



## Turbocompressor Audit for Anti-surge Control and Reverse-flow Protection



Safe and Trouble-free Operation



## *Turbocompressor „surging“*

interrupts the downstream process and can quickly lead to severe damage. Anti-surge control and reverse-flow protection are key prerequisites that are implemented to ensure that the operation is not only reliable and safe, but also efficient.

During trouble-free normal operation, neither the anti-surge control nor the reverse-flow protection is engaged, which is why shortcomings of these systems are not immediately recognized. The operator assumes that the compressor is well protected, yet damage is caused to the machine and production comes to a standstill.

*Do you provably know  
the quality of turbocompressor monitoring  
at your plant?*



# kmo turbo

provides transparency and improves the production reliability with a new range of services: the turbocompressor audit.

## Benefits for Users

- Certainty about the actual state of your anti-surge control:
  - Control concept
  - Setting of the control characteristic
  - Correct control intervention
- Detailed image of the actual state of your reverse-flow protection:
  - Concept (surge detection and control sequence)
  - Determination of the surge line
  - Correct surge detection and correct control intervention
- Action recommendations for the efficiency improvement and optimization of your machine with the following objective:
  - Trouble-free, stable operation
  - Optimal utilization of the compressor characteristic and reliable protection of the compressor by means of an overriding security control
- Development of a compressor map, specifically for your machine. The axes will be dimensioned so that the operating values can be entered directly without need of conversion.
- Clear and comprehensive documentation

The turbocompressor audit by **kmo turbo** is definitely worthwhile:

- As user, you are given the opportunity to discuss all operating problems with a manufacturer-independent expert on turbocompressors.
- Experience has shown that even control settings implemented by OEM staff are often faulty.
- A setting that was once correct is not necessarily a long-term guarantee. Long-term operation can change boundary conditions; e.g. due to wear, soiled coolers, reduced flow, changed operating conditions etc. other parameters can be required.

## New Service Concept

**kmo turbo** offers turbocompressor users an anti-surge control and reverse-flow protection auditing service. The offer applies to compressors from all manufacturers. Electronic and pneumatic systems are checked as well as hydraulic-mechanical systems.

## Scope of the Turbocompressor Audit

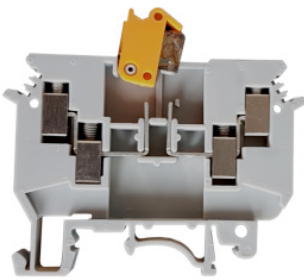
- Survey of control system and documentation
- Testing of both the capacity and the suitability of the anti-surge valve
- Function test of the anti-surge control
- Function test of the reverse-flow protection
- Measuring and creating of a compressor map
- Evaluation of the actual state
- System-related action recommendations and optimization proposals

*Knowing  
rather than  
suspecting*

## Step by Step towards Improved Performance

The plant will need to be shut down for several hours for the initial decoupling of the relevant transmitter signals and for the measuring run during blow off or bypass operation.

The mA signals of the transmitters are measured and recorded. To convert the measured values into engineering units, the calibration of the transmitter needs to be known!

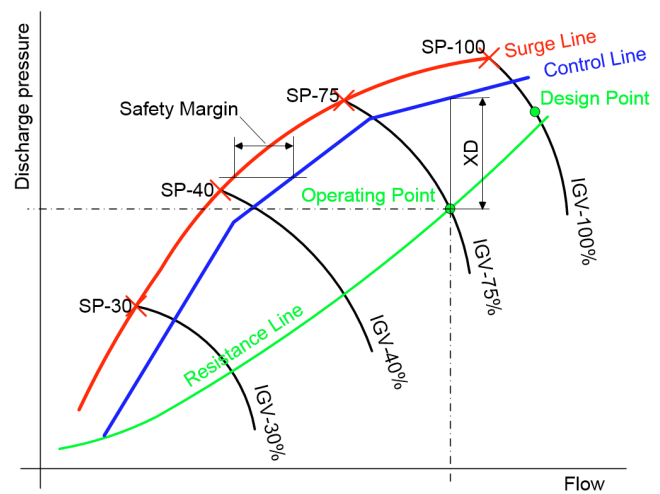


**kmo turbo** recommends installing double-level knife disconnect terminal blocks for decoupling transmitter signals. These allow future measurement of the mA signals without opening the loop.

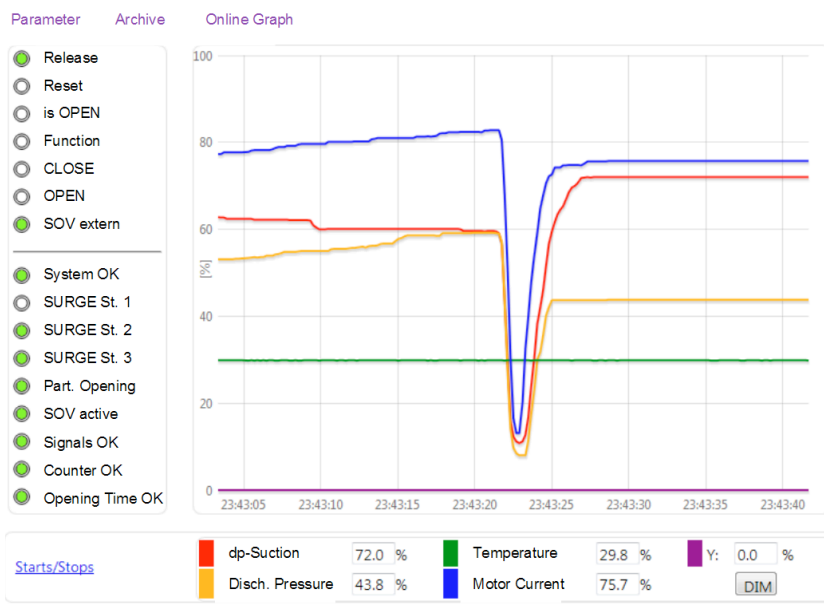
## Measuring of the Surge Line

The throttling of the anti-surge valve, the reliable detection of surge and the quick relief by opening the anti-surge valve all run automatically. The automated loading process can be stopped or manually influenced at any time.

The surge line of the compressor is measured during blow-off operation with at least three different flow rates (variation of the guide vanes, the suction throttle valve, the suction pressure etc.). During the test run the downstream process is disconnected. The discharge pressure, respectively the pressure ratio, is raised to "surge" by a slow throttling of the anti-surge valve. The graphical connection of the individual measuring points represents the surge line based on the current calibration of the transmitters.



Compressor map measured in dimension of operating values



Online graph during measurement

The function of the existing system is tested using the existing operating instruments (column A).

**kmo turbo** uses a special feature of the approved kmo Reverse-Flow Protection for the automated start-up and for the measurement of the surge line and the compressor map (columns B and respectively C). It's an own development based on the SIEMENS S7-1200 compact controller hardware

(W x H x D = 135 x 100 x 80 mm; 24 V DC), which is connected with a minimum of wiring parallel to the existing monitoring system.

All relevant measured values can be observed online in real-time; the values are also simultaneously evaluated and recorded in an internal memory.

| Test scope<br>Designation | A<br>Functional testing<br>ASC + RFP | B<br>Start-up/measurment<br>of surge line | C<br>Compressor<br>characteristics measure-<br>ment and evaluation |
|---------------------------|--------------------------------------|-------------------------------------------|--------------------------------------------------------------------|
| dp volumetric flow        | ✓                                    | ✓                                         | ✓                                                                  |
| Discharge pressure        | ✓                                    | ✓                                         | ✓                                                                  |
| Suction pressure          | ✓                                    | ✓                                         | ✓                                                                  |
| Inlet temperature         | ✓                                    | ✓                                         | ✓                                                                  |
| Y-ASV from ASC            | ✓                                    | ✓                                         | ✓                                                                  |
| Y-ASV kmo test unit       |                                      | ✓                                         | ✓                                                                  |
| Activation SV-PVV         |                                      | ✓                                         | ✓                                                                  |
| Guide vanes position      |                                      | ✓                                         | ✓                                                                  |
| ASV position              |                                      | ✓                                         | ✓                                                                  |
| Motor current/power       |                                      |                                           | ✓                                                                  |
| Mass flow                 |                                      |                                           | ✓                                                                  |
| Cooling water temperature |                                      |                                           | ✓                                                                  |
| Estimated duration        | max. 1 working day                   | 1 – 2 working day/s                       | 1 – 2 working day/s<br>+ evaluation                                |

*Required signals in accordance with the test scope*

## Comprehensive Specialist Expertise

Based on decades of hands-on experience the experts of **kmo turbo** can offer competent support in all matters relating to turbocompressors. All services and own products are characterized by profound practical orientation.

### Services

- Turbocompressor audit
- Troubleshooting
- Optimizing operations
- Commissioning
- Vibration monitoring

### New Developments

#### Based on SIEMENS S7-1200

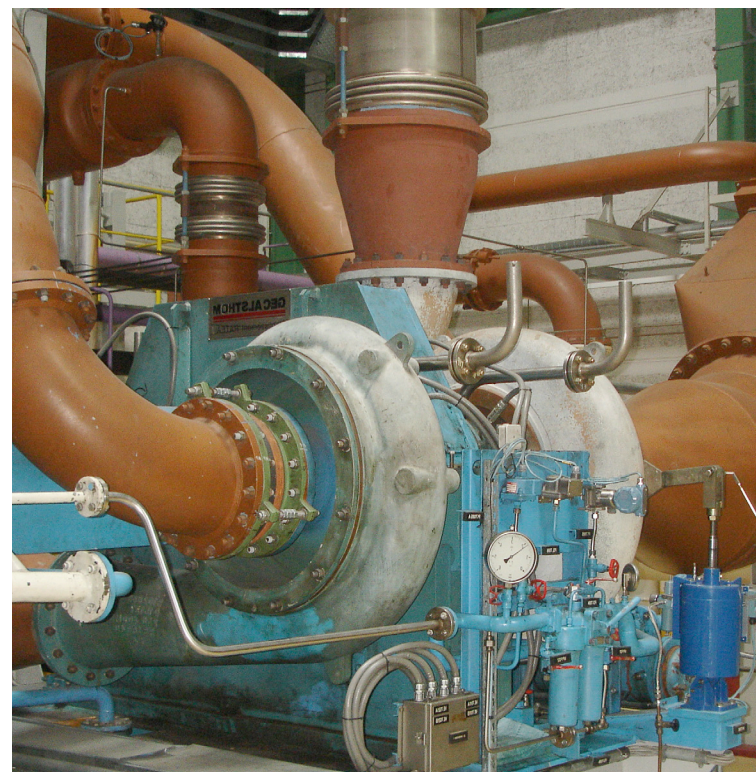
- Stand-alone anti-surge control with proven special features
- Stand-alone reverse-flow protection including multiple surge detection
- API670 compliant combination of anti-surge control and reverse-flow protection
- Master control for compressor management (load-sharing, automated start-up and shut-down etc.)
- Process control (pressure, flow etc.)
- Various limiting controls (motor current, system pressure etc.)

In addition **kmo turbo** offers further industrially approved control solutions for turbocompressors of all types.

## Advantages of the Used S7-1200 Controller

- Intuitive handling, parameterization and visualization during commissioning and service via web-based user interface
- Simple integration with higher-level controllers via Profibus, Modbus TCP etc.
- Diagnostic memory for all relevant signals with convenient evaluation options

*Practical expertise –  
maximum efficiency*



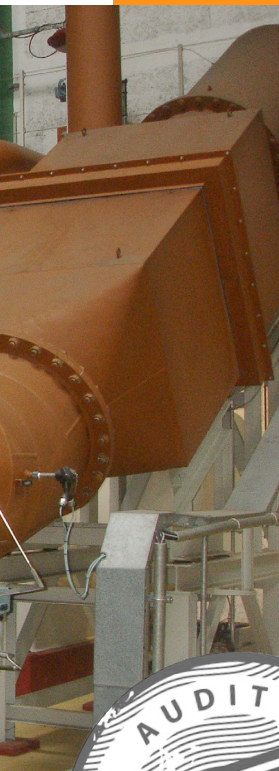
## *Systematically safe*

The task of the anti-surge control is to prevent surging; this intervenes shortly before the operating point exceeds the stable range of the compressor map. A malfunction of the anti-surge control can be very inefficient and adversely affects the downstream process.

In order that an anti-surge control works properly, each of the involved components have to work and be adjusted properly; just one leaky sensing line for instance can lead to total breakdown. Thus, as an additional safety, kmo turbo recommends a reverse-flow protection to protect the compressor against destructive persistent surging.

Although a reverse-flow protection typically uses the same transmitter signals as the anti-surge control, a reverse-flow protection is more reliable: the anti-surge control processes absolute values, whereas the reverse-flow protection responds to rapid signal changes (gradient monitoring).

Machine damage caused by surging usually leads to a long-lasting loss of production. Still many compressor users don't implement reverse-flow protection for the sake of cost saving, sometimes however with fatal economic consequences.



*The safety, availability and economic efficiency of the overall system depend on the surge monitoring. In view of the variety of possible malfunctions, regular testing should be an integral part of your quality management.*

Your competent partner for trouble-free, stable operation:

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