Test of Safety Devices in Gas Pressure Regulating Stations

Von Leif Bro Jensen
HMN Naturgas I/S

The Kamstrup inspection system in operation
Within the next two years, the Danish natural gas distributor, HMN Naturgas, will implement the digital tool: Kamstrup Inspection System for the visual and functional testing of all MR and DR stations.

HMN Naturgas has 451 pressure regulating stations, distributed on 134 high and 193 low pressure stations in the east (the Greater Copenhagen area) and 124 high pressure stations in the west (Central and North Jutland). The key function of the stations is to reduce the pressure. The high pressure stations reduce the pressure from typically 50/40/19 bar to 25/4 bar, whereas the low pressure stations reduce the pressure from typically 4/2.5 bar to 100/22 mbar.

From the very beginning of the introduction of natural gas in Denmark, the Danish working environment legislation contains requirements on the safety devices in the stations with one purpose: Protection from unintended overpressure.

The basis of meeting the requirements of the Danish Working Environment Authority is the American GTPC guide (previously ASME guide) supplemented by WEA Guideline F.0.1 of July 2001. The safety devices can e.g. be safety valves or monitoring regulators. If the supply pressure is above 4 bar, two independent safety devices must be used.

Requirements for annual testing
The gas companies assign a very high priority to security of supply, and therefore, focus especially addresses the optimal function of safety devices and working regulators. According to the authority requirements, safety devices must be inspected and tested every calendar year at an interval of maximum 15 month. For a part of the stations, the gas companies have increased the number of tests to ensure a high security of supply, and in addition, objects are separated for service and exchange of soft parts.

In historical terms, the security of supply from the stations in the Danish natural gas system has been high. But what is then the reason for HMN Naturgas to invest DKK 3.3 million in a system for visual and functional testing? Before answering this question, a description of the Kamstrup inspection system is given below.
Kamstrup Inspection System

Today, gas station inspectors test the safety devices and the regulators by installing hoses between pressure outlets and pressure gauges and manually carry out blockings and readings. The Kamstrup system performs these tests automatically, and a digital data collection of the function of the individual objects is performed.

In the steel influence pipes of the safety devices of the gas line, the Kamstrup BMA and BDA system couplings are installed to which the mobile test device can be connected by means of the flexible hoses. Dependent on the safety devices, 5 or 6 system couplings per gas line are installed. In most stations, there is an operation line and a reserve line, and therefore, 10 to 12 system couplings are installed in one station. The system couplings are permanently installed in the stations.

The mobile test device

The mobile test device is named PLEXOR. It consists of a casing with two digital pressure gauges, a function selector for selecting the object that is to be tested, e.g. the regulator, SAV or SBV, and a start handle for activating the test. Dependent on the actual pressure range, the pressure gauges are exchangeable to ensure that the measurement is carried out with the required precision.

The PLEXOR test device is connected to the system couplings by means of the flexible stainless steel connecting hoses. Two types of system couplings are available: BDA, the safe diagnosis coupling, and BMA, the safe measuring coupling. The BDA coupling has a three-way valve that makes it possible to isolate the safety device, e.g. the SAV, and then apply a test pressure via the PLEXOR test device to test the safety device. During the test, the PLEXOR test device will increase the pressure by 1.5 % per second, until the safety device is released. The PLEXOR test device digitally registers all pressure conditions before and after the release of the device.

Figure 1: The Kamstrup inspection system can be easily linked to a business management system.
**CONNEXION software**

The key component of the Kamstrup inspection system is the CONNEXION software package. In addition to the previously mentioned modules INSPECTOR and MANAGER, the module DIAGNOSTICS is also included.

CONNEXION controls both the visual and the functional inspection, stores all the inspection results and presents them in various screenshots, dependent on the requirements of the operating technician.

The DIAGNOSTICS module imports the measurement data required for analysis and presents them graphically, which eases the evaluation of the states of the AMR stations. If one of the components of the gas line requires further attention, a zoom function makes it possible to draw attention to error indications.

An essential function of DIAGNOSTICS is the possibility of comparing numerous measurements that can be presented in one diagram. This provides a good statistical basis.

---

**Implementation**

The installation of system couplings on MR stations started in August 2011 and is expected to be finalised within two years. At the moment, HMN Naturgas works on collecting documentation for all stations, which is to be transferred to CONNEXION. Kamstrup assists in building up the database structure, and furthermore, all procedures installed on the PDA must be in Danish. In late 2011, HMN Naturgas receives the PLEXOR test devices and software, and training in the use of the device will take place. To begin with, four gas station inspectors are trained, two in HMN east and two in HMN west. Subsequently, these inspectors must train their colleagues in their group in the use of the device.

---

**Instructions via PDA**

The figure shows how the PLEXOR test device communicates wirelessly with an Ex-PDA. On this PDA, the gas station inspector is instructed about the installation of hose connections and valve positions. The procedure is prepared specially for the station in question, and the gas station inspector cannot perform the test incorrectly or finalise the test uncompleted. The gas station inspector can read the test result on the PDA, and therefore, he can decide on site if a safety device requires service.

The software INSPECTOR is installed on the PDA. This module compares the test results with the predefined criteria and informs the gas station inspector of any discrepancies. The INSPECTOR module cannot change the set-up or procedures - such changes are only possible by means of the MANAGER module installed on a desktop computer of the responsible operations manager.

Figure 2: Performing the inspection with the INSPECTOR Ex-PDA.

Figure 3: Shows a graph of the DIAGNOSTICS module.
**Uniform functional testing**

Back to the question about why HMN Naturgas invests DKK 3.3 million in a system for visual and functional testing. The Kamstrup inspection system provides a uniform visual and functional testing that is completely independent of the individual. The test results are stored, and the data collection means that the test will be reproducible. This means that, at an early stage, it is possible to detect if an object is soon to be renovated. With this system, it will therefore be possible to complete predictive maintenance to a great extent and thereby reducing the spare part consumption and the time consumption of overhauls.

The functional testing is carried out with pressure on the gas line, in contrast to today, where the test is carried out without pressure. This means that the inner density of the gas line is controlled, and small leaks in valves and objects are registered, as even very small pressure changes are visible.

The system has been in operation in Holland since 2000, and e.g. in Germany and Austria, many gas companies have adopted it within the last five years. On the basis of experience gained from these markets, HMN Naturgas expects that the system in a few years proves to be a good investment.