SAFETY PHILOSOPHY FOR
SERVICE LINES AND GAS INSTALLATION

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ABSTRACT

An overview of the requirements under DVGW standards concerning service lines and gas installation is given.

The goals of the requirements regard the following areas:

- Prevention of unauthorised interference by a third party
- Identification of damage at an early stage
- Limitation of damage and defence against manipulation

The standards to archive the goals consist of requirements concerning procedures and components, which are both described briefly.
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1 Introduction

In contrast to other national constructions in Germany the devices for pressure regulation (to 22 mbar) and gas measurement are typically placed inside the house (figure 1). The gas pressure prior to the regulation can be up to 5000 mbar, predominantly it does not exceed 1000 mbar.

The requirements for the devices, the construction and the operation of the service lines (and the grid) are stipulated in the standards of the DVGW (Deutsche Vereinigung des Gas- und Wasserfaches e.V. - Technisch-wissenschaftlicher Verein = DVGW German Technical and Scientific Association for Gas and Water). The main task of the non-profit making association is the compilation of the technical standards and therefore the self-regulation in the gas and water supply industry.

Concerning service lines the safety philosophy is based on three pillars:
• Prevention of unauthorised interference by a third party
• Identification of damage at an early stage
• Limitation of damage and defence against manipulation

An overview of the requirements under DVGW standards concerning service lines and gas installation is given.

![Figure 1: A typical German construction of the service line and installation](image)

2 Prevention of unauthorised interference by a third party

2.1 Cover

The minimum cover for service lines is 50 cm [1], which ensures a sufficient distance for works in the area of the service lines. In many cases the cover is even larger, depending on the cover of the grid. The minimum cover for the grid is 60 cm, the usual one about 80 cm.
2.2 Investigation of service lines prior to civil engineering works

Before starting civil engineering works any company is obliged to ask all affected network operators for the location of their grid and their service lines. It is the duty of the company that performs the civil engineering works to instruct their workers.

The network operators take care of the up-to-dateness of their data and give indications as to how to work near pipes and service lines. To ensure this special procedures are installed in the network operator companies, which also include a documentation that the information has been given.

However, there is still a noteworthy amount of the so-called third party interference and therefore there are discussions on how to minimize it. Some companies carry out information events for the civil engineering companies or have formed partnerships with them. The reduction of third party interference is also discussed in the affected organizations, e.g. DVGW.

3 Identification of damage at an early stage

3.1 Leakage survey

Leakage survey is carried out periodically, including both the grid and the service lines. Thus damage can be identified at an early stage. The frequency of the survey depends on the state of the grid (Table 1).

Typically the leakage survey is done on foot with special devices for the detection of methane and usually with a paper map of the grid. New developments concern the survey by car (usually just for the grid) and the use of digital maps.

<table>
<thead>
<tr>
<th>Frequency of leakages per km</th>
<th>≤ 0,1</th>
<th>≤ 0,5</th>
<th>≤ 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating pressure in bar</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>≤ 0,1</td>
<td>6 1)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 0,1 to ≤ 1</td>
<td>4 1)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 1</td>
<td>4 1)</td>
<td>1</td>
<td>0,5</td>
</tr>
</tbody>
</table>

1) only valid for PE pipes or cathodic protected steel pipes

Table 1: Minimum period of survey [2]

3.2 Odourisation

An odourant is added to the gas to allow the detection of it. In case of a leakage in the installation and an emission of gas the odour must be noticed at a gas concentration which will not cause danger. It is required that the odour can be noticed at every point of the grid. Therefore a threshold of the concentration of the odourant is defined. It has to be checked periodically whether the concentration at the end points of the grid is sufficient.

The amount of odourant dosed in the outlet of the gas pressure regulating station is chosen to meet the required threshold. The operability of the equipment for the odourisation has to be monitored.

The procedures are described in DVGW G 280-1 [3].

The customers are asked to inform the gas supplier immediately in case they notice the odour. An on-call service, which is available 24 hours a day, ensures that action is taken immediately.
3.3 Testing of the service line and the gas installation prior to commissioning

The service line (including the pipeline up to the regulator) must have undergone pressure testing prior to commissioning. The test pressure must exceed the design pressure by a minimum of 2 bars [1], e.g. a service line designed for a pressure of 4 bars is tested with 6 bars.

The main shut-off device, the regulator and its safety features must have been tested concerning leak tightness and functional ability.

New pipes of the gas installation are pressure tested with a pressure of 1 bar. Afterwards the complete installation, including valves, fittings and when required the meter are tested concerning leak tightness with a pressure of 110 mbar [4].

Requirements from DVGW exist for each component used in the service line, e.g. pipes, fittings, meters, regulators ... The requirements contain both an approval of the component and its construction - regarding operability and durability - and demands concerning the quality assurance.

4 Limitation of damage and defence against manipulation

4.1 Excess flow valve outside (to guard the service line)

An excess flow valve is installed directly at the beginning of the service line. It closes when the flow rate in the service pipe exceeds a certain limit. Thus the flow is cut off in case of third party damage of the service line, for example. Thereby a hazard caused by uncontrolled gas exhaust due to a damage of the pipe is prohibited.

For dimensioning the excess flow valves the gas flow rate is the crucial factor. Different types of excess flow valves are available both concerning the construction, the way of installation and special features. One of them is that the excess flow valves reopen, but only when the outlet pressure is built up which can only occur when there are no openings behind. The requirements for the excess flow valves are described in DVGW VP 305-2 [5], which also contains a brief description of the different types. New developments are expected.

4.2 Excess flow valve inside (to guard installation)

Another excess flow valve is installed directly after the main shut-off device or inside the regulator. It closes when the flow rate in the installation exceeds a certain limit. If necessary, additional excess flow valves may be installed to guard further distribution pipes inside the house. Uncontrolled gas exhaust in case of manipulation is prohibited, e.g. an unauthorised intrusion to steel gas.

The requirements of these excess flow valves are given in DVGW VP 305-1 [6].

4.3 Requirements of the residential service gas entry device (GED)

The GED connects the service line and the installation. It is installed in such a way that forces which may arise outside the house, for example caused by an attack on the service line, have no effect on the installation. Thus third party damage cannot lead to an exhaust of gas inside the house. This is achieved by an anchor point inside the wall or a protection against pull out [7].

4.4 Safety features of the regulator

A safety shut off valve (SSV) inside the regulator closes when the outlet pressure rises above a preset value. Thereby it is prohibited that the pressure in the installation exceeds a value which might cause damage. The SSV can only be reset manually.
The regulator can also be supplied with a low pressure cut off feature. It closes, when the outlet pressure falls below a preset value. This might be either due to a drop of the inlet pressure caused by a defect of the grid or a drop of the outlet pressure caused by a defect of the installation. The low pressure cut off feature reopens only when the outlet pressure is built up which can only occur when there are no openings in the installation [8].

The safety features have to be checked prior to commissioning and periodically [9].

4.5 High temperature resistance

All devices inside the house must be resistant against high temperatures. In case of fire an exhaust of gas is prohibited – at least for a certain time. Thus explosions or an enhancement of the fire can be prevented. The devices must be leak-proof for 30 minutes at a temperature of 650 °C.

4.6 Main shut-off device

An easily accessible shut-off device is installed at the end of the service line, mostly directly after the GED. It could also be installed in a connexion box outside the house. In a case of danger the gas flow can be shut off without excavation.
References
[1] DVGW G 459-1 (07.1998) Gas service pipes for operating pressures up to 4bar - Design and construction
[8] DVGW VP 200 (11.2004) Gas-Druckregelgeräte und Sicherheitseinrichtungen der Gas-Installation für Eingangsdrücke bis 5 bar (Gas regulators and safety features of the gas installation for inlet pressures up to 5 bars)

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