



API 682 Seal Qualification Test Certificate

Seal Tested:	ES Seals – CFC / CFFC / HPVS / HPVD
Nominal Sizes Tested:	90mm (3.5")
Seal Materials Tested:	Premium Grade Blister Resistant Carbon Graphite Reaction Bonded Silicon Carbide
API Seal Type:	ES
API Seal Configuration(s):	1CW-FX 2CW-CW 3CW-FB 3CW-FF
API Seal Category:	2, 3
API Flush Plan(s):	11 & 52/53
Test Fluid:	Non-Flashing Hydrocarbon
Base Pressure:	7 barg (100 psig)
Base Temperature:	20°C (70°F)
Speed:	3600 rpm

This is to certify that the above seals have been tested in accordance with API 682 requirements.

Stephen Shaw CEng FIMechE CMIOSH BEng (Hons) MBA
Group Engineering Director



ENVIRONMENTAL TECHNOLOGY

Mechanical Seal Qualification Test Form



1CW, 2CW-CW, 3CW-FB, 3CW-FF, 3CW-BB

Test Ref: T4/17/PT01131_1 Revision: 06/23

Manufacturer: AESSEAL plc Seal Type / Model: CFC/CFFC/HPVS/HPVD

Seal Type: A B C ES

Materials of Construction: Primary Seal Faces: Antimony Carbon FH82A/SC2 Reaction Bonded Silicon Carbide Secondary Seal Faces*: N/A

Secondary Seals: Fluoroelastomer Metal Hardware: 316 SS

Seal Size: 90mm Seal Code: _____ Piping Plan: 11 Shaft Speed: 3600rpm

Pumped Fluid (Table I.2): Nonhydrocarbon (water, caustic acid) Nonflashing Hydrocarbon Flashing Hydrocarbon

Shaft Runout (Figure 19): <0.1mm Sleeve Runout (Figure 19): _____ Chamber Concentricity (Figure 12): 0.127mm Seal Chamber Face Runout (Figure 14): <0.1mm

Test Fluid: Mineral Oil Base-point Temperature °C (°F): 20 / (68) Base-point Pressure MPa (bar) (psi): 0.7 / (7) / (102)

Relative Density (SG): 0.873 Vapor Pressure: N/A Solids: None Particle Size: N/A *Dual Seals

DYNAMIC TEST 100 h minimum			Pressure barg (psig)	Process Temp. °C (°F)	Flush Temp. IN °C (°F)	Flush Temp. OUT °C (°F)	Flush Flow Rate m ³ /h (U.S. gal/min)	Seal Chamber Temp. °C (°F)	Barrier Fluid Pressure barg (psig)	Barrier Fluid Temp. IN °C (°F)	Barrier Fluid Temp. OUT °C (°F)	Power Consumption kW (hp)	Hydrocarbon Leakage g/day	Nonhydrocarbon Leakage cm ³ /min	Circulating Device m ³ /h (U.S. gal/min)
Date	Time														
	Start	Stop													
23-04-2012	11:50		7.09 (103)	18.72 (66)	17.21 (63)	18.72 (66)	0.36 (1.6)	17.08 (63)				0.74 (1.0)	0	N/A	
27-04-2012		17:00	6.98 (101)	20.98 (70)	14.63 (58)	20.98 (70)	0.32 (1.4)	35.69 (96)				0.86 (1.2)	223	N/A	
STATIC TEST 4 h minimum															
27-04-2012	17:15		6.96 (101)	21.64 (71)	21.07 (70)	21.64 (71)	0	20.45 (69)				0	32	N/A	
28-04-2012		08:57	7.04 (102)	17.50 (64)	17.78 (64)	17.50 (64)	0	19.35 (67)				0	32	N/A	
CYCLE TEST 5 cycles minimum															
30-04-2012	10:20		7.02 (102)	20.25 (69)	17.04 (63)	20.25 (69)	0.32 (1.4)	31.30 (88)				0.74 (1.0)	270	N/A	
30-04-2012			7.07 (103)	20.89 (70)	15.95 (61)	20.00 (68)	0.31 (1.4)	37.14 (99)				0.60 (0.8)	348	N/A	
01-05-2012		16:25	7.02 (102)	20.23 (68)	13.57 (56)	20.23 (68)	0.34 (1.5)	36.71 (98)				0	0	N/A	

This is to certify that the seal noted above has been tested in accordance with the API 682 requirements.

Notes:

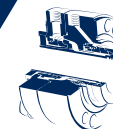
1. Conducted to latest version of API 682 at time of test; 3rd edition.
2. Seal design is outside the scope of the API 682 standard, leakage and performance is typical of a high duty seal of this type at the given conditions.
3. Test undertaken to demonstrate seal performance when operation at lower pressures is required.
4. Average outer seal leakage measured 9 g/hr
5. kW / HP are calculated theoretical values.

Authorised By:
Stephen Shaw
Group Engineering Director



ENVIRONMENTAL TECHNOLOGY

Mechanical Seal Qualification Test Form



1CW, 2CW-CW, 3CW-FB, 3CW-FF, 3CW-BB

Test Ref: T4/18/PT01131_1 Revision: 06/23

Manufacturer: AESSEAL plc Seal Type / Model: CFC/CFFC/HPVS/HPVD

Seal Type: A B C ES

Materials of Construction: Primary Seal Faces: Reaction Bonded Silicon Carbide/Silicon Carbide Graphite composite Secondary Seal Faces*: N/A

Secondary Seals: Fluoroelastomer Metal Hardware: 316 SS

Seal Size: 90mm Seal Code: _____ Piping Plan: 11 Shaft Speed: 3600rpm

Pumped Fluid (Table I.2): Nonhydrocarbon (water, caustic acid) Nonflashing Hydrocarbon Flashing Hydrocarbon

Shaft Runout (Figure 19): <0.1mm Sleeve Runout (Figure 19): _____ Chamber Concentricity (Figure 12): 0.127mm Seal Chamber Face Runout (Figure 14): <0.1mm

Test Fluid: Mineral Oil Base-point Temperature (°C (°F)): 20 / (68) Base-point Pressure MPa (bar) (psi): 0.7 / (7) / (102)

Relative Density (SG): 0.873 Vapor Pressure: N/A Solids: None Particle Size: N/A *Dual Seals

DYNAMIC TEST 100 h minimum			Pressure barg (psig)	Process Temp. °C (°F)	Flush Temp. IN °C (°F)	Flush Temp. OUT °C (°F)	Flush Flow Rate m ³ /h (U.S. gal/min)	Seal Chamber Temp. °C (°F)	Barrier Fluid Pressure barg (psig)	Barrier Fluid Temp. IN °C (°F)	Barrier Fluid Temp. OUT °C (°F)	Power Consumption kW (hp)	Hydrocarbon Leakage g/day	Nonhydrocarbon Leakage cm ³ /min	Circulating Device m ³ /h (U.S. gal/min)
Date	Time														
	Start	Stop													
23-04-2012	11:50		7.09 (103)	18.72 (66)	17.21 (63)	18.72 (66)	0.36 (1.6)	17.08 (63)				0.98 (1.3)	0	N/A	
27-04-2012		17:00	6.98 (101)	20.98 (70)	14.63 (58)	20.98 (70)	0.32 (1.4)	35.69 (96)				0.80 (1.1)	185	N/A	
STATIC TEST 4 h minimum															
27-04-2012	17:15		6.96 (101)	21.64 (71)	21.07 (70)	21.64 (71)	0	20.45 (69)				0	21	N/A	
28-04-2012		08:57	7.04 (102)	17.50 (64)	17.78 (64)	17.50 (64)	0	19.35 (67)				0	21	N/A	
CYCLE TEST 5 cycles minimum															
30-04-2012	10:20		7.02 (102)	20.25 (69)	17.04 (63)	20.25 (69)	0.32 (1.4)	31.30 (88)				0.98 (1.3)	0	N/A	
30-04-2012			7.07 (103)	20.89 (70)	15.95 (61)	20.00 (68)	0.31 (1.4)	37.14 (99)				0.80 (1.1)	155	N/A	
01-05-2012		16:25	7.02 (102)	20.23 (68)	13.57 (56)	20.23 (68)	0.34 (1.5)	36.71 (98)				0	0	N/A	

This is to certify that the seal noted above has been tested in accordance with the API 682 requirements.

Notes:

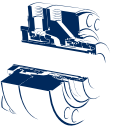
1. Conducted to latest version of API 682 at time of test; 3rd edition.
2. Seal design is outside the scope of the API 682 standard, leakage and performance is typical of a high duty seal of this type at the given conditions.
3. Test of common seal face design undertaken to demonstrate seal performance when operation at lower pressures is required.
4. Average outer seal leakage measured 8 g/hr
5. kW / HP are calculated theoretical values.

Authorised By:
Stephen Shaw
Group Engineering Director



ENVIRONMENTAL TECHNOLOGY

Mechanical Seal Qualification Test Form



1CW, 2CW-CW, 3CW-FB, 3CW-FF, 3CW-BB

Test Ref: T4/19/PT01131_2 Revision: 06/23

Manufacturer: AESSEAL plc Seal Type / Model: CFC/CFFC/HPVS/HPVD

Seal Type: A B C ES

Materials of Construction: Primary Seal Faces: Reaction Bonded Silicon Carbide/Silicon Carbide Graphite composite Secondary Seal Faces*: N/A

Secondary Seals: Fluoroelastomer Metal Hardware: 316 SS

Seal Size: 90mm Seal Code: _____ Piping Plan: 11 Shaft Speed: 3600rpm

Pumped Fluid (Table I.2): Nonhydrocarbon (water, caustic acid) Nonflashing Hydrocarbon Flashing Hydrocarbon

Shaft Runout (Figure 19): <0.1mm Sleeve Runout (Figure 19): _____ Chamber Concentricity (Figure 12): 0.127mm Seal Chamber Face Runout (Figure 14): <0.1mm

Test Fluid: Mineral Oil °C (°F): 20 / (68) Base-point Pressure MPa (bar) (psi): 0.7 / (7) / (102)

Relative Density (SG): 0.873 Vapor Pressure: N/A Solids: None Particle Size: N/A *Dual Seals

DYNAMIC TEST 100 h minimum			Pressure barg (psig)	Process Temp. °C (°F)	Flush Temp. IN °C (°F)	Flush Temp. OUT °C (°F)	Flush Flow Rate m ³ /h (U.S. gal/min)	Seal Chamber Temp. °C (°F)	Barrier Fluid Pressure barg (psig)	Barrier Fluid Temp. IN °C (°F)	Barrier Fluid Temp. OUT °C (°F)	Power Consumption kW (hp)	Hydrocarbon Leakage g/day	Nonhydrocarbon Leakage cm ³ /min	Circulating Device m ³ /h (U.S. gal/min)
Date	Time														
	Start	Stop													
24-05-2012	13:00		6.93 (101)	21.78 (71)	15.68 (60)	21.78 (71)	0.33 (1.5)	35.46 (96)				0.98 (1.3)	0	N/A	
25-05-2012		17:00	7.03 (102)	22.38 (72)	16.35 (61)	22.38 (72)	0.32 (1.4)	36.00 (97)				0.80 (1.1)	81	N/A	
STATIC TEST 4 h minimum															
27-05-2012	17:00		7.04 (102)	21.67 (71)	16.94 (63)	21.67 (71)	0.35 (1.5)	36.57 (98)				0	3	N/A	
19-05-2012		08:30	7.08 (103)	19.75 (68)	18.29 (65)	19.75 (68)	0.36 (1.6)	18.27 (65)				0	3	N/A	
CYCLE TEST 5 cycles minimum															
29-05-2012	12:51		7.06 (103)	18.42 (65)	17.29 (63)	18.42 (65)	0.13 (0.6)	21.15 (70)				0.98 (1.3)	0	N/A	
30-05-2012			7.02 (102)	21.91 (71)	18.36 (65)	21.91 (71)	0.31 (1.4)	37.14 (99)				0.80 (1.1)	0	N/A	
30-05-2012		13:01	7.02 (102)	20.83 (69)	14.3 (58)	20.83 (69)	0.38 (1.7)	36.45 (98)				0	0	N/A	

This is to certify that the seal noted above has been tested in accordance with the API 682 requirements.

Notes:

1. Conducted to latest version of API 682 at time of test; 3rd edition.
2. Seal design is outside the scope of the API 682 standard, leakage and performance is typical of a high duty seal of this type at the given conditions.
3. Test of common seal face design undertaken to demonstrate seal performance when operation at lower pressures is required.
4. API 682 specifies pass rate for liquid leakage as <5.6 g/h which equates to 134.4 g/day or 1000ppm for gas and vapour.
4. Special balance ratio used to achieve leakage rate for ES seal designs operating up API 682 pressure limits.
4. Average outer seal leakage measured 3 g/hr
5. kW / HP are calculated theoretical values.

Authorised By:
Stephen Shaw
Group Engineering Director