1. INTRODUCTION

Thermoplastic pipe is increasingly used in many industry sectors such as gas, water and mining. The advantages over traditional materials such as steel and cast iron include cost, lack of corrosion, weight and ease of joining. The ease of joining is only applicable if correct procedures, qualified personnel, pipe and fitting tolerances are all adhered to. This Guidance Note address the basic elements of welding polyethylene (PE) pipes.

2. STANDARDS

2.1 Fittings

AS/NZS 4129: 2000 "Fittings for Polyethylene (PE) Pipes for Pressure Applications"

2.2 Pipe

AS/NZS 4130:2003 "Polyethylene (PE) Pipes for Pressure Applications"

2.3 Installation

AS 2033 "Installation of Polyethylene Pipe Systems";
AS 3723 "Installation and Maintenance of Plastic Pipe Systems for Gas.

2.4 Testing

ISO 3501 "Assembled Joints Between Fittings and Polyethylene (PE) Pressure Pipes-Test of Resistance to Pull Out";
ISO 3503 "Assembled Joints Between Fittings and Polyethylene (PE) Pressure Pipes-Test of Leak Proofness under Internal Pressure when Subject to Bending";
ISO DIS 13956 "Plastic Pipes and Fittings - Determination of Cohesive Strength-Tear Test for Polyethylene (PE) Assemblies".

Many other Standards exist nationally and internationally for plastic pipe, fittings, joining and testing. A review of the specifications in which the work is to be carried out should include obtaining the correct Standard and latest issue.

3. WELDING

Welding of Polyethylene pipe involves heating and softening of the pipe at the joint interface, this needs to be sufficient for the pipes to fuse together. Polyethylene has low coefficients of thermal conductivity, which means that during welding the joint faces reach a high temperature but not the surrounding pipe.The two main welding techniques for PE Pipe are Hot Plate Welding and Electro-Fusion Welding

3.1 Hot Plate Welding

This involves heating and ends of the pipe to be joined against an electrically heated plate until sufficiently plastic. The heater plate is then removed and the pipes pressed together and allowed to cool for a defined period to establish weld strength. Various machines are available including automatic machines. These latter machines include the welding procedure information such as heating time, cooling time and force.

This technique is used extensively for butt welding of PE pipe from small diameter to in excess of 1 meter diameter pipes. Very few problems exist provided the operator is trained and follows the welding procedure including pipe preparation, cleanliness, protection from contamination and adverse weather conditions. The machine should be positioned on a clean level surface and be regularly maintained and calibrated.

3.2 Electro-Fusion Welding

Electro-fusion joining involves an electrically conducting implant being incorporated into the socket and/or fitting to be jointed to the pipe. A high electric current is applied via an appropriate power source and causes resistive heating which melts and fuses the pipe and fitting material. As with hot plate welding the machine manufacturers and fitting manufacturers provide welding procedure advice such as heat-up-time, soak time and cooling cycle time. Attention to joint preparation is critical as is restraining, aligning and pipe fitting tolerances. Joint preparation should involve an appropriate pipe scraper, following the pipe and fitting manufacturers recommendation.

The manufacturers also advise on the use of an iso-propanol impregnated pipe-wipe to clean fittings and scraped surfaces immediately prior to welding. Heating cycles are defined by the fitting manufacturers and the power source control box should be set correctly. Melt indicators reveal the heating cycle is complete.

4. WELD TESTING

4.1 Testing of Butt Fusion Welds

Much research work is being carried out to find suitable NDT Techniques for assessment of field joints with limited success to-date. Testing is normally carried out by mechanical testing of a sample number of joints.

Tests include:

- Tensile test;
- Bend test;
- Hydrostatic/pneumatic pressure test.

4.2 Testing of Electro-Fusion Joints

As with hot plate welding, success with NDT for electro-fusion joints is limited. Testing is normally carried out by mechanical testing of a sample number of joints.

Tests include:

- Peel test;
- De-cohesion test;
- Crush test;
- Hydrostatic/pneumatic pressure test.

5. POLYETHYLENE WELDING CHECK LIST:

- The Welding operator is trained;
  Note: Australian Standards are currently working on a new Australian Standard for Polyethylene Welding Personnel Certification.
- Equipment is maintained in good working order and calibrated;
- Pipe and fittings are manufactured in accordance with an approved Standard and are within tolerance;
- Cleanliness of the joining and work site is critical;
- Provide a shelter to achieve adequate protection of the pipe and fitting during the weld cycle, this should include blanking the pipe ends.
- Protect against contamination such as dust, sand and rain.
- The operator must understand the heating cycle, cooling cycle and joint restraint requirements for each joint type to be welded.
- No tapping of saddles should occur or movement of the pipe until the required cooling time has elapsed.

NDNP TECHNOLOGY DIFFUSION ACTIVITY # 27	ABN 69 003 696 526 **NATIONAL DIFFUSION NETWORKS PROJECT** **TECHNOLOGY QUESTIONNAIRE** **Water Industry Group** **"Butt and Socket Fusion Welding of Polyethylene (PE) Pipe"**	**Document No:** 1 9.4.3QR-0003 **Revision No:** Rev 0 **Page 1 of 2** **Date:** 22 Feb 2006

As part of the WTIA National Diffusion Networks Project the Water Industry Sector identified the need for elementary guidance on the welding of Polyethylene (PE) Pipe. The WTIA has prepared a Technical Guidance Note "Butt and Socket Fusion Welding of Polyethylene (PE) Pipe" to introduce the basic concepts to the Water Industry. As a valued technology expert in this area we would like you to be part of the Technology Expert Group to review this note. Please complete this questionnaire so that we can gauge the success of meeting this need.

Objective 1: Identify the welding methods for PE Pipe

PE pipe and associated pipe components are being increasingly used in the water industry. This guidance note is intended to introduce the two main methods of welding PE pipe and identify the significant parameters that eventually determine weld performance. How well does the document explain the benefits of polyethylene welding technology?

poor ☐ average ☐ good ☐ very good ☐

Comments: _____

Objective 2: Identify appropriate technology receptors in the Water Industry

This document was written for Designer, Maintenance and Installation Engineers in the Water Industry. Are these people the appropriate individuals we should be targeting?

yes ☐ no ☐

What other types of companies and/or personnel do you suggest we target? _____

_____

Objective 3: Identify latest PE welding technology

The document was written to reflect current best practice and latest technology for joining PE pipe. Do you envisage opportunities for the use of this technology in the industry?

yes ☐ no ☐

If yes, what and where, if no why not? _____

_____

Objective 4: Is the information provided clear, concise and accurate?

yes ☐ no ☐

If not, why? _____

Objective 5: Broad dissemination of technology to the Water Industry

Please indicate how best to disseminate this Technical Guidance Note to the appropriate Water Industry Recipients

Free Website Download ☐ Poster ☐ Pocket Guide ☐ Pamphlet ☐

If poster, what size? A1 ☐ A2 ☐ A3 ☐ Laminated ☐ What selling price? $

If a pocket guide, what selling price? $

Other format? _____

Objective 6: Continuous Improvement

Please Identify areas where the document can be improved or return the document with your recommended additions/amendments. Alternatively, please use the area below to provide any additional comments.

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Please Fax (02 9748 2858) or E-mail (b.gross@wtia.com.au) your response. Your prompt response is appreciated.