or equivalent should be laid between 200 mm and 300 mm above the pipe.

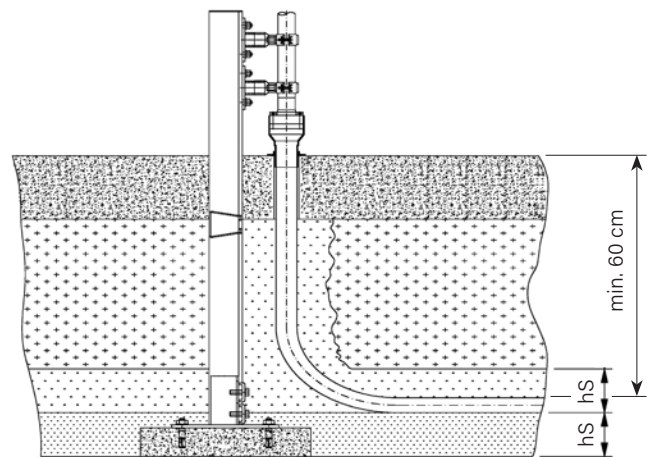
Fixed anchor points

Stresses occur during operation and during pressure testing of FLEXWELL®-LPG Piping due to linear expansion at the connections. Additional stress is placed on the connection joint by earth-compacting work and the weight of heavy components of the assembly added later (flanges, valves etc.). These stress forces must be compensated by a simple fixed point anchor. The fixed point is installed for this purpose before the piping is laid.

Take care that the anchor is of sufficient dimensions and is firmly secured in place.

After laying the piping, the FLEXWELL®-LPG connections are securely fixed in place in the mountings of the anchor point by means of stable pipe clamps (see figure).

If it is not possible to attach the piping to an anchor point at the time of laying the FLEXWELL®-LPG Piping then care must be taken that excessive loading is not applied to the pipe ends i.e. pressure testing above 6 bar gauge must not be carried out and valves / fittings must not be affixed to the pipework. When carrying out the first pressure test, please observe clause **Pressure Testing**.



Thickness of the sand bedding $h_S = 10 - 15$ cm, grain size < 2 mm

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Installation guide

Safety measures

Take care to ensure adequate protection from mechanical damage to the piping during laying and subsequent construction work. In particular, ensure that no mechanical damage can occur to above-ground FLEXWELL®-LPG connection joints, e.g. by providing protection against vehicles driving against them.

FLEXWELL®-LPG Piping must be fitted with a system to prevent the permissible working pressure being exceeded during operation. Please take this into account when planning the installation of safety equipment.

Free pipe ends must be sealed to prevent any liquid escaping.

Prior to Laying Pipework

Prior to laying the FLEXWELL®-LPG Piping, a visual test must be carried out to see if the piping has been damaged during transit in any way. Slight scratches in the plastic outer casing are not a problem. Deeper scratches in the outer plastic casing or extensive abrasion of the plastic surface can be easily repaired where necessary using a heat shrink tube.

If there are deeper cracks in the outer plastic casing which make it seem likely that there is damage to the reinforcing bands, or if the pipe surface is dented, please only continue work on the pipe after consultation with BRUGG.

Laying into the trench

The trench must be dug according to the instructions of clause **Pipe trench**.

FLEXWELL®-LPG Piping is laid direct off the reel or from the ring into the trench and the appropriate length cut off as required. Due to its extreme flexibility you can lay great lengths of piping in one piece. Use the bending jig supplied by BRUGG for bending the pipe through very tight bending radii.

Fix the pipe ends to the pipe supports as per clause **Pipe trench**. Apply abrasion resistant cloth where the pipework passes through backfill and concrete layers as per clause **Pipe trench**.

Pressure Testing

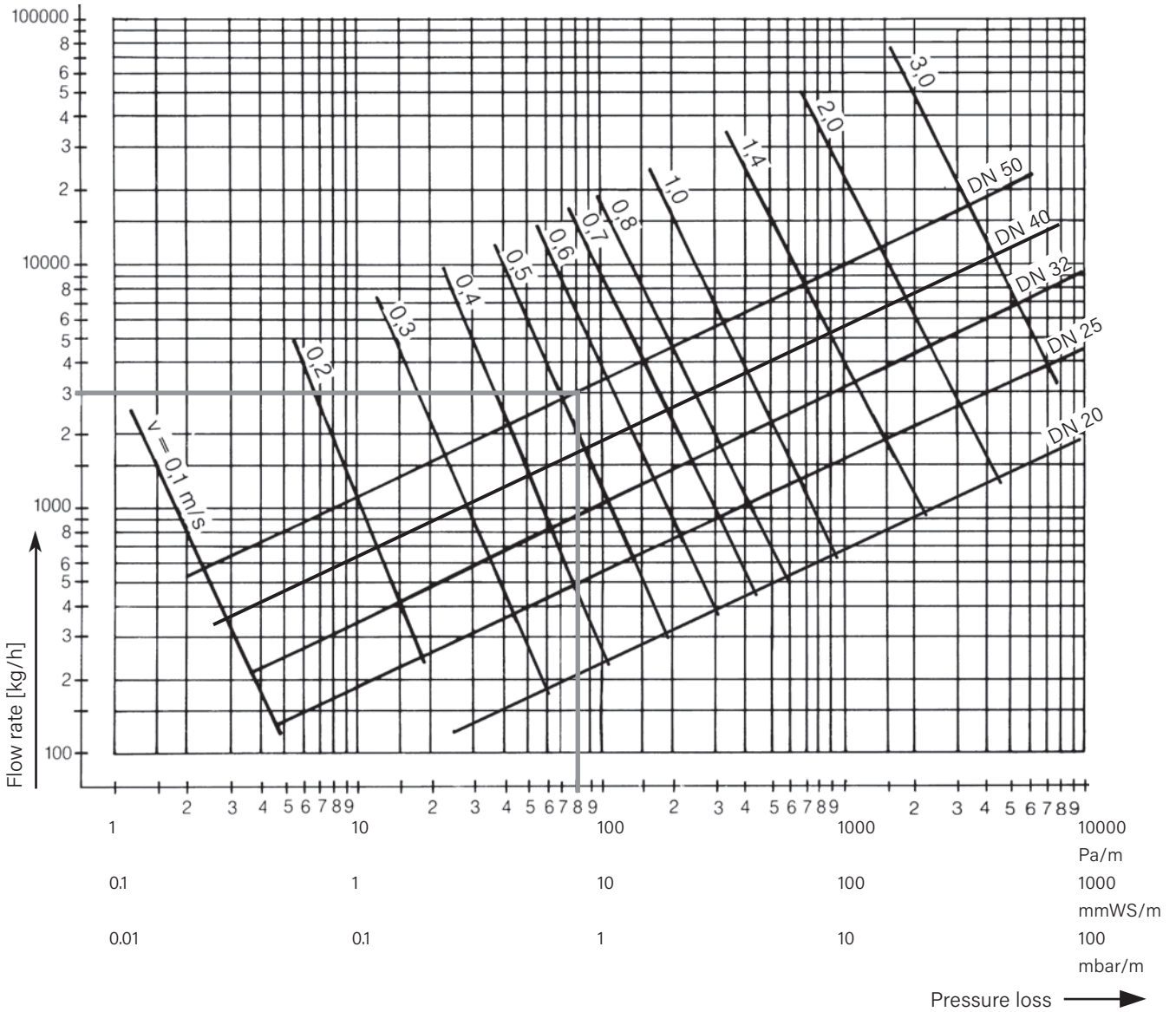
Pressure testing must be carried out in accordance with Codes of Practice for the country of installation. A maximum pressure of 1.43 times the operating pressure must not be exceeded. A pressure gauge of suitable accuracy to meet local Codes of Practice is to be used for this. If analog gauges are used, the scale diameter should be at least 100 mm. The pressure gauges must be calibrated once a year to a suitable standard and the calibration data recorded.

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Fluidics

Pressure loss diagram for fluid propane

Temperature: 15 °C
 Specific weight: 508 kg/m³
 Kinematic viscosity: 2.1 · 10⁻⁷ m²/s



Example:

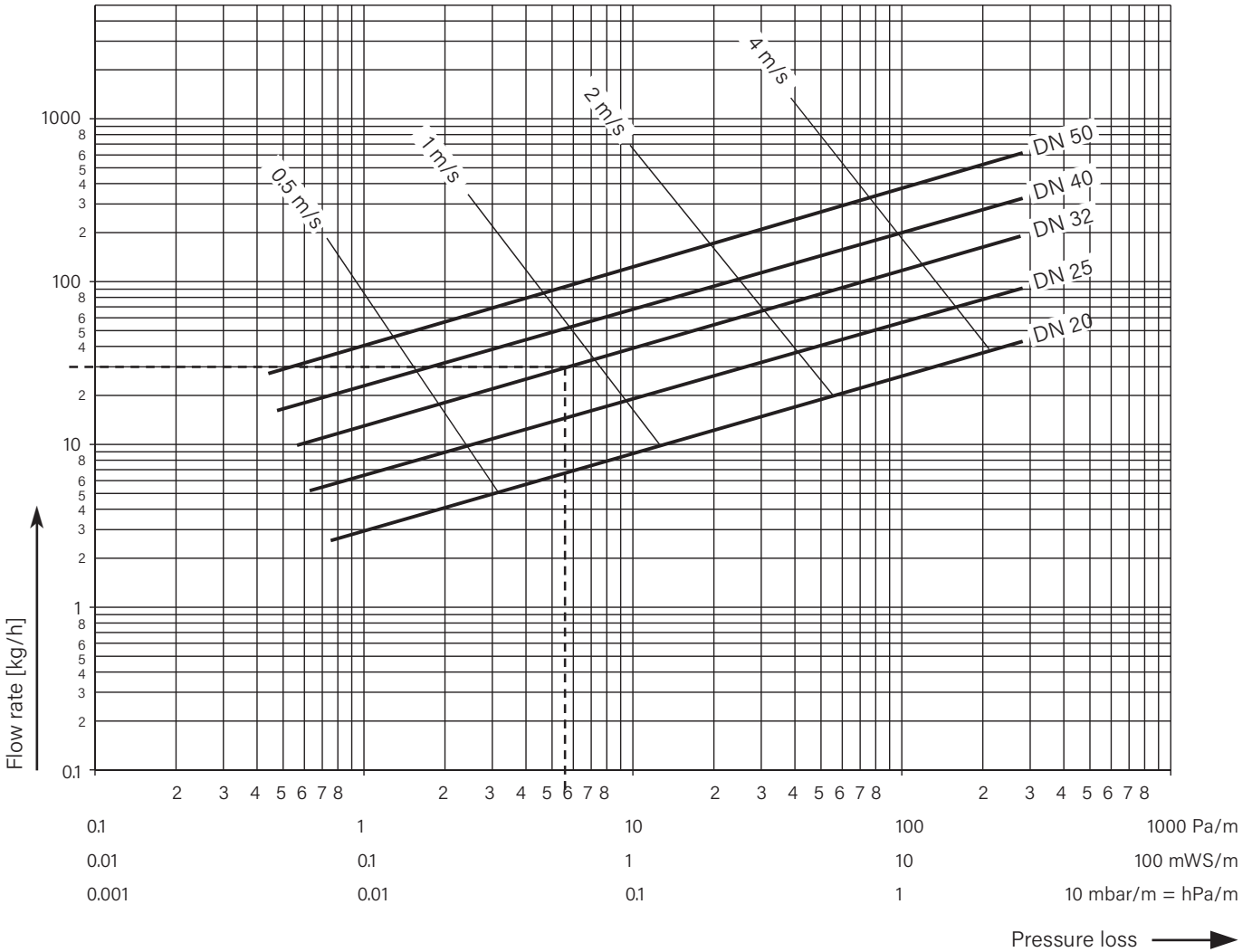
Pipe DN 50
 Mass flow rate 3000 kg/h:
 at a velocity of approx. 0.5 m/s the
 pressure loss is 0.8 mbar/m

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Fluidics

Pressure loss diagram for vaporized propane

Temperature: 15 °C
 Specific weight: 8 kg/m³ (3 bar)
 Dynamic viscosity: 7.9 · 10⁻⁶ Ns/m² = kg/ms

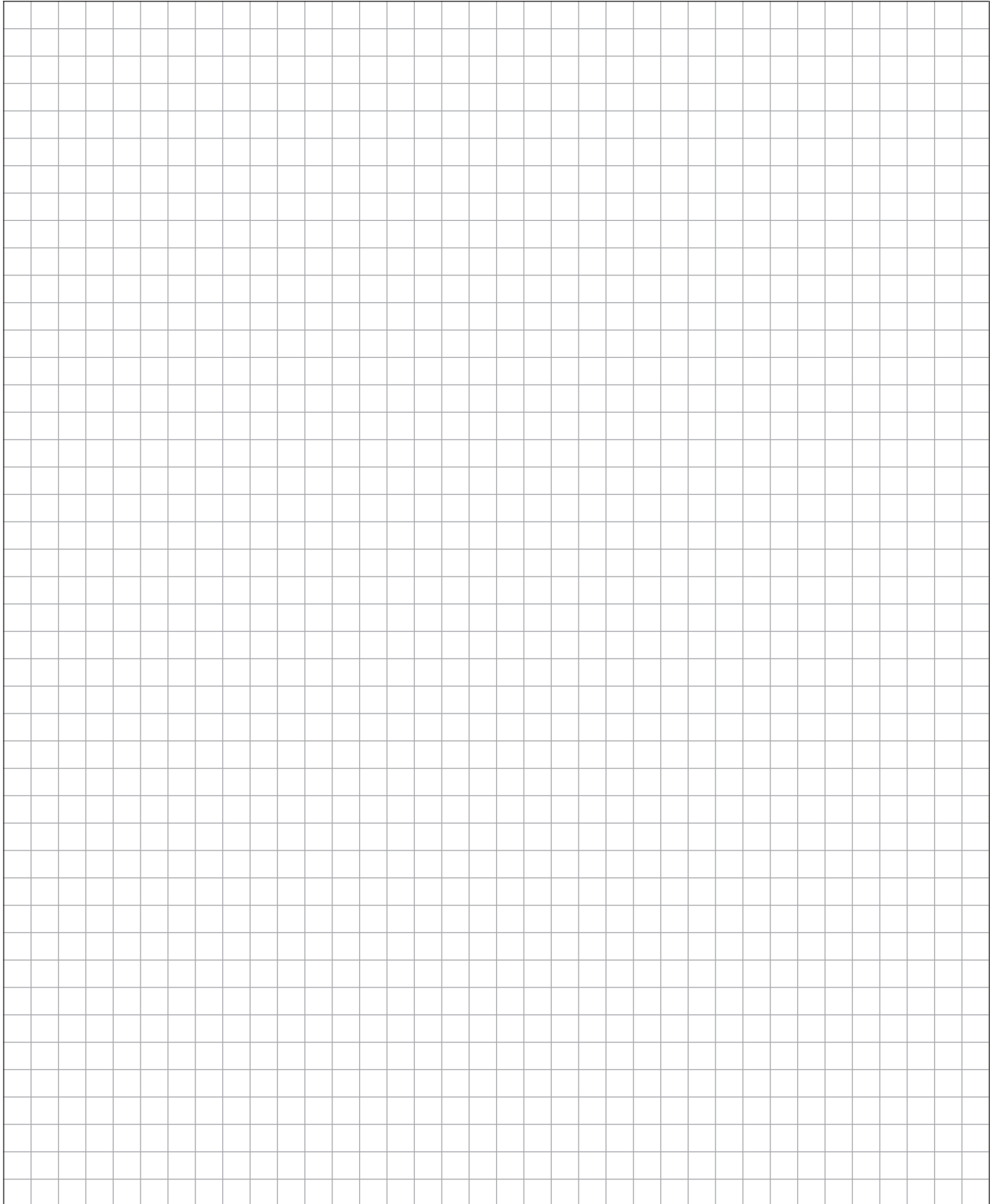


Example:

Pipe DN 32
 Mass flow rate 30 kg/h:
 at a velocity of approx. 0.9 m/s the
 pressure loss is 5.6 · 10⁻² mbar/m = hPa/m

FLEXWELL®-LPG Pipe Systems for Petrol Stations

Notes



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