

# PIONEERING LOW FUGITIVE EMISSION TECHNOLOGIES

Burgmann Packings



## **PIONEERING LOW FUGITIVE EMISSION TECHNOLOGIES**

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# FUGITIVE EMISSION MANAGEMENT

## **SUSTAINABLE SOLUTIONS**

Pacesetter innovations, uncompromising quality and tailored solutions are our strengths. Our quality products and reliable performance have earned us long-term business relationships with international corporations. We work together with industry specialists to collect data that enables us to push the performance of our products further and further. We highly appreciate the permanent dialog with our customers and our hands on approach enables us to create cost-effective, but sustainable solutions to meet our clients most challenging enquires. We believe in sharing our knowledge with the aim to make sealing technologies more efficient and support our clients' effort to reduce their environmental impacts and increase the operating efficiency of plants worldwide.

## **OUR EXPERTISE**

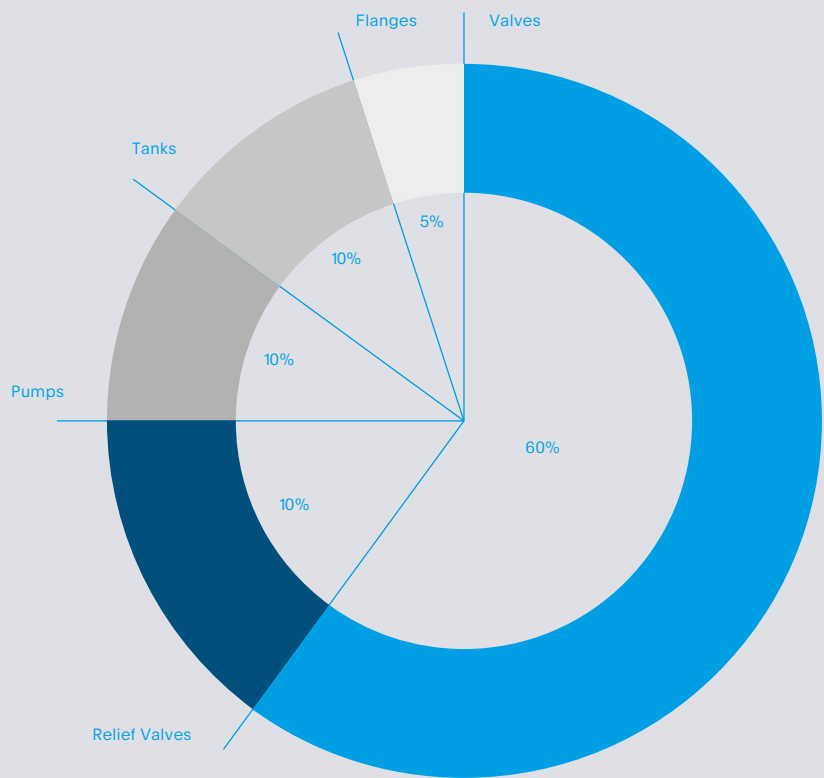
Burgmann Packings offers the complete range of low fugitive emission sealing products – for both new valves and retrofits. When combined with an application specific live-loading system they achieve leakage rates which are consistently lower than those required by legislation. Our low fugitive emission sealing products comply to ISO 15848 (Parts 1 and 2), Clean Air Act, API 622, API 624, VDI 2440 and TA Luft. Valves, especially control valves, account for approximately 60 % of the leakage loss in a plant. For processes containing hazardous fluids conventional packings can be replaced with low emission sealing sets. Burgmann Packings fugitive emission control (FEC) sealing products are ideal to increase plant safety and efficiency and to improve environmental protection. This is why our "Best Available Technology" (BAT) products are approved at leading end users and OEM manufacturers.

**We work together with industry specialists to collect data that enables us to push the performance of our products further and further.**

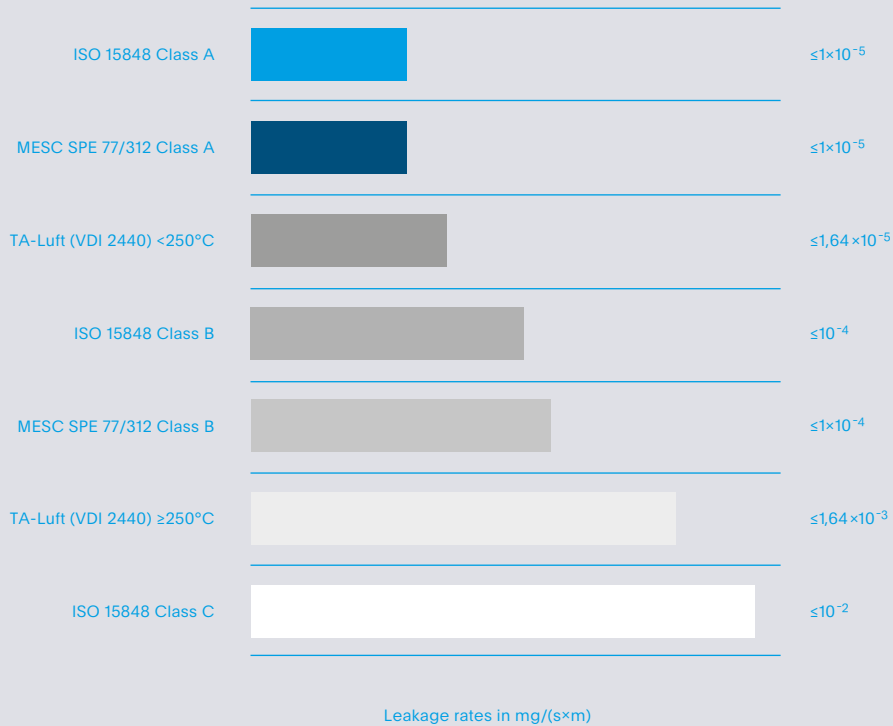


Leak Detection and Repair programs have shown to be a key lever to reduce the overall site emissions.

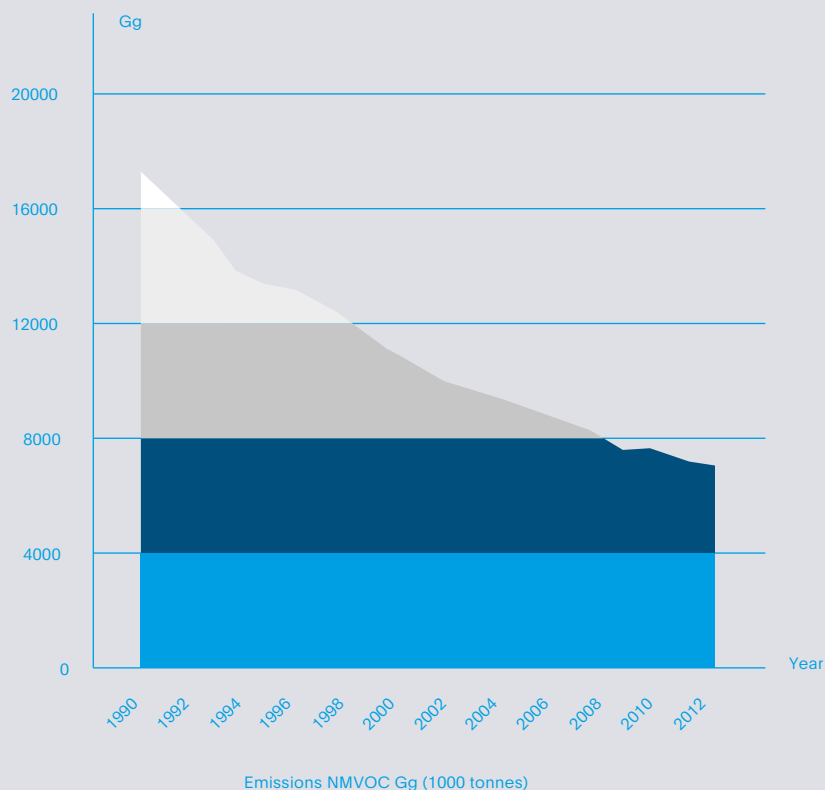
# SOURCES OF EMISSIONS



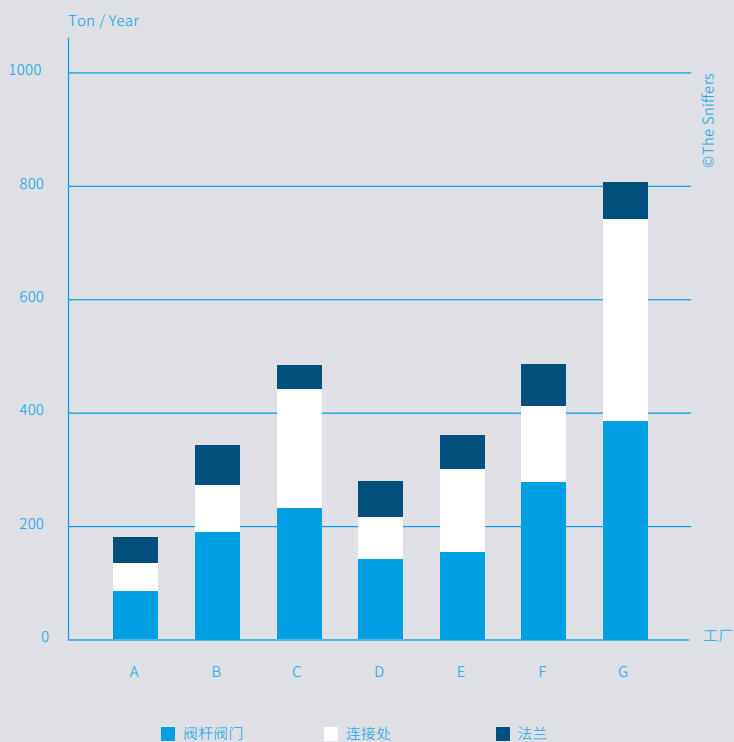
# EMISSION STANDARDS



## REDUCTION OF EMISSIONS



## SOURCES OF FUGITIVE EMISSIONS



Life-cycle cost analysis show that leakage reduction of expensive process media will also improve the bottom line.



**Surveys have shown that the vast majority of emissions arise from valves and flanges, whereas the biggest issues arise from valves.**

#### **STANDARDS AND REGULATIONS**

Fugitive Emissions usually defined as gases or vapors, which leak unintentionally from industrial installations, have a significant impact on health, safety and environment. Surveys have shown that the vast majority of emissions arise from valves and flanges, whereas the biggest issues arise from valves. The good news is that with an integrated approach these emissions can be significantly reduced. In Europe, for example, the Non Methane Volatile Organic Compounds (NMVOC) have been reduced from 1990 – 2011 by 57%. This development has been fostered and accelerated by the legislative frameworks, e.g. the European Directive Industrial Emission Directive IED2010/75/EU and the European Integrated Pollution Prevention and Control (IPPC). The concept of Best Available Techniques (BAT) and the BREFs Reference documents have supported the end-user efforts to comply with stricter emission standards, which have been transformed into national standards like the TA Luft in Germany. Burgmann Packings actively contributes to this process by developing and manufacturing Fugitive Emission Control (FEC) products to meet and exceed the lowest emission regulations. Besides comprehensive internal testing these products have been certified by independent testing institutes to comply with the latest emission standards like ISO 15848, TA-Luft or API regulations.

Evidence has been shown world-wide that another key lever to reduce the overall site emissions are Leak Detection and Repair (LDAR) programs. These programs produce transparency, where the biggest leaks occur and where maintenance activities should be focused on to produce short-term, high impact results. The Sniffers, a market leader in LDAR Fugitive Emission Management Program has completed more than 6.000 LDAR projects around the world over the past 25 years. Data from a Emission Reduction Program in a European refinery show that an annual reduction of emissions by 75% can be achieved if an aligned and effective program has been implemented. Compliance however is only one benefit for the plant operator. The improvement of various HSE (Health, Safety and Environment) factors create measurable results. In addition, Life-cycle cost analysis show that leakage reduction of expensive process media will also improve the bottom line. To learn more about these opportunities browse our website or contact Burgmann Packings engineers. To learn more about LDAR services we recommend to visit [www.the-sniffers.com](http://www.the-sniffers.com).



# FUGITIVE EMISSION CONTROL PACKINGS

**We have invented the mechanically braided, self-lubricating packing in 1884. Since then we have built a legacy of pacesetting innovations, uncompromising quality and tailored solutions for our global customers. Today our braided packings are the preferred choice for end-users and OEM customers around the globe.**

**Beginning of the 21st century we were among the first manufacturers, which presented the first generation of Fugitive Emission Control (FEC) sealing solutions.**

**Today we offer a complete range of low fugitive emission sealing products – for both new valves and retrofits. Off-the-shelf or tailored to your individual needs. Combat-tested, certified and safe.**

**Burgmann Packings Fugitive Emission Control Packings comply with world's strictest standards including TA LUFT, ISO 15848, API 622, API 624, API 641, API 607 and API 589.**



## BPG 7200

### PROPERTIES

This packing is made from high grade impregnated non-woven materials. The rings consist of aramid non-woven fibers with a special PTFE impregnation and are suitable for Low Emission applications.

### APPLICATIONS

The product is designed for use in valve applications.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-200°C...+280°C
PH Value	0...14
Pressure	25 MPa

### PRODUCT SPECIFICATIONS

Media	Most chemicals* (solvents, hydrocarbons, acids, lyes), alcohols, water, oils etc.
Certificates / Approvals	TA Luft, ISO 15848

\*Exceptions: highly concentrated acids and lyes, fluorine and some fluorine compounds

## BENEFITS

- Extremely low leakage rate
- High cross sectional density and stability
- Excellent low friction properties
- Suitable for applications which require high cleanliness



## BPG 7250

### PROPERTIES

State of the art sealing technology by combination of two non-woven materials. The end rings are made of non woven fibers with a high carbon content. The intermediate rings consist of aramid non-woven fibers with special PTFE impregnation.

### APPLICATIONS

The product is designed for use in valve applications.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-200°C...+280°C
PH Value	0...14
Pressure	25 MPa

### PRODUCT SPECIFICATIONS

Media	Most chemicals* (solvents, hydrocarbons, acids, lyes), alcohols, water, oils etc.
Certificates / Approvals	TA Luft, ISO 15848

\*Exceptions: highly concentrated acids and lyes, fluorine and some fluorine compounds

## BENEFITS

- Ideally suited for control valves in fugitive emission applications
- Excellent resistance against gap extrusion





## BPG 6552

### PROPERTIES

BPG 6552 is braided from special expanded graphite yarn and over knitted with stainless steel wire. It contains a high temperature impregnation as well as a corrosion inhibitor. Due to the high wire content it can be used without end rings.

### APPLICATIONS

The product is designed for use in valve applications

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-200°C...+450°C (most media) -200°C...+650°C (steam)
PH Value	0...14
Pressure	45 MPa

### PRODUCT SPECIFICATIONS

Media	Hot water and steam, gases, oils, acids* and alkalis.
Certificates / Approvals	TA Luft, ISO 15848, API 622

\*Exceptions: Strong oxidizing acids like sulphuric acid and nitric acid in high concentrations.

## BENEFITS

- High temperature and chemical resistance
- Dense and resilient
- Excellent sealing effect and constant elasticity
- Good extrusion resistance at high pressures



## BPG 6559

### PROPERTIES

This packing is braided from high purity expanded graphite material (C-content >98 %) and over knitted with Inconel wire. It contains a special high temperature impregnation and a corrosion inhibitor.

### APPLICATIONS

The product is designed for use in valve applications.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-200°C...+450°C (most media) -200°C...+650°C (steam)
PH Value	0...14
Pressure	45 MPa

### OPERATION PARAMETERS

Media	Hot water, steam, gases, oils, acids* and alkalis.
Certificates / Approvals	TA Luft, ISO 15848, API 622, API 589 (fire safe), Chevron and Texaco Test

\*Exceptions: strongly oxidising acids like sulphuric acid and nitric acid in high concentrations

## BENEFITS

- High pressure resistance
- Excellent performance for fugitive emission and TA Luft valves
- Quick repair for all valve dimensions



## BPG 7290

### PROPERTIES

This packing is based on braided end rings of expanded pure graphite reinforced with carbon yarn corners. It has high density expanded graphite disks with permeation barrier and uniquely impregnated high density expanded graphite adapter rings and low density expanded graphite sealing ring with special friction reducing coating.

### APPLICATIONS

The product is designed for use in valve applications.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-200°C ... +400°C (most media) -200°C ... +550°C (steam)
PH Value	0...14
Pressure	30 MPa

### PRODUCT SPECIFICATIONS

Media	Most chemicals (solvents, hydrocarbons, acids, lyes), steam, alcohols, oils etc.
Certificates / Approvals	TA Luft, ISO 15848, API 622, API 589 (fire safe)

## BENEFITS

- Up to 80 % lower friction compared to standard sealing systems made of expanded graphite
- Very low spindle torques at high temperature
- Low compression required due to optimized force deflection



## BPG 6500

### PROPERTIES

This packing is braided from special expanded graphite foil material over knitted with a high tensile strength fiber. It contains a high temperature impregnation as well as a corrosion inhibitor. This pressure-resistant braided packing has an excellent sealing effect and it fulfils fugitive emission and TA Luft requirements. It contains a high temperature lubricant which ensures low friction forces which guarantees long service life in control valves.

### APPLICATIONS

This packing can be used for on/off and control valve applications in process industry. It is particularly suited for fugitive emission applications.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-200°C ... +380°C
PH Value	0 ... 14
Pressure	25 MPa

### OPERATION PARAMETERS

Media	Hot water and steam, gases, oils, acids* and alkalis.
Certificates / Approvals	TA-Luft, ISO 15848, API 622

\*Exception: strongly oxidizing acids like sulphuric acid and nitric acid in high concentrations.

## BENEFITS

- Special expanded graphite yarn
- High temperature and chemical resistance
- Excellent sealing effect and constant elasticity
- Outer yarn reinforcement
- Good extrusion resistance at higher pressures



## BPG 6350

### PROPERTIES

This packing has a carbon yarn core and is concentrically over braided with a dense PTFE yarn sleeve. In addition it contains a special impregnation to enhance the cross-sectional density of the packing.

### APPLICATIONS

This product is designed for the use in fugitive emission on/off and control valves. It is very flexible and retains sufficient gland pressure even after several temperature cycles without retightening. Ideal for ISO 15848 qualification.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-100°C ... +280°C
PH Value	0 ... 14
Pressure	30 MPa

### PRODUCT SPECIFICATIONS

Media	Hot water, alkalis, organic solvents, gases, oils, greases, medium concentration acids* and lyes.
Certificates / Approvals	TA Luft, ISO 15848

\*Exceptions: strongly oxidising acids such as sulphuric and nitric acid in high concentrations.

## BENEFITS

- Very low leakage rates
- Stays flexible even after temperature cycles
- Good pressure and extrusion resistance
- Low friction
- Easy handling



## BPG 6225

### PROPERTIES

This packing is a zebra braid made from aramid and PTFE yarns. It contains a special impregnation to enhance the cross-sectional density of the packing.

### APPLICATIONS

This product is designed for the use in fugitive emission valves. It can be used for quick repair service as alternative to specialised TA Luft packing sets. Due to its low friction it is also suitable for control valves. For ISO 15848 and frequent temperature cycling life-loading of the gland bolts is recommended.

### OPERATION PARAMETERS

Speed	2 m/s
Temperature	-100°C ... +280°C
PH Value	0 ... 14
Pressure	30 MPa

### PRODUCT SPECIFICATIONS

Media	Hot water, alkalis, organic solvents, gases, oils, greases, medium concentration acids* and lyes.
Certificates / Approvals	TA Luft, ISO 15848

\*Exceptions: strongly oxidising acids such as sulphuric and nitric acid in high concentrations.

## BENEFITS

- Low leakage rates
- Emission certification
- Good pressure and extrusion resistance
- Low friction
- Suitable for quick repair service

# KEY BENEFITS OF FUGITIVE EMISSION CONTROL PACKINGS

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**1 INCREASE PLANT SAFETY**

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**2 PROTECT OUR ENVIRONMENT**

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**3 COMPLIANCE WITH STRICTEST  
EMISSION STANDARDS WORLD-WIDE**

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**4 INCREASE PLANT EFFICIENCY**

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**5 IMPROVE YOUR BOTTOM LINE**

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# LIVE LOADING

**Live loading provides a constant load over the life of the FEC packing set and therefore helps to maintain lowest leakage levels. This greatly reduces or, in many applications, helps to eliminate your need for packing box adjustment and reduces maintenance.**

**While many Burgmann Packings FEC products can be used without live loading systems, without compromising product performance we recommend to consider live loading for extreme service applications.**

**In order to get your customized live loading system please reach out to Burgmann Packings Engineering team.**



## BPG 7900

### PROPERTIES

Live loading system with a special arrangement of disc springs combined with a stainless steel protection sleeve

### APPLICATIONS

Valves, especially control valves, thermal cycling applications and critical nuclear and low emission service

### PRODUCT SPECIFICATIONS

Housing material	All common stainless steel materials incl. high temperature alloys
Spring material	51cv4, other materials upon request

### VARIATIONS

BPG 7910	consisting of sleeve, springs and bottom disc
BPG 7920	consisting of sleeve with inner thread and springs
BPG 7930	consisting of sleeve with inner thread, springs and bottom discs



## INFLUENCE FACTORS

- Pressure
- Temperature
- Medium
- Sealing Set (compression rate)
- Type of application (valve or mixer)
- Dimensions (stuffing box, surrounding)
- Compression Force (bolts, spring set)

## BENEFITS

- Defined compression by customised spring stack
- Sleeve acts as protection for springs
- Springs are guided by the sleeve and not by the bolts
- Ideal compression easy to initiate by gap between sleeve and housing
- Gap indicates constitution of packing set
- Extended service life for FEC packing set

# TECHNICAL INFORMATION

## FUGITIVE EMISSION MANAGEMENT

Burgmann Packings offers the complete range of low fugitive emission sealing products – for both new valves and retrofits. Especially when combined with an application specific live-loading system they achieve leakage rates which are consistently lower than those required by legislation. This is why our “Best Available Technology” (BAT) products are approved at leading end users and OEM manufacturers.

## ENVIRONMENTAL PROTECTION

Valves, especially control valves, account for approximately 60 % of the leakage loss in a plant. For processes containing hazardous fluids conventional packings can be replaced with low emission sealing sets.

## FUGITIVE EMISSION CONTROL SEALING TECHNOLOGY HELPS TO:

- › Increase plant safety
- › Protect our environment
- › Increase plant efficiency and throughput
- › Improve your bottom line
- › Meet strictest emission standards worldwide

## FUGITIVE EMISSION STANDARDS

### ISO 15848

ISO 15848 regulation describes measurement, test and qualification procedures for fugitive emissions at industrial valves. The regulation is separated into 2 parts:

- › ISO 15848-1: Classification system and qualification procedures for type testing of valves
- › ISO 15848-2: Specifies production acceptance test of valves for valve manufacturer

ISO 15848 categorises three tightness classes:

Grade	Measured leakage rate	Remarks
A	$\leq 10^{-5} \text{ mg} / (\text{s} \times \text{m})$	Typically achieved with bellow seals or equivalent spindle / shaft gasket system for swivel valves
B	$\leq 10^{-4} \text{ mg} / (\text{s} \times \text{m})$	Typically achieved with packing system based on PTFE or elastomer materials
C	$\leq 10^{-2} \text{ mg} / (\text{s} \times \text{m})$	Typically achieved with packing on flexible graphite basis

### TA-LUFT (VDI 2440)

The German Fugitive Emission Control Legislation refers in TA-Luft regulation to VDI 2440 for defining leakage rates, test and measuring methods.

VDI 2440 defines following maximum leak rates for harmful VOC's (Volatile Organic Compounds) for valves:

Temperature rate	Measured leakage rate
< 250°C	$\leq 10^{-4} \text{ mbar} \times \text{l} / (\text{s} \times \text{m})$
$\geq 250^\circ\text{C}$	$\leq 10^{-2} \text{ mbar} \times \text{l} / (\text{s} \times \text{m})$

Flange connections according to VDI 2200, VDI 2440 and TA-Luft According to TA-Luft and VDI 2440 flange connections must comply with maximum leakage rate of  $10^{-4} \text{ mbar} \times \text{l} / (\text{s} \times \text{m})$  at test pressure of 1 bar. VDI 2200 defines the selection, calculation, design and assembly of bolted flange connections as well as test procedures and refers to VDI 2440 regarding permissible leak rates. VDI 2200 also defines criteria for “Blow-out” safety test for gaskets. Aim of this Blow-out test is to avoid a sudden leakage through seal burst.

## CLEAN AIR ACT

The Clean Air Act defines maximum leakage levels for flange connections, valves, pumps and agitators in the USA. Leakage test has to be done according to EPA Method 21 (sniffing method) with methane.

### API 622

API 622, 2nd Edition is an international performance test for packing materials considering several factors such as temperature, pressure, thermal and mechanical cycling. 2nd Edition of API 622 defines 1510 mechanical cycles and 5 thermal cycles. High temperature test shall be performed from ambient temperature to 260°C (500 °F) and pressures from 0 to 600 psig (0 – 41 barg). Permissible leakage level is 100 ppm with test medium methane.

### API 624

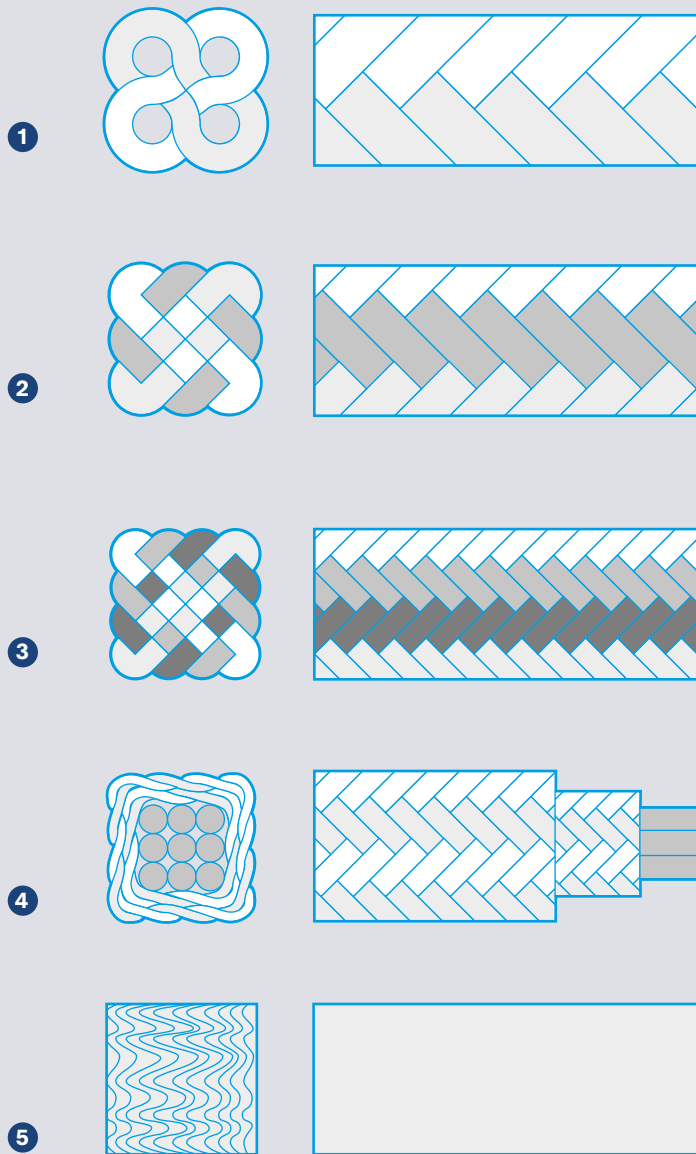
First edition of API 624 is a type testing of rising stem valves equipped with graphite packing for Fugitive Emissions. The standard covers rising and rising-rotating stem valves up to 24" diameter and has to be performed at original valves. The test procedure requires 310 mechanical cycles and three thermal cycles to 260°C (500 °F). Allowable leakage is 100 ppm maximum. It requires that the tested valve packing be previously tested according to API 622 and be suitable for use at service temperatures –29°C to +538°C (–20 °F to 1000 °F).

### API 641

The API 641 test is one of three prevalent valve standards tests that evaluate fugitive emissions' performance over an accelerated life cycle. Of the three, the API 641 Standard is the most stringent type test for quarter-turn valves and covers different designs, temperature ratings and sealing components. To pass this critical test, valves must meet the demanding criteria of maximum leakage of 100 ppmv, while undergoing 610 cycles of the valve under extreme temperatures.



## BRAIDING TYPE



### 1 2-TRACK SQUARE BRAID (Double diagonal braid)

Coarse surface  
Good elasticity  
Used for smaller square packing  
up to a nominal size of 6 mm

### 2 3-TRACK DIAGONAL BRAID (Interbraid / Cross-braid)

Good cross-sectional stability  
Dense but flexible braiding structure  
Nominal packing dimension between  
5 and 12mm

### 3 4-TRACK DIAGONAL BRAID (Interbraid / Cross-braid)

Smooth surface  
Highly resistant to wear  
high cross-sectional stability  
Highly dense braid structure  
Nominal packing dimension  
between 10 and 80 mm

### 4 CONCENTRIC BRAID (Braid-over-braid)

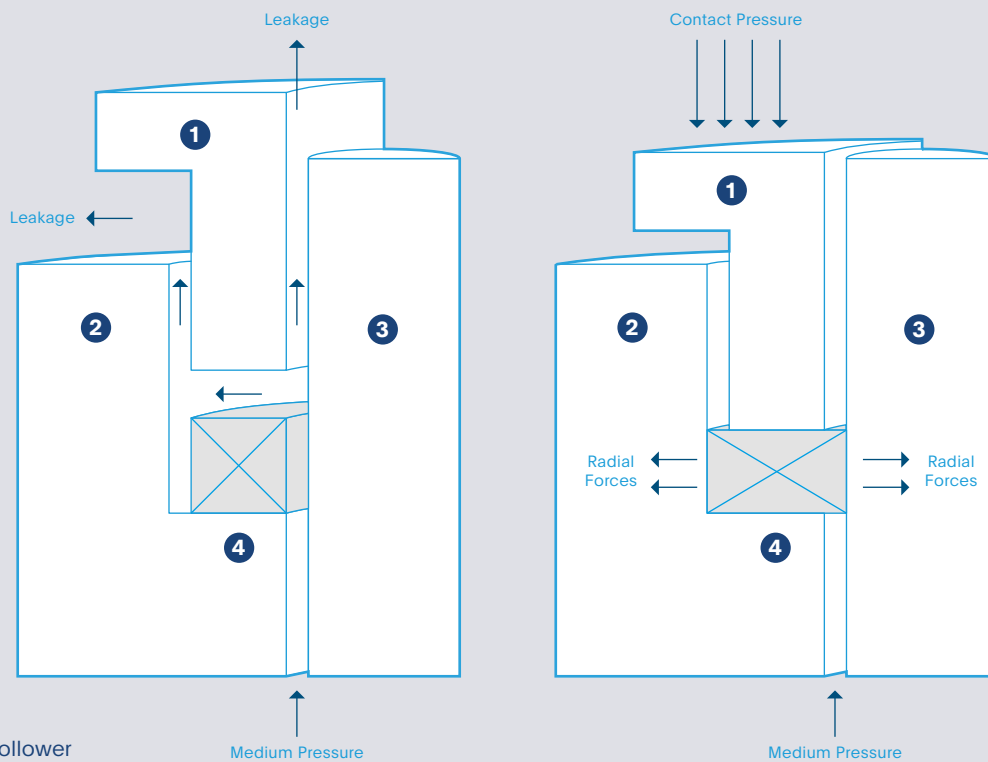
Fine, dense surface structure  
Low mechanical resistance to wear  
Rectangular or round shapes available

### 5 GRAPHITE RINGS

(Rings or ring segments made  
of compressed graphite foil or  
expanded graphite material)

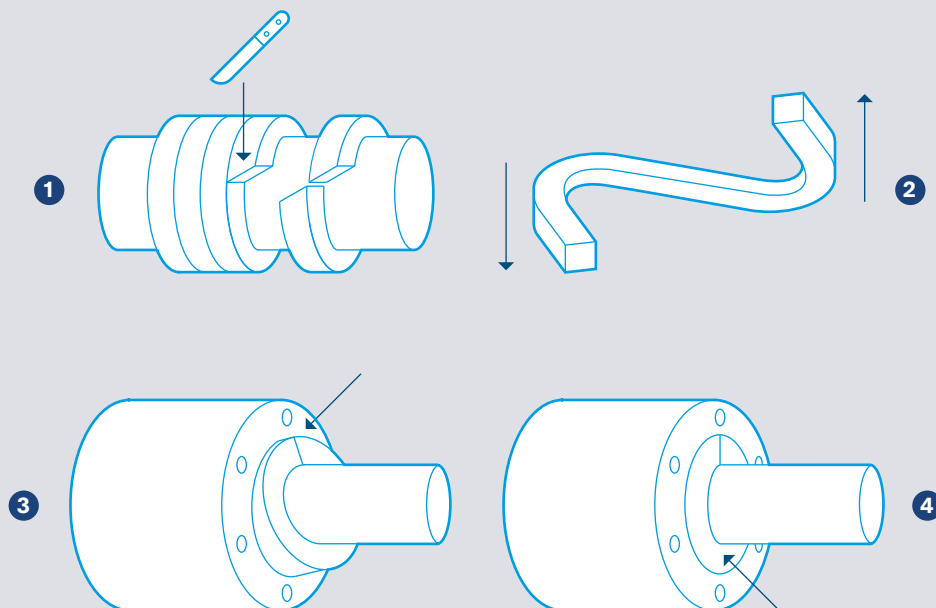
High cross-sectional density  
Outstanding resistance to pressure,  
temperature and chemicals

## COMPRESSION



- 1 Gland/Glandfollower
- 2 Housing
- 3 Spindle/Shaft
- 4 Packing

## CUTTING AND INSTALLATION



- 1 Cutting packing at a 45° angle
- 2 First open axially, then radially
- 3 Introduce the joint end first
- 4 Insert the packing

## FUNDAMENTALS

Control of fluid loss is essential to the successful operation of mechanical equipment used in fluid handling. Various methods are utilized to control leakage at shafts, rods, or valve stems and other functional parts of equipment requiring containment of liquids or gases.

The oldest, still most common and proven sealing solution is compression packing. Compression packings seal all types of fluids in valves, pumps, and other equipment in the process and service industries. Advancements in fiber and lubricant technology have enabled high performance of packings in a wide range of modern applications.

Made from relatively soft, pliant materials, compression or mechanical packings consist of a number of rings, which are inserted into the stuffing box between the rotating shaft or reciprocating stem and the body of the pump or valve.

Stuffing box packings are manufactured from yarns in braiding machines using various braiding types depending on dimension and packing type. The type and area of application defines if the packings are additionally manufactured with lubricants, fillers, and binding agents.

Because compression packings are specifically engineered to solve each application in the broad range of fluid sealing, they are provided in a wide array of configurations, materials, and dimensions.

## FUNCTION

By tightening a follower or packing gland against the top or outboard ring, pressure is transmitted to each individual packing ring, which expands the rings radially against the side of the stuffing box and the reciprocating stem or rotating shaft and effects a seal. In addition, the applied compressive force closes the internal structure of the packing ring material.

## CONSTRUCTION

The square braid is formed when yarns, rovings, ribbons, and other various materials, either alone or in combination, are processed on equipment where strands pass over and under strands running in the same direction. Resulting packings are usually supplied in a square cross-section, but rectangular sizes can also be braided by this method. Depending on the braiding method, compression packings can have different mechanical properties such as density or flexibility.

## AVAILABILITY

- Packings can be supplied on KG-creels, as pre-cut metre lengths or as pre-pressed / pre-formed rings (single or in ready to install sealing sets)
- Packings are available in standard sizes 3 to 25 mm
- Other shapes or sizes on request

Packing size	Weight
≤ 6.4 mm	1 kg / creel
7 – 10 mm	2 kg / creel
11 – 12.7 mm	3 kg / creel
14 – 24 mm	5 kg / creel
≥ 25 mm	10 kg / creel

## PACKING INSTALLATION

The ideal way to pack a stuffing box is with die-formed rings. Also pre-cut lengths or self cut lengths can be used. If cutting lengths from a creel a packing cutter can be used. By wrapping the cut packing around the shaft or spindle it can be checked if the length is correct. Alternatively the packing can be directly wound around the shaft from the creel and cut accordingly.

A diagonal cut helps to produce a better sealing effect than a straight cut. When cutting packings which tend to fray adhesive tape should be placed on appropriate side of the area to be cut, prior to cutting, in order to prevent fraying.

Install each ring into the stuffing box, ensuring the ends are placed together and inserted first followed by the rest of the ring. The joints of the individual packing rings should be staggered by 90°. The packing set should initially be tightly compressed, so that it will mould and seat itself into the stuffing box. The gland nut should then be loosened and retightened to an appropriate setting.

## INSTALLING DIE-FORMED RINGS

Die-formed rings with exact dimensions should be handled with care in order to retain the advantages that these rings offer. If the rings have to be opened to fit onto the shaft then the ring ends should only be opened axially so far that the ring will fit over the shaft. Bending the ring radially deforms the ring and makes installation more difficult.

## PRE-COMPRESSION OF PACKINGS

The correct compression of packing set is dependent of the type of packing and application. If a torque wrench or a similar tool is available the necessary gland pressure can be adjusted precisely.

## PRE-COMPRESSION FOR PUMPS

Pump packings should be compressed with a gland pressure of 1.05 to 2 times the media pressure. A minimum compression of 0.5 to 1.5 MPa is necessary.

## PRE-COMPRESSION FOR VALVES

Valve packings should be compressed with a gland pressure of 2 to 5 times the media pressure. A minimum compression of 5 MPa is necessary.

## “RUNNING-IN” OF NEW PACKINGS

Pump packings are particularly susceptible to damage through high temperature during the run-in period. If the packing is running dry it will get too hot and the pump must be stopped. After a short cooling down period a regular leakage drip should appear and the pump can be restarted. It may be necessary to repeat this procedure several times until regular leakage appears.

## RECOMMENDED SURFACE

The recommended surface roughness for the stem or spindle should be  $R_z < 1.6 \mu\text{m}$ . For increased sealing effect and longer service life the surface roughness can be reduced to  $R_z < 0.6 \mu\text{m}$ . The permissible eccentricity on centrifugal pumps should be less than 0.001 of the shaft diameter. In the interest of reduced leakage the eccentricity must not exceed 0.01 of the packing width. The permissible extrusion gaps between shaft and gland or housing are 0.02 of the packing section. If the gaps are larger or the packing in question is inclined to extrude, suitable anti-extrusion rings should be fitted.



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