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1.0 PURPOSE

This specification describes the minimum requirements for Electromagnetic testing and evaluating Hoist Ropes in accordance with established VALE practices. This specification covers the testing procedure and the discard criteria for the purpose of Electromagnetic testing hoist ropes while still in service. This specification does not apply to external service provider conducting EM testing on Vale hoist ropes.

2.0 REFERENCE DOCUMENTATION

The following documents were used in the development of this document or have instructions and procedures applicable to it. They shall be used in their most recent revision.

- GUID-83005   WRITTEN PRACTICE FOR PERSONNEL QUALIFICATION AND CERTIFICATION TO CONDUCT EM WIRE ROPE TESTING PER SNT-TC-1A(2011)-MODIFIED
- Rotescograph-2R Operations manual
- OHSA Reg.854   Sec:38(4) ; Sec. 228 Inclusive
- MGUID-80004   EM Testing of Hoist Ropes - Escalation of Abnormal Results and Communication of Actions Required
- ASTM E-1571   Standard Practice for Electromagnetic Examination of Ferromagnetic Steel Wire Rope
- NDE Proc040   Electromagnetic Wire Rope Testing Safety Procedures
- NDE Proc041
- NDE Proco42
- NDE Proc043
- NDE Proc044
- NDE Proc045

3.0 RESPONSIBILITY

All personnel performing the evaluation are to ensure compliance to this specification Any deviation from this specification must be noted and it will be subject to VALE approval.

4.0 PREREQUISITE

Review and Understanding of Safety procedure NDE PROC 040 To PROC 045.
5.0 GENERAL

Any deviation from the specification shall be noted on the report.

6.0 PERSONNEL QUALIFICATIONS

Trainee can conduct a test independently, but shall not interpret the results without the help of NDE Level I or II (Limited)

NDE Level I or II (Limited) per Vale Engineering Guideline GUID-83005

NDE Trainee and Level I should work in strict according with a written instruction (GUID-83009)

The person performing the E/M tests and evaluation of the results shall conform to O.S.H.A. Regulation (228), Sec 5.

7.0 PROCEDURE

Position of EM test head 6 to 8 feet away from the recap.

Test speed not more than 300ft per minute while performing long end and not more than 100ft/minute while performing short/drum end.

The smooth wheel (wheel encoder) of the EM test head always facing the drum during either long end or short end of EM test.

In Friction hoist (Coleman and Stobie9 skip) during the test of short end of the rope the smooth wheel (encoder wheel) should be reversed form the long end compartment. EM test of long end of all friction hoist ropes the smooth wheel faces towards the hoist and during the short end test from different compartment the smooth wheel face downwards.

When there is more than one rope attached to conveyance the Plastic pelican board should be placed in between the rope to stop the magnetic effect of other ropes during EM test.

For Calibration use the rod diameter as mentioned in the configuration file of particular rope (typically for large test head 3/16” dia. and for medium test head 1/8” dia.)

Once the instrument is calibrated, do not adjust the LMA gain

Record the calibration file, test files for long end of rope and short end of the rope under the same file number.
8.0 TEST FREQUENCIES

A hoisting rope being used as a shaft rope shall be tested throughout its full working length by a competent person using an electromagnetic testing device of appropriate engineering standards.

(a) within six months of being put into service and;

(b) thereafter at regular intervals not exceeding 4 months or;

At intervals shorter than 4 months where, by extrapolation from past tests, the loss in breaking strength will exceed 10 % before the next prescribed test.

It is VALE Standard practice to test Plastic Impregnated Balance (tail ropes) ropes within 6 months of being put into service and; thereafter at regular intervals of 8 months and where a test discloses a loss exceeding 5% of the breaking strength recorded on the Test, in which case the regular intervals shall not exceed 4 months.

It is VALE Standard practice to test ropes within 42 days approx. of being put into service and; thereafter at regular intervals of 4 months.

The date of each electromagnetic test and the results obtained shall be recorded in the Hoist Mechanical book (green book) in Hoist room by the EM tester.

9.0 ACCEPTANCE CRITERIA

a) Rope must be removed from service if estimated loss of breaking strength (LBS) greater than 10%. The LBS calculation method is described in Section 12.0 and in the Rotescograph 2R operating manual.

b) If a test shows a loss exceeding 7.5% of the breaking strength recorded on the Certificate of Test, the person who signs the record shall send a copy of the record of the test to the owner and the joint health and safety committee or health and safety representative, if any, within 14 days after the test is completed.

c) Number of allowed broken wires in one lay length is 5%, rope construction excluding the filler wire. A split and cracked wire is not considered as a broken wire.
BROKEN WIRE RETIREMENT CRITERIA EXAMPLE

Retirement Criteria Based Upon Visual Inspection:
The number of broken wires within a rope lay length, excluding filler wires, exceeds either:
5% of the total number of wires. Using an example

Rope Construction: Flattened Strand/Round Strand
Number of Strands: 6
Number of Wires per Strand: 28 (not including filler wire)
Total Number of Wires in Rope: 6X28 = 168 wires
Lay length of Rope: 17 inches

For 5% Criteria:

i) 5% * Total Number of Wires: 5% X 168 = 8.4 (round down to 8)

ii) Actual Number of broken wires per 1 lay length: So up to 8 wires can be broken in one lay length

LAY LENGTH

![One Rope Lay with Strand Numbers](image-url)
10.0 REPORT

Entry in Hoist Mechanical log book (Green Book)

The report shall include the following

The Mine

The shaft number.

The compartment number.

The date of the E/M test.

The rope reel number.

The test number.

The test frequency– 4 month – 6 month

The rope diameter in inches.

The maximum estimated loss in breaking strength.

The location on the rope of this loss.

Any remarks as required.

The name and signature of the person doing the test.

The name of the equipment used for the test.

The original E/M test report is sent to the Plant Maintenance. If the E/M loss exceeds 7.5%, then a copy of the report is sent to the Manager and the joint Health and Safety representative as well.
11.0 LBS ESTIMATE EXAMPLE

File No.233SK102011.r2

Location of LMA best and Value is 5.6
Location of LMA worst and Value is 4

Location of LF at LMA best and Value is 0.4
Location of LF at LMA worst and Value is 3.2

TEST CHART INTERPRETATION

Test File: 233SK102011.r2

Rope Number/Mine/Mine Position: #3 skip rope/ Garson/ NA

Location of LMA best (The location on the Test Chart with no LMA): 300ft- Rotescograph reading

Location of LMA worst (The location on the Test Chart indicating the Maximum LMA): 1471 ft.- Rotescograph reading

LMA worst (Value of the Maximum LMA): 4.0

$\text{LMA}_{\text{max}} = \text{LMA}_{\text{best}} - \text{LMA}_{\text{worst}}$

(The difference in % between LMA best and LMA worst) 5.6 - 4 = 1.6

$\text{LF}_{\text{lay-noise}} = \text{average peak-to-peak amplitude of the LF Channel trace at the LMA}_{\text{best}}$

0.4

$\text{LF}_{\text{max}} = \text{average peak-to-peak amplitude of the LF Channel trace at the LMA}_{\text{worst}}$

3.2

CALCULATION OF THE MAXIMUM ESTIMATED LOSS OF BREAKING STRENGTH ($\text{LBS}_{\text{est}}$)
USING THE FOLLOWING FORMULA:

$\text{LBS}_{\text{est}} = K \times \text{LMAX}_{\text{max}}$

where: $K = \sqrt{\frac{\text{LF}_{\text{max}}}{\text{LF}_{\text{lay-noise}}}}$

1/ $\text{LMA}_{\text{max}} = 1.6$

2/ $K = \sqrt{\frac{\text{LF}_{\text{max}}}{\text{LF}_{\text{lay-noise}}}} = \sqrt{\frac{3.2}{0.4}} = 2.82$

3/ $\text{LBS}_{\text{est}} = K \times \text{LMAX}_{\text{max}}$

= 2.82 x 1.6

= 4.5%
12.0 APPENDICES

Appendix A: Revision and Transition Notes
Appendix B: Keywords
Appendix A: Revision and Transition Notes

(Revisions are listed in reverse chronological order with most recent revision at the top. Revision notes describe: what was changed, why it was changed, and the plan to implement the change, including whether changes are retroactive)

Revision 2
Excluded external service providers in Section 1.0,
Added reference to MGUID-80004 in Section 3.0
Added details to personnel qualification requirements in section 7.0

Revision 1
New Engineering Specification

Appendix B: Keywords

EM, Rope testing, Magnetic Flux Leakage, Hoist