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TEST CERTIFICATE No. T 65250

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Customer:	Tyco Water, Ductile Iron Pipelines, Yennora
Test Represents:	Type tests on Tyco Water DN400 DI Tyton Joints under positive internal hydrostatic pressure, negative internal pressure, positive external hydrostatic pressure, and cyclic internal hydraulic pressure.
Sample Description:	DN400 K9/C42 DI Tyton joints, comprising spigot and socket sections and rubber joint ring.
Identified:	DN400 K9 socket section 1200 mm long with cement mortar lining (CML) identified Tubemakers 400 mm 2000. DN400-K9 spigot section 1460 mm long without CML Rubber joint ring identified: DN400 HT TYTON M585 C2 DIN EN 99 Cyclic tests: DN400-K9 socket section 1310 mm long identified SGS-400, DN400-K9 spigot section 1470 mm long identified SGS-400, & Rubber joint ring identified: DN400 Made in Costa Rica DR2130 N-308 U EN-681-1 EPDM WA/50
Specifications:	BS EN 545:2010

This report reproduces testing completed in August, 2000 (reported in test certificate T64382), in November, 2006 (reported in test certificate T64766), and in September, 2009 (reported in test certificate T65032). The tests were originally performed in accordance with BS EN 545: 1995 and BS EN 545:2006.

The results reported in this document are based on testing to BS EN 545:2010 requirements.

The results reported herein demonstrate compliance with BS EN 545:2010 Type Tests as detailed in Sections 5.2.2 & 7.2 and Table 11 on Tyco Water DN400 DI Tyton joints under positive internal hydrostatic pressure, negative internal pressure, positive external hydrostatic pressure, and cyclic internal hydraulic pressure.

In accordance with BS EN 545:2010 Section 5.2.3.1 the socket section was machined internally to produce the required annular gap. In accordance with BS EN 545:2010 Section 5.2.3.2 the spigot section was machined internally to produce the required average wall thickness over the specified length. This necessitated removal of the cement mortar lining.



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TEST RESULTS

1. Leak Tightness Test with Positive Internal Hydrostatic Pressure & Shear Load

This test was undertaken in accordance with BS EN 545:2010 Sections 5.2.2 & 7.2 and Table 11.

Shear load applied at gasket: 20,068 N. Requirement: $\geq 20,000$ N (50 x DN)

The test assembly was filled with water and vented to remove all air. The pressure was then gradually raised to 6.8 MPa (requirement: ≥ 6.8 MPa) and the shear load was applied.

The pressure was maintained at ≥ 6.8 MPa for 2 hours. Pressure and temperature readings were recorded and checks for leakage were made at 15 minute intervals. No leaks were observed during the 2 hour test duration.

The requirements of BS EN 545:2010, Sections 5.2.2 & 7.2 and Table 11 for "Leak tightness of flexible joints to positive internal pressure", with a shear load, were satisfied by this test.

2. Leak Tightness Test with Positive Internal Pressure & Maximum Angular Deflection

This test was undertaken in accordance with BS EN 545:2010 Sections 5.2.2 & 7.2 and Table 11.

The joint components were assembled and the maximum allowed angular deflection of 5° was then applied to the joint. The assembly was filled with water and vented to remove all air. The pressure was then gradually raised to 6.8 MPa (requirement: ≥ 6.8 MPa).

The pressure was maintained at ≥ 6.8 MPa for 2 hours. Pressure and temperature readings were recorded and checks for leakage were made at 15 minute intervals. No leaks were observed during the 2 hour test duration.

The requirements of BS EN 545:2010, Sections 5.2.2 & 7.2 and Table 11 for "Leak tightness of flexible joints to positive internal pressure", with maximum angular deflection, were satisfied by this test.



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3. Leak Tightness Test with Negative Internal Pressure & Shear Load

This test was undertaken in accordance with BS EN 545:2010 Sections 5.2.2 & 7.2 and Table 11.

Shear load applied at gasket: 20,018 N. Requirement: $\geq 20,000$ N (50 x DN)

The assembly was evacuated to a pressure of - 0.90 bar (requirement - 0.9 bar), and then isolated from the vacuum pump at the start of the test, with the joint at 18°C. At the end of the 2 hour test duration the pressure was - 0.88 bar and the temperature was 17°C.

The requirements were: Pressure change ≤ 0.09 bar and temperature change $\leq 10^\circ\text{C}$.

The requirements of BS EN 545:2010, Sections 5.2.2 & 7.2 and Table 11 for "Leak tightness of flexible joints to negative internal pressure", with a shear load, were satisfied by this test.

4. Leak Tightness Test with Negative Internal Pressure & Maximum Angular Deflection

This test was undertaken in accordance with BS EN 545:2010 Sections 5.2.2 & 7.2 and Table 11.

The joint components were assembled and the maximum allowed angular deflection of 5° was then applied to the joint. The assembly was evacuated to a pressure of - 0.90 bar (requirement - 0.9 bar), and then isolated from the vacuum pump at the start of the test, with the joint at 16°C. At the end of the 2 hour test duration the pressure was - 0.90 bar and the temperature was 16°C.

The requirements were: Pressure change ≤ 0.09 bar and temperature change $\leq 10^\circ\text{C}$.

The requirements of BS EN 545:2010, Sections 5.2.2 & 7.2 and Table 11 for "Leak tightness of flexible joints to negative internal pressure", with maximum angular deflection, was satisfied by this test.



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5. Leak Tightness Test with Positive External Hydrostatic Pressure

This test was undertaken in accordance with BS EN 545:2010 Sections 5.2.2 & 7.2 and Table 11.

Shear force applied: 20,020 N. Requirement: $\geq 20,000\text{N}$ (50 x DN)

The assembly was pressurised to 2.0 bar and held at 2.0 ± 0.1 bar for 2 hours. The requirement was that it be held at 2 ± 0.1 bar for 2 hours. The internal side of the joint was inspected every 15 minutes during this period and no leakage was observed.

The requirements of BS EN 545:2010, Sections 5.2.2 & 7.2 and Table 11 for "Leak tightness of flexible push-in joints to positive external pressure", with a shear load, were satisfied by this test.

6. Leak Tightness Test under Cyclic Internal Hydraulic Pressure

This test was undertaken in accordance with BS EN 545:2010 Sections 5.2.2 & 7.2 and Table 11.

Shear force applied: $\geq 20,000$ N. Requirement: $\geq 20,000$ N (50 x DN)

The joint components were assembled within a test fixture and the spigot was inserted to the minimum insertion depth.

The internal pressure was cycled between 5.1 MPa (PMA) and 4.6 MPa (PMA - 5 bar), as specified in BS EN 545 Section 7.2.5 for the required 24,000 cycles. Each cycle was nominally 15 seconds, including a minimum 5 second hold period at PMA and (PMA - 5 bar). The mean pressure between the "high" and "low" pressure holding periods was ≥ 5 bar. No leakage was observed during the test.

The requirements of BS EN 545:2010, Sections 5.2.2 & 7.2 and Table 11 for "Leak tightness of flexible joints to cyclic internal hydraulic pressure" were satisfied by this test.

Statement of Compliance: The results of all tests reported in this test certificate meet the requirements of the specifications referred to herein.



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