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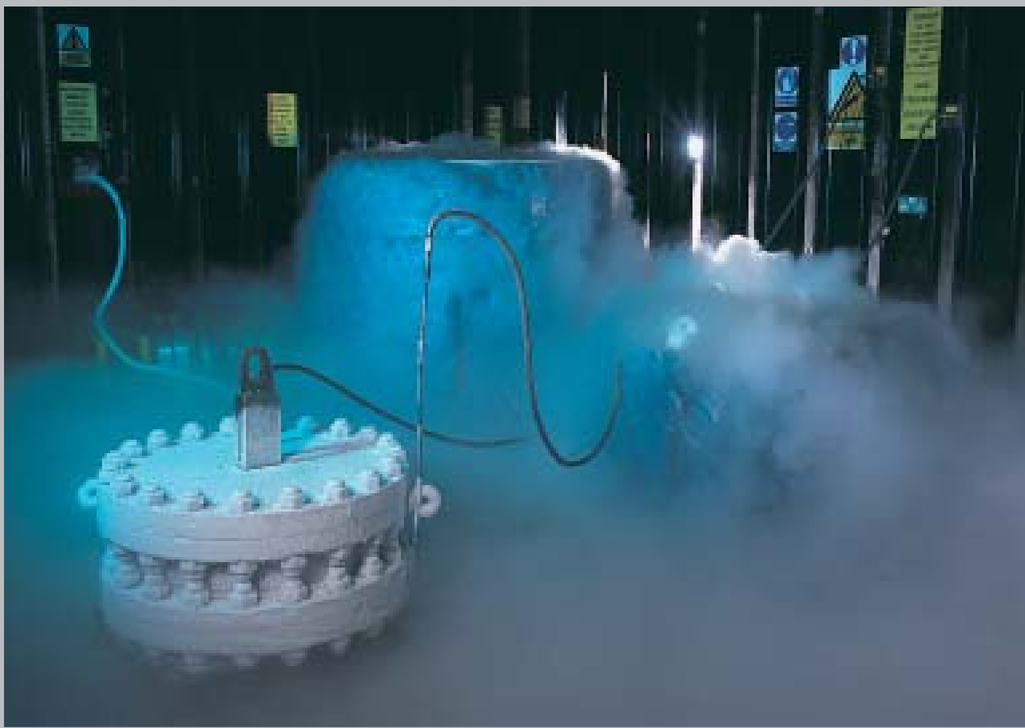

Cryogenic, Low Temperature and High Pressure Gas Testing Facility

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Goodwin - a success story in LNG

The following is a brief resume of Goodwin supply to LNG projects where, over the last decade, Goodwin has furnished more than US$ 20,000,000 of product.

Year	Project	Country	Customer	Contractor
1992	MLNG: DUA Plant	Malaysia	Malaysia LNG	JGC Corp/MW Kellogg, Japan
1995	Inchon LNG Import Terminal	Korea	Korea Gas Corp	Daelim Ind Co Ltd, Korea
1995	Qatargas LNG Utilities	Qatar	Oatar Liquefied Gas Co	Chiyoda,Japan
1996/98	Bonny Island Trains 1&2	Nigeria	Nigeria LNG Ltd/Shell	MW Kellogg, UK
1997/98	RasGas Trains 1&2	Qatar	Ras Laffan LNG Co	JGC Corp, Japan
1998	RasGas LNG Storage Tanks	Qatar	Ras Laffan LNG Co	MHI, Japan
1998	Oman LNG	Oman	Oman LNG/Shell	Chiyoda/Foster Wheeler, UK
1998	Inchon LNG Import Terminal	Korea	Korea Gas Corp	Daelim Ind Co Ltd, Korea
1999	Ourhoud LNG	Algeria	Sonatrach	Bechtel Corp, Texas USA
2000	Tongyeong LNG Import Terminal	Korea	Korea Gas Corp	Daelim Industrial, Korea
2000	Pinson LNG Peak Shaving Plant	USA	Alabama Gas Co	Black & Veatch Prichard, USA
2000	Trinidad Atlantic Train 2	Trinidad	Atlantic LNG	Bechtel Corp, Texas, USA
2000	Tiga LNG	Malaysia	MLNG Tiga SDN BHD	JGC/KBR/SIME/JMSM/KMSB, Japan
2000	Bonny Island Train 3	Nigeria	Nigeria LNG Ltd/Shell	MW Kellogg, UK
2001/02	RasGas Train 3	Qatar	Ras Laffan LNG Co	Chiyoda/Snamprogetti/Mitsui, Japan
2002	North West Shelf Ph IV	Australia	Woodside Energy Ltd	KBR/JGC/Hatch/Clough (Australia)

Goodwin Dual Plate Check Valves: achievable seat leakage rates

Goodwin International is capable of incremental pressure testing at temperatures from room temperature down to -196°C.

Goodwin has a custom built test chamber that allows the safe testing of valves with helium at the full design pressure of the valve (6000psig/414barg).

The test procedure is in accordance with Shell International specification SPE 77/306 and British Standard BS6364. Valves to be used in cryogenic or low temperature service are prepared and conditioned. With its range of Dual Plate Check Valve, Goodwin can offer the following achievable leakrates:

- 700 cc/minute/inch diameter nominal bore (API 598)
- 300 cc/minute/inch diameter nominal bore (SPE 77/306) – additional cost
- 100 cc/minute/inch diameter nominal bore (special) – additional cost

These leakrates are for metal to metal sealing with no overlay on either the body or plate seats.

Should stelliting on the valve body seat be required then the minimum achievable leakrate is 700cc/min/inch diameter nominal bore.

Goodwin's expertise and facilities - availability to other companies

Goodwin International's cryogenic test facilities are available for use to suppliers and manufacturers of other types of valves requiring testing to SPE 77/306 or like procedure. With it's supply history to LNG and other liquid gas applications Goodwin, with it's proven expertise, is highly qualified to be a cryogenic valve "test house" facility for other companies.

Features

- BS EN ISO 9001 accredited facility
- Onsite technical support from qualified engineers
- Onsite skilled fitters
- Provision of Test Report certification

Facilities

- Explosion proof chamber
- On-site bulk liquid nitrogen supply
- On-site portable PMI (Positive Material Identification)
- Thermocouple connections
- State-of-the-art portable microprocessor for temperature and time recording and graph plotting
- Calibrated equipment/regular calibration
- Helium Mass Spectrometer
- Drying out/warming furnace

Capabilities

- High pressure gas testing (6000psig/414barg)
- Testing down to -196°C
- Incremental pressure testing
- Testing to SPE 77/306 (and BS 6364)
- Maximum size: to 2m (80") overall dimension
- Maximum weight: 10,000 kg

From top left to bottom right this page:

Explosion proof chamber

Onsite liquid nitrogen supply

24" ANSI 150 Check Valve on cryogenic test

Helium Mass Spectrometer

'Sniffer' for shell leak detection

From top left to top right right hand page:

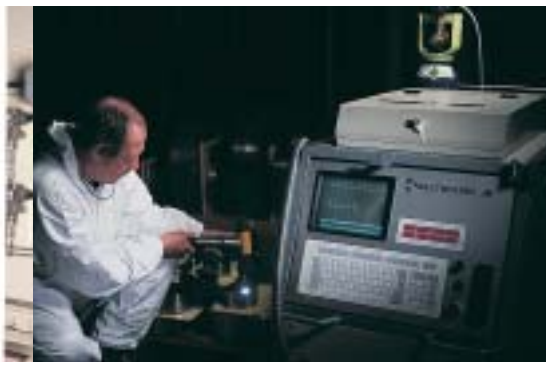
Temperature recording

Control panel

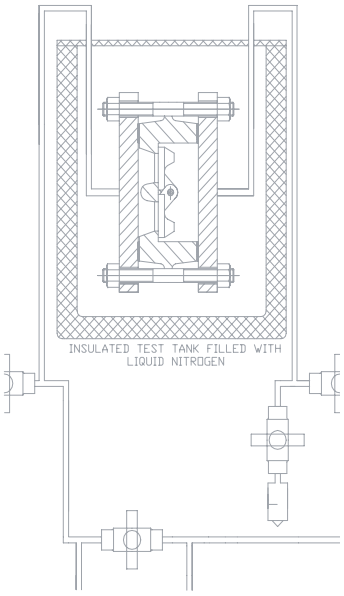
Positive Material Identification (PMI)

Back page:

42" ANSI 600lb Buttweld end Check Valve with test plates removed



Low Temperature and Cryogenic Testing Procedures



*SPE 77/306 is the specification of Shell Global Solutions International B.V. for 'Production Testing of valves in Low Temperature Services'

Whether the valve is to be low temperature tested or cryogenic tested, the test method will be in accordance with *SPE 77/306 (latest revision) or similar procedure e.g. BS 6364. The sequence of testing per SPE 77/306 is as follows:

- Hydrotest at ambient temperature

  Acceptance standard API 598

- Pneumatic test at ambient temperature

  Acceptance specification SPE 77/306

- Cryogenic/Low temperature testing

  Coolant Selection:

  Cryogenic testing at -196°C: Immersion of valve in liquid nitrogen.
  Low temperature testing -46°C: Immersion in liquid nitrogen vapour.
  Intermediate temperature testing: Immersion in liquid nitrogen or liquid nitrogen vapour.

  Temperature Control:

  Temperature is monitored by the use of thermocouples located both internally and externally of the valve body and internally and externally of the test tank. Once the required valve temperature has been achieved and stabilised the pressure test commences.

  Selection of leak test medium:

  Cryogenic ie. -196°C: pure helium.
  Low temperature ie. -46°C: 99% helium/1% nitrogen mix or pure helium.
  Intermediate temperature: pure helium, or 99% helium/1% nitrogen mix dependent on test temperature.

  Test Method – SPE 77/306:

  Pressure within the test valve is increased in 3 equal increments and seat leakage is measured using a series of calibrated flowmeters. The maximum pressure at which the valve is tested is limited by the Cold Working Pressure (CWP) as designated in ANSI B16.34 for the rating of valve under test.

  Shell (body) Leakage Test:

  Following seat leakage test, the valve is removed from the tank and the valve body integrity is tested whereby the body cavity is pressurised and a shell leak detection test carried out using a Helium Mass Spectrometer. The detection limit for acceptance is 5×10^{-4} ml/sec, this being defined as zero leakage.

  Operational Test:

  The test valve can be operated 5 times (open and closed) at the maximum allowable rated seat test pressure. The open and close torque forces can be recorded.

- Test Reports

  All observations, data and results shall be recorded in sequence with dates and times into a single Test Report document.

Goodwin - the international company - performing where it matters

Based in the United Kingdom and seen as the market leader in the manufacture and design of Dual Plate Check Valves, Goodwin has a strong international presence exporting to over 50 countries. With over 20 years of supply to the world's hydrocarbon, energy and process industries, Goodwin has an enviable reputation for quality and reliability of product complimented by internationally competitive prices.

From its UK manufacturing base and through its network of agents and distributors holding some US$ 5,000,000 of inventory in 14 stocking locations worldwide, Goodwin offers outstanding support to its customers, listed amongst whom are many of the world's end users, oil majors and international engineering contractors.

Goodwin and Liquefied Natural Gas (LNG)

With 20 years of experience of valve supply into cryogenic applications coupled with in-house cryogenic testing, the last decade in particular has seen Goodwin become a major supplier to the world's LNG industry. With its range of Dual Plate Check Valves, Goodwin has been the successful check valve supplier to a number of the world's most prestigious LNG export projects as well as many LNG ships and receiving terminal projects. The vast majority of valves are of 316 Stainless Steel construction for use in Liquefied Natural Gas at a temperature of -161°C. Often these valves are accompanied by a large number of valves of Low Temperature Carbon Steel (LTCS) construction for low temperature service applications and which require low temperature testing.

In support of its increasing involvement and increasing business in the LNG and liquid gases industries, Goodwin has built a new cryogenic test facility where, under supervision of its qualified engineers, Dual Plate Check Valves as large as 72" diameter can be tested at temperatures down to -196°C and to pressures of 6,000 psig (414 bar).

Information on the complete range of Goodwin Dual Plate Check Valves is available on our website: www.checkvalves.co.uk

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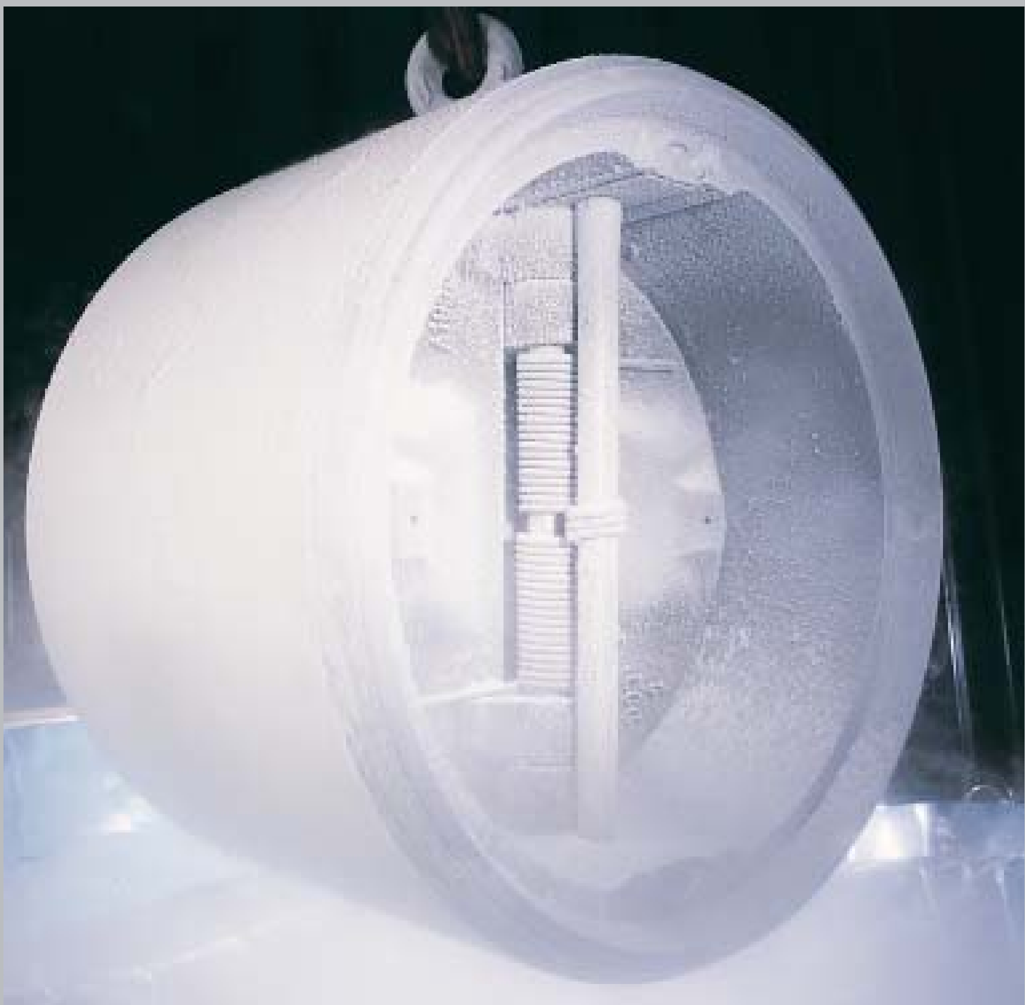

CERT No. FM 00343

SUPPLIER No. 42851

Certificate No.
CE 55079

API 6FA - API 6FD • FIRETESTED TO BS 6755 PART 2 •

GCV CRYO-2M02

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