magazine for innovative gasket technologies and applications – by revoseal

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How changing a simple part changes it all in HIGH TEMPERATURE PROCESSES

# REDEFINING SUSTAINABILITY

-> High temperature processes • Revolutionary insight • Sealing technology • Intensive trade relations • TA Luft

*Dr. Ulrich Horsmann,*
*CEO Xeless Group*

# Dear Readers,

**Welcome to the first issue of "Revo News". This new magazine will report on a semi-annual basis on topics of sealing technology and related applications.**

Two years ago, when we decided to acquire the assets of the company Jungtec GmbH hence creating the basis of Revoseal Europe GmbH, we were fully aware that we were entering a completely new area within the Xeless group. Xeless GmbH, a strongly service oriented and globally active company, was enhanced by a production facility of the sealing industry that is well-known for its innovative solutions and technologies going far beyond standard solutions.

The consistently patented products are problem solvers in many industries. As a better, safe and environment-friendly alternative they have also the potential to replace established and well-known standard products. In this issue of "Revo News" you will find a specialist article dealing particularly with the tanged graphite seals standards, depicting their weak points and finally characterising the ultimate approach: The utilisation of Revoseal Revolution.

A further, very application-oriented topic is the utilisation of seals in high-temperature ranges above 450° C. In this area Revoseal not only offers suitable products but is also able to give calculated proof of the tightness according to the newest standards. This subject is excellently complemented by Prof. Alexander Riedl's elaboration concerning the redrafting of the German "TA Luft 2016" standard.

However, what benefit the best seals would provide without a professional maintenance? For this reason we are publishing in this first issue of "Revo News" an interview with an experienced maintenance manager from the industry.

*We would like to establish "Revo News" as a publication which will highlight interesting industrial developments and innovations. We look forward to your suggestions and contributions our future issues.*

## Content





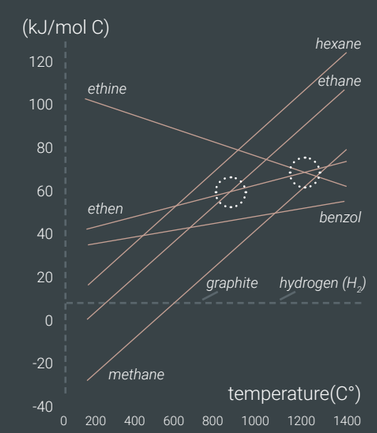
# 23.000.000

Did you know that the steam cracker in chemistry is the starting point of many plastic products of daily use and that the total capacity of steam crackers in Europe amounts to 23 million tons per year (as measured by ethylene)?

## Steam cracking

Steam cracking is a complex thermal cracking process that is performed in presence of steam. This procedure generates the basic components of the chemical industry with a capacity of 23 million tons per year in Europe alone. These are, for example, reactive low-molecular compounds such as ethylene or propylene.

The following chart demonstrates that this process requires very high temperatures.




### A typical naphtha steam cracker provides the following products (in % of mass)

| | |
|---|---|
| hydrogen | 2.0 % |
| methane | 15.4 % |
| Ethyne | 0.4 % |
| ethene | 28.7 % |
| ethane | 3.9 % |
| propene | 16.1 % |
| propane | 1.2 % |
| butadiene | 4.3 % |
| butene | 5.5 % |
| pyrolysis gasoline | 19.6 % |

The most important downstream products (derivates?) of ethene are for example polyethylene (56 %), ethylene dichloride for the production of PVC (14 %), ethylene oxide (11 %) and ethyl benzene (7 %) for the production of polystyrene.

Propene is used for the flame cutting and similar applications. Furthermore, it is one of the most important basic materials of the chemical industry and serves to the producion of many other downstream products (derivates?).

These, in turn, are used for various purposes such as bleaching agent for paper and plastic materials (e.g. polypropene for smartphone displays). The cracker comprises various temperature zones (ranges?) 150 – 170 °C; 350 – 400 °C; 550 – 600 °C and 805 – 850 °C in which the several chemical processes take place.

In every zone, gaskets are exposed to high permanent loads.

**Did you also know that Revoseal Europe GmbH provides high-performance gaskets for all these zones and, in addition, is also able to reduce the variety of previously utilised standard gaskets to a few specific products (usually two)?**

# Reliable control of high temperature processes and reliable calculation of sealing joints

## Features of the revoseal JP gasket

- Temperature: - 200°C to + 1000°C (dependent on the carrier material)
- Pressure: from a vacuum up to 400 bar (1,500 lbs)
- Lowest leakage rates of all gaskets available on the market
- As to device flanges, the effective gasket width can be adapted in order to achieve optimum sealability in accordance with the Technical Instructions on Air Quality Control (TA-Luft), **VDI 2290** according to **DIN EN 1591** standards.
- Standard material: 1.4571 (additional materials on request)
- Total thickness 4.2 mm (additional thicknesses on request)
- The gasket is used in the following working areas: welding neck flange welding neck flange (full or raised face), tongue and groove, male and female facings, groove against smooth sealing as well as rectangular profiles.
- certificates: EN 13555 gasket characteristic values, FDA conformity (PTFE version), Firesafe API607 / DIN EN ISO 10497, TA-Luft (including blow-out resistance according to VDI 2200)

**If certain working processes require temperatures in the high three- or even four-digit range it is necessary that gaskets withstand these extremely high loads. In order to meet such conditions high temperature gaskets are used. Ideally they are extremely resistant, have a long life cycle and seal reliability.**

The example of a medium-sized chemical company which decided for the installation of the revoseal high temperature gasket JP in its technical facilities shows that this product is convincing on various levels. On the one hand the patented geometry of outer and inner cogging completely encapsulates the graphite or PTFE layers. In addition the tooth geometry was calculated in such a way that even in case of using low quality bolts an ideal compression of the graphite layers and a double metallic sealing can be achieved. While the abilities of commercial grade semi-metallic gaskets are limited for the permanent use to max. 400 °C, the metal teeth of the revoseal JP gasket form a unit with the surface roughness of the flange, encapsulate the graphite and prevent contact with oxygen. This principle allows a reliable sealing at temperatures of up to 1000°C. Usually graphite starts coking or burning at temperatures beyond 400 °C when it comes into contact with oxygen. That leads to an immediate failure of standard gaskets.

*This is not the case with the Revoseal JP. For this gasket generation there are now gasket characteristic values available according to EN13555 standard for the strength calculation at 600 °C. Until now our competitors have only determined temperatures up to 400 °C, so that it can rightly be claimed that the JP gasket has started a new era in the sealing industry.*

Within the mentioned example the gaskets come into contact with ethylene dichloride (EDC), vinyl chloride (VC), hydrogen chloride (HCL) and steam. The encapsulated flat profile gasket was successfully implemented under the following operating conditions in appliances and pipelines:

- pressure: 40 bar
- temperatures: up to 700 °C
- medium: flue gas

The JP gasket not only enhances the plant availability, but also the safety standards are significantly higher. Thus at the same time installation and maintenance cost are reduced.

# Revolutionary insight

## Spring-tooth seal surpasses tanged graphite

**An investigation commissioned by the company Revoseal Europe GmbH based in Pulheim near Cologne opens a new chapter in sealing technology for the process industry. The study by GAIST Dichtungstechnik GmbH, a Fachhochschule Münster spin-off, compares a classic tanged graphite seal with a spring-toothed seal from Revoseal. Under realistic test conditions, it is especially clear how fault-prone the old technology is already in the installation. The consequences range from leakages to complete failures of the sealing system – with corresponding cost-intensive consequences for repair and shutdowns: Saving potentials in millions of Euros are wasted annually in the German process industry only.**

The holistic approach of a flange connection has become state of the art with the VDI guideline 2290. However, comparative tests on the basis of this directive are still a rarity. The present study shows that the sustainable economy of an installation alone should determine the selection of the sealing technology used. The right sealing technology, the appropriate geometry and the easiest possible installation are the parameters that determine the error rate of a connection and their sustainable future. The compliance with the TA-Luft criteria is a huge challenge for a large number of current sealing systems.

## Best Results

*The GAIST test arrangement uses a DN50 PN40 flange – a particularly problematic but often used composite due to its geometry and number of screws – under realistic conditions.*

In contrary to the laboratory scale, the experiment takes account into the actual conditions of a connection with all the forces acting on the flange. A pressure of 40 bar was selected for the test. The study compares a tanged graphite seal with a spring-toothed seal (Revoseal Revolution) comparing the torque applied during installation and the resulting leakage potential of the flange connection. When using a M16 screw of quality class 5.6 and 90 % utilization of the screw stretch limit, the Revoseal Revolution is 80 times tighter than the leakage class L0,01.

By following the VCI mounting recommendation for 25CrMo4 screws or A2-70 screws – it is even 250 times denser. However, it is particularly dramatic that the old-fashioned tanged graphite gasket reaches the VDI2290 sealing class L0.01 only at a tightening torque of approx. 170Nm. A value which is far above the VCI recommendation and therefore can easily cause damage to the assembly.

## Maximum tightness and operational safety

The result clearly shows the Achilles heel of the DN50 PN40 flange and how difficult it is to reach the required surface pressure. The spring-toothed seal Revoseal Revolution achieves this with 5.6 screws, which are still used today in a variety of companies. It guarantees maximum tightness and operational safety and can thus avoid high conversion costs. Mounting errors in the form of insufficient tightening torque no longer lead automatically to a failure of the flange connection with high consequential costs. It can therefore be said that, in practice, spring-tooth seals are permanently tight.

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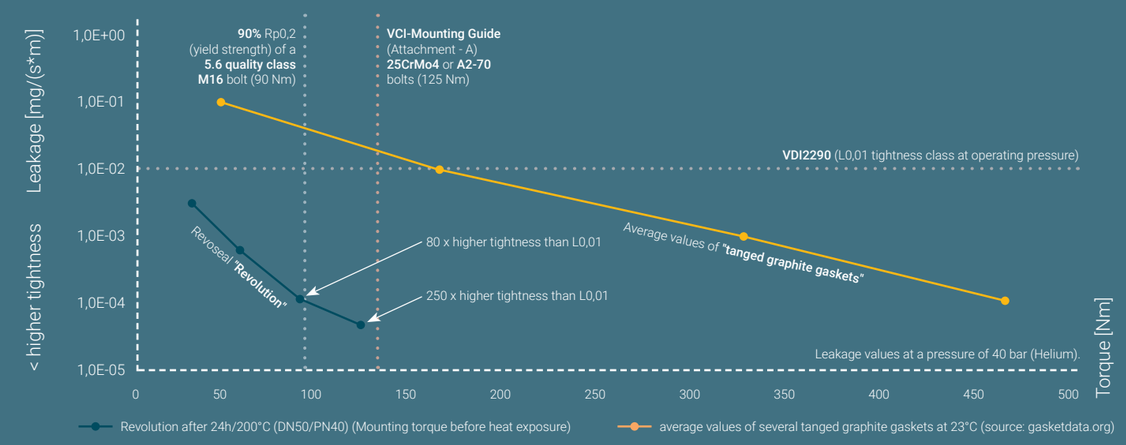
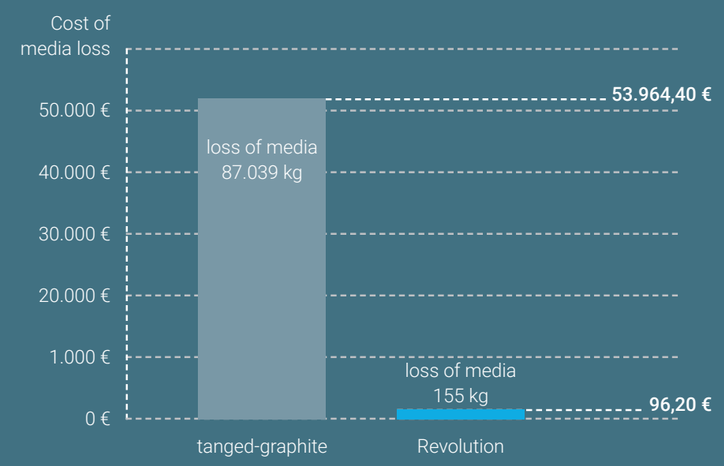
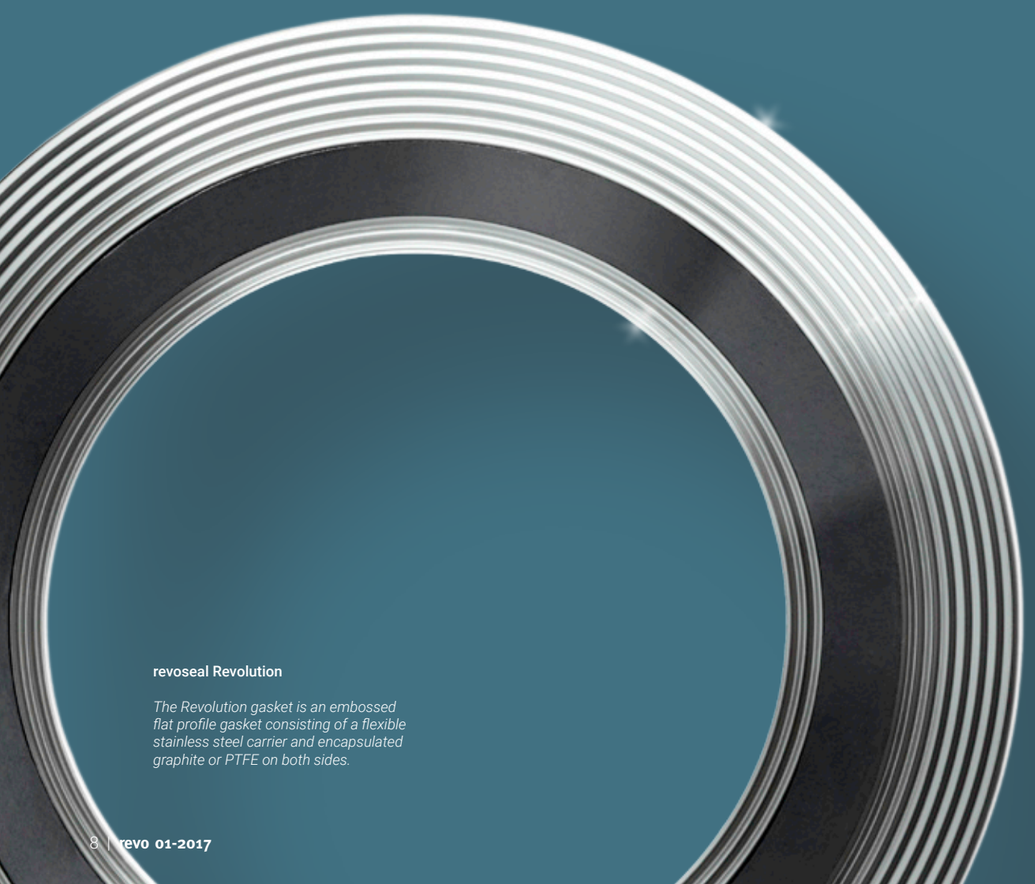


## Loss of diffuse emission per manufacturing cycle



**revoseal Revolution**

*The Revolution gasket is an embossed flat profile gasket consisting of a flexible stainless steel carrier and encapsulated graphite or PTFE on both sides.*



## About Lifetime-Costs

**The economic damage caused by material losses and diffuse emissions is clearly shown in the following example of an ethylene processing plant using 25CrMo4 screws (torque: 125Nm, according to VCI guidelines).**

**Operating parameters:**

- 50,000 sealing connections
- averaged sealing circumference: 0.48m
- Production cycle: 5 years
- Ethylene production costs: 0.62 € / kg
- Leakage Tanged Graphite Seals *1 0.023000mg / (s * m)
- Leakage Revoseal „Revolution“ *1 0,000041mg / (s * m)

**1) Examination GAIST*

When using expanded graphite gaskets in connection with 5.6 screws, an additional investment of more than 400,000 EUR would be necessary only for high-quality screws to achieve seal class L0,01. This investment can be avoided through the use of spring-toothed seals.

## About spring-tooth seals

**The spring-toothed gasket is characterized by the following advantages:**

- The Revoseal Revolution is an embossed flat profile seal, made of a flexible stainless steel carrier with two layers, either of PTFE or graphite.
- The excellent spring characteristics compensate pressure and temperature fluctuations. It is not necessary to retighten the screws.
- The construction and flexibility of the embossed teeth ensures a double metallic seal as well as the encapsulation of the PTFE or graphite.
- Easy installation due to thin construction.
- Due to the narrow layers, only very small screw forces or surface pressures are required.
- Certificates: EN 13555 Gasket values, FDA conformity (PTFE version), Firesafe API607 / DIN EN ISO 10497, TA-Luft (including blow-out safety according to VDI 2200).

## About Revoseal

„Awesome applications require awesome gaskets“ is the mission statement of the Revoseal Group, an entity of the XELESS Industrial Holding. The revolutionary spring-tooth technology of the Revoseal gaskets is appreciated by the international process industry as of its superior tightness and its durable performance. The product portfolio includes the product families Eco+, Revolution, Visio, Vario und JP/JG and is straightened to all applications in the process industry, Oil &Gas, Chemical and Petrochemical manufacturing and Pharma and Food.as well as engineering solutions for the machine industry..

www.revoseal.com

# Closer look: Turnaround Management

## An interview with Michael Heb, Kiel Montagebau GmbH

**The planning, management and performance of plant shutdowns and large-scale repairs in refineries, petrochemical and chemical enterprises is a big challenge. Why?**
Heb: Because such a procedure needs to consider different aspects. First of all customers are increasingly requesting shorter downtimes in order to save costs and to return to normal operation as quickly as possible. This is understandable, but requires an entirely different planning and organisation. Furthermore, within the review of the parts of installations regularly occur additional unplanned works. Nevertheless, the schedule for the machine stoppage is to be adhered to restart production machines on time. Another challenge is in the area of human resources, especially with regard to the shortage of skilled professionals or staff transfers due to delays. It is also important that everyone has access to the same resources. Finally, the material is an important factor as well. Special emphasis is placed on old-new-pairings and the utilisation of new gaskets on old types of flanges. Rule of thumb: In each project the key elements installation, material, tool and quality assurance have equally to be taken into account.

**How much time usually takes a plant shutdown and what costs are generally associated with it?**
Heb: This question cannot be answered generally, because each business is different. Elements to be used for the calculation are for example size of the plant, process engineering, accessibility, components requiring testing, welding work, maintenance, replacement of components, related areas and many others. Just to take the example of a current project in an acetylene plant of BASF, conducted by the Kiel Montagebau GmbH. The countdown phase as well as the standstill time will take two months each. Temporarily there is involved a staff of up to 90 people. The cost of the mechanical maintenance alone amount to one million euro. Additional costs occur in related areas, transports, special tools, auditors, personnel for plants and TA etc.

**What is crucial for a good shutdown management?**
Heb: It requires a good preparation and afterwards a successful machine stoppage.

**For what reason it is necessary to shut down major industrial plants periodically at all?**
Heb: There are several reasons, for example if certain components are defective or facilities must be cleaned and maintained or if legally specified inspection intervals must be observed.

**Which components are of particular importance within the maintenance?**
Heb: Especially facilites and machine components which are subject to abrasion and wear. In addition, there are facilities and machine components with specific stresses by high pressure, high thermal stress, chemical strains and safety techology components.

**Which role does the sealing technology play in this context? In other words: Which positive effects can have a small but highly efficient component like the spring-tooth seal?**
Heb: A gasket alone does not lead to success, but an interaction of technician, gasket and screw joint system. However, the quality is, of course, very important, because high-quality gaskets are able to compensate pressure and temperature changes hence reducing harmful emissions.

*Michael Heb, Materials Processing Engineer*

### About Michael Heb

Dipl.-Ing. (FH) /SFI / IWE Michael Heb has worked for Kiel Montagebau GmbH as a site manager at BASF SE Ludwigshafen and as a key account manager at BASF locations in the sectors industrial pipeline construction and maintenance since 2015. His comprehensive know-how in the working areas maintenance and machinery shutdown results from his more than 20 years of professional experience that he gained in different companies and projects.

### About Kiel Industrial Services AG

Kiel Industrial Services AG was founded in 2006 in Nördlingen (GER). The foundation for today's structure as a German AG was laid already in 1944 in Witten / Ruhr (GER) with the foundation of the company Kiel Rohrleitungsbau. Under the holding Kiel Industrial Services AG there are operating today in total 15 legally independent companies, which have established themselves during the recent years to international service providers in industrial services. The range of services of this companies covers the complete life cycle of process plants. The portfolio of these companies meets the integrated principle of a comprehensive industrial service for the business segments engineering – maintenance – turnaround – project.

Customers are globally operating group companies ranging from chemical, petrochemical, pharmaceutical to food industry as well as to refinery, power plant and energy system operators.

# New draft design of TA Luft

## The most important changes at a glance

Prof. Dr.-Ing.
Alexander Riedl

Head of the Center of Sealing Technologies at the Fachhochschule Münster

**The "Technical Instructions for the Protection of Air - TA Luft" of the German Federal Government is currently being revised after 14 years without any changes and adapted to the state of the art. At present there is a draft report of TA Luft (as of 9.9.2016), although it has to be assumed that minor amendments will be made in the further legislative process. Irrespective of this, the main adjustments and their effects on plant operators and seal manufacturers are discussed below.**

In section 5.3.6.1, mixers were added in addition to already listed pumps in 2002. Possible sealing variants for closed mixers are double-acting mechanical seals, multi-chamber sealing lip systems or magnetic couplings. The tightness has to be ensured by means of barrier media with suitable monitoring. If no closed mixers can be used, the emissions must be excluded by means of, for example, a vacuum system or collected by means of gas collecting systems. For existing sealing systems, however previously used sealing systems may continue to be used until replacement.

In section 5.2.6.3 Flange connections the most significant changes were made. In the future, all flange connections with static-acting seals will meet the TA Luft, provided that "the leakage class L0,01 with the corresponding specific leakage rate ≤ 0,01 mg/s/m for the test medium helium" is not exceeded. If flange connections can be calculated according to DIN EN 1591-1, the proof of leakage must be done according to this calculation standard. Typical representatives are flange connections according to DIN EN 1092-1.

In order to perform calculations, gasket values according to DIN EN 13555, which are typically provided by gasket manufacturers, must exist. Many characteristic values can be viewed and downloaded free of charge on the gasket database www.gasketdata.org. In addition, as it has been the case up to now, the specific tightness for a certain gasket must not exceed a leak rate of 0,0001 mbar·l/s/m. This has to be proven by means of a component test according to VDI 2200. The two tightness values 0,01 mg/s/m and 0,0001 mbar·l/s/m are clearly different in magnitude. The units are also different. The differences in the amount are due to the fact that a differential pressure of 1 bar is tested during the component test but the tightness proof according to DIN EN 1591-1 must be carried out with real, typically higher pressures.

For a large part of flange connections, however, no tightness calculations according to DIN EN 1591-1 can be done. Examples include flanged connections made out of

- Glass-lined Steel
- Plastic or FRP
- Lined pipes (often with PTFE) with flanges
- Aseptic flanges, for example according to DIN 11864, etc.

*For these flange types, no computational leakage proofs can currently be provided. For this reason, the draft design requires a leakage test with a maximum permissible leakage rate ≤ 0,01 mg/s/m for the test medium helium, which is based on the component test according to VDI 2200.*

However, contrary to the component test with the permissible leakage rate of 0,0001 mbar·l/s/m, with which a differential pressure of 1 bar is tested, the respective pressure-temperature combination is considered as a test variable. In particular, the increased pressure is a decisive difference, but this is taken into account with a higher tightness class. Note, however, also here the different unity of the tightness class (see above).

This means for plant operators and gasket manufacturers that appropriate component tests must be carried out for all non-calculable flange connections. Only when the component test with the increased internal pressure/temperature ratio has passed the above mentioned test, these flange connections be used. It should be emphasized that a combination of flanges of a particular manufacturer and a seal type, also of a certain manufacturer, must always be tested. In practice, these combinations must also be used. As already mentioned for mixers, existing sealing systems, may be used until replacement.

Orientation tests by the company GAIST GmbH, a spin-off of the Münster University of Applied Sciences with the participation of the Transfer Agency of Münster University of Applied Sciences, showed that the requirements of the component test represent a relatively high hurdle for many common flange sealing combinations. Glass-lines steel connections meet the requirements even with high-quality seals only partially. The same applies to plastic, FRP and lined connections, whereby the diffusion through the pipeline or the liner material itself can represent a significantly high proportion of the leakage. Here, in the foreseeable future, deeper understanding must be gained. With regard to aseptic flange connections, no problems are to be expected when using rubber gaskets, but when using hard seals, for example based on PTFE, passing the component test will depend strongly on the type of mounting and the available sealing forces.



## Conclusion

For all above mentioned flange connections, it should be emphasized that the draft design requires the implementation of VDI 2290. This means, in particular, that assembly instructions must be made available to the fitters. Again, this means that suitable specifications have to be worked out, for example torque-tables. As a result, fitters must be trained, see DIN EN 1591-4. Finally, the procedure must be secured within the framework of a suitable quality assurance.

In sum, also with regard to the experience gained so far in the purposeful implementation of VDI 2290, it is to be expected that the initially higher expenses in the examination, training and determination of default values will be more than compensated by lower leaks and a higher availability of the process units. This benefits both the environment and gasket manufacturers and in particular plant operators.

Finally, it should be noted that section 5.2.6.4 Shut-off devices also included ball valves in the TA Luft view. The valves must then be tested in accordance with DIN EN ISO 15848-1. As already mentioned above, existing valves, may be used until replacement.