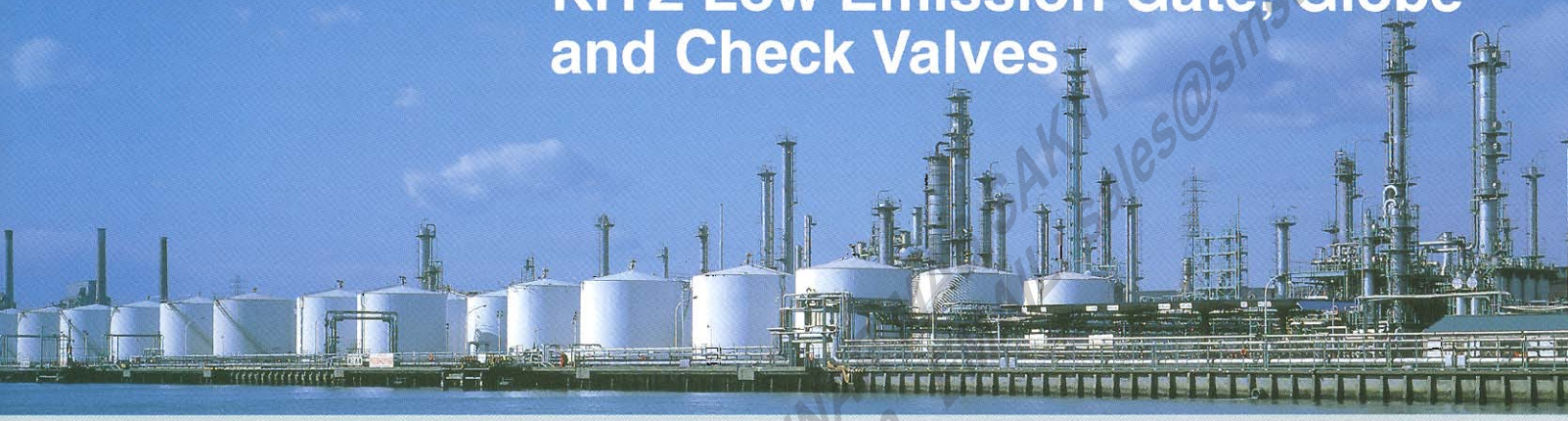
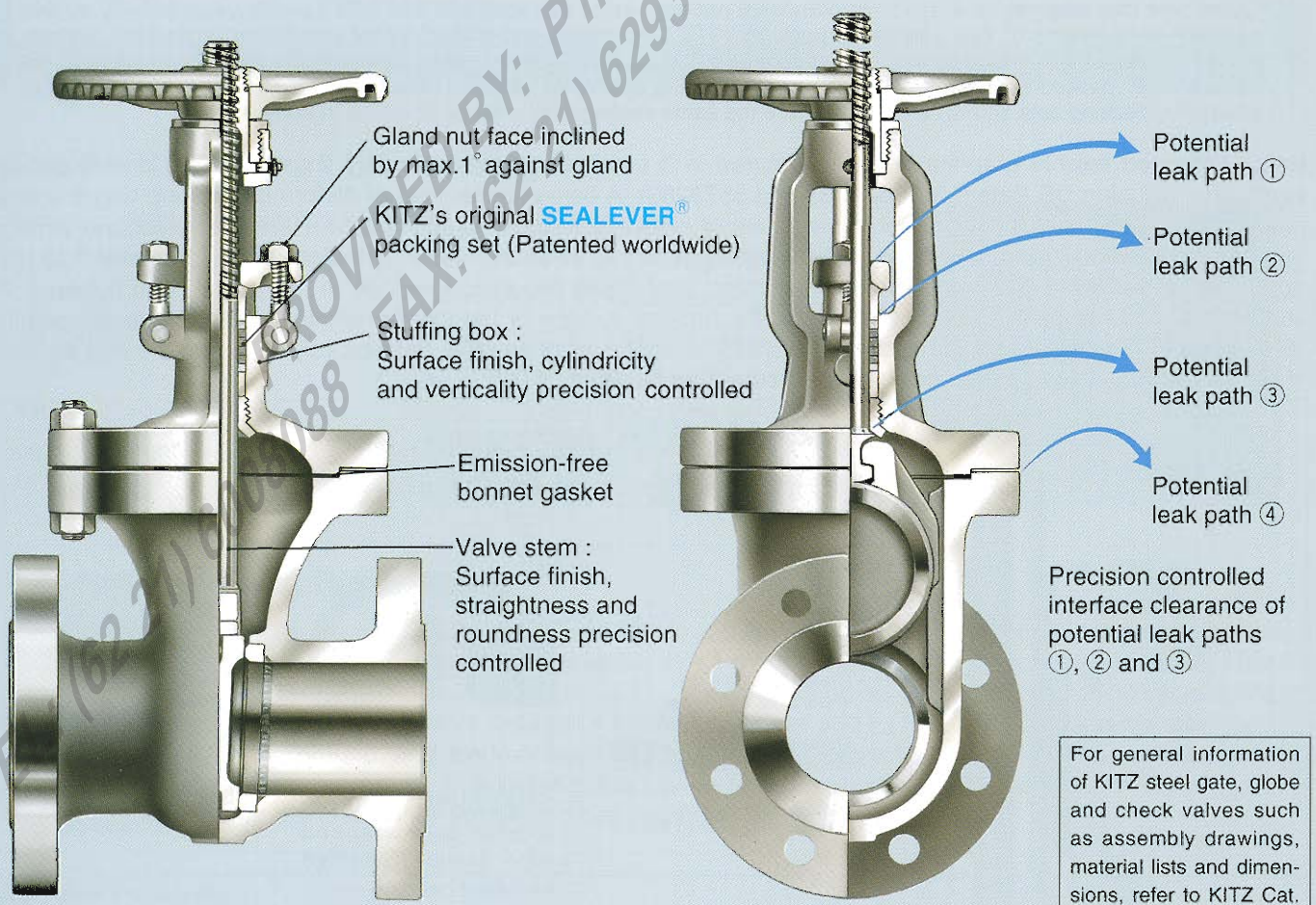
KITZ

Find the Optimum Solution to Minimize Fugitive Emission from Your Plant Facilities and Maximize Your Production Efficiency with KITZ Low Emission Gate, Globe and Check Valves





For general information of KITZ steel gate, globe and check valves such as assembly drawings, material lists and dimensions, refer to KITZ Cat. No. E-150 and E-170.

KITZ Class 300 Low Emission Steel Gate Valves, API 600 Design

Introduction

The US Federal Clean Air Act requires all plants handling the toxic gases and chemicals*1 listed by the Environmental Protection Agency to periodically monitor their plant equipment for detection of fugitive emissions exceeding 500 ppm, and repair or replace all defective equipment immediately. The California state regulation requires 100 ppm maximum leak level for the Northern California Region.
Our low emission valves developed after several years of trial and error at our laboratory, are designed, engineered, manufactured and tested to now meet the 100 ppm maximum emission level*2. This is KITZ standard specification in North America*3 for Class 150, 300 and 600 flanged or butt-welding end gate, globe and check valves designed to API 600 or ASME B16.34, and made of carbon, low alloy or austenitic stainless steel. This brochure reveals the design features that make these products the lowest emission performers without the aid of cost inflating add-ons such as the bellows seal mechanical packing system.

*1 Volatile organic compounds (VOC) and hazardous air pollutants (HAP)
*2 Guaranteed maximum leak monitored with EPA Method 21 procedures and methane-calibrated organic vapor analyzers.
*3 Option for other markets

SEALEVER® Packing Set

KITZ low emission service valves are packed with "SEALEVER®" flexible graphite packing sets*4, the KITZ original stem sealing system exclusively developed for full conformity to CAA and California state requirements.

*4 ASME B16.34 valves may be alternatively provided with PTFE packing sets for medium temperature low emission service. Refer to KITZ Cat. No. E-150 for detailed information.

KITZ's original SEALEVER® packing sets are employed as the stem seals for KITZ low emission valves, unless other types or brands of packing are specified by customers*5. A SEALEVER® packing set consists of 4 dieformed endless flexible graphite packing rings and 2 braided, split flexible graphite rings placed on the top and bottom as wipers, combined with a pure carbon spacer used for Class 300 and 600 rated valves (**Fig. 1**).

*5 Customers may request other types or brands of packing under the condition that they assume responsibility for the emission performance of their alternative packing. KITZ Corporation guarantees proper installation procedures according to the directions provided by the product suppliers of other brand packing sets. However, the information provided for SEALEVER® packed KITZ valves on packing retightening and valve operation force may be affected by installation of alternative packing sets and KITZ cannot ensure the same sealing performance of valves in such a case.

Each dieformed flexible graphite ring is structured in 3 sections as shown in **Fig. 2** (patented or patent pending worldwide including US Patent No.5522603 and 5573253). A conventional type of dieformed packing ring is entirely made of Section C, which consists of many layers of vertically wrapped graphite tape. Here, interlayer and through-graphite permeation of line fluid in the vertical axis direction is rather an inherent problem, while interfacial fluid leakage between the valve stem and the packing rings (and finally the inside surface of the gland), and between the stuffing box and the packing rings (and finally the outside surface of the gland) remains another inherent problem (**Fig. 1** again). Section A and B made of horizontally wrapped graphite tape, are securely fixed into the ring structure of SEALEVER® packing as the **permeation protective barriers**.

KITZ SEALEVER® packing sets

Fig. 1

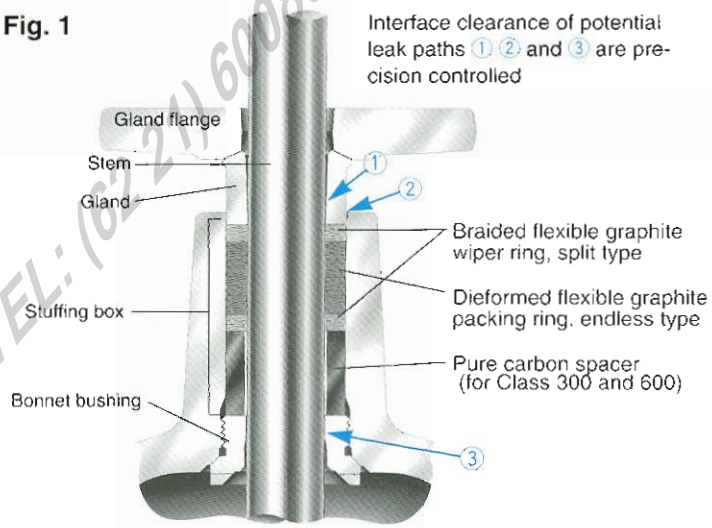
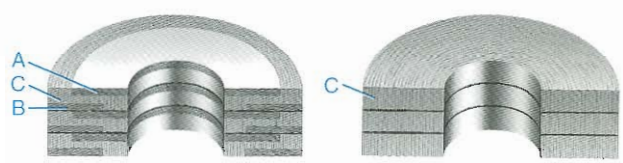


Fig. 2



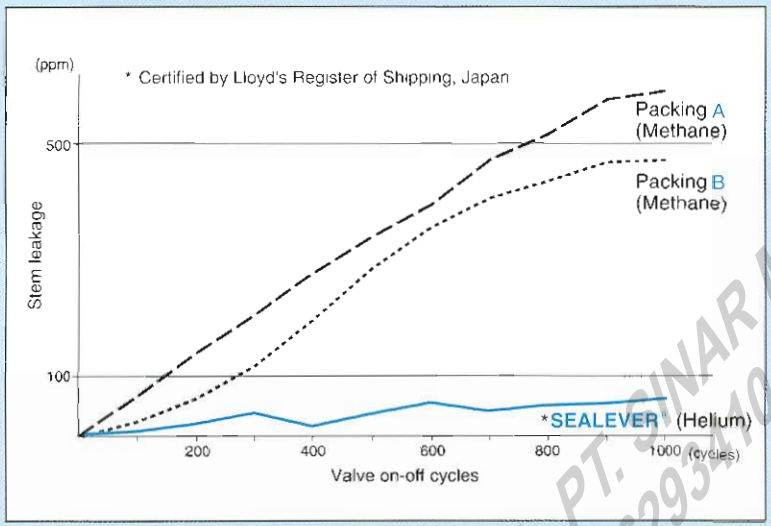
SEALEVER® parpendicular dual-wrapped tape design (patented or patent pending worldwide)

Conventional single wrapped tape design

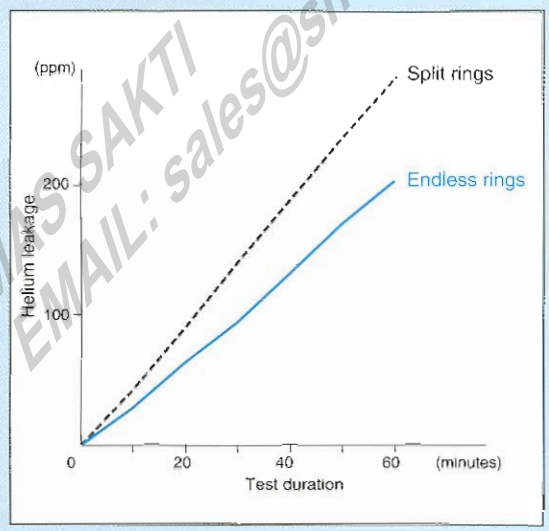
Test Data 1 indicates the results of a comparative emission parameter test carried out on **SEALEVER®** packing set and two kinds of conventional flexible graphite packing set. The test was witnessed by an assessor of Lloyd's Register of Shipping, Japan, for certification.
Split type rings are used as our wiper rings for reinforcing the mechanical strength to resist retightening stress. However, the endless, solid type rings are employed as our dieformed packing rings because of their incomparably higher sealing performance, as the parameter test shown in **Test Data 2** proves.

Test Data 1 : *Comparative packing emission test*

Test valve : 3" Class 300 gate valve
Test conditions : 740 psig (52kgf/cm²g) helium or methane gas pressure at a room temperature
Test Method : Sniffing to EPA method 21 with no gland retightening allowed



Test Data 2 : *Endless vs split packing ring*



SEALEVER® packing : Engineering Data

Maximum valve service pressure	: 6250 psig (439 kgf/cm²g)
Maximum service temperature	: 1110°F (600°C) for steam service
	850°F (455°C) for oxidizing atmosphere
Ash content	: 5% maximum according to JIS B 8511 (Eq. to ASTM C561)
Chloride content	: 50 ppm maximum according to ASTM D512
Sulpher content	: 1000 ppm maximum according to ASTM E350
pH range	: 0 to 14 (excluding strong oxidizing media)

YRT Emission Test Results

In addition to our in-house lab tests and certifications by Lloyd's Register of Shipping, a third-party performance test was carried out on a KITZ 6" Class 300 gate valve at Yarmouth Research and Technology, Maine, USA, according to one user's testing specifications. The test conditions included an unprecedented 3500 cycle operation of a 99% methane pressurized valve through 3 thermal cycles at 350°F (177°C), with the valve stem positioned horizontally to the ground, and the leak level was monitored at every 100 cycles, from an aluminum foil housing sealed the valve gland area. In spite of these severe test conditions, the results were in close agreement with findings from the tests made at our laboratory over the last several years.

U.S. PERF Project 93-20

In 1994, KITZ Corporation participated as a sponsor in Project No.93-20 Valve Emissions Study conducted by PERF (Petroleum Environmental Research Forum), a non-profit industry research group, to determine the best mechanical variables to reduce fugitive emisson from API 600 valves. This two-year project resulted in our confirmation that KITZ low emission valve designs were of higher precision than those best qualified by the project task force.

Some results of lab tests done on our packing rings installed in a special test rig (**Fig. 3**) are introduced here. Besides the excellent sealing capability (**Test Data 3**), **SEALEVER**® packing sets, which contain corrosion inhibitor to minimize in-service stem corrosion, feature low valve operating force, due to its ability to maintain a stem friction very low (**Test Data 4**). At 3500 psig (246 kgf/cm²g) packing pressure, the compression rate is as low as mere 13% (**Test Data 5**), and the stress relaxation rate is as modest as 12% after a continuous compression for 100 hours (**Test Data 6**). These characteristics support our confidence in maintenance ease of **SEALEVER**® packing sets. The test rig components were prepared according to the dimensional tolerances and smoothness requirements of valve parts specified on Page 5 for simulation of actual valve servicing conditions.

Test Data 3* : SEALEVER® *Sealing capability

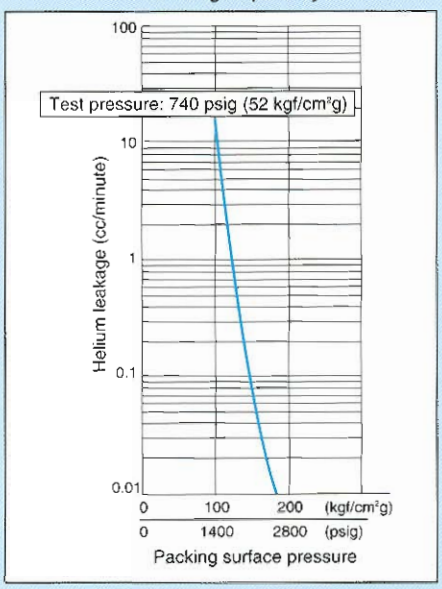
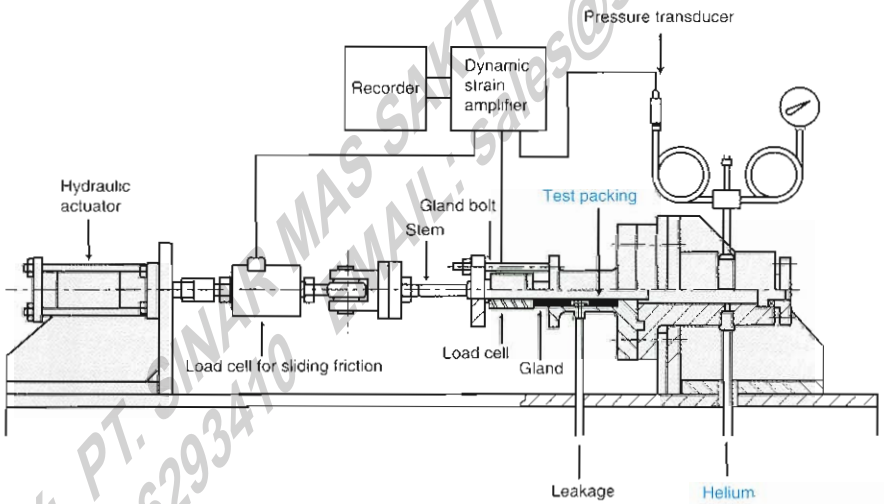
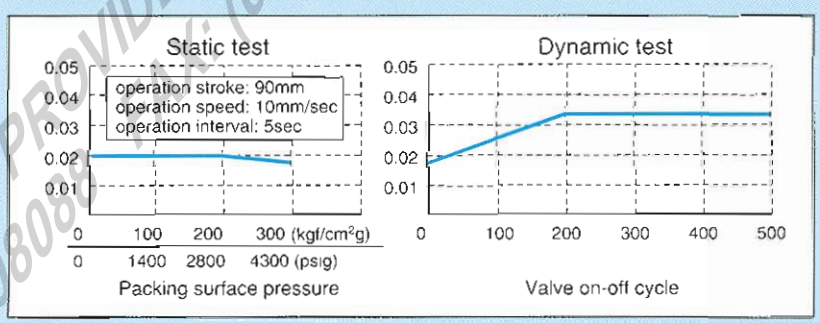


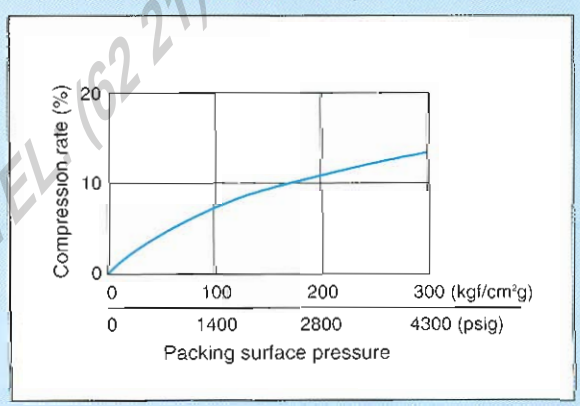
Fig. 3 : Packing test rig



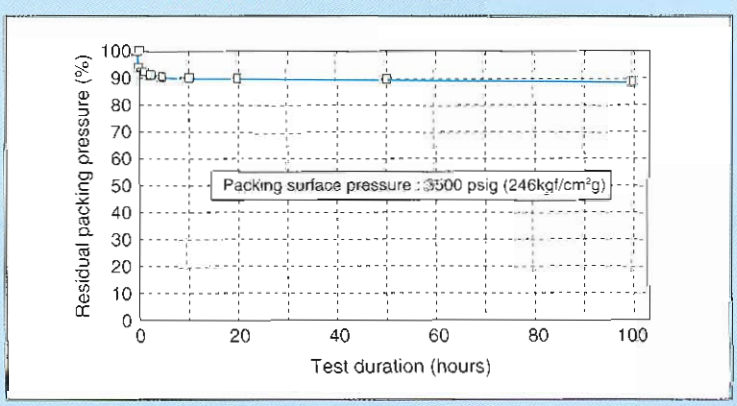
Test Data 4* : SEALEVER® *stem friction coefficient



Test Data 5* : SEALEVER® *compression rate



Test Data 6* : SEALEVER® *stress relaxation



Precision Control of Valve Component Design

Dimensional tolerance and smoothness of KITZ low emission valve components which may affect the external sealing function of valves are precision controlled, according to KITZ design and manufacturing standards developed after repeated lab tests to determine the most essential emission parameters.

Conditions of Valve Design Emission Parameter Tests (unless otherwise noted in test data)			
Test valve	: 3" Class 300 gate valve	**Test method**	: Leak chamber method for 60 minutes
Packing	: Conventional dieformed flexible graphite (P/6610 endless)	**Test fluid**	: Methane + nitrogen gas
Stem finish	: 32 RMS maximum	**Temperature**	: Ambient
S.box finish	: 125 RMS maximum	**Pressure**	: 740 psig (52 kgf/cm²g)
Clearance	: KITZ low emission design	**Packing surface pressure**	: 2500 psig (176 kgf/cm²g)

Valve Stem

The stem surface finish is controlled to a maximum 32 RMS and a minimum 16 RMS. While the stem travels through the packing rings, graphite tends to fill micro scratches on the stem surface and migrates to the stem to function as a lubricant. Our lab tests found that a stem smoothness finer than 16 RMS loses this kind of inherent advantage and results in a higher rate of leakage (**Test Data 7**). The stem straightness and roundness, which our research engineers determined to be very important emission parameters, are precision controlled according to KITZ design and manufacturing standards.

Stuffing Box

The surface finish is controlled to a maximum 125 RMS. Contrary to the valve stem, the stuffing box wall statically contacts the packing rings, and a reasonably rougher surface finish results in a better sealing performance. Our own findings favored 180RMS, however, we chose a maximum 125 RMS as our standard, to minimize the difference from user specifications and our conventional design (**Test Data 8**). The cylindricality and verticality are precision controlled according to KITZ design and manufacturing standards.

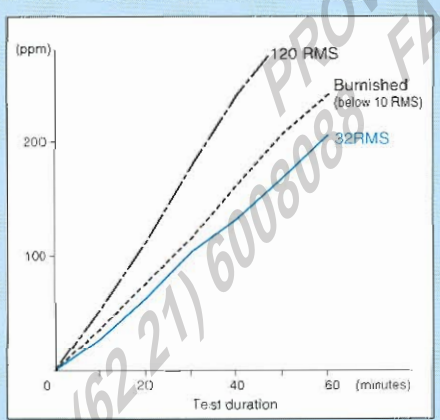
Diametrical Interface Clearance (Fig. 1)

20 mils to 32 mils (0.5 to 0.8 mm) for stem to gland interface
20 mils to 32 mils (0.5 to 0.8 mm) for stem to bonnet bushing interface*
4 mils to 12 mils (0.1 to 0.3 mm) for gland to stuffing box interface

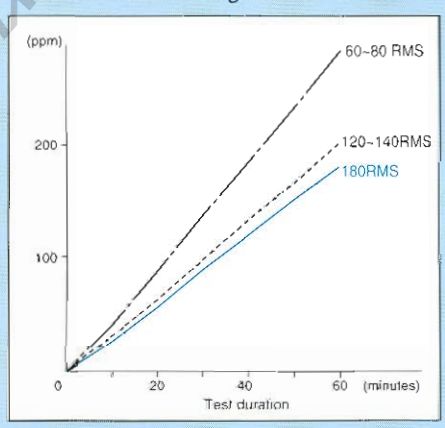
*ASME B16.34 valves are designed with 16 to 28 mils (0.4 to 0.7mm) clearance for stem to backseat interface

The stem to gland, and stem to bonnet bushing contacts are subject to dynamic stem motion, and we have found that 12 mils (0.3 mm) or smaller clearance may cause stem galling and valve malfunction. The gland to stuffing box contact is static and a smaller clearance better reduces emission (**Test Data 9**).

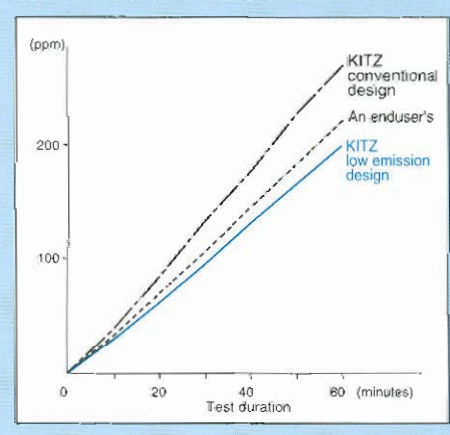
Test Data 7 *: Stem surface finish*



Test Data 8 *: Stuffing box surface finish*



Test Data 9 *: Interface clearance*



Low Emission Gaskets

Bonnet gaskets* (including check valve cover gaskets)

Class 150 : Flexible graphite sheet with stainless steel insert and permeation protective barrier for low emission service.
Class 300 : Spiral wound (flexible graphite filler and stainless steel hoop) with a stainless steel inner ring
Class 600 : Ring joint metal gasket

Plug gaskets for check valves

Class 150 / 300 : Flexible graphite sheet with stainless steel insert and permeation protective barrier.
Class 600 : Spiral wound metal, flexible graphite filled

*ASME B16.34 valves may be alternatively provided with PTFE gaskets for medium temperature low emission service. Refer to KITZ Cat No C-150 for detailed information.

Choice of Emission Test Method and Test Media

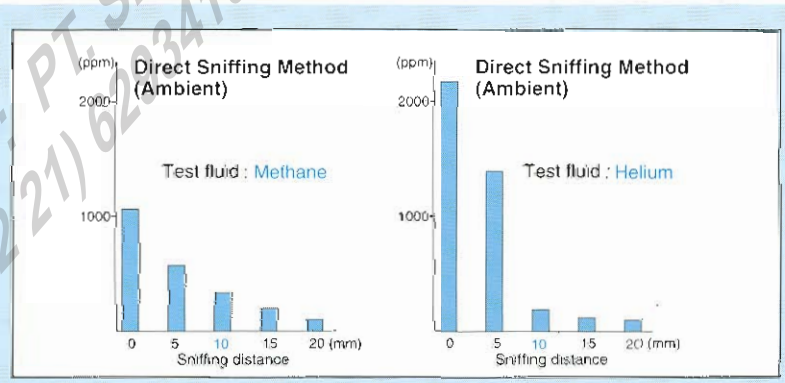
EPA Method 21 requires plant owners to monitor fugitive emission from plant equipment, using leak detectors like an organic vapor analyser to read the level of gas concentration in ppm. We refer to this as the **Direct Sniffing Method (Fig.4)** . The accuracy of leak detection at plant sites depends on various factors which include wind effects and positioning of sample sniffing probes. To make test results as reliable as possible, our valve production tests are always carried out in an isolated indoor facility with the sampling probe positioned along possible leak paths, directly or within a distance of 10mm maximum, wherever physically possible. **Test Data 10** shows how much sniffing distance affects the measurement of gas concentration in the air.

Fig.4 : Direct sniffing method

An absolutely accurate leak measurement can be achieved by what we call the **Leak Chamber Method (Fig.5)**, which completely encloses the bonnet area of the test valve in a tightly sealed bag or chamber to enable measurement of accumulated absolute leak rate by minutes, hours or other time intervals. **Test Data 11** demonstrates that helium leak rate is always higher than that of methane when the leak chamber method is used. Smaller molecular weight of helium (4 kg·mol^{-1} against 16 kg·mol^{-1} of methane) appears to result in a higher leak rate. **For this reason, evaluation of emission suppressing performance of valves can be more accurately done by use of helium and the leak chamber method**. The leak measurement is read in cc/min. or other volume units preferred, using a mass spectrometer. This is recommended for type approval or general qualification tests of valve design.

Fig.5 : Leak chamber method

***Test Data 10** : Compared sniffing distances for leak monitoring*

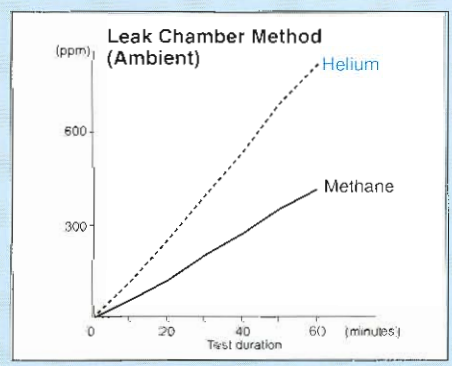


Leak Detectors

Methane : An organic vapor analyser for gas concentration in ppm

Heliume : A mass spectrometer for absolute leak rate in cc / min, which was correlated to concetration in ppm, using a standard helium gas.

***Test Data 11** : Choice of test media*



Test Data 10 shows that reading of helium leak concentration was also recorded higher than that of methane when the sampling probe contacted leak paths directly or very close. However, this data also shows that methane leak reading becomes reversely higher when the sampling probe is set with a larger distance to leak paths. We assume that higher molecular diffusion coefficient of helium (0.72 cm^2/sec. against 0.23cm^2/sec. of methane) has caused this test result. Unlike the bagging method, one has a concern of inaccurate leak measurement, using methane, helium or any other test media. **With the direct sniffing method, the test procedure is more important than choice of test media**. Contacting a sampling probe very close to valve component interfaces in as many positions as possible with an adequate duration will help minimize misleading evaluation of emission suppressing performance of production valves.

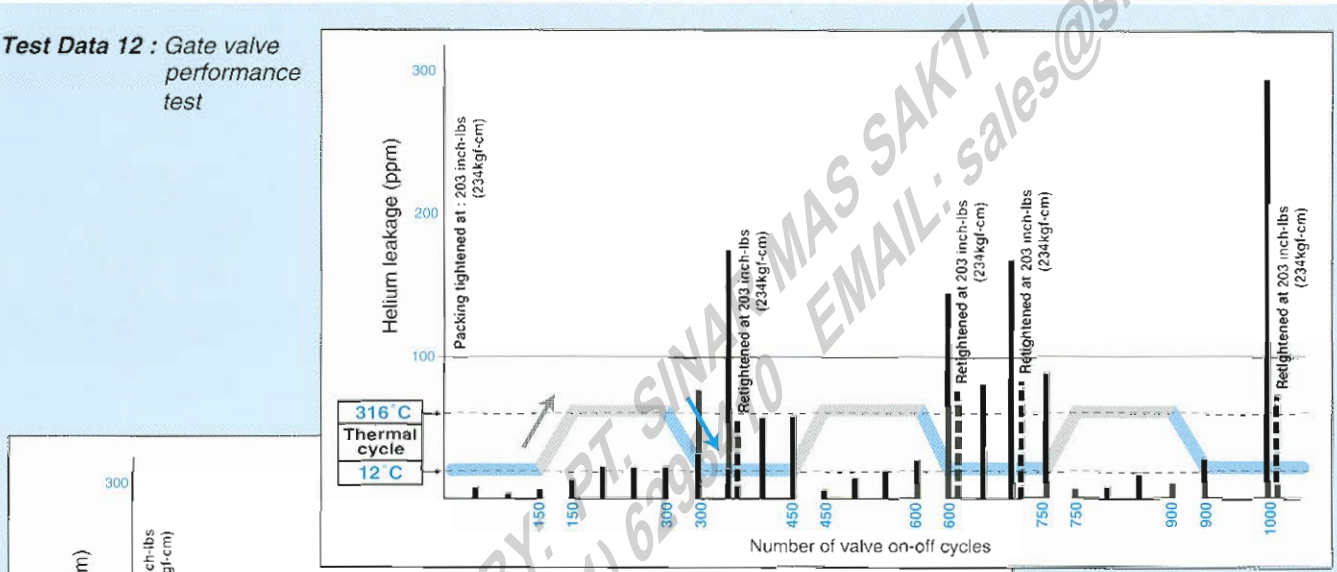
KITZ Valve Emission Performance Tests

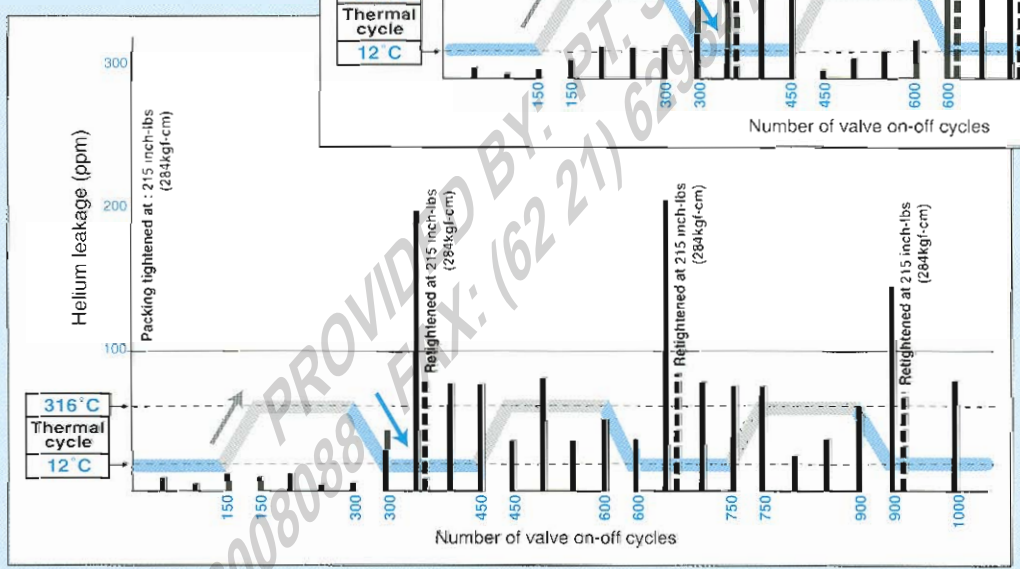
The outstanding low emission performance of KITZ steel gate and globe valves was proved by KITZ laboratory tests conducted at its Nagasaka Plant and certified by an assessor of Lloyd's Register of Shipping, Japan.

Conditions of Valve Emission Performance Tests

Test Valve	: 3" Class 300 gate/globe valves	**Test method**	: Sniffing to EPA Method 21
Packing	: SEALEVER® endless dieformed graphite	**Test fluid**	: Helium gas
Stem finish	: 16 RMS to 32 RMS	**Temperature**	: 3 cycles : ambient/600°F (316°C)
Stuffing box finish	: 125 RMS maximum	**Test pressure**	: 740 psig (52 kgf/cm²g) ambient
Clearance	: KITZ low emission design		550 psig (39 kgf/cm²g) 600°F (316°C)
Leak detector	: ULVAC TP3 Helium Detector	**Packing surface pressure**	: 3500 psig (246 kgf/cm²g)

Test Data 12 : *Gate valve performance test*



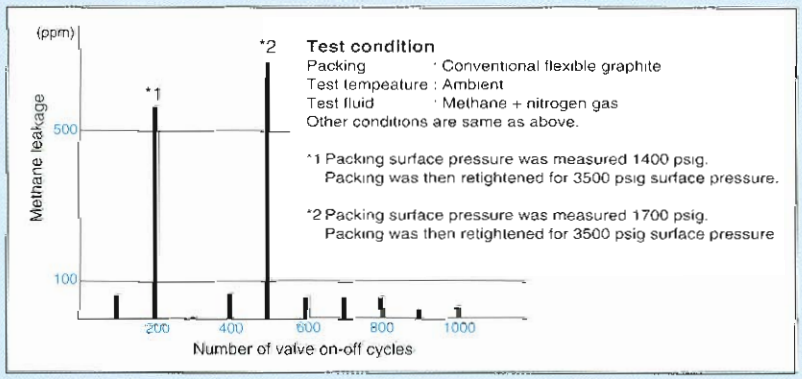


Test Data 13 : *Globe valve performance test*

Packing Stress Relaxation

In contrast, this test of our another steel globe valve sealed with the packing produced by other manufacturer showed leakage exceeding 500 ppm after only 200 on-off cycles. Test conditions were identical, except using methane at the room temperature. We found the packing surface pressure dropped to 1400 psig from the original assembly pressure of 3500. We then retightened the gland and reduced the leakage to almost zero. After 500 cycles, leakage again exceeded 500 ppm. This time we recorded the packing pressure at 1700. Following one more gland retightening, leakage was stabilized under 100 ppm for up to 1000 valve on-off cycles. (**Test Data 14**)

Test Data 14 *: Packing stress relaxation measured on a globe valve*



Upgrading KITZ Steel Valves, New or Used, for Low Emission Service

Conventionally designed KITZ Class 150, 300 and 600 steel gate and globe valves stocked by our distributors or returned to KITZ authorized modification shops for maintenance, can be upgraded to meet the US Federal requirement of **500 ppm**, by replacing the sealing components with **SEALEVER®** packing sets and bonnet gaskets specified by KITZ, if packing and gasket installation, valve disassembly, reassembly and subsequent pressure tests are carried out exactly in accordance with the KITZ low emission valve maintenance manual. (Used valves require an overhaul by our modification shops and might need replacement of corroded stems.)

Conventional KITZ Class 150, 300 and 600 steel check valves may be similarly upgraded by replacement of cover gaskets and installation of plug gaskets.

Total valve performance shall be subject to the full warranty of KITZ Corporation when **new** valves are upgraded as specified above. Warranty for modified **used** valves shall be the responsibility of modification shops performing upgrading work.

KITZ General Term of Warranty for Low Emission Service Valves

Warranty Periods :

12 months after placement in service, but not exceeding 18 months after shipment from KITZ factories.

Warranty Conditions :

1. Proper storage and maintenance of valves prior to installation, according to the KITZ maintenance manual.
2. Proper handling of valves during transportation and plant construction, which includes sandblasting and painting, for protection of exposed stems and glands of valves.
3. Need of adequate retightening of gland packing sets*, according to the KITZ maintenance manual to reduce the leak level, when an excessive fugitive emission level is detected during :
   a) Pre-installation valve inspection
   b) Process pilot run or start-up operation
   c) Periodic or occasional inspection of valves in service
4. Valve stems must be kept free of scratches, scars or corrosion.
5. Following all other instructions provided in the KITZ maintenance and operation manuals.

* This condition is particularly important when valves are subjected to thermal cycles on the site as proved by Test Data 12, 13 and 14. We recommend to ensure that packing is retightend after every cool-down of the process.

⚠CAUTION	Technical data published in this brochure have been developed from our design calculation, in-house testing, field reports provided by our customers and/or published official standards or specifications. They are good only to cover typical applications as a general guideline to users of KITZ products introduced in this brochure. For any specific application, users are kindly requested to contact KITZ Corporation for technical advice, or to carry out their own study and evaluation for proving suitability of these products to such an application. Failure to follow this request could result in property damage and/or personal injury, for which we shall not be liable. While this catalog has been compiled with the utmost care, we assume no responsibility for errors, impropriety or inadequacy. Any information provided in this catalog is subject to from-time-to-time change without notice for error rectification, product discontinuation, design modification, new product introduction or any other cause that KITZ Corporation considers necessary. This edition cancels all previous issues.

ISO 9001 certified since 1989

KITZ

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