

## Measurement of air consumption saves energy costs

Compressed air is an essential source of energy. Roughly 60,000 plants are in use in Germany. Although compressed air is the most expensive energy source, industrial concerns consume up to 40 % more of it than necessary.

Many plants are not adapted to the actual requirements or are in need of repair. Leak repairs could save approximately € 200 million in electricity and avoid around 1.7 million tons of carbon dioxide emissions every year.

Source: Fraunhofer Institut, Karlsruhe



The efficiency of a compressed air supply system begins with the generation of compressed air and ends with the consumer. Loss of compressed air through leaks in the pipe network generates extremely high costs and reduces efficiency. Until now these costs were hidden in the overall electricity bill and were not transparent.

Complete transparency usually prevails in all companies with regards to the consumption of most other mediums such as electricity, water and gas. Water meters, for example, indicate the exact water consumption. In contrast to compressed air, water leaks are immediately visible to everyone and are repaired straight away whilst air continues to escape unnoticed from leaks in the compressed air network even at the weekend and during shutdowns.

The compressors continue to turn blithely during this period just to maintain constant pressure in the network.

These observations do not cover the cost of "generating clean, dry" compressed air. Refrigeration driers and adsorption driers dry the air at considerable running costs and this expensive air is just carelessly wasted.

At a time of increasingly rising energy costs, it is even more important to exploit potential savings in order to remain competitive.

**Table 1 shows the annual energy costs wasted as a result of leaks.**

Size of hole	Air loss at 6 bar, l/s	Air loss at 12 bar, l/s	Energy loss kWh, 6 bar	Energy loss kWh, 12bar	Costs in € at 12 bar
1 mm	1.2	1.8	0.3	1.0	480.- €
3 mm	11.1	20.8	3.1	12.7	6,096.- €
5 mm	30.9	58.5	8.3	33.7	16,176.- €

Source: Compressed air efficiency, kWh x 0.06 € x 8000 operating hours per year

## 1. Compressed air analysis with DS 300

### 1.2 Multifunction measuring instrument DS 300

Many consumers of compressed air do not know their total consumption of compressed air and therefore they also do not know the costs which arise for them due to leakages. The current consumption of the compressors is hidden in the overall electricity bill.

In practice very often sizzling screwings or contacts are not sealed immediately since the compressed air users have not been sensitized to this problem yet.

Leaks are only audible if they are larger than 1 mm<sup>2</sup> at a pressure of 7 bar. Ten leaks smaller than 1 mm<sup>2</sup>, however, will generate costs of € 10,000 a year.

This is the point where **CS Instruments GmbH** consumption meters come into action.

They have been developed in cooperation with **worldwide leading companies** in compressed air technology. The results are innovative, practical measuring instruments which exceed the previous consumption meters by far.

From the very start, our goal was quite clear: The multifunction measuring instrument DS 300 should enable the user to get a survey on the whole compressed air system.



**Picture 1 Stationary multifunction measuring instrument DS 300**

#### Special features:

All relevant measured data for an economic operation of the compressed air line at a glance:

- Actual air consumption in m<sup>3</sup>/h or m<sup>3</sup>/min
- Total air consumption in m<sup>3</sup>
- Pressure dew point in °Ctd
- Line pressure in bar
- Current consumption in A
- Temperature in °C

The data transfer to the PC is effected

- by means of the CS data collector (manually)
- via USB interface for short distances from the PC to the display DS 3000
- via RS 485 interface for long distances

The CS data collector (USB) is able to

- read out up to 64 x DS 300 at the PC
- evaluate data in the CS Soft Professional
- reprogram DS 300

## CS Soft Professional with leakage calculation

Measuring period 31.12.2006 until 31.01.2007, measuring rate 1 second

<b>Compressed air consumption</b>		
Total consumption: 1,309,013 m <sup>3</sup>	Average consumption: 1,805 m <sup>3</sup> /h	Maximum consumption: 2,400 m <sup>3</sup> /h
<b>Leakage</b>		
Leakage in total: 299,000 m <sup>3</sup>	Average leakage: 415 m <sup>3</sup> /h	Leakage rate: 23 %
<b>Energy data</b>		
Total energy consumption: 129,000 kWh	Energy costs: 129,000 kWh x 0.11 € = <b>14,190 €</b>	Energy costs per m <sup>3</sup> : 14,190 € / 1,309,013 m <sup>3</sup> = <b>0.011 €/m<sup>3</sup></b>
<b>Further measuring data</b>		
Maximum pressure: 7 bar	Minimum pressure: 5.8 bar	Average value: 6 bar
Maximum dew point: -11 °Ctd	Minimum dew point: -50 °Ctd	
<b>Leakage costs:</b> 299,000 m <sup>3</sup> x 0.011 € = <b>3,289 €</b>		

The data collected in DS 300 can be evaluated by means of the newly developed **CS Soft Professional with leakage calculation** which was especially developed for the compressed air branch.

### 1. How is leakage determined?

The easiest way is the leakage determination on production-free days, e. g. weekends, holidays, at the end of a shift. During this time the compressor carries compressed air which is required to keep a constant pressure. According to statistics even if production is effected day and night there is at least one short period of time during which all load is switched off, e. g. maintenance times.

This period of time is determined automatically by the CS Soft Professional.

### 2. What has to be done by the user?

The user has to enter the following parameters:

- Current costs per kWh
- Measuring rate, duration of measurement

### 3. Which evaluations does the user get?

Apart from the graphic evaluation with curve progressions of all measured data the customer will get information on:

- the total air consumption in m<sup>3</sup>
- the leakage in total in m<sup>3</sup> und % of the total air consumption
- the current consumption in kWh
- costs per m<sup>3</sup> of produced compressed air in €
- costs of the leakage in €
- pressure progression
- pressure dew point progression



**Picture 2 Graphic evaluation of all relevant data by means of CS Soft Professional**

## 1.2 Simple installation of a probe under pressure using a 1/2" ball valve



**Picture 3 Precise positioning of the measuring probe**

Simple installation and removal of the probe under pressure using a 1/2" ball valve without the need to disconnect pressure or empty the compressed air pipe.

The position of the measuring probe is accurately set via an adjustable mounting thread and a scale. The tip of the probe is positioned in the centre of the pipe. The measuring probe is then aligned using the wrench.

Accurate installation and removal takes only minutes and can even be carried out by untrained personnel after brief instructions.

**The advantages towards customary consumption meters which are permanently fitted in pipes are obvious.**

### **Advantages:**

- Simple installation and removal of the measuring probe under pressure for calibration without pressure disconnection using low-priced, standard 1/2" ball valves
- No additional costs necessary for bypass pipes
- In case of service the measuring probe can be easily removed, quickly tested and replaced if necessary without the need for pressure disconnection
- No pipe restrictions due to different pipe diameters
- Can be used in any pipe diameter

## 1.3 Compressed air needed around the clock - no measurement possible?

Many industrial concerns require compressed air "around the clock" and it is often not possible to empty the entire network to allow the installation and removal of consumption meters.

Also in this case the measuring professionals from **CS Instruments GmbH** are able to offer a practical solution. By means of a special drill fixture a measuring point with a 1/2" ball valve can be set up anywhere in the compressed air network in a few minutes.

Compressed air users very often require quick and accurate measurement of air consumption in specifically selected compressed air pipes for a variety of reasons.

More and more consumers are being connected to existing compressed air systems without any precise knowledge of the actual consumption of certain production halls or departments.

With existing pipes there is the risk that high consumption will lead to excessively high flow speeds and thus to high frictional loss. The flow speed should not exceed 6 m/s. Higher values lead to an extreme energy loss.

#### 1.4 What if no 1/2" ball valve is existing at the measuring site?

By means of a special drilling device a measuring site with 1/2" ball valve can be easily set up within a few minutes at any place in the compressed air system.



Picture 4 Drilling device



Picture 5 Spot drilling collar



Picture 6 Drilling under pressure

## 2. Mobile measuring instrument for fast measurement of air consumption

The drill fixture comes together with the mobile flow meter which enables the user to carry out measurements in the pipes of any diameter.

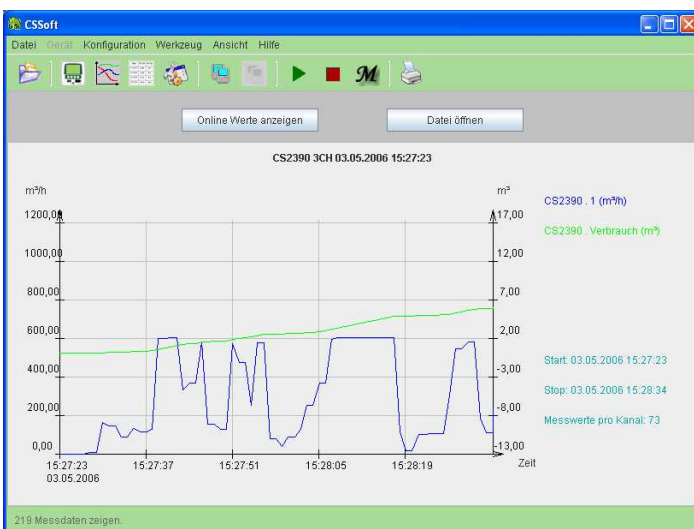


**Picture 7 Mobile consumption meter**

### Special features:

- Can be used in pipes of any diameter
- Depth scale engraved on probe for accurate positioning inside pipe
- Quick and fast installation and removal under pressure without pressure disconnection
- Display in m<sup>3</sup>/h and m/s
- Easily adjustable to any inner diameter
- PC evaluation
- Further probes for dew point, pressure...

Apart from the actual measurement, up to 6,000 measured values can be saved and evaluated by CS Soft. Graphs or tables enable an accurate analysis of the compressed air profile with current consumption in m<sup>3</sup>/h, total consumption in m<sup>3</sup>.



**Picture 8 Graphic evaluations**

The stored measured values can be displayed in the form of a graph or a table.

Data can be easily and quickly transferred to "Excel".

This enables customised data presentation.

### 3. Threefold improvement with multifunction measuring instruments DS 300

#### 3.1 Compressed air analysis with DS 300

Once the multifunction measuring instrument DS 300 has been installed measured data is recorded over a longer period of time. Consumption can be recorded during weekends and shutdown periods in particular, please see **picture 2**.

This is just a first step for optimising the whole system.

#### 3.2 The user-related analysis

Measurement of air consumption at several distribution stations immediately shows the high level of consumption of the individual departments, machines or systems. It quickly becomes clear which costs can be allocated to which point of measurement or department. This leads to a higher transparency of the air consumption costs, a greater feeling of responsibility and a more economic consumption.

#### 3.3 Improving the system

The measured consumption values enable a quick and easy improvement of compressor loads. The user receives an exact profile of the quantities of compressed air consumed, please see **picture 8**.

Evaluation of the measuring results also includes targeted leak detection and repair.

Leaks can be quickly and reliably detected with the **LD 300 ultrasonic detector**, even at a distance of several meters. The integrated laser helps to locate the leaks.



#### Picture 9 Finding leaks with the ultrasonic detector

When compressed air escapes from leaks, ultrasonic waves are created which cannot be heard by the human ear.

The **LD300 ultrasonic detector** transforms these inaudible ultrasonic waves into signal which can be heard in earphones.

The sound-proof earphones ensure that surrounding noise does not interfere with the detection.

The LD 300 locates compressed air escaping from fissures, worn flanged joints, faulty gaskets, leaky plug-in couplings and loose pipe connections with utmost precision.



**Picture 10 Checking for leakages in flanges**

For compressed air pipes running at great height it is possible to carry out checks from the ground using the telescope.

#### **4. Consumption analysis before and after leak repair**

Savings are very quickly evident if regular comparative measurements are carried out before and after detection and repair of the leaks.

These measurements should be carried out at regular intervals as leaks get larger over time and more and more air is lost in the process.

If these measurements are carried out continuously, steadily increasing compressed air loss will become a thing of the past.

If only approx. 10 % of the leaks are repaired in the very first stage, the savings can be several times as high than the purchase price of the measuring instruments, depending on the air consumption.

## 6. High quality standard of production

Apart from cost savings generated by leak repair, modern compressed air plants require continuous humidity control (e. g. **FA 300 dew point measuring instruments**) to avoid production stops.



**Picture 11 Continuous dew point control**

Even if the cooling temperature of a refrigeration drier seems to be correct, faulty steam traps, excess condensation in the refrigeration drier, corroded heat exchanger tubes etc. can cause an increase in humidity in the compressed air network.

In extreme cases this can cause production stops due to condensation accumulation. This situation should be prevented.

## Final reflection

With its precise multifunction measuring instruments **DS 300** and the ultrasonic leak detector **LD 300 CS Instruments GmbH** offers unique and practical measuring instruments for compressed air analysis and leak detection. In case of averagely 30 % leaks in standard industrial compressed air networks, there is no easier and better way of achieving savings than leak repair.

The purchase of these measuring instruments will be amortized after a short period of time.

If 2 or 3 leaks with a diameter of 1 to 2 mm are found by using these measuring instruments savings will cover the purchasing costs in just 1 year.

The tried-and-tested mobile and stationary dew point measuring instruments **FA 300** und **DP 300** finally complete our product range.

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