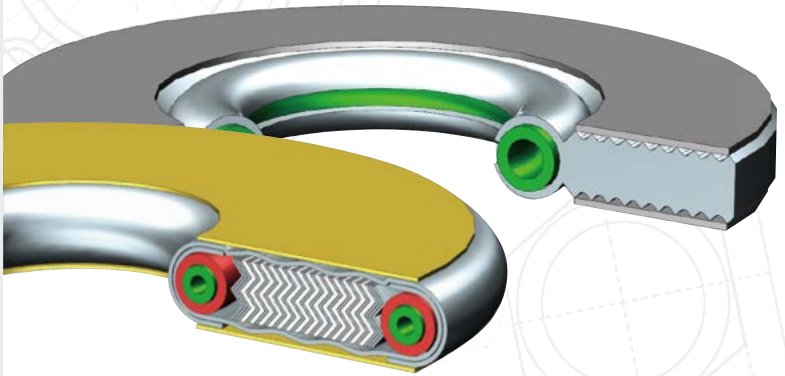
ISO9001:2008	ISO14001:2004	OHSAS 18001 2007	API Spec Q1 & API Spec 6A
Certificate No. 31200	Certificate No. 46260	Certificate No. 46259	License No 6A-0357

HIFLEX® GASKET

G-21
G-23
G-25
G-31



KOREA

Ministry of SMEs and Startups | KBIZ Korea Federation of SMEs

Host

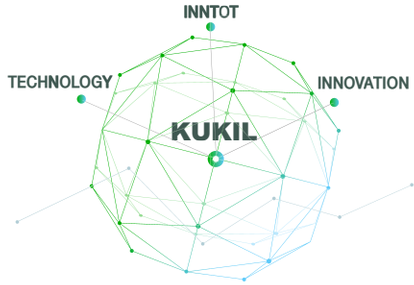
أديبك ADIPEC | ادنوك ADNOC

31 October - 3 November 2022
Abu Dhabi, United Arab Emirates

INNTOT 주식회사국일인토트
KUKIL INNTOT CO., LTD.

Top of the best!

For the last 37 years, KUKIL INNTOT Co., Ltd. has been in the manufacturing business of sealing products for industry use.
HIFLEX® Gasket, one of our newly developed sealing products, is a gasket guaranteeing high performance in the extreme operating conditions.



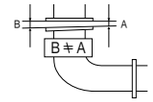
Apply for weak point of existing gasket

Buckling & Filler Oxidation

- Over bolt load
- Insufficient width of inner ring at high temperature
- Graphite oxidation over 842°F (450℃)

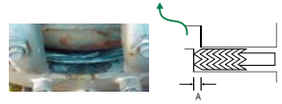
Flange Deformation

- Flange flatness deformation
- Constant direction force
- Bolting sequence error
- Roughening corrosion
- MAX 0.6㎜ deformation



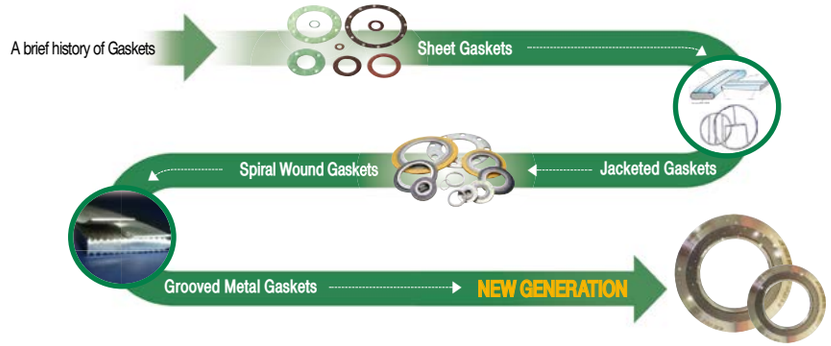
Breakaway of Sealing Parts

- Flange groove tolerance: Max 0.59"(1.5㎜) each
- Impossibility of ring application to gasket



Lack of Recovery

- Vibration condition
- Thermal expansion condition
- Hot bolting after operation
- Insufficient recovery of gaskets



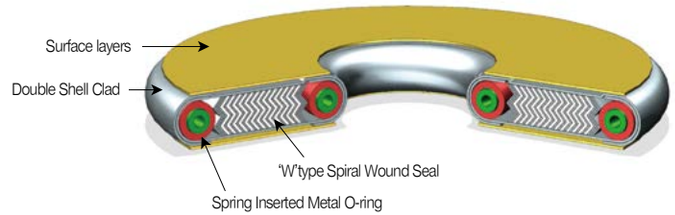
Benefit

Why should we use the Hiflex gasket ?

Strong solidity (Double shell type)	- No buckling - Easy handling - Easy installation
Flange deformation	- Cover with flange gap and deformation up to 2mm - Good at vibration , Thermal cycle conditions - Available with unexpected sudden temperature change
Flexible torque load application	- Standard gasket seating stress - Low and overloaded gasket seating stress
Excellent sealing performance	- 3 times leak protection (3 parts sealing) - Available with Hydrogen treatment services - No more unexpected shutdown

Comparison to Traditional Metal Gasket!

GASKETS	m[1]	y[2]	Compressibility	Recovery	Max. Temperature	Max. Pressure
HIFLEX® G-21	2.5	5,800psi	15%	81%	1000℃	320 kgf/cm²
HIFLEX® G-23	2.5	5,800psi	14%	83%	1000℃	350 kgf/cm²
HIFLEX® G-25	2.5	5,800psi	31%	62%	550℃	90 kgf/cm²
HIFLEX® G-31	2.5	5,800psi	14%	70%	1000℃	300 kgf/cm²
DJAF	3.75	9,000psi	26%	24%	550℃	60 kgf/cm²
SPW-V	3	10,000psi	21%	48%	750℃	200 kgf/cm²
SPW-W	3	10,000psi	16%	60%	750℃	200 kgf/cm²
SERRATED	4.25	10,100psi	13%	26%	1000℃	300 kgf/cm²



HIFLEX® G-21

Characteristic

■ Surface layers : Make up for the sealing surface damage of flange and increase sealing performance — 1UP

■ Spring Inserted Metal O-ring : • Substitution of inner/outer ring • Increase recovery performance • Self energized — 1ST & 3RD Sealing 2&3UP

■ 'W'type Spiral Wound Seal : Increase recovery comparing with 'V'type sealing part — 2ND Sealing 4UP

■ Double Shell Clad : • Prevent scattering & oxidizing filler • Integrate all components(No buckling & No breakaway) — 5UP

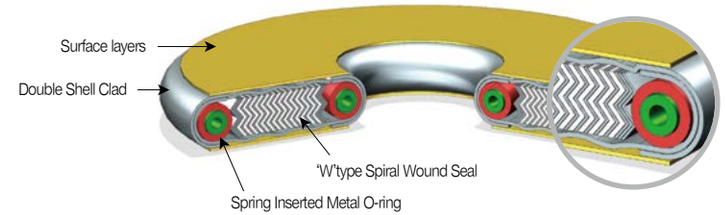
Descriptions

W-type spiral wound gasket is applied to Hiflex G-21 at from cryogenic to high temperature and high pressure. Due to its excellent restoring force, it is suitable for the environment where vibration, contraction, and expansion of flange exist.

Application	Availability	Service	Gasket Factor[1]
▸ Hydro Cracking Unit ▸ Hydro Desulfurization Unit ▸ Cocker / FCC / CCR Unit ▸ Crude Unit ▸ MEROX / BTX Unit ▸ Steam line	▸ Gasket Size : 8"~6,000Ø ▸ Gasket Width : 20~40㎜ ▸ Gasket Thickness : 6.4㎜, 7.4㎜ etc.	▸ Max. Temperature : 1000℃ ▸ Max. Pressure : 320 kg/㎠ ▸ Cryogenic : -240℃ ▸ High temperature steam ▸ Ultra vaccum	▸ m : 2.5 ▸ y : 5,800 psi

Footnote 1) Please contact our company for m & y of Hiflex.
2) Critical conditions such as high temperature, pressureand thermal expansion shall be informed to KUKIL's design engineer before applying HIFLEX gasket
3) After turn around, HIFLEX gasket can be used for long term period only after flange gap check and re-bolting. For more detail , please inform us of the design engineer.

KUKIL INNTOT
HIFLEX®



HIFLEX® G-23

Characteristic

■ Surface layers : Make up for the sealing surface damage of flange and increase sealing performance — 1UP

■ Spring Inserted Metal O-ring : • Substitution of inner/outer ring • Increase recovery performance • Self energized — 1ST & 3RD Sealing 2&3UP

■ 'W'type Spiral Wound Seal : Increase recovery comparing with 'V'type sealing part — 2ND Sealing 4UP

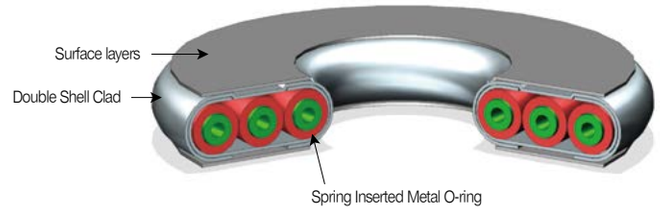
■ Corrugated Double Shell Clad : • Prevent scattering & oxidizing filler • Integrate all components (No buckling & No breakaway) — 5UP

Descriptions

Corrugated type metal clad is applied to Hiflex G-23. It is possible to use Hiflex G-23 in a place which requires higher compression than Hiflex G-21. It is excellent to use at high temperature.

Application	Availability	Service	Gasket Factor[1]
▸ Hydro Cracking Unit ▸ Hydro Desulfurization Unit ▸ Cocker / FCC / CCR Unit ▸ Crude Unit ▸ MEROX / BTX Unit ▸ Steam line	▸ Gasket Size : 8"~up to 6,000Ø ▸ Gasket Width : 20~40㎜ ▸ Gasket Thickness : 6.4㎜, 7.4㎜ etc.	▸ Max. Temperature : 1000℃ ▸ Max. Pressure : 350 kg/㎠ ▸ Cryogenic : -240℃ ▸ High temperature steam ▸ Ultra vaccum	▸ m : 2.5 ▸ y : 5,800 psi

Footnote 1) Please contact our company for m & y of Hiflex.
2) Critical conditions such as high temperature, pressureand thermal expansion shall be informed to KUKIL's design engineer before applying HIFLEX gasket
3) After turn around, HIFLEX gasket can be used for long term period only after flange gap check and re-bolting. For more detail , please inform us of the design engineer.



HIFLEX® G-25

Characteristic

■ Surface layers : Make up for the sealing surface damage of flange and increase sealing performance → 1UP

■ Spring Inserted Metal O-ring : • Substitution of inner/outer ring • Increase recovery performance • Self energized → Sealing 2UP

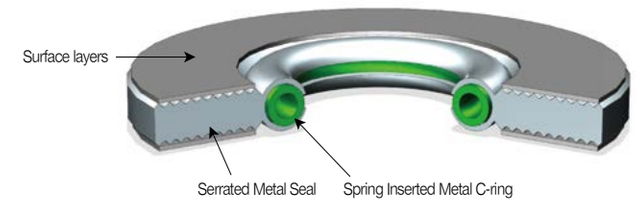
■ Double Shell Clad : • Prevent scattering & oxidizing filler • Integrate all components(No buckling & No breakaway) → 3UP

Descriptions

Hiflex G-25 is filled with metal tube O-rings inside. It is possible to use Hiflex G-25 for narrow surface, sealing width of 10~16mm, where existing double jacketed metal gasket is usually applied. It has better perfomance than double jacketed metal gaskets where leakage occurs due to vibration.

Application	Availability	Service	Gasket Factor[1]
Hydro Cracking Unit	Gasket Size : 8"~up to 6,000Ø	Max. Temperature : 750℃	m : 2.5
Hydro Desulfurization Unit	Gasket Width : 10~16㎜	Max. Pressure : 90 ㎏f/㎠	y : 5,800 psi
Cocker / FCC / CCR Unit	Gasket Thickness : 5.5㎜, 6.4㎜ etc.	Cryogenic : -240℃	
Crude Unit		High temperature steam	
MEROX / BTX Unit		Ultra vaccum	
Steam line			

Footnote 1) Please contact our company for m & y of Hiflex.
2) Critical conditions such as high temperature, pressureand thermal expansion shall be informed to KUKIL's design engineer before applying HIFLEX gasket
3) After turn around, HIFLEX gasket can be used for long term period only after flange gap check and re-bolting. For more detail , please inform us of the design engineer.



HIFLEX® G-31

Characteristic

■ Surface layers : Make up for the sealing surface damage of flange and increase sealing performance → 1UP

■ Spring Inserted Metal C-ring : • Substitution of inner ring • Increase recovery performance • Self energized → 1ST Sealing 2UP

■ Serrated Metal Seal : High pressure sealing → 2ND Sealing 3UP

Descriptions

Hiflex G-31 is an improved serrated metal gasket having internal spring metal C-ring which functions as a kind of self-energizer improving restoring force. Its double sealing structure also complements sealing performance. It is specifically recommended for use in the pipes of small diameter size.

Application	Availability	Service	Gasket Factor[1]
Hydro Cracking Unit	Gasket Size : 1/2"~60"	Max. Temperature : 1000℃	m : 2.5
Hydro Desulfurization Unit	Gasket Width : 10~40㎜	Max. Pressure : 300 ㎏f/㎠	y : 5,800 psi
Cocker / FCC / CCR Unit	Gasket Thickness : 4.8㎜, 6㎜ etc.	Cryogenic : -240℃	
Crude Unit		High temperature steam	
MEROX / BTX Unit		Ultra vaccum	
Steam line			

Footnote 1) Please contact our company for m & y of Hiflex.
2) Critical conditions such as high temperature, pressureand thermal expansion shall be informed to KUKIL's design engineer before applying HIFLEX gasket
3) After turn around, HIFLEX gasket can be used for long term period only after flange gap check and re-bolting. For more detail , please inform us of the design engineer.

Performance Test of Recovery

Tested by "Korea Nano and Seal Institute" in Korea

TEST CONDITIONS

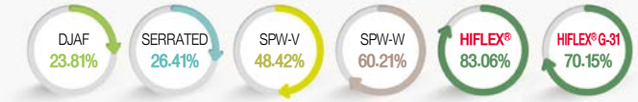
Pressure	Fluid	Temperature	Holding Time
50 kgf/cm²	Helium	Room Temp	72 min

Leakage did not occur during the test period of total 72 minutes when pressure of 50kgf/cm² per minute is applied.

Seating Stress : ASME Standard

Type		GASKETS					
		DJAF	SERRATED	SPW-V	SPW-W	HIFLEX®	HIFLEX® G-31
Compressibility		25.75%	13.04%	21.30%	16.40%	13.59%	13.96%
Recovery		23.81%	26.41%	48.42%	60.21%	83.06%	70.15%
Compression [mm]		0.8	0.59	1.15	0.81	0.86	0.67
Factor	m	3.75	4.25	3	3	2.5	2.5
	y [psi]	9,000	10,100	10,000	10,000	5,800	5,800
Seating Stress [kgf]		27287	21573	17085	17085	15,245	16,029
Leakage [kgf/cm²]		50 → 48.6 (Leak)			50 → 50 (No Leak)		

Recovery(%)



Seating Stress : ASME Standard x 2

Type		GASKETS					
		DJAF	SERRATED	SPW-V	SPW-W	HIFLEX®	HIFLEX® G-31
Compressibility		32.17%	17.33%	26.48%	21.05%	22.11%	23.60%
Recovery		6.93%	17.95%	23.08%	48.08%	67.67%	53.39%
Compression [mm]		1.01	0.78	1.43	1.04	1.59	1.18
Seating Stress [kgf]		54574	43137	36197	36197	30,489	32,057
Leakage [kgf/cm²]		50 → 48.6 (Leak)			50 → 50 (No Leak)		

Recovery(%)

Performance Test of API 6FB Fire Safety

Tested by "Yarmouth Research and Technology, LLC" in America

Specification

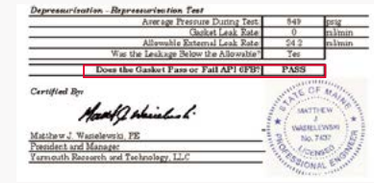
- API 6FB, Third Edition, Nov.1988

Conditions

- Burn / Cooldown : 60min
- Average Pressure During Burn / Cooldown : 557 psig

Result

- Does the Gasket Pass or Fail API 6FB? ⇒ Pass


Depressurization - Repressurization Test

Average Pressure During Test	549	psig
Gasket Leak Rate	0	ml/min
Allowable External Leak Rate	54.2	ml/min
Was the Leakage Below the Allowable?	Yes	
Does the Gasket Pass or Fail API 6FB?	PASS	

Certified By
Matthew J. Wasielewski, PE
President and Manager
Yarmouth Research and Technology, LLC


Yarmouth Research and Technology, LLC
API 6FB FIRE TEST REPORT


Fire Test Report
API Standard 6FB, Third Edition
Performed for
Kukil Inntot Co., Ltd.
http://www.kukil.com/
6 inch Class 300 Hiflex Gasket
Project Number: 214184
Test Date: September 12, 2014
Performed by
YARMOUTH RESEARCH AND TECHNOLOGY, LLC
434 Walnut Hill Road
North Yarmouth, ME 04097 USA
(207) 829-5559
info@yarmouthresearch.com
www.yarmouthresearch.com

Performance Test of Shell spec. MESC 85/300

| G-31 Series |

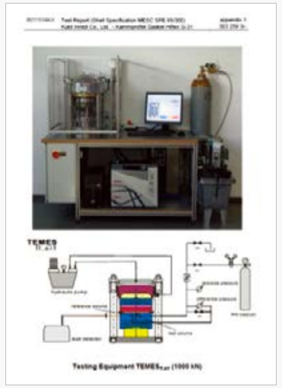
Tested by “amtec Services GmbH” in Germany

Shell leakage test at ambient and elevated temperature (MESC SPE 85/300 - 3.3.2)

The Shell leakage test is carried out at ambient and at elevated temperature. For the tests at elevated temperature first the temperature is raised to the required test temperature under an initial gasket stress. Afterwards the gasket is compressed in steps of 10 MPa to a maximum gasket stress of 110 MPa at ambient and at elevated temperature. After reaching the first gasket stress level the test volume is pressurised with 51 bar at ambient temperature and 34.7 bar at 400°C according to ASME B16.5-2003 - PT-Rating for Group 1.1 Materials. For the leakage measurement helium is used as test medium.

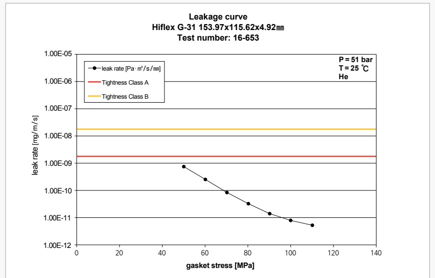
The leak rate can be classified in tightness classes:

- Class A: ≤ 1.78 10-9 Pa ㎥/s/㎜,
- Class B: ≤ 1.78 10-8 Pa ㎥/s/㎜.



amtec - Shell leakage test at ambient temperature

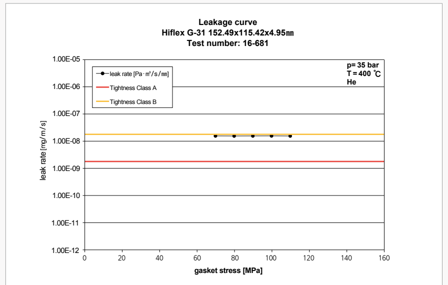
Test pressure	51 bar
Shell required gasket stress level	70 Mpa
Leakage rate	8.38E-11 Pa · ㎥/s/㎜
Shell tightness class	Class A
Test no.	16-653



Shell leakage test (RT) according MESC SPE 85/300 - 3.3.2

amtec - Shell leakage test at 400℃

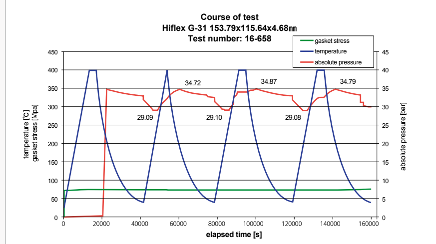
Test pressure	34.7 bar
Shell required gasket stress level	70 Mpa
Leakage rate	1.54E-08 Pa · ㎥/s/㎜
Shell tightness class	Class B
Test no.	16-681



Shell leakage test (400℃) according MESC SPE 85/300 - 3.3.2

amtec - Shell cycle test at 400℃

Test pressure	34.7 bar
Shell required gasket stress level	74 Mpa
Leakage rate	No
Shell tightness class	Passed
Test no.	16-658



Shell cycle test at 400℃ according MESC SPE 85/300 - 3.3.5

Applications Case 1. : SPW Gasket Leaks by Operating 650℃ Hydrogen Gas

Process and Devices

Reactor Body Flange reacting with propane gas of high temperature and catalyst and surrounding pipes

	164 (INLET)	186 (OUTLET)	162	302
Temp. (℃)	648	612.7	557.1	142
Press. (kg/㎠)	2.2	0.3	2.5	0.2

Applied Products

- Spiral Wound Gasket

UOP Spec. application -I/R : SS304 , O/R : SS304 , H : In800 , F : Gr.+Asb.

Customers' Problems

Existing SPW Gasket after use

- Producing propylene by dehydrogenation, reacting high temperature propane gas heated by fired heater with catalyst
- The existing Spiral Wound Gasket leaks after one month from installation and causes a fire.
- In the event of fire, lots of expenses are required due to N_2 gas purge, frequent stop and replacement.
- Corrosion and damage of metal due to high temperature and hydrogen brittleness
- Damage to the equipment due to the insertion of SPW gasket inner ring to the inside of ring reactor

Solution

- Technology Team of KUKIL INNTOT reviews the operation conditions and problems of process and devices provided by customers
- We suggested a new solution to solve the problems of flange deformation by the influence of high temperature environment and elbow and hydrogen brittleness.
- We proposed to replace current spiral wound gasket with the new Hiflex Metal Gasket in which the new technology of KUKIL INNTOT is integrated.
- Customers have completed replacement with the proposed new Hiflex Metal Gasket.

Results

- Due to high temperature and hydrogen embrittlement, existing SPW gasket leaks because of corrosion and damage.
- Significant cost loss due to fire and disruption of equipment caused by leakage
- Applying new Hiflex gasket eliminates the problem of fire and disruption of equipment caused by leakage.
- Saving of significant cost loss
- Customers are impressed by Kukil Inntot's technology and quick & effective solutions.

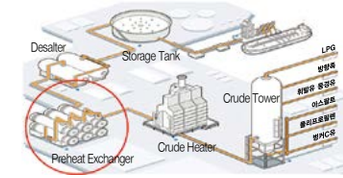
Hiflex Metal Gasket after normal installation and use

Difference in compression amount after installing eccentricity (top and bottom)
Damage to Hiflex Gasket after use due to occurrence
However, no leak with the performance of 3st O-Ring

Applications Case 2. : Hot Atmospheric Residue/Crude Exchangers Leak

Process and Devices

Crude Feed/Residue Preheat Exchangers



Applied Products

- Spiral Wound Gasket

Device 3, Device 4: Inner Ring SPW Gasket

Customers' Problems

- As the equipment was manufactured in 1990, leakage occurs due to the temperature difference between Tube (Residue) 389℃ _ 29.9㎏/㎠ and Shell (Crude) 321℃ _ 47.8㎏/㎠ of heat exchanger preheated before entering into crude heater through desalter
- Leakage that continues at start up after maintenance and leakage during operation
- Environmental pollution and decline of operation efficiency due to oil leak

Solution

- Technology Team of KUKIL INNTOT reviews the operation conditions and problems of process and devices provided by customers.
- We suggested a new solution to solve it.
- We proposed to replace it with the new Hiflex Metal Gasket in which the new technology of KUKIL INNTOT is integrated.
- Customers have completed replacement with the proposed new Hiflex Metal Gasket.

Device 3 : Hiflex Metal Gasket K/#Hiflex-G21 6.4T, 1360 x 1410 A & B1
Hiflex Metal Gasket K/#Hiflex-G25 6.4T, 1509 x 1531 A
Device 4 : Hiflex Metal Gasket K/#Hiflex-G21 6.4T, 1397 x 1447 A
Hiflex Metal Gasket K/#Hiflex-G21 6.4T, 1241 x 1291 A & C1
Hiflex Metal Gasket K/#Hiflex-G21 6.4T, 1245 x 1287 C1

Results

- Existing spw gasket leaks due to temperature difference in heat exchanger.
- Significant cost loss due to environmental pollution caused by oil leakage and lower operating efficiency
- Applying new Hiflex gasket eliminates the problem of environmental pollution caused by leakage and lower operating efficiency.
- Longer gasket replacement cycle reduces environmental pollution more than before which occurs when replacing it.
- Customers are impressed by Kukil Inntot's technology and quick & effective solutions.

Applications Case 3.

: SPW Gasket Leaks by Operating Thermal Cycle

Process and Devices

Girth Flange of CVD-OFF GAS FILTERING SYS

Applied Products

- Spiral Wound Gasket

Device 1 : In & Out Ring SPW Gasket _ 7.2T, 2048 x 2078 x 2111 x 2139
Device 2 : In & Out Ring SPW Gasket _ 7.2T, 3244 x 3274 x 3307 x 3335

Customers' Problems

- Girth Flange of the equipment filtering compound gas of TCS STC H_2 Si-dust of customers producing polysilicon
- After maintaining in the pressure condition of 7.5bar (DP 10bar) and the state of 250℃ (DT 280℃) for 2~3 days, repeating to maintain the room temperature (Amt.) for a day.
- Coefficient of expansion difference occurs due to the materials of Tube Sheet (SS304) and Girth Flange (A105+SS304 Clad)
- Leak occurs at the existing Spiral Wound Gasket, when a week passes after installation.
- Lots of expenses are required due to frequent stops and replacements.

Solution

- Technology Team of KUKIL INNTOT reviews the operation conditions and problems of process and devices provided by customers
- We suggested a new solution to solve it.
- We proposed to replace current spiral wound gasket with the new Hiflex Metal Gasket in which the new technology of KUKIL INNTOT is integrated.
- Customers have completed replacement with the proposed new Hiflex Metal Gasket.

Device 1 : Hiflex Metal Gasket K/#Hiflex-G23 _ 7.4T, 2061 x 2111
Device 2 : Hiflex Metal Gasket K/#Hiflex-G23 _ 7.4T, 3257 x 3307

Results

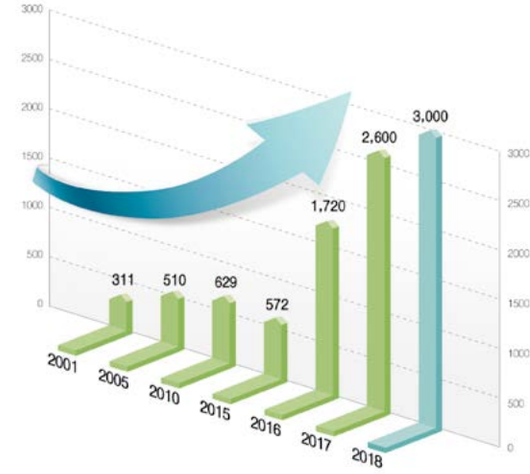
- Existing spw gasket leaks due to thermal cycle process inside the equipment.
- Significant cost loss due to failure of process equipment and frequent gasket replacement caused by leakage
- Applying new Hiflex gasket eliminates unexpected factory shutdown due to gas leakage.
- Stable sealing for thermal cycle reduces the number of unexpected factory shutdown.
- Customers are impressed by Kukil Inntot's technology and quick & effective solutions.

Customer satisfaction is our priority

Hiflex®

▶ 97 Client
Hiflex® is supplied
9,355 worldwide

100%
Perfect Sealing



- Individual sealing solutions
- Global customized service
- Sealing technology of the advanced
- Approved major customers

Major Clients

한국수력원자력㈜ | KEPCO | KOGAS | 한국가스공사 | 한국동서발전㈜
한국남부발전㈜ | KOEN 한국남동발전 | KOMIPO 한국중부발전 | wp 한국서부발전㈜ | DSME 대우조선해양 | HYUNDAI HEAVY INDUSTRIES CO.,LTD.
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HYUNDAI ENGINEERING & CONSTRUCTION | GS Caltex | S-OIL | Hyundai Oilbank | SK energy

Major Clients

SK incheon petrochem
Hanwha TOTAL
TAEKWANG
KUMHO PETROCHEMICAL
KOREA PETROCHEMICAL IND. CO., LTD.
YONGSAN CHEMICALS INC.
동서석유화학주식회사
ISU 이수화학
BASF We create chemistry
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GASCO
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KNPC
LUKOIL
Orpic
TOYO
Linde
NPCC
POGC
Qatar Petroleum
sabic
eni saipem
satorp
Petrofac
JGC

Recommended Torque

Torque Table for Hiflex® G-20 Series

Size (In)	Class 150		Class 300		Class 600	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
8	150	200	240	320	533	710
10	240	320	368	490	750	1000
12	240	320	533	710	750	1000
14	368	490	533	710	1020	1360
16	368	490	750	1000	1200	1600
18	533	710	750	1000	1650	2200
20	533	710	750	1000	1650	2200
24	750	1000	1200	1600	3000	4000

Size (In)	Class 900		Class 1500		Class 2500	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
8	1020	1360	1650	2200	3300	4400
10	1020	1360	3000	4000	6600	8800
12	1020	1360	3300	4400	8880	11840
14	1200	1600	4770	6360		
16	1650	2200	6600	8800		
18	3000	4000	8880	11840		
20	3300	4400	11580	15440		
24	6600	8800	18750	25000		

Notes
1. Bolt Torque values listed assume a lubricated stud bolt resulting in a 0.16 friction factor.
2. KUKIL INNTOT does not generally recommend a bolt stress above 60,000 PSI.
3. Torque values limit minimum and maximum gasket seating stresses based upon pressure calss anc certain operating conditions.
4. Extreeme operating conditions such as high temperature may reduce bolt yield strength.

Recommended Torque

Torque Table for Hiflex® G-31

Size (In)	Class 150		Class 300		Class 600	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
1/2	40	60	40	60	40	60
3/4	40	60	90	120	90	120
1	40	60	90	120	90	120
1-1/4	40	60	90	120	90	120
1-1/2	40	60	150	200	150	200
2	90	120	90	120	90	120
2-1/2	90	120	150	200	150	200
3	90	120	150	200	150	200
3-1/2	90	120	150	200	240	320
4	90	120	150	200	240	320
5	150	200	150	200	368	490
6	150	200	150	200	368	490
8	150	200	240	320	533	710
10	240	320	368	490	750	1000
12	240	320	533	710	750	1000
14	368	490	533	710	1020	1360
16	368	490	750	1000	1200	1600
18	533	710	750	1000	1650	2200
20	533	710	750	1000	1650	2200
24	750	1000	1200	1600	3000	4000

Size (In)	Class 900		Class 1500		Class 2500	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
1/2	150	200	150	200	150	200
3/4	150	200	150	200	150	200
1	240	320	240	320	240	320
1-1/4	240	320	240	320	368	490
1-1/2	368	490	368	490	533	710
2	240	320	240	320	368	490
2-1/2	368	490	368	490	533	710
3	240	320	533	710	750	1000
4	533	710	750	1000	1200	1600
5	750	1000	1200	1600	2250	3000
6	533	710	1020	1360	3300	4400
8	1020	1360	1650	2200	3300	4400
10	1020	1360	3000	4000	6600	8800
12	1020	1360	3300	4400	8880	11840
14	1200	1600	4770	6360		
16	1650	2200	6600	8800		
18	3000	4000	8880	11840		
20	3300	4400	11580	15440		
24	6600	8800	18750	25000		

Notes
1. Bolt Torque values listed assume a lubricated stud bolt resulting in a 0.16 friction factor.
2. KUKIL INNTOT does not generally recommend a bolt stress above 60,000 PSI.
3. Torque values limit minimum and maximum gasket seating stresses based upon pressure calss anc certain operating conditions.
4. Extreeme operating conditions such as high temperature may reduce bolt yield strength.

Recommended Torque

Torque Table for Hiflex® G-20 Series

ASME B16.47 Ser.A

Size (In)	Class 150		Class 300		Class 600		Class 900	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
26	750	1000	1650	2200	3000	4000	8880	11840
28	750	1000	1650	2200	3300	4400	11580	15440
30	750	1000	2250	3000	3300	4400	11580	15440
32	1200	1600	3000	4000	4770	6360	15000	20000
34	1200	1600	3000	4000	4770	6360	18750	25000
36	1200	1600	3300	4400	6600	8800	18750	25000
38	1200	1600	1200	1600	4770	6360	18750	25000
40	1200	1600	1650	2200	4770	6360	18750	25000
42	1200	1600	1650	2200	6600	8800	18750	25000
44	1200	1600	2250	3000	6600	8800	23150	30900
46	1200	1600	3000	4000	6600	8800	30833	37000
48	1200	1600	3000	4000	8880	11840	30833	37000
50	2250	3000	3300	4400	11580	15440		
52	2250	3000	3300	4400	11580	15440		
54	2250	3000	4770	6360	11580	15440		
56	2250	3000	4770	6360	15000	20000		
58	2250	3000	4770	6360	15000	20000		
60	2250	3000	4770	6360	18750	25000		

Torque Table for Hiflex® G-20 Series

ASME B16.47 Ser.B

Size (In)	Class 150		Class 300		Class 600		Class 900	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
26	150	200	750	1000	1650	2200	6600	8800
28	150	200	750	1000	2250	3000	8880	11840
30	150	200	1020	1360	3000	4000	11580	15440
32	150	200	1200	1600	3300	4400	11580	15440
34	240	320	1200	1600	4770	6360	15000	20000
36	240	320	1650	2200	4770	6360	11580	15440
38	368	490	1650	2200				
40	368	490	1650	2200				
42	368	490	2250	3000				
44	368	490	2250	3000				
46	533	710	3000	4000				
48	533	710	3000	4000				
50	533	710	3000	4000				
52	533	710	3000	4000				
54	533	710	3000	4000				
56	533	710	4770	6360				
58	750	1000	4770	6360				
60	750	1000	4770	6360				

Notes
1. Bolt Torque values listed assume a lubricated stud bolt resulting in a 0.16 friction factor.
2. KUKIL INNTOT does not generally recommend a bolt stress above 60,000 PSI.
3. Torque values limit minimum and maximum gasket seating stresses based upon pressure calss anc certain operating conditions.
4. Extreeme operating conditions such as high temperature may reduce bolt yield strength.

Recommended Torque

Torque Table for Hiflex® G-31
ASME B16.47 Ser.A

Size (In)	Class 150		Class 300		Class 600		Class 900	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
26	750	1000	1650	2200	3000	4000	8880	11840
28	750	1000	1650	2200	3300	4400	11580	15440
30	750	1000	2250	3000	3300	4400	11580	15440
32	1200	1600	3000	4000	4770	6360	15000	20000
34	1200	1600	3000	4000	4770	6360	18750	25000
36	1200	1600	3300	4400	6600	8800	18750	25000
38	1200	1600	1200	1600	4770	6360	18750	25000
40	1200	1600	1650	2200	4770	6360	18750	25000
42	1200	1600	1650	2200	6600	8800	18750	25000
44	1200	1600	2250	3000	6600	8800	23150	30900
46	1200	1600	3000	4000	6600	8800	30833	37000
48	1200	1600	3000	4000	8880	11840	30833	37000
50	2250	3000	3300	4400	11580	15440		
52	2250	3000	3300	4400	11580	15440		
54	2250	3000	4770	6360	11580	15440		
56	2250	3000	4770	6360	15000	20000		
58	2250	3000	4770	6360	15000	20000		
60	2250	3000	4770	6360	18750	25000		

Torque Table for Hiflex® G-31
ASME B16.47 Ser.B

Size (In)	Class 150		Class 300		Class 600		Class 900	
	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)	Suggested (ft.lbs)	Max (ft.lbs)
26	150	200	750	1000	1650	2200	6600	8800
28	150	200	750	1000	2250	3000	8880	11840
30	150	200	1020	1360	3000	4000	11580	15440
32	150	200	1200	1600	3300	4400	11580	15440
34	240	320	1200	1600	4770	6360	15000	20000
36	240	320	1650	2200	4770	6360	11580	15440
38	368	490	1650	2200				
40	368	490	1650	2200				
42	368	490	2250	3000				
44	368	490	2250	3000				
46	533	710	3000	4000				
48	533	710	3000	4000				
50	533	710	3000	4000				
52	533	710	3000	4000				
54	533	710	3000	4000				
56	533	710	4770	6360				
58	750	1000	4770	6360				
60	750	1000	4770	6360				

Notes
1. Bolt Torque values listed assume a lubricated stud bolt resulting in a 0.16 friction factor.
2. KUKIL INNTOT does not generally recommend a bolt stress above 60,000 PSI.
3. Torque values limit minimum and maximum gasket seating stresses based upon pressure calss anc certain operating conditions.
4. Extreeme operating conditions such as high temperature may reduce bolt yield strength.

Gasket Installation Procedure

By ESA / FSA Guidelines for safe seal usage - Flanges and Gasket

Tools Required
Specific tool are required for cleaning and tensioning the fasteners.
Additionally, alwasys use standard safety equipment and follow good safety practices.
Acquire the follwoing equipment prior to installation
- Calibrated torque wrench, hydraulic or other tensioner
- Wire brush (brass if possible)
- Helmet
- Safety goggles
- Lubricant
- Other plant-specified equipment

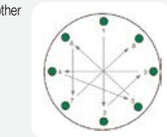
1. Clean and examine
- Remove all foreign material and debris from the seating surfaces, fasteners (bolts or studs), nuts, and washers. Use plant-specified dust control procedures.
- Examine fasteners (bolts or studs), nuts, and washers for defects such as burrs or cracks.
- Examine flange surfaces fro warping, radial scores, heavy tool marks, or anything prohibiting proper gasket seating.
- Replace components if found to be defective. If in doubt, seek advice.

2. Align Flanges
- Align flange faces and bolt holes without using excessive force.
- Report and misalignment.

3. Install gasket
- Assure gasket is the specified size and material.
- Examine the gasket to ensure it is free of defects.
- Carefully insert gasket between flanges.
- Make sure the gasket is centered between the flanges.
- Do not use jointing compounds or release agents on the gasket or seating surfaces unless specified by the gasket manufacturer.
- Bring flanges together, ensuring the gasket isn't pinched or damaged.

4. Lubricate load-bearing surfaces
- Use only specified or approved lubricants.
- Liberally apply lubricant uniformly to all thread, nut and washer load-bearing surfaces.
- Ensure Lubricant doesn't contaminate either flange or gasket face.

5. Install and tighten bolts
- Always use proper tools: calibrated torque wrench or other controlled tensioning device.
- Consult KUKIL for guidance on torque specifications.
- Always torque nuts in a cross bolt tightening pattern:



6. Tighten the nuts in multiple steps
Step 1. Tighten all nuts initially by hand. (larger bolts may require a small hand wrench.)
Step 2. Torque each nut to approximately 30% of full torque.
Step 3. Torque the nuts to approximately 60% of full torque.
Step 4. Torque each nut to full torque, again using the cross bolt tightening pattern.
(Large-diameter flanges may require additional tightening passes.)
Step 5. Apply at least one final full torque to all nuts in a clock-wise direction until all torque is uniform.
(Large-diameter flanges may require additional tightening passes.)

7. Retightening
- Caution: Consult KUKIL for guidance and recommendation on retightening.
- Do not retorque elastomer-based, asbestos-free gaskets after they have been exposed to elevated temperatures unless otherwise specified.
- Retorque fasteners exposed to aggressive thermal cycling.
- All retorquing should be performed at ambient temperature and atmospheric pressure.

Certificate of patent registration

Kukil Inntot, being a Korea's top sealing manufacturer having best technology, has been recognized for its technology for 37 years as a supplier of sealing products to all industries including onshore & offshore facilities, oil refining, petrochemistry, power generation and construction.

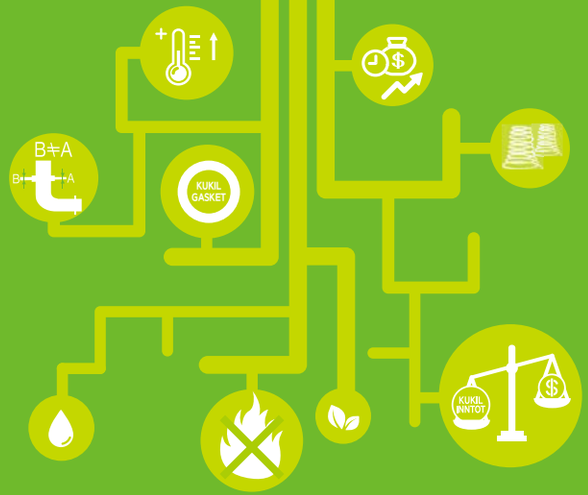
In addition, it is Kukil Inntot's management philosophy to become top of technology innovation by continuous technology development. Based on this, we have developed many products such as gaskets, couplings, and construction materials, and now we have 170 intellectual property rights.

Among the developed products, the performance of Hiflex has been proved 100% as sealing product through the application of 12,000 units or so in leaking sites of refinery and petrochemistry around the world for 17 years. In addition, for the first time it has commercialized newly developed products for special use, and has a supply performance of approximately more than 100,000 units over nearly 10 years. Furthermore, the demand for supply is increasing every year thanks to the recognition of technology applied to developed products.

As such, Kukil Inntot has been solving the problems caused by leakage in various industrial fields that cannot be solved at home and abroad, and now secure the right solution and know–how for that. Based on this, we also possess technology to offer solutions for other areas beyond sealing. Going forward, Kukil Inntot will communicate with customers for their problems and will continue to research and develop so as to suggest solution to all kinds of problem.

DO NOT LOOK AT
THE INDIVIDUAL TREE,
BUT LOOK AT
THE FORESTS.

Big Concept



B.R.C.R
Best **R**ecovery , **C**ut the **R**isk

- **Best**: -sealing, -recovey / flexible, -thermal cycle, -safety
- **Reduce**: -loss, -dangerous, -exchange cycle
- **Cut**: -down time, -down money, -down personnel

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