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FIRE PERFORMANCE EVALUATION OF FIRE MAIN VALVES IN ACCORDANCE WITH UK DOT APPENDIX D, *FIRE TEST REQUIREMENTS FOR FIRE MAINS AND FITTINGS*

FINAL REPORT
SwRI® Project No. 01.10933.01.719

Consisting of 18 Pages
August 2005

Prepared for:

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ABSTRACT

A fire performance evaluation of fire main valves was conducted by Southwest Research Institute's (SwRI) Department of Fire Technology, located in San Antonio, Texas, on July 15, 2005 and July 18, 2005, for PCC EuroValve BV, located in the Netherlands. Testing was conducted in accordance with UK DOT Appendix D, *Fire Test Requirements for Fire Mains and Fittings*.

Two butterfly valves, a 4-in. and 8-in., were tested. The 4-in. valve was identified as Dynaxe L201, Class 150 / PN10 / PN16, RTFE fire safe (FS) design, identity nr. 800872 (DN100). The 8-in. valve was identified as Dynaxe L201, Class 150 / PN10 / PN16, RTFE fire safe (FS) design, identity nr. 800893 (DN200). The valve bodies and discs were made of cast aluminum EN1982-CC333G. According to PCC EuroValve, material specifications are comparable with ASTM B148-C95800 and ASTM B148-C95500. The valves included gear-operated actuators with hand cranks.

Each valve was tested separately in SwRI's small horizontal furnace. Each test was conducted for 20 min at a furnace temperature of 540°C (1000°F). During the 20-min furnace exposure, the internal water pressure was maintained at 8.3 bars (120 psig). A post-test inspection of the valves revealed no leaks. Both valves **met** the requirements of UK DOT Appendix D, *Fire Test Requirements for Fire Mains and Fittings*.

1.0 INTRODUCTION

This report describes the fire performance evaluation of fire main valves manufactured by PCC EuroValve BV, and includes a description of the test procedure followed, sample description, and test results obtained. The tests were performed at Southwest Research Institute's (SwRI's) Department of Fire Technology, located in San Antonio, Texas, on July 15, 2005 and July 18, 2005, in accordance with UK DOT, Appendix D, *Fire Test Requirements for Fire Mains and Fittings*.

UK DOT, Appendix D, is intended to evaluate the ability of fire mains and fittings to withstand a fire exposure for 20 min and not allow leaks in excess of 22.7 liters (5 gal) per min. The results presented in this report apply only to the assemblies tested, in the manner tested, and not to any similar assembly or assembly combinations.

This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment, which takes into account all the factors that are pertinent to an assessment of the fire hazard of a particular end-use.

2.0 TEST PROCEDURE

SwRI's small horizontal furnace is used to subject the valves to the fire test for 20 min, and is equipped with four pre-mixed air/natural gas burners, one placed on each wall of the furnace. The burners are controlled by a variable ratio gas/air regulator. Regulated natural gas enters the furnace at the nozzle of each burner, and a constant supply of air is provided to the nozzle by a blower unit. The gaseous products of combustion exit the furnace through an exhaust duct and flow through an exhaust fan into the atmosphere.

The conduct of the fire test is controlled to 540°C (1000°F), as indicated by the average temperature obtained from the readings of four thermocouples located within the furnace. Each furnace thermocouple is a 1.02-mm diameter (18-Ga), Type K (Chromel-Alumel) wire, housed in a 12.5-mm diameter protective Inconel® pipe with ceramic inserts. Each furnace thermocouple has a welded junction at one end of the thermocouple wire. The welded junction is 25 mm from the end of the ceramic insert and 75 mm from the end of the Inconel® pipe. The time constant for this type of thermocouple is less than 20 sec.

A water pressure of 8.3 bars (120 psig) is maintained within the valves throughout the fire test.

Following the fire test, the valves are checked for leaks by monitoring pressure and visual observation.

3.0 TEST SAMPLES

Two butterfly valves, a 4-in. and 8-in., were received on July 5, 2005. The 4-in. valve was identified as Dynaxe L201, Class 150 / PN10 / PN16, RTFE fire safe (FS) design, identity nr. 800872 (DN100). The 8-in. valve was identified as Dynaxe L201, Class 150 / PN10 / PN16, RTFE fire safe (FS) design, identity nr. 800893 (DN200). The valve bodies and discs were made of cast aluminum EN1982-CC333G. The valve body was drilled and tapped for threaded studs in a pattern corresponding to 150 lb class flange conforming to ASTM A105 and ANSI B16.5. According to PCC EuroValve, material specifications are comparable with ASTM B148-C 95800 and ASTM B148-C 95500. The valves included gear-operated actuators with hand cranks.

The valves were installed between two spool-piece pipes that were approximately 1.2 m (4 ft) in length. Studs were threaded through the valve body and bolted to the flanges of the spool pieces. The bolts were tightened to a torque of 195 N-m (144 ft-lb) for the 4-in. valve, and 335 N-m (247 ft-lb) for the 8-in. valve. Graphite gaskets provided by PCC EuroValve were located between the valve and the flanges. The valves were tested in the open position. The opposite ends of the spool pieces were capped with blind flanges and located outside the furnace environment. Taps were included on the spool pieces to maintain the internal water pressure. A flash tank was connected to the spool piece taps.

A nominal 10-gal flash tank was connected to the spool pieces to maintain the water pressure by venting any steam generated out of the spool pieces and condensing the steam to water within the flash tank. An air pressure line, a pressure gauge, a pressure transducer, and a relief valve were connected to the flash tank to monitor and control the water pressure. Figure 1 below is a schematic illustration of the test set-up.

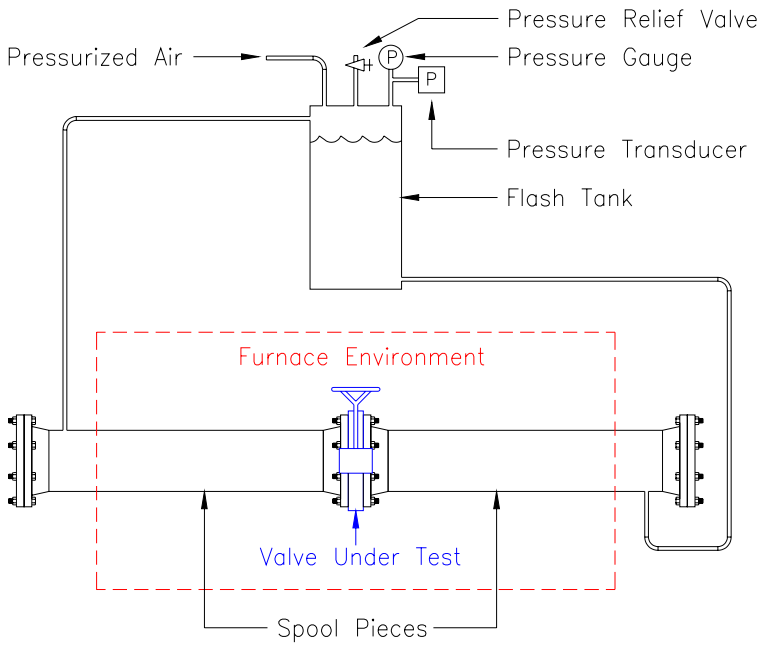


Figure 1. Schematic of Test Set-up.

4.0 TEST RESULTS

The 8-in. valve was tested on July 15, 2005, and the 4-in. valve was tested on July 18, 2005. The valve and spool piece assembly was placed in the furnace and data acquisition connections were verified. The furnace burners were ignited to begin the fire exposure. Once the furnace reached 540°C (1000°F), the 20-min duration was started. At the end of the 20-min fire test, the furnace lid was removed and the valves were observed for leaks. There was no water leakage from either valve.

5.0 SUMMARY

A fire performance evaluation of two fire main valves was conducted by Southwest Research Institute's (SwRI) Department of Fire Technology, located in San Antonio, Texas, on July 15, 2005 and July 18, 2005, for PCC EuroValve BV, located in the Netherlands. Testing was conducted in accordance with UK DOT Appendix D, *Fire Test Requirements for Fire Mains and Fittings*.

Each valve was tested separately in SwRI's small horizontal furnace. Each test was conducted for 20 min at a furnace temperature of 540°C (1000°F). During the 20-min furnace exposure, the internal water pressure was maintained at 8.3 bars (120 psig). A post-test inspection of the valves revealed no leaks. Both valves **met** the requirements of UK DOT Appendix D, *Fire Test Requirements for Fire Mains and Fittings*.

APPENDIX A
PHOTOGRAPHIC DOCUMENTATION
(CONSISTING OF 2 PAGES)

Figure A-1. 8-in. Valve in Furnace Prior to Fire Test.

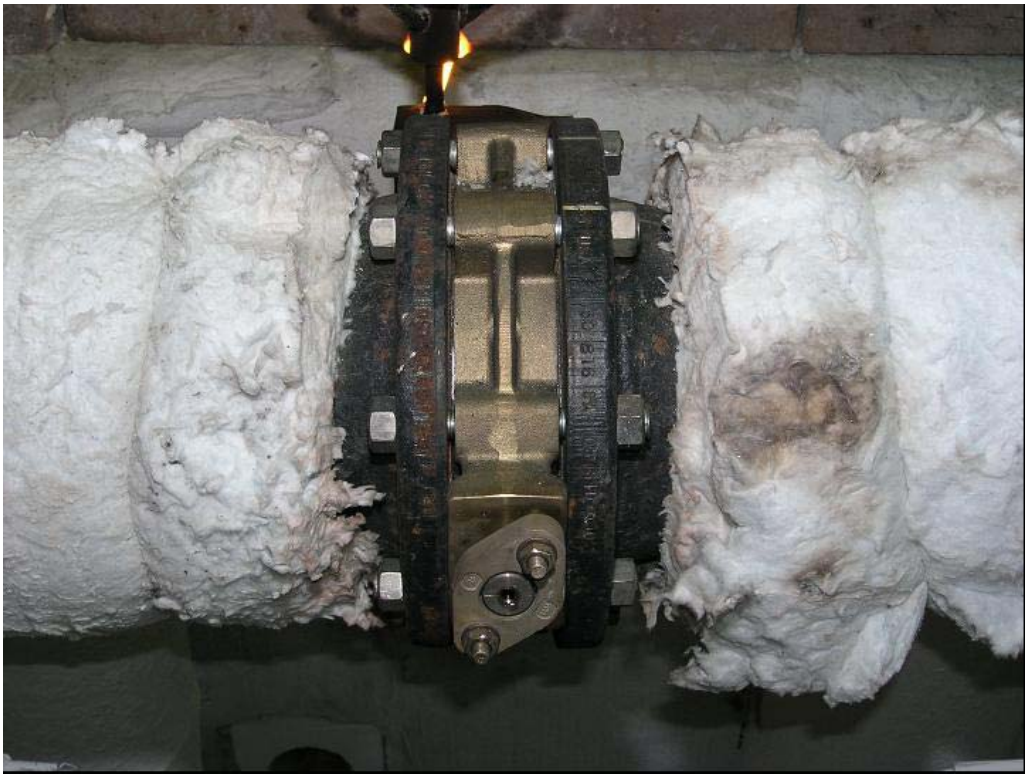


Figure A-2. 8-in. Valve in Furnace After the Fire Test.

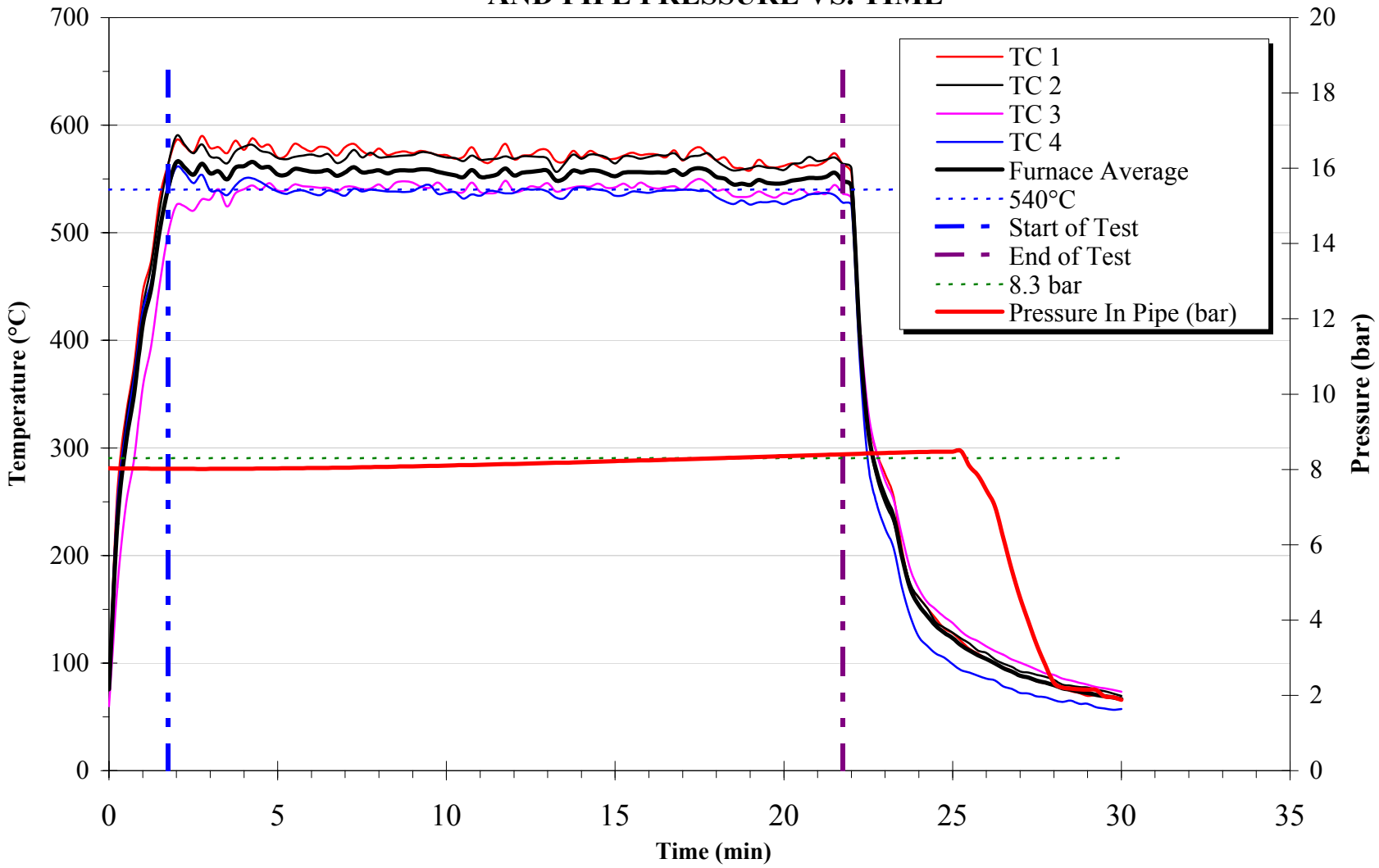
Figure A-3. 4-in. Valve in Furnace Prior to Fire Test.

Figure A-4. 4-in. Valve After the Fire Test.

APPENDIX B
8-IN. VALVE TEST DATA
(CONSISTING OF 4 PAGES)

CLIENT: PCC EUROVALVE, BV
SwRI PROJECT NO.: 01.10933.01.719
DATE: JULY 15, 2005
TEST ID: 196PCE1.DAT

8-IN VALVE
FURNACE TEMPERATURE VS. TIME
AND PIPE PRESSURE VS. TIME



PCC EUROVALVE, BV
8-IN VALVE, FURNACE TEMPERATURES (°C), PIPE PRESSURE (bar)

DATE: JULY 15, 2005 **SwRI PROJECT NO.: 01.10933.01.719**
FILE ID: 196PCE1.DAT **TEST TYPE: UK DOT, APPENDIX D**

Time (min:sec)	TC 1	TC 2	TC 3	TC 4	Furnace Average	Pipe Pressure (bar)
0:00	80	79	60	83	76	8.03
0:15	259	239	171	249	230	8.03
0:30	329	322	246	315	303	8.03
0:45	377	370	290	366	351	8.02
1:00	445	431	357	428	415	8.02
1:15	474	469	395	454	448	8.02
1:30	532	521	452	502	502	8.02
1:45	563	563	499	538	541	8.02
2:00	586	590	526	561	566	8.02
2:15	581	582	524	556	561	8.02
2:30	575	574	521	546	554	8.01
2:45	590	582	531	554	564	8.01
3:00	579	571	531	539	555	8.01
3:15	579	569	541	539	557	8.02
3:30	574	564	524	535	549	8.02
3:45	586	576	537	544	560	8.02
4:00	577	580	541	551	562	8.02
4:15	588	582	544	551	566	8.02
4:30	580	576	540	547	561	8.02
4:45	582	574	546	542	561	8.02
5:00	570	569	539	538	554	8.03
5:15	572	568	539	536	554	8.03
5:30	583	571	545	539	559	8.03
5:45	579	572	543	539	558	8.03
6:00	576	573	543	537	557	8.04
6:15	580	571	542	535	557	8.04
6:30	578	573	542	539	558	8.04
6:45	572	565	538	537	553	8.04
7:00	579	568	543	534	556	8.05
7:15	583	577	543	541	561	8.05
7:30	576	570	541	538	556	8.06
7:45	572	574	541	540	557	8.06
8:00	578	570	545	539	558	8.07
8:15	572	571	540	538	555	8.07
8:30	574	571	547	538	558	8.07
8:45	576	572	548	538	558	8.08
9:00	574	572	547	539	558	8.08
9:15	576	575	543	543	559	8.09
9:30	574	574	542	544	559	8.09
9:45	572	572	547	536	557	8.10
10:00	572	570	540	537	555	8.10
10:15	569	569	538	538	553	8.11
10:30	571	567	538	532	552	8.11
10:45	579	572	547	536	558	8.12
11:00	568	568	538	534	552	8.12
11:15	565	568	537	539	552	8.13
11:30	572	569	538	538	554	8.13
11:45	583	571	548	537	560	8.14
12:00	568	569	538	537	553	8.15
12:15	572	571	539	541	556	8.15
12:30	572	571	543	540	557	8.16
12:45	577	571	542	541	558	8.16
13:00	577	569	546	538	558	8.17
13:15	567	557	538	533	549	8.18
13:30	566	564	540	532	551	8.18

PCC EUROVALVE, BV
8-IN VALVE, FURNACE TEMPERATURES (°C), PIPE PRESSURE (bar)

DATE: JULY 15, 2005 **SwRI PROJECT NO.: 01.10933.01.719**
FILE ID: 196PCE1.DAT **TEST TYPE: UK DOT, APPENDIX D**

Time (min:sec)	TC 1	TC 2	TC 3	TC 4	Furnace Average	Pipe Pressure (bar)
13:45	576	573	542	541	558	8.19
14:00	570	569	543	542	556	8.19
14:15	576	573	543	541	558	8.20
14:30	572	572	546	540	558	8.21
14:45	569	570	542	539	555	8.21
15:00	569	564	542	534	553	8.22
15:15	572	571	546	535	556	8.22
15:30	574	571	542	538	556	8.23
15:45	572	569	547	538	556	8.24
16:00	573	571	543	537	556	8.24
16:15	573	572	541	539	556	8.25
16:30	570	572	542	539	556	8.26
16:45	577	574	543	539	558	8.26
17:00	567	568	540	540	554	8.27
17:15	576	571	547	540	558	8.28
17:30	579	572	550	539	560	8.28
17:45	573	574	546	539	558	8.29
18:00	568	567	539	533	552	8.30
18:15	570	562	540	529	550	8.30
18:30	561	558	534	527	545	8.31
18:45	560	559	533	530	546	8.32
19:00	558	560	534	526	544	8.33
19:15	568	562	538	528	549	8.33
19:30	562	561	535	528	546	8.34
19:45	561	560	533	529	546	8.35
20:00	562	558	537	527	546	8.35
20:15	564	564	536	530	549	8.36
20:30	561	565	541	532	549	8.37
20:45	563	571	536	536	551	8.37
21:00	563	567	538	536	551	8.38
21:15	567	568	536	537	552	8.39
21:30	574	570	544	535	556	8.40
21:45	563	564	536	528	548	8.40
22:00	556	560	532	526	543	8.41
22:15	407	412	416	381	404	8.42
22:30	329	314	334	285	316	8.43
22:45	296	273	296	248	278	8.43
23:00	276	249	270	226	255	8.44
23:15	254	231	252	207	236	8.44
23:30	206	201	218	170	198	8.45
23:45	172	173	187	143	169	8.46
24:00	161	161	169	124	154	8.46
24:15	151	151	157	116	144	8.46
24:30	142	138	150	109	135	8.47
24:45	132	133	143	105	128	8.47
25:00	128	128	137	99	123	8.47
25:15	121	123	129	93	117	8.49
25:30	113	118	124	91	112	8.08
25:45	109	112	121	88	107	7.84
26:00	104	109	116	86	104	7.46
26:15	101	103	111	84	100	7.02
26:30	96	99	108	78	95	6.18
26:45	93	97	103	76	92	5.33
27:00	88	92	101	72	88	4.59
27:15	86	91	97	72	87	3.95

PCC EUROVALVE, BV
8-IN VALVE, FURNACE TEMPERATURES (°C), PIPE PRESSURE (bar)

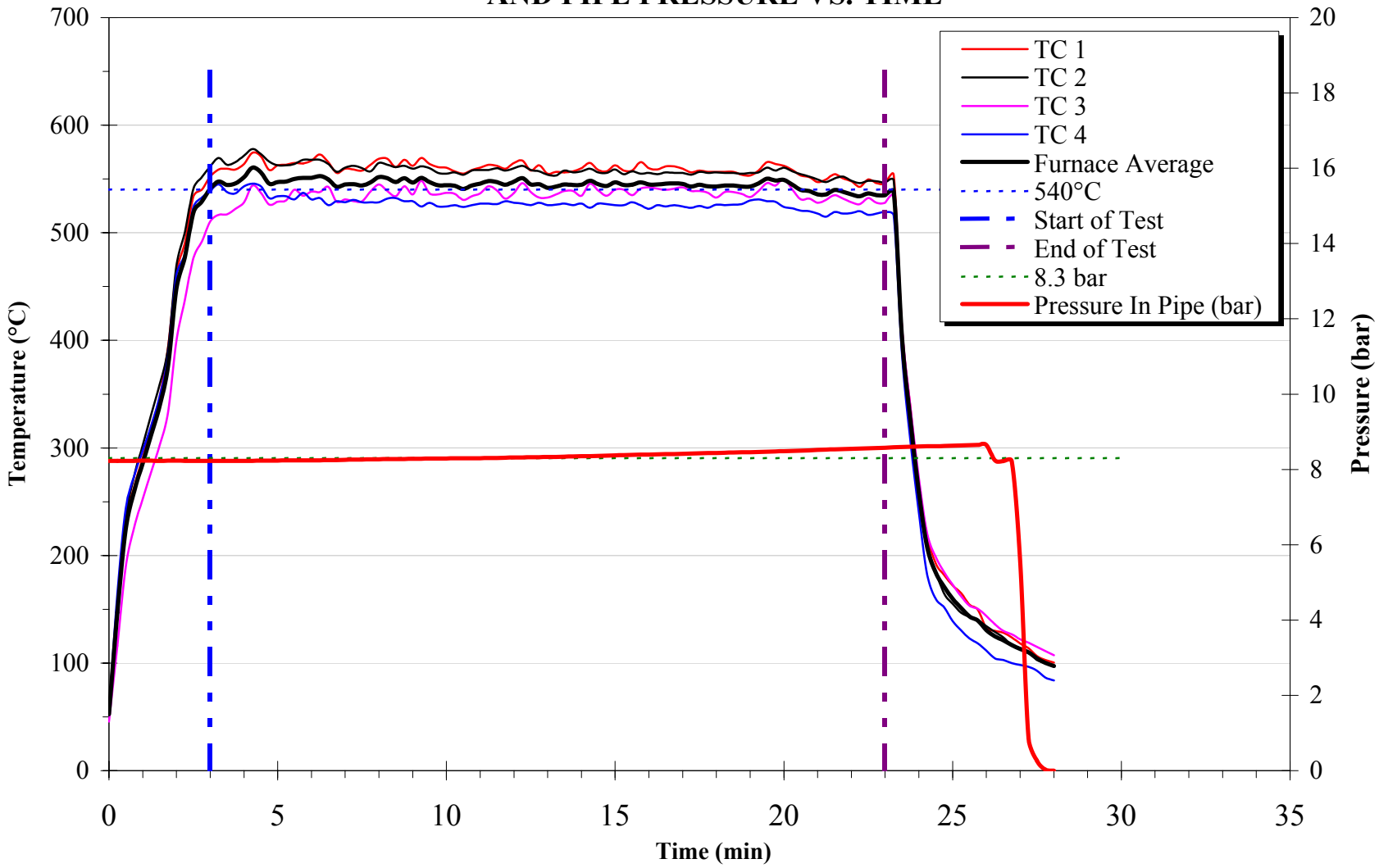
DATE: JULY 15, 2005 **SwRI PROJECT NO.: 01.10933.01.719**
FILE ID: 196PCE1.DAT **TEST TYPE: UK DOT, APPENDIX D**

Time (min:sec)	TC 1	TC 2	TC 3	TC 4	Furnace Average	Pipe Pressure (bar)
27:30	83	89	94	69	84	3.33
27:45	81	87	91	68	82	2.80
28:00	79	84	89	66	79	2.33
28:15	77	80	86	64	77	2.21
28:30	74	79	84	65	75	2.18
28:45	72	78	82	62	73	2.16
29:00	69	77	80	62	72	2.15
29:15	70	75	78	59	70	2.15
29:30	69	74	77	58	69	1.97
29:45	69	72	75	57	68	1.95
30:00	67	69	73	57	67	1.88

APPENDIX C
4-IN. VALVE TEST DATA
(CONSISTING OF 3 PAGES)

CLIENT: PCC EUROVALVE, BV
SwRI PROJECT NO.: 01.10933.01.719
DATE: JULY 18, 2005
TEST ID: 199PCE2.DAT

4-IN VALVE
FURNACE TEMPERATURE VS. TIME
AND PIPE PRESSURE VS. TIME



PCC EUROVALVE, BV
4-IN VALVE, FURNACE TEMPERATURES (°C), PIPE PRESSURE (bar)

DATE: JULY 18, 2005 **SwRI PROJECT NO.: 01.10933.01.719**
FILE ID: 199PCE2.DAT **TEST TYPE: UK DOT, APPENDIX D**

Time (min:sec)	TC 1	TC 2	TC 3	TC 4	Furnace Average	Pipe Pressure (bar)
0:00	57	53	46	54	53	8.23
0:15	155	153	116	164	147	8.23
0:30	231	234	189	244	225	8.23
0:45	264	274	226	274	259	8.23
1:00	291	303	253	298	286	8.23
1:15	320	331	278	321	312	8.23
1:30	347	359	302	348	339	8.23
1:45	393	392	333	386	376	8.23
2:00	463	469	399	460	448	8.23
2:15	490	500	437	480	477	8.23
2:30	534	541	477	524	519	8.23
2:45	540	552	492	533	529	8.23
3:00	552	562	511	539	541	8.23
3:15	559	569	517	545	548	8.23
3:30	559	563	517	538	544	8.23
3:45	559	566	522	537	546	8.23
4:00	564	572	528	543	552	8.23
4:15	574	578	544	546	560	8.23
4:30	571	573	537	543	556	8.24
4:45	558	566	526	532	546	8.24
5:00	563	563	529	534	547	8.24
5:15	563	563	530	534	548	8.24
5:30	565	564	540	531	550	8.24
5:45	564	568	534	537	551	8.24
6:00	567	568	538	531	551	8.24
6:15	573	568	538	532	553	8.24
6:30	566	564	543	526	549	8.25
6:45	556	557	529	529	543	8.25
7:00	559	561	531	528	545	8.26
7:15	559	562	529	531	545	8.26
7:30	558	560	529	528	544	8.26
7:45	563	557	538	528	547	8.27
8:00	569	565	545	528	552	8.27
8:15	569	563	539	532	551	8.27
8:30	561	561	534	532	547	8.28
8:45	568	562	543	529	551	8.28
9:00	562	559	536	529	547	8.28
9:15	569	562	548	524	551	8.28
9:30	564	560	537	528	547	8.29
9:45	561	556	536	524	544	8.29
10:00	561	555	537	524	544	8.29
10:15	557	556	536	526	544	8.29
10:30	555	554	531	524	541	8.29
10:45	558	558	534	526	544	8.30
11:00	561	558	537	527	546	8.30
11:15	563	558	543	527	548	8.30
11:30	562	560	539	527	547	8.31
11:45	559	558	532	529	545	8.31
12:00	565	560	537	528	548	8.31
12:15	567	562	546	527	551	8.32
12:30	558	558	538	526	545	8.32
12:45	563	557	533	528	545	8.33
13:00	555	554	533	526	542	8.33
13:15	557	553	536	526	543	8.33
13:30	556	558	539	527	545	8.34

PCC EUROVALVE, BV
4-IN VALVE, FURNACE TEMPERATURES (°C), PIPE PRESSURE (bar)

DATE: JULY 18, 2005 **SwRI PROJECT NO.: 01.10933.01.719**
FILE ID: 199PCE2.DAT **TEST TYPE: UK DOT, APPENDIX D**

Time (min:sec)	TC 1	TC 2	TC 3	TC 4	Furnace Average	Pipe Pressure (bar)
13:45	557	556	539	526	544	8.34
14:00	560	557	534	527	545	8.35
14:15	565	559	546	523	548	8.36
14:30	558	556	539	527	545	8.36
14:45	557	556	534	527	543	8.37
15:00	563	559	540	526	547	8.37
15:15	558	554	540	526	544	8.38
15:30	558	557	535	528	545	8.39
15:45	566	555	541	526	547	8.39
16:00	560	556	542	522	545	8.40
16:15	559	554	541	526	545	8.40
16:30	562	556	540	524	546	8.41
16:45	562	556	541	526	546	8.41
17:00	559	556	542	524	545	8.42
17:15	556	554	539	523	543	8.42
17:30	558	557	539	525	545	8.43
17:45	557	556	537	523	543	8.43
18:00	557	556	533	526	543	8.44
18:15	557	556	538	526	544	8.44
18:30	557	556	538	526	544	8.45
18:45	554	555	536	527	543	8.45
19:00	553	556	533	530	543	8.46
19:15	558	556	539	531	546	8.47
19:30	566	561	546	529	550	8.47
19:45	564	558	544	529	549	8.48
20:00	562	561	550	524	549	8.49
20:15	558	557	540	523	545	8.49
20:30	553	554	531	521	540	8.50
20:45	552	552	532	520	539	8.51
21:00	547	549	528	518	536	8.52
21:15	549	547	531	515	536	8.52
21:30	554	551	535	519	540	8.53
21:45	551	552	532	518	538	8.54
22:00	548	548	528	518	536	8.55
22:15	543	546	527	520	534	8.55
22:30	549	548	532	517	537	8.56
22:45	546	548	528	518	535	8.57
23:00	546	547	528	519	535	8.58
23:15	554	549	534	516	538	8.59
23:30	411	399	411	386	402	8.60
23:45	337	319	338	306	325	8.60
24:00	266	257	272	240	259	8.61
24:15	218	210	220	182	208	8.62
24:30	193	186	199	160	184	8.62
24:45	182	164	184	152	171	8.63
25:00	172	155	173	139	160	8.63
25:15	165	147	162	131	151	8.64
25:30	154	143	153	123	143	8.64
25:45	149	140	151	118	140	8.65
26:00	133	134	144	112	131	8.65
26:15	130	129	136	104	125	8.24
26:30	128	124	130	103	121	8.22
26:45	124	117	127	100	117	8.22
27:00	118	114	122	98	113	5.58
27:15	114	111	119	97	110	0.87

PCC EUROVALVE, BV
4-IN VALVE, FURNACE TEMPERATURES (°C), PIPE PRESSURE (bar)

DATE: JULY 18, 2005 **SwRI PROJECT NO.: 01.10933.01.719**
FILE ID: 199PCE2.DAT **TEST TYPE: UK DOT, APPENDIX D**

Time (min:sec)	TC 1	TC 2	TC 3	TC 4	Furnace Average	Pipe Pressure (bar)
27:30	107	103	115	93	104	0.26
27:45	103	100	111	87	100	0.03
28:00	101	97	107	84	97	0.00