Client:	John Davidson (Pipes) Ltd	Report Ref:	UC 14046-B v0.5
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Testing of JDP - ULTRA 3 UPVC Sewer Pipe to the requirements of WIS 4-35-01

1. Introduction

John Davidson (Pipes) Ltd (JDP) requested to have their UPVC Pipe to be tested in accordance with WIS 4-35-01:2008 Specification for thermoplastics structured wall pipes – supplementary test requirement. The JDP ULTRA3 Pipe system is a structured wall UPVC pipe and available in diameters between 110mm to 630mm. The pipe is available in range of lengths dependent on diameter and wall thickness. The WIS 4-35-01:2008 has three performance requirements:

- Appendix A: Resistance to internal puncture in accordance with method and requirement of the appendix.
- Appendix B: Resistance to water jetting pressure in accordance with method and requirements of the appendix.
- Appendix C Longitudinal bending in accordance with method and requirements of the appendix.

2. Testing and results

2.1 Test samples

JDP provided WRc with the following pipe samples for testing:

- one 160mm diameter 6m in length SN8
- Three 315mm diameter 300mm in length
- Three 400mm diameter 300mm in length

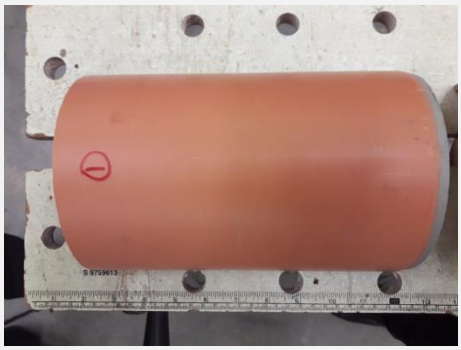
2.2 Testing Appendix A: Internal puncture resistance

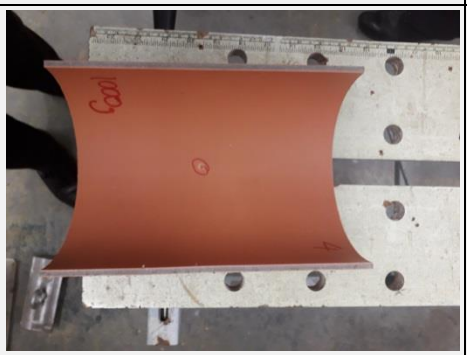
Testing was undertaken to determine that the requirements of clause 3.2 are met when tested in accordance with test method in appendix A. Testing was undertaken on DN/OD160mm pipe as supplied by JDP.

Conclusion: The 160mm diameter structured wall PVC-U pipe as supplied by JDP has been tested and has met the requirement of WIS 4-35-01:2008 Appendix A; Internal puncture resistance.

Table 1 shows the pipe internal wall both before and after impact as well the external wall. A 250g strike head from a 1m drop the internal wall had a minor indentation (>0.5mm) and the external wall had whitening which is not considered a failure.

Table 1 Internal puncture resistance

Ref	Load	Post impact internal	Post impact external
1	**250g PASS**		

2	**500g PASS**		
3	**900g PASS**		
4	**1000g PASS**		

Conclusion: The 160mm diameter structured wall PVC-U pipe as supplied by JDP has been tested and has met and exceeded the requirement of WIS 4-35-01:2008 Appendix A; internal puncture resistance.

The DN/OD160 is considered to be the most onerous diameter for internal puncture resistance as the thinnest wall pipe of the product range.

2.3 Testing Appendix B: Resistance to high pressure jetting

2.3.1 Introduction

2018: DYKA requested WRc to undertake high pressure water jetting testing in accordance with WIS 4-35-01: October 2008. The objective is to confirm the PVC ULTRA3 SN8 pipe meets the requirements of WIS 4-35-01 and determine the maximum water jetting pressure the pipe can resist.

2019: JDP wished to repeat the HPWJ at 280B / 4060 PSI on the ULTRA3 SN8 pipe on 400mm diameter

This report includes the test results from 2018 as reported in WRc report UC 13265-B.

WIS 4-35-01: October 2008 states that the pipe shall withstand a jetting pressure of 180 bar (2600 PSI) without unacceptable damage. WIS 4-35-01 provides the test method and the requirement for assessing the resistance of structured wall pipes to withstand pressure jetting. The jetting resistance of a material is defined as the maximum pressure at which five consecutive successful 120 second duration tests are achieved. Testing was undertaken at an angle of 30 degrees. The method requires the test pressure to be achieved within 20 seconds. Unacceptable damage is defined as a puncture or crack of the wall for a solid wall or multi- layer pipe where all the layers are of a solid construction. Ductile bending or "whitening" is not considered to be unacceptable damage.

2.3.2 Equipment:

The following equipment was used:

- A single jet nozzle (marked WRc 06) manufactured to the dimensions given in Figure C.1 of WIS 4-35-01: October 2008.
- Calibrated pressure transducer s/n 433047.
- Hi-force 700 BAR pressure gauge serial no PG 170
- A modified commercial trailer-jetting unit, fitted with a piston pump capable of a maximum pressure of 340 bar (5000 psi) and capable of a flow rate of 36 litres per minute.
- Test rig capable of operating at a maximum pressure of 340 bar (5000 psi).

2.3.3 Test samples

2018 DYKA supplied three of each pipe type in 300 mm length. Test samples were selected at random and marked up into segments and numbered. No information was provided to WRc indicating expected performance. The 315mm PVC ULTRA3 SN8 pipe was supplied to WRc on 1st June 2018.

2019 JDP DYKA supplied three of each pipe type in 300mm length. Test samples were selected at random and marked up into segments and numbered. No information was provided to WRc indicating expected performance. The 400mm PVC ULTRA3 SN8 pipe was supplied to WRc on 2nd October 2019.

2.3.4 Testing and results

Testing was undertaken by David Holmes and Elye Darragh of WRc. The water temperature for the test was 14°C and the ambient air temperature was 22°C.

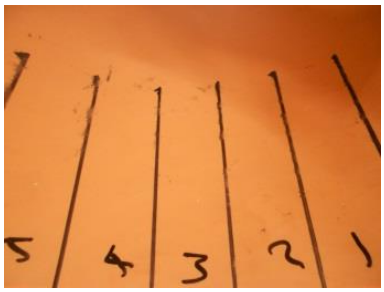
Table 4.1: PVC ULTRA3 SN8 315 mm

Segment number	Test pressure (bar / PSI)	Comments/type of failure
1/1	180 / 2600	No damage
1/2	180 / 2600	No damage
1/3	180 / 2600	No damage
1/4	180 / 2600	No damage
1/5	180 / 2600	No damage
1/6	220 / 3200	Minor pitting
1/7	280 / 4060	Severe pitting
1/8	280 / 4060	Severe pitting
1/9	280 / 4060	Hole after 115 seconds pressure drifted above 280bar
1/10	280 / 4060	Severe pitting
1/11	280 / 4060	Severe pitting
1/12	280 / 4060	Severe pitting
1/13	280 / 4060	Severe pitting
1/14	280 / 4060	Severe pitting

Conclusion: The PVC ULTRA3 SN8 315 mm pipe met the requirement of WIS 4-35-01: Issue 2 for resistance to jetting pressure of 180 bar (2600 PSI).

The testing determined the pipe was capable of resisting a pressure of 280 bar (4060 PSI). for Diameter range 110mm to 315mm

Photograph 4.1: PVC ULTRA3 SN8 315 mm

Test segments 1-5 testing was undertaken at 180 bar / 2600 PSI with no damage	
Test segments 10-15 testing was undertaken at 280 bar / 4060 PSI with severe pitting	

4.2 ULTRA3 pipe 400mm diameter (2019)

Testing was undertaken by Kevin Whittaker and Kevin Adams of WRc. The water temperature for the test was 10°C and the ambient air temperature was 12°C.

HPWJ testing was undertaken on the ULTRA3 pipe in 2018 on diameter of 315mm and below when a jetting resistance of 280b / 4060psi was achieved (WRc report13256-B). For the 2019 testing the 400mm pipes sample was divided into 6 equal segments and each segment was tested at the central point, thereby testing the complete circumference of the pipe.

The ULTRA3 pipe is available in nominal diameter up to 600mm. The test results for the 400mm are seen as representative of diameters up to 630mm

Table 4.2: ULTRA3 Pipe 400mm

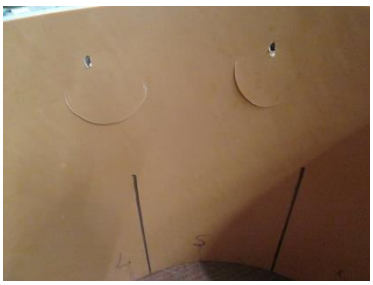
Segment number	Test pressure (bar / PSI)	Wall thickness (mm)	Comments/type of failure
B-1/1	280 / 4060	13.05	Inner layer punctured and lifted after 30 seconds, no impact on central core
B-1/2	280 / 4060	13.27	Inner layer punctured and lifted

			after 15 seconds, no impact on central core
B-1/3	280 / 4060	13.46	Inner layer punctured and lifted after 30 seconds, no impact on central core.
B-1/4	280 / 4060	13.33	Inner layer punctured and lifted after 20 seconds, not impact on central core
B-1/5	280 / 4060	13.21	Inner layer punctured and lifted after 25 seconds, no impact on central core
B-1/6	280 / 4060	13.56	Inner layer punctured after 30 seconds, no impact on central core

Conclusion: The ULTRA3 400mm pipe met the requirement of WIS 4-35-01: Issue 2 for resistance to jetting pressure of 180 bar (2600 PSI).

The testing determined the pipe was capable of resisting a pressure of 280 bar (4060 PSI)

Photograph 4.2: PVC ULTRA3 SN8 400 mm

	Consistent damage of de-bonding of inner layer in semi-circular shape occurring within 30 seconds. The central core of the pipe wall was not penetrated. The lifting of the inner layer may be considered undesirable damage.	

2.4 Testing Appendix C: longitudinal bending

Testing was undertaken in to determine that the requirements of Clause 3.4 were met when tested in accordance with test method in appendix C. Testing was undertaken on the DN/OD110 pipe 6m length as supplied by JDP.

Testing on 6m, SN8 pipe length was undertaken by WRc on a pipe selected at random from stock. The testing was undertaken on 1st November 2019.

Table 5 Photographs of longitudinal bending WRc

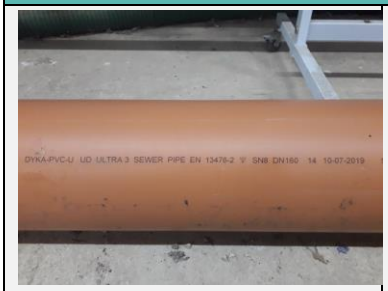
160mm pipe under test		
		
End point 1 datum	**Detail of deflection measurement**	**End point 2 datum 0.74mm within tolerance**
		

Table 6 Summary of longitudinal bending (6m length) by WRc

Samples	Diameter (mm)	Allowable defection 5% of pipe length	Measured deflection	Observation	P / F
1	160	300mm	22.4mm	None	Pass

Conclusion: The DN/OD160 structured wall ULTRA3 pipe as supplied by JDP has been tested and has met and exceeded the requirement of WIS 4-35-01:2008 Issue 2 for longitudinal bending. The DN/OD160 is considered to be the most onerous diameter to for longitudinal bending.

3. Conclusion

JDP ULTRA3 UPVC pipes have exceeded the requirements of WIS 4-35-01:2008.

- Appendix A: Resistance to internal puncture in accordance with method and requirement of Appendix.
- Appendix B: Resistance to water jetting pressure in accordance with method and requirement of the appendix.
- Appendix C Longitudinal bending in accordance with method and requirements of the appendix.