API 682 Seal Qualification Test Certificate

Seal Tested:	DMSF & SMSS
Nominal Sizes Tested:	50mm (2”)
Seal Materials Tested:	Premium Grade Blister Resistant Carbon Graphite Reaction Bonded Silicon Carbide
API Seal Type:	Type A
API Seal Configuration(s):	1CW-FX 2CW-CW 3CW-FB
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

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

Mechanical Seal Qualification Test Form

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

Test Ref: T4/13/PT00964_1 Revision: 06/23

Manufacturer: AESSEAL plc Seal Type / Model: DMSF

Seal Type: A ☑ B ☐ ☐ C ☐ ES ☐

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

Secondary Seals: Fluoroelastomer Metal Hardware: 316 SS

Seal Size: 50mm Seal Code: 2CW-CW Piping Plan: 11 & 52 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	Time Stop													
21-07-2009	16:57		7.02 (102)	22.48 (73)	23.52 (74)	26.37 (80)	0.12 (0.5)	25.52 (78)	6.00 (87)	25.50 (78)	32.47 (91)	0.74 (1.0)	0	N/A	0.06 (0.3)
28-07-2009		09:30	7.20 (104)	20.80 (69)	28.40 (83)	23.30 (74)	0.11 (0.5)	28.30 (83)	6.00 (87)	24.63 (76)	31.60 (89)	0.74 (1.0)	0	N/A	0.06 (0.3)
STATIC TEST 4 h minimum															
28-07-2009	09:30		7.08 (103)	21.10 (70)	27.90 (82)	27.90 (82)	0.10 (0.4)	27.70 (82)	5.80 (84)	19.93 (68)	26.90 (80)	0	0	N/A	0
29-07-2009		09:30	7.00 (102)	21.60 (71)	28.00 (82)	25.15 (77)	0.10 (0.4)	26.50 (80)	6.00 (87)	21.33 (70)	28.30 (83)	0	0	N/A	0
CYCLE TEST 5 cycles minimum															
29-07-2009	09:55		7.00 (102)	20.70 (69)	22.80 (82)	23.30 (74)	0.20 (0.9)	25.30 (78)	5.90 (86)	21.23 (70)	28.20 (83)	0.74 (1.0)	0	N/A	0.06 (0.3)
29-07-2009			6.90 (100)	22.00 (72)	20.70 (69)	24.90 (77)	0.16 (0.7)	24.90 (77)	5.90 (86)	23.73 (75)	30.70 (87)	0.74 (1.0)	0	N/A	0.06 (0.3)
30-07-2009		11:33	7.10 (103)	18.90 (66)	18.70 (66)	21.40 (71)	0.16 (0.7)	21.40 (71)	6.00 (87)	18.03 (65)	25.00 (77)	0	0	N/A	0

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

Authorised By:
Stephen Shaw
Group Engineering Director

Notes:
1. Conducted to latest version of API 682 at time of test; 3rd edition.
2. 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.
3. Average outer seal leakage barrier fluid measured at less than <0.1 g/hr
4. kW / HP are calculated theoretical values.

AESSEAL® ENVIRONMENTAL TECHNOLOGY

Mechanical Seal Qualification Test Form

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

Test Ref: T4/14/PT00964_1 Revision: 06/23

Manufacturer:	AESSEAL plc			Seal Type / Model:	SMSS
Seal Type:	A ☑	B ☐ ☐	C ☐	ES ☐	
Materials of Construction:	Primary Seal Faces:	Antimony Carbon FH82A/Sintered Silicon Carbide		Secondary Seal Faces*:	N/A
	Secondary Seals:	Fluoroelastomer		Metal Hardware:	316 SS
Seal Size:	50mm	Seal Code: 1CW-FX	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	Time Stop													
21-07-2009	16:57		7.02 (102)	22.48 (73)	25.10 (77)	26.37 (80)	0.11 (0.5)	25.52 (78)				0.27 (0.36)	84	N/A	
28-07-2009		09:30	7.20 (104)	20.80 (69)	20.80 (69)	23.30 (74)	0.09 (0.4)	28.30 (83)				0.27 (0.36)	170	N/A	
STATIC TEST 4 h minimum															
28-07-2009	09:30		7.08 (103)	21.10 (70)	21.10 (70)	27.90 (82)	0.21 (1.0)	27.70 (82)				0	96	N/A	
29-07-2009		09:30	7.00 (102)	21.60 (71)	21.60 (71)	25.15 (77)	0.15 (0.7)	26.50 (80)				0	94	N/A	
CYCLE TEST 5 cycles minimum															
29-07-2009	09:55		7.00 (102)	20.70 (69)	20.70 (69)	23.30 (74)	0.17 (0.8)	25.30 (78)				0.27 (0.36)	250	N/A	
29-07-2009			6.90 (100)	22.00 (72)	22.00 (72)	24.90 (77)	0.16 (0.7)	24.90 (77)				0.27 (0.36)	73	N/A	
30-07-2009		11:33	7.10 (103)	18.90 (66)	18.90 (66)	21.40 (71)	0	21.40 (71)				0	0	N/A	

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

Authorised By:
Stephen Shaw
Group Engineering Director

Notes:
1. Conducted to latest version of API 682 at time of test; 3rd edition.
2. 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.
3. Average outer seal leakage measured at less than <0.1 g/hr
4. kW / HP are calculated theoretical values.

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Mechanical Seal Qualification Test Form

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

Test Ref: T4/15/PT00964_2 Revision: 06/23

Manufacturer: AESSEAL plc Seal Type / Model: DMSF

Seal Type: A ☑ B ☐ ☐ C ☐ ES ☐

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

Secondary Seals: Fluoroelastomer Metal Hardware: 316 SS

Seal Size: 50mm Seal Code: 3CW-FB Piping Plan: 53 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	Time Stop													
06-08-2009	12:30		6.85 (99)	20.55 (69)	17.82 (64)	19.66 (67)	0.15 (0.7)	21.51 (71)	7.95 (115)	17.90 (64)	26.10 (79)	0.74 (1.0)	0	N/A	0.09 (0.4)
10-08-2009		16:45	7.15 (104)	21.37 (71)	26.10 (79)	21.93 (71)	0.16 (0.7)	22.13 (72)	7.95 (115)	14.48 (58)	27.37 (81)	0.74 (1.0)	0	N/A	0.08 (0.4)
STATIC TEST 4 h minimum															
10-08-2009	16:45		7.12 (103)	20.34 (69)	26.27 (79)	21.12 (70)	0.12 (0.5)	22.06 (72)	8.14 (118)	14.27 (58)	27.20 (81)	0	0	N/A	0
11-08-2009		08:50	7.08 (103)	18.18 (65)	21.69 (71)	20.43 (69)	0.17 (0.8)	19.23 (67)	8.08 (117)	21.54 (71)	22.01 (72)	0	0	N/A	0
CYCLE TEST 5 cycles minimum															
11-08-2009	08:50		6.99 (101)	20.05 (68)	22.27 (72)	20.77 (69)	0.16 (0.7)	19.27 (67)	7.95 (115)	18.01 (64)	23.58 (74)	0.74 (1.0)	0	N/A	0.08 (0.4)
11-08-2009			7.14 (104)	21.40 (71)	18.81 (66)	21.83 (71)	0.15 (0.7)	24.86 (77)	7.91 (115)	15.43 (60)	28.46 (83)	0.74 (1.0)	0	N/A	0.09 (0.4)
11-08-2009		17:07	7.16 (104)	18.01 (64)	16.06 (61)	19.79 (68)	0.16 (0.7)	23.53 (74)	8.01 (116)	17.45 (63)	28.38 (83)	0	0	N/A	0

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

Authorised By:
Stephen Shaw
Group Engineering Director

Notes:
1. Conducted to latest version of API 682 at time of test; 3rd edition.
2. 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.
3. Average outer seal leakage barrier fluid measured at less than <0.8 g/hr
4. kW / HP are calculated theoretical values.

AESSEAL® ENVIRONMENTAL TECHNOLOGY

Mechanical Seal Qualification Test Form

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

Test Ref: T4/16/PT00964_2 Revision: 06/23

Manufacturer: AESSEAL plc Seal Type / Model: DMSF/SMSS

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: 50mm Seal Code: 1CW-FX 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	Time Stop													
06-08-2009	12:30		6.85 (99)	20.55 (69)	17.75 (64)	19.63 (67)	0.13 (0.6)	21.51 (71)				0.3 (0.4)	0	N/A	
10-08-2009		16:45	7.15 (104)	21.37 (71)	17.85 (64)	19.99 (63)	0.15 (0.7)	22.13 (72)				0.3 (0.4)	94	N/A	
STATIC TEST 4 h minimum															
10-08-2009	16:45		7.12 (103)	20.34 (69)	16.92 (63)	19.49 (67)	0.17 (0.8)	22.06 (72)				0	21	N/A	
11-08-2009		08:50	7.08 (103)	18.18 (65)	16.95 (63)	18.09 (65)	0.16 (0.7)	19.23 (67)				0	21	N/A	
CYCLE TEST 5 cycles minimum															
11-08-2009	08:50		6.99 (101)	20.05 (68)	18.59 (66)	18.93 (66)	0.15 (0.7)	19.27 (67)				0.3 (0.4)	84	N/A	
11-08-2009			7.14 (104)	21.40 (71)	16.71 (62)	20.78 (69)	0.12 (0.5)	24.86 (77)				0.3 (0.4)	63	N/A	
11-08-2009		17:07	7.16 (104)	18.01 (64)	14.10 (57)	18.81 (66)	0.14 (0.6)	23.53 (74)				0	21	N/A	

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

Authorised By:
Stephen Shaw
Group Engineering Director

Notes:
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2. 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.
3. kW / HP are calculated theoretical values.

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