



Soil Assessment for Installation of Ductile Iron Pipes without Sleeving

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Revision details

Version No.	Clause	Description of revision
1	N/A	New document
2	All	Minor editing

1 Overview

1.1 Intent

This document describes the process for assessing the suitability of soil for installation of a newer generation of ductile iron pipes without loose polyethylene sleeving.

1.2 Scope

This document is relevant to the following stakeholders:

- Sydney Water staff
- contractors
- consultants
- suppliers
- project managers
- water servicing coordinators.

1.3 Objective

A new generation of ductile iron pipes was introduced into the Australian market in 2014. The pipes feature either a thermally sprayed metallic zinc or zinc-aluminium alloy with a polymeric topcoat coating system. These protective coating systems are effective in most of soils around Australia without using loose polyethylene sleeving. However, soil properties must be assessed prior to pipe installation to ensure a 100-year design life is achieved.

Notes:

1. For extremely aggressive soils, the pipes can be coated with polyurethane or an extruded high-density polyethylene coating to isolate the ductile iron from the environment.
2. Previously, ductile iron pipes were typically supplied in Australia with a bituminous coating system but no zinc. This coating system requires additional loose polyethylene sleeving to warrant adequate performance against external corrosion, regardless of the soil conditions.

1.4 References

Reference documents are listed in Table 1.

Table 1 Reference documents

Document No	Title	Document reference
AS 1289.4.3.1	Methods of testing soils for engineering purposes Method 4.3.1: Soil chemical tests – Determination of the pH value of a soil – Electrometric method	Clause 2.2
AS 1289.4.4.1	Methods of testing soils for engineering purposes Method 4.4.1: Soil chemical tests – Determination of the electrical resistivity of a soil – Method for fine granular materials	Clause 2.2
AS/NZS 2280	Ductile iron pipes and fittings	Clause 1.3, Section 4
ASTM G57	Standard Test Method for Measurement of Soil Resistivity Using the Wenner Four-Electrode Method	Clause 2.2

2 Soil aggressivity assessment

The soil aggressivity must be tested before installation of the ductile iron pipes. This is to identify any areas of highly aggressive soil that are not suitable for installation of the ductile iron pipes without sleeving.

For newly developed (greenfield) areas, information on soil properties is often available from the Land and Soil Capability Assessment Scheme or a geotechnical assessment that has been carried out within the area. Where soil properties are not readily available, such as in brownfield areas, soil aggressivity testing and assessment must be carried out.

2.1 Soil parameters

For assessing the soil aggressivity on metallic pipes, the 3 critical soil parameters are:

- resistivity (or conductivity)
- pH level
- chlorides concentration.

Note: Soil resistivity (ohm.cm) may be calculated from soil conductivity (S/m) using Equation 2.1.

$$\text{Resistivity (ohm.cm)} = \frac{1}{\text{Conductivity}} \times \frac{1}{100} \text{ (S/m)} \quad (2.1)$$

It is also important to assess if the pipeline route contains any of the following conditions:

- acid sulphate soil
- contamination and waste from mining, processing or manufacturing industries such as refuse, ash, slag, liquid manure, dairy waste
- stray currents from industrial plants or equipment using direct current such as cathodically protected structures and electric trains/trams.

2.2 Acceptable test methods

All acceptable test methods are shown in Table 2.

Table 2 Acceptable test methods

Parameters	Test methods ^{Note 1}		
	AS	CSIRO	Other
Resistivity	AS 1289.4.4.1	-	ASTM G57
Conductivity	-	3A1 EC of 1:5 soil/water extract	-
pH	AS 1289.4.3.1	4A1 pH of 1:5 soil/water suspension	-
Chlorides	-	5A1 Chloride – 1:5 soil/water extract, potentiometric titration	-

Notes:

1. Only one test method for every parameter is required for each soil sample.

2.3 Recommended testing frequency

Where testing outside the Land and Soil Capability Assessment Scheme or a geotechnical assessment is required, carry out soil testing at every 100 metres along the pipeline route. The soil samples or measurements shall be obtained from the approximate depth of the pipeline invert.

Additional testing is required in locations of waterways, wetlands, polluted soils, or when the soil conditions are variable.

2.4 Acceptable testing organisation

Only test results produced by a National Association of Testing Authorities (NATA) accredited testing organisation are acceptable.

The combined results must be reviewed by the pipe supplier, who then issues a certificate indicating level of suitability and expected design life.

3 Soil condition criteria

Table 3 shows the acceptable soil properties for installation of ductile iron pipes without using loose polyethylene sleeving according to the external coating types.

Table 3 Acceptable soil properties

Parameters	Ductile iron pipes external coating system ^{Note 2}		
	Zn coating (200 g/m ² or higher)	Zn-Al coating (400 g/m ² or higher)	PU coating (≥800 µm) or extruded PE coating (≥1.8 mm)
Resistivity	≥2500 ohm.cm	≥500 ohm.cm	No limit
pH	≥6	≥5	No limit
Chlorides concentration	≤5000 ppm	≤50,000 ppm	No limit
Acid sulphate soil	Not allowed	Not allowed	Allowed
Contaminated soil ^{Note 1}	Not allowed	Not allowed	Allowed
Stray currents potential	Not allowed	Not allowed	Allowed

Notes:

1. Refer to Clause 2.1 for definition of contaminated soil.
2. Loose polyethylene sleeving is required for ductile iron pipes with bituminous coatings to warrant adequate performance against external corrosion, regardless of the soil conditions.

4 Submissions

The contractor who is installing the ductile iron pipes must submit the following documents to the project manager or water servicing coordinator in case of developer works:

1. a product technical data sheet relating to the proposed product and specifying the composition of the external corrosion protection system
2. a current product certification for the proposed product stating compliance to AS/NZS 2280
3. the test results of the soil parameters specified in Section 2 along with the information of the test locations. An excerpt of the relevant Land and Soil Capability or a geotechnical report containing the required information is also acceptable. All test certificates must be from a NATA accredited testing organisation.
4. the supplier's recommendation and certification of design life considering the soil aggressivity assessment results.

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The project manager or water servicing coordinator must review submissions and provide acceptance or rejection of proposal to install ductile iron pipes without loose polyethylene sleeving based on the criteria set in this document (Table 3).

Ownership

Ownership

Role	Title
Group	Specialist Engineering, Engineering and Technical Support
Owner	Norbert Schaeper, Engineering Manager
Author	Maxim Kovtun, Senior Materials Engineer

Change history

Version No.	Prepared by	Date	Approved by
1	Jerry Sunarho	12/12/2017	-
2	Maxim Kovtun, Senior Materials Engineer	02/2023	Norbert Schaeper, Engineering Manager