1. Certificate (1 of 1)

Description	Certificate Authority	Certificate No.	Issued Date	Renewal Interval	Date
Quality Management System KS Q ISO 9001 : 2009 ISO 9001 : 2008	Korean Standards Association (KSA)	QMS-0698	1995.08.03	3 Years	2019.09.21
Environmental Management System KS I ISO 14001 : 2009 ISO 14001 : 2004	Korean Standards Association (KSA)	EMS-0731	2009.10.08	3 Years	2018.10.07
Health & Safety Management System K-OHSMS 18001:2007 /OHSAS 18001:2007	Korean Standards Association (KSA)	HSS-0089	2013.05.19	3 Years	2019.05.18
API MONOGRAM ANSI/API Specification Q1:2007 / ISO 9001:2008 / 6A:2010 Ring Joint Gasket	American Petroleum Institute (API)	6A-1347	2016.05.04	3 Years	2018.04.09
EC CERTIFICATE OF QUALITY SYSTEM APPROVAL(PED) In accordance with the requirement of the Pressure Equipment Directive 97/23/EC Manufacture of metallic, non-metallic and semi-metallic gaskets.	Lloyd's Resister (LR)	0038/PED/MUM /131005/1	2013.04.26	3 Years (매년 사후심사 2월 25일 이전 사후관리신청)	2019.04.25
Self-Inspection Items GASKET	Hyundai Heavy Industries Co., Ltd	15-047	2015.02.01	2 Years	2017.01.31 5월까지홀딩
Quality Certificate GASKET & INSULATION SETS	DAEWOO SHIPBUILDING & MARINE NGINEERING Co., Ltd	DSME-QM-16-040	2015.02.28	1 Years	2018.02.28 (A등급일시 1년간유예됨)
유자격공급자 등록증	한국수력 원자력(주) (KHNP)	201601370	2017.01.11	4 Years	2021.01.10
발전설비정비적격 업체 등록증 **Metal Gasket 외**	한국남부발전㈜	MG5I-CT1R-R765-ND62	2014.04.01	3 Years	2017.03.31
INSULATING JOINTS, RUBBER, GASKETM PACKING, JOINT SHEET	ADWEA(UAE)	9944024	2014.10.13	5 Years	2019.07.21
VENDOR & CONTRACTORS EVALUATION COMMITTEE GASEKTS, JOINTING COMPOUNDS	KNPC	277069	2014.09.22	5 Years	2019.09.22
Notice of Subcontractor Evaluation Results Gasket, Packing and PTFE Product	KOBELCO	J009	2014.08.19	3 Years	2017.08.19
CERTIICATE OF QUALIFICATION Joint qualification system	Achilles JQS	ACHILLES ID.28492	2013.09.17	1 years	2016.05.16 (갱신안함)

2. Vendor Registration & ETC

Description	Certificate Authority	Certificate No.	Issued Date
Company Registration PACKING	Aramco Overseas Company	10036961	2007.08.13
Company Registration GASKET, INSULATING JOINTS, GRAPHITE GASKETS, PIPES & FITTINGS LINED	Abu Dhabi Oil Refining Company (TAKREER)	908546	2013.02.06
Registration & Pre-Qualification as Manufacturer GASKET, INSULATION GASKET, GRAPHITE GASKET, RING JOINT	Abu Dhabi Polymers Co., Ltd (Borouge)	0000003251	2013.11.20
Registration CERTIICATE GASKET	ADGAS	105954	2014.05.19
SADARA Chemical (Saudi Arabia)	SADARA	1000001306	2015.01.02
신기술 적용 제품 확인서 LEAKBLOK®	MKE (지식경제부)	제0693호	2013.03.13
기업부설연구소 인정서	한국산업기술진흥협회	제19951270호	1995.09.26
Quality Management System Approval Status INSULATION KIT	Aramco Asia Korea Limited 아람코 아시아 코리아 유한회사	30007592	2016.02.26
Q등급	두산중공업	JS-QAM-03 Rev.13 (승인메뉴얼)	2017.03.30

3. Type Approval

Description	Certificate Authority	Certificate No.	Issued Date	Renewal Interval	Date
TYPE APPROVAL **Compressed Non-Asbestos Sheet and Gasket** **JIC 6000, 6100, 6200**	한국선급 (KR)	BSN02359 -GT001	1987.06.20	5 Years	2017.06.19
TYPE APPROVAL **– Design Assessment** Gasket, Compressed Non-Asbestos Sheet LEAKBLOK®, JIC 6000	American Bureau of Shipping (ABS)	16-BK1558501-PDA	2016.09.22	5 Years	2021.09.21
TYPE APPROVAL **– Manufacturing Assessment** Gasket, Compressed Non-Asbestos Sheet	American Bureau of Shipping (ABS)	BK2897500-X	2015.05.12	5 Years (5/12~ 90일 이내 신청)	2020.05.13
TYPE APPROVAL **LEAKBLOK®**	Lloyd's Resister(LR)	14/40001	2014.03.26	5 Years	2019.03.25
TYPE APPROVAL **ISO-KIT (JIC 9210-ER, JIC 9230-ES,** **JIC 9320-OS, JIC 3850-SE(HT))**	Lloyd's Resister(LR)	14/40004	2014.07.11	5 Years	2019.07.10
TYPE APPROVAL **ISO-KIT (JIC 9320-OFS)**	Lloyd's Resister(LR)	14/40012	2014.07.11	5 Years	2019.07.10
TYPE APPROVAL **JIC 6000, JIC 6200 , JIC 6400**	Lloyd's Resister(LR)	15/40029(E1)	2015.02.04	5 Years	2020.02.14
TYPE APPROVAL Cryogenic Service for LNG Plants & LNG Carriers Spiral Wound Gasket JIC 3836-R-SF & JIC 3834-R-SF	Det Norske Veritas (DNV) -GL	TAP0000004	1998.09.21	4 Years (2년마다 중간점검 2017년 4월 30일 신청)	2019.06.28
WRAS Test Report LEAKBLOK®	WRAS	1307531	2013.07	5 Years	2018.07
WRAS Test Report JIC 6010	WRAS	1311541	2013.11	5 Years	2018.11
WRAS Test Report JIC 6200	WRAS	1311542	2013.11	5 Years	2018.11
TYPE APPROVAL JIC 4201 Series JIC 4201, JIC 4201-B, JIC 4201-P, JIC 4201-W	Lloyd's Resister(LR)	15/40129	2015.12.10	5 Years	2020.12.09

4. Test Report (1 of 2)

Description	Certificate Authority	Qualification ID / Certificate No	Date
Fugitive Test VOC Packing	Lloyd's Resister (LR)	KID 0114048/1	2001.05.28
Certificate TA-LUFT LEAKBLOK®	AMTEC	30245401E/FH	2013.03.04
Certificate Fire-Safe JIC 4201-B CLASS 300 6"	AMTEC	30279631E/CS	2015.09.15
Fire test Report, API Standard 6FB, Third Edition STARTEC® 9320-OFS	AMTEC	30252301E/FH	2013.11.26
Fire test Report, API Standard 6FB, Third Edition STARPITE® 4201-HT	AMTEC	30252302E/FH	2014.02.26
Fire Endurance Test JIC 6000	Fire Insurers Laboratories of Korea	2003-0966	2003.08.19
Fire Endurance Test LEAKBLOK®	Fire Insurers Laboratories of Korea	G2014-0396	2014.04.17
Fire Endurance Test Spiral Wound Gasket	Fire Insurers Laboratories of Korea	G2014-0844	2014.07.31
극저온용 시험 LEAKBLOK®	고기능성밸브 기술지원센터	TCHPV-15-04-113	2015.04.17
초저온 누설시험 LEAKBLOK®	고기능성밸브 기술지원센터	TCHPV-15-05-104	2015.05.12
API 607 FIRE TEST JIC 6000	고기능성밸브 기술지원센터	TCHPV-15-06-103	2015.06.29
고압시험 STARTEC® 9320-HP	고기능성밸브 기술지원센터	TCHPV-15-10-105	2015.10.28
저온성능시험 LEAKBLOK® P200	고기능성밸브 기술지원센터	TCHPV-15-10-114 (사용금지)	2015.10.29
API 6FB, Fire Test Report Spiral Wound Gasket JIC 3836-R-SF-316-SS 6 inch Class 300	YARMOUTH RESEARCH AND TECHNOLOGY, LLC	PJT No. : 211073	2011.03.25
API 6FB, Fire Test Report Spiral Wound Gasket JIC 3850-SE-316(SF) 6 inch Class 300	YARMOUTH RESEARCH AND TECHNOLOGY, LLC	PJT No. : 211073	2011.03.25

4. Test Report (2 of 2)

Description	Certificate Authority	Qualification ID / Certificate No	Date
저온성능시험 LEAKBLOK® P200	고기능성밸브 기술지원센터	TCHPV-16-01-103 (사용금지)	2016.01.12
저온성능시험 LEAKBLOK® P200 (ANSI 600 CLASS – 6 INCH)	고기능성밸브 기술지원센터	TCHPV-16-03-107	2016.04.05
LEAKBLOK® 식약청 기구 및 용기포장기준 TEST	한국식품과학연구원 부산지소	제 1600 호	2017.03.02
Epoxy Rubber 시편의 내전압, 표면저항 TEST	Koptri	17-1199	2017.05.10
고분자시편의 압축시험	Koptri	-	2017.09.29
LEAKBLOK 절연파괴전압, 절연파괴강도 시험	Koptri	17-3000	2017.10.13
LEAKBLOK 절연파괴전압, 절연파괴강도 시험	Koptri	17-3001	2017.10.13
LEAKBLOK 수분흡수율 시험	Koptri	17-3002	2017.10.13
LEAKBLOK 수분흡수율 시험	Koptri	17-3003	2017.10.13

CERTIFICATE OF APPROVAL

JEIL E&S Co., Ltd.

- HEAD OFFICE & 1 FACTORY : 309, CHUNGJOYEOL-RO, YANGSAN-SI, GYEONGSANGNAM-DO, KOREA
- HWASEONG FACTORY : 11, MADOGONGDAN-RO 4-GIL, MADO-MYEON, HWASEONG-SI, GYEONGGI-DO, KOREA
- 2 FACTORY : 73, JWASAM-GIL, SANGBUK-MYEON, YANGSAN-SI, GYEONGSANGNAM-DO, KOREA
- SEOUL OFFICE : 4-27, YANGJAE-DAERO 71-GIL, SONGPA-GU, SEOUL, KOREA

Korean Standards Association hereby certifies that the Quality Management System of the above organization has been assessed and found to meet the requirements of the standard and scope of certification detailed below:

CERTIFICATION No. QMS-0698

STANDARD KS Q ISO 9001:2009/ISO 9001:2008

SCOPE OF CERTIFICATION

DESIGN, DEVELOPMENT, PRODUCTION, SALES AND SERVICING OF SEALING PRODUCTS (METALLIC GASKET, SEMI-METALLIC GASKET, NON-METALLIC GASKET AND GLAND PACKING) AND FLUOROCARBON RESIN LINED PRODUCTS (PIPINGS, TANKS, VESSELS, MACHINED PRODUCTS AND SEMI-CONDUCTOR RELATED PRODUCTS)

VALID FROM 22 September, 2016

VALID UNTIL 21 September, 2019

Due to the revison of ISO standard in 2015, this certificate is valid until 14th September 2018

Original Certification Date : 03 August, 1995

Date of Issue : 14 May, 2016

Baek Soo Hyun

PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION

305, Teheran-Ro, Gangnam-Gu, Seoul, Korea

KSA IAF KAB

Accredited by Member of the IAF MLA for QMS.
The Accreditation Mark indicates accreditation in respect of those activities covered by the Accreditation Certification Number KAB-QC-30.

CERTIFICATE OF APPROVAL

JEIL E&S Co., Ltd.

· HEAD OFFICE & 1 FACTORY : 309, CHUNGYEOL-RO, YANGSAN-SI, GYEONGSANGNAM-DO, KOREA
· HWASEONG FACTORY : 11, MAEDOGONGDAN-RO 4-GIL, MADO-MYEON, HWASEONG-SI, GYEONGGI-DO, KOREA
· 2 FACTORY : 73, JANGANB-GIL, SANGBUK-MYEON, YANGSAN-SI, GYEONGSANGNAM-DO, KOREA
· SEOUL OFFICE : 4-27, YANGJAE-DAERO 71-GIL, SONGPA-GU, SEOUL, KOREA

Korean Standards Association hereby certifies that the Environmental Management System of the above organization has been assessed and found to meet the requirements of the standard and scope of certification detailed below:

CERTIFICATION No. EMS-0731

STANDARD KS I ISO 14001:2009/ISO 14001:2004

SCOPE OF CERTIFICATION

DESIGN, DEVELOPMENT, PRODUCTION, SALES AND SERVICING OF SEALING PRODUCTS(METALLIC GASKET, SEMI-METALLIC GASKET, NON-METALLIC GASKET AND GLAND PACKING) AND FLUOROCARBON RESIN LINED PRODUCTS(PIPINGS, TANKS, VESSELS, MACHINED PRODUCTS AND SEMI-CONDUCTOR RELATED PRODUCTS)

VALID FROM 08 October, 2015

VALID UNTIL 07 October, 2018

Due to the revision of ISO standard in 2015,
this certificate is valid until 14th September 2018

Original Certification Date : 08 October, 2009

* This certificate is reissued due to the addition of the remote functioning site

Date of Issue : 14 May, 2016

Baek, Soo Hyun
PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION

305, Teheran-Ro, Gangnam-Gu, Seoul, Korea

KSA

Accredited by Member of the IAF MLA for EMS.
The Accreditation Mark( ) indicates accreditation in respect of those activities covered by the Accreditation Certification Number KAB-EC-11.

CERTIFICATE OF APPROVAL

JEIL E&S Co., Ltd.

- HEAD OFFICE & 1 FACTORY : 309, CHUNGSEOL-RO, YANGSAN-SI, GYEONGSANGNAM-DO, KOREA
- BUSEONG FACTORY : 31, BANGGONGSAN-RO 4-GIL, BUSEO-MYEON, BUSEONG-SI, GYEONGGI-DO, KOREA
- 2 FACTORY : 23, JIKSIM-GIL, SINGEOK-MYEON, YANGSAN-SI, GYEONGSANGNAM-DO, KOREA
- SEOUL OFFICE : 4-27, YANGJAE-DAERO 21-GIL, SONGPA-GU, SEOUL, KOREA

Korean Standards Association hereby certifies that the Occupational Health Safety Management System of the above organization has been assessed and found to meet the requirements of the standard and scope of certification detailed below:

CERTIFICATION No. HSS-0089

STANDARD K-OHSMS 18001:2007/OHSAS 18001:2007

SCOPE OF CERTIFICATION

DESIGN, DEVELOPMENT, PRODUCTION, SALES AND SERVICING OF SEALING PRODUCTS(METALLIC GASKET, SEMI-METALLIC GASKET, NON-METALLIC GASKET AND GLAND PACKING) AND FLUOROCARBON RESIN LINED PRODUCTS(PIPINGS, TANKS, VESSELS, MACHINED PRODUCTS AND SEMI-CONDUCTOR REALTED PRODUCTS)

VALID FROM 19 May, 2016

VALID UNTIL 18 May, 2019

Original Certification Date : 19 May, 2013

Date of Issue : 14 May, 2016

Baek, Soo Hyun
PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION
305, Teheran-Ro, Gangnam-Gu, Seoul, Korea

KSA

The Accreditation Mark ( ) indicates accreditation in respect of those activities covered by the Accreditation Certification Number KAB-OC-02.

Certificate of Authority to use the Official API Monogram

License Number: 6A-1347 **ORIGINAL**

The American Petroleum Institute hereby grants to

JEIL E & S CO., LTD.
309, Chungnyeol-ro
Yangsan-si, Gyeongsangnam-do
South Korea

the right to use the Official API Monogram® on manufactured products under the conditions in the official publications of the American Petroleum Institute entitled API Spec Q1® and **API-6A** and in accordance with the provisions of the License Agreement.

In all cases where the Official API Monogram is applied, the API Monogram shall be used in conjunction with this certificate number: **6A-1347**

The American Petroleum Institute reserves the right to revoke this authorization to use the Official API Monogram for any reason satisfactory to the Board of Directors of the American Petroleum Institute.

The scope of this license includes the following: Ring Joint Gaskets

American Petroleum Institute

CORPORATE SEAL

2015-033

QMS Exclusions: Design and Development; Servicing

Effective Date: MAY 4, 2016
Expiration Date: APRIL 9, 2018

To verify the authenticity of this license, go to www.api.org/compositelist.

Vice President, API Global Industry Services

KOBELCO

KOBE STEEL, LTD.

Equipment Group
Global Procurement Department
Machinery Business Unit
2-3-1,Shinhama, Arai-cho, Takasago,676-8670,Japan
Phone : + 81-79-445-7152 Fax : + 81-79-445-7234

To: JEIL E&S Co.,Ltd.
c/o: 福助機工株式会社

Date: 14-Oct-14
J-009

Notice of Subcontractor Evaluation Results

Dear Sirs,
Thank you very much for your kind cooperation in submitting us related data in our carrying out subcontractor evaluation. We have carried out strict evaluations and would like to inform you of the results as follows:

NOTE:

1. Products evaluated : Gasket, Packing and PTFE Product

2. Evaluation results : Accepted
3. Requirements for improvements : None
4. Others : None

Date of Validity : From August 19, 2014 To August 19, 2017

Date of Authorization : August 19, 2014

KOBE STEEL,LTD.

M.Takiguchi, Team Leader
Equipment Group
Global Procurement Department

ISO-FORM-073

MG5I-CT1R-R765-ND62

발전설비정비적격업체 등록증

상 호 : 제일E&S(주)

대 표 자 : 김진태 업체코드 : D423

주 소 : 경남 양산시 유산동 39-5

출입책임 :

대표품목 : Metal Gasket 외 1건

[상세품목은 다음페이지 참조]

자격유효기간 : 2014.04.01 ~ 2017.03.31

상기 업체를 발전설비정비적격업체로 등록함

2014.04.01

한국남부발전㈜ 부산복합화력본부장

※ 인터넷으로 발급된 인증서이며, 한국남부발전(주) 홈페이지(www.kospo.co.kr)에서 원본 확인이 가능합니다.

등록품목

NO.	분야/그룹명	품목명	제작범위	자격만료일	운용분야
1	기타/기타설비(1-2)	Metal Gasket	제작 및 정비	2017.03.31	■ 제조
2	기타/기타설비(1-2)	고온, 고압 Packing gasket	Mold Packing	2017.03.31	■ 제조

KHNP
KOREA HYDRO & NUCLEAR POWER CO.,LTD

유자격공급자 등록증

Certificate of Registration

등록번호 (Certificate No.) : 201601370

상 호 (Company Name) : JEIL E&S CO.,LTD

공장주소 (Factory Location) : 309, Chungryeol-ro, Yangsan-si, Gyeongsangnam-do, Korea

대 표 자 (Chief Executive officer) : KIM CHI YEON

□상기 업체는 우리 회사의 공급자관리지침에 따라 심사한 결과 예비품목
□기자재 공급업체로 등록되었음을 증명합니다.

This is to certify that according to KHNP's qualification procedure, this company has been registered on KHNP's Approved Spare Parts Vendor List for the below Items.

※ 유의사항

1. 유효기간 만료일 4개월 전에 공급자관리시스템을 통하여 갱신신청을 해야 합니다. 만료일 이후 1개월 안에 갱신 신청을 하지 않은 경우 예비품목 공급자 자격이 취소됩니다.
Supplier must apply renewal registration through supply control system before 4 months form expiration date. If you don't apply renewal registration within 1 month after expiration date, you'll be disqualified supplier qualification.
2. 품질보증서류 및 그 밖에 등록을 위해 제출한 서류나 자료의 전부 또는 일부가 허위로 밝혀진 경우 업체에 대하여 10년간 자격이 취소됩니다.
Qualification of supplier can be cancelled for 10 years in case documents related to QA and registration turn out to be false.
3. 원제조사 및 대리점간의 계약이 해지가 된 경우, 원제조사는 공급자관리 담당자에게 해지사실에 대하여 통보해야 합니다.
Manufacture must notify the fact of cancellation to someone in charge of supplier control in expiration date. If you don't apply renewal registration within 1 month after expiration date, case the contract between manufacture and agent have been cancelled.

NO	품목코드 Item Code	품 명 Item Description	품질등급 Quality Class	유효기간 Authorized Period
1	511(A)	O-RINGS & GASKETS	A	2017.01.11~2021.01.10

2017.01.11

한국수력원자력(주)

KOREA HYDRO & NUCLEAR POWER CO., LTD

[REPORT NO. 2003-0966]

TEST REPORT

on

NON-ASBESTOS GASKET(JIC 6000)

of

JEIL E & S CO., LTD.

FIRE INSURERS LABORATORIES OF KOREA

69-1 Simseok-Ri, Ganam-Myeon, Yeoju-Gun, Gyeonggi-Do, 469-881, Korea

TEL : (031) 881-6010, FAX : (031) 884-8101

[REPORT NO. 2003-0966]

FOREWORD

This test report was made in accordance with a contract signed by JEIL E & S Co., Ltd. and Fire Insurers Laboratories of Korea.

The test result of the specimen provided by the applicant are as follows :

1. Applicant : JEIL E & S Co., Ltd.
2. Name of test specimen : NON-ASBESTOS GASKET(JIC 6000)
3. Nominal diameter size of test specimen : 50 A
4. Nominal thickness of test specimen : 1.5 mm
5. Design pressure : 16.5 bar
6. Number of test specimens : 3 set
7. Test result
   The NON-ASBESTOS GASKET(JIC 6000) specimens of nominal diameter 50 A have passed the fire endurance test acceptance requirements of tests referred to IACS Req. 2002, P2.11.5.5.6(Requirements concerning pipes and pressure vessels - Rules for piping design, construction and testing - Fire endurance test).

This test report shall not be used for commercial advertisement, or legal claims, suits, liabilities of whatever nature, other than for the original purpose of this test.

August 19, 2003

Reported by :

Kim Dongsuk
Senior Project Engineer
Fire Protection System Division

Reviewed by :

Kim Dongil
General Manager
Fire Protection System Division

Approved by :

Ryu Eunyeol
***The Director*, Fire Insurers Laboratories of Korea**

CONTENTS

[REPORT NO: 2003-0966]

1. SUMMARY

1.1 Test item : Fire endurance test

1.2 Applicant : JEIL E & S Co., Ltd.
39-5, Yusan-Dong, Yangsan-City, Kyungnam, Korea

1.3 Test specimen
1.3.1 Name of test specimen : NON-ASBESTOS GASKET(JIC 6000)
1.3.2 Nominal diameter : 50 A
1.3.3 Nominal thickness of test specimen : 1.5 mm
1.3.4 Design pressure : 16.5 bar
1.3.5 Number of test specimens : 3 set

1.4 Manufacturer of the specimen : JEIL E & S Co., Ltd.

1.5 Date of test : August 12, 2003

1.6 Referred test standard : IACS Req. 2002, P2.11.5.5.6 (Requirements concerning pipes and pressure vessels - Rules for piping design, construction and testing - Fire endurance test)

1.7 Test place : Fire Insurers Laboratories of Korea(FILK)

1.8 Test result
The NON-ASBESTOS GASKET(JIC 6000) specimen of nominal diameter 50 A have satisfied with the acceptance requirements of IACS Req. 2002, P2.11.5.5.6(Requirements concerning pipes and pressure vessels - Rules for piping design, construction and testing - Fire endurance test).

2. PURPOSE OF THE TEST

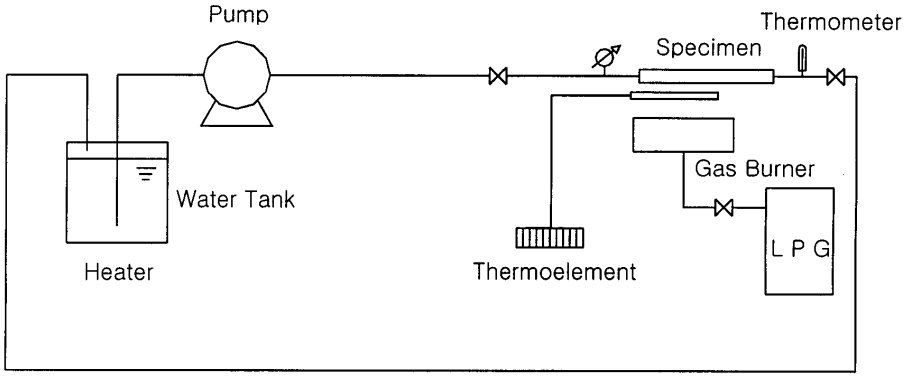
The purpose of these test was to confirm the performance of NON-ASBESTOS GASKET (JIC 6000) supplied by JEIL E & S Co., Ltd. according to the following test method.

(This is the first page of a report consisting of 6 pages and should not be accepted as a substitute for complete report.)

Report Issued : August 19, 2003

3. TEST METHOD

The test specimen was subjected to fire for 30 min at a temperature of 800±50 ℃, while water at pressure of 5±0.2 bar was circulated inside. To completely engulf the one side of the test specimen in the flame envelope, the test burners were installed below of the test specimen. The water temperature measured at the outlet of the test specimen was not less than 80±5 ℃ during the fire test. After the fire test, the specimen was subjected to a subsequent pressure test to twice the design pressure for a minimum period of 5 minutes. Test rig arrangements used in this fire endurance test shown in figure 1.



[Figure 1] Schematic diagram of fire test rig arrangements

4. MEASURING DEVICES

4.1 Thermoelements for recording the flame temperature.
4.2 Thermoelement for recording the water outlet temperature.
4.3 Pressure transmitter for recording the internal pressure.

5. REQUIREMENT

The test is deemed to have been passed if a specimen which was fire tested under a pressure of 5 bar shows no leakages when subjected to twice the design pressure after the fire test.

6. TEST RESULT

Specimen numbers	During the fire test	During the pressure test	
		Test pressure (bar)	Leakage
1	No leakage	33	No leakage
2	No leakage	33	No leakage
3	No leakage	33	No leakage

7. CONCLUSION

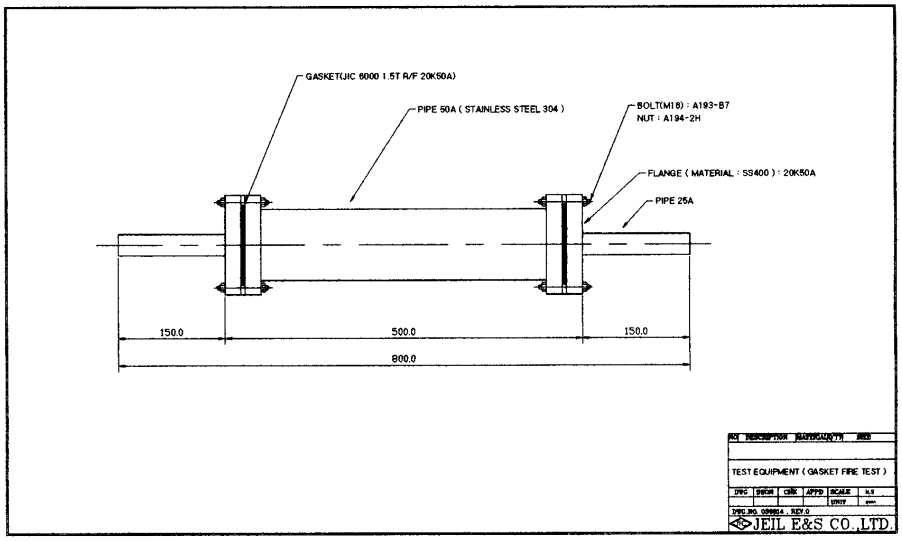
The NON-ASBESTOS GASKET(JIC 6000) specimen of nominal diameter 50 A have satisfied with the fire endurance test requirement of IACS Req. 2002, P2.11.5.5.6 (Requirements concerning pipes and pressure vessels - Rules for piping design, construction and testing - Fire endurance test).

The end of report.

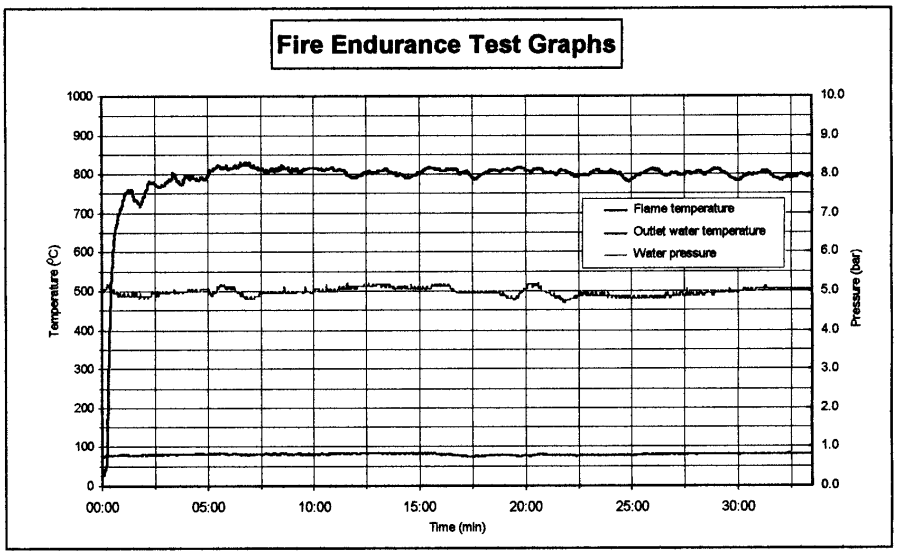
[APPENDICES]

[L I S T]

1. DRAWING OF ASSEMBLED TEST SPECIMEN



2. FIRE ENDURANCE TEST GRAPHS



3. PHOTOGRAPHS

[Photo 1] The front of test specimen

[Photo 2] The back of test specimen

[Photo 3] The fire endurance test

شركة البترول الوطنية الكويتية
إحدى شركات مؤسسة البترول الكويتية
A Subsidiary of Kuwait Petroleum Corporation
KNPC

VENDOR S & CONTRACTORS EVALUATION COMMITTEE

JEIL E & S CO. LTD., SOUTH KOREA
39-5 YUSAN DONG , YANGSAN CITY,
KYUNGNAM ,
Korea, Republic of

DATE: 22-Sep-2014
REF: V/C-V 5056-14-0818L
FILENO: V05056

SUBJECT: **VENDOR APPROVAL**

GENTLEMEN,

REFERENCE TO YOUR APPLICATION NO. 25-08-2014 ON THE ABOVE SUBJECT, YOUR COMPANY IS APPROVED AS A VENDOR EFFECTIVE 22-09-2014 FOR THE SUPPLY OF THE FOLLOWING PRODUCT(S) FOR K.N.P.C REFINERIES:

PRODUCT		DESCRIPTION
18	15	GASKETS
18	40	JOINTING COMPOUNDS

THE COMPANY (VENDOR) CODE ALLOCATED TO YOUR COMPANY IS **277069.**
PLEASE ENSURE TO QUOTE THIS CODE AND ABOVE FILE NO. ON ALL YOUR FUTURE CORRESPONDENCE

VERY TRULY YOURS,

HAT/KJ/ AEB

OUSAMA SHAMMAS
CHAIRMAN V & CEC

NOTE:
APPROVAL VALIDITY IS UP TO 22-09-2019

Head Office : Kuwait National Petroleum Company - P. O. Box : 70 Safat 13001, Safat - Kuwait - Tel: 23989000 www.knpc.com C.R : 8149 Capital : 360.000.000

Instructions to the Vendor

This approval letter is issued subject to the following:

1. KNPC reserve the rights to remove vendor from the approved vendors list without notification, if failed to renew the registration before the expiry date of this approval letter or due to poor performance.
2. Vendor is responsible to update KNPC with any information related to vendor such as contact details, change of local agent, amalgamation of companies, relocation of manufacturing facility.
3. KNPC reserve the rights to remove the local agent relationship without notification, if failed to submit renewed local agency certificate before the expiry date. Unlimited period local agency certificate will not be accepted.
4. Vendor can supply materials to KNPC through the third parties deal with KNPC such as EPC Contractors.
5. Vendor is committed to participate in KNPC tenders/ inquires, if invited. Failing to participate, KNPC reserve the rights to remove any vendor from the approved vendor list without notification.
6. KNPC reserve the rights to shortlist the vendors based on KNPC's interest without any obligation.

Aramco Asia Korea Limited
아람코 아시아 코리아 유한회사
18F, Seoul Finance Center, 136 Sejong-daero,
Jung-gu, Seoul, 04520, Korea

Tel.: (82 2) 6270-5555
Fax: (82 2) 6270-5592

February 26, 2016
Letter Ctrl # SRK-009-16 / L014-16

JEIL E&S CO LTD_YANGSAN PLANT

309, CHUNGNYEOL-RO
YANGSAN-SI, KYUNGNAM, 50592
SOUTH KOREA

Subject: Quality Management System Approval Status

Assessment Dates: November 03-04, 2015 & February 17, 2016
Reference: Manufacturer ID: 10036961; Plant ID: 30007592

Dear Mr. Jung-June Gil

Aramco Asia Korea is pleased to advise you that your company's Quality Management System is approved to supply the attached list of commodity (9COM's) that have been linked to your Plant ID No. 30007592. See Attachment 1.

This approval is granted for your manufacturing plant (309, CHUNGNYEOL-RO, YANGSAN-SI, KYUNGNAM, 50592, SOUTH KOREA) and your company is expected to continue complying with Saudi Arabian and Saudi Aramco Standards.

This approval, however, should not be construed as a commitment by Saudi Aramco to purchase from you. However, your company will have the opportunity along with other approved suppliers to respond to requests for submitting proposals in accordance with established policies and procedures.

Aramco Asia Korea would like to take this opportunity to thank you for your interest in doing business with Saudi Aramco. Please use the above referenced Manufacturer ID and Plant ID on all future written correspondence.

Regards,

Hassan R. Al-Dhafiri
Deputy Managing Director
Strategic Sourcing & Suppliers Relationship Management
Aramco Asia Korea Ltd.

It is the responsibility of the manufacturer to notify Aramco Asia Korea of the following:

1. *Change of company's Name/Address*
2. *Any change of manufacturing location (sub sourcing fabrication of major components)*
3. *Discontinuance of fabrication of approved 9COMs*

Attachment 1

Approved 9COM(s).

9COM	DESCRIPTION
6000000366	*GASKET KIT INSULATING; AB. SLEEVES AND GASKETS, CONSISTING OF WASHERS, SLEEVES AND GASKETS*

(The end of list)

هيئة أبوظبي للماء والكهرباء
Abu Dhabi Water & Electricity Authority

Company Name : INMARCO EMIRATES LLC **Fax:009715521718**

Attention : Preesh George

Registration Number :9944024 **Date :** 13 OCT 2018

Subject : Pre-Qualification Status

We have pleasure to inform you that **M/s. INMARCO EMIRATES LLC, United Arab Emirates, Code No. 9944024,** has been pre-qualified as a possible source to supply of the following products. which has been rated as per the schedule below:

S.No	Principal Name	PG No.	PG Description	Current Status
1	INMARCO FZC	0107485	INSULATING JOINTS	Not Rated
2	INMARCO FZC	0102030	O-RINGS (ALL TYPES)	Not Rated
3	INMARCO FZC	0102040	GASKETS, PACKING, JOINTING SHEETS/SHIMS	Not Rated
4	JEIL E&S CO LTD.	0102040	GASKETS, PACKING, JOINTING SHEETS/SHIMS	Not Rated
5	JEIL E&S CO LTD.	0107485	INSULATING JOINTS	Not Rated
6	JEIL E&S CO LTD.	0115005	RUBBER PRODUCTS GENERAL	Not Rated

The above decision is valid until **21-Jul-2019**, However you have to maintain and update your company records in ADWEA Commercial directory to avoid any inactivation due to such. These record shall be maintained and updated through e-registration system and shall include but not limited to the following documents once they are renewed.

1. Respective licenses
2. Agency certificates and Agreements where applicable
3. Any other changes in your address,contact person,owners/sponsors etc.

Please note that at the time of release of enquiries, a further short listing takes place based on exhibited interest at that time and the specifics of material/equipment in question as needed.

You are advised to quote your registration No.**(9944024)** in all future correspondence.

Regards,

ADWEA Company Registration Dept. Abu Dhabi Water & Electricity Authority

Alia Ahmed Al Kaabi
Supply Department Manager

Cc: Company Registration Section
Cc: End Users

QUALIFIED (Q): As a result of the pre-qualification process, the product was found acceptable and defined as qualified in the ADWEA Vendor List.
NOT RATED (R): The Product Group does not require evaluation.
ORDERED (O): The Product Group has been ordered and used
REJECTED (N) : As a result of the pre-qualification process, the product was found not acceptable and not included in the ADWEA Vendor List.
UNDER EVALUATION: The product Group is under Evaluation.

Telephone: +971 2 694 3333, Facsimile: +971 2 694 3294 | PO Box 6120, Abu Dhabi, United Arab Emirates | www.adwea.ae, crs@adwea.ae

بروج
Borouge
SHAPING the FUTURE with PLASTICS

Fax

To	General Manager
Company	**M/s INMARCO EMIRATES LLC**
Fax no.	02 5521718
From	Procurement Strategy Department Manager
Date	20th November 2013
Ref. No.	PRC/2013/
Subject	**Registration & Pre-Qualification as Manufacturer**
Total pages	1

Please be informed that based on the Pre-Qualification document submitted your principal M/s **JEIL E&S CO,.LTD** is pre-qualified for the following product(s):

- **GASKETS ANSI & MSS & API**
- **INSULATION GASKET ANSI/MSS/API/BS**
- **GRAPHITE GASKET ANSI/MSS/API/BS**
- **RING JOINT ANSI/MSS/API/BS**

Please note that at the time of release of enquires, a short listing takes place based on the specific scope of requirements.

You are advised to quote your **Principal Registration No. 0000003251** in all future correspondence.

Best Regards,

Khaled Hadi Nasser Sumaida

Abu Dhabi Polymers Co. Ltd.
Sheikh Khalifa Energy Complex I Borouge Tower I Corniche Road I P.O. Box 6925 I Abu Dhabi I UAE.
Tel +971 2 6070 300 I Fax +971 2 6070 399 I www.borouge.com
Borouge is part of the ADNOC and Borealis group of companies

Fax No. : 02-4160027

هيئة أبوظبي للماء والكهرباء
Abu Dhabi Water & Electricity Authority

Company Name : INMARCO EMIRATES LLC Fax:009715521718

Attention : Preesh George

Registration Number :9944024 Date : 13 OCT 2014

Subject : Pre-Qualification Status

We have pleasure to inform you that **M/s. INMARCO EMIRATES LLC, United Arab Emirates, Code No. 9944024,** has been pre-qualified as a possible source to supply of the following products, which has been rated as per the schedule below:

S.No	Principal Name	PG No.	PG Description	Current Status
1	INMARCO FZC	0107485	INSULATING JOINTS	Not Rated
2	INMARCO FZC	0102030	O-RINGS (ALL TYPES)	Not Rated
3	INMARCO FZC	0102040	GASKETS, PACKING, JOINTING SHEETS/SHIMS	Not Rated
4	JEIL E&S CO LTD.	0102040	GASKETS, PACKING, JOINTING SHEETS/SHIMS	Not Rated
5	JEIL E&S CO LTD.	0107485	INSULATING JOINTS	Not Rated
6	JEIL E&S CO LTD.	0115035	RUBBER PRODUCTS GENERAL	Not Rated

The above decision is valid until **21-Jul-2019**, However you have to maintain and update your company records in ADWEA Commercial directory to avoid any inactivation due to such.These record shall be maintained and updated through e-registration system and shall include but not limited to the following documents once they are renewed.

1. Respective licenses
2. Agency certificates and Agreements where applicable
3. Any other changes in your address,contact person,owners/sponsors etc.

Please note that at the time of release of enquiries, a further short listing takes place based on exhibited interest at that time and the specifics of material/equipment in question as needed.

You are advised to quote your registration No.(**9944024**) in all future correspondence.

Regards,

Alia Ahmed Al Kaabi
Supply Department Manager

Cc: Company Registration Section
Cc: End Users

QUALIFIED (Q): As a result of the pre-qualification process, the product was found acceptable and defined as qualified in the ADWEA Vendor List.
NOT RATED (R): The Product Group does not require evaluation.
ORDERED (O): The Product Group has been ordered and used.
REJECTED (N) : As a result of the pre- qualification process, the product was found not acceptable and not included in the ADWEA Vendor List.
UNDER EVALUATION: The product Group is under Evaluation.

Telephone: +971 2 694 3333 Facsimile: +971 2 694 3294 | PO Box 6120, Abu Dhabi, United Arab Emirates | www.adwea.ae, info@adwea.ae

00971 2 6027442

تكرير
TAKREER
شركة أبوظبي لتكرير النفط

We Refine Right

FACSIMILE MESSAGE

To : M/s. Inmarco Emirates - LLC.
Attn.: General Manager

Fax No.: 5521718
Abu Dhabi

From : Procurement Support Department Manager

Fax No.: 6027442

Abu Dhabi Oil Refining Company (TAKREER)
P.O. Box 3503 – Tel. (9712) 6027000 – Abu Dhabi, U.A.E.

Ref. No. : TKR/S/S/ 6250/7FES/2013

Date : 06 FEB 2013

Subject : REGISTRATION & PRE-QUALIFICATION STATUS

This has reference to the Pre-qualification Document of your Principal M/s. **Jill E&S Co., Ltd. – KOREA**, submitted by you as a *Manufacturer*. Please be informed that based on the evaluation, the above principal has been included in TAKREER records as a possible source for supply of the following products:

- **Gaskets**
- **Insulating Joints**
- **Graphite Gaskets**
- **Pipes & Fittings Lined**

Please note that at the time of release of enquiries, a further short listing takes place based on exhibited interest at that time and the specifics of material /equipment in question as the need may be.

You are advised to quote your Principal's Registration No. **908546** in all future correspondence.

Regards,

Hashim Al Hashmi

If you do not receive all the pages, please call Telephone : (9712) 6027479

No. of pages to follow:

TOTAL P.001

FOUNDED 1862 ABS

CERTIFICATE NUMBER
16-BK1558501-PDA

DATE
22 Sep 2016

ABS TECHNICAL OFFICE
Busan Engineering Services

CERTIFICATE OF DESIGN ASSESSMENT

This is to certify that a representative of this Bureau did, at the request of

JEIL E&S CO., LTD.

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product: **Gasket, Compressed Non-Asbestos Sheet**

Model: **Compressed Non-Asbestos Sheets & Gaskets 1. LEAKBLOK® Premium 2. JIC6000**

This Product Design Assessment (PDA) Certificate 16-BK1558501-PDA, dated 22/Sep/2016 remains valid until 21/Sep/2021 or until the Rules or specifications used in the assessment are revised (whichever occurs first).

This PDA is intended for a product to be installed on an ABS classed vessel, MODU or facility which is in existence or under contract for construction on the date of the ABS Rules or specifications used to evaluate the Product.

Use of the Product on an ABS classed vessel, MODU or facility which is contracted after the validity date of the ABS Rules and specifications used to evaluate the Product, will require re-evaluation of the PDA.

Use of the Product for non ABS classed vessels, MODUs or facilities is to be to an agreement between the manufacturer and intended client.

AMERICAN BUREAU OF SHIPPING

Hyun-Dae Lee

Hyun-Dae Lee
Engineer/Consultant

JEIL E&S CO.
309, CHUNGNYEOL-RO
YANGSAN-SI, GYEONGSANGNAM-DO
Korea, Republic of
Telephone: 82-55-370-01871
Fax: 82-55-382-0853
Email: jeilqa@jeilens.co.kr
Web: www.jeilens.co.kr

Tier: 3 - Type Approved, unit certification not required

Product: **Gasket, Compressed Non-Asbestos Sheet**
Model: **Compressed Non-Asbestos Sheets & Gaskets**
1. LEAKBLOK® Premium
2. JIC6000

Intended Service:
Fuel Oil System, Fresh Water System, Sea Water System, Lubricating System, Sanitary System, Air System

Description:
Compressed Non Asbestos Sheets & Gaskets
Thickness : 0.8mm ~ 3.2mm

Rating:
LEAKBLOK® Premium
- Service Temperature
Short-term peak(1 Hour) : 350(660)
Maximum continuous : 220(428)
- Pressure
Short-term peak(1 Hour) : 80kg/cm21140 PSI

JIC6000
- Service Temperature
Short-term peak(1 Hour) : 350(660)
Maximum continuous : 220(428)
- Pressure
Short-term peak(1 Hour) : 80kg/cm21140 PSI

Service Restriction:
Unit Certification is not required for this product. If the manufacturer or purchaser's request an ABS Certificate for compliance with a specification or standard, the specification or standard, including inspection standards and tolerances, must be clearly defined.
Not to be used where materials rendered ineffective by heat are prohibited in accordance with 4-6-2/9.13.1, 4-6-4/13.5.3, 4-6-4/15.3.2 and 4-7-3/1.11.1 of the Steel Vessel Rules.

Comments:
The Manufacturer has provided a declaration about the control of, or the lack of Asbestos in this product.

Notes/Drawing/Documentation:
1. Drawing Name : Compressed Non-Asbestos Sheets & Gaskets
1.1. LEAKBLOK® Premium
1.2 JIC6000

2. Fire tests
2.1. LEAKBLOK® Premium : Report No. G2014-0396 on 17 April 2014 by FILK(Fire Insurers Laboratories of Korea)
2.2. JIC6000 : Report No. TCHPV-15-06-103 on 29 June 2015 by Dong-A University and Report No. 2003-0966 on 19 August 2003 by FILK (Fire Insurers Laboratories of Korea)

3. Performance test

JEIL E&S CO.
309, CHUNGNYEOL-RO
YANGSAN-SI, GYEONGSANGNAM-DO
Korea, Republic of
Telephone: 82-55-370-01871
Fax: 82-55-382-0853
Email: jeilqa@jeilens.co.kr
Web: www.jeilens.co.kr

Tier: 3 - Type Approved, unit certification not required

3.1. LEAKBLOK : Report No. TAU-019634 on 24 October 2012 by 7 November 2012
3.2. JIC 6000 : Report No. TAU-022182 on 26 October 2015 by KTR (Korea Testing & Research Institute)

Terms of Validity:
This Product Design Assessment (PDA) Certificate 16-BK1558501-PDA, dated 22/Sep/2016 remains valid until 21/Sep/2021 or until the Rules or specifications used in the assessment are revised (whichever occurs first).

This PDA is intended for a product to be installed on an ABS classed vessel, MODU or facility which is in existence or under contract for construction on the date of the ABS Rules or specifications used to evaluate the Product.

Use of the Product on an ABS classed vessel, MODU or facility which is contracted after the validity date of the ABS Rules and specifications used to evaluate the Product, will require re-evaluation of the PDA.

Use of the Product for non ABS classed vessels, MODUs or facilities is to be to an agreement between the manufacturer and intended client.

STANDARDS

ABS Rules:
2016 Steel Vessel Rules 1-1-4/7.7, 1-1-A3 & A4

National:
1. ASTM F147-87, (Reapproved 2003)
2. ASTM F104-11, (Published May 2003)
3. ASTM F146-04, (Published May 2004)
4. ASTM F495-99a, (Reapproved 2004)
5. ASTM F152-95, (Reapproved 2002)
6. ASTM F36-99(Procedure J), (Reapproved 2003)

International:
NA

Government:
NA

EUMED:
NA

OTHERS:
NA

CERTIFICATE NUMBER: BK2897500-X

PORT OFFICE: BUSAN, KOREA

Certificate of
MANUFACTURING ASSESSMENT

This is to certify that: The Undersigned did evaluate the relevant manufacturing quality procedures for the type of products of the manufacturer:

JEIL E&S CO., LTD. Plant at YANGSAN, KOREA

The methods of assuring and controlling quality during production as required by the ABS Rules or Guides for the product and the associated specifications or standard were verified to reflect the specific surveys, required by the Rules and Standards for the manufacture of:

Gasket, Compressed Non-Asbestos Sheet

The manufacturer presented a sample or specimen of the product, representative of the "type" approved, to the undersigned, for the purpose of verifying that the "type" has been manufactured in conformance with the Manufacturer's Product Design Assessments.

This Certificate of Manufacturing Assessment is an evaluation of the manufacturer alone and is neither an approval nor a rejection of the product described above. Unless cancelled, expired or revoked, this certificate remains valid subject to annual audits

Consult the ABS Type Approval website to confirm the continued validity of this certificate and the status of the particular products being manufactured.

ISSUE DATE	12 May 2015	EXPIRATION DATE	13 May 2020

SURVEYOR	YOUNG-IL NA
FIRST ANNUAL ENDORSEMENT	Hyun-Seok Jang
SECOND ANNUAL ENDORSEMENT	Ki-Taek Lee
THIRD ANNUAL ENDORSEMENT	
FOURTH ANNUAL ENDORSEMENT	

Date : 12 May 2015
File Ref : S-6
Msg. No. : BK15-029

To : **JEIL E&S CO., LTD.**
309, Chungnyeol-Ro, Yangsan-Si,
Gyungnam, KOREA

Attn.: Mr. J. T. Kim – President

Dear Mr. J.T. Kim,

We are pleased to enclose the reports and certificates of your satisfactory Manufacturing Assessment together with our invoice for the services rendered. Please recognize that the certificates will remain valid subject to annual assessments on or about the anniversary date of the certificate of Manufacturing Assessment. An audit that becomes 90-days overdue will automatically suspend the publishing of your product as "Type Approved" on the ABS Internet Site (note: to remain valid, the expiration date on the certificate of Manufacturing Assessment cannot be exceeded). The undersigned, or a successor, will be your point of contact to schedule the periodic assessments.

Please recognize that Product Type Approval will not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. Should your client require ABS unit-certification of your product, you must call in a Surveyor to witness required testing. This certification cost is not included in the assessments thus far completed.

We also remind you of the implementation of SOLAS II-1, Regulation 3-5 and MSC.1/Circ.1379 which I summarize as "From 1 January 2011, for all ships, new installation of materials which contain asbestos shall be prohibited. In the context of this regulation, new installation of materials containing asbestos means any new physical installation on board. Any material purchased prior to 1 January 2011 being kept in the ship's store or in the shipyard for a ship under construction, should not be permitted to be installed after 1 January 2011 as a working part." We advise you that any shipments you make also contain a declaration of absence of Asbestos.

We must remind you that a Product Design Assessment (PDA) is not an approval. The PDA is a generic assessment of materials, components, products or systems for a specific use in compliance with the Rules, Guides and recognized standards. In the absence of a known vessel, MODU or facility, materials, products, components and systems cannot be fully "Approved". These particular products have generic approvals to provide clients and ABS with pre-approvals of products that will

PACIFIC DIVISION
6TH FL., DK BUILDING, #1211-7, CHORYANG-DONG, DONG-KU, BUSAN 601-839, KOREA
TEL : 82-51-463-4600 FAX : 82-51-463-4610 www.eagle.org

help to reduce back logs and expedite final approvals. Final approval is given when an Engineer or Surveyor accepts the assessed item for a specific user and installation. Therefore, the PDAs are written assuming that the end user and installation of the product are unknown.

The certificate of Manufacturing Assessment indicates that you have established a systematic quality monitoring system sufficient to show your capacity to consistently manufacture a product that meets the specification. In the concept of ABS Type Approval, the specification is the Design Assessment Certificate.

The certificates will remain valid for five years, subject to annual surveillance audits and no changes to the scope and conditions of approval. Unless the change is submitted to ABS for a new evaluation and audit, any of the following will cause immediate suspension of the certificate of Design or Manufacturing Assessment.

1. Redesign of the product or products covered by the certificate;
2. Change in production methods;
3. Substantial change in management organization;
4. Substantial change in frequency or curriculum for personnel training;
5. Refusing access to ABS personnel for audits during normal business hours;
6. Failure to correct a non-compliance identified in service or during an audit;
7. Failure to pay ABS fees.

We look forward to working with you and encourage you to contact the undersigned for any needed explanations of the ABS Type Approval Program.

Sincerely Yours,

Sang-Won Jeong
District Principal Surveyor
ABS Busan

Encl.: As stated

PACIFIC DIVISION
6TH FL., DK BUILDING, #1211-7, CHORYANG-DONG, DONG-KU, BUSAN 601-839, KOREA
TEL : 82-51-463-4600 FAX : 82-51-463-4610 www.eagle.org

TYPE APPROVAL CERTIFICATE

Certificate No. : BSN02359-GT001 **Initial Approval** : 20th June, 1987.

Product : Gaskets

Manufacturer : Jeil E & S Co., Ltd.
39-5, Yusan-dong, Yangsan-city, Kyungnam, Korea

Product Description : Compressed Non-Asbestos Sheet and Gasket

- Brand	: JIC 6000,	JIC 6100,	JIC 6200
- Max. Thickness	: 3.0 mm,	3.0 mm,	3.2 mm
- Size	: Max. 2540 x 3810 mm		
- Design Press.	: Max. 30 kgf/cm²		
- Design Temp.	: Max. 350 °C		
- Used for	: F.O., L.O., Compressed Air, Water		

Approval Condition : 1. This approval is granted on the basis of the previous certificate & test report no. 7-3-411-583 & 77411-00780 by FITI Testing & Research Institute.
2. Individual Product Certification is not required.

THIS IS TO CERTIFY that the above-mentioned product has been approved in accordance with the relevant requirement of this Society's Rules and / or of the recognized standards as follows and entered in the "List of Approved Manufacturers and Type Approved Equipment".

Pt. 5, Ch. 6, Sec. 1 of the Rules for Classification, Steel Ships and KS L 5406.

This Certificate is valid until 19th June, 2017.
Issued at Daejeon, Korea on 19th June, 2012.

KOREAN REGISTER OF SHIPPING

General Manager of
Materials and Equipment Team

Note : 1 : The approval will be automatically suspended and the Certificate become invalid from the expiry date of the Certificate in the event that the extension has not been granted or the renewal of the Certificate is not underway.
2 : The manufacturer should notify this Society of any modification or changes that may affect the validity of this Certificate.

Lloyd's Register

CERTIFIED COPY OF ORIGINAL

Project: **VOC Packing Fugitive Test**

Certificate Number: **KID 0114048/1**

Client: **JEIL E & S Co., Ltd.**

Office: **Seoul**

Client's Order Number:

Date: **May 28, 2001**

Order Status: **Complete**

Inspection Dates
First: **May 22, 2001**

Final: **May 23, 2001**

This certificate is issued to Messrs. JEIL E & S Co., Ltd. to certify that the undersigned Surveyor to this Society attend at their factory, Yang san, Korea on May 22, 2001 and subsequently for the purpose of witnessing leak tests of the undernoted A.V.P(Anti-VOC Packing) Combination Set.

Description

1) Test Conditions

① Packing Type : A.V.P.(Anti-VOC Packing) Combination Set.
② Packing Size : Ø28.6 X Ø45.2 X 39.6H (5 Rings)
③ Test Gas : Methane 99.999%
④ Gas Pressure : 45 kg/cm².G
⑤ Seating Stress : 130 kgf/cm²
⑥ Test Temp. : Room Temp.(App. 18℃)
⑦ Gland Bolt Torque : 200 kg.cm
⑧ Cycling

Stem Stroke	50 mm
Stem Speed	31 mm/sec
Total Cycle	6,000 cycle

2) Test Method : EPA Method 21 - determination of volatile organic compound leaks

3) The Results of Inspection and Tests

Leak test for the subject packing has been carried out at the Manufacturer's factory, in the presence of the undersigned surveyor, and the results found are as follows :

Cycle	1000	2000	3000	4000	5000	6000
Leakage(ppm)	3.18808	3.40185	3.77576	5.41477	3.50187	11.17460

* Finally total leakage at 6000 cycle is found to be 11.17460ppm.

It was verified that the leak test equipments and leak detector has been calibrated as follows:

Equipment	Serial No.	Calibration Date
Pressure Gauge	130455	Nov. 29. 2000
Torque wrench	00014Y	Nov. 25. 2000
Gas Chromatography	HP6890	Feb. 13. 2001

LLOYD'S REGISTER OF SHIPPING

D.H. Lee

Surveyor to Lloyd's Register of Shipping

신기술인증서

기 술 명 : 플루엔을 사용하지 않는 비석면 개스킷 제조기술

회 사 명 : 제일E&S(주)

대 표 자 : 김진태

소 재 지 : 경남 양산시 유산동 39-5

인증번호 : 제0693호

유효기간 : 2012년 12월 18일부터 2014년 12월 17일까지

위의 기술을 「산업기술혁신 촉진법」 제15조의2에 따른 신기술로 인증합니다.

2012년 12월 18일

지식경제부장관

신기술적용제품확인서

제 품 명 : 비석면 시트 개스킷
(모 델 명) : (LEAKBLOK™)

회 사 명 : 제일E&S(주)

대 표 자 : 김진태

소 재 지 : 경남 양산시 유산동 39-5

인증기술명 : 불루엔을 사용하지 않는 비석면 개스킷 제조기술

인증번호 : 제0693호

위 제품은 「산업기술혁신 촉진법」 제15조의2제3항에 따른 신기술적용제품임을 확인합니다.

2013년 3월 13일

지식경제부장관

Lloyd's Register Asia

Busan Port Office
11th Floor, CJ Korea Express Bldg., 119 Daegyo-ro, Jung-gu (2, 6-ga, Jungang-dong), Busan 600-700 Republic of Korea

Telephone +82-51-640-5050
Direct line +82-51-640-5040
Facsimile +82-51-637-0770
Email busan-port@lr.org

http://www.lr.org

JEIL E&S CO., LTD.
309 Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, 626-230, Korea

Date 21 July 2014
Your ref
Our ref PUS/BWK/BU51306566

Welcome to the Lloyd's Register List of Type Approval.

Lloyd's Register (LR) is one of the world's foremost ship classification societies.

We are a leading independent technical inspection, certification and advisory organisation, operating worldwide in the marine, offshore and industrial sectors.

We aim to provide risk management solutions to enhance our clients' quality, safety, environmental and business performance.

We are pleased to inform you that the Type Approval Certificate of the subject product is granted and will be included in the appropriate part of the List of Lloyd's Register Type Approved Products. These lists appear, in English, on the Lloyd's Register web site which is updated regularly (www.cdlive.lr.org/information/).

Please find enclosed herewith a Type Approval Certificate, associated Marine Design Appraisal Documents and a copy of List Entry for presentation to your company.

Please be noted that this Type Approval is conditional upon you complying with the requirements of the LR Type Approval procedure, it should also be noted that any change in the conditions under which approval was given that affect the validity of the Certificate must be notified to Lloyd's Register without delay.

We believe that your relationship with LR will prove a valuable promotion resource for your company and we look forward to a long and mutually beneficial partnership in the future.

Yours truly,

B. W. Kim
Senior Surveyor
Busan Port Office
Lloyd's Register Asia

Working together for a safer world

Lloyd's Register

Type Approval Certificate

This is to certify that the undernoted product has been tested with satisfactory results in accordance with the relevant requirements of the LR Type Approval System.
This certificate is issued to:

PRODUCER	JEIL E&S Co., Ltd.
PLACE OF PRODUCTION	309 Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, 626-230, Korea
DESCRIPTION	Insulation Gasket set
TYPE	JIC 9210 - ER JIC 9230 - ES JIC 9320 - OS JIC 3850 - SE (HT)
APPLICATION	Industrial fields, used as Protection of corrosion & electrical insulation in pipeline
STANDARD	LR Rules and Regulations for the Classification of Ships, Part 5, Chapter 12, July 2013 ASME B16.5 ASTM A193, A194 Manufacturer's test specifications No. JEIL-13-10-002

Certificate No.	14/40004
Issue Date	11 July 2014
Expiry Date	10 July 2019
Sheet	1 of 2

Lloyd's Register
Busan Technical Support Office
D. Y. Kang
Busan Technical Support Office
Lloyd's Register Group Limited

Lloyd's Register Group Limited, registered office:
71 Fenchurch Street, London EC3M 4BS

Lloyd's Register

RATING

Manufacturer's product specification No. JIC 9210 - ER, JIC 9230 - ES, JIC 9320 - OS, JIC 3850 - SE(HT)

	Core Thickness	Pressure
JIC 9210 - ER	Basic 4.0 mm (4.0 ~ 8.0mm available)	Max. ANSI 600LB
JIC 9230 - ES	Basic 3.2 mm (3.0 ~ 8.0mm available)	Max. ANSI 600LB
JIC 9320 - OS	Basic 6.6 mm (6.0 ~ 8.0mm available)	Max. ANSI 2500LB
JIC 3850 - SE (HT)	Basic 3.0 mm (3.0 ~ 8.0mm available)	Max. ANSI 2500LB

Note : The producer's catalogue to be consulted for maximum pressure and temperature ratings.

PERFORMANCE TESTS

Representative samples tested in accordance with the manufacturer's test specifications No. JEIL-13-10-002
Hydraulic test : 3.0 Mpa
Insulation Resistance : 1MΩ, 1000V

OTHER CONDITIONS

The insulation set is to be installed and maintained in accordance with the manufacturer's instructions.

"This Certificate is not valid for equipment, the design, ratings or operating parameters of which have been varied from the specimen tested. The manufacturer should notify Lloyd's Register Asia of any modification or changes to the equipment in order to obtain a valid certificate."

The Design Appraisal Document No. 14/40004 and its supplementary Type Approval Terms and Conditions form part of this Certificate.

Certificate No.	14/40004
Issue Date	11 July 2014
Expiry Date	10 July 2019
Sheet	2 of 2

Lloyd's Register
Busan Technical Support Office
Lloyd's Register Asia

D. Y. Kang
Busan Technical Support Office
Lloyd's Register Group Limited

Marine Design Appraisal Document

Lloyd's Register Asia
Busan Technical Support Office
10th Floor, CJ Korea Express Bldg.,
119, Daegyo-ro, Jung-gu, Busan
Republic of Korea
TEL. +82 51 640 5000 FAX. +82 51 637 4114

Date
11 July 2014

Please quote the document number on all future communications

THE LR TYPE APPROVAL SYSTEM, 2002.

Issued to: JEIL E&S CO., LTD.
For: Insulation Gasket set
TYPE APPROVAL CERTIFICATE No. 14/40004

The undernoted documents have been reviewed for compliance with the requirements of the LR Type Approval System, 2002 and this Design Appraisal Document forms part of the Certificate.

APPROVAL DOCUMENTATION

Request for Marine Service (Form LR2502) dated 10 October 2013
Application for Type Approval (Form LR2571) dated 10 October 2013
Inspection and Test Plan (Doc. No. JEIL 13-10-002) (1 page) dated 16 October 2013

TEST REPORTS

Firm's Test reports (7 pages) dated 26 November 2013 witnessed by LR Busan Port Surveyor

Busan Port memorandum dated 30 October 2013 accompanying Inspection and Surveillance of Production Facilities Control No. BUS 1306566 witnessed by LR Busan Surveyor dated10 October 2013

Supplementary Type Approval Terms and Conditions

Type Approval certifies that a representative sample of the product(s) referred to herein has/have been found to meet the applicable design criteria for the use specified herein. It does not mean or imply approval for any other use, nor approval of any product(s) designed or manufactured otherwise than in strict conformity with the said representative sample.

Type Approval is based on the understanding that the manufacturer's recommendations and instructions and any relevant requirements of the Rules and Regulations are complied with.

Type Approval does not eliminate the need for normal inspection and survey procedures required by the Rules and Regulations.

Lloyd's Register reserves the right to cancel or withdraw this Type Approval Certificate in accordance with the LR Type Approval System Procedure.

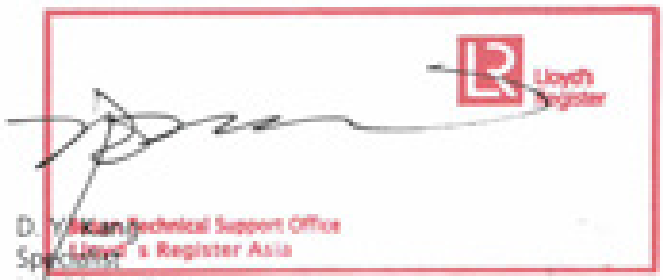
FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Lloyd's Register Asia
is a subsidiary of Lloyd's Register Group Limited

Lloyd's Register Asia
Busan Technical Support Office
10th Floor, CJ Korea Express Bldg.,
119, Daegyo-ro, Jung-gu, Busan
Republic of Korea
TEL. +82 51 640 5000 FAX. +82 51 637 4114

Date
11 July 2014

Please quote the document number on all future communications



D. Y. Kang
Specialist
Machinery Team
Busan Technical Support Office
Lloyd's Register Asia
Tel: +82 51 640 4904
Fax: +82 51 637 4114
Email: da-young.kang@lr.org

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Part 1A
Subject: Pipe and Pipe Couplings
Product: Flange Gasket (Part 1A)

Producer/Licence No.	Description of Product				Cert. No.
	Type	Details of Approval	Application	Remarks	
JEIL E&S Co., Ltd. 309 Chungryool-ro, Yangsan-si, Gyeongsangnam-do, 626-230, Korea, Republic of.	JIC 9210 - ER, JIC 9230 - ES, JIC 9320 - OS, JIC 3850 - SE(HT)	Insulation Gasket set Manufacturer's product specification No. JIC 9210 - ER, JIC9230 - ES, JIC9320 - OS, JIC38 0 - SE(HT)	Industrial fields, used as protection of corrosion & electrical insulation in pipeline	Expires: 10 July 2019 Representative samples tested in accordance with the manufacturer's test specifications No. JEIL-13-10-002	14/40004

	Core Thickness	Pressure
JIC 9210-ER	Basic 4.0 mm (4.0~8.0 mm available)	Max.ANSI 600LB
JIC 9230-ES	Basic 3.2 mm (5.0 ~ 8.0 mm available)	Max.ANSI 600LB
JIC 9320-OS	Basic 6.6 mm (6.0~8.0 mm available)	Max.ANSI 2500LB
JIC3850-SE(HT)	Basic 3.0 mm (3.0~8.0 mm available)	Max.ANSI 2500LB

Note : The producer's catalogue to be consulted for maximum pressure and temperature ratings.

Lloyd's Register

Busan Technical Support Office
Lloyd's Register Asia

Lloyd's Register

Type Approval Certificate

This is to certify that the undernoted product has been tested with satisfactory results in accordance with the relevant requirements of the LR Type Approval System.
This certificate is issued to:

PRODUCER	JEIL E&S Co., Ltd.
PLACE OF PRODUCTION	309 Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, 626-230, Korea
DESCRIPTION	Insulation Gasket set
TYPE	JIC 9320 - OFS
APPLICATION	Industrial fields, used as Protection of corrosion & electrical insulation in pipeline
STANDARD	LR Rules and Regulations for the Classification of Ships, Part 5, Chapter 12, July 2013 ASME B16.5 ASTM A193, A194 API 6FB Fire Test
RATING	Manufacturer's product specification No. JIC 9320 - OFS

	Core Thickness	Pressure
JIC 9320 - OFS	Basic 6.6 mm (6.0 ~ 8.0mm available)	Max. ANSI 2500LB

Note : The producer's catalogue to be consulted for maximum pressure and temperature ratings.

Certificate No.	14/40012
Issue Date	11 July 2014
Expiry Date	10 July 2019
Sheet	1 of 2

Lloyd's Register
D. Y. Kang
Busan Technical Support Office
Lloyd's Register Group Limited

Busan Technical Support Office
Lloyd's Register Asia

Lloyd's Register Group Limited, registered office:
71 Fenchurch Street, London EC3M 4BS

PERFORMANCE TESTS	Representative samples tested in accordance with the manufacturer's test Specification Hydraulic test : 3.0 MPa Insulation Resistance : Min. 1MΩ, 1000V Fire test carried out amtec (Certificate No. 30252301E/FH/26.11.13)
OTHER CONDITIONS	The insulation set is to be installed and maintained in accordance with the manufacturer's instructions.

"This Certificate is not valid for equipment, the design, ratings or operating parameters of which have been varied from the specimen tested. The manufacturer should notify Lloyd's Register Asia of any modification or changes to the equipment in order to obtain a valid certificate."

The Design Appraisal Document No. 14/40012 and its supplementary Type Approval Terms and Conditions form part of this Certificate.

Certificate No.	14/40012
Issue Date	11 July 2014
Expiry Date	10 July 2019
Sheet	2 of 2

Lloyd's Register

Busan Technical Support Office
Lloyd's Register Asia

D. Y. Kang
Busan Technical Support Office
Lloyd's Register Group Limited

Lloyd's Register Group Limited, registered office:
71 Fenchurch Street, London EC3M 4BS

Marine Design Appraisal Document

Lloyd's Register Asia
Busan Technical Support Office
10th Floor, CJ Korea Express Bldg.,
119, Daegyo-ro, Jung-gu, Busan
Republic of Korea
TEL. +82 51 640 5000 FAX. +82 51 637 4114

Date
11 July 2014

Please quote the document number on all future communications

THE LR TYPE APPROVAL SYSTEM, 2002.

Issued to: JEIL E&S CO., LTD.
For: Insulation Gasket Set
TYPE APPROVAL CERTIFICATE No. 14/40012

The undernoted documents have been reviewed for compliance with the requirements of the LR Type Approval System, 2002 and this Design Appraisal Document forms part of the Certificate.

APPROVAL DOCUMENTATION

Request for Marine Service (Form LR2502) dated 30 May 2014
Application for Type Approval (Form LR2571) dated 15 May 2014
Insulation Sets (JIC7700 SERIES) for JIC 9320-OFS date 30 May 2014 witnessed by LR Busan Port Surveyor

TEST REPORTS

Firm's Test reports (6 pages) dated 14 May 2014 witnessed by LR Busan Port Surveyor

Busan Port memorandum dated 30 October 2013 accompanying Inspection and Surveillance of Production Facilities Control No. BUS 1305827 witnessed by LR Busan Surveyor dated10 October 2013

Fire Test Certificate (No. 30252301E/FH/26.11.13) issued by amtec dated 26 November 2013

Supplementary Type Approval Terms and Conditions

Type Approval certifies that a representative sample of the product(s) referred to herein has/have been found to meet the applicable design criteria for the use specified herein. It does not mean or imply approval for any other use, nor approval of any product(s) designed or manufactured otherwise than in strict conformity with the said representative sample.

Type Approval is based on the understanding that the manufacturer's recommendations and instructions and any relevant requirements of the Rules and Regulations are complied with.

Type Approval does not eliminate the need for normal inspection and survey procedures required by the Rules and Regulations.

Lloyd's Register reserves the right to cancel or withdraw this Type Approval Certificate in accordance with the LR Type Approval System Procedure.

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Lloyd's Register Asia
is a subsidiary of Lloyd's Register Group Limited

Lloyd's Register Asia
Busan Technical Support Office
10th Floor, CJ Korea Express Bldg.,
119, Daegyo-ro, Jung-gu, Busan
Republic of Korea
TEL. +82 51 640 5000 FAX. +82 51 637 4114

Date
11 July 2014

Please quote the document number on all future communications

D. Y. Kang
Surveyor
Engineering Systems
Busan Technical Support Office
Lloyd's Register Asia
Tel.: +82 51 640 4904
Fax: +82 51 637 4114
Email: da-young.kang@lr.org

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPENDS(S) ON SATISFACTORY SURVEY AND TESTING

Part 1A
Subject: Pipe and Pipe Couplings
Product: Flange Gasket (Part 1A)

Producer/Licence No.	Description of Product				Cert. No.
	Type	Details of Approval	Application	Remarks	
JEIL E&S Co., Ltd. 309 Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, 626-230, Korea, Republic of.	JIC 9320-OFS	Manufacturer's product specification No. JIC 9320-OFS JIC 9320-OFS: Core Thickness: Basic 6.6 mm (6.0~8.0mm available); Pressure: Max. ANSI 2500LB Note : The producer's catalogue to be consulted for maximum pressure and temperature ratings.	Industrial fields, used as protection of corrosion & electrical insulation in pipeline	Expires: 10 July 2019 Representative samples tested in accordance with the manufacturer's test specifications	14/40012

Lloyd's Register

Type Approval Certificate Extension

This is to certify that Certificate No. 10/10004 for the undernoted products is extended and renumbered as shown.

This certificate is issued to:

PRODUCER	JEIL E&S Co., Ltd.
PLACE OF PRODUCTION	309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea, Republic of.
DESCRIPTION	Compressed Non-Asbestos Sheet & Gasket
TYPE	JIC 6000, JIC 6200 & JIC 6400
APPLICATION	Marine, offshore and industrial piping system for oils and water
DESIGN CODE STANDARD	LR Rules and Regulations for the Classification of Ships, Part 5, Chapter 12, July 2014 ASTM F 104-03 F712100-E23M5 "Standard Classification System for Non-metallic Gasket Materials"
RATINGS	JIC 6000: Sheet thickness : 0.5 ~ 3.2 mm Maximum limits of working pressure : 3.0 MPa Maximum limits of working temperature : 350 °C JIC 6200: Sheet thickness : 0.5 ~ 3.2 mm Maximum limits of working pressure : 6.0 MPa Maximum limits of working temperature : 430 °C

Certificate No.	15/40029(E1)
Issue Date	04 February 2015
Expiry Date	14 February 2020
Sheet	1 of 2

Da-Young Kang
Busan Technical Support
Lloyd's Register Asia
Lloyd's Register Group Limited
Da-Young Kang
Date: 2015.02.04 13:25:07 +09'00'

D. Y. Kang
Busan Technical Support Office
is a member of Lloyd's Register Group

Lloyd's Register

JIC 6400:
Sheet thickness : 0.5 ~ 3.2 mm
Maximum limits of working pressure : 5.0 MPa
Maximum limits of working temperature : 480 °C

Note: The producer's applications are to be complied with.

PERFORMANCE TESTS Representative samples of 1.5 mm sheets tested in accordance with the requirements as specified for F712100-E23M5 in ASTM F104.

"This Certificate is not valid for equipment, the design, ratings or operating parameters of which have been varied from the specimen tested. The manufacturer should notify Lloyd's Register Asia of any modification or changes to the equipment in order to obtain a valid certificate."

The attached Design Appraisal Document No. 15/40029(E1) and its supplementary Type Approval Terms and Conditions form part of this Certificate.

All other details remain as the previous Certificate No. 10/10004 to which this extension should be attached.

Certificate No.	15/40029(E1)
Issue Date	04 February 2015
Expiry Date	14 February 2020
Sheet	2 of 2

Da-Young Kang
Busan Technical Support
Lloyd's Register Asia
Lloyd's Register
Digitally signed by Da-Young Kang
Date: 2015.02.04 13:25:23 +09'00'

D. Y. Kang
Busan Technical Support Office
is a member of Lloyd's Register Group

Lloyd's Register, registered office:
71 Fenchurch Street, London EC3M 4BS

Marine Design Appraisal Document

Lloyd's Register Asia
Busan Technical Support Office
10th Floor, CJ Korea Express Bldg.,
119, Daegyo-ro, Jung-gu, Busan
Republic of Korea
Tel. +82 51 640 5000 Fax. +82 51 640 4114

Date
04 February 2015

Please quote the document number on all future communications

THE LR TYPE APPROVAL SYSTEM, 2002.

Issued to: JEIL E&S CO., LTD.
For: NON-ASBESTOS SHEET & GASKET
TYPE APPROVAL CERTIFICATE No. 15/40029(E1)

The undernoted documents have been reviewed for compliance with the requirements of the LR Type Approval System, 2002 and this Design Appraisal Document forms part of the Certificate.

APPROVAL DOCUMENTATION

Request for Marine Services, Form 2502 dated 29 January 2015

Application for Type Approval (TA), Form 2571 dated 29 January 2015

Declaration from Manufacture for Extension of LR Type approval dated 29 January 2015

TEST REPORTS

Busan Port memorandum dated 30 January 2015 accompanying Inspection and Surveillance of Production Facilities Control No. BUS 1501245 witnessed by LR Busan Surveyor dated 29 January 2015

Supplementary Type Approval Terms and Conditions

Type Approval certifies that a representative sample of the product(s) referred to herein has/have been found to meet the applicable design criteria for the use specified herein. It does not mean or imply approval for any other use, nor approval of any product(s) designed or manufactured otherwise than in strict conformity with the said representative sample.

Type Approval is based on the understanding that the manufacturer's recommendations and instructions and any relevant requirements of the Rules and Regulations are complied with.

Type Approval does not eliminate the need for normal inspection and survey procedures required by the Rules and Regulations.

Lloyd's Register Group Limited reserves the right to cancel or withdraw this Type Approval Certificate in accordance with the LR Type Approval System Procedure.

Da-Young Kang
D. Y. Kang
Specialist
Engineering Systems
Busan Technical Support Office
Lloyd's Register Asia

Lloyd's Register
Digitally signed by Da-Young Kang
Date: 2015.02.04 13:30:29 +09'00'

Tel.:+82 51 640 4904
Fax:+82 51 637 4114
Email: da-young.kang@lr.org

FINAL ACCEPTANCE OF ACTUAL ITEM(S) DEPEND(S) ON SATISFACTORY SURVEY AND TESTING

Lloyd's Register Asia
is a member of Lloyd's Register group

Part 1A
Subject: Pipe and Pipe Couplings
Product: Flange Gasket (Part 1A)

Producer/Licence No.	Description of Product				Cert. No.
	Type	Details of Approval	Application	Remarks	
JEIL E&S Co., Ltd., 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea, Republic of.	JIC 6000, JIC 6200 & JIC6400	Compressed Non-Asbestos Sheet & Gasket JIC 6000: Sheet thickness : 0.5 ~ 3.2 mm Maximum limits of working pressure : 3.0 MPa Maximum limits of working temperature : 350 °C JIC 6200: Sheet thickness : 0.5 ~ 3.2 mm Maximum limits of working pressure : 6.0 MPa Maximum limits of working temperature : 430 °C JIC 6400: Sheet thickness : 0.5 ~ 3.2 mm Maximum limits of working pressure : 5.0 MPa Maximum limits of working temperature : 480 °C Note: The manufacturer's applications are to be complied with. LR Rules and Regulations for the classification of ships, Part 5, Chapter 12, July 2014 ASTM F104 F712100-E23M5	Marine and offshore piping system for water, oil air and steam fluid	Expires: 14 February 2020	15/40029(E1)

Da-Young Kang
Busan Technical Support
Lloyd's Register Asia

Lloyd's Register
Da-Young Kang
Date: 2015.02.04 13:31:24 +09'00'

amtec Messtechnischer Service GmbH
Hoher Steg 13
D - 74348 Lauffen
Telefon: +49 7133 9502-0
Telefax: +49 7133 9502-22
e-mail: temes@amtec.de
Internet: www.amtec.de

CERTIFICATE

Nr. 30252301E/FH/26.11.13

In accordance with the Specification API 6FB (dated Dezember 2008) the gasket

STARTEC™ 9320-OFS
6" Class 300

of the gasket manufacturer

JEIL E&S CO., LTD.
KOR – 309 Chungyeolro, Yangsan-Si,
Gyongsangnam-do,

was tested in respect of fire safety. The test was made under the following conditions:

Total bolt load:	1021	kN
Burn period:	30	min
Average temperature calorimeters:	> 620	°C
Test pressure (absolute):	38.3	bar
Test medium:	Water	
Leak rate:	0.20	ml/(inch · min)

After the burn period the connection was air cooled to a flange temperature below 100 °C. During the cool-down the connection was still pressurized with the test pressure.

Therefore the gasket is in compliance with the tightness criteria of **1 ml/(inch · min)** of API 6FB during burn period and cool-down. The gasket manufacturer can mark the gasket as 'FIRE-SAFE' in accordance to the specification API 6FB.

This certificate is only valid in combination with the test report 3025301/-.

Lauffen, 26.11.2013

amtec Messtechnischer Service GmbH

Dipl.-Ing. F. Herkert

신기술적용제품확인서

제 품 명 : 비석면 시트 개스킷
(모 델 명) : (LEAKBLOK™)

회 사 명 : 제일E&S(주)

대 표 자 : 김진태

소 재 지 : 경남 양산시 유산동 39-5

인증기술명 : 불루엔을 사용하지 않는 비석면 개스킷 제조기술

인증번호 : 제0693호

위 제품은 「산업기술혁신 촉진법」 제15조의2제3항에 따른 신기술적용제품임을 확인합니다.

2013년 3월 13일

지식경제부장관

Korea Advanced Food Research Institute Busan Branch
314-79 Daeyeon 3 Dong Nam-Gu, Busan, Korea
TEL : 051-628-7915 FAX : 051-628-7953 http://www.kafribusan.re.kr

Certificate of Analysis

Receipt No.	2017-11-001600	Date of Receipt	2017.03.02
Client Company	JEIL E&S CO.,LTD		
Client Address	309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea		
Client Name	Kim Chi Yeon	Client Tel / Fax	
Name of Product	LEAKBLOK GASKET(NON-ASBESTOS GASKET)		
Lot No.		Date of Manufacture or Shelf life.	/
Test Method Used			
Use of Report		Date of Issue	2017.03.07

Test Result

Lead(mg/kg)	:	Not Detected
Cadmium(mg/kg)	:	Not Detected
1,3-Butadiene(mg/kg)	:	Not Detected
Lead(mg/l)	:	Not Detected
Overall migration(mg/l)	:	9
Phenol(mg/l)	:	0
Formaldehyde(mg/l)	:	0
Zinc(mg/l)	:	10.7

- The above merchandise was submitted and identified by the client.
- The results shown in this test report refer only to sample tested and it does not cover the quality of all products
- No one can use this report for the purpose of public information, advertisement and litigation without KAFRI's consent.
- This document cannot be reproduced except in full, without prior written approval of the client.

Tested by

Ho su hyun

Analyst

Approved by

Director General

Korea Advanced Food Research Institute Busan Branch
Food Sanitation Inspection Agency Designated by Ministry of Food and Drug Safety

일반 제 1600 호

시 험 성 적 서

검 체 명	LEAKBLOK GASKET(NON-ASBESTOS GASKET)						
회 사 명	제일E&S주식회사				대 표 자	김치연	
주 소	경상남도 양산시 중앙로 309(유산동)						
시험항목	납 외 7항목				의뢰목적	참고용	
제조번호		제조일자		유통기한		접수일자	2017.03.02

귀하가 우리 연구원에 검사 의뢰한 결과는 다음과 같습니다.

납(mg/kg).....불검출
카드뮴(mg/kg).....불검출
1,3-부타디엔(mg/kg).....불검출
납(mg/l).....불검출
총용출량(mg/l).....9
페놀(mg/l).....0
포름알데히드(mg/l).....0
아연(mg/l).....10.7 끝.

2017년 03월 07일

환 국 식 품 과 학 연 구 원 부 산 지 소 장

TEST REPORT

동아대학교 산학협력단
고기능성밸브 기술지원센터

부산광역시 사하구 하단2동 840번지
동아대학교 고기능성밸브 기술지원센터
Tel. : 051-200-6546, Fax. : 051-200-6598

성적서번호 :
TCHPV-16-01-103

고기능성밸브 기술지원센터

1. 의뢰인
   - o 기 관 명 : 제일 E&S 주식회사
   - o 주　　소 : 경남 양산시 유산동 39-5번지

2. 시험성적서의 용도 : 품질관리용

3. 시험 대상 품목 또는 물질, 시료명 : Compressed non Asbestos Sheets & Gaskets, LEAKBLOK® Premium P200

4. 시험기간 : 2015. 10. 19

5. 시험규격 : 신청자 제공 규격 (2페이지 참조)

6. 시험환경
   - o 온도 : (23.8 ±3.0) ℃
   - o 습도 : (48 ±5) % R.H.

7. 시험결과 : 시험결과 참조.

확 인	시험자 직 위: 실무자 성 명: 권 준 영 (서명)	승인자 직 위: 기술책임자 성 명: 오 승 준 (서명)

2016. 01. 12.

동아대학교 고기능성밸브 기술지원센터 소장 (인)

◆ 시험결과

1. 시험항목

비석면 Sheet Gasket 저온 성능 시험

2. 시료규격

① 모델 : LEAKBLOK® Premium P200
② 시료 규격 : Compressed Non Asbestos Sheets & Gaskets
③ 시험 플랜지 규격 : ASME B 16.5 / 600LB 6" Raised Face Flange
④ 시료 식별 번호 : 600LBS - 6"- #7

3. 시험방법

BS 6364:1984 Valves for cryogenic service _ Appendix A cryogenic test를 참고하여 시험을 진행 한다.

(1) 시험 전 외형 검사

① 시료 Gasket의 외,내경 치수 및 표면 균열 및 파손 육안으로 확인 한다.
(단, 시료의 외,내경 치수는 5회 측정하여 그 평균값을 기록한다.)

(2) 상온 Helium 누설 시험

① 시료 가스켓을 두 플렌지 사이에 부착하여 신청자가 승인한 토크로 볼트를 체결
② 상온에서 헬륨을 이용하여 단계별로 승압하여 8.0 MPa 까지 누설 여부 확인한다.
(단, 승압은 1 MPa 씩 승압하며 도중에 누설이 발생하면 누설 발생 압력까지만 확인한다.)
③ 각 단계별 압력을 10분간 유지하며 헬륨디텍터와 Bubble을 체크하여 누설유무를 확인한다.

(3) 저온 Helium 누설 시험

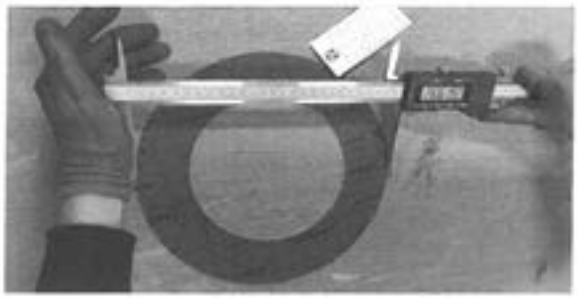
① 저온 챔버에 결합된 플렌지를 넣어 1시간 이상 냉각한다. (-29 ℃ ~ -32 ℃)
② 1시간 후 저온 챔버에 넣어둔 상태에서 헬륨을 이용하여 단계별로 승압하여 80 bar 까지 누설 여부 확인한다.(단, 도중에 누설이 발생하면 누설 발생 압력까지만 확인한다.)
③ 각 단계별 압력을 10분간 유지하며 헬륨디텍터를 이용하여 누설유무를 확인한다.

(4) 상온 복귀 후 기밀시험

① 저온에서 누설이 없을 경우 시료를 상온에 24시간 방치 후 **(2) 상온 Helium 누설 시험**을 진행한다.
② 저온에서 누설이 발생할 경우 상온 복귀 시험은 실시하지 않는다.

(5) 최종 외형 검사

① 누설 유,무와 상관없이 저온 시험을 진행한 시료를 상온에 24시간 방치 후 해체하여 시료 Gasket의 치수 및 표면 상태를 육안으로 확인 한다



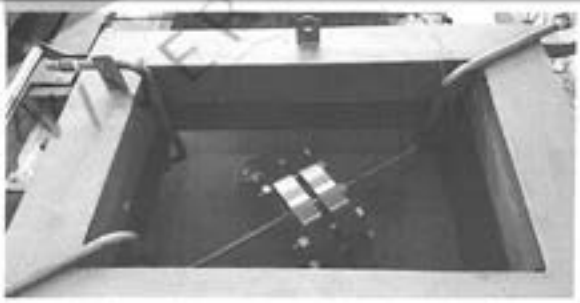
(1) 시험전 외형 검사 - ①

(2) 상온 Helium 누설 시험 - ①

(2) 상온 Helium 누설 시험 - ②

(2) 상온 Helium 누설 시험 - ③

(2) 상온 Helium 누설 시험 - ③



(3) 저온 Helium 누설 시험 - ①

(3) 저온 Helium 누설 시험 - ②

(3) 저온 Helium 누설 시험 - ③

(3) 저온 Helium 누설 시험 - ③

(4) 상온 복귀후 기밀시험 - ①

(4) 상온 복귀후 기밀시험 - ①

(5) 최종외형검사 - ①

4. 결과

① 상온 시험

시험 유체 : 헬륨 (순도 99%)

Helium Detector의 감도 : 10^{-4}(cc/sec)

■ 외부 누설 시험

압력 단계 (MPa)	온도 (℃)	압력 유지 시간 (min)	누설 여부 (Helium detector & Bubble Cheeck)
1.10	17.4	10	No Leak
2.09	17.4	10	No Leak
3.09	17.4	10	No Leak
4.09	17.4	10	No Leak
5.05	17.4	10	No Leak
6.18	17.4	10	No Leak
7.08	17.4	10	No Leak
8.20	17.4	10	No Leak

② 저온 시험

시험 유체 : 헬륨

Helium Detector의 감도 : 10^{-4}(cc/sec)

■ 외부 누설 시험 (순도 99%)

압력 단계 (MPa)	온도 (℃)	압력 유지 시간 (min)	누설 여부 (Helium detector & Bubble Cheeck)
1.24	- 33.9	10	No Leak
2.18	- 33.9	10	No Leak
3.58	- 33.9	10	No Leak
3.98	- 33.9	10	Leak

③ 상온 복귀 후 기밀 시험 (신청자 요청 진행)

시험 유체 : 헬륨 (순도 99%)

■ 외부 누설 시험

압력 단계 (MPa)	온도 (℃)	압력 유지 시간 (min)	누설 여부 (Helium detector & Bubble Cheeck)
1.06	21.3	10	No Leak
2.08	21.3	10	No Leak
3.11	21.3	10	No Leak
4.13	21.3	10	No Leak
5.11	21.3	10	No Leak
6.07	21.3	10	No Leak
7.03	21.3	10	No Leak
8.06	21.3	10	No Leak

③ 외형 치수 측정

■ 저온 시험 전

Check No.	1	2	3	4	5	AVG.
I.D [mm]	167.17	167.55	166.84	165.23	167.48	166.85
O.D [mm]	266.15	265.42	264.9	266.75	266.37	265.92

■ 저온 시험 후

Check No.	1	2	3	4	5	AVG.
I.D [mm]	167.04	166.95	166.12	167.32	166.91	166.87
O.D [mm]	266.38	265.43	266.02	266.17	264.59	265.72

- END -

TEST REPORT

FILK
a Subsidiary of KFPA

Report No : G2014-0396
Page(1)/(9)Pages

1030, Gyeongchung-daero, Gonam-eup, Yeoju-si, Gyeonggi-Do, 469-881, Korea

1. Client
   - Name : JEIL E&S Co., Ltd. (Kim Chi Yeon)
   - Address : 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
   - Date of Receipt : April 10, 2014
2. Test specimen : LEAKBLOK® Premium(50A)
3. Date of Test : April 17, 2014
4. Use of Report : Capability verification
5. Test method used : ISO 19921 and ISO 19922
6. Test Results :

Specimen	Nominal size	Result	
		Fire endurance test	Hydrostatic tightness test
LEAKBLOK® Premium	50A	Not leaked	Not leaked

- The results shown in this test report refer only to the specimen(s) tested unless otherwise stated.

Affirmation	Tested by	Technical Manager
	Name : Ann, Byung-Ho (Signature)	Name : Kim, Doeg-Suk (Signature)

Fire Insurers Laboratories of Korea
a subsidiary of Korean Fire Protection Association

FPD03-10A(1)

210×297(㎜)

TEST CONTENTS

1. GENERAL

1.1 Name of test sample : LEAKBLOK® Premium(50A)

1.2 Applicant : JEIL E&S Co., Ltd.

309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do Korea

1.3 Manufacturer of the specimen : JEIL E&S Co., Ltd.

1.4 Application date : April 15, 2014

1.5 Date of test : April 17, 2014

1.6 Test place : Fire Insurers Laboratories of Korea(FILK)

1.7 Referenced test standard

IACS Req. 2011, Requirements concerning pipes and pressure vessels(P2.11.5.5.6 Fire endurance test). The fire endurance test was to be conducted on the selected test specimens as per the following standards.

(a) ISO 19921:2005(E): Ships and marine technology - Fire resistance of metallic pipe components with resilient and elastomeric seals - Test methods

(b) ISO 19922:2005(E): Ships and marine technology - Fire resistance of metallic pipe components with resilient and elastomeric seals - Requirements imposed on the test bench

2. TEST SPECIMENS

2.1 Name of test sample : LEAKBLOK® Premium(50A)

2.2 Type of specimen : Compressed Non-Asbestos sheet & Gaskets

2.3 Nominal size : 10K 50A, FR Type, Thickness 1.5 mm

2.4 Design pressure : 1 MPa(10 bar)

2.5 Material : Synthetic rubber + Aramid fiber + Filler & etc.

2.6 The number of test sample : 1 unit

2.7 Other details : Refer to the appendix 1. Specifications and drawing of the test specimen

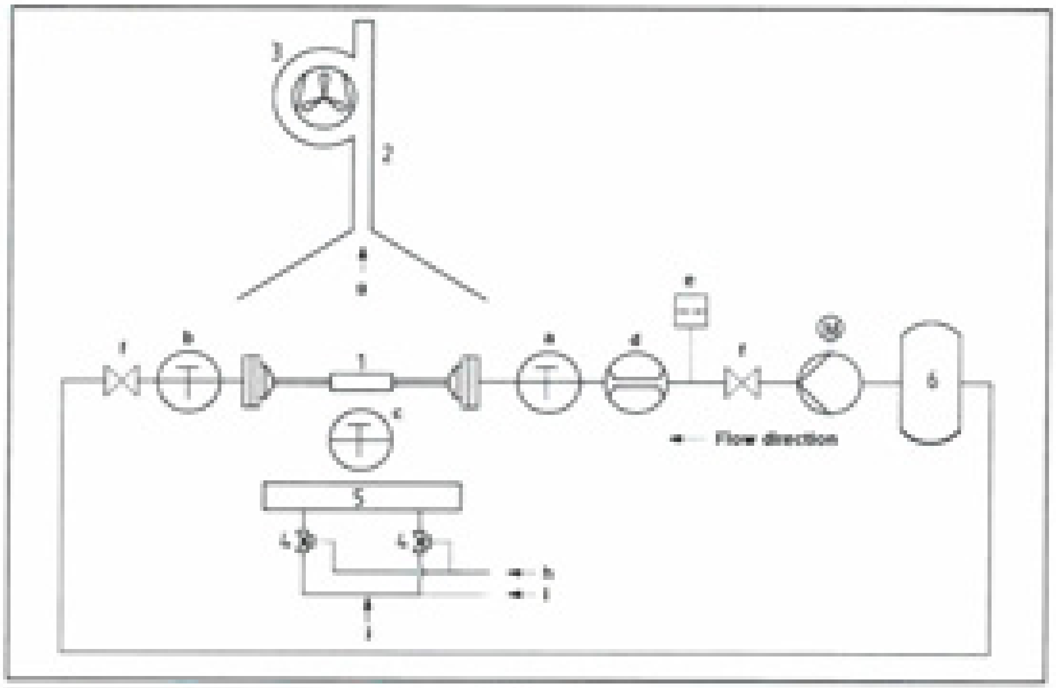
3. PURPOSE OF THE TEST

The purpose of this test is to evaluate the fire resistance performance of the LEAKBLOK® Premium(50A) submitted by JEIL E&S Co., Ltd. according to the following test methods.

4. TEST METHODS

4.1 Test apparatus

Test rig arrangements for the fire test are to be as indicated in [Figure 1].



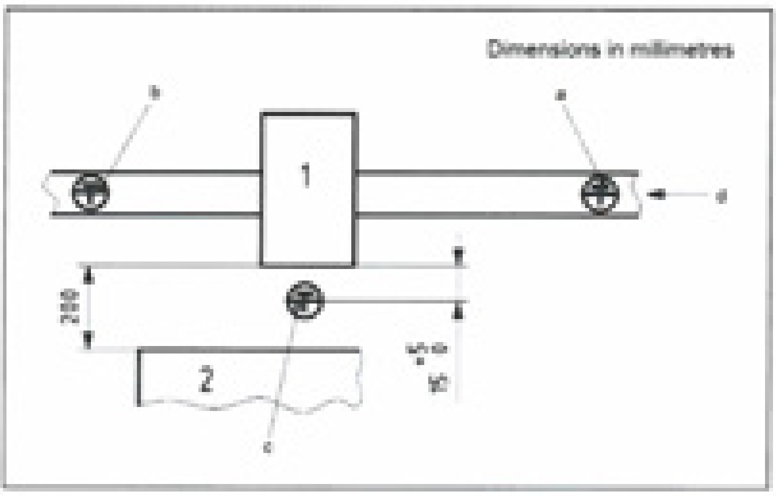
Key	
1. test piece	a. Water temperature at test piece, inlet.
2. exhaust gas truck	b. Water temperature at test piece, outlet.
3. exhaust fan	c. Flame temperature below centre of test piece.
4. mixing valve	d. Flow rate of water
5. sectional area burner	e. Working pressure during test
6. water tank with heating/cooling	f. Control valves.
	g. Exhaust gas.
	h. gas
	i. Combustion air.
	j. Air supply.

[Figure 1] Schematic diagram of the test rig arrangements for the fire test

4.2 Test procedures

4.2.1 Fire endurance test

(1) The test specimen is to be installed on the test rig such that the end of burner extends beyond the mechanical joint by at least 20 mm.



Key	
1. Test piece 2. Burner	a. Water temperature at test piece (inlet). b. Water temperature at test piece (outlet). c. Flame temperature below centre of test piece. d. Flow direction.

[Figure 2] Temperature measuring points

(2) After installation, the test specimen is rinsed with the water at the pressure of (500 ± 20) kPa for at least 1 min in order to evacuate as far as possible the air contained in the specimen.

(3) The specimen is exposed to the flame with the test temperature of (800 ± 50) ℃ for the duration of 30 min at the pressure of at least 500 kPa(5 bar).

(4) The specimen is to be completely enclosed by the flame.

(5) The inlet water temperature is maintained at the temperature of (80 ± 2) ℃ and the outlet water temperature is to be kept within 85 ℃.

4.2.2 Hydrostatic tightness test

After the fire test, the pressure inside the joint assembly is to be slowly increased to 1.5 times of the design pressure. This test pressure is to be retained for a minimum duration of 5 min.

4.3 Requirements

4.3.1 Fire endurance test

There should be no sign of leakage when the specimen is exposed to the flame for 30 min.

4.3.2 Hydrostatic tightness test

There should be no sign of leakage when the specimen is maintained at the pressure of 1.5 times of the design pressure for 5 min after the fire test.

[NOTE]

For services other than flammable fluids, a leakage rate of not more then 0.2 L/min is considered acceptable.

4.4 Measuring Instrumentation

4.4.1 Thermocouples

(1) K-type thermocouple : 3.2 mm in diameter

4.4.2 Pressure gauge

(1) Bourdon gauge : maximum range of 5.0 MPa(50 bar)

(2) Digital pressure gauge : maximum range of 3.0 MPa(30 bar)

4.4.3 Transmitter for recording the internal pressure.

5. CLASSIFICATION CRITERIA

The test specimen subjected to fire for 30 min at the temperature of 800 ℃ under the design pressure should not show any sign of leakage when subjected to proof pressure(1.5 times of design pressure) after the fire test.

6. TEST RESULTS

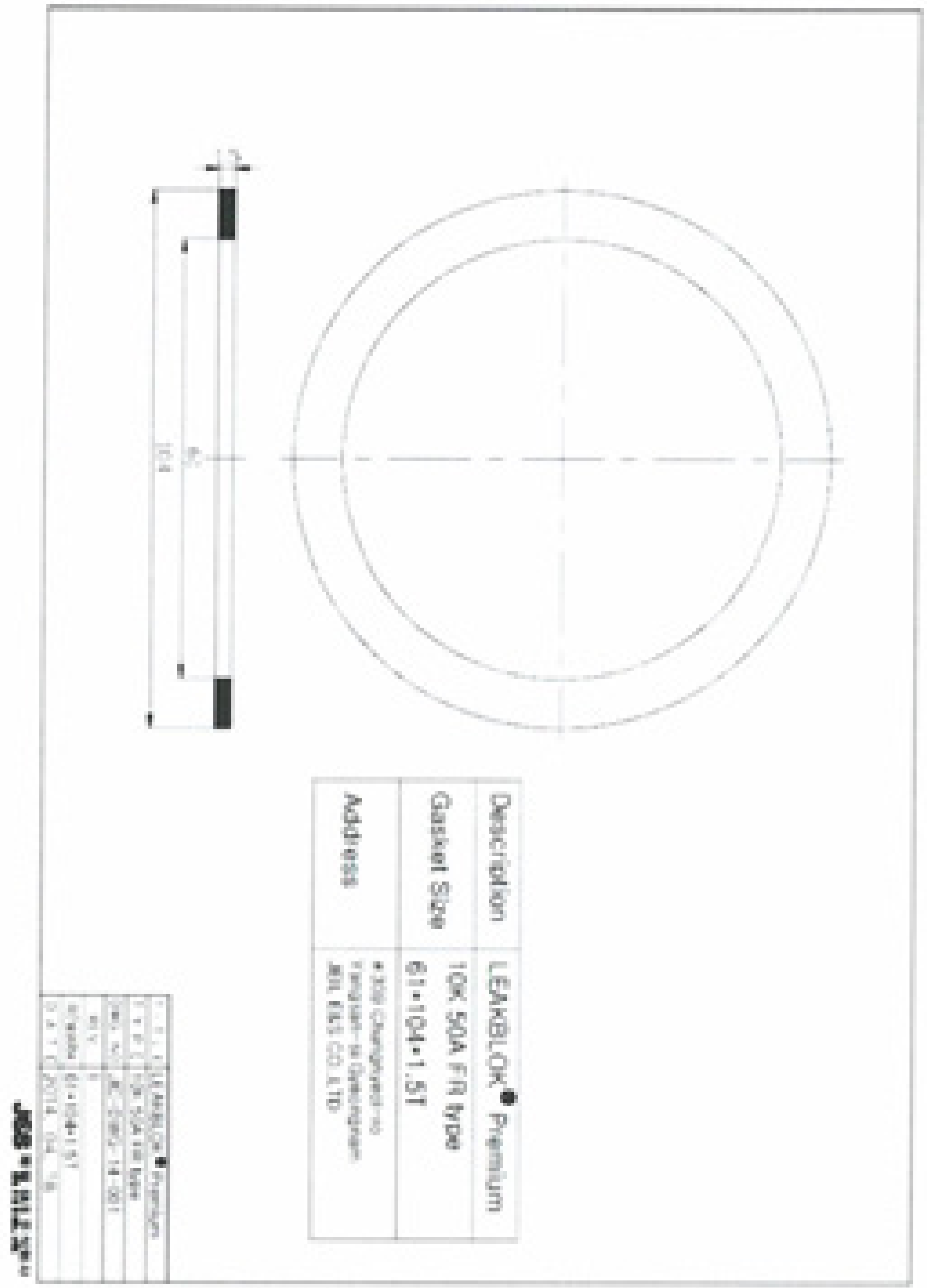
Test specimen	Design pressure (bar)	Fire endurance test		Hydrostatic tightness test	
		Test pressure (bar)	Leakage	Test pressure (bar)	Leakage
LEAKBLOK® Premium(50A)	10	5	Not leaked	15	Not leaked

7. CONCLUSION

The LEAKBLOK® Premium(50A) submitted by the client, JEIL E&S Co., Ltd. satisfied the classification criteria of the marine piping system specified in ISO 19921 and ISO 19922 as required by IACS Req. 2011(Requirements concerning pipes and pressure vessels - P2.11.5.5.6. Fire endurance test).

[APPENDICES]

APPENDIX 1. DRAWING OF THE TEST SPECIMEN

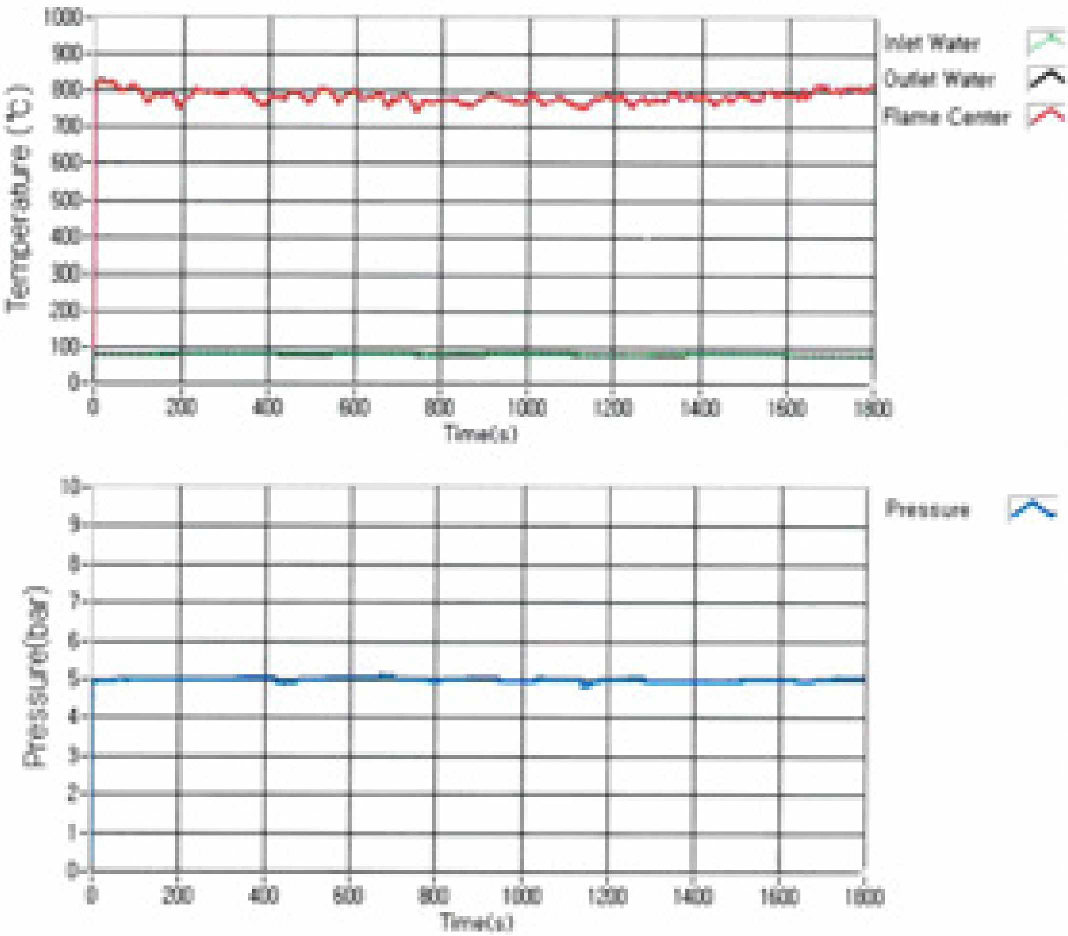


[Figure 1] Drawing of the test specimen

APPENDIX 2. GRAPH OF THE FIRE ENDURANCE TEST

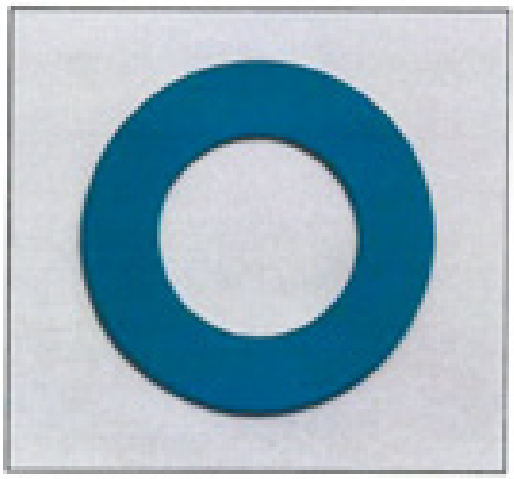
Fire endurance test

Laboratory	FILK
Test Standard	ISO 19921 & 19922
Description	LEAKBLOK
Test Date	2014-04-17
Nominal Size	50A
Condition Temperature(℃)	20
Humidity(% R.H.)	52

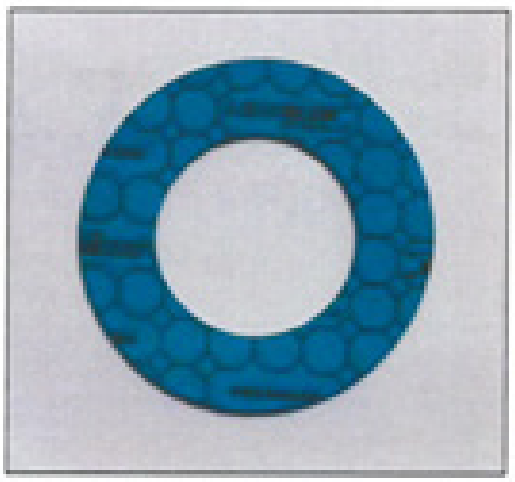


[Figure 2] Graph of the fire endurance test

APPENDIX 3. PHOTOGRAPH OF THE TEST SPECIMEN



[Photo 1] The front of test specimen

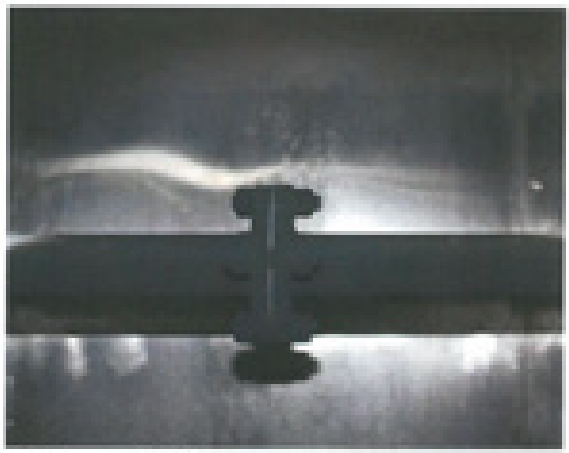


[Photo 2] The back of test specimen

APPENDIX 4. PHOTOGRAPH OF THE TEST

LEAKBLOK® Premium(50A)

[Photo 3] Fire endurance test



[Photo 4] Hydrostatic tightness test

The end of the report.

TEST REPORT

Dong-A University
Technical Center for
High-Performance Valves

840 Hadan2-dong, Saha-gu, Busan-city, Korea
(Tel: +82 51-200-6546 Fax: +82 51 200-6598)

Certificate No.:
TCHPV-15-04-113

1. Client
   - Name : JEIL E&S CO., LTD
   - Address : 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
   - Person in charge : Hyeon-woo Jeong

2. Use of Report : Quality Management

3. Test Sample
   : Compressed Non-Asbestos Sheets & Gaskets, LEAKBLOK® Premium

4. Date of Test : 2015. 03. 27

5. Test Meathod Used
   : Reference to the 'BS 6364:1984 Valves for cryogenic service'.

6. Testing Environment
   - Temperature : (16.3 ± 3.0) ℃
   - Relative Humidity : (42 ± 5) % R.H.

7. Test Result : Refer to the test result.

• The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Researcher Name : J.Y. KWON. (Sig.)	Approved by Technical Manager Name : S.J. OH. (Sig.)

2015. 04. 17.

Director of Dong-A University
Technical Center for High Performance Valves

◆ Test Result

1) Test

Cryogenic leak test for Compressed Non-Asbestos Gasket

2) Test Method Used

Cryogenic test has performed in accordance with BS 6364:1984 Valves for cryogenic service _ Appendix A.

① Gasket sample shall be centralized between flanges and installed with recommended torque value.
② Leakage verification shall be performed under ambient condition by pressurized 30 bar with helium gas.
③ Careful inspection is required for bubble detection during 15 minutes.
④ Immerse the completely installed gasket flange set in liquid nitrogen and freezing more than 1 hour.(-196 ℃ ~ -185 ℃)
⑤ After 1 hour immersed liquid nitrogen, check a cryogenic leakage by input 30 bar of helium gas.
⑥ Careful inspection is required for bubble detection during 15 minutes.

3) Test Sample

① Model : LEAKBLOK® Premium
② Material : Aramid fiber, Glass fiber, Inorganic filler, Elastomer & Chemicals
(The exact material composition ratio is not indicated in the report of the technical confidential to JEIL E&S CO., LTD.)
③ Test sample standard : ASME B 16.21 / 600LB 2" Flat Ring Type Gasket
④ Test flange standard : ASME B 16.5 / 600LB 2" Raised Face Flange

4) Result

① Ambient temperature test results

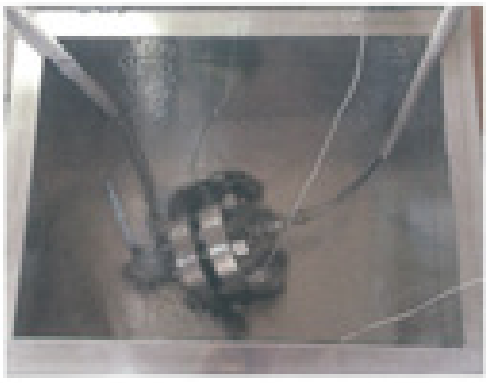
■ Shell leakage test [**Test Fluid : Helium Gas**]

Pressure (MPa)	Temperature (℃)	Duration (min)	Leakage Test (bubble detection)
3.1	16.3	15	No Leak

② Cryogenic test results

■ Shell leakage test (Test Fluid : Helium Gas)

Pressure (MPa)	Temperature (℃)	Duration (min)	Leakage Test (bubble detection)
3.1	-188.9	15	No Leak



③ Dimension check

■ Before cryogenic test

Check No.	1	2	3	4	5	AVG.
I.D [mm]	60.11	59.47	59.71	59.87	60.05	59.84
O.D [mm]	112.62	111.9	111.87	111.79	111.91	112.02

■ After cryogenic test

Check No.	1	2	3	4	5	AVG.
I.D [mm]	60.23	59.87	60.12	59.32	59.52	59.81
O.D [mm]	111.82	111.93	112.02	112.14	112.04	111.99

- END -

AMTEC Messtechnischer Service GmbH
Hoher Steg 13
74348 Lauffen
GERMANY
Telefon: +49-7133-9502-0
Telefax: +49-7133-9502-22
e-mail: info@amtec.de
Internet: www.amtec.de

Qualität zertifiziert
ISO 9001

DAkkS
Deutsche Akkreditierungsstelle

CERTIFICATE

No. 30245401E/FH/04.03.13

In accordance with the VDI Guideline 2440 (edition November 2000) the compliance with the tightness criteria of
$1.0 \cdot 10^{-4}$ mbar · l/(s · m) of the gasket type

LEAKBLOK™
(Compressed Non-Asbestos Sheet & Gasket)
DN40/PN40

of the gasket manufacturer

JEIL E&S CO., LTD.
309 Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea

was verified in a first-time test under the following test conditions:

initial gasket stress:	28.8	MPa
temperature of exposure:	150	°C
period of exposure:	48	h
remaining gasket stress:	10.3	MPa
test pressure (absolute):	1	bar
period of leakage measurement:	24	h

The leak rate measured with the Helium leak detector at the end of the period of the leakage measurement was

$2 \cdot 10^{-8}$ mbar · l/(s · m),

therefore the gasket is in compliance with the tightness criteria of VDI 2440. If the design of the sealing system can be expected to permit normal function in the long term in the given operating conditions and the characteristic sealing value as per DIN 28090-1 or EN 13555, respectively, are observed when choosing and dimensioning the flange connection, the gasket can be regarded as a high-grade sealing system for the purposes of TA-Luft.

This certificate is only valid in combination with the test report 3024541/a.

Lauffen, March 04, 2013

amtec Messtechnischer Service GmbH

Dipl.-Ing. F. Herkert

CERTIFICATE

HYUNDAI HEAVY INDUSTRIES CO., LTD

Certificate

Certificate No. : **15-047**

Company Name : **JEIL E&S CO., LTD.(UZ006)**

Address : **39-5, Yusan-dong, Yangsan-si, Gyeongnam, Korea**

We hereby certify that the above mentioned company is qualified to carry out self-control and self-guarantee of quality condition of goods by complying in all respects with the applicable rules and regulations which Shipbuilding Division stipulates, and the below items are certified as self-inspection items.

Self-Inspection Items

- **GASKET**

** **EXCEPT OWNER INSPECTION, DRILL SHIP & RIG ITEM)**

Issued Date : Feb. 1, 2015

Valid Date : Jan. 31, 2017

D. Y. Choi

General Manager of QM Dep't
Shipbuilding Division

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Our Ref: NJ/ M1302067
Test Report: MA4725/U

20th November 2013

WRAS
Water Regulations Advisory Scheme

JEIL E&S CO., LTD
309, Chungnyeol-ro,
Yangsan-si,
Gyeongsangnam-do,
Korea

WATER REGULATIONS ADVISORY SCHEME (WRAS)
MATERIAL APPROVAL

The material referred to in this letter is suitable for contact with wholesome water for domestic purposes having met the requirements of BS 6920-1:2000 'Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water'.

The reference relates solely to its effect on the quality of the water with which it may come into contact and does not signify the approval of its mechanical or physical properties for any use.

FIBRE **5075**

LEAKBLOK®. Blue coloured, compressed NBR/fibre non-asbestos sheet material, manufactured by calendering. For use with water up to 85°C. For use only as a jointing/gasket material having been tested at a reduced surface area to volume ratio.

APPROVAL NUMBER: 1307531
APPROVAL HOLDER: JEIL E&S CO., LTD

The Scheme reserves the right to review approval. This approval is valid between July 2013 and July 2018.

An entry, as above, will accordingly be included in the Water Fittings Directory on-line under the section headed, "Materials which have passed full tests of effect on water quality".

The Directory may be found at: www.wras.co.uk/directory

Yours faithfully

Jason Furnival
Approvals & Enquiries Manager
Water Regulations Advisory Scheme

Water Regulations Advisory Scheme Ltd,
18 Fan Close, Pen-Y-Fan Industrial Estate
Oakdale, Gwent, NP11 3EH
Tel: +44 (0) 333 207 9000 Fax: +44 (0) 1495 249 649
Email: info@wras.co.uk Website: www.wras.co.uk

WRAS MATERIAL APPROVAL - MATERIALS WHICH HAVE PASSED FULL TESTS OF EFFECT ON WATER QUALITY

The material referred to in this letter is suitable for contact with water for domestic purposes. **Approval of this material does not signify the approval of its mechanical or physical properties for any use.**

Manufacturers or applicants may only quote in their sales literature terms which are used in this letter, namely that; 'the material as listed, having passed the tests of effect on water quality, is suitable for use in contact with wholesome water'

This may be abbreviated to 'Water Regulations Advisory Scheme - Approved Material' or 'WRAS Approved Material'.

The scope of an Approval does not extend to rebranded materials unless otherwise agreed by the Scheme.

Use of the WRAS Approved Material Logo

The WRAS Approved Material logo is registered under the Trade Marks Acts 1994

Approval holders may use the WRAS Approved Material logo and make reference to any approval issued by WRAS Ltd. in respect of a particular material or range of materials provided the approval is, and remains valid.

Approval holders are entitled to use the logo on the packing, promotional literature and point of sale advertising Approved Materials.

Modifications to existing Approvals

It is a condition of WRAS Material Approval that NO changes or modifications to the Approved Material, be made without the Approval Holder first notifying WRAS Ltd. Full details of the proposed changes must be provided to the Scheme. Failure to comply with this condition will immediately invalidate a previously granted Approval.

Re-Approval

WRAS will write to you 1 year before the approval expires asking whether you would like to renew it. Please complete the relevant section of the MA3 application form which will be included with the letter and return to WRAS (via e-mail or post).

Please note it is the responsibility of the Approval Holder to ensure the Approval remains valid. WRAS Ltd. accepts no liability for the delay in granting approval where this is caused by circumstances outside of the Scheme's control.

신기술인증서

기 술 명 : 플루엔을 사용하지 않는 비석면 개스킷 제조기술

회 사 명 : 제일E&S(주)

대 표 자 : 김진태

소 재 지 : 경남 양산시 유산동 39-5

인증번호 : 제0693호

유효기간 : 2012년 12월 18일부터 2014년 12월 17일까지

위의 기술을 「산업기술혁신 촉진법」 제15조의2에 따른 신기술로 인증합니다.

2012년 12월 18일

지식경제부장관

Our Ref: HL/M1303106
Test Report: MA4904/R section 1

9th December 2013

Jeil E&S Co. Ltd.
309, Chungnyeol-ro,
Yangsan-si,
Gyeongsangnam-do,
Korea

WATER REGULATIONS ADVISORY SCHEME (WRAS)
MATERIAL APPROVAL

The material referred to in this letter is suitable for contact with wholesome water for domestic purposes having met the requirements of BS 6920-1:2000 'Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water'.

The reference relates solely to its effect on the quality of the water with which it may come into contact and does not signify the approval of its mechanical or physical properties for any use.

FIBRE **5075**

JIC 6010. Light green coloured, compressed non-asbestos fibre sheet material manufactured by calendaring. For use with water up to 30°C.
For use only as a jointing/gasket material having been tested at reduced surface area to volume ratio.

APPROVAL NUMBER: 1311541
APPROVAL HOLDER: JEIL E&S CO. LTD.

The Scheme reserves the right to review approval. This approval is valid between November 2013 and November 2018.

An entry, as above, will accordingly be included in the Water Fittings Directory on-line under the section headed, "Materials which have passed full tests of effect on water quality".

The Directory may be found at: www.wras.co.uk/directory

Yours faithfully

Jason Furnival
Approvals & Enquiries Manager
Water Regulations Advisory Scheme

Water Regulations Advisory Scheme Ltd,
Tel: +44 (0) 333 207 9600. Fax: +44 (0) 1480 240 648
Email: info@wras.co.uk. Website: www.wras.co.uk

WRAS MATERIAL APPROVAL - MATERIALS WHICH HAVE PASSED FULL TESTS OF EFFECT ON WATER QUALITY

The material referred to in this letter is suitable for contact with water for domestic purposes. **Approval of this material does not signify the approval of its mechanical or physical properties for any use.**

Manufacturers or applicants may only quote in their sales literature terms which are used in this letter, namely that; 'the material as listed, having passed the tests of effect on water quality, is suitable for use in contact with wholesome water'

This may be abbreviated to 'Water Regulations Advisory Scheme - Approved Material' or 'WRAS Approved Material'.

The scope of an Approval does not extend to rebranded materials unless otherwise agreed by the Scheme.

Use of the WRAS Approved Material Logo

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Approval holders are entitled to use the logo on the packing, promotional literature and point of sale advertising Approved Materials.

Modifications to existing Approvals

It is a condition of WRAS Material Approval that NO changes or modifications to the Approved Material, be made without the Approval Holder first notifying WRAS Ltd. Full details of the proposed changes must be provided to the Scheme. Failure to comply with this condition will immediately invalidate a previously granted Approval.

Re-Approval

WRAS will write to you 1 year before the approval expires asking whether you would like to renew it. Please complete the relevant section of the MA3 application form which will be included with the letter and return to WRAS (via e-mail or post).

Please note it is the responsibility of the Approval Holder to ensure the Approval remains valid. WRAS Ltd. accepts no liability for the delay in granting approval where this is caused by circumstances outside of the Scheme's control.

Our Ref: HL/M1303106
Test Report: MA4904/R section 2

9th December 2013

WRAS
Water Regulations Advisory Scheme

Jeil E&S Co. Ltd.
309, Chungnyeol-ro,
Yangsan-si,
Gyeongsangnam-do,
Korea

<u>WATER REGULATIONS ADVISORY SCHEME (WRAS)</u>
<u>MATERIAL APPROVAL</u>

The material referred to in this letter is suitable for contact with wholesome water for domestic purposes having met the requirements of BS 6920-1:2000 'Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water'.

The reference relates solely to its effect on the quality of the water with which it may come into contact and does not signify the approval of its mechanical or physical properties for any use.

FIBRE **5075**

JIC 6200. Brown coloured, compressed non-asbestos fibre sheet material manufactured by calendaring.
For use with water up to 30°C.
For use only as a jointing/gasket material having been tested at reduced surface area to volume ratio.

APPROVAL NUMBER: 1311542
APPROVAL HOLDER: JEIL E&S CO. LTD.

The Scheme reserves the right to review approval. This approval is valid between November 2013 and November 2018.

An entry, as above, will accordingly be included in the Water Fittings Directory on-line under the section headed, "Materials which have passed full tests of effect on water quality".

The Directory may be found at: <u>www.wras.co.uk/directory</u>

Yours faithfully

<u>Jason Furnival</u>
<u>Approvals & Enquiries Manager</u>
<u>Water Regulations Advisory Scheme</u>

WRAS MATERIAL APPROVAL - MATERIALS WHICH HAVE PASSED FULL TESTS OF EFFECT ON WATER QUALITY

The material referred to in this letter is suitable for contact with water for domestic purposes. **Approval of this material does not signify the approval of its mechanical or physical properties for any use.**

Manufacturers or applicants may only quote in their sales literature terms which are used in this letter, namely that; 'the material as listed, having passed the tests of effect on water quality, is suitable for use in contact with wholesome water'

This may be abbreviated to 'Water Regulations Advisory Scheme - Approved Material' or 'WRAS Approved Material'.

The scope of an Approval does not extend to rebranded materials unless otherwise agreed by the Scheme.

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Approval holders are entitled to use the logo on the packing, promotional literature and point of sale advertising Approved Materials.

Modifications to existing Approvals

It is a condition of WRAS Material Approval that **NO** changes or modifications to the Approved Material, be made without the Approval Holder first notifying WRAS Ltd. Full details of the proposed changes must be provided to the Scheme. Failure to comply with this condition will immediately invalidate a previously granted Approval.

Re-Approval

WRAS will write to you 1 year before the approval expires asking whether you would like to renew it. Please complete the relevant section of the MA3 application form which will be included with the letter and return to WRAS (via e-mail or post).

Please note it is the responsibility of the Approval Holder to ensure the Approval remains valid. WRAS Ltd. accepts no liability for the delay in granting approval where this is caused by circumstances outside of the Scheme's control.

Fire Test Report

API Standard 6FB, Third Edition

Performed for

JEIL E&S Co.,Ltd.

www.jeilens.co.kr

SWGK Gasket
JIC 3836-R-SF-316-SS
6 inch Class 300

Project Number: 211073
March 25, 2011

Performed by

YARMOUTH RESEARCH AND TECHNOLOGY, LLC

434 Walnut Hill Road
North Yarmouth, ME 04097 USA
(207) 829-5359
info@yarmouthresearch.com
www.yarmouthresearch.com

Yarmouth Research and Technology, LLC

API 6FB FIRE TEST REPORT

Customer:	Jeil E&S Co., Ltd.		**Date:**	3/25/2011
Product Code:	6 inch Class 300 Spiral Wound Gasket			
	JIC 3836-R-SF-316-SS			
	SWGK,300LB 6" IR=SS316, OR=Carbon Steel			
Project Number:	PN211073			
Specification:	API 6FB, Third Edition, Nov. 1998			
	Non-Bending, On-shore or Open-offshore Test			
Seal Area OD:	8.30	**Seal Area ID:**	6.90	inches
Mean Seal Diameter:	7.60	inches		
Mean Circumference:	23.9	inches		
Allowable Leakage:	23.9	ml/min		
Nominal Test Pressure:	555	psig		
YRT Technician:	Matthew J. Wasielewski, P.E.			

Version of YRT's FIRE-Control 6FB Software: A

Equipment Confirmed to be in Calibration to NIST Standards: Yes

Burn and Cool Down Test

Burn Start Time:	14:49:00	
Burn / Cooldown Duration:	60	minutes
Average Pressure During Burn/Cooldown:	573	psig
Leak Rate During Burn/Cool Down:	0.0	ml/min
Allowable External Leak Rate:	23.9	ml/min
Amount of Time of Avg. Cal. Block > 1200 deg.:	21.3	minutes
Were Test Conditions Within Compliance?	Yes	
Was the Leakage Below the Allowable?	Yes	

Depressurization - Repressurization Test

Average Pressure During Test:	566	psig
Gasket Leak Rate:	0	ml/min
Allowable External Leak Rate:	23.9	ml/min
Was the Leakage Below the Allowable?	**Yes**	

Does the Gasket Pass or Fail API 6FB?	**PASS**

Witnesses

Note:

Yarmouth Research and Technology, LLC

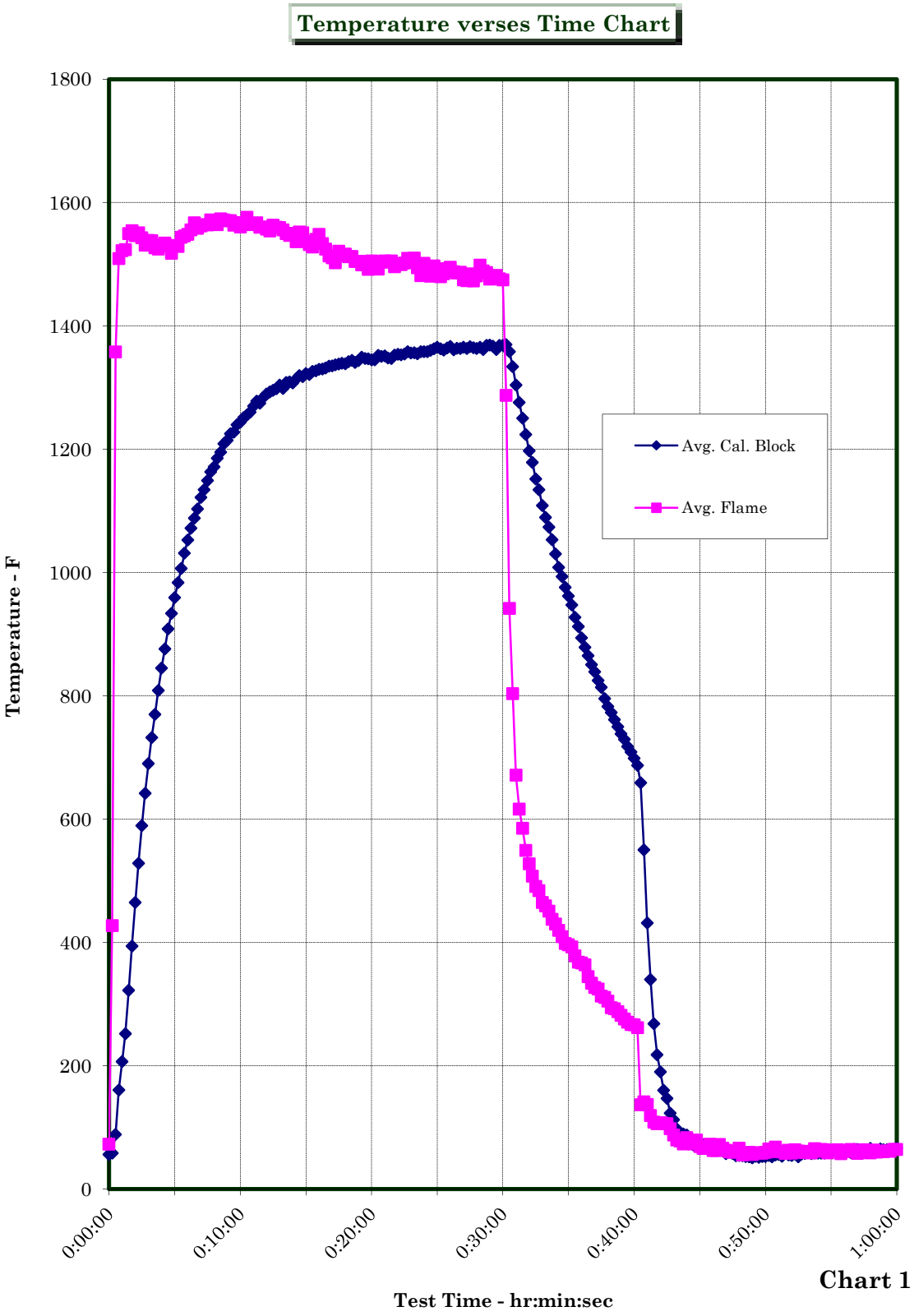


Chart 1

Yarmouth Research and Technology, LLC

Pressure verses Time Chart

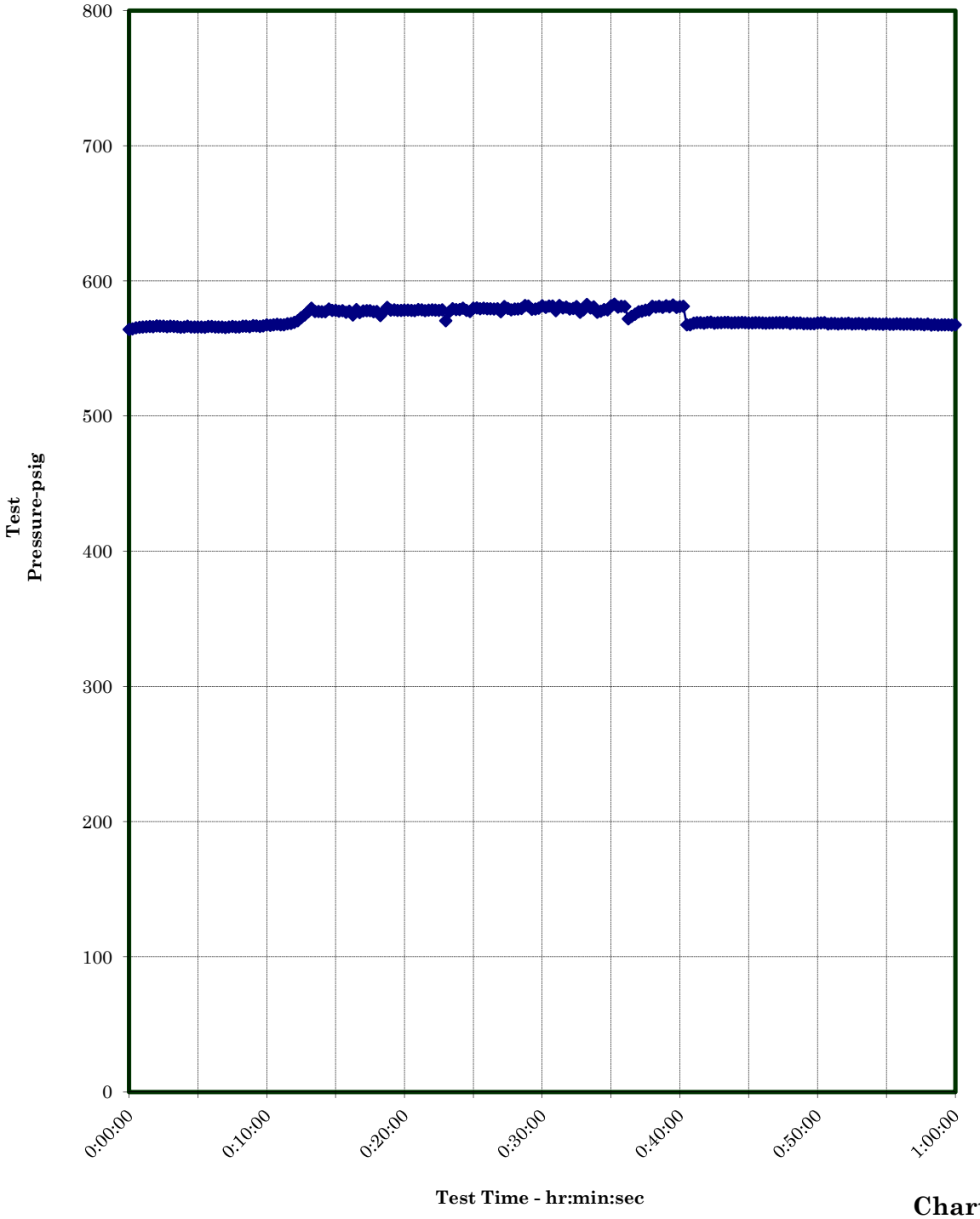
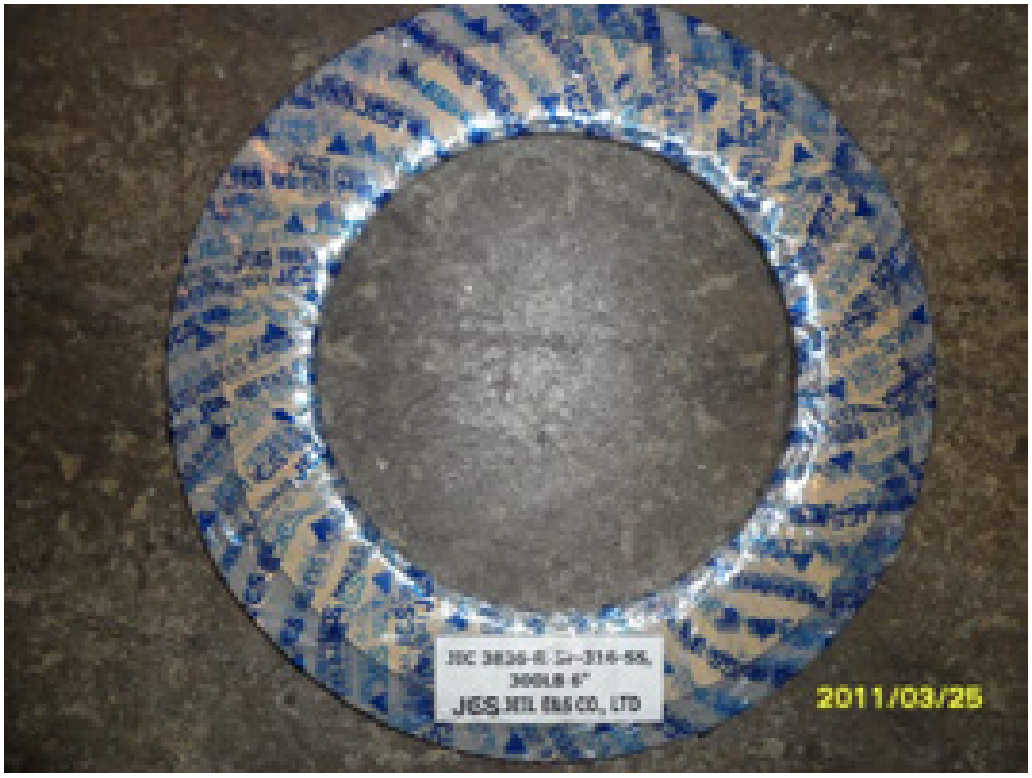


Chart 2



Gasket Before Test

Gasket Fire Test

Gasket After Test

Yarmouth Research and Technology, LLC

Fire Test Information

Customer: Jeil E&S Co., Ltd. **Date:** 3/25/2011

Product Code: 6 inch Class 300 Spiral Wound Gasket

Project Number: PN211073

Fire Test Raw Data

Time	Pressure (psig)	Water Volume (mls)	Cal. 1 Block Temp - F	Cal. 2 Block Temp - F	Cal. 3 Block Temp - F	Cal. 4 Block Temp - F	*Average Block Temp - F*	Flame 1 Temp - F	Flame 2 Temp - F	Flame 3 Temp - F	Flame 4 Temp - F	*Average Flame Temp - F*
14:49:00	564	36013	56	56	53	60	*56*	114	51	55	72	*73*
14:49:15	564	36015	59	59	53	63	*59*	336	317	705	352	*428*
14:49:30	565	36016	100	80	72	103	*89*	1232	1442	1594	1163	*1358*
14:49:45	566	36039	196	161	121	165	*161*	1445	1600	1713	1279	*1509*
14:50:00	566	36059	219	212	185	211	*207*	1506	1523	1733	1325	*1522*
14:50:15	566	36053	268	239	259	243	*252*	1510	1526	1718	1341	*1524*
14:50:30	566	36027	344	308	344	294	*323*	1495	1615	1729	1359	*1550*
14:50:45	566	36041	425	388	429	335	*394*	1495	1614	1756	1353	*1555*
14:51:00	567	36043	509	466	507	377	*465*	1496	1567	1753	1369	*1546*
14:51:15	567	36034	588	529	577	420	*529*	1489	1576	1763	1376	*1551*
14:51:30	566	36056	657	599	638	463	*589*	1487	1559	1757	1369	*1543*
14:51:45	566	36078	719	648	687	514	*642*	1466	1550	1752	1356	*1531*
14:52:00	566	36053	767	709	732	552	*690*	1442	1577	1764	1371	*1539*
14:52:15	566	36044	815	758	772	584	*732*	1432	1579	1767	1375	*1538*
14:52:30	566	36043	856	801	809	613	*770*	1428	1563	1761	1354	*1527*
14:52:45	566	36081	893	847	843	652	*809*	1436	1532	1763	1367	*1525*
14:53:00	566	36029	926	892	881	681	*845*	1421	1567	1768	1370	*1532*
14:53:15	567	36042	969	920	911	705	*876*	1415	1557	1775	1390	*1534*
14:53:30	566	36079	995	959	935	745	*909*	1419	1559	1762	1378	*1530*
14:53:45	566	36087	1016	989	963	766	*934*	1413	1522	1757	1379	*1518*
14:54:00	566	36066	1042	1021	988	787	*960*	1404	1577	1762	1379	*1531*
14:54:15	566	36069	1067	1041	1017	810	*984*	1410	1552	1761	1392	*1529*
14:54:30	566	36130	1082	1071	1033	840	*1007*	1407	1562	1772	1433	*1544*
14:54:45	566	36078	1112	1100	1052	861	*1031*	1405	1562	1784	1433	*1546*
14:55:00	566	36087	1129	1115	1080	886	*1053*	1381	1587	1771	1454	*1548*
14:55:15	566	36118	1138	1139	1097	913	*1072*	1413	1564	1792	1454	*1556*
14:55:30	566	36075	1164	1156	1116	916	*1088*	1472	1580	1767	1449	*1567*

14:55:45	566	36145	1173	1178	1130	932	*1103*	1448	1557	1769	1459	*1558*
14:56:00	565	36137	1180	1191	1156	961	*1122*	1423	1596	1775	1454	*1562*
14:56:15	566	36137	1200	1200	1165	972	*1134*	1407	1607	1779	1463	*1564*
14:56:30	566	36120	1209	1216	1184	987	*1149*	1385	1595	1797	1478	*1564*
14:56:45	566	36127	1221	1227	1197	1007	*1163*	1380	1627	1794	1486	*1572*
14:57:00	566	36180	1226	1239	1209	1012	*1172*	1362	1628	1795	1480	*1566*
14:57:15	566	36144	1236	1250	1224	1032	*1186*	1365	1628	1780	1483	*1564*
14:57:30	566	36212	1247	1262	1235	1037	*1195*	1362	1664	1781	1487	*1574*
14:57:45	566	36159	1260	1274	1250	1052	*1209*	1356	1648	1784	1499	*1572*
14:58:00	567	36196	1255	1282	1254	1067	*1215*	1345	1647	1788	1502	*1571*
14:58:15	567	36270	1262	1291	1267	1080	*1225*	1348	1645	1789	1500	*1571*
14:58:30	566	36323	1269	1289	1268	1084	*1228*	1346	1647	1767	1494	*1564*
14:58:45	567	36268	1277	1307	1281	1094	*1240*	1335	1654	1771	1510	*1568*
14:59:00	567	36309	1277	1305	1290	1103	*1244*	1330	1623	1783	1505	*1560*
14:59:15	567	36442	1284	1315	1297	1108	*1251*	1326	1668	1756	1508	*1565*
14:59:30	567	36314	1290	1316	1300	1116	*1256*	1324	1678	1795	1507	*1576*
14:59:45	568	36182	1289	1320	1309	1122	*1260*	1314	1668	1765	1512	*1565*
15:00:00	568	36277	1292	1327	1312	1148	*1270*	1317	1673	1747	1519	*1564*
15:00:15	567	36342	1302	1338	1324	1148	*1278*	1302	1691	1764	1511	*1567*
15:00:30	568	36237	1300	1325	1321	1152	*1275*	1307	1691	1741	1500	*1560*
15:00:45	568	36314	1308	1336	1328	1164	*1284*	1328	1653	1775	1485	*1560*
15:01:00	569	36322	1309	1344	1336	1169	*1290*	1331	1645	1754	1498	*1557*
15:01:15	570	36407	1310	1344	1341	1177	*1293*	1333	1675	1713	1494	*1554*
15:01:30	573	36594	1314	1346	1345	1177	*1296*	1337	1688	1738	1491	*1564*
15:01:45	575	36598	1320	1348	1346	1178	*1298*	1333	1667	1752	1487	*1560*
15:02:00	577	37709	1322	1345	1350	1199	*1304*	1337	1668	1739	1494	*1560*
15:02:15	580	37185	1320	1341	1350	1183	*1299*	1342	1676	1724	1481	*1556*
15:02:30	577	36652	1321	1341	1359	1212	*1308*	1338	1662	1713	1486	*1550*
15:02:45	577	35919	1326	1342	1364	1205	*1309*	1337	1670	1708	1472	*1547*
15:03:00	577	35777	1327	1344	1362	1196	*1307*	1341	1665	1713	1481	*1550*
15:03:15	577	37695	1336	1350	1370	1199	*1314*	1341	1668	1663	1474	*1537*
15:03:30	579	37218	1331	1348	1377	1222	*1320*	1345	1671	1711	1482	*1552*
15:03:45	578	37067	1329	1347	1378	1216	*1318*	1348	1661	1700	1495	*1551*
15:04:00	578	36996	1332	1348	1382	1229	*1323*	1347	1642	1684	1474	*1537*
15:04:15	578	37073	1334	1346	1382	1222	*1321*	1360	1677	1630	1460	*1532*
15:04:30	578	36993	1337	1350	1385	1232	*1326*	1360	1690	1602	1460	*1528*
15:04:45	577	37025	1336	1351	1387	1234	*1327*	1371	1691	1629	1470	*1540*
15:05:00	578	36997	1336	1349	1395	1238	*1330*	1371	1711	1654	1458	*1549*

15:05:15	575	36690	1336	1352	1398	1234	*1330*	1374	1668	1629	1462	*1533*
15:05:30	579	37229	1337	1352	1400	1237	*1332*	1375	1641	1609	1473	*1525*
15:05:45	576	36947	1337	1349	1400	1253	*1335*	1377	1618	1602	1457	*1514*
15:06:00	578	37044	1338	1354	1402	1246	*1335*	1377	1590	1627	1447	*1510*
15:06:15	578	37074	1336	1349	1406	1256	*1337*	1386	1567	1624	1432	*1502*
15:06:30	578	36984	1341	1349	1405	1257	*1338*	1393	1614	1643	1434	*1521*
15:06:45	577	37020	1341	1348	1410	1259	*1340*	1389	1616	1625	1427	*1514*
15:07:00	577	37023	1339	1350	1410	1255	*1339*	1397	1594	1638	1436	*1516*
15:07:15	574	36724	1337	1350	1415	1265	*1342*	1409	1615	1572	1452	*1512*
15:07:30	577	35945	1342	1357	1420	1258	*1344*	1404	1587	1627	1433	*1513*
15:07:45	580	37972	1336	1353	1415	1258	*1341*	1409	1571	1594	1443	*1504*
15:08:00	578	37034	1340	1355	1417	1262	*1344*	1407	1556	1631	1424	*1505*
15:08:15	579	36931	1340	1356	1428	1273	*1349*	1412	1547	1609	1427	*1499*
15:08:30	578	37704	1341	1354	1424	1270	*1347*	1413	1596	1590	1418	*1504*
15:08:45	578	37024	1337	1354	1424	1272	*1347*	1414	1545	1575	1433	*1492*
15:09:00	578	37101	1340	1355	1425	1260	*1345*	1420	1546	1619	1436	*1505*
15:09:15	578	37002	1338	1354	1422	1265	*1345*	1425	1556	1618	1418	*1504*
15:09:30	578	37060	1342	1353	1426	1287	*1352*	1428	1535	1592	1414	*1492*
15:09:45	578	37031	1339	1352	1428	1282	*1350*	1432	1543	1625	1412	*1503*
15:10:00	579	37079	1342	1355	1429	1280	*1352*	1437	1552	1601	1432	*1506*
15:10:15	579	37024	1339	1356	1432	1265	*1348*	1441	1536	1613	1425	*1504*
15:10:30	578	37011	1335	1354	1431	1268	*1347*	1444	1556	1586	1435	*1505*
15:10:45	578	37014	1339	1356	1430	1285	*1353*	1438	1538	1590	1417	*1496*
15:11:00	578	36986	1340	1357	1431	1287	*1354*	1438	1557	1573	1434	*1501*
15:11:15	578	37021	1344	1356	1434	1278	*1353*	1441	1555	1591	1410	*1499*
15:11:30	578	37005	1339	1355	1436	1288	*1355*	1451	1540	1579	1437	*1502*
15:11:45	578	36991	1343	1360	1440	1289	*1358*	1458	1539	1607	1435	*1510*
15:12:00	571	30217	1336	1356	1438	1294	*1356*	1448	1544	1572	1461	*1506*
15:12:15	577	35668	1339	1355	1437	1295	*1357*	1475	1545	1576	1444	*1510*
15:12:30	579	35559	1340	1358	1440	1281	*1355*	1462	1523	1562	1429	*1494*
15:12:45	579	37094	1341	1358	1438	1295	*1358*	1452	1526	1531	1417	*1482*
15:13:00	579	37375	1342	1359	1439	1293	*1358*	1449	1536	1609	1412	*1502*
15:13:15	580	38298	1339	1361	1442	1291	*1358*	1458	1510	1575	1417	*1490*
15:13:30	578	36916	1345	1362	1438	1296	*1360*	1457	1508	1539	1419	*1481*
15:13:45	577	37545	1345	1363	1444	1300	*1363*	1459	1532	1575	1422	*1497*
15:14:00	580	37317	1342	1364	1444	1311	*1365*	1459	1527	1571	1411	*1492*
15:14:15	580	37100	1343	1364	1446	1298	*1363*	1461	1482	1568	1408	*1480*
15:14:30	579	37053	1343	1363	1440	1296	*1361*	1464	1497	1560	1416	*1484*

15:14:45	580	37068	1344	1362	1445	1306	*1364*	1465	1498	1586	1423	*1493*
15:15:00	579	37048	1345	1366	1448	1307	*1367*	1468	1528	1560	1424	*1495*
15:15:15	579	37041	1343	1361	1440	1300	*1361*	1461	1541	1537	1412	*1488*
15:15:30	579	36977	1342	1362	1445	1305	*1364*	1464	1516	1543	1420	*1486*
15:15:45	579	37072	1343	1362	1442	1306	*1363*	1463	1515	1557	1413	*1487*
15:16:00	577	37538	1341	1361	1442	1317	*1365*	1466	1459	1562	1412	*1475*
15:16:15	581	38962	1344	1366	1441	1302	*1363*	1467	1450	1558	1418	*1473*
15:16:30	580	36987	1345	1363	1446	1311	*1366*	1467	1471	1571	1428	*1484*
15:16:45	578	37631	1345	1366	1441	1306	*1365*	1469	1477	1532	1414	*1473*
15:17:00	579	36537	1347	1364	1440	1302	*1363*	1471	1505	1535	1413	*1481*
15:17:15	579	35692	1345	1364	1443	1310	*1366*	1469	1510	1586	1429	*1499*
15:17:30	580	36972	1342	1361	1439	1304	*1362*	1467	1494	1566	1430	*1489*
15:17:45	582	38963	1346	1364	1444	1319	*1368*	1477	1468	1577	1424	*1487*
15:18:00	581	37972	1347	1368	1445	1316	*1369*	1472	1483	1527	1422	*1476*
15:18:15	579	38012	1348	1367	1444	1309	*1367*	1473	1486	1525	1431	*1479*
15:18:30	579	36030	1337	1353	1435	1322	*1362*	1461	1475	1569	1423	*1482*
15:18:45	580	36902	1348	1366	1442	1317	*1368*	1478	1447	1557	1424	*1477*
15:19:00	582	36516	1349	1366	1443	1316	*1369*	1479	1456	1542	1421	*1475*
15:19:15	580	36978	1348	1367	1440	1324	*1370*	1394	1256	1212	1287	*1287*
15:19:30	581	38812	1344	1357	1428	1304	*1358*	1228	877	897	766	*942*
15:19:45	581	36204	1323	1330	1397	1286	*1334*	1152	690	711	661	*804*
15:20:00	578	36812	1297	1293	1367	1259	*1304*	910	578	597	600	*671*
15:20:15	582	38046	1271	1259	1335	1238	*1276*	877	501	524	564	*617*
15:20:30	580	36772	1250	1234	1308	1208	*1250*	858	454	488	540	*585*
15:20:45	581	36973	1218	1204	1280	1193	*1224*	841	414	429	514	*550*
15:21:00	579	37972	1194	1176	1253	1167	*1198*	821	393	395	502	*528*
15:21:15	580	37633	1176	1156	1235	1148	*1179*	801	363	375	492	*508*
15:21:30	581	37153	1144	1132	1211	1120	*1152*	786	343	359	475	*491*
15:21:45	577	36587	1124	1114	1198	1101	*1134*	789	342	341	465	*484*
15:22:00	579	37772	1104	1086	1172	1073	*1109*	755	323	331	451	*465*
15:22:15	582	38054	1078	1062	1151	1066	*1089*	738	311	333	455	*459*
15:22:30	580	36935	1067	1055	1137	1035	*1074*	735	307	318	443	*451*
15:22:45	581	36959	1048	1020	1113	1031	*1053*	736	293	300	421	*438*
15:23:00	577	36580	1023	1009	1087	1001	*1030*	721	281	293	424	*430*
15:23:15	577	36843	1000	987	1065	981	*1008*	696	274	287	422	*420*
15:23:30	579	36117	979	968	1048	979	*994*	676	269	284	409	*410*
15:23:45	579	37478	964	951	1032	956	*976*	666	262	269	396	*398*
15:24:00	582	37049	952	939	1020	936	*962*	662	260	274	389	*396*

15:24:15	583	38096	939	929	998	924	*948*	658	259	269	385	*393*
15:24:30	581	36127	915	908	981	905	*927*	637	246	257	373	*378*
15:24:45	581	37186	899	888	964	899	*913*	625	244	248	356	*368*
15:25:00	581	37030	882	876	948	870	*894*	613	240	254	361	*367*
15:25:15	572	36506	867	860	933	855	*879*	593	237	263	363	*364*
15:25:30	574	36425	853	846	916	845	*865*	555	226	251	347	*345*
15:25:45	575	36550	838	832	900	832	*851*	525	222	250	338	*334*
15:26:00	577	36763	822	820	890	824	*839*	514	221	246	328	*327*
15:26:15	578	36296	814	805	878	803	*825*	509	221	238	331	*325*
15:26:30	578	36151	800	790	861	804	*814*	496	211	233	312	*313*
15:26:45	578	36854	780	776	845	781	*796*	483	207	231	322	*311*
15:27:00	581	37124	765	759	837	770	*783*	473	200	228	318	*305*
15:27:15	581	37842	752	750	819	770	*773*	455	194	220	308	*294*
15:27:30	581	37154	744	742	809	750	*761*	449	197	219	306	*293*
15:27:45	580	37734	735	730	799	736	*750*	437	193	213	309	*288*
15:28:00	582	37699	723	716	789	726	*739*	427	191	210	299	*282*
15:28:15	581	36328	719	705	776	717	*729*	418	182	209	294	*276*
15:28:30	582	37445	701	695	761	715	*718*	406	185	208	285	*271*
15:28:45	580	36604	695	690	746	705	*709*	387	188	203	290	*267*
15:29:00	581	36909	682	683	743	686	*699*	385	190	201	291	*267*
15:29:15	581	36940	668	672	730	679	*687*	373	183	201	290	*262*
15:29:30	568	36228	616	659	704	657	*659*	116	163	148	120	*137*
15:29:45	567	36239	400	627	575	598	*550*	122	160	146	139	*142*
15:30:00	569	36242	248	544	447	487	*432*	97	162	144	147	*138*
15:30:15	569	36245	162	474	350	374	*340*	64	160	145	109	*120*
15:30:30	569	36223	118	407	277	271	*268*	57	152	136	90	*109*
15:30:45	569	36208	93	355	219	205	*218*	57	139	137	91	*106*
15:31:00	569	36181	81	310	183	187	*190*	52	132	160	88	*108*
15:31:15	569	36148	67	265	146	163	*160*	53	123	164	86	*107*
15:31:30	569	36094	66	244	127	152	*147*	65	122	153	84	*106*
15:31:45	569	36115	57	209	101	126	*123*	56	112	143	81	*98*
15:32:00	569	36162	60	191	92	108	*113*	64	115	109	64	*88*
15:32:15	569	36126	45	158	75	113	*98*	45	94	120	59	*80*
15:32:30	569	36118	42	138	65	104	*87*	42	90	113	67	*78*
15:32:45	569	36101	47	138	66	107	*90*	53	93	95	53	*74*
15:33:00	569	36072	52	137	66	97	*88*	62	92	116	64	*84*
15:33:15	569	36102	48	122	60	93	*81*	53	90	109	55	*77*
15:33:30	569	36089	40	107	49	90	*72*	46	83	99	66	*74*

15:33:45	569	36108	45	112	52	82	*73*	54	86	113	65	*80*
15:34:00	569	36068	49	103	49	93	*74*	50	82	93	51	*69*
15:34:15	569	36106	47	99	47	95	*72*	43	74	82	66	*66*
15:34:30	569	36140	45	92	50	79	*67*	47	72	92	54	*66*
15:34:45	569	36092	39	90	45	81	*64*	53	73	97	68	*73*
15:35:00	569	36119	47	84	47	81	*65*	50	72	76	52	*63*
15:35:15	569	36092	41	86	47	90	*66*	50	74	67	59	*63*
15:35:30	569	36100	44	81	51	81	*64*	47	67	118	58	*73*
15:35:45	569	36104	45	88	36	84	*63*	45	78	74	69	*67*
15:36:00	569	36129	42	82	37	69	*58*	52	73	73	54	*63*
15:36:15	569	36096	40	80	43	80	*61*	48	68	70	56	*61*
15:36:30	569	36083	49	66	38	78	*58*	42	62	74	61	*60*
15:36:45	569	36095	35	74	40	68	*54*	52	76	64	54	*62*
15:37:00	568	36061	41	66	36	76	*55*	48	65	84	69	*67*
15:37:15	569	36165	38	70	44	65	*54*	51	65	59	47	*56*
15:37:30	569	36078	38	74	40	60	*53*	40	73	72	53	*60*
15:37:45	569	36110	41	66	38	64	*52*	39	66	79	54	*60*
15:38:00	568	36049	42	66	34	60	*51*	47	62	67	49	*56*
15:38:15	568	36080	43	63	40	67	*53*	48	59	77	53	*59*
15:38:30	568	36115	41	67	39	59	*52*	48	59	75	51	*58*
15:38:45	568	36077	45	65	36	65	*53*	45	67	62	59	*58*
15:39:00	569	36106	35	70	37	69	*53*	45	62	63	69	*60*
15:39:15	569	36048	54	54	36	74	*55*	65	65	75	55	*65*
15:39:30	569	36058	39	64	40	67	*53*	49	62	60	72	*61*
15:39:45	568	36079	62	49	39	72	*56*	69	62	78	64	*68*
15:40:00	568	36083	47	60	52	66	*56*	60	58	64	63	*61*
15:40:15	568	36116	44	60	41	68	*53*	59	59	52	72	*61*
15:40:30	568	36083	47	72	53	62	*59*	53	56	67	56	*58*
15:40:45	569	36086	45	65	45	66	*55*	57	64	73	59	*63*
15:41:00	568	36067	45	62	45	67	*55*	58	58	58	60	*59*
15:41:15	569	36089	50	56	50	72	*57*	60	60	62	74	*64*
15:41:30	568	36045	52	50	47	61	*53*	69	58	50	71	*62*
15:41:45	568	36075	48	64	47	67	*57*	58	58	74	51	*60*
15:42:00	568	36084	48	63	45	75	*58*	58	64	53	62	*59*
15:42:15	568	36150	49	69	45	78	*60*	48	60	65	73	*62*
15:42:30	568	36065	49	60	46	75	*58*	56	57	59	63	*59*
15:42:45	568	36069	51	62	51	70	*59*	61	62	67	72	*66*
15:43:00	568	36077	49	58	50	76	*58*	62	62	55	67	*62*

15:43:15	568	36052	52	61	51	69	*58*	56	67	74	61	*65*
15:43:30	568	36111	50	65	53	66	*59*	58	61	72	64	*64*
15:43:45	568	36091	52	65	52	71	*60*	55	66	50	65	*59*
15:44:00	568	36035	54	65	53	79	*63*	60	64	61	65	*63*
15:44:15	568	36099	52	68	56	78	*64*	66	58	62	65	*63*
15:44:30	568	36109	51	66	50	71	*60*	60	65	66	64	*64*
15:44:45	568	36089	45	73	60	68	*62*	53	55	56	66	*58*
15:45:00	568	36031	50	70	43	77	*60*	54	70	63	56	*61*
15:45:15	568	36119	54	60	56	83	*63*	63	64	51	70	*62*
15:45:30	568	36083	54	59	55	69	*59*	64	61	70	62	*64*
15:45:45	568	36089	48	70	60	80	*65*	55	62	56	70	*61*
15:46:00	568	36054	58	62	50	87	*64*	56	62	46	67	*58*
15:46:15	568	36088	53	62	55	83	*63*	56	65	51	66	*60*
15:46:30	568	36053	53	63	54	78	*62*	61	69	66	59	*64*
15:46:45	567	36088	55	65	55	75	*63*	55	56	67	60	*60*
15:47:00	568	36014	48	74	62	80	*66*	51	55	71	59	*59*
15:47:15	567	36052	63	56	54	75	*62*	61	61	66	66	*64*
15:47:30	568	36096	56	60	65	68	*62*	60	58	52	70	*60*
15:47:45	567	36044	58	68	58	77	*65*	57	61	59	66	*61*
15:48:00	567	36073	51	69	64	71	*64*	56	55	70	62	*61*
15:48:15	568	36120	56	64	59	77	*64*	60	63	66	60	*62*
15:48:30	568	36064	59	61	59	79	*65*	56	60	63	66	*61*
15:48:45	567	36052	59	59	59	81	*65*	62	59	66	70	*64*
15:49:00	567	36045	56	62	56	92	*67*	60	60	56	81	*64*

Yarmouth Research and Technology, LLC

Leakage Summary for Burn and Cool Down Periods

All pressure transducers and thermocouples are in calibration per YRT's QA program.
External leakage was collected electronically.

Test Duration:	60	minutes
Tank Water Loss:	-32	
System Relief Water Collected:	0	mls
Calculated Water Loss:	-32	
Average Leak Rate:	0.0	ml/min
Average Seal Circumference	23.9	inches
Allowable Leak Rate:	23.9	ml/min

Was the Leakage Below the Allowable?	**Yes**

Summary of Test Parameters During Burn and Cool Down Periods

Amount of Time of Average Cal. Block > 1200 deg.:	21.3	minutes
Minimum Allowable Time at Temperature:	15	minutes
Average Cal. Block Temperature During Burn:	1163	deg. F
Maximum Average Cal. Block Temperature During Burn:	1369	deg. F
Minimum Average Cal. Block Temperature During Burn:	56	deg. F
Average Flame Temperature During Burn:	1503	deg. F
Maximum Average Flame Temperature During Burn:	1576	deg. F
Minimum Average Flame Temperature During Burn:	73	deg. F

Notes

Were Test Conditions Within Compliance?	**Yes**

Yarmouth Research and Technology, LLC

Depressurization - Repressurization Test Information

Customer: Jeil E&S Co., Ltd. **Date:** 3/25/2011

Product Code: 6 inch Class 300 Spiral Wound Gasket

Project Number: PN211073

System pressure was lowered to 0 and then repressurized.

Operational Test Raw Data

Time	Pressure (psig)	Average Block Temp-F
15:54:10	567	66
15:54:25	566	66
15:54:40	566	66
15:54:55	566	65
15:55:10	566	66
15:55:25	566	66
15:55:40	566	66
15:55:55	566	66
15:56:10	566	66
15:56:25	566	66
15:56:40	566	66
15:56:55	566	66
15:57:10	566	65
15:57:25	566	66
15:57:40	566	65
15:57:55	566	65
15:58:10	566	66
15:58:25	566	66
15:58:40	566	66
15:58:55	566	66
15:59:10	566	66

Leakage was collected manually.

Total External Leakage Collected Over 5 Minute Duration:	0	mls
Average Leak Rate Over 5 Minute Duration:	0.0	ml/min
Allowable Leak Rate:	23.9	ml/min

Was the Leakage Below the Allowable?	**Yes**

Fire Test Report

API Standard 6FB, Third Edition

Performed for

JEIL E&S Co.,Ltd.

www.jeilens.co.kr

SWGK Gasket
JIC 3850-SE-316(SF)

6 inch Class 300

Project Number: 211073

March 26, 2011

Performed by

YARMOUTH RESEARCH AND TECHNOLOGY, LLC

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info@yarmouthresearch.com
www.yarmouthresearch.com

Yarmouth Research and Technology, LLC

API 6FB FIRE TEST REPORT

Customer:	Jeil E&S Co., Ltd.		**Date:**	3/26/2011
Product Code:	6 inch Class 300 Kammprofile Gasket			
	JIC 3850-SE-316(SF)			
Project Number:	PN211073			
Specification:	API 6FB, Third Edition, Nov. 1998			
	Non-Bending, On-shore or Open-offshore Test			
Seal Area OD:	8.30	**Seal Area ID:**	6.90	inches
Mean Seal Diameter:	7.60	inches		
Mean Circumference:	23.9	inches		
Allowable Leakage:	23.9	ml/min		
Nominal Test Pressure:	555	psig		
YRT Technician:	Matthew J. Wasielewski, P.E.			

Version of YRT's FIRE-Control 6FB Software: A

Equipment Confirmed to be in Calibration to NIST Standards: Yes

Burn and Cool Down Test

Burn Start Time:	11:04:00	
Burn / Cooldown Duration:	60	minutes
Average Pressure During Burn/Cooldown:	552	psig
Leak Rate During Burn/Cool Down:	0.0	ml/min
Allowable External Leak Rate:	23.9	ml/min
Amount of Time of Avg. Cal. Block > 1200 deg.:	22.0	minutes
Were Test Conditions Within Compliance?	Yes	
Was the Leakage Below the Allowable?	Yes	

Depressurization - Repressurization Test

Average Pressure During Test:	553	psig
Gasket Leak Rate:	0	ml/min
Allowable External Leak Rate:	23.9	ml/min
Was the Leakage Below the Allowable?	**Yes**	

Does the Gasket Pass or Fail API 6FB?	**PASS**

Witnesses

Note:

Yarmouth Research and Technology, LLC

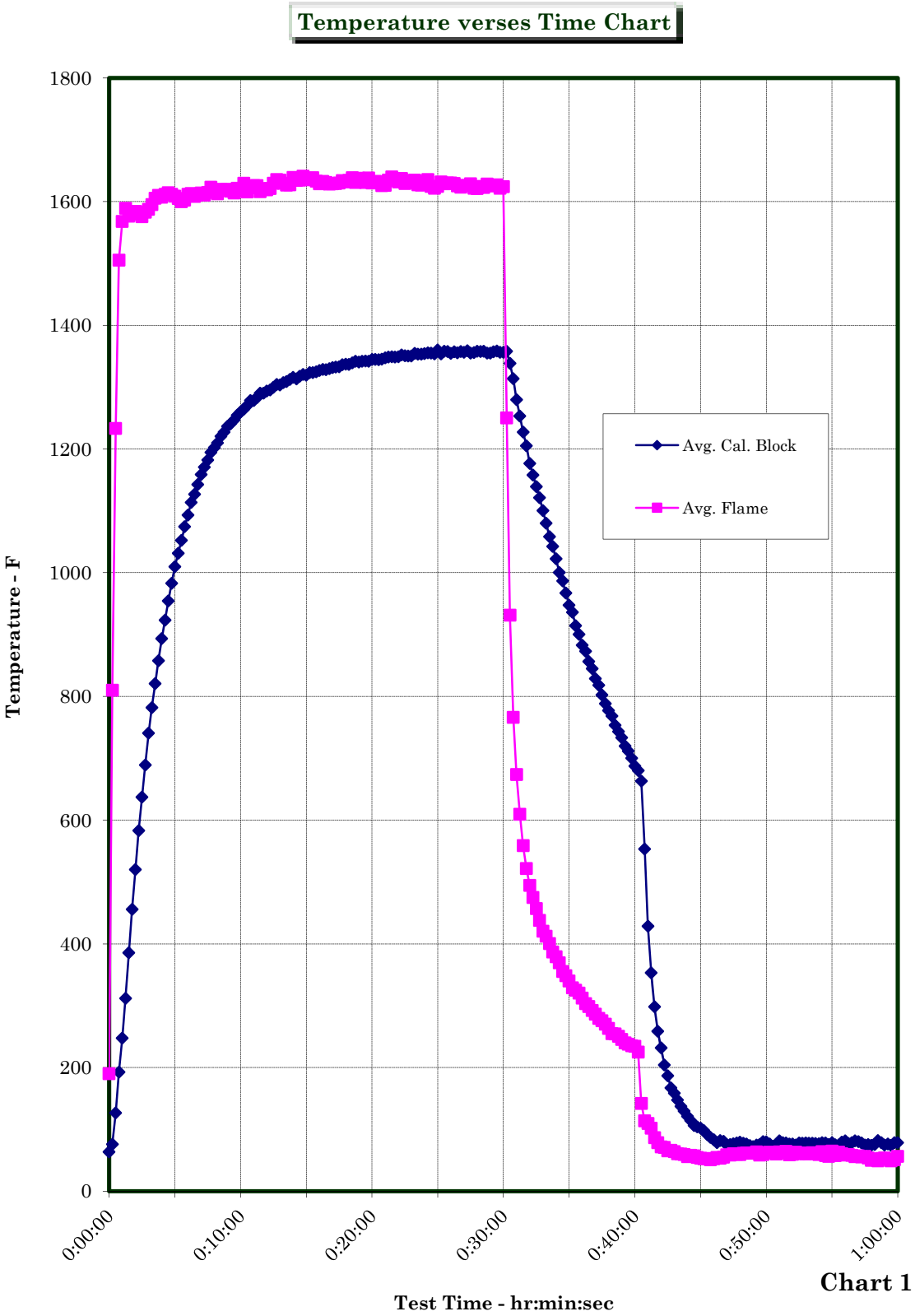


Chart 1

Yarmouth Research and Technology, LLC

Pressure verses Time Chart

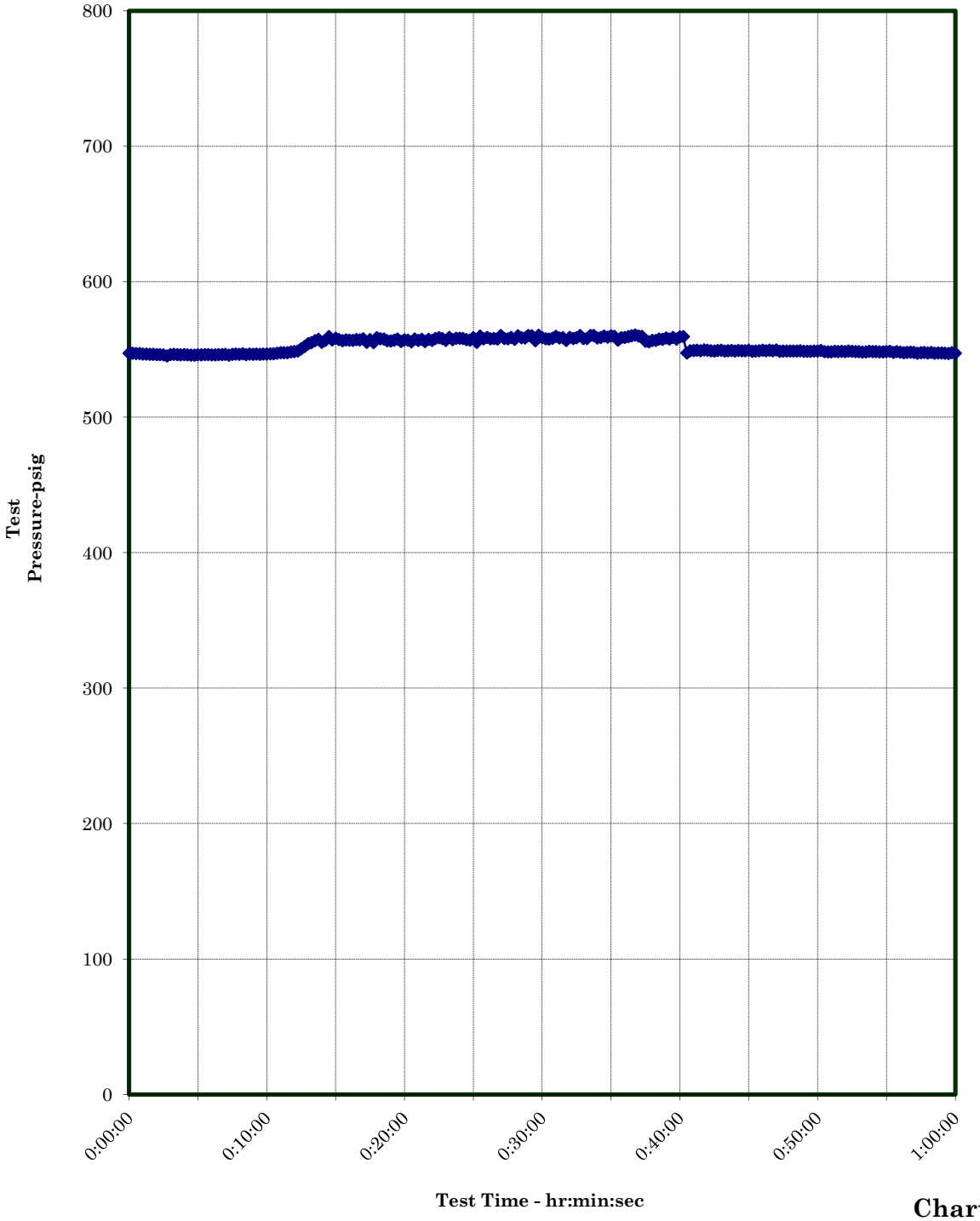


Chart 2

Gasket Before Test

Gasket Fire Test

Gasket After Test

Yarmouth Research and Technology, LLC

Fire Test Information

Customer: Jeil E&S Co., Ltd. **Date:** 3/26/2011

Product Code: 6 inch Class 300 Kammprofile Gasket

Project Number: PN211073

Fire Test Raw Data

Time	Pressure (psig)	Water Volume (mls)	Cal. 1 Block Temp - F	Cal. 2 Block Temp - F	Cal. 3 Block Temp - F	Cal. 4 Block Temp - F	*Average Block Temp - F*	Flame 1 Temp - F	Flame 2 Temp - F	Flame 3 Temp - F	Flame 4 Temp - F	*Average Flame Temp - F*
11:04:00	547	32755	73	55	61	66	*64*	150	146	313	151	*190*
11:04:15	547	32710	86	60	73	85	*76*	979	842	976	443	*810*
11:04:30	547	32739	143	87	113	163	*127*	1378	1214	1411	930	*1233*
11:04:45	547	32827	210	157	183	220	*193*	1483	1411	1583	1544	*1505*
11:05:00	547	32724	244	210	257	279	*248*	1511	1478	1623	1660	*1568*
11:05:15	547	32729	323	234	326	365	*312*	1544	1508	1635	1670	*1589*
11:05:30	546	32631	399	297	395	451	*386*	1521	1505	1610	1670	*1577*
11:05:45	546	32833	467	368	457	531	*456*	1511	1509	1622	1676	*1580*
11:06:00	546	32662	532	429	518	602	*520*	1525	1500	1634	1677	*1584*
11:06:15	546	32678	591	501	577	663	*583*	1539	1517	1606	1671	*1583*
11:06:30	546	32870	647	553	630	719	*637*	1544	1505	1586	1668	*1576*
11:06:45	545	32934	700	606	681	769	*689*	1536	1512	1598	1686	*1583*
11:07:00	546	32553	752	667	728	815	*741*	1538	1510	1610	1693	*1588*
11:07:15	546	32659	798	700	773	857	*782*	1517	1519	1638	1706	*1595*
11:07:30	546	32628	841	733	814	894	*821*	1546	1536	1643	1696	*1605*
11:07:45	546	32935	882	766	854	929	*858*	1545	1562	1674	1659	*1610*
11:08:00	546	32701	920	802	890	962	*894*	1543	1566	1682	1637	*1607*
11:08:15	546	32610	956	820	925	992	*923*	1565	1565	1694	1624	*1612*
11:08:30	546	32625	988	855	956	1019	*955*	1588	1555	1690	1625	*1615*
11:08:45	546	32907	1017	886	985	1043	*983*	1585	1556	1682	1625	*1612*
11:09:00	546	32798	1046	914	1012	1067	*1010*	1590	1534	1672	1639	*1609*
11:09:15	546	32737	1069	932	1036	1089	*1032*	1582	1548	1660	1630	*1605*
11:09:30	546	32879	1096	944	1059	1110	*1052*	1571	1569	1662	1597	*1600*
11:09:45	546	32780	1117	971	1081	1129	*1075*	1572	1553	1675	1610	*1603*
11:10:00	546	32835	1139	986	1101	1146	*1093*	1575	1557	1690	1626	*1612*
11:10:15	546	32816	1158	1015	1120	1162	*1114*	1610	1552	1684	1606	*1613*
11:10:30	546	32810	1174	1021	1136	1177	*1127*	1620	1543	1664	1607	*1609*

11:10:45	546	32824	1192	1037	1152	1190	*1143*	1631	1544	1659	1611	*1611*
11:11:00	546	32821	1205	1060	1166	1204	*1159*	1644	1554	1653	1605	*1614*
11:11:15	546	32796	1218	1069	1180	1216	*1171*	1647	1548	1646	1602	*1611*
11:11:30	546	32891	1230	1079	1192	1227	*1182*	1655	1547	1653	1604	*1615*
11:11:45	547	32648	1242	1098	1203	1236	*1195*	1668	1557	1655	1613	*1623*
11:12:00	546	32677	1250	1099	1214	1246	*1202*	1660	1551	1662	1597	*1618*
11:12:15	547	32917	1259	1102	1224	1254	*1210*	1656	1555	1660	1580	*1613*
11:12:30	546	32841	1270	1117	1233	1262	*1221*	1664	1560	1672	1584	*1620*
11:12:45	547	32864	1275	1124	1241	1270	*1228*	1660	1560	1667	1584	*1618*
11:13:00	546	32865	1288	1132	1249	1277	*1237*	1663	1560	1668	1589	*1620*
11:13:15	547	32861	1295	1126	1257	1286	*1241*	1644	1565	1670	1589	*1617*
11:13:30	546	32869	1302	1131	1264	1291	*1247*	1649	1554	1676	1577	*1614*
11:13:45	547	32835	1311	1137	1271	1300	*1255*	1660	1563	1678	1586	*1622*
11:14:00	547	32875	1316	1142	1276	1306	*1260*	1646	1568	1684	1570	*1617*
11:14:15	547	32853	1324	1144	1282	1307	*1264*	1649	1588	1696	1586	*1630*
11:14:30	547	32837	1328	1151	1288	1314	*1270*	1639	1569	1694	1561	*1616*
11:14:45	547	32846	1333	1166	1294	1321	*1279*	1650	1573	1696	1571	*1623*
11:15:00	548	32934	1338	1158	1297	1321	*1279*	1647	1577	1706	1574	*1626*
11:15:15	548	32930	1343	1161	1303	1325	*1283*	1653	1583	1699	1568	*1626*
11:15:30	548	32964	1348	1179	1307	1328	*1291*	1642	1562	1700	1560	*1616*
11:15:45	548	32947	1351	1167	1311	1332	*1290*	1654	1584	1684	1563	*1621*
11:16:00	548	33022	1351	1172	1315	1337	*1294*	1653	1585	1689	1549	*1619*
11:16:15	549	33023	1354	1171	1318	1339	*1296*	1658	1589	1689	1549	*1621*
11:16:30	550	33122	1357	1177	1323	1342	*1300*	1668	1606	1684	1561	*1630*
11:16:45	552	33224	1360	1190	1326	1342	*1305*	1661	1617	1695	1570	*1636*
11:17:00	554	33352	1364	1176	1327	1348	*1304*	1671	1603	1702	1564	*1635*
11:17:15	555	33451	1365	1186	1329	1350	*1308*	1670	1595	1693	1560	*1630*
11:17:30	556	33754	1367	1181	1334	1355	*1309*	1658	1595	1692	1562	*1627*
11:17:45	557	33185	1369	1193	1336	1352	*1313*	1669	1603	1681	1555	*1627*
11:18:00	555	33002	1371	1196	1338	1358	*1316*	1676	1620	1690	1570	*1639*
11:18:15	557	33679	1372	1185	1338	1359	*1314*	1677	1599	1700	1562	*1635*
11:18:30	560	34783	1375	1192	1343	1361	*1318*	1657	1612	1702	1568	*1635*
11:18:45	557	32684	1376	1201	1342	1363	*1321*	1684	1611	1701	1569	*1641*
11:19:00	558	33748	1379	1194	1343	1361	*1319*	1680	1622	1690	1549	*1635*
11:19:15	557	33750	1381	1202	1346	1365	*1324*	1675	1631	1695	1551	*1638*
11:19:30	556	33600	1382	1198	1348	1366	*1324*	1688	1626	1689	1552	*1639*
11:19:45	557	33130	1381	1204	1347	1368	*1325*	1682	1628	1683	1540	*1633*
11:20:00	557	32580	1382	1203	1353	1370	*1327*	1679	1608	1697	1531	*1629*

11:20:15	557	33273	1384	1208	1350	1373	*1329*	1674	1617	1692	1548	*1633*
11:20:30	557	33769	1384	1210	1346	1373	*1328*	1665	1622	1687	1550	*1631*
11:20:45	557	33755	1385	1207	1350	1377	*1330*	1666	1628	1681	1538	*1628*
11:21:00	558	34286	1385	1214	1350	1378	*1332*	1683	1625	1684	1523	*1629*
11:21:15	555	34082	1389	1210	1352	1379	*1333*	1680	1633	1679	1525	*1629*
11:21:30	557	34034	1390	1211	1355	1375	*1333*	1683	1635	1695	1508	*1630*
11:21:45	555	33581	1391	1220	1356	1379	*1337*	1680	1632	1695	1528	*1634*
11:22:00	559	34414	1392	1222	1357	1378	*1337*	1685	1625	1694	1523	*1632*
11:22:15	558	34416	1393	1220	1358	1376	*1337*	1685	1623	1702	1527	*1634*
11:22:30	558	33741	1393	1224	1359	1381	*1339*	1694	1642	1701	1518	*1639*
11:22:45	556	33830	1392	1231	1362	1383	*1342*	1681	1642	1692	1509	*1631*
11:23:00	556	33023	1393	1225	1360	1384	*1341*	1687	1651	1697	1517	*1638*
11:23:15	557	33369	1393	1226	1361	1387	*1342*	1681	1637	1700	1517	*1634*
11:23:30	558	33825	1394	1224	1364	1387	*1342*	1683	1635	1695	1511	*1631*
11:23:45	556	32743	1395	1224	1365	1384	*1342*	1693	1647	1698	1515	*1638*
11:24:00	557	33428	1396	1232	1365	1386	*1345*	1686	1640	1698	1496	*1630*
11:24:15	557	33508	1398	1226	1367	1389	*1345*	1687	1641	1686	1516	*1633*
11:24:30	556	33379	1397	1227	1367	1386	*1344*	1675	1645	1685	1524	*1632*
11:24:45	558	33045	1399	1221	1369	1392	*1345*	1681	1621	1695	1507	*1626*
11:25:00	557	33012	1398	1230	1371	1391	*1348*	1680	1631	1699	1496	*1627*
11:25:15	557	33771	1400	1235	1370	1389	*1349*	1680	1647	1694	1518	*1635*
11:25:30	556	34270	1397	1228	1378	1394	*1349*	1699	1663	1688	1509	*1640*
11:25:45	557	34408	1399	1234	1374	1388	*1349*	1694	1653	1677	1513	*1634*
11:26:00	557	33426	1396	1239	1375	1386	*1349*	1680	1654	1688	1506	*1632*
11:26:15	558	34856	1394	1242	1378	1395	*1352*	1683	1652	1690	1525	*1638*
11:26:30	559	33636	1394	1239	1376	1394	*1351*	1683	1654	1673	1507	*1629*
11:26:45	558	33781	1397	1238	1373	1394	*1351*	1687	1661	1676	1507	*1633*
11:27:00	557	33625	1396	1236	1376	1394	*1351*	1695	1661	1679	1501	*1634*
11:27:15	559	33026	1398	1247	1381	1392	*1355*	1697	1648	1684	1510	*1635*
11:27:30	557	33602	1398	1245	1378	1392	*1353*	1678	1654	1664	1513	*1627*
11:27:45	558	33783	1397	1241	1381	1394	*1353*	1671	1655	1667	1514	*1627*
11:28:00	558	34953	1396	1245	1383	1393	*1354*	1689	1649	1684	1509	*1633*
11:28:15	558	34578	1398	1246	1383	1395	*1356*	1686	1656	1697	1504	*1636*
11:28:30	557	33376	1400	1245	1381	1394	*1355*	1687	1661	1675	1475	*1625*
11:28:45	557	34016	1398	1239	1382	1397	*1354*	1687	1659	1671	1470	*1622*
11:29:00	559	33643	1401	1256	1387	1396	*1360*	1696	1650	1667	1485	*1625*
11:29:15	555	33261	1397	1240	1382	1397	*1354*	1689	1672	1671	1495	*1632*
11:29:30	560	34054	1398	1250	1387	1397	*1358*	1684	1665	1673	1493	*1629*

11:29:45	558	33458	1396	1248	1389	1397	*1358*	1692	1665	1657	1507	*1630*
11:30:00	559	35049	1395	1247	1383	1393	*1355*	1696	1673	1659	1492	*1630*
11:30:15	558	33318	1396	1249	1387	1397	*1357*	1691	1665	1667	1494	*1629*
11:30:30	558	33785	1395	1245	1385	1397	*1356*	1677	1668	1664	1493	*1626*
11:30:45	558	33434	1397	1245	1387	1401	*1358*	1687	1673	1648	1485	*1623*
11:31:00	560	33532	1394	1239	1392	1400	*1356*	1697	1677	1650	1482	*1627*
11:31:15	558	38410	1396	1249	1390	1400	*1359*	1676	1672	1658	1498	*1626*
11:31:30	558	34219	1394	1240	1386	1401	*1355*	1688	1674	1659	1494	*1629*
11:31:45	559	34043	1393	1241	1389	1400	*1356*	1695	1672	1636	1483	*1622*
11:32:00	558	33662	1395	1247	1389	1402	*1358*	1685	1665	1645	1489	*1621*
11:32:15	560	34770	1395	1245	1389	1402	*1358*	1690	1676	1650	1483	*1625*
11:32:30	559	34058	1394	1252	1389	1398	*1358*	1686	1670	1653	1483	*1623*
11:32:45	559	38423	1392	1241	1388	1400	*1355*	1708	1680	1646	1480	*1629*
11:33:00	560	35125	1393	1240	1389	1398	*1355*	1683	1675	1653	1490	*1625*
11:33:15	560	33849	1391	1245	1391	1402	*1357*	1683	1683	1650	1487	*1626*
11:33:30	556	32468	1390	1253	1390	1401	*1359*	1678	1682	1647	1501	*1627*
11:33:45	560	34871	1390	1246	1390	1400	*1357*	1684	1671	1645	1486	*1622*
11:34:00	559	33636	1391	1241	1391	1402	*1356*	1692	1670	1658	1476	*1624*
11:34:15	558	33664	1391	1249	1391	1401	*1358*	1334	1294	1263	1111	*1251*
11:34:30	558	33220	1373	1222	1377	1381	*1338*	1002	963	927	833	*931*
11:34:45	558	33666	1344	1212	1349	1350	*1314*	805	802	763	695	*766*
11:35:00	560	33977	1309	1171	1323	1316	*1280*	697	717	670	611	*674*
11:35:15	558	33925	1281	1153	1296	1284	*1254*	623	658	601	556	*610*
11:35:30	559	33562	1253	1127	1272	1257	*1227*	560	605	551	519	*559*
11:35:45	557	34002	1235	1110	1249	1227	*1205*	513	574	510	490	*522*
11:36:00	559	32728	1196	1080	1230	1200	*1177*	470	548	490	470	*495*
11:36:15	558	32564	1173	1065	1218	1175	*1158*	448	532	466	454	*475*
11:36:30	559	34766	1151	1044	1208	1154	*1139*	428	510	450	440	*457*
11:36:45	560	34835	1135	1023	1192	1135	*1121*	405	490	429	427	*438*
11:37:00	558	32826	1115	1005	1165	1117	*1101*	379	473	415	415	*421*
11:37:15	558	34499	1093	986	1141	1100	*1080*	373	467	404	405	*412*
11:37:30	560	34655	1072	965	1115	1081	*1058*	362	446	399	395	*401*
11:37:45	560	34042	1063	949	1096	1062	*1043*	352	434	375	387	*387*
11:38:00	558	33639	1030	941	1075	1044	*1023*	339	441	357	380	*379*
11:38:15	559	34467	1006	917	1053	1025	*1000*	326	422	359	370	*369*
11:38:30	560	34882	1003	902	1035	1007	*987*	315	404	339	363	*355*
11:38:45	559	33836	969	897	1013	990	*967*	299	398	341	356	*349*
11:39:00	560	33658	953	872	994	972	*948*	288	387	335	350	*340*

11:39:15	560	33782	945	870	974	955	*936*	285	371	317	343	*329*
11:39:30	557	33349	917	845	957	939	*915*	279	367	319	336	*325*
11:39:45	559	34078	903	835	940	923	*900*	280	361	310	331	*321*
11:40:00	559	34463	883	822	920	907	*883*	268	353	301	328	*313*
11:40:15	559	34609	873	823	905	891	*873*	256	343	291	323	*303*
11:40:30	560	33475	858	802	889	877	*857*	256	340	281	318	*299*
11:40:45	561	33682	846	796	876	862	*845*	249	332	275	313	*292*
11:41:00	560	33580	828	780	859	848	*829*	239	324	276	307	*287*
11:41:15	560	33822	816	777	846	834	*818*	233	318	266	301	*280*
11:41:30	556	33448	800	756	833	821	*803*	226	316	263	297	*276*
11:41:45	556	33418	781	747	817	808	*788*	225	304	259	293	*270*
11:42:00	557	33498	774	737	803	795	*777*	218	299	248	288	*263*
11:42:15	557	33524	762	737	791	783	*768*	205	285	245	284	*255*
11:42:30	558	33596	748	715	780	771	*754*	208	286	241	282	*254*
11:42:45	557	33836	738	710	765	759	*743*	208	281	235	278	*251*
11:43:00	559	33450	726	702	756	749	*733*	198	278	231	274	*245*
11:43:15	558	33350	713	687	743	736	*720*	195	266	228	270	*240*
11:43:30	559	34196	703	684	733	727	*712*	195	269	223	265	*238*
11:43:45	558	33245	692	673	720	715	*700*	189	269	221	262	*235*
11:44:00	559	33669	680	653	712	705	*688*	194	268	216	259	*234*
11:44:15	559	33791	674	651	700	695	*680*	185	248	211	256	*225*
11:44:30	547	33004	657	641	674	681	*663*	138	126	171	133	*142*
11:44:45	549	33007	570	535	483	626	*554*	96	88	159	112	*114*
11:45:00	549	32941	474	403	297	541	*429*	78	63	204	94	*110*
11:45:15	549	32942	390	330	197	495	*353*	71	70	174	93	*102*
11:45:30	549	32945	321	265	152	455	*298*	64	57	143	82	*87*
11:45:45	550	32913	278	208	122	426	*259*	66	63	111	74	*79*
11:46:00	549	32923	236	180	110	402	*232*	55	55	106	71	*72*
11:46:15	549	32888	196	143	99	379	*204*	61	60	101	62	*71*
11:46:30	549	32881	182	123	94	348	*187*	59	56	87	60	*66*
11:46:45	549	32876	149	102	85	332	*167*	57	54	91	62	*66*
11:47:00	549	32849	141	97	88	309	*159*	59	54	84	60	*64*
11:47:15	549	32873	133	86	83	288	*148*	55	55	79	54	*61*
11:47:30	549	32867	124	77	81	268	*138*	55	50	75	61	*60*
11:47:45	549	32820	115	68	80	255	*130*	59	55	67	56	*59*
11:48:00	549	32868	107	67	73	237	*121*	53	46	66	59	*56*
11:48:15	549	32860	94	65	74	225	*115*	48	53	72	60	*58*
11:48:30	549	32845	86	55	77	207	*106*	50	47	76	56	*57*

11:48:45	549	32865	84	58	72	202	*104*	48	48	68	55	*55*
11:49:00	549	32825	89	55	69	194	*102*	50	47	63	54	*54*
11:49:15	549	32830	85	56	71	181	*98*	46	41	67	57	*53*
11:49:30	549	32799	80	47	68	172	*92*	54	48	58	52	*53*
11:49:45	549	32831	76	45	69	159	*87*	47	47	58	51	*51*
11:50:00	549	32779	69	45	71	148	*83*	48	47	62	54	*53*
11:50:15	549	32794	68	41	66	139	*79*	56	50	59	54	*55*
11:50:30	549	32828	71	49	67	140	*82*	51	50	58	55	*54*
11:50:45	549	32817	71	51	67	133	*81*	53	54	59	55	*55*
11:51:00	550	32808	63	44	63	131	*75*	58	57	62	58	*59*
11:51:15	549	32792	61	46	68	128	*76*	56	58	58	62	*59*
11:51:30	549	32840	65	43	65	135	*77*	59	60	61	62	*61*
11:51:45	549	32809	66	46	67	133	*78*	60	59	59	62	*60*
11:52:00	549	32793	68	53	66	131	*80*	57	55	60	65	*59*
11:52:15	549	32796	70	44	68	129	*78*	64	62	59	61	*62*
11:52:30	549	32821	66	53	64	123	*77*	59	62	61	65	*62*
11:52:45	549	32820	63	43	65	124	*74*	63	62	61	60	*62*
11:53:00	549	32803	56	43	65	125	*72*	65	58	62	62	*62*
11:53:15	549	32743	55	43	68	133	*75*	68	61	63	63	*64*
11:53:30	549	32832	65	48	67	122	*76*	57	49	65	63	*59*
11:53:45	549	32828	73	55	68	125	*80*	56	61	60	61	*60*
11:54:00	549	32825	66	59	68	127	*80*	65	66	56	62	*62*
11:54:15	549	32790	62	55	67	122	*77*	69	62	61	61	*63*
11:54:30	548	32830	61	45	66	119	*73*	60	62	65	62	*62*
11:54:45	548	32802	61	52	67	123	*76*	61	56	63	61	*60*
11:55:00	548	32787	72	60	69	125	*82*	62	64	67	62	*64*
11:55:15	548	32789	71	50	67	126	*79*	59	59	68	62	*62*
11:55:30	548	32833	77	51	69	115	*78*	61	64	71	62	*65*
11:55:45	549	32808	59	55	71	121	*77*	56	60	59	61	*59*
11:56:00	548	32816	65	56	69	115	*76*	52	61	65	62	*60*
11:56:15	549	32780	64	47	71	116	*75*	57	63	70	62	*63*
11:56:30	549	32812	63	57	69	123	*78*	51	65	65	61	*61*
11:56:45	548	32786	67	60	72	112	*78*	60	62	65	61	*62*
11:57:00	548	32801	64	55	66	127	*78*	56	61	65	61	*61*
11:57:15	548	32820	65	58	71	117	*78*	60	59	63	61	*61*
11:57:30	548	32813	74	48	66	122	*78*	61	62	65	61	*62*
11:57:45	548	32792	70	53	71	115	*77*	58	60	65	62	*61*
11:58:00	548	32812	66	56	67	119	*77*	51	64	60	62	*59*

11:58:15	548	32793	70	62	69	114	*79*	69	64	62	61	*64*
11:58:30	548	32837	60	63	72	118	*78*	57	58	55	60	*58*
11:58:45	548	32782	64	54	67	118	*76*	59	54	52	61	*57*
11:59:00	548	32805	71	63	68	113	*79*	62	62	74	61	*65*
11:59:15	548	32782	66	54	69	111	*75*	49	58	62	61	*58*
11:59:30	548	32782	63	53	70	113	*75*	62	65	64	61	*63*
11:59:45	548	32800	72	62	69	115	*80*	65	58	59	61	*61*
12:00:00	548	32789	67	69	74	116	*82*	54	58	61	61	*59*
12:00:15	548	32811	74	55	68	112	*77*	55	60	62	60	*59*
12:00:30	548	32797	70	62	69	114	*79*	62	60	50	60	*58*
12:00:45	548	32794	77	62	72	115	*82*	64	50	52	58	*56*
12:01:00	548	32811	71	63	70	117	*80*	59	53	60	57	*57*
12:01:15	547	32789	71	60	68	114	*78*	56	49	62	55	*56*
12:01:30	548	32767	54	64	67	113	*75*	51	52	68	55	*57*
12:01:45	548	32818	68	55	70	110	*76*	57	43	61	54	*54*
12:02:00	547	32812	62	55	66	114	*74*	52	46	49	53	*50*
12:02:15	548	32774	59	55	70	119	*76*	45	46	64	53	*52*
12:02:30	547	32781	74	72	70	112	*82*	45	47	53	52	*49*
12:02:45	547	32773	64	66	67	117	*79*	58	47	55	52	*53*
12:03:00	547	32779	65	60	67	106	*75*	55	48	60	52	*54*
12:03:15	547	32772	65	62	69	110	*77*	53	46	56	52	*52*
12:03:30	547	32778	62	58	69	108	*74*	46	43	55	53	*49*
12:03:45	548	32735	69	65	69	111	*79*	47	47	55	54	*51*
12:04:00	547	32775	64	65	69	116	*79*	59	48	63	55	*56*

Yarmouth Research and Technology, LLC

Leakage Summary for Burn and Cool Down Periods

All pressure transducers and thermocouples are in calibration per YRT's QA program.
External leakage was collected electronically.

Test Duration:	60	minutes
Tank Water Loss:	-20	
System Relief Water Collected:	0	mls
Calculated Water Loss:	-20	
Average Leak Rate:	0.0	ml/min
Average Seal Circumference	23.9	inches
Allowable Leak Rate:	23.9	ml/min

Was the Leakage Below the Allowable?	**Yes**

Summary of Test Parameters During Burn and Cool Down Periods

Amount of Time of Average Cal. Block > 1200 deg.:	22.0	minutes
Minimum Allowable Time at Temperature:	15	minutes
Average Cal. Block Temperature During Burn:	1175	deg. F
Maximum Average Cal. Block Temperature During Burn:	1360	deg. F
Minimum Average Cal. Block Temperature During Burn:	64	deg. F
Average Flame Temperature During Burn:	1599	deg. F
Maximum Average Flame Temperature During Burn:	1641	deg. F
Minimum Average Flame Temperature During Burn:	190	deg. F

Notes

Were Test Conditions Within Compliance?	**Yes**

Yarmouth Research and Technology, LLC

Depressurization - Repressurization Test Information

Customer: Jeil E&S Co., Ltd. **Date:** 3/26/2011

Product Code: 6 inch Class 300 Kammprofile Gasket

Project Number: PN211073

System pressure was lowered to 0 and then repressurized.

Operational Test Raw Data

Time	Pressure (psig)	Average Block Temp-F
12:04:53	555	66
12:05:08	555	66
12:05:23	554	66
12:05:38	554	66
12:05:53	554	66
12:06:08	553	66
12:06:23	553	66
12:06:38	553	66
12:06:53	553	65
12:07:08	553	66
12:07:23	553	66
12:07:38	553	65
12:07:53	553	65
12:08:08	552	66
12:08:23	552	66
12:08:38	552	66
12:08:53	552	66
12:09:08	552	66
12:09:23	552	66
12:09:38	552	66
12:09:53	552	65

Leakage was collected manually.

Total External Leakage Collected Over 5 Minute Duration:	0	mls
Average Leak Rate Over 5 Minute Duration:	0.0	ml/min
Allowable Leak Rate:	23.9	ml/min

Was the Leakage Below the Allowable?	**Yes**

Test report

Applicant	: JEIL E&S CO., LTD.
Address	: 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
Sample Name	: Refer to Table 1, (2 page).
Sample Received	: January 17, 2017
Test Performing Date	: January 17, 2017~ January 24, 2017
Test Laboratory	: Korea Polymer Testing & Research Institute. LTD. (KOPTRI)
Test Item	: Dielectric breakdown voltage, Dielectric breakdown strength, Surface resistance, Volume resistance, Dielectric constant, Tangent delta
TEST Method(s)	: Refer to Table 2-1 ~ 2-2
TEST Result(s)	: Refer to Table 2-1 ~ 2-2

Tested by,

Jihye Lee/ Lab. Technical Manager

Authorized by,

Kyoungho Min /Lab. General Manager

Tested by

Korea Polymer Testing & Research Institute (KOPTRI), Ltd.

(ISO 17025 Certified Laboratory)

Lab. Tel: +82-1588-1574 Fax: +82-2-963-2587
Lab. Address: 24-194 Sangwolgok-dong, Sungbook-ku, Seoul 136-120, Korea

Table 1. Sample name & picture

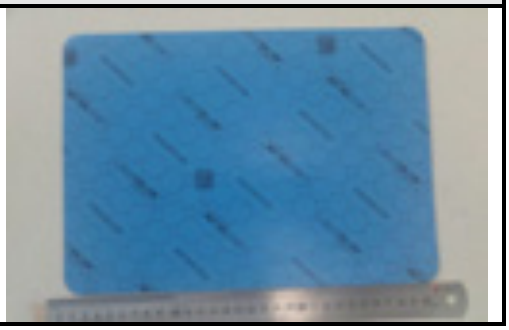
Sample Name	Sample ID	Picture
LEAKBLOK®	Koptri-1760071-1	

Table 2-1. Test results

Sample ID	Test ttem	Unit	Test method	Test result
Koptri-1760071-1 (LEAKBLOK®)	Surface resistance	Ω/sq	ASTM D257	5.51 x 10^{13}
	Volume resistance	Ω·cm	ASTM D257	4.10 x 10^{13}
	Dielectric breakdown strength	Kv/mm	ASTM D149	19.7
	Dielectric breakdown voltage	kv	ASTM D149	42

Note 1) Surface resistance, Volume resistance test condition – Impressed voltage : 500 V

Note 2) Rise speed of voltage : 667 V/s

Note 3) ASTM D257 (Standard test methods for DC resistance or conductance of insulating materials)

ASTM D149 (Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies)

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Table 2-2. Test results

Sample ID	Test item	Unit	Test method	Frequency (kHz)	Test result
Koptri-1760071-1 (LEAKBLOK®)	Dielectric constant (ε')	-	ASTM D150	1	16.5
	Tangent δ (ε'')	-	ASTM D150	1	0.004 2

Note) ASTM D150 (Standard test methods for AC loss characteristics and permittivity (Dielectric constant) of solid electrical insulation

End

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Lab. Address: 24-194 Sangwolgok-dong, Sungbook-ku, Seoul 136-120, Korea

***Raw data**

1. Test condition

1-1. Surface resistance, Volume resistance

(1) Equipment : High resistance meter (Agilent, 4339B)

(2) Test method : ASTM D257(Standard test methods for DC resistance or conductance of insulating materials)

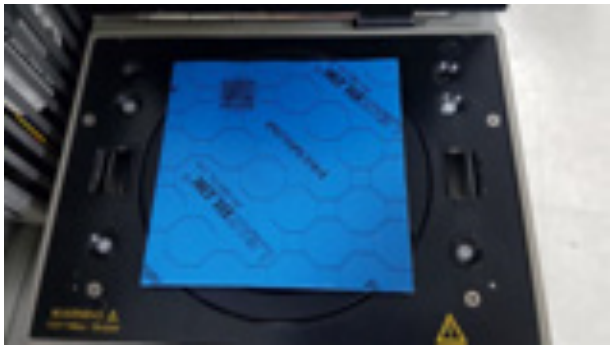
(3) Test range : 10^4 ~ 10^{17} Ω

(4) Test fixture : 16008B (50 mm diameter electrode)

(5) Test environment: (22±2) ℃, (40±5) % RH

(6) Test location : Center

(7) Impressed voltage : 500 V



1-2. Dielectric breakdown voltage, Dielectric breakdown strength

(1) Test method : ASTM D149 (Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies)

(2) Equipment : Automated dielectric breakdown test set (Phenix, 6CCEI00-5/D149)

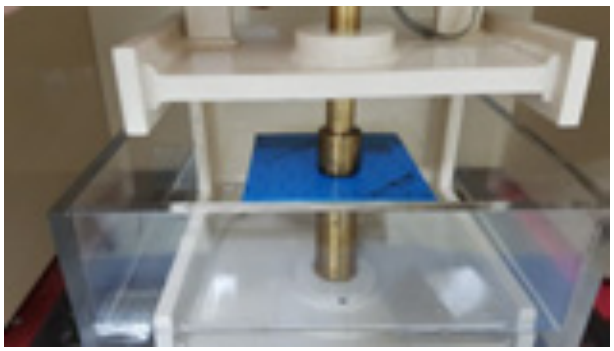
(3) Test condition : Insulating oil (KS C 2301 1st class No. 2)

(4) Test environment : (23 ± 2) ℃, (50 ± 5) % RH

(5) Electrode : Opposing cylinders 1" (25 mm) in diameter, 1" (25 mm) thick with edges rounded to 0.125" (0.8 mm) radius

(6) Test specimen : 50 x 50 mm sheet

(7) Rise speed of voltage: 667 V/s



1-3. Dielectric constant, Tangent delta

(1) Test method : ASTM D150 (Standard test methods for AC loss characteristics and permittivity (Dielectric Constant) of solid electrical insulation)

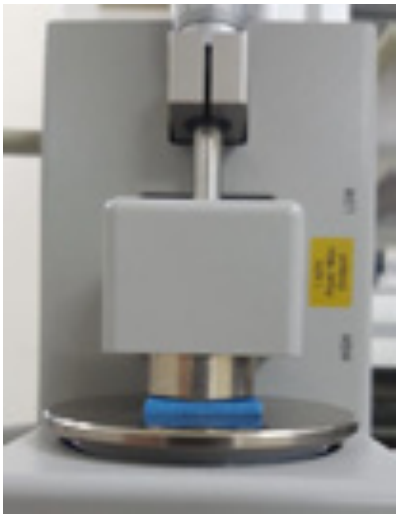
(2) Equipment : LCR meter (Agilent)

(3) Frequency : 1 kHz

(4) Test environment: (23±2) ℃, (45±5) % RH

(5) Electrode radius : 5 mm

(6) Electrode mode : G10



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2. Test results

2-1. Surface resistance, Volume resistance

Table 3. Surface resistance, Volume resistance

Sample ID	Run	Thickness (mm)	Surface resistance (Ω/sq)	Volume resistance (Ω·cm)
Koptri-1760071-1 (LEAKBLOK®)	1	2.107	5.37×10^{13}	4.09×10^{13}
	2	2.111	1.11×10^{14}	4.89×10^{13}
	3	2.110	3.32×10^{11}	3.31×10^{13}
	SD	-	5.54×10^{13}	7.91×10^{12}
	CV (%)	-	1.01×10^{2}	1.93×10^{1}
	Average	**-**	**5.51×10^{13}**	**4.10×10^{13}**

SD: Standard deviation

CV: Coefficient of variation=(SD/average)x100

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2-2. Dielectric breakdown voltage, Dielectric breakdown strength

Table 4. Dielectric breakdown voltage, Dielectric breakdown strength

Sample ID	Run	Thickness (mm)	Dielectric breakdown voltage (kV)	Dielectric breakdown strength (kV/mm)
Koptri-1760071-1 (LEAKBLOK®)	1	2.126	42.0	19.8
	2	2.130	42.2	19.8
	3	2.130	42.2	19.8
	4	2.110	41.3	19.6
	5	2.121	41.3	19.5
	SD	-	0.5	0.2
	CV (%)	-	1.11	0.78
	Average	**-**	**42**	**19.7**

SD: Standard deviation

CV: Coefficient of variation=(SD/average)x100

2-3. Dielectric constant, Tangent delta

Table 5. Dielectric constant, Tangent delta

Sample ID	Thickness (mm)	Run	Frequency (kHz)	Dielectric loss	Capacity (pF)	Dielectric constant (ε')	Tangent δ (ε'')
Koptri-1760071-1 (LEAKBLOK®)	2.124	1	1	0.0763	5.192	15.87	0.004 8
	2.122	2	1	0.0606	5.631	17.19	0.003 5
	Average					**16.53**	**0.004 2**

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TEST REPORT

FILK
a Subsidiary of KFPA

Report No : G2014-0844
Page(1)/(9)Pages

1030, Gyeongchung-daero, Gaeam-eup, Yeoju-si, Gyeonggi-Do, 469-883, Korea

1. Client
   - Name : JEIL E&S Co., Ltd. (Kim Chi Yeon)
   - Address : 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
   - Date of Receipt : July 30, 2014
2. Test specimen : Spiral Wound Gasket with STARPITE® Filler Type(300LB 2")
3. Date of Test : July 31, 2014
4. Use of Report : Capability verification
5. Test method used : ISO 19921 and ISO 19922
6. Test Results :

Specimen	Nominal size	Result	
		Fire endurance test	Hydrostatic tightness test
Spiral Wound gasket with STARPITE® Filler Type	ASME B16.20 300LB 2"	Not leaked	Not leaked

* The results shown in this test report refer only to the specimen(s) tested unless otherwise stated.

Affirmation	Tested by	Technical Manager
	Name : Ann, Byung-Ho (Signature)	Name : Kim, Dong-Suk (Signature)

Fire Insurers Laboratories of Korea
a subsidiary of Korean Fire Protection Association

FPD03-10A(1)

210×297(㎜)

TEST CONTENTS

1. GENERAL

1.1 Name of test sample : Spiral Wound Gasket with STARPITE® Filler Type(300LB 2")

1.2 Applicant : JEIL E&S Co., Ltd.
309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do Korea

1.3 Manufacturer of the specimen : JEIL E&S Co., Ltd.

1.4 Application date : July 30, 2014

1.5 Date of test : July 31, 2014

1.6 Test place : Fire Insurers Laboratories of Korea(FILK)

1.7 Referenced test standard

IACS Req. 2011, Requirements concerning pipes and pressure vessels(P2.11.5.5.6 Fire endurance test). The fire endurance test was to be conducted on the selected test specimens as per the following standards.

(a) ISO 19921:2005(E): Ships and marine technology - Fire resistance of metallic pipe components with resilient and elastomeric seals - Test methods

(b) ISO 19922:2005(E): Ships and marine technology - Fire resistance of metallic pipe components with resilient and elastomeric seals - Requirements imposed on the test bench

1.8 Test result : The specimen showed no leakage during the fire endurance test and the hydrostatic tightness test.

2. TEST SPECIMENS

2.1 Name of test sample : Spiral Wound Gasket with STARPITE® Filler Type(300LB 2")

2.2 Type of specimen : Inner-Outer Ring Type

2.3 Product code : JIC 3838-R-HT Series

2.4 Nominal size : ASME B16.20 300LB 2" / Thickness 4.5 mm

2.5 Design pressure : 2.1 MPa(21 bar)

2.6 Proof pressure : 3.35 MPa(33.5 bar)

2.7 Material : STARPITE(R)Filler / Stainless Steel 316L

2.8 The number of test sample : 1 unit

2.9 Other details : Refer to the appendix 1. Specifications and drawing of the test specimen

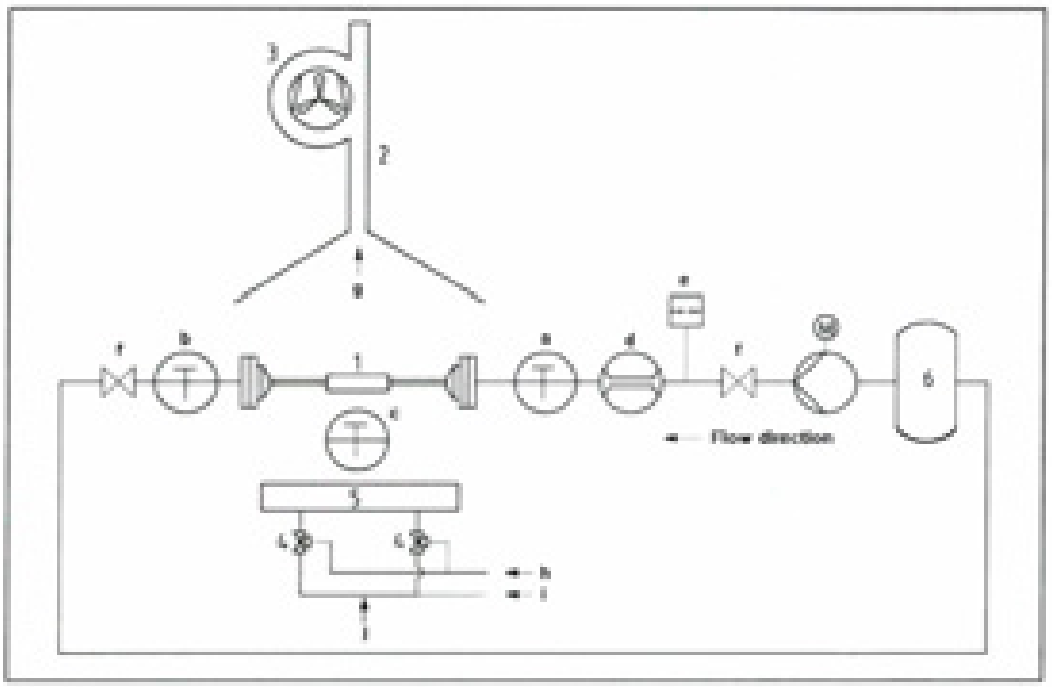
3. PURPOSE OF THE TEST

The purpose of this test is to evaluate the fire resistance performance of the spiral wound gasket with STARPITE® filler type(300LB 2") submitted by JEIL E&S Co., Ltd. according to the following test methods.

4. TEST METHODS

4.1 Test apparatus

Test rig arrangements for the fire test are to be as indicated in [Figure 1].



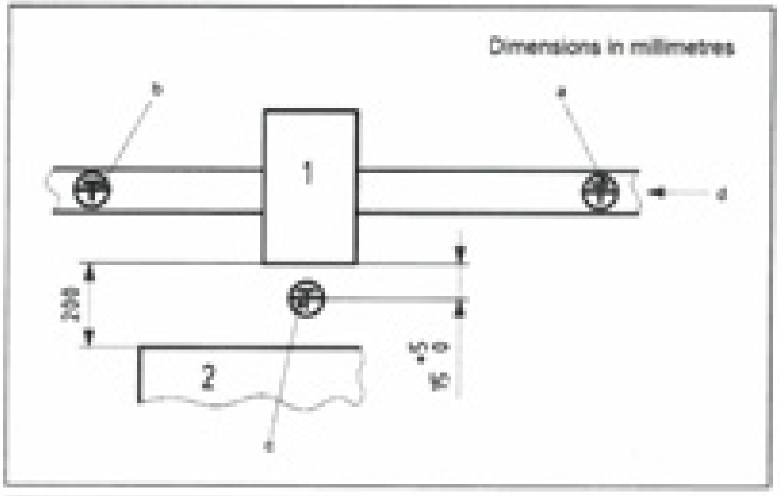
Key	
1. test piece	a. Water temperature at test piece, inlet.
2. exhaust gas truck	b. Water temperature at test piece, outlet.
3. exhaust fan	c. Flame temperature below centre of test piece.
4. mixing valve	d. Flow rate of water
5. sectional area burner	e. Working pressure during test
6. water tank with heating/cooling	f. Control valves.
	g. Exhaust gas.
	h. gas
	i. Combustion air.
	j. Air supply.

[Figure 1] Schematic diagram of the test rig arrangements for the fire test

4.2 Test procedures

4.2.1 Fire endurance test

(1) The test specimen is to be installed on the test rig such that the end of burner extends beyond the mechanical joint by at least 20 mm.



Key	
1. Test piece 2. Burner	a. Water temperature at test piece (inlet). b. Water temperature at test piece (outlet). c. Flame temperature below centre of test piece. d. Flow direction.

[Figure 2] Temperature measuring points

(2) After installation, the test specimen is rinsed with the water at the pressure of (500 ± 20) kPa for at least 1 min in order to evacuate as far as possible the air contained in the specimen.

(3) The specimen is exposed to the flame with the test temperature of (800 ± 50) ℃ for the duration of 30 min at the pressure of at least 500 kPa(5 bar).

(4) The specimen is to be completely enclosed by the flame.

(5) The inlet water temperature is maintained at the temperature of (80 ± 2) ℃ and the outlet water temperature is to be kept within 85 ℃.

4.2.2 Hydrostatic tightness test

After the fire test, the pressure inside the joint assembly is to be slowly increased to 1.5 times of the design pressure. This test pressure is to be retained for a minimum duration of 5 min.

4.3 Requirements

4.3.1 Fire endurance test

There should be no sign of leakage when the specimen is exposed to the flame for 30 min.

4.3.2 Hydrostatic tightness test

There should be no sign of leakage when the specimen is maintained at the pressure of 1.5 times of the design pressure for 5 min after the fire test.

[NOTE]

For services other than flammable fluids, a leakage rate of not more then 0.2 L/min is considered acceptable.

4.4 Measuring Instrumentation

4.4.1 Thermocouples

(1) K-type thermocouple : 3.2 mm in diameter

4.4.2 Pressure gauge

(1) Bourdon gauge : maximum range of 5.0 MPa(50 bar)

(2) Digital pressure gauge : maximum range of 3.0 MPa(30 bar)

4.4.3 Transmitter for recording the internal pressure.

5. CLASSIFICATION CRITERIA

The test specimen subjected to fire for 30 min at the temperature of 800 ℃ under the design pressure should not show any sign of leakage when subjected to proof pressure(1.5 times of design pressure) after the fire test.

6. TEST RESULTS

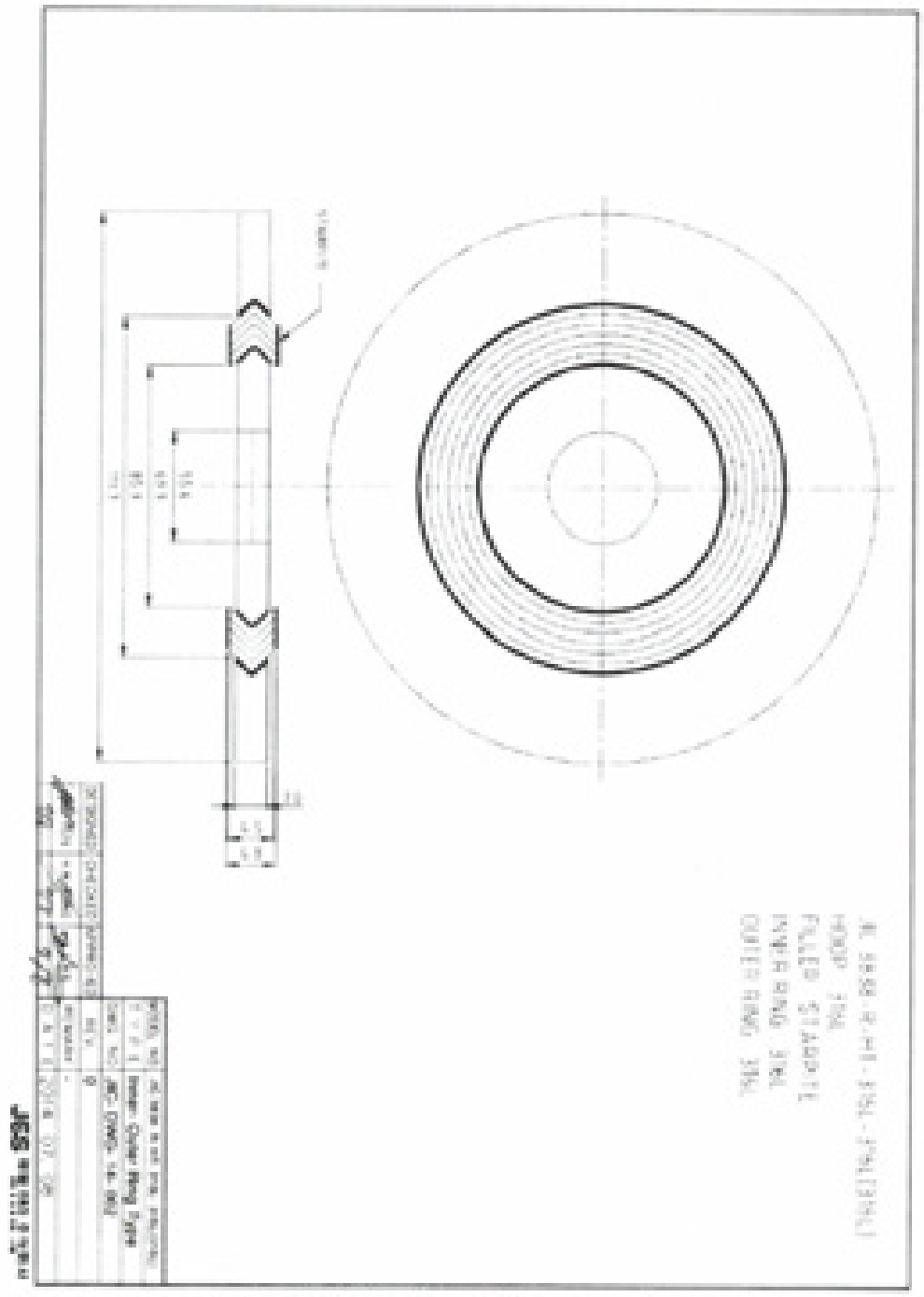
Test specimen	Design pressure (bar)	Fire endurance test		Hydrostatic tightness test	
		Test pressure (bar)	Leakage	Test pressure (bar)	Leakage
Spiral Wound Gasket with STARPITE® Filler Type (300LB 2")	21	5	Not leaked	33.5	Not leaked

7. CONCLUSION

The spiral wound gasket with STARPITE® filler type(300LB 2") submitted by the client, JEIL E&S Co., Ltd. satisfied the classification criteria of the marine piping system specified in ISO 19921 and ISO 19922 as required by IACS Req. 2011(Requirements concerning pipes and pressure vessels - P2.11.5.5.6. Fire endurance test).

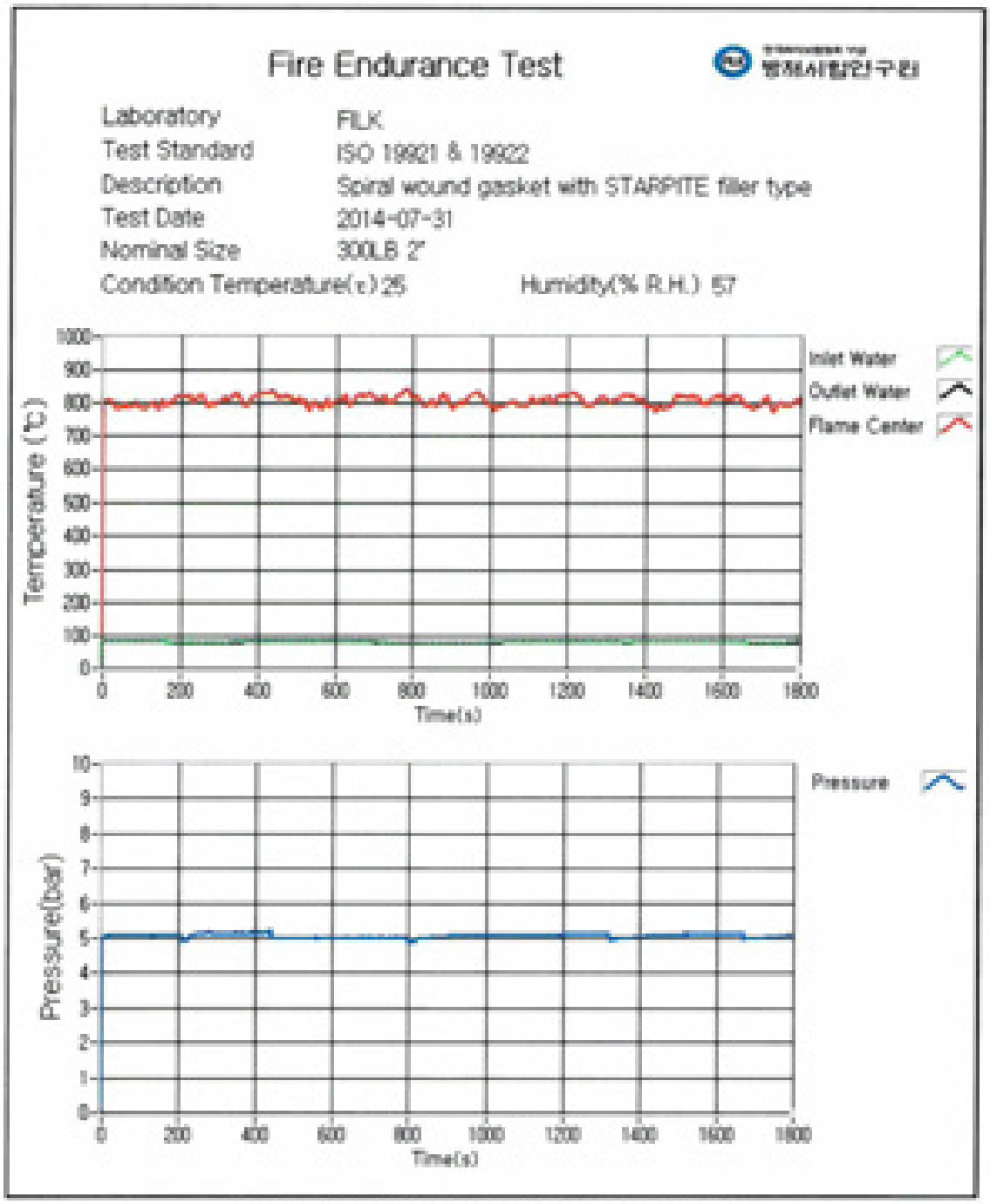
[APPENDICES]

APPENDIX 1. DRAWING OF THE TEST SPECIMEN



[Figure 1] Drawing of the test specimen

APPENDIX 2. GRAPH OF THE FIRE ENDURANCE TEST



[Figure 2] Graph of the fire endurance test

APPENDIX 3. PHOTOGRAPH OF THE TEST SPECIMEN

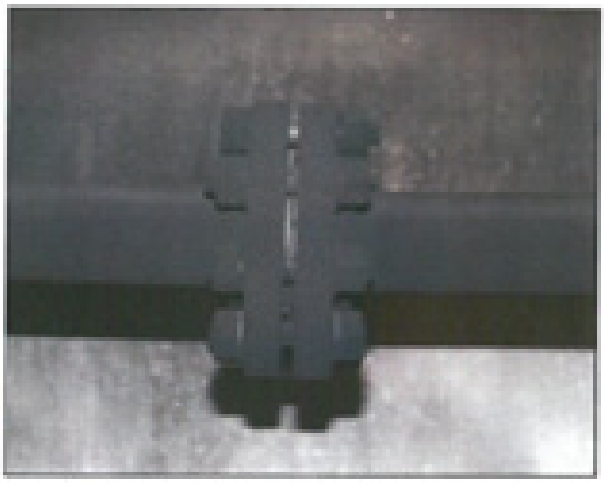
[Photo 1] The front of test specimen

[Photo 2] The back of test specimen

APPENDIX 4. PHOTOGRAPH OF THE TEST

Spiral Wound Gasket with STARPTFE® Filler Type(300LB 2")

[Photo 3] Fire endurance test



[Photo 4] Hydrostatic tightness test

The end of the report.

TEST REPORT

Dong-A University
Technical Center for
High-Performance Valves

840 Hadan2-dong, Saha-gu, Busan-city, Korea
(Tel: +82 51-200-6546 Fax: +82 51 200-6598)

Certificate No.:
TCHPV-15-10-105

1. Client
   - Name : JEIL E&S CO., LTD
   - Address : 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
   - Person in charge : Hyeon-woo Jeong

2. Use of Report : Quality Management

3. Test Sample : STARTEC® 9320-HP

4. Date of Test : 2015. 10. 01

5. Test Meathod Used : Pressure Testing (The applicant provides standard)

6. Testing Environment
   - Temperature : (22.1 ± 3.0) ℃
   - Relative Humidity : (58 ± 5) % R.H.

7. Test Result : Refer to the test result.

Affirmation	Tested by Researcher Name : J.Y. KWON. (Signature)	Approved by Technical Manager Name : S.J. OH. (Signature)

2015. 10. 28.

Director of Dong-A University
Technical Center for High Performance Valves

◆ Test Result

1) Test

STARTEC 9320-OS : Water Pressure Testing

2) Test Method Used

Pressure test has performed in accordance with KS B 2304:2001 General rules for inspection of valves.

① Gasket sample shall be centralized between flanges and installed with recommended torque value.

② Leakage verification shall be performed under ambient condition by pressurized 460 bar with water.

③ Careful inspection is required for visual inspection during 10 minutes.

3) Test Sample

Manufacturer	JEIL E&S CO., LTD
Model	STARTEC®
Model No.	9320-HP
Material	Glass Reinforced Epoxy Faced Metal plate with dual PTFE Seal
Class	API 6BX 15,000 psi
Size	2-1/16" Gasket
Weight	632 g
Max. Temperature	Max 200℃
Max. Pressure	Max API 6BX 15,000 psi
Serial No.	20150916O029-003

4) Test Equipment

Equipment Name : Valve Durability Test System
Production Companies : KOREA HYDRAULIC CO., LTD.
Management Agency : Dong-A University Technical Center for High Performance Valves
Management No. : 4-31-003

◦ Instruments calibration (Pressure Gage)
Production Companies : Sensys
TYPE : PMSH1000KAAA (100 kgf/cm²)
Device Number : 103191
Calibration Date : 2015. 04. 06.
Certificate Number : KP15D-1185
Calibration Supplier : KCS Co.,Ltd

◦ Instruments calibration (Stopwatch)
Production Companies : CASIO
TYPE : HS-3
Calibration Date : 2015. 05. 06.
Certificate Number : KS15E-0106
Calibration Supplier : KCS Co.,Ltd

5) Test Result

Temperature	Test Media	Test Pressure (kgf/cm²)	Hoding Time (min)	Result
AMB.	Water	460	10	No Leak

※ Result is a visual inspection result.

- END -

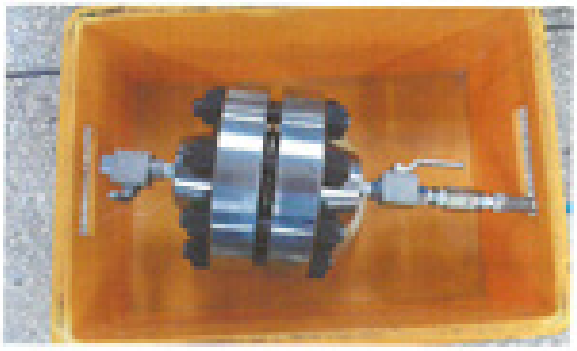
※Attached files

01. Test Picture.....(Page : 5 of 5)

Attach.01 Test Picture

Installed Test Sample

Test Start



Check of Leakage

Test End

TEST REPORT

Dong-A University
Technical Center for
High-Performance Valves

840 Hadan2-dong, Saha-gu, Busan-city, Korea
(Tel: +82 51-200-6546 Fax: +82 51 200-6568)

Certificate No.:
TCHPV-15-06-103

1. Client
   - Name : JEIL E&S CO., LTD
   - Address : 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
   - Date of Receipt : 2015.05.12

2. Use of Report : Test & Analysis

3. Test Sample : Compressed Non-Asbestos Sheets & Gaskets (JIC 6000)

4. Date of Test : 2015. 06. 16

5. Test method used : Reference to the
   'API STANDARD 607:2010_SIXTH EDITION, SEPTEMBER 2010'

6. Testing Environment & Locations
   - Temperature : (21.1 ± 3.0) ℃
   - Relative Humidity : (59 ± 5) % R.H.
   - Locations : Laboratory of TCHPV (Room No. SM118, S14, DONG-A UNIV.)

7. Test Result : Page 3 & 4.

Affirmation	Tested by Researcher Name : J.Y. KWON. (Signature)	Approved by Technical Manager Name : S.J. OH. (Signature)

* The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

2015. 06. 29.

Director of Dong-A University
Technical Center for High Performance Valves

◆Test Result

1) Test :

JEIL E&S Compressed Non-Asbestos Sheets & Gaskets (JIC 6000) - Fire Safety Test

2) Test Method Used :

Fire safety test has performed in accordance with API STANDARD 607:2010_SIXTH EDITION, SEPTEMBER 2010

<Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats>

1. Install test flange onto sample gasket and connect it to a pipe inside the chamber of Fire Safety Test Equipment.
2. Pressurize the system with water to a test pressure of 1.4 times the maximum permissible working pressure at 20℃ the actual test pressure may be rounded up to the next highest bar. Check for leaks in the test apparatus and eliminate as necessary. Release the pressure.
3. Pressurize the system to 30 bar.(Test pressure was request of manufacturer.)
4. Open the fuel supply, establish a fire and monitor the flame environment temperature throughout the burn period of 30 min. Maintain the average temperature between 750℃ and 1000℃ for the burn period of 30 minutes.
5. At the end of the burn period shut off the fuel supply. And force-cool with water so that its external surface temperature remains below 100℃.
(Less than 10 minutes after extinguishing the fire.)
6. Measure external leakage.

3) Test Sample

Model		JIC 6000
Type		Compressed Non-Asbestos Sheets
Material		NBR Rubber, Aramid Fiber & etc
Class		600 Class - 2 Inch
Weight		17.8 g
Pressure Test Report (Attach. 04)	REF. NO.	14-3005-2
	DATE	2015. 03. 10

① Fire Burn Test Record

Time Min:Sec	Upstream Pressure MPa	Flame Temp. ℃		Body & Connector Temp. ℃		Calorimeter Temp. ℃	
		T1	T2	Bonnet	Body	T3	T4
5:00	3.12	291.4	215.9	893	307.4	328.8	448.5
35:00	3.11	859.5	900.6	846	845.3	868.3	832.5
Average	3.12	864	864.3	784.1	754.2	852	840.5

Time Min:Sec	Sight Gauge In Vessel 192.4 mL/mm		Reading In Container 76.7 mL/mm	
	mm	mL	mm	mL
5:00	509.5	98 027.8		
35:00				

② Cool Down Test Record

Time Min:Sec	Upstream Pressure MPa	Flame Temp. ℃		Body & Connector Temp. ℃		Calorimeter Temp. ℃	
		T1	T2	Bonnet	Body	T3	T4
35:00	3.11	859.5	900.6	846	845.3	868.3	832.5
45:00	3.13	70.1	90.8	28.2	29	28.3	28.4

Time Min:Sec	Sight Gauge In Vessel 192.4 mL/mm		Reading In Container 76.7 mL/mm	
	mm	mL	mm	mL
44:00				
54:00	500	96 200		

③ Fire Safe Test Result

No	External leakage [mL/min]	
	During burn and cool-down period	
	Permissible Leakage	Actual Leakage
1	200	45.69
Test Result	The Actual Leakage is lower than the Permissible Leakage	

- END -

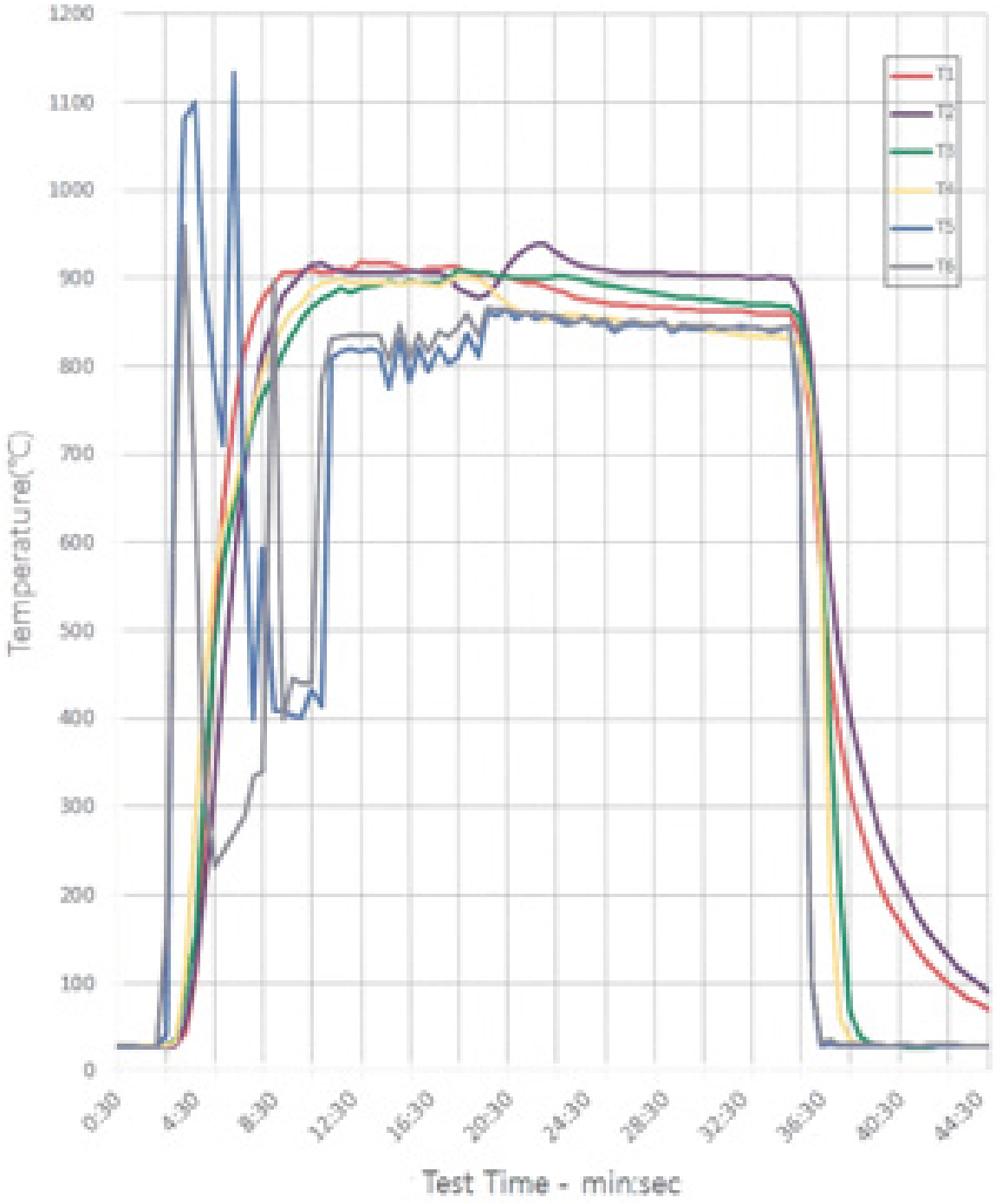
※Attached files

Attach.01 Burning Temperature & Pressure Records

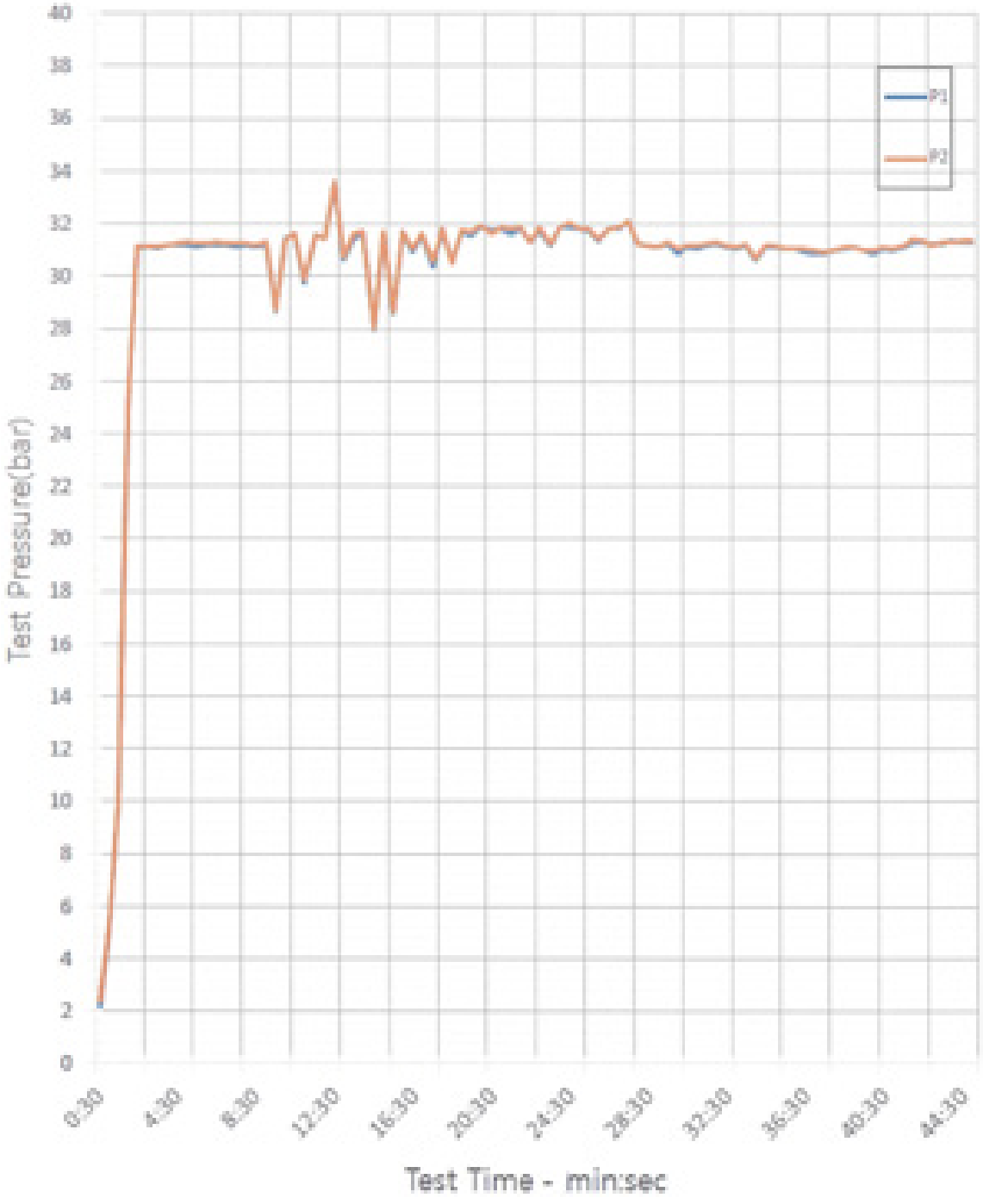
Time	t1	t2	t3	t4	bonnet	body	p1	p2
Min:Sec	℃	℃	℃	℃	℃	℃	MPa	MPa
5:00	291.42	215.9	328.83	448.53	893.03	307.41	31.21	31.31
5:30	494.24	326.2	480.85	560.67	792.98	232.44	31.16	31.26
6:00	647.25	455.63	578.51	617.15	711.31	250.76	31.18	31.26
6:30	750.07	579.84	644.45	659.13	1133.01	270.51	31.21	31.31
7:00	814.58	676.85	696.57	702.69	670.74	288.16	31.17	31.26
7:30	851.3	754.86	735.95	753.88	399.74	334.69	31.16	31.24
8:00	876.87	812.18	766.54	794.55	592.92	340.25	31.2	31.24
8:30	895.14	852.21	791.27	824.75	409.51	896.63	31.15	31.21
9:00	898.72	879.28	815.23	846.58	408.99	399.67	31.23	31.33
9:30	906.42	893.74	836.11	862.53	402.96	445.88	28.66	28.74
10:00	907.8	904.64	851.8	870.18	401.86	440.04	31.46	31.41
10:30	910.27	915.71	866.72	886.78	432.76	440.13	31.55	31.65
11:00	906.23	917.31	876.43	895.63	414.7	781.74	29.79	29.88
11:30	907.06	911.77	881.18	896.87	809.86	831.05	31.55	31.59
12:00	912.46	908.16	886.62	898.98	817.08	834.14	31.44	31.45
12:30	910.62	905.57	883.1	895.48	821.41	836.17	33.48	33.6
13:00	919.35	905.91	889.62	895.89	817.22	834.93	30.63	30.78
13:30	917.85	905.68	891.85	894.66	821.27	835.32	31.44	31.62
14:00	917.83	906.29	893.36	894.64	817.05	834.96	31.65	31.71
14:30	917.85	906.1	896.81	895.87	774.9	806.86	27.99	28.04
15:00	914.34	907.12	893.02	893.85	832.23	849.2	31.59	31.71
15:30	910.72	908.92	897.73	895.68	783.19	810.11	28.58	28.67
16:00	908.68	908.38	894.34	895.37	822.64	836.51	31.67	31.68
16:30	911.88	906.58	894.9	893.33	795.2	816.3	30.95	31.09
17:00	912.61	905.72	894.67	890.99	822.2	840.28	31.57	31.66
17:30	913.06	902.33	899.04	897.24	803.95	833.18	30.4	30.56
18:00	914.48	890	909.99	902.07	812.02	845.21	31.74	31.81
18:30	907.79	883.7	907.21	900.21	837.56	860.45	30.55	30.52
19:00	904.59	878.6	906.45	898.75	811.57	834.71	31.72	31.78
19:30	905.47	881.57	905.61	893.22	862.36	866.25	31.55	31.69
20:00	901.07	894.67	901.72	890.78	857.34	866.02	31.86	31.93

Time	t1	t2	t3	t4	bonnet	body	p1	p2
Min:Sec	℃	℃	℃	℃	℃	℃	MPa	MPa
20:30	901.59	911.18	901.83	872.41	864.83	866.03	31.75	31.66
21:00	898.33	925.07	901.13	865.46	854.14	862	31.8	31.91
21:30	894.58	933.69	901.29	858.85	862.01	859.82	31.64	31.79
22:00	894.56	940.09	900.94	854.5	854.53	861.21	31.82	31.88
22:30	892.22	939.35	901.33	852.5	859.15	858.58	31.3	31.32
23:00	887.24	930.36	902.15	856.66	854.36	858.68	31.73	31.89
23:30	882.99	923.33	902.43	859.54	848.77	854.88	31.2	31.29
24:00	879.02	917.29	899.9	858.42	849.65	851.02	31.87	31.86
24:30	876.49	914	898.29	857.08	855.25	855.74	31.9	32.05
25:00	874.79	911.09	895.76	855.6	848.54	851.08	31.81	31.84
25:30	872.9	909.58	892.42	854.37	850.9	853.69	31.73	31.79
26:00	871.55	908.24	891.07	853.11	838.97	844.28	31.37	31.45
26:30	870.84	907.01	889.01	850.28	847.16	849.7	31.79	31.79
27:00	869.65	906.89	887.59	849.51	848.55	851.43	31.83	31.9
27:30	868.67	906.2	886.54	849.96	846.79	847.83	32.12	32.12
28:00	867.94	905.37	883.17	848.44	846.89	849.58	31.24	31.25
28:30	867.32	905.53	882.3	847.75	849.48	851.39	31.22	31.19
29:00	866.99	904.34	880.86	846.34	838.7	843.04	31.12	31.11
29:30	865.65	903.71	878.59	844.15	845.62	848.3	31.24	31.3
30:00	864.46	903.84	878.12	843.61	843.33	845.82	30.92	31.06
30:30	864.13	902.79	876.63	841.54	843.55	845.81	31.16	31.22
31:00	864.1	902.71	875.67	839.94	845.65	846.15	31.1	31.18
31:30	863.88	902.03	874.69	838.86	842.13	844.54	31.17	31.24
32:00	862.92	901.65	873.02	836.75	845.01	845.38	31.24	31.33
32:30	862.7	901.71	872.69	835.32	846.43	843.45	31.16	31.21
33:00	861.14	901.33	870.88	833.89	845.47	844.44	31.09	31.16
33:30	860.42	901.35	870.29	833.68	844.52	843.33	31.21	31.25
34:00	859.77	901.59	870.04	833.58	840.02	843.07	30.65	30.69
34:30	859.01	900.67	868.49	833.05	843.73	844.32	31.13	31.18
35:00	859.58	900.62	868.35	832.53	846.01	845.38	31.16	31.21
AVG.	**851.74**	**851.50**	**815.37**	**802.81**	**779.80**	**887.59**	**16.36**	**16.31**

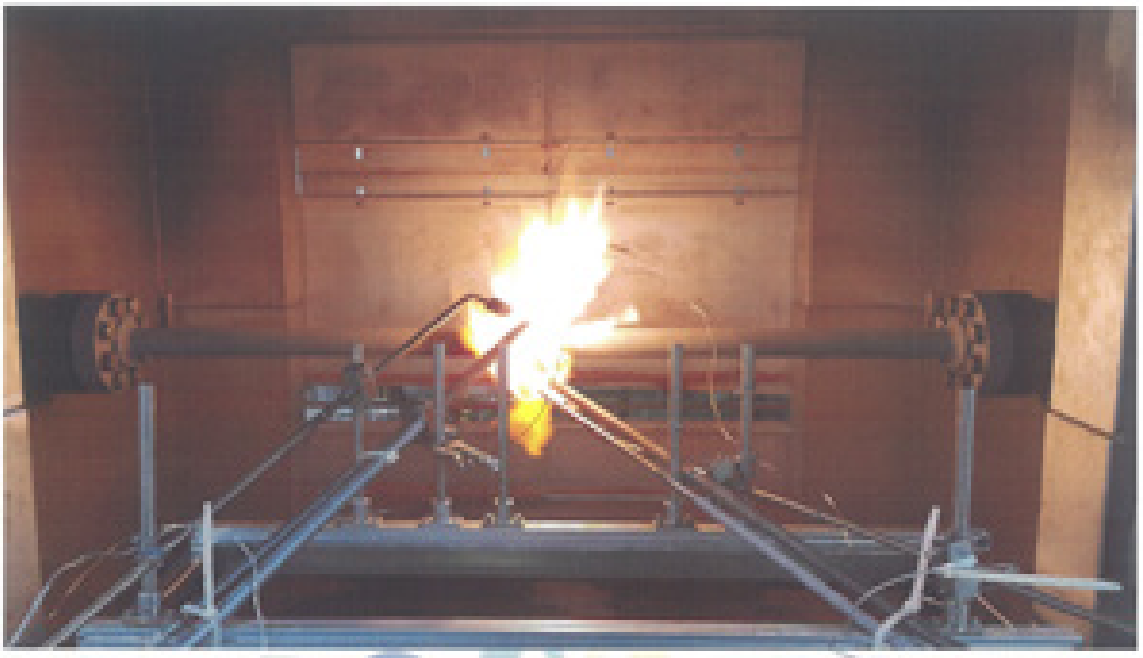
Attach.02 Test Temperature Graph



Attach.03 Test Pressure Graph



Attach.05 Test Picture



amtec Services GmbH
Hoher Steg 13
D - 74348 Lauffen
Tel.: +49 7133 9502-0
Fax: +49 7133 9502-22
e-mail: temes@amtec.de
Internet: www.amtec.de

CERTIFICATE

No. 30279631E/CS/15.09.2015

In accordance with the Specification API 6FB (dated Dezember 2008) the gasket

JIC-4201-B
6" Class 300

of the gasket manufacturer

JEIL E&S CO., LTD.
KOR – 309 Chungnyeol-ro, Yangsan-Si,
Gyeongsangnam-do,

was tested in respect of fire safety. The test was made under the following conditions:

Total bolt load:	1388	kN
Burn period:	30	min
Average temperature calorimeters:	> 650	°C
Test pressure (absolute):	40	bar
Test medium:		Water
Leak rate:	0.01	ml/(inch · min)

After the burn period the connection was air cooled to a flange temperature below 100 °C. During the cool-down the connection was still pressurized with the test pressure.

Therefore the gasket is in compliance with the tightness criteria of **1 ml/(inch · min)** of API 6FB during burn period and cool-down. The gasket manufacturer can mark the gasket as 'FIRE-SAFE' in accordance to the specification API 6FB.

This certificate is only valid in combination with the test report 3027961/-.

Lauffen, 15.09.2015

amtec Messtechnischer Service GmbH

B. Eng. C. Six

Quality Certificate

DSME

DAEWOO SHIPBUILDING & MARINE ENGINEERING CO.,LTD. certifies that the company and items below have been assessed and found to comply with the requirements of Quality Certificate of DSME.

Company Name : JEIL E&S CO.,LTD.

Address : 309, Chungnyeol-ro,Yangsan-si, Gyeongsangnam-do, Korea

Items : Gasket, Packing

Certificate No. : DSME-QM-16-040

Valid Date : Feb. 28th,2018

In-Min Lee / Director
Offshore Quality Management
Daewoo Shipbuilding & Marine Engineering Co., LTD.

Lloyd's Register

Type Approval Certificate

This is to certify that the undernoted product has been tested with satisfactory results in accordance with the relevant requirements of the LR Type Approval System.
This certificate is issued to:

PRODUCER	JEIL E&S Co., Ltd.
PLACE OF PRODUCTION	309 Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, 626-230, Korea
DESCRIPTION	Compressed Non-Asbestos Sheet & Gasket
TYPE	LEAKBLOK®
APPLICATION	Marine piping system Hot oil & oil gas : Below 20 kg/cm² at 260 °C Fresh water, alkali, sea water : Below 30 kg/ cm² at 260 °C Organic solvent : Below 20 kg/cm² at 260 °C Steam Service : Below 10 Kg/ cm² at 180 °C
STANDARD	Lloyd's Register Rules and Regulations for Classification of Ships, Part 5, Chapter 12, Section 5, July 2013 ASTM F104/F36/F146/F152
RATING	Sheet Thickness (mm): 0.8~3.2 Short-term peak : 350°C Maximum continuous : 220 °C Short term peak : 80 kg/cm² PH range : 4-11 above is general range and has no guarantee for every case The producer's "Remark & Warning"are to be complied with.

Certificate No.	14/40001
Issue Date	26 March 2014
Expiry Date	25 March 2019
Sheet	1 of 2

D. Y. Kang
Busan Technical Support Office
Lloyd's Register Group Limited

Lloyd's Register Group Limited, registered office:
71 Fenchurch Street, London EC3M 4BS

Lloyd's Register

"This Certificate is not valid for equipment, the design, ratings or operating parameters of which have been varied from the specimen tested. The manufacturer should notify Lloyd's Register Asia of any modification or changes to the equipment in order to obtain a valid certificate."

The Design Appraisal Document No. 14/40001 and its supplementary Type Approval Terms and Conditions form part of this Certificate.

Certificate No.	14/40001
Issue Date	26 March 2014
Expiry Date	25 March 2019
Sheet	2 of 2

D. Y. Kang
Busan Technical Support Office
Lloyd's Register Group Limited

Lloyd's Register Group Limited, registered office:
71 Fenchurch Street, London EC3M 4BS

amtec Messtechnischer Service GmbH
Hoher Steg 13
D - 74348 Lauffen
Telefon: +49 7133 9502-0
Telefax: +49 7133 9502-22
e-mail: temes@amtec.de
Internet: www.amtec.de

quality certified
ISO 9001

DAkkS

CERTIFICATE

Nr. 30252302E/FH/26.02.14

In accordance with the Specification API 6FB (dated Dezember 2008) the gasket

STARPITE®
model: JIC 4201-HT
6" Class 300

of the gasket manufacturer

JEIL E&S CO., LTD.
KOR – 309 Chungyeolro, Yangsan-Si,
Gyeongsangnam-do,

was tested in respect of fire safety. The test was made under the following conditions:

Total bolt load:	1443	kN
Burn period:	30	min
Average temperature calorimeters:	> 620	°C
Test pressure (absolute):	38.3	bar
Test medium:	Water	
Leak rate:	0.32	ml/(inch · min)

After the burn period the connection was air cooled to a flange temperature below 100 °C. During the cool-down the connection was still pressurized with the test pressure.

Therefore the gasket is in compliance with the tightness criteria of 1 **ml/(inch · min)** of API 6FB during burn period and cool-down. The gasket manufacturer can mark the gasket as 'FIRE-SAFE' in accordance to the specification API 6FB.

This certificate is only valid in combination with the test report 3025232/-.

Lauffen, 26.02.2014

amtec Messtechnischer Service GmbH

Dipl.-Ing. F. Herkert

amtec Messtechnischer Service GmbH
Hoher Steg 13
74348 Lauffen
GERMANY

Test Report

Customer:	Jeil E&S CO. LTD. KOR – 39-5 Yusan-dong, Yangsan-city
Project number (amtec):	302 363
Report number:	302 363 1/-
Test procedure:	Shell Specification MESC SPE 85/300
Material:	JIC3836-R-SF-316-SS
Date:	22.08.2012
Pages:	10
Appendices:	21

Dipl.-Ing. F. Herkert

Test results are only relevant to the test objects submitted.

1. Subject of Investigation

The subject of investigation was a spiral wound gasket which is named

- JIC3836-R-SF-316-SS.

The spiral wound gasket is a Type C/I SWG according to EN 1514-2 with outer ring and inner ring. The material of the outer ring is carbon steel, the material of the hoop and inner ring is SS316L and graphite is the filler material.

2. Goal of Investigation

The goal of the investigation was the qualification of the gasket material JIC3836-R-SF-316-SS in accordance to the Shell Specification MESC SPE 85/300 (dated June 2007: Procedure and Technical Specification for Type Acceptance Testing (TAT) of Gaskets).

The Shell Specification describes several testing procedures for the evaluation of the gasket compressibility and the tightness characteristics of the gasket material at ambient and elevated temperature.

In this project, 8 different tests were performed in respect of the Shell approval:

- Shell leakage test at ambient temperature (MESC SPE 85/300 - 3.3.2),
- Shell leakage test at 400 °C (MESC SPE 85/300 - 3.3.2),
- Compression test at ambient temperature (MESC SPE 85/300 - 3.3.4: EN 13555),
- Compression test at 400 °C (MESC SPE 85/300 - 3.3.4: EN 13555),
- Relaxation test at ambient temperature (MESC SPE 85/300 - 3.3.4: EN 13555),
- Relaxation test at 400 °C (MESC SPE 85/300 - 3.3.4: EN 13555),
- Leakage test (MESC SPE 85/300 - 3.3.4: EN 13555) and
- Shell cycle test at 400 °C (MESC SPE 85/300 - 3.3.5).

3. Test Specimens

The dimensions of the test specimens were different for the 8 tests which were performed:

- Shell leakage test (MESC SPE 85/300 - 3.3.2): 4" Class 300
- Compression test (EN13555): DN40/PN40
- Relaxation test (EN 13555): DN40/PN40
- Leakage test (EN 13555): DN40/PN40
- Shell cycle test (MESC SPE 85/300 - 3.3.5): 4" Class 300

4. Testing Equipment

The gasket tests were carried out on the following testing equipment:

Test rig:	Serial number
$TEMES_{fl.ai1}$	010 181
$TEMES_{fl.ai1}$	010 362

A photo and the schematic view of the testing equipment $TEMES_{fl.ai1}$ are shown in **appendix 1**.

Multifunctional Testing Equipment $TEMES_{fl.ai1}$

The servo-hydraulic press $TEMES_{fl.ai1}$ is capable to load up to 1 MN. Gaskets up to 180 mm diameter can be tested.

Depending on the type of test, different components (heating platens for temperatures up to 450 °C, insulation and cooling platens, different flange face designs etc.) can be used.
The load (gasket stress) is measured by a load cell on the bottom of the test rig, the gasket deformation is recorded by three displacement transducers and the temperature profile is controlled, too. LabView-Software is used for data logging and online evaluation. The entire test can be performed under software-control, thus automatic tests according to international standards or user defined procedures are possible.

Also, the simulation of different flange stiffness can be realised within the equipment. In dependence on the gasket deformation the gasket surface pressure is reduced automatically according to the nominal stiffness.

Due to the modular design, the above test rig can be modified to perform leakage tests. The heating and cooling platens are replaced by platens for leakage tests, which are connected to a separate measurement device, see appendix 1. The leak rate measurement principle is based on the pressure decay method, using a differential pressure method, leak rates down to about $1.0 \cdot 10^{-4}$ mg/m/s can be measured. For higher tightness classes a leak detector can be used.

5. Test Procedure

5.1 Fugitive Emission: 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 of 64.6 MPa. Afterwards the gasket is compressed with a gasket stress between 64.6 and 111.1 MPa which is equivalent to a bolt stress between 210 and 361 MPa. After reaching the first gasket stress level the test volume is pressurized 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: $\leq 1.78 \cdot 10^{-9}$ Pa·m³/s/mm,
- Class B: $\leq 1.78 \cdot 10^{-8}$ Pa·m³/s/mm.

5.2 EN 13555 (MESC SPE 85/300 - 3.3.4)

According to the European Standard EN 13555 (dated February 2005: Flanges and their joints – gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections) the determination of the following gasket characteristics, which are necessary for the calculation according to EN 1591-1 (dated August 2011: Flanges and their joints - Design rules for gasketed circular flange connections - Part 1: Calculation method), was done:

- Maximum allowable gasket stress Q_{smax} (RT, 400 °C),

- Modulus of elasticity E_G (RT, 400 °C),
- Creep relaxation factor P_{QR} (50 MPa – RT, 400 °C),
- Minimum required gasket stress in assembly $Q_{min(L)}$ (40 bar) and
- Minimum required gasket stress in service $Q_{smin(L)}$ (40 bar).

5.2.1 Compression test

The compression test can be carried out at ambient or at elevated temperature. For the tests at elevated temperature first the temperature of the gasket is raised to the required test temperature under an initial gasket stress. Then cyclic compression and recovery loadings on the gasket at progressively higher surface pressures are carried out until the gasket collapses or the maximum load of the test machine or the maximum gasket stress specified by the manufacturer is reached.

The gasket stress of the loading cycle prior to collapse is taken to be the maximum allowable gasket stress at ambient temperature Q_{smax}(RT) or the maximum allowable gasket stress at the test temperature Q_{smax}(T).

The unloading cycles of the Q_{smax} test allow the generation of values of the modulus of elasticity E_G. The E_G value is determined for each gasket stress level of the different unloading cycles, the E_G value is also dependent on the test temperature level.

5.2.2 Creep relaxation test

The factor P_{QR} is the ratio of the residual and the initial gasket stress from a relaxation test. The test is performed by using the stiffness simulated control mode. The load will be decreased according to the creeping of the gasket and the nominal set point for stiffness simulation. A stiffness of 500 KN/mm is typical for a PN designated flange and 1500 KN/mm for a Class designated flange. For this test the stiffness of the rig shall be 500, 1000 or 1500 KN / mm.

The test procedure consists of loading the test gasket until the initial load is applied. The loading is then held for 5 minutes. Then the temperature of the test rig is raised until the test temperature is reached and the temperature is held constant for a period of 4 hours. During the heating period and at elevated temperature the stiffness controlled mode of the equipment is activated. After the 4 hour period the remaining

load after relaxation is noted and P_{QR}, the ratio of the residual load to the original load, is calculated.

5.2.3 Leakage test

The leakage test procedure consists of loading and unloading the gasket in a cyclic manner with measurement of the leak rate at several effective gasket stress levels with an internal gas pressure of 40 bar.

The procedure therefore consists of loading to 10 MPa, holding the load and measuring the leak rate and then raising the gasket stress to 20 MPa. The load is then held whilst the leak rate is measured. In the next step the load is reduced to 10 MPa and the leak rate is measured. Then measurements are done for the next loading - unloading cycle at 40 MPa, 20 MPa and 10 MPa and so on until either the 160 MPa loading - unloading cycle is completed or the value of Q_{smax} would have been exceeded.

Deviant from the standard test procedure the lowest gasket stress level is set to 5 MPa instead of 10 MPa.

The test gas used for this test shall be helium.

From the generated leakage curve the minimum required gasket stress in assembly $Q_{min(L)}$ (40 bar) and the minimum required gasket stress in service $Q_{smin(L)}$ (40 bar) in dependence on the gasket surface pressure prior to the unloading Q_A can be evaluated for different tightness classes L.

5.3 HOTT: Shell cycle test at 400 °C (MESC SPE 85/300 – 3.3.5)

In the leakage test at elevated temperature the gasket is compressed with a gasket stress of 64.6 MPa. After heating up to 400 °C the specimen was pressurized with 34.7 bar helium (in accordance to ASME B16.5-2003 - PT-Rating for Group 1.1 Materials), no load compensation of the internal pressure is done.

After one hour the test rig is cooled down to ambient temperature. The thermal cycle is repeated three times. During the last thermal cycle, the pressure loss shall not exceed 1 bar.

6. Results

All test results of the gasket material JIC3836-R-SF-316-SS are summarized in **appendices 2 and 3**.

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

In the Shell leakage test at ambient temperature the gasket was compressed in 5 steps from 64.6 MPa to 111.1 MPa. The detected leak rate at 64.6 MPa gasket stress at an internal pressure of 51 bar was $2.9 \cdot 10^{-3}$ mg/m/s, see **appendix 4**. The leak rate was decreasing with increasing gasket stress. For the maximum gasket surface stress of 111.1 MPa the leak rate was $3.6 \cdot 10^{-4}$ mg/m/s.

The leak rate at a gasket stress of 111.1 MPa is equivalent to $2.2 \cdot 10^{-7}$ Pa·m³/mm/s which is higher than the Tightness Class B.

In the Shell leakage test at 400 °C the gasket was compressed in 5 steps from 64.6 MPa to 111.1 MPa. The detected leak rate at 64.6 MPa gasket stress at an internal pressure of 34.7 bar was $7.3 \cdot 10^{-4}$ mg/m/s, see appendix 4. The leak rate was decreasing with increasing gasket stress. For the maximum gasket surface stress of 111.1 MPa the leak rate was $1.3 \cdot 10^{-4}$ mg/m/s.

The leak rate at a gasket stress of 111.1 MPa is equivalent to $1.8 \cdot 10^{-7}$ Pa·m³/mm/s, which is higher than the Tightness Class B.

6.2 EN 13555 (MESC SPE 85/300 - 3.3.4)

All tests according to EN 13555 with the material JIC3836-R-SF-316-SS were performed twice; they are listed in appendices 2 and 3. All gasket characteristics which are necessary for the use of the flange calculation code EN 1591-1 are summarized in these tables.

6.2.1 Compression tests

In appendix 2 the results of the compression tests with loading and unloading cycles are given, the gasket characteristics are

- the maximum allowable gasket stress Q_{smax} (RT),
- the modulus of elasticity E_G (RT),
- the maximum allowable gasket stress Q_{smax} (400 °C) and
- the modulus of elasticity E_G (400 °C).

Compression tests were performed at ambient temperature and at elevated temperature at 400 °C. According to EN 13555 loading and unloading cycles were carried out to determine the deformation behaviour of the gasket material. The compression curves and the corresponding graphs of the modules of elasticity for the different test temperature levels are shown in **appendices 5 to 8.**

In both compression tests at ambient temperature no collapse of the gasket specimens can be recognized until the maximum load of the testing equipment is reached. Also in the diagrams of the modules of elasticity no distinctive feature is visible which would indicate a damage of the gasket material. Therefore, the maximum allowable gasket stress Q_{smax} is set to 500 MPa.

In both compression tests at 400 °C no damage of the gasket specimen can be recognized until the maximum load of the testing equipment is reached. Also in the diagrams of the modules of elasticity no distinctive feature is visible which would indicate a damage of the gasket material. Therefore, the maximum allowable gasket stress Q_{smax} is set to 500 MPa.

The modulus of elasticity E_G at ambient temperature increases steadily with increasing gasket stress up to a maximum near 25.000 MPa. For the tests at 400 °C a linear increase of the modulus of elasticity with increasing gasket stress is observed. The maximum of the modulus of elasticity at 400 °C is significant lower than the maximum at ambient temperature.

A good repeatability of the double test is noticeable.

6.2.2 Creep relaxation tests

In appendix 2 the gasket characteristics of the creep relaxation tests for one gasket stress, two temperatures and one stiffness levels are listed:

- creep relaxation factor P_{QR} (50 MPa, RT, 500 kN/mm) and
- creep relaxation factor P_{QR} (50 MPa, 400 °C, 500 kN/mm).

In total 4 creep relaxation tests were performed. The initial gasket stress level was set to 50 MPa, the temperature was assessed to RT and 400 °C. For the stiffness the typical value for a PN designated flange (500 KN/mm) was chosen.

The results of all creep relaxation tests are given in **appendices 9 to 12**. The creep relaxation factors P_{QR} are 0.98 resp. 0.97 (50 MPa, RT, 500 kN/mm) and 0.91 resp. 0.87 (50 MPa, 400 °C, 500 kN/mm).

6.2.3 Leakage tests

The tightness behaviour of the gasket material JIC3836-R-SF-316-SS was examined in two leakage tests at 40 bar helium. In appendix 3 the determined gasket characteristics

- minimum required gasket stress in assembly $Q_{min(L)}$ and
- minimum required gasket stress in service $Q_{smin(L)}$ in dependence on the gasket surface pressure prior to the unloading Q_A

are listed for both tests in dependence on the tightness class L.

For the determination of the leak rate two different measurement devices were used in parallel. The pressure drop method with a differential pressure was used for the leak tightness evaluation for leak rates higher $1.0 \cdot 10^{-3}$ mg/m/s, for lower leak rates the signal of the helium leak detector was taken for the calculation of the leak rate.

The graphical presentation of the leakage curves are shown in **appendix 13**. The tightness class $L_{0.01}$ was reached when the gasket stress raised above 58 MPa or 61 MPa, respectively. The minimum gasket stress in assembly for the tightness class $L_{0.01}$ is $Q_{min(0.01)}$ = 61 MPa. The highest tightness class which could be reached was $L_{0.001}$, therefore a gasket stress of 116 is necessary.

The leak rate is decreasing with an increasing gasket stress up to 160 MPa. The lowest leak rate which could be measured at 160 MPa was $1.9 \cdot 10^{-4}$ mg/m/s in test 12-323.

During the unloading cycles the leak rate is increasing again, but the gasket is clearly tighter as during the first loading to a defined gasket stress level. In the unloading curves after a gasket stress level of 160 MPa and after a gasket stress level of 100 MPa in test 12-326 a drastic increase of the leak rate (or sudden blow-out) is observed at the lowest gasket stress level of 5 MPa. At all other unloading curves no drastic increase of the leak rate (or sudden blow-out) is observed until the lowest gasket stress of 5 MPa is reached.

The minimum gasket stress in service for the tightness class $L_{0.1}$ for an initial gasket surface pressure Q_A of 60 MPa is $Q_{smin(0.1)}$ = 9 MPa.

A good repeatability of the double test is noticeable.

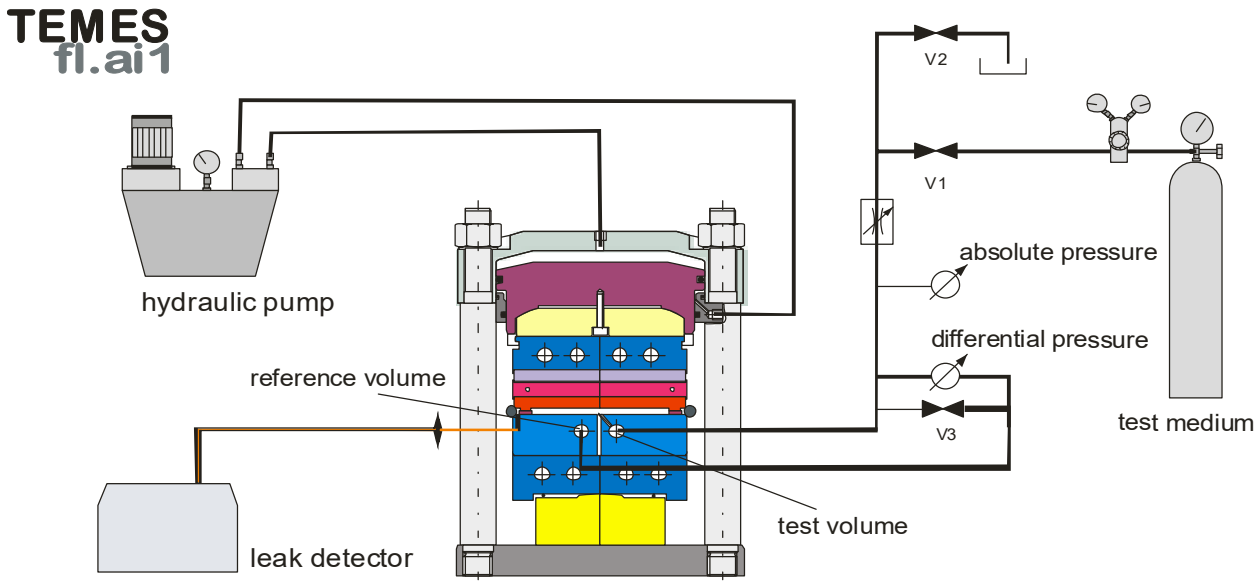
6.3 HOTT: Shell cycle test at 400 °C (MESC SPE 85/300 – 3.3.5)

For the Shell cycle test at elevated temperature the gasket was compressed initially with 64.6 MPa. After heating up to 400 °C, the specimen was pressurized with 34.7 bar helium. During the thermal cycles in the leakage test at 400 °C, only a slight pressure drop is measured, see **appendix 14**.

During the last thermal cycle the pressure loss is less than 1 bar. The gasket material JIC3836-R-SF-316-SS has passed the Shell requirement of a pressure drop less than 1 bar.

7. Photo documentation

In **appendices 15 to 21** photos of the tested gasket specimens JIC3836-R-SF-316-SS for the 8 different test procedures are presented.



Testing Equipment TEMES*fl.ai1*

Table 1: Data Sheet for Gasket Characteristics (EN 13555)

Manufacturer: Jeil E&S CO. LTD.

Product: **JIC3836-R-SF-316-SS**

Maximum allowable Gasket Stress Q_{smax} [MPa]

T [°C]	25	25	400	400			
Q_{smax} [MPa]	500	500	500	500			
test no.	12-324	12-325	12-336	12-340			

Modulus of Elasticity E_G [MPa]

T [°C] / Q [MPa]	25	25	400	400			
20	1465	1397	2857	2438			
30	1988	1887	3624	3074			
40	2423	2359	4263	3821			
50	2845	2767	5007	4702			
60	3503	3257	5696	5654			
80	4290	4230	7076	6536			
100	4843	4698	8105	7840			
120	5716	5568	9792	9656			
140	6807	6584	11531	11105			
160	7908	7651	13175	12550			
180	9144	8955	14196	13991			
200	10598	10707	15157	14648			
220	12606	12840	16249	15161			
240	14713	15035	16506	15699			
260	16821	17261	17000	16493			
280	18876	19026	17803	17159			
300	20634	20485	18414	17597			
320	21899	21878	18419	18621			
340	22857	22541	18287	19038			
360	23394	23361	18876	20123			
380	23829	23847	19413	20453			
400	24666	24518	21396	21299			
420	24876	24705	20525	21944			
440	25192	24733	22238	22399			
460	25195	25067	22674	22541			
480	25511	25053	22828	22818			
500	25794	25592	23393	22958			
test no.	12-324	12-325	12-336	12-340			

Creep-/Relaxation Factor P_{QR} [-]

C = 500 kN/mm	T [°C] / Q [MPa]	25	25	400	400			
	30							
	test no.							
	50	0.98	0.97	0.91	0.87			
	test no.	12-327	12-328	12-332	12-333			
	100							
	test no.							

Table 1: Data Sheet for Gasket Characteristics (EN 13555)

Manufacturer: Jeil E&S CO. LTD.

Product: **JIC3836-R-SF-316-SS**

Minimum required Gasket Stress in Assembly $Q_{min(L)}$ [MPa]

L / p [bar]	10	1	0.1	0.01	0.001	0.0001	0.00001
40	6	9	17	58	116	x	x
test no.	12-323						
40	5	6	19	61	115	x	x
test no.	12-326						

Minimum required Gasket Stress in Operation $Q_{smin(L)}$ [MPa]

	L / Q_A [MPa]	10	1	0.1	0.01	0.001	0.0001	0.00001
p = 40 bar	10	5	8	x	x	x	x	x
	20	5	5	10	x	x	x	x
	40	5	5	9	x	x	x	x
	60	5	5	9	55	x	x	x
	80	5	5	9	29	x	x	x
	100	5	5	9	20	x	x	x
	160	10*	10*	10*	14	61	x	x
	test no.	12-323						

Minimum required Gasket Stress in Operation $Q_{smin(L)}$ [MPa]

	L / Q_A [MPa]	10	1	0.1	0.01	0.001	0.0001	0.00001
p = 40 bar	10	5	5	x	x	x	x	x
	20	5	5	14	x	x	x	x
	40	5	5	9	x	x	x	x
	60	5	5	9	60	x	x	x
	80	5	5	9	28	x	x	x
	100	10*	10*	10*	19	x	x	x
	160	10*	10*	10*	13	54	x	x
	test no.	12-326						

* an high increase of the leak rate after unloading to 5 MPa is recognizable

Shell leakage test at ambient temperature

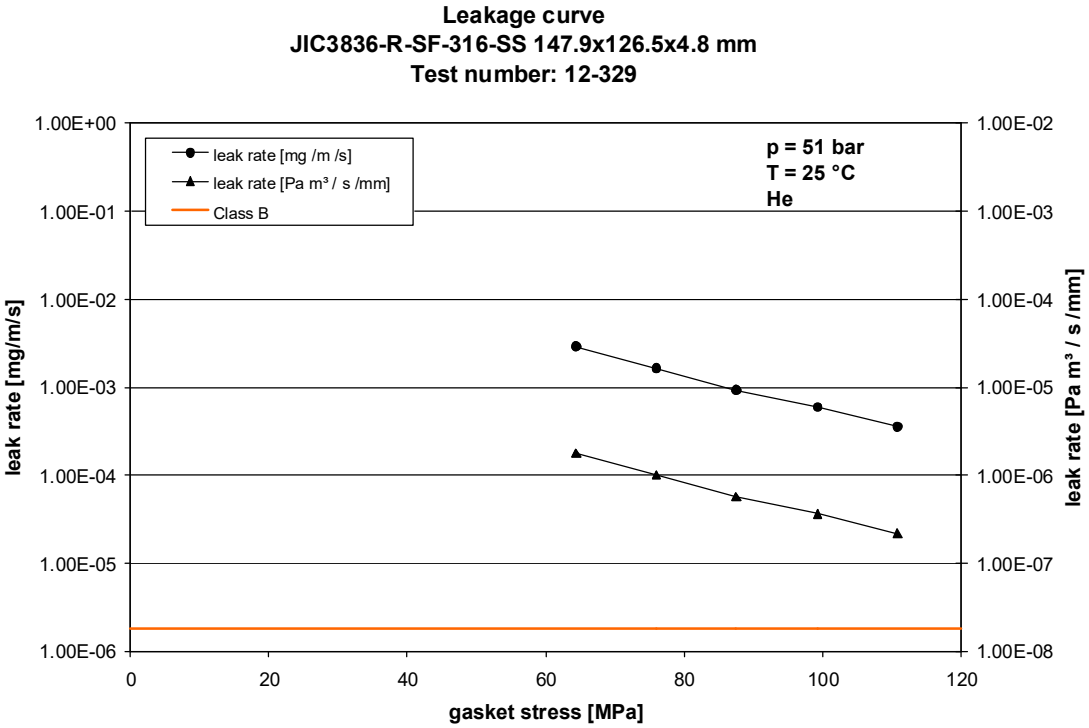
Test pressure:	51	bar
Maximum gasket stress level:	111.1	MPa
Leakage rate:	2.20E-07	Pa.m³/s/mm
Shell tightness class:	-	
test no.	12-329	

Shell leakage test at 400 °C

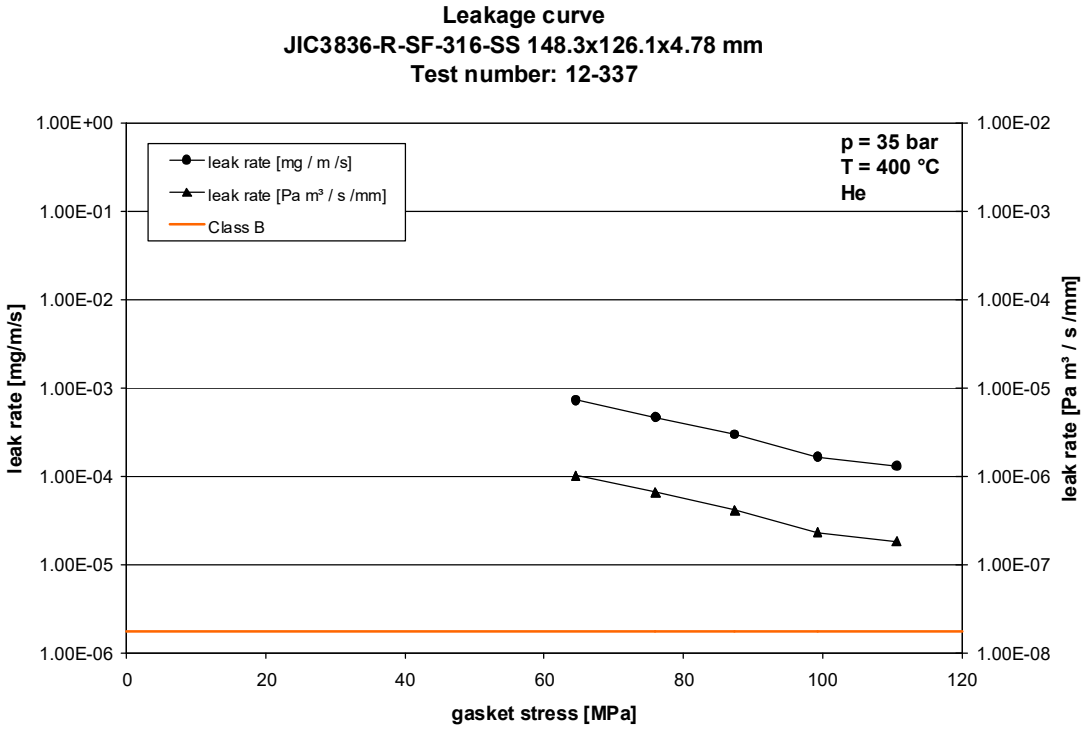
Test pressure:	34.7	bar
Maximum gasket stress level:	111.1	MPa
Leakage rate:	1.80E-07	Pa.m³/s/mm
Shell tightness class:	-	
test no.	12-337	

Shell cycle test at 400 °C

Test pressure:	34.7	bar
Initial gasket stress level:	64.6	MPa
Pressure drop in last cycle:	< 1	bar
test no.	12-339	

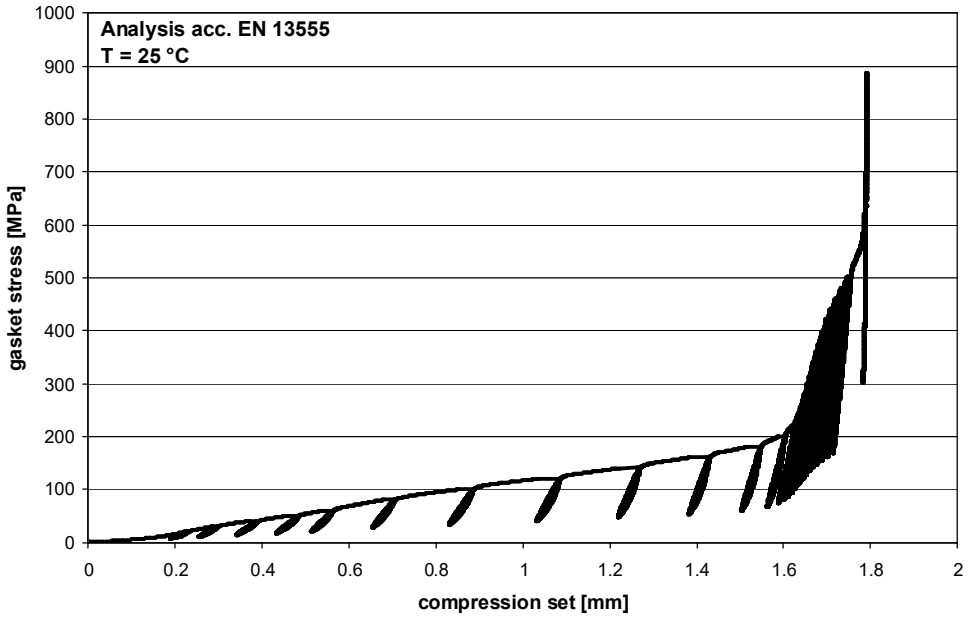


Shell leakage test (RT) according MESC SPE 85/300 - 3.3.2

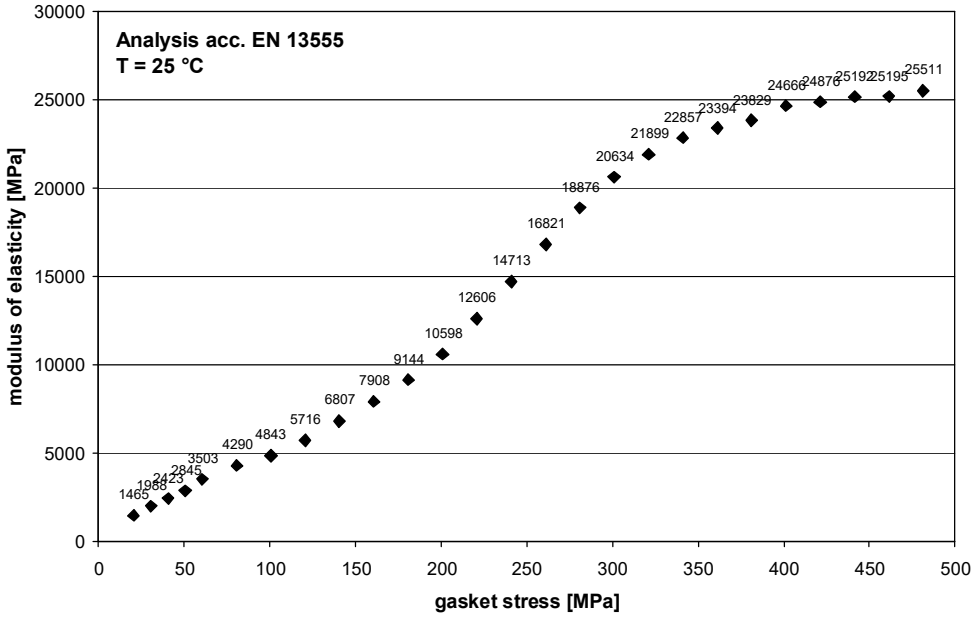


Shell leakage test (T) according MESC SPE 85/300 - 3.3.2

Compression curve
JIC3836-R-SF-316-SS 67.35x55.89x4.849 mm
Test number: 12-324

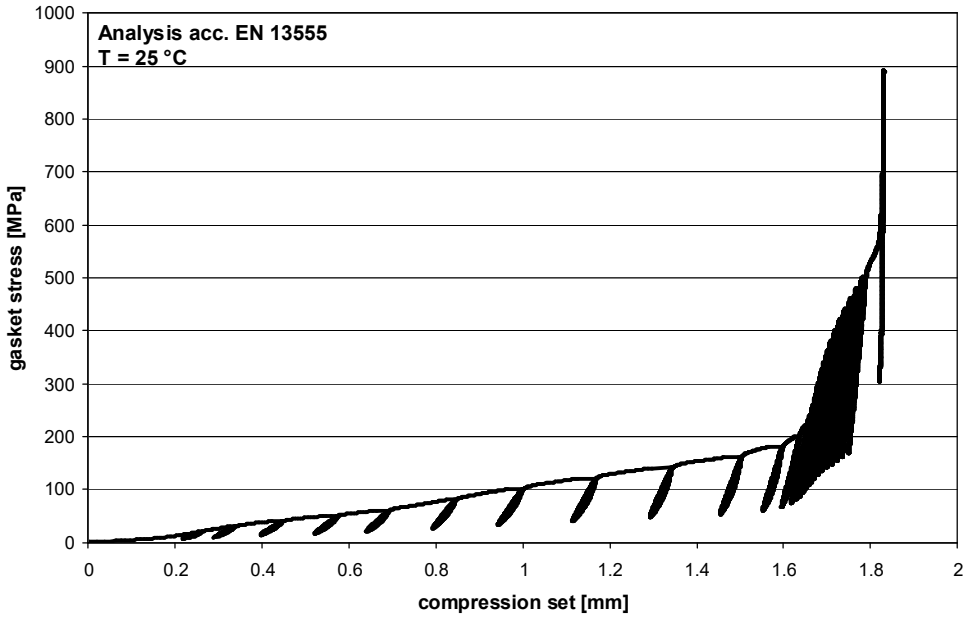


Modulus of elasticity
JIC3836-R-SF-316-SS 67.35x55.89x4.849 mm
Test number: 12-324

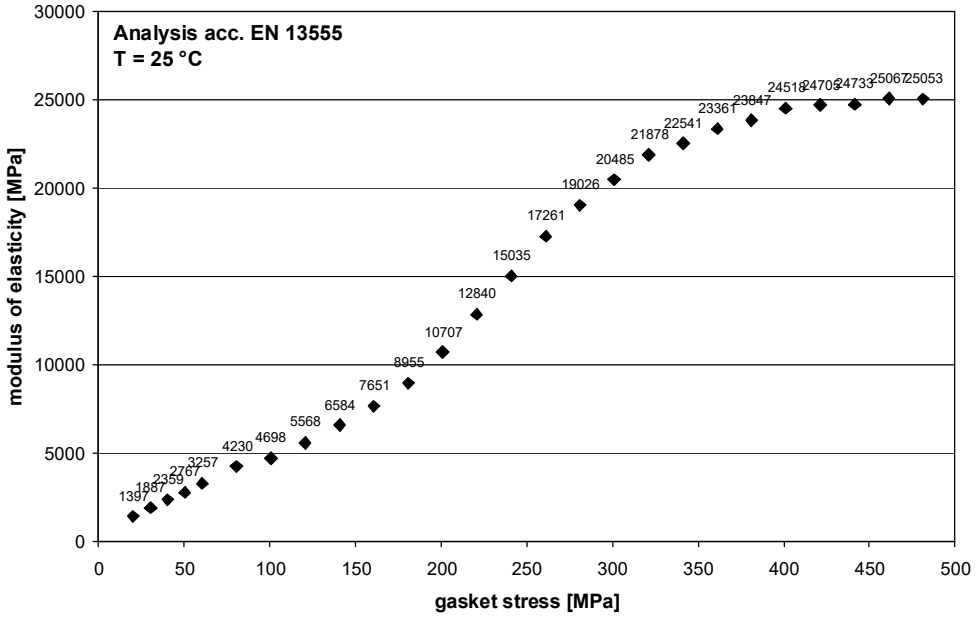


Compression test (RT) according EN 13555

Compression curve
JIC3836-R-SF-316-SS 67.34x55.94x4.86 mm
Test number: 12-325

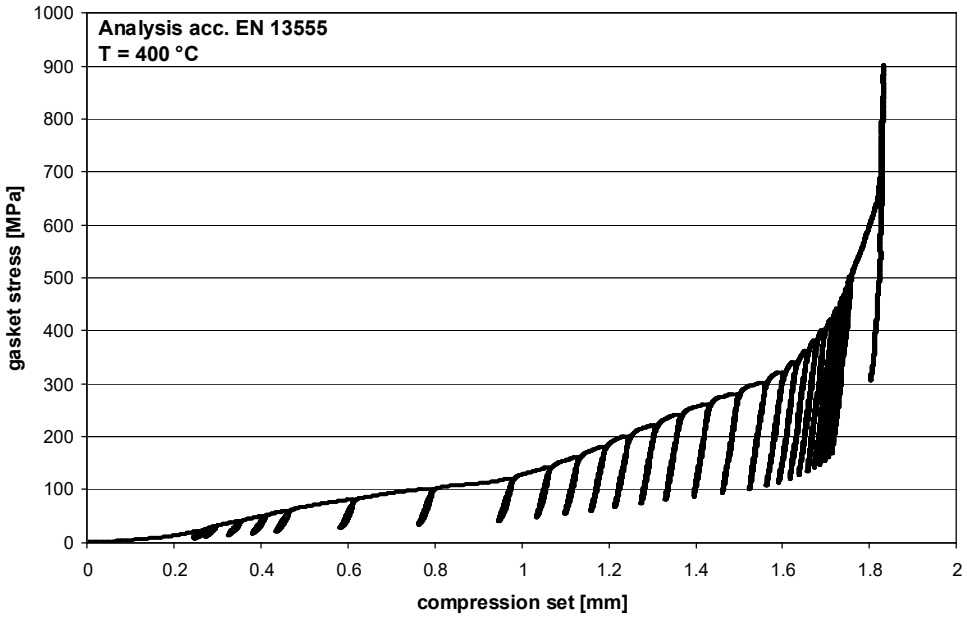


Modulus of elasticity
JIC3836-R-SF-316-SS 67.34x55.94x4.86 mm
Test number: 12-325

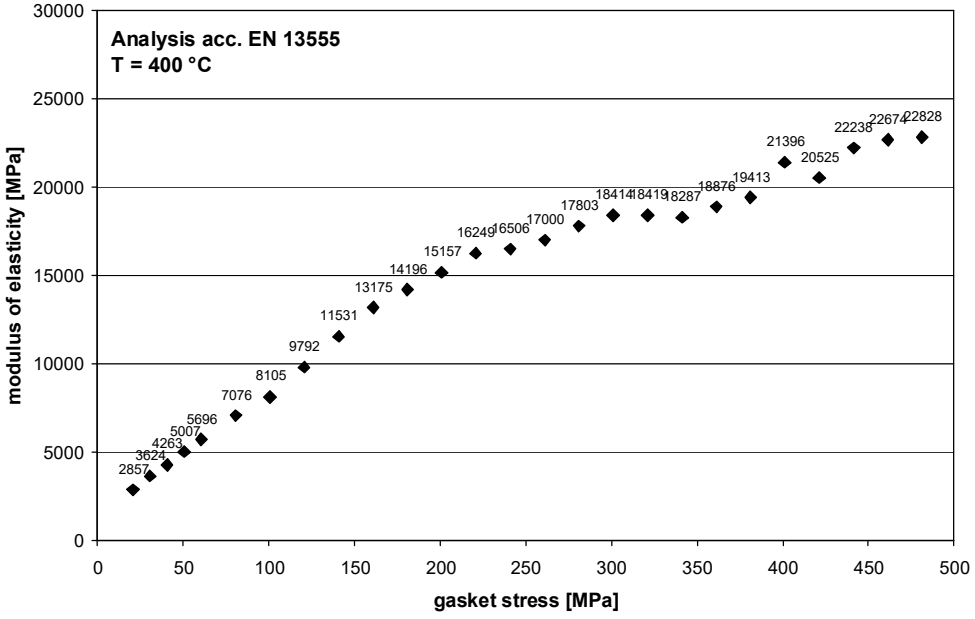


Compression test (RT) according EN 13555

Compression curve
JIC3836-R-SF-316-SS 67.28x56x4.867 mm
Test number: 12-336

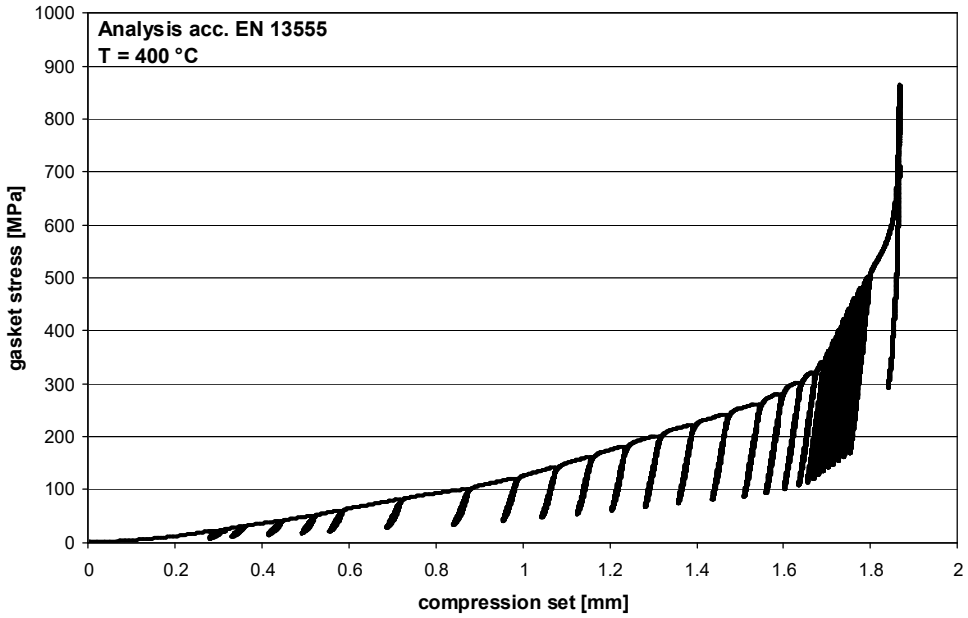


Modulus of elasticity
JIC3836-R-SF-316-SS 67.28x56x4.867 mm
Test number: 12-336

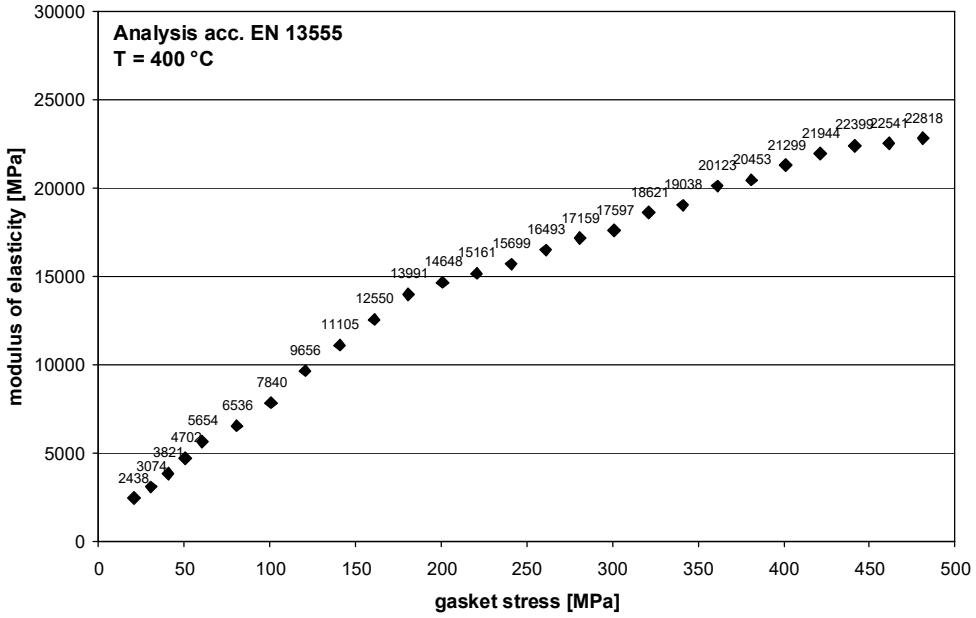


Compression test at 400 °C according EN 13555

Compression curve
JIC3836-R-SF-316-SS 67.59x55.82x4.869 mm
Test number: 12-340



Modulus of elasticity
JIC3836-R-SF-316-SS 67.59x55.82x4.869 mm
Test number: 12-340



Compression test at 400 °C according EN 13555

Creep relaxation test (EN 13555)

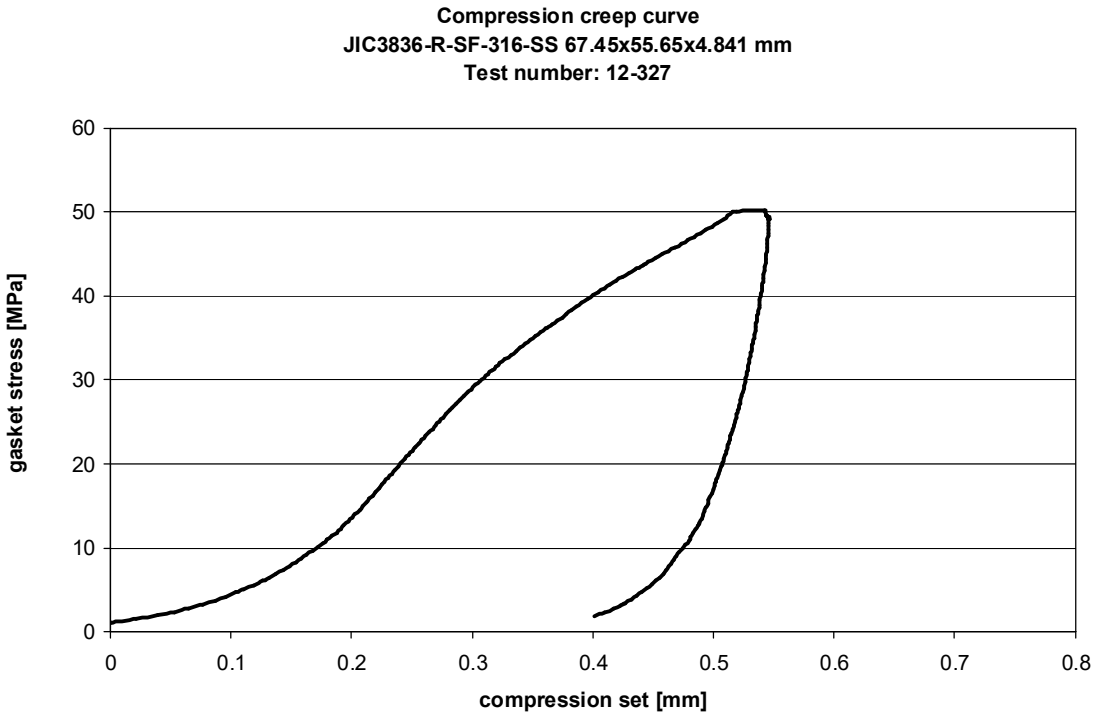
JIC3836-R-SF-316-SS
67.45x55.65x4.841 mm
Test number: 12-327

Test parameters

Initial gasket stress Q_i:	50.2	MPa
Test temperature T_P:	25	°C
Time at T_P:	3:59	hh:mm
Stiffness C:	500	kN/mm

Test results

Remaining gasket stress Q_r:	49.2	MPa
Relaxation factor $P_{QR}(T_P)$:	0.98	



Creep relaxation test (EN 13555)

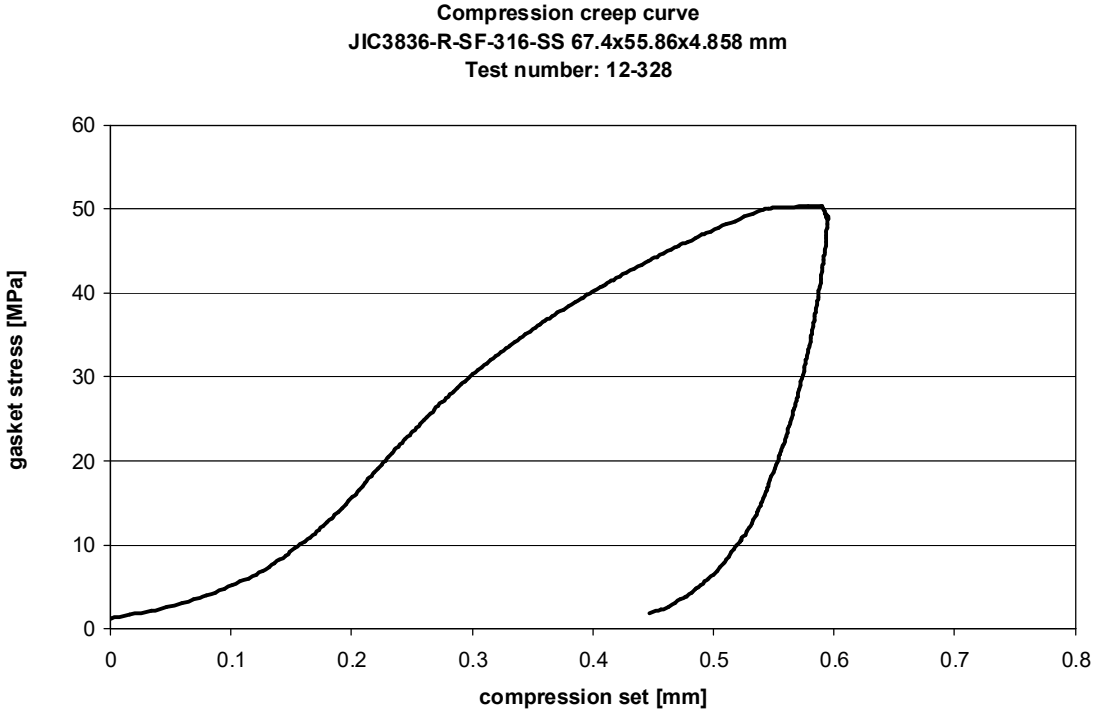
JIC3836-R-SF-316-SS
67.4x55.86x4.858 mm
Test number: 12-328

Test parameters

Initial gasket stress Q_i:	50.4	MPa
Test temperature T_P:	25	°C
Time at T_P:	3:59	hh:mm
Stiffness C:	500	kN/mm

Test results

Remaining gasket stress Q_r:	48.8	MPa
Relaxation factor $P_{QR}(T_P)$:	0.97	



Creep relaxation test (EN 13555)

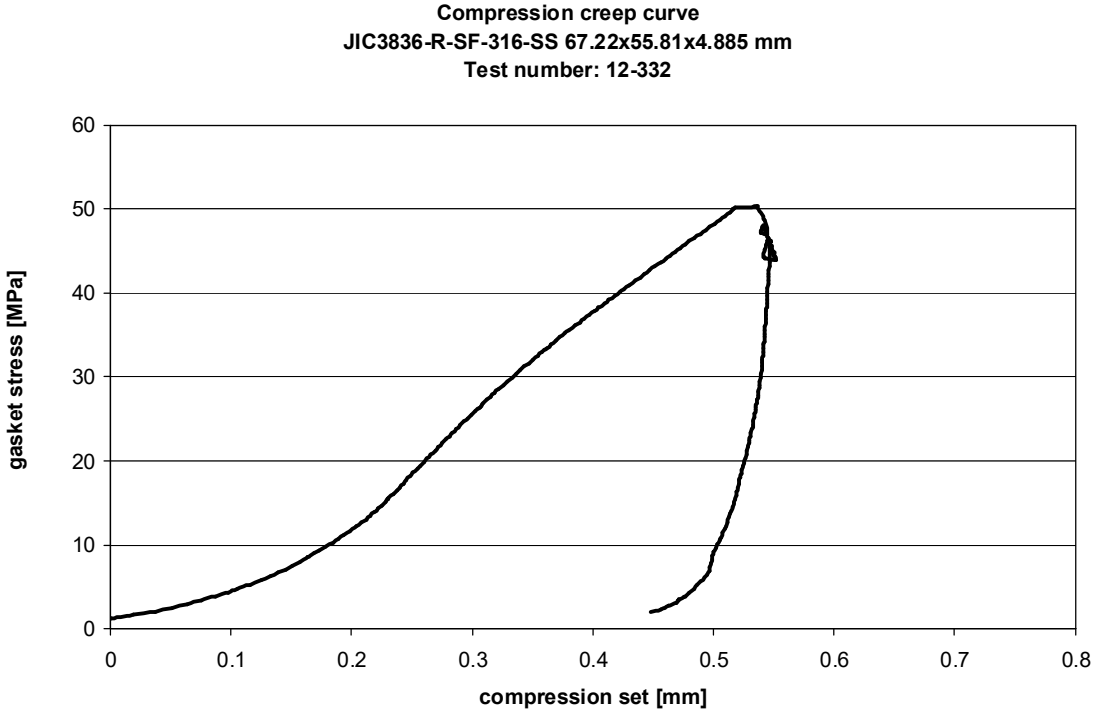
JIC3836-R-SF-316-SS
67.22x55.81x4.885 mm
Test number: 12-332

Test parameters

Initial gasket stress Q_i:	50.3	MPa
Test temperature T_P:	400	°C
Time at T_P:	4:00	hh:mm
Stiffness C:	500	kN/mm

Test results

Remaining gasket stress Q_r:	45.9	MPa
Relaxation factor $P_{QR}(T_P)$:	0.91	



Creep relaxation test (EN 13555)

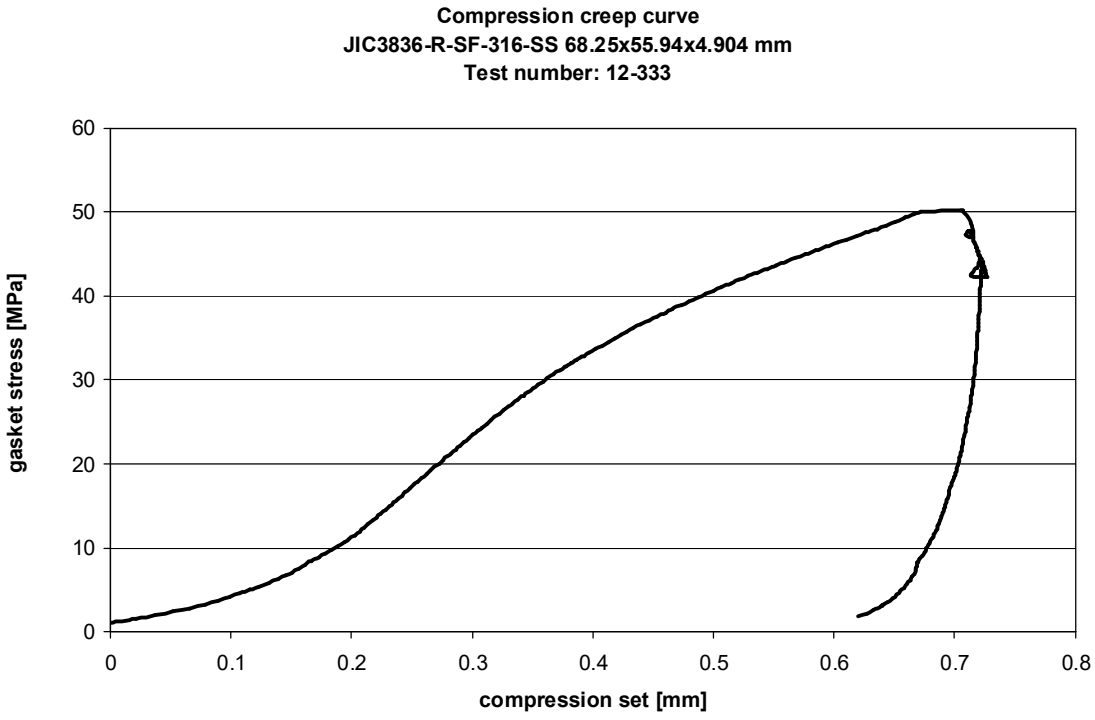
JIC3836-R-SF-316-SS
68.25x55.94x4.904 mm
Test number: 12-333

Test parameters

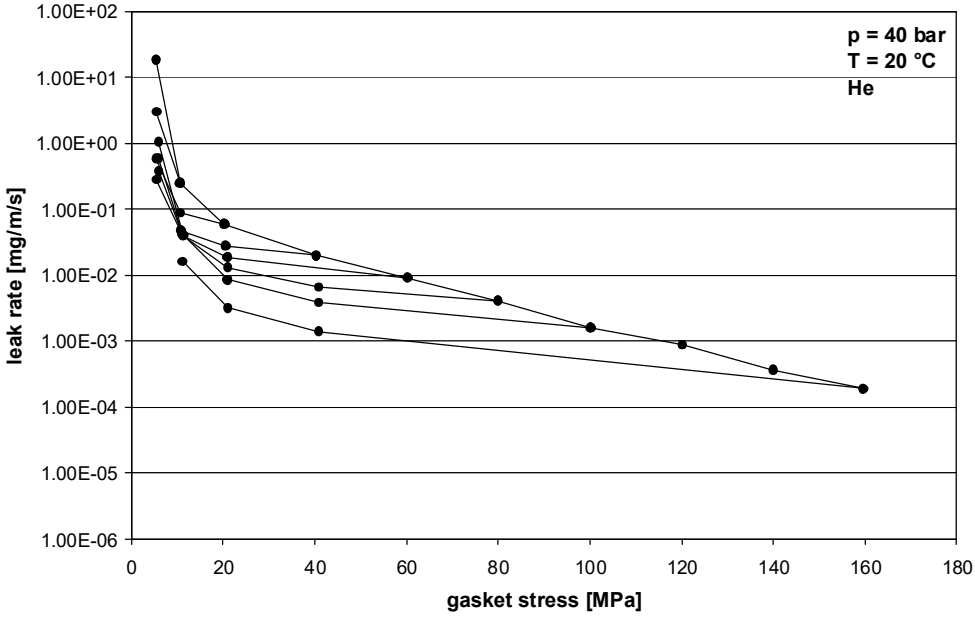
Initial gasket stress Q_i:	50.2	MPa
Test temperature T_P:	400	°C
Time at T_P:	4:00	hh:mm
Stiffness C:	500	kN/mm

Test results

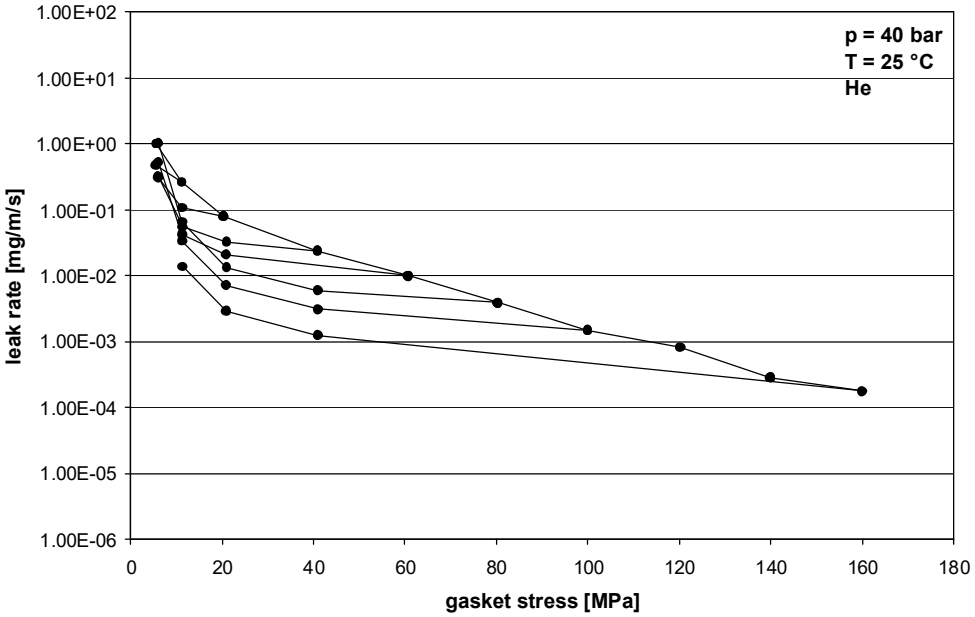
Remaining gasket stress Q_r:	43.9	MPa
Relaxation factor $P_{QR}(T_P)$:	0.87	



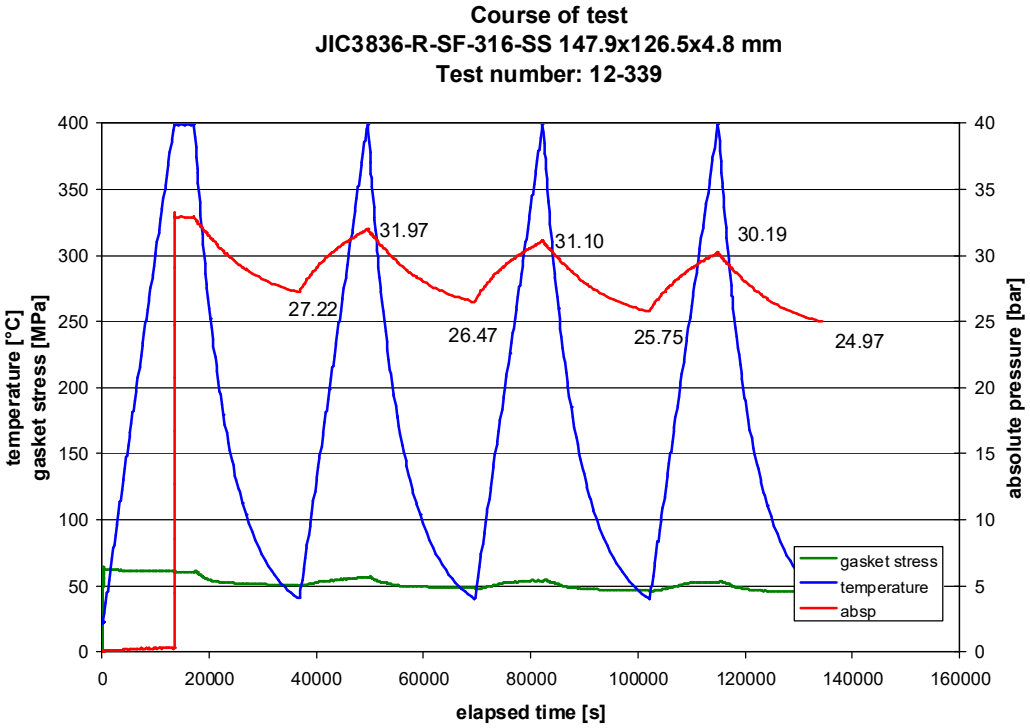
Leakage curve
JIC3836-R-SF-316-SS 67.41x55.84x4.915 mm
Test number: 12-323



Leakage curve
JIC3836-R-SF-316-SS 67.38x55.6x4.879 mm
Test number: 12-326



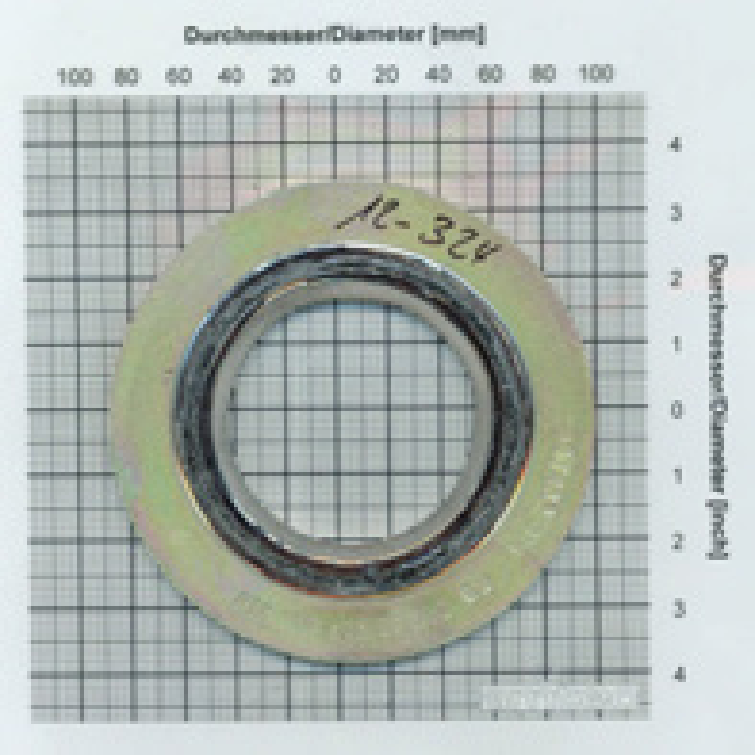
Leakage test according EN 13555



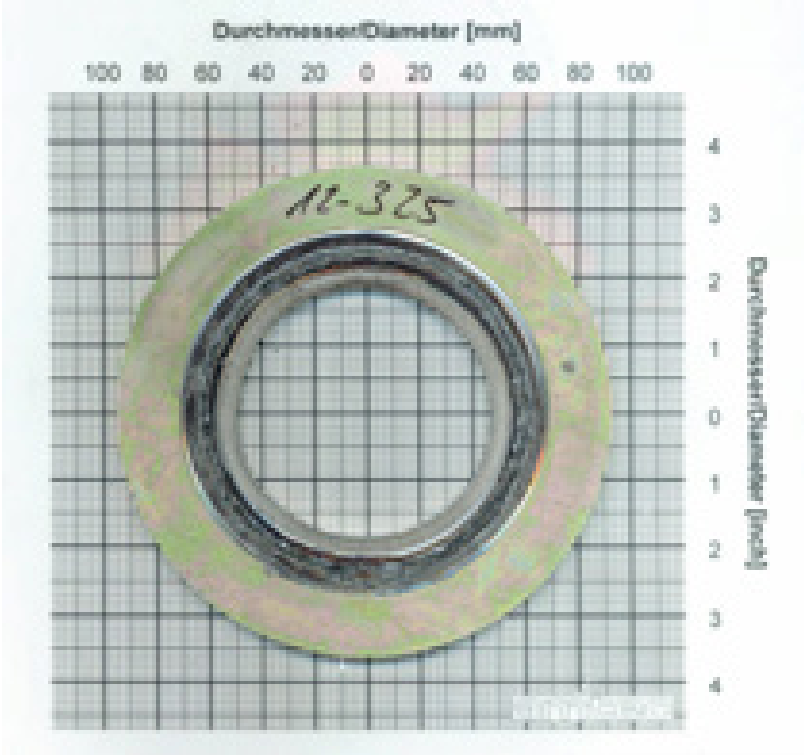
Shell cycle test at 400 °C according MESC SPE 85/300 - 3.3.5

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

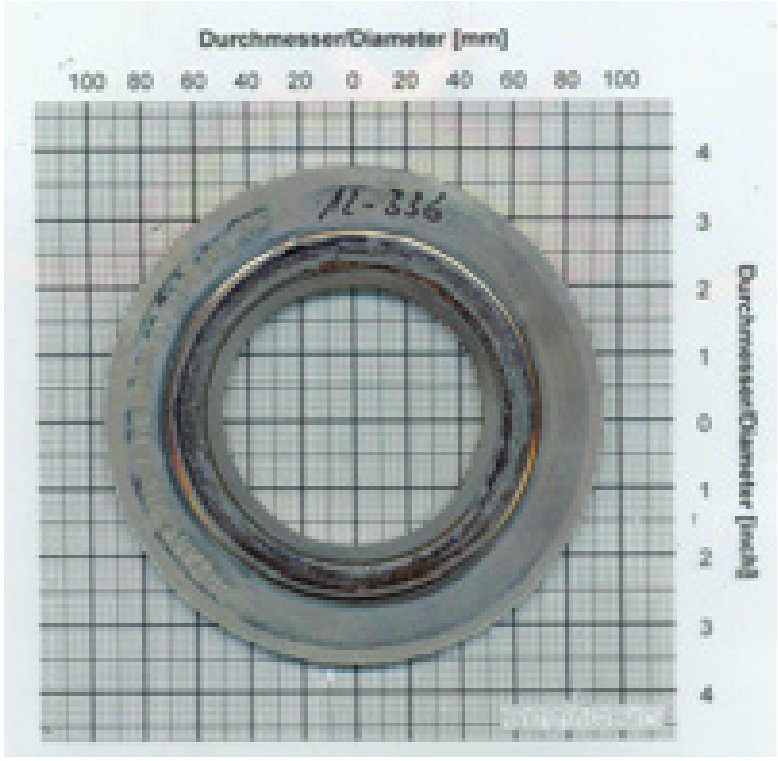
Shell leakage test (T) according MESC SPE 85/300 - 3.3.2



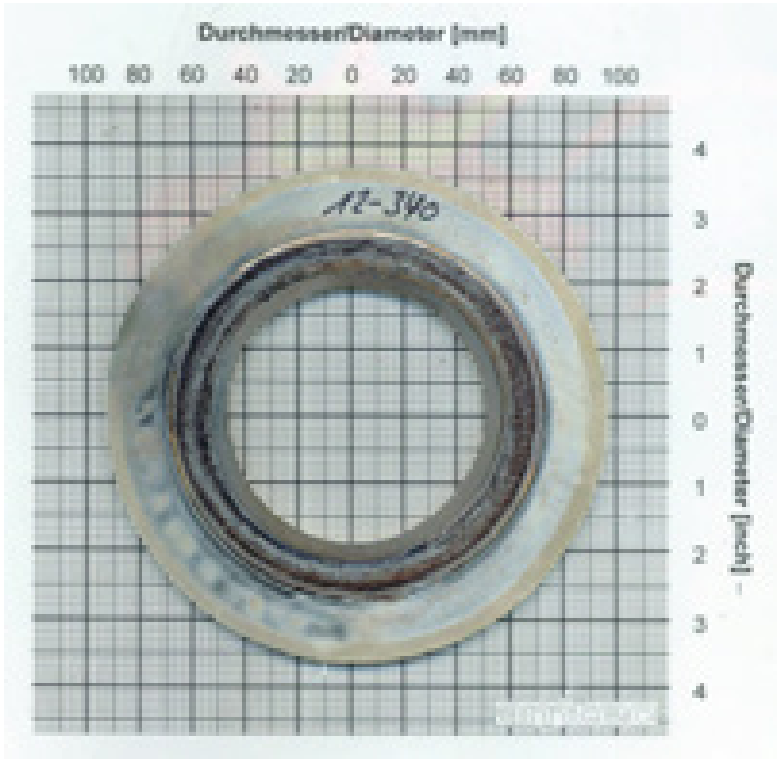
Compression test at RT (EN 13555)



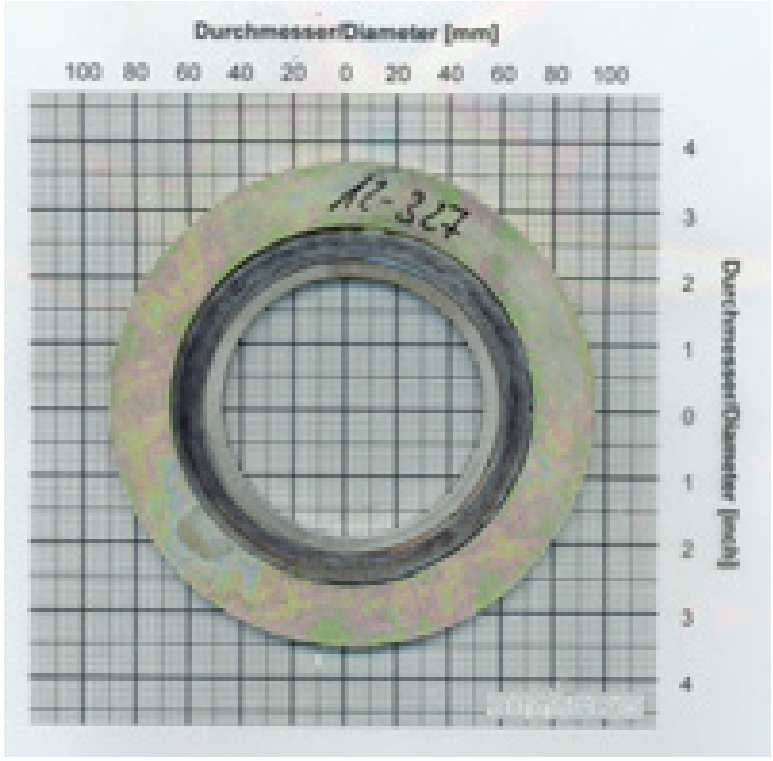
Compression test at RT (EN 13555)



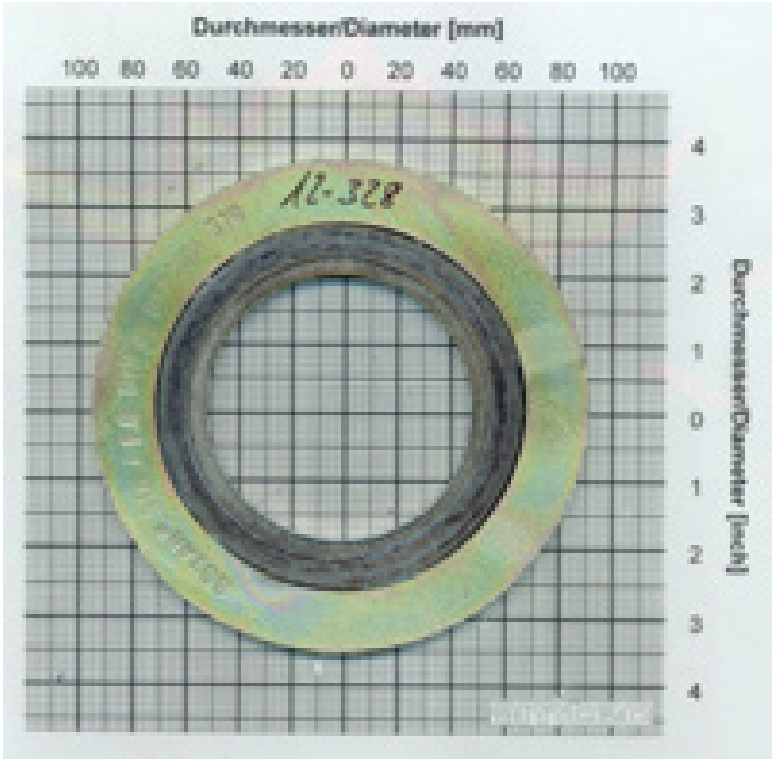
Compression test at 400 °C (EN 13555)



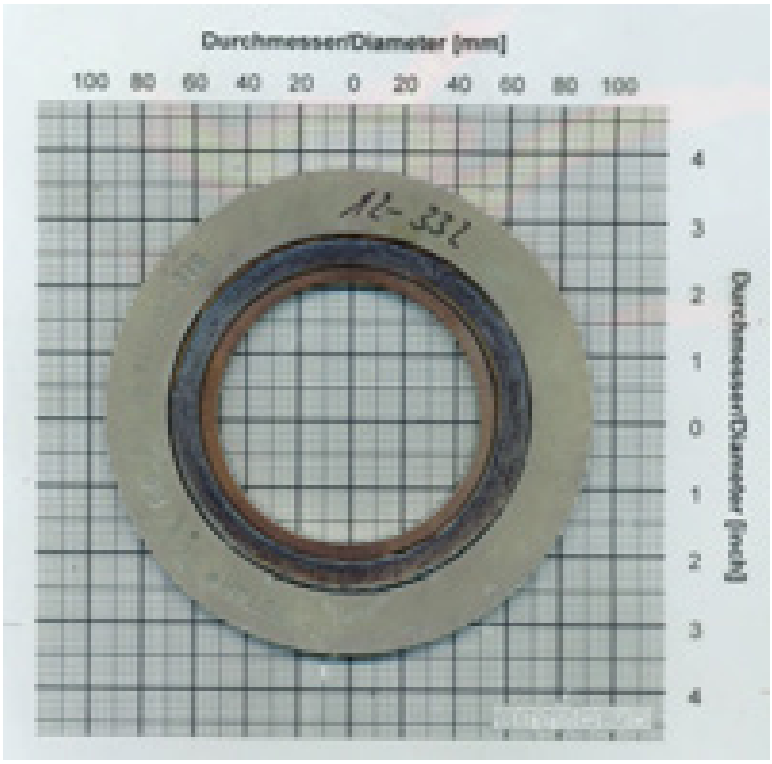
Compression test at 400 °C (EN 13555)



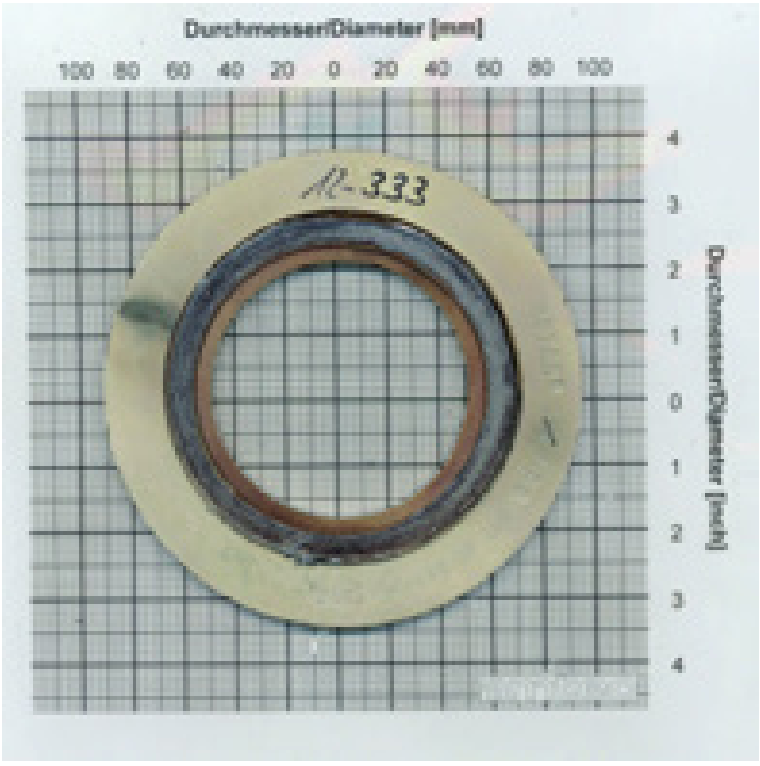
Creep relaxation test at 50 MPa - RT (EN 13555)



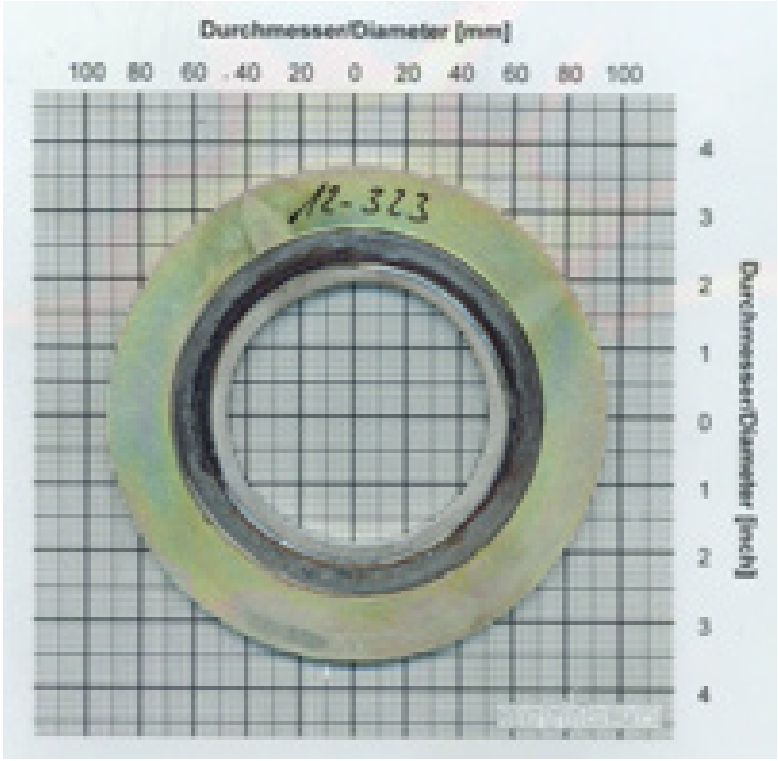
Creep relaxation test at 50 MPa - RT (EN 13555)



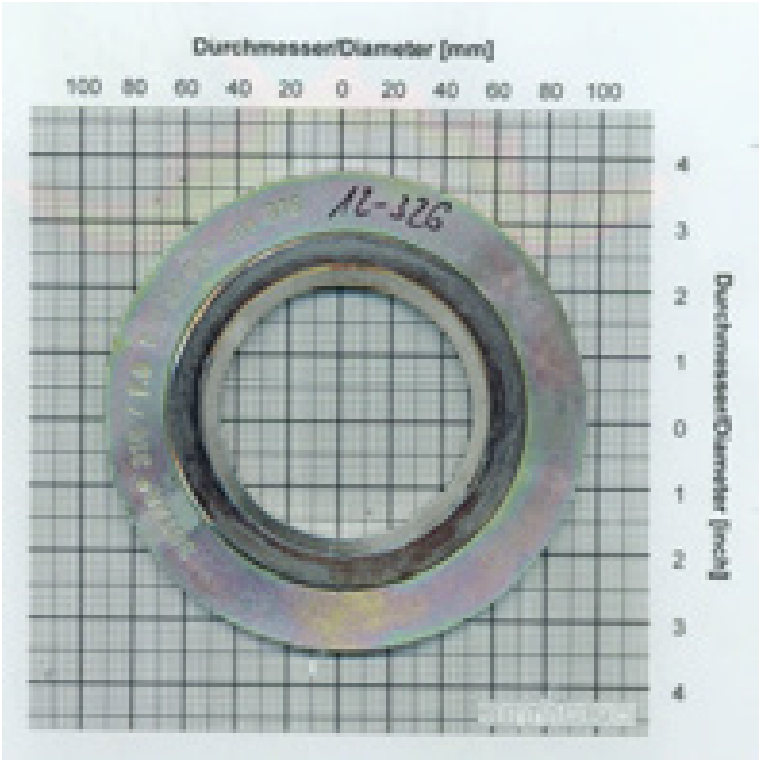
Creep relaxation test at 50 MPa - 400 °C (EN 13555)



Creep relaxation test at 50 MPa – 400 °C (EN 13555)



Leakage test at RT (EN 13555)



Leakage test at RT (EN 13555)

Shell cycle test (T) according MESC SPE 85/300 - 3.3.5

TEST REPORT

Dong-A University
Technical Center for
High-Performance Valves

SM226, 37 Nakdong-Daero 550beon-gil,
Saha-gu, Busan-city, Korea
(Tel: +82 51-200-6546 Fax: +82 51 200-6508)

Certificate No.:
TCHPV-16-07-109

1. Client
   - Name : JEIL E&S CO., LTD
   - Address : 309, Chungnyeol-ro, Yangsan-si, Gyeongsangnam-do, Korea
   - Date of Receipt : 2016. 07. 04

2. Use of Report : Quality Management

3. Test Sample : THERMBLOK 431-UHT(300 CLASS - 2 INCH RF TYPE)

4. Date of Test : 2016. 07. 15

5. Test method used :
   Reference to the 'API STANDARD 607:2010_SIXTH EDITION, SEPTEMBER 2010'
   <Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats>

6. Test Locations & Environment
   - Locations : Laboratory of TCHPV (Room No. SM118, S14, DONG-A UNIV.)
   - Temperature : (21.9 ± 3.0) ℃
   - Relative Humidity : (63 ± 5) % RH

7. Test Result : Page 3 & 4.

Affirmation	Tested by Researcher Name : J.Y. KWON (Signature)	Approved by Technical Manager Name : S.J. OH (Signature)

* The results shown in this test report refer only to the sample(s) tested, unless otherwise stated. This Test Report cannot be reproduced, except in full.

2016. 07. 27.

Director of Dong-A University
Technical Center for High Performance Valves

◆Test Result

1) Test :
JEIL E&S Stainless Steel Reinforced sheets Gaskets (THERMBLOK 4201-UHT) - Fire Safety Test

2) Test Method Used :

Fire safety test has performed in accordance with API STANDARD 607:2010_SIXTH EDITION, SEPTEMBER 2010

<Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats>

1. Install test flange onto sample gasket and connect it to a pipe inside the chamber of Fire Safety Test Equipment.
2. Pressurize the system with water to a test pressure of 1.4 times the maximum permissible working pressure at 20℃ the actual test pressure may be rounded up to the next highest bar. Check for leaks in the test apparatus and eliminate as necessary. Release the pressure.
3. Pressurize the system to 2 bar.(Test pressure was request of manufacturer.)
4. Open the fuel supply, establish a fire and monitor the flame environment temperature throughout the burn period of 30 min. Maintain the average temperature between 750℃ and 1000℃, for the burn period of 30 minutes.
5. At the end of the burn period shut off the fuel supply. And force-cool with water so that its external surface temperature remains below 100℃.
(Less than 10 minutes after extinguishing the fire.)
6. Measure external leakage.

3) Test Sample

Model		THERMBLOK 4201-UHT
Type		Stainless Steel Reinforced sheets Gaskets
Material		Vermiculite, Stainless Steel Tanged
Class		300 Class - 2 Inch
Weight		17.8 g
Pressure Test Report (Attach. 04)	**REF. NO.**	연구소 16-005
	DATE	2016. 03. 18.

4) Test Result

① Fire Burn Test Record

Time Min:Sec	Upstream Pressure MPa	Flame Temp. ℃		Calorimeter Temp. ℃		Body Temp. ℃	Connector Temp. ℃
		T1	T2	T3	T4	T5	T6
06:30	0.24	34.80	30.10	32.70	30.30	75.30	89.40
36:30	0.21	848.80	858.60	906.50	823.40	928.20	825.30
Average	0.24	842.06	835.97	750.16	765.84	891.40	822.30

Time Min:Sec	Sight Gauge In Vessel 192.4 mL/mm	Reading in Container g = mL
	mL	mL
06:30	96 584.80	
36:30		

② Cool Down Test Record

Time Min:Sec	Upstream Pressure MPa	Flame Temp. ℃		Calorimeter Temp. ℃		Body Temp. ℃	Connector Temp. ℃
		T1	T2	T3	T4	T5	T6
36:30	0.21	848.80	858.60	906.50	823.40	928.20	825.30
46:30	0.22	57.90	96.50	29.40	29.10	26.80	28.00

Time Min:Sec	Sight Gauge In Vessel 192.4 mL/mm	Reading in Container g = mL
	mL	mL
36:30		
46:30	96 584.80	

③ Low Pressure Test Record

Time Min:Sec	Upstream Pressure MPa	Flame Temp. ℃		Calorimeter Temp. ℃		Body Temp. ℃	Connector Temp. ℃
		T1	T2	T3	T4	T5	T6
46:30	0.22	57.90	96.50	29.40	29.10	26.80	28.00
51:30	0.22	32.60	54.10	29.30	29.80	27.60	30.60

Time Min:Sec	Sight Gauge In Vessel 192.4 mL/mm	Reading in Container g = mL
	mL	mL
46:30		
51:30	96.5848.80	

④ Fire Safe Test Result

No	External leakage [mL/min]	
	During burn and cool-down period	
	Permissible Leakage	Actual Leakage
1	100.00	0.00
Test Result	The Actual Leakage is lower than the Permissible Leakage	

- END -

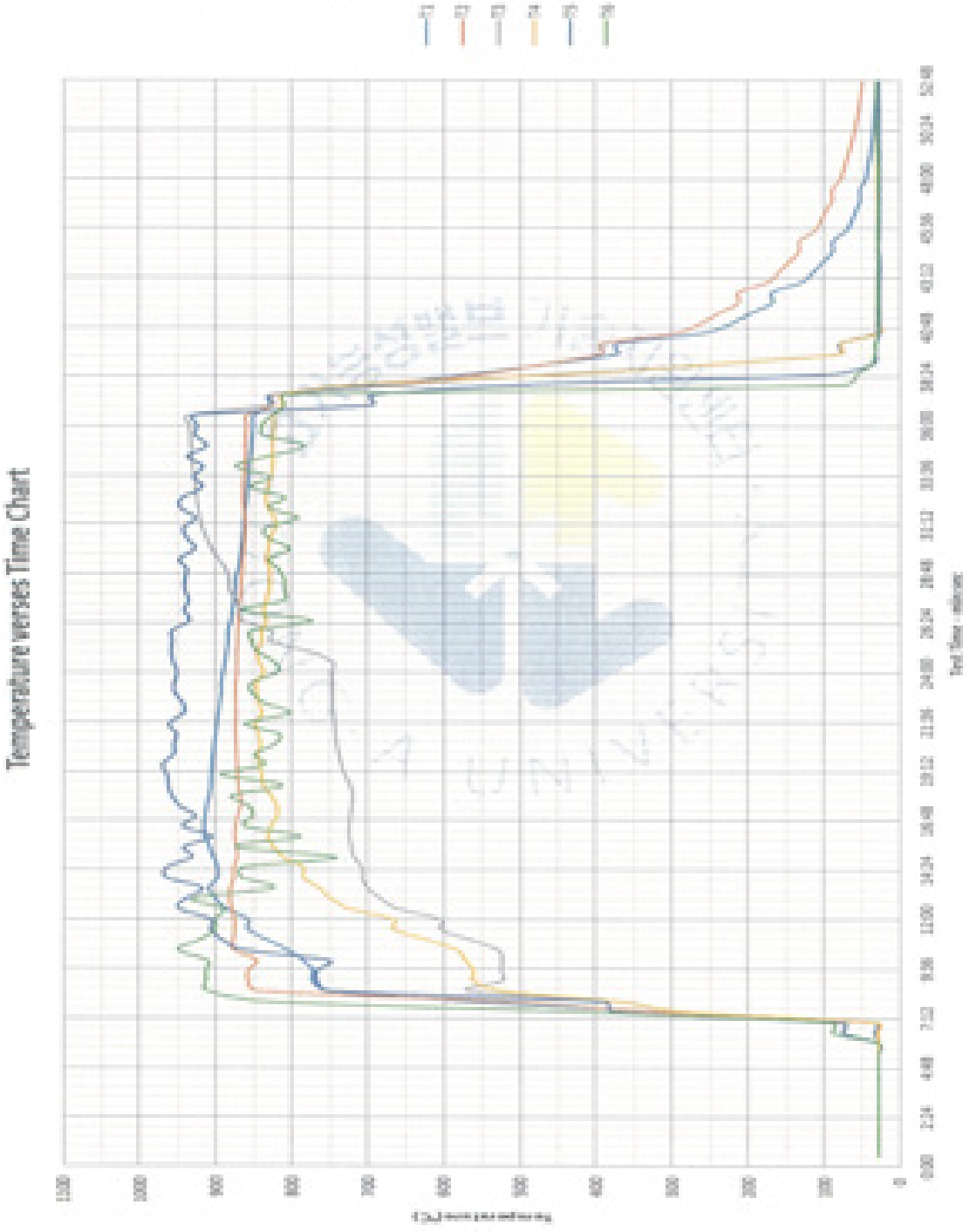
※Attached files

Attach.01 Burning Temperature & Pressure Records

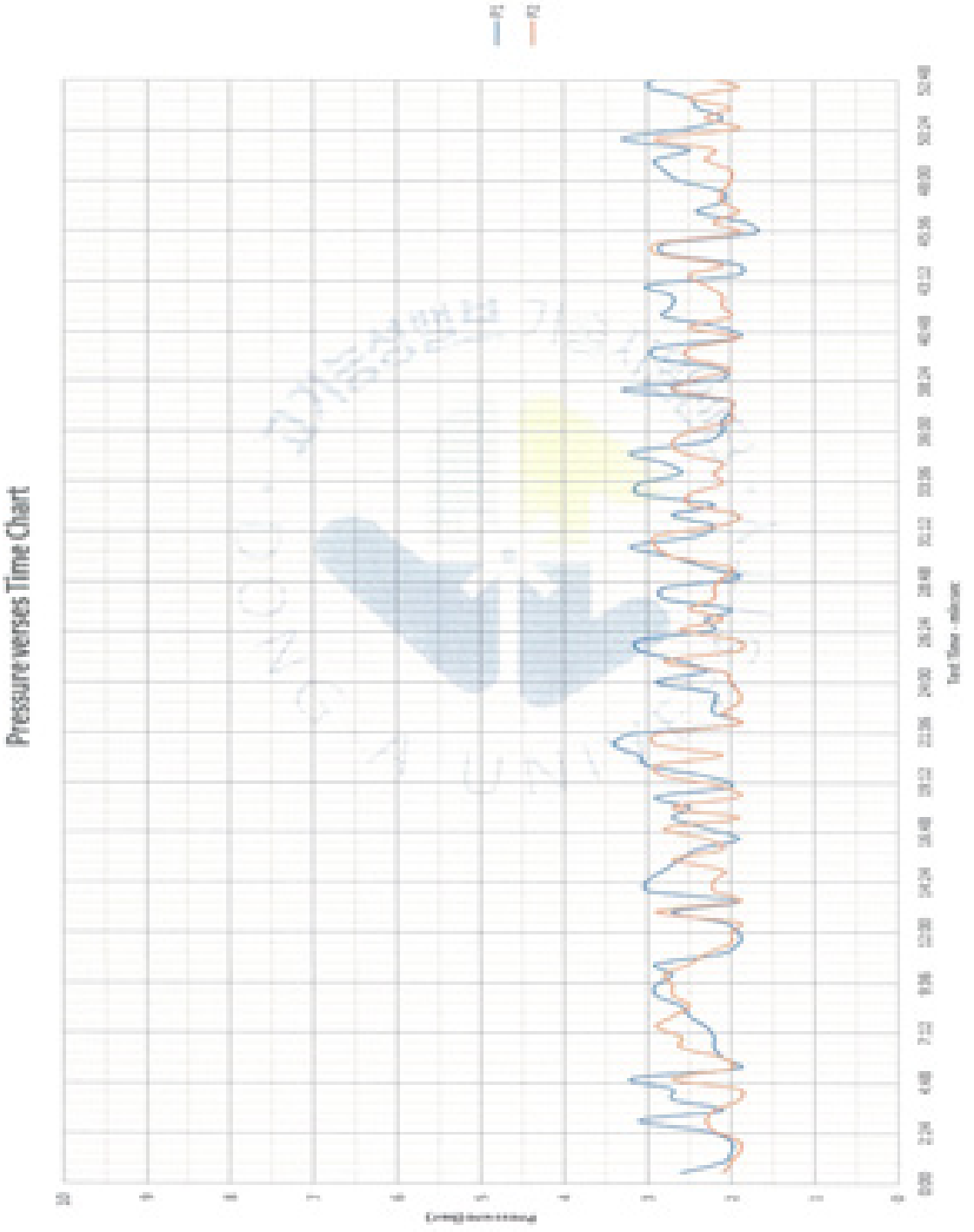
Time	t1	t2	t3	t4	t5	t6	p1	p2
Min:Sec	℃	℃	℃	℃	℃	℃	MPa	MPa
6:30	34.80	30.10	32.70	30.30	75.30	89.40	0.22	0.26
7:00	34.80	30.10	32.70	30.30	75.30	89.40	0.22	0.26
7:30	307.00	321.30	290.10	286.20	378.40	429.20	0.23	0.29
8:00	562.50	515.50	364.70	369.10	388.60	837.40	0.25	0.27
8:30	753.50	846.10	567.00	525.60	750.60	911.30	0.26	0.25
9:00	772.20	857.30	525.00	561.00	766.90	912.50	0.29	0.27
9:30	772.20	857.30	525.00	561.00	766.90	912.50	0.29	0.27
10:00	784.30	846.10	524.30	572.20	750.60	911.30	0.27	0.28
10:30	805.50	876.80	528.60	583.70	864.20	960.10	0.29	0.25
11:00	832.50	877.10	565.40	623.60	891.70	920.40	0.21	0.23
11:30	857.10	875.80	604.20	666.40	906.50	900.80	0.19	0.20
12:00	857.10	875.80	604.20	666.40	906.50	900.80	0.19	0.20
12:30	886.40	879.50	660.10	724.10	948.80	890.10	0.21	0.19
13:00	900.20	881.70	682.00	748.70	939.80	930.60	0.27	0.29
13:30	908.80	880.90	699.50	763.70	917.40	824.50	0.19	0.19
14:00	897.30	876.60	706.80	784.60	964.10	864.60	0.30	0.22
14:30	897.30	876.60	706.80	784.60	964.10	864.60	0.30	0.22
15:00	903.20	871.80	717.30	810.90	931.70	740.90	0.28	0.21
15:30	908.00	873.20	720.70	824.00	941.70	873.90	0.26	0.27
16:00	913.40	875.20	723.70	831.20	904.80	788.10	0.24	0.21
16:30	915.00	874.40	723.70	827.30	943.00	860.90	0.19	0.23
17:00	913.80	871.60	722.20	819.20	926.90	850.90	0.23	0.28
17:30	911.60	867.30	720.30	819.80	947.90	856.40	0.27	0.19
18:00	908.20	867.50	719.10	827.20	958.20	878.70	0.25	0.27
18:30	906.20	870.60	722.10	837.50	962.40	811.70	0.29	0.19
19:00	905.90	871.30	729.20	838.80	963.80	892.40	0.20	0.21
19:30	904.80	872.10	734.30	842.90	969.70	836.00	0.23	0.28
20:00	903.50	873.00	737.60	844.00	965.60	849.10	0.30	0.29
20:30	902.20	873.30	740.70	841.30	954.90	822.30	0.31	0.21
21:00	900.00	874.40	742.30	844.20	952.30	816.60	0.34	0.29
21:30	898.00	874.20	743.40	847.90	961.30	860.40	0.32	0.29
22:00	896.30	873.50	744.70	839.00	942.00	801.30	0.19	0.19

Time	t1	t2	t3	t4	bonnet	body	p1	p2
Min:Sec	℃	℃	℃	℃	℃	℃	MPa	MPa
22:30	894.50	874.00	746.10	843.40	943.00	835.20	0.22	0.21
23:00	892.20	874.10	746.10	845.70	954.70	852.30	0.22	0.19
23:30	892.20	874.10	746.10	845.70	954.70	852.30	0.22	0.19
24:00	889.80	872.20	746.80	836.50	951.20	818.50	0.29	0.20
24:30	887.50	872.20	746.00	843.00	956.30	822.40	0.23	0.21
25:00	885.50	872.50	776.80	845.60	958.60	845.30	0.26	0.28
25:30	883.50	871.20	826.20	839.30	957.40	852.00	0.31	0.19
26:00	883.50	871.20	826.20	839.30	967.40	852.00	0.31	0.19
26:30	879.80	869.80	863.50	833.40	935.30	773.20	0.22	0.26
27:00	878.00	869.60	867.60	836.70	941.10	864.90	0.23	0.21
27:30	876.30	867.90	873.00	833.50	936.00	810.30	0.20	0.25
28:00	874.40	865.80	882.30	829.20	940.30	809.20	0.28	0.22
28:30	874.40	865.80	882.30	829.20	940.30	809.20	0.28	0.22
29:00	870.20	863.80	886.50	828.60	938.20	817.20	0.19	0.21
29:30	867.90	863.80	896.10	833.40	947.70	829.00	0.23	0.20
30:00	865.60	862.80	905.50	830.10	927.90	802.50	0.27	0.27
30:30	863.80	861.10	911.30	828.70	937.40	828.90	0.32	0.29
31:00	862.30	860.30	917.40	822.00	942.40	834.30	0.24	0.29
31:30	861.70	860.70	920.50	822.70	926.70	791.50	0.22	0.21
32:00	860.30	862.70	923.30	831.10	947.30	829.70	0.27	0.19
32:30	858.80	863.50	925.40	833.30	943.60	808.70	0.22	0.25
33:00	857.80	863.70	927.00	831.10	917.10	854.20	0.31	0.25
33:30	856.40	862.10	929.30	827.50	929.20	826.80	0.31	0.21
34:00	855.60	861.00	930.50	824.90	916.50	874.00	0.26	0.22
34:30	854.20	860.70	932.00	824.50	937.20	830.40	0.28	0.21
35:00	852.90	860.90	932.90	825.40	911.50	782.90	0.32	0.26
35:30	851.60	860.20	933.40	824.90	927.40	835.80	0.23	0.27
36:00	849.90	858.80	934.80	822.90	924.40	838.00	0.21	0.25
36:30	848.80	858.60	936.50	823.40	928.20	825.30	0.21	0.20
AVG.	**863.83**	**863.40**	**906.23**	**828.90**	**934.23**	**824.00**	**0.25**	**0.23**

Attach.02 Test Temperature Graph



Attach.03 Test Pressure Graph



SM226, 37 Nakdong-Daero 550beon-gil,
Saha-gu, Busan-city, Korea
(Tel: +82 51-200-6546 Fax: +82 51 200-6598)

Attach.04 Pressure Test Report

JES 제일E&S(주) 부설연구소

시험/분석 보고서

결재	작성	검토		승인
	[illegible]	[illegible]		[illegible]
	3/18	[illegible]		3/18

제 품 명 THERMBLOK

시험일자 2016.3.16~2016.3.17

시 험 자 허인철

Report No. 연구소 16-005

작성일자 2016.03.18(금)

Report Use ■ 내부 보고용 ■ 외부 제출용

Subject THERMBLOK 물성 평가

1. 시험 목적 : THERMBLOK 물성 평가
2. 시험 내용
   - **2-A. Physical Properties:** Compression & Recovery Test
   - **2-B. Sealing Performance:** Test Equipment : TEMES fl.ai-1
3. 결과

3-A Physical Properties

Style No. / Item	THERMBLOK
Actual Test result	Jeil E&S Lab Test data
Sample Thickness	3.0t
ASTM F 36J Compressibility [%]	55~60
ASTM F 36J Recovery [%]	7~8

3-B Sealing Performance (DIN3535-6 Modified)

-Room Temperature

Style No. / Item		THERMBLOK
Actual Test result		Jeil E&S Lab Test data
Test Method		DIN 3535 Modified -Gasket Stress:60MPa -Internal Pressure(N_2): 2, 5, 10, 20, 40, 60, 80 bar -Temperature : Room Temperature
Gas Permeability (ml/min)	2bar	-
	5bar	-
	10bar	0.0026
	20bar	0.0066
	40bar	0.007
	60bar	0.1280

- High Temperature Leakage Test

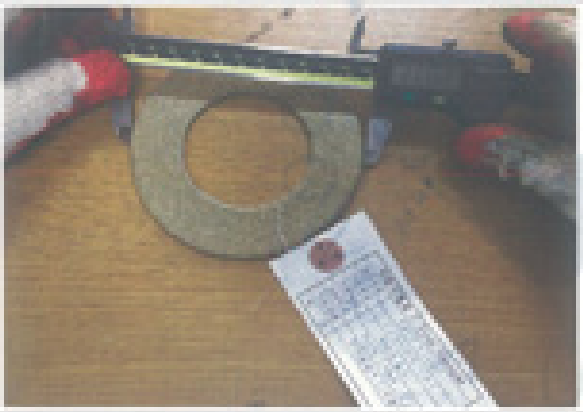
Style No. / Item		THERMBLOK
Actual Test result		Jeil E&S Lab Test data
Test Method		DIN 3535 Modified -Gasket Stress:50MPa -Internal Pressure(N_2):10bar -Temperature : 400℃
Leak late (mg/m/s)	10bar	0.045

* 상기 자료는 제일 E&S의 회사 기밀 사항 및 노하우가 포함된 자료입니다. 담당자 및 관계자 이외에는 공개를 금합니다.

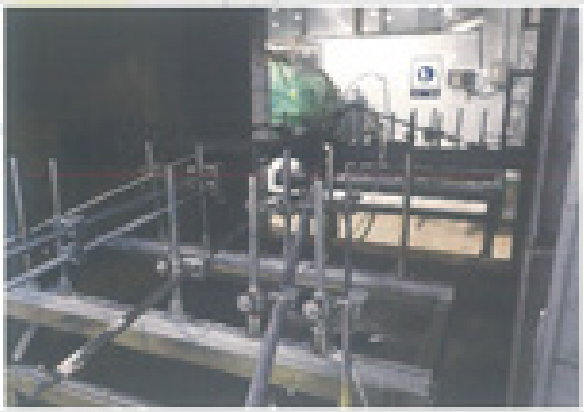
Attach.05 Test Pictures

Weight sample

Inspection check(I.D.)



Inspection check(O.D.)



Setting test Thermocouples

During burn

Cool down