Australian Standard®

NON-DESTRUCTIVE TESTING—DETERMINATION OF THICKNESS

Part 1—DETERMINATION OF WALL THICKNESS OF PIPE BY THE USE OF RADIOGRAPHY

This Australian standard was prepared by Committee MT/7, Non-destructive Testing of Metals and Materials. It was approved on behalf of the Council of the Standards Association of Australia on 18 May 1982 and published on 11 October 1982.

The following interests were represented on the committee responsible for the preparation of this standard:

Australian Atomic Energy Commission
Australian Gas Association
Australian Institute for Non-destructive Testing
Australian Pipeline Industry Association
Australian Welding Institute
Bureau of Steel Manufacturers of Australia
Commonwealth Aircraft Corporation
Confederation of Australian Industry
Department of Defence
Department of Industrial Relations, N.S.W.
Department of Labour and Industry, Vic.
Electricity Supply Association of Australia
Institute of Australian Foundrymen
Metal Trades Industries Association of Australia
National Association of Testing Authorities
Pipeline Authority
Railways of Australia Committee
Society of Automotive Engineers—Australasia

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PREFACE

This standard was prepared by the Association's Committee on Non-destructive Testing of Metals and Materials, at the request of the Metals Standards Board and the Committee on Gas Cylinders.

This standard is the first part of a proposed three-part standard on thickness measurements; Part 2 covers the determination of the depth of corrosion pits in pipe by the use of radiography; Part 3* covers the measurement of wall thickness of pipe by acoustic methods.

The methods in this standard provide suitable bases for the testing of round pipe or other small pressure vessels, including gas cylinders. The methods rely on the use of a source of radiation, X-rays or gamma-rays, and require testing personnel to be experienced in the handling and use of radiation equipment and materials.

NOTE: The effectiveness of radiographic testing is dependent on the technical competence of the personnel performing the tests and on their ability to assess radiographs.

The National Association of Testing Authorities, Australia (NATA) operates a system of accreditation of laboratories in Australia and facilities for the tests in this standard are afforded by laboratories registered by NATA for this class of testing.

In its assessment of non-destructive testing laboratories, NATA recognizes the qualifications granted by the Australian Institute for Non-destructive Testing as evidence of a person's general knowledge of non-destructive testing techniques, e.g. radiographic, ultrasonic testing etc.

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* In course of preparation.

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
NON-DESTRUCTIVE TESTING—DETERMINATION OF THICKNESS

PART 1—DETERMINATION OF WALL THICKNESS OF PIPE BY THE USE OF RADIOGRAPHY

1 SCOPE. This standard sets out methods for the determination of the wall thickness of pipes and small fabricated vessels using X-ray or gamma-ray radiography.

NOTES:

1. Under a given set of radiographic conditions, the accuracy of the methods specified herein is reduced with decreasing wall thickness and with increasing pipe or vessel diameter.
2. The methods specified herein are more accurate when a pipe is empty.

2 REFERENCED DOCUMENTS. The following documents are referred to in this standard:

AS 1238 Preferred (Soft Metric) Sizes of Steel Pipes

AS 1929 Non-destructive Testing—Glossary of Terms

Code of Practice for the Control and Safe Handling of Sealed Radioactive Sources Used in Industrial Radiography*

3 SAFETY PRECAUTIONS. Exposure of any part of the human body to ionizing radiation can be injurious. It is therefore essential that when X-ray equipment or radioactive sources are being used adequate precautions be taken to protect testing personnel and any other persons in the vicinity.

NOTE: The use of radioactive substances and irradiating apparatus is controlled by various Statutory Regulations. Reference should also be made to the 'Code of Practice for the Control and Safe Handling of Sealed Radioactive Sources Used in Industrial Radiography'.

4 DEFINITIONS. For the purposes of this standard, the terms and definitions given in AS 1929 apply.

5 PRINCIPLE. An image of the tangential section of a pipe produced on a radiographic film positioned with its plane approximately normal to the path of the beam of radiation on the opposite side. The wall thickness of the pipe at the point which is tangential to the beam is determined from the resultant film images by the use of appropriate formulas.

6 EQUIPMENT AND ACCESSORIES.

6.1 Radiation Source. Either X-ray or gamma-ray sources of radiation may be used. The choice is dependent upon the ability of the radiation beam to penetrate the material and produce satisfactory film image contrast in a reasonable period of time.

6.2 Screens. Screens (lead foil) are necessary when using tube voltages above 120 kV and when using gamma-rays to reduce exposure time and effects of scatter.

6.3 Identification of Radiographs. Each radiograph shall be identifiable with the corresponding area of interest under test. Markers in the form of lead arrows, or other symbols shall be used. They shall be placed on the film away from the area of interest.

6.4 Film Type. The accuracy of image measurement is increased by low unsharpness values with fine grain film, low radiation energies and small diameter radiation source.

Typical examples of film types are given in Appendix A.

7 PROCEDURE.

7.1 General.

7.1.1 *Arrangement.* The radiation source, the area of interest and the radiographic film shall be arranged in accordance with the method chosen (see Figs 1 to 6).

NOTE: Vibration can effect the sharpness of the image.

7.1.2 *Source-to-object distance.* The distance of the radiation source to the edge of the area of interest should preferably be not less than 5 times the distance of the tangent point to the plane of the film. This ratio should be increased proportionately with sources larger than 2 mm.

7.1.3 *Exposure for steel.* Exposure should be selected to produce a film image of the area of interest which can be satisfactorily measured. Consequently it is not necessary to achieve the radiographic density levels used for the detection of discontinuities in normal radiography.

NOTE: Exposure charts (see Figs 7 and 8) are provided for steel using the following sources of radiation:
(a) Ir^{192}.
(b) Co^{60}.
These charts give exposures which have been found by experience for the various chord lengths of a range of sizes of steel pipe. An alternative procedure involves the use of conventional exposure charts (pipe thickness *vs* exposure) prepared for the type of radiation source it is proposed to use.

Dimensions of chord lengths for typical pipe sizes are given in Appendix B.

7.1.4 *Radiographic equivalence factors.* Exposures for materials other than steel may be calculated by multiplying the section thickness by the Radiographic Equivalence Factor (Table 1) and referring to the appropriate exposure curve for steel.

7.1.5 *Film processing.* Normal film processing shall be carried out in accordance with the instructions of the film manufacturer.

* Issued by the National Health and Medical Research Council, Canberra.