API 682 Seal Qualification Test Certificate

Seal Tested:	CAPI Type C Dual
Nominal Sizes Tested:	50mm (2”), 100mm (4”)
Seal Materials Tested:	Premium Grade Blister Resistant Carbon Graphite Reaction Bonded Silicon Carbide
API Seal Type:	Type C
API Seal Configuration(s):	2CW-CW 3CW-FB
API Seal Category:	2, 3
API Flush Plan(s):	52 & 62 53 & 62
Test Fluid:	Non-Flashing Hydrocarbon
Base Pressure:	7 barg (100 psig)
Base Temperature:	260°C (500°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

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Mechanical Seal Qualification Test Form

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

Test Ref: T5/6/PT00843_5 Revision: 06/23

Manufacturer: AESSEAL plc

Seal Type / Model: CAPI Type C Dual

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: Graphite

Metal Hardware: 316 SS

Seal Size: 50mm Seal Code: 2CW-CW Piping Plan: 52 & 62

Shaft Speed: 3600rpm

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

Shaft Runout (Figure 19): 0.025mm

Sleeve Runout (Figure 19):

Chamber Concentricity (Figure 12): 0.1mm

Seal Chamber Face Runout (Figure 14): <0.1mm

Test Fluid: Mineral Oil

Base-point Temperature °C (°F): 260 (500)

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													
04-09-2007	11:39		7.02 (102)	259 (498)				262 (504)	4.95 (72)	102 (216)	121 (250)	0.15 (0.2)	0	N/A	0.18 (0.8)
10-09-2007		09:27	6.95 (101)	260 (500)				262 (504)	5.01 (73)	89 (192)	113 (235)	0.14 (0.2)	0	N/A	0.24 (1.1)
STATIC TEST 4 h minimum															
10-09-2007	09:27		7.05 (102)	260 (500)				270 (518)	5.07 (74)	88 (190)	115 (239)	0	0	N/A	0
10-09-2007		13:29	6.83 (97)	259 (498)				276 (529)	5.09 (74)	48 (118)	122 (252)	0	0	N/A	0
CYCLE TEST 5 cycles minimum															
10-09-2007	13:31		6.87 (100)	259 (498)				260 (500)	5.14 (75)	86 (187)	111 (232)	0.14 (0.2)	0	N/A	0.24 (1.1)
11-09-2007			6.87 (100)	257 (495)				261 (502)	4.97 (72)	88 (190)	113 (235)	0.14 (0.2)	0	N/A	0.25 (1.1)
12-09-2007		14:38	7.06 (102)	258 (496)				266 (511)	5.13 (74)	78 (172)	118 (244)	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. 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: T5/7/PT00843_6b Revision: 06/23

Manufacturer:	AESSEAL plc			Seal Type / Model:	CAPI Type C Dual
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:	Graphite			Metal Hardware:	316 SS
Seal Size: 50mm	Seal Code: 3CW-FB	Piping Plan: 53 & 62		Shaft Speed:	3600rpm
Pumped Fluid (Table I.2):	Nonhydrocarbon (water, caustic acid) ☐		Nonflashing Hydrocarbon ☑		Flashing Hydrocarbon ☐
Shaft Runout (Figure 19): 0.025mm	Sleeve Runout (Figure 19):		Chamber Concentricity (Figure 12): 0.1mm		Seal Chamber Face Runout (Figure 14): <0.1mm
Test Fluid: Mineral Oil	Base-point Temperature °C (°F): 260 (500)		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													
18-01-2008	13:33		6.95 (101)	260 (500)				260 (500)	8.08 (117)	65 (151)	96 (205)	0.69 (0.9)	21	N/A	0.18 (0.8)
23-01-2008		10:24	6.93 (101)	260 (500)				260 (500)	7.96 (115)	68 (154)	98 (208)	0.68 (0.9)	74	N/A	0.24 (1.1)
STATIC TEST 4 h minimum															
23-01-2008	10:24		6.88 (100)	260 (500)				260 (500)	7.90 (115)	68 (154)	98 (208)	0	2.1	N/A	0
23-01-2008		14:24	6.89 (100)	261 (502)				261 (502)	8.01 (116)	55 (131)	117 (243)	0	2.1	N/A	0
CYCLE TEST 5 cycles minimum															
23-01-2008	14:24		6.93 (101)	260 (500)				260 (500)	8.04 (117)	68 (154)	99 (210)	0.69 (0.9)	21	N/A	0.24 (1.1)
24-01-2008			6.91 (100)	260 (500)				260 (500)	7.98 (116)	68 (154)	98 (208)	0.69 (0.9)	32	N/A	0.25 (1.1)
25-01-2008		11:44	7.02 (102)	261 (502)				261 (502)	8.02 (116)	64 (147)	106 (223)	0	2.1	N/A	0

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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. 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: T5/10/PT00843_7 Revision: 06/23

Manufacturer:	AESSEAL plc			Seal Type / Model:	CAPI Type C Dual
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: Graphite			Metal Hardware:	316 SS
Seal Size:	100mm	Seal Code: 2CW-CW	Piping Plan: 52 & 62	Shaft Speed:	3600rpm
Pumped Fluid (Table I.2):	Nonhydrocarbon (water, caustic acid) ☐		Nonflashing Hydrocarbon ☑		Flashing Hydrocarbon ☐
Shaft Runout (Figure 19):	0.025mm	Sleeve Runout (Figure 19):		Chamber Concentricity (Figure 12):	0.1mm	Seal Chamber Face Runout (Figure 14):	
Test Fluid:	Mineral Oil	Base-point Temperature °C (°F):	260 (500)	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													
07-03-2008	15:00		7.01 (102)	257 (495)				257 (495)	3.40 (49)	96 (205)	143 (289)	1.74 (2.3)	<21	N/A	0.26 (1.1)
12-03-2008		09:13	6.93 (101)	260 (500)				260 (500)	3.40 (49)	99 (210)	148 (298)	1.74 (2.3)	<21	N/A	0.26 (1.1)
STATIC TEST 4 h minimum															
12-03-2008	09:13		6.95 (101)	261 (502)				261 (502)	3.47 (50)	99 (210)	154 (309)	0	<2.1	N/A	0
12-03-2008		13:39	6.96 (101)	260 (500)				260 (500)	3.40 (49)	46 (115)	150 (302)	0	<21	N/A	0
CYCLE TEST 5 cycles minimum															
12-03-2008	13:39		6.98 (101)	258 (496)				258 (496)	3.39 (49)	95 (203)	150 (302)	1.74 (2.3)	<11	N/A	0.26 (1.1)
13-03-2008			6.89 (100)	261 (502)				261 (502)	3.38 (49)	98 (208)	146 (295)	1.74 (2.3)	<21	N/A	0.26 (1.1)
14-03-2008		12:58	6.91 (100)	261 (502)				261 (502)	3.45 (50)	90 (194)	148 (298)	0	<2.1	N/A	0

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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. 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: T5/11/PT00843_8 Revision: 06/23

Manufacturer:	AESSEAL plc		Seal Type / Model:	CAPI Type C Dual
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: Graphite		Metal Hardware:	316 SS
Seal Size:	100mm Seal Code: 3CW-FB Piping Plan: 53 & 62		Shaft Speed:	3600rpm
Pumped Fluid (Table I.2):	Nonhydrocarbon (water, caustic acid) ☐	Nonflashing Hydrocarbon ☑	Flashing Hydrocarbon ☐	
Shaft Runout (Figure 19):	0.025mm	Sleeve Runout (Figure 19):	Chamber Concentricity (Figure 12): 0.1mm	Seal Chamber Face Runout (Figure 14): <0.1mm
Test Fluid:	Mineral Oil	Base-point Temperature °C (°F): 260 (500)	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													
02-06-2008	16:10		6.89 (100)	256 (493)				256 (493)	7.96 (115)	100 (212)	151 (304)	1.74 (2.3)	<2.1	N/A	0.26 (1.1)
07-06-2008		08:31	7.05 (102)	260 (500)				260 (500)	8.02 (116)	103 (217)	155 (311)	1.74 (2.3)	<21	N/A	0.26 (1.1)
STATIC TEST 4 h minimum															
07-06-2008	08:31		7.09 (103)	261 (502)				261 (502)	8.08 (117)	100 (212)	161 (322)	0	<2.1	N/A	0
09-06-2008		09:14	7.16 (104)	261 (502)				261 (502)	8.03 (116)	50 (122)	137 (279)	0	<2.1	N/A	0
CYCLE TEST 5 cycles minimum															
09-06-2008	09:27		7.03 (102)	260 (500)				259 (498)	8.02 (116)	99 (210)	151 (304)	1.74 (2.3)	<2.1	N/A	0.26 (1.1)
10-06-2008			7.09 (103)	260 (500)				260 (500)	7.94 (115)	102 (216)	157 (315)	1.74 (2.3)	<11	N/A	0.26 (1.1)
10-06-2008		15:09	7.12 (103)	261 (502)				261 (502)	8.01 (116)	90 (194)	135 (275)	0	<2.1	N/A	0

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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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