

Australian/New Zealand Standard™

**Non-destructive examination and
discard criteria for wire ropes in mine
winding systems**

AS/NZS 4812:2003

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee ME-018, Mining Equipment. It was approved on behalf of the Council of Standards Australia on 13 December 2002 and on behalf of the Council of Standards New Zealand on 13 December 2002. It was published on 24 February 2003.

The following are represented on Committee ME-018:

Australasian Institute of Mining and Metallurgy
Australian Chamber of Commerce and Industry
Australian Coal Association
Bureau of Steel Manufacturers of Australia
Chamber of Mines of Western Australia
Department of Labour, New Zealand
Department of Infrastructure, Energy and Resources, Tasmania
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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-018, Mining Equipment.

The Standard is intended to promote the safe use of wire ropes for mine winding systems.

The following documents were referred to when drafting this Standard:

AS 1929 Non-destructive testing—Glossary of terms

AS 2759 Steel wire rope—Application guide

AS 3569 Steel wire ropes

AS 3978 Non-destructive testing—Visual inspection of metal products and components

ASTM E1571 Standard practice for electromagnetic examination of ferromagnetic steel wire rope

MDG No. 26 Guidelines for examination, testing and retirement of mine winder ropes for use in coal mines—Department of Mineral Resources, N.S.W.

SABS 0293:1996 Condition assessment of steel wire ropes on mine winders

Techniques to better exploit the possibilities of wire testing with permanent magnet equipped EM instruments—Canmet Noranda Project 1990—1992

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	4
1.2 REFERENCED DOCUMENT	4
1.3 DEFINITIONS	4
SECTION 2 NON-DESTRUCTIVE EXAMINATION (NDE)	
2.1 EXAMINERS	6
2.2 EM INSTRUMENTS	6
2.3 CALIBRATION	8
2.4 ROPE EXAMINATIONS	8
SECTION 3 ROPE DISCARD CRITERIA	
3.1 GENERAL	14
3.2 WINDING ROPES, INCLUDING BALANCE ROPES	14
3.3 GUIDE ROPES AND RUBBING ROPES	15
APPENDICES	
A PRINCIPLES FOR OPERATING NDT EQUIPMENT	17
B VISUAL ACUITY	19
C TYPICAL WORK SHEET	20
D USEFUL TECHNIQUES FOR DETERMINING AREA RELATIONSHIPS	22
E METHOD FOR CLASSIFYING CORROSION AND WEAR	25
F MEASURING THE DIAMETER OF ROPE	26

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Non-destructive examination and discard criteria for wire ropes in mine winding systems**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for non-destructive examination and discard of wire ropes of mine winding systems, including winding, hoisting, balance, rubbing, guide and shaft sinking ropes, but excluding full locked-coil ropes.

This Standard is not intended to replace mine-site inspection schedules or destructive tests. Destructive tests may be required in areas not accessible to a non-destructive examination, or in addition to a non-destructive examination.

NOTES:

- 1 This Standard is not a rope management system, but should be used as input for such a system.
- 2 This Standard only applies to the use of full-coil sensor heads with EM instruments.

1.2 REFERENCED DOCUMENT

The following documents are referred to in this Standard:

AS

3785 Underground mining—Shaft equipment

3785.6 Part 6: Guides and rubbing ropes for conveyances

3978 Non-destructive testing—Visual inspection of metal products and components

1.3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.3.1 Anomaly

An irregularity in a rope that results in a change of signal to an NDT instrument.

1.3.2 Area**1.3.2.1 Rope area**

The metallic cross-sectional area of a wire rope.

1.3.2.2 Strand area

The metallic cross-sectional area of a strand.

1.3.3 Competent person

A person having practical and theoretical knowledge and relevant experience of wire ropes, sufficient to enable that person to detect and evaluate any defects and any weaknesses of wire ropes that may affect the intended performance of the winding equipment.

1.3.4 Customer

The organization or its authorized representative for whom the testing service is being provided.

1.3.5 Datum point

The point on the rope to which measurements are referred.

1.3.6 EM instrument

An electromagnetic or magnetic instrument, consisting of—

- (a) a sensor head that is clamped around a rope during testing;
- (b) a unit that processes signals from the sensor head; and
- (c) a recording device (e.g., strip chart recorder, data recorder) that records the output of the processing unit.

NOTE: See Appendix A for further details.

1.3.7 Examiner

A person qualified as an examiner of ropes (see Clause 2.1).

1.3.8 Local fault (LF)

A localized anomaly (see Clauses 1.3.1).

1.3.9 Loss of metallic area (LMA)

The indicated loss of steel in the cross-section of a rope or strand, expressed as a percentage.

1.3.10 Non-destructive examination (NDE)

An examination using non-destructive testing equipment and visual inspection.

1.3.11 Non-destructive testing (NDT)

An examination using magnetic detecting and recording instruments.

1.3.12 Shall

Indicates that a statement is mandatory.

1.3.13 Should

Indicates a recommendation.

1.3.14 Uniform distribution of broken wires

An even distribution of broken wires over a rope length.

1.3.15 Visual inspection

The physical examination of rope by a person qualified as an examiner of ropes.

SECTION 2 NON-DESTRUCTIVE EXAMINATION (NDE)

2.1 EXAMINERS

2.1.1 Competency and training

Following suitable training and experience, examiners shall be capable of—

- (a) setting up the equipment;
- (b) taking measurements, such as rope diameter and lay length;
- (c) performing the tests;
- (d) recording the results;
- (e) classifying the results in terms of written criteria;
- (f) performing a visual inspection of dubious zones; and
- (g) reporting on the results.

2.1.2 Competency assessments

The competency of the examiner shall be assessed by one of the following:

- (a) In-house assessments acceptable to the owner and relevant statutory authorities.
- (b) NATA.

2.1.3 Visual acuity

Examiners shall be able to demonstrate clear near vision (corrected or uncorrected) by being capable of reading Jaeger No. 2 or equivalent type and size of letters at a convenient distance.

Where the ability to discriminate between colours is required, the examiners shall pass a colour perception test.

The visual acuity of an examiner shall be tested periodically, with a maximum duration of two years between each test, by a suitably trained person, preferably a qualified medical officer.

NOTE: Appendix B gives information on visual acuity.

2.2 EM INSTRUMENTS

2.2.1 Type

EM instruments used to non-destructively test ropes shall have a sensor head that is able to induce a magnetic field in a section of rope that is located within the instrument.

Relative movement is required between the rope being tested and the sensor head to detect changes in the magnetic field. Changes in the magnetic field may be indicative of an anomaly. Dependent on the type of instrument used, the following information may be indicated:

- (a) Length of rope tested.
- (b) Rope speed.
- (c) Any anomalies in the rope.

NOTE: Appendix A describes principles for operating NDT equipment.

2.2.2 LMA

Depending on the stage at which an examination program commences, the rope in its as-new condition or the least deteriorated section of the rope shall be used as the base for determining the LMA.

NOTE: It should be realized that the least deteriorated section may have lost some metallic area. The actual total loss of area will be greater than the indicated LMA. In this case, selection and condition assessments of the least deteriorated area is, therefore, critical.

2.2.3 Specification

The following requirements apply to EM instruments used to non-destructively examine the ropes:

- (a) The instrument shall be suitable for the environmental conditions in which it is intended to be used.
- (b) The instrument shall function in either direction of travel.
- (c) The instrument sensitivity shall be such that it is capable of detecting a change in metallic cross-sectional area of rope of 0.5%.
- (d) The instrument shall produce a signal with an amplitude that is readily discernible from the background noise, while it is passed over a broken outer wire having a gap between the ends of 1 mm, in any rope construction and size in the range that is specified by the manufacturer. The detection of the signal produced by such a gap shall not be dependent on the location of the gap with respect to the sensing medium in the sensing head.

2.2.4 Limitations

Notwithstanding the accuracy of EM instruments, the following limitations exist with this type of testing:

- (a) Deterioration of a purely metallurgical nature (e.g., brittleness, fatigue) is not detectable.
- (b) Interference effects (e.g., electrical, magnetic) may cause the results to be inaccurate.
- (c) The practice is limited to the examination of ferromagnetic ropes.
- (d) Some rope constructions may not be magnetically saturated by the NDT machine, especially if the diameter is near to the upper limit of the sensor head range. In such cases, the ability of the NDT machine to detect LMA and LF may be seriously impaired.
- (e) The instrument is limited to rope speeds within the limits specified by the manufacturer.
- (f) The sensitivity of this type of instrument decreases as the depth of the flaw from the surface of the rope increases.
- (g) Internal broken wires may not be detected.
- (h) Measurements of changes in metallic cross-sectional area may be limited to showing comparative changes at various positions along the rope.
- (i) Signals due to the presence of corrosion in a rope may make individual anomalies indistinguishable.
- (j) It is difficult, if not impossible, to detect flaws at or near rope terminations and ferromagnetic steel connections.

- (k) The relationship between LMA and loss of actual breaking force may not be necessarily linear or fixed. Conversion factors from LMA to loss of breaking force vary with the type of deterioration in the rope. Care should be taken when attempting to convert LMA into loss of breaking force, especially if there is corrosion within the rope. In extreme cases, it has been found that loss of breaking force can be six times the indicated LMA.

2.3 CALIBRATION

Where any of the following instruments are used during examinations, they shall be calibrated and tested, where applicable, in accordance with any relevant Australian Standard:

- (a) Straight edge or other flatness indicator.
- (b) Measuring tape or lay length ruler.
- (c) Vernier callipers or micrometer.
- (d) Monocular microscope with graduated reticule (see AS 3978).
- (e) EM instrument that has traceable calibration records and has been calibrated on an annual basis or as recommended by the manufacturer.

2.4 ROPE EXAMINATIONS

2.4.1 General

Rope examinations shall include the following sequential processes:

- (a) Non-destructively testing a rope using a magnetic instrument, as specified in Clause 2.4.6.
- (b) Visually examining the areas where non-destructive testing has indicated anomalies to exist, as specified in Clause 2.4.7.

All rope measurements and appropriate comments shall be recorded.

2.4.2 Reference values of new rope

Examinations of rope allow changes to be observed, by comparing the rope to an examination made when it was new.

After a newly installed rope has been bedded in, but before the rope has aged, deteriorated or been damaged in any way, the rope shall be non-destructively tested and the rope diameter and the rope lay length at datum locations shall be measured. Rope diameter shall be measured in accordance with Clause 2.4.8.

The locations of these measurements shall be recorded for future reference. Allowance shall be made for rope crops, which affect the locations of these positions.

2.4.3 Frequency

The frequency of NDEs shall comply with any relevant requirements of the statutory authority. Testing frequencies should be based on expected rope life operating cycles, operating conditions and rope constructions.

It is recommended that NDE be conducted at frequencies not exceeding the following periods or one sixth of the expected rope life:

- (a) Friction winder head ropes 6 months.
- (b) Friction winder balance ropes 12 months.
- (c) Guide/rubbing ropes 30 months.
- (d) Drum winding ropes 6 months.